vengine

0.1.0

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Chapter 1

vengine

1.1 VEngine - Vulkan Graphics Engine

WORK IN PROGRESS!

Welcome to **VEngine**, a Vulkan-based graphics engine.

This project is designed to provide a high-performance and flexible foundation for building 3D applications and games, taking full advantage of the Vulkan API.

1.1.1 Features

- **Vulkan Rendering Pipeline**: Leveraging Vulkan for high-performance graphics rendering
- **Basic Camera System**: Control camera movement in the 3D space
- **Input System**: Keyboard-based controls for movement and looking around
- **Model Loading**: Import 3D models using `assimp`
- **Real-time debugging**: Toggle debug windows using key bindings
- **Doxygen Documentation**: Automatically generated documentation hosted on `GitHub Pages`

1.1.1.1 Planned Features:

- **Cross-platform support** (Linux, macOS, Windows)
- Improve shadow
- Physics Integration
- Support for more input devices (e.g., mouse, game controller)
- Audio Integration

1.1.2 Prerequisites

Make sure you have the following dependencies installed on your system:

- `CMake 3.27`
- `C++20`
- `Vulkan SDK`
- `X11`

if you are using a Debian-based distribution, you can install the required packages using the following command:

```
$> ./tools/install-dependencies.sh build
```

1.1.3 External Libraries

- **Assimp**: Open Asset Import Library to load various 3D model formats into the engine.
- **Doxygen Awesome CSS**: A custom CSS theme for Doxygen documentation.
- **GLFW**: For creating windows, receiving input, and managing OpenGL and Vulkan contexts.
- **GLM**: A header-only C++ mathematics library for 3D transformations, vectors, and matrices, compatible with OpenGL and Vulkan.
- **ImGui**: Immediate Mode Graphical User Interface for real-time debugging and tool development.
- **stb**: A set of single-file public domain libraries for graphics, image loading, and more.

These libraries are included directly into the project to simplify dependency management. Be sure to initialize and update the submodules when cloning the repository:

```
$> git submodule update --init --recursive
```

1.1.4 Usage

1.1.4.1 Build

```
$> ./tools/build.sh build
[...]
```

This script also handle several other commands: `clean`, `format` and `doc`.

1.1.4.2 Run

```
$> ./vengine
[...]
```

1.1.5 Key Bindings

The following keyboard controls are currently available for interacting with the engine:

Key	Description
`z`	Move forward
`S`	Move backward
`q`	Move left
`D`	Move right
`SHIFT`	Move down
`SPACE`	Move up
`arrow up`	Look up
`arrow down`	Look down
`arrow left`	Look left
`arrow right`	Look right
`F1`	Show debug windows

1.1.6 Documentation

The documentation is generated using `Doxygen`. You can access the latest version on the `GitHub Pages`.

1.1.7 Commit Norms

Commit Type	Description
build	Changes that affect the build system or external dependencies (npm, make, etc.)
ci	Changes related to integration files and scripts or configuration (Travis, Ansible, BrowserStack, etc.)
feat	Addition of a new feature
fix	Bug fix
perf	Performance improvements
refactor	Modification that neither adds a new feature nor improves performance
style	Change that does not affect functionality or semantics (indentation, formatting, adding space, renaming a variable, etc.)
docs	Writing or updating documentation
test	Addition or modification of tests

1.1.8 License

This project is licensed under the MIT License - see the `LICENSE` file for details.

1.1.9 Acknowledgements

Special thanks to `Brendan Galea` for inspiration and resources related to Vulkan development.

Chapter 2

Namespace Index

2.1 Namespace List

Here is a list of all namespaces with brief descriptions:

Chapter 3

Hierarchical Index

3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 4

Class Index

4.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 5

File Index

5.1 File List

Here is a list of all files with brief descriptions:

Chapter 6

Namespace Documentation

6.1 ven Namespace Reference

Classes

- class ARenderSystemBase

  Abstract class for render system base.
- class Buffer

  Class for buffer.
- class Camera

  Class for camera.
- class Clock

  Class for clock.
- class Colors

  Class for colors.
- class DescriptorPool

  Class for descriptor pool.
- class DescriptorSetLayout

  Class for descriptor set layout.
- class DescriptorWriter

  Class for descriptor writer.
- class Device

  Class for device.
- class Engine

  Class for engine.
- class EventManager

  Class for event manager.
- struct FrameInfo
- struct GlobalUbo
- class Gui

  Class for Gui.
- struct KeyAction
- struct KeyMappings
- class Light

  Class for light.
- struct LightPushConstantData

- class Model

  Class for model.
- class Object

  Class for object.
- struct ObjectBufferData
- struct ObjectPushConstantData
- class ObjectRenderSystem

  Class for object render system.
- struct PipelineConfigInfo
- struct PointLightData
- class PointLightRenderSystem

  Class for point light system.
- struct QueueFamilyIndices
- class Renderer

  Class for renderer.
- class SceneManager

  Class for object manager.
- class Shaders

  Class for shaders.
- class SwapChain

  Class for swap chain.
- struct SwapChainSupportDetails
- class Texture

  Class for texture.
- class Transform3D

  Class for 3D transformation.
- class Window

  Class for window.

Typedefs

- using TimePoint = std::chrono::time_point<std::chrono::high_resolution_clock>

Enumerations

- enum ENGINE_STATE : uint8_t { EDITOR = 0 , GAME = 1 , PAUSED = 2 , EXIT = 3 }
- enum GUI_STATE : uint8_t { VISIBLE = 0 , HIDDEN = 1 }

Functions

- template<typename T , typename... Rest>
  void hashCombine (std::size_t &seed, const T &v, const Rest &... rest)

Variables

- static constexpr glm::vec3 DEFAULT_POSITION {0.F, 0.F, -2.5F}
- static constexpr glm::vec3 DEFAULT_ROTATION {0.F, 0.F, 0.F}
- static constexpr float DEFAULT_FOV = glm::radians(50.0F)
- static constexpr float DEFAULT_NEAR = 0.1F
- static constexpr float DEFAULT_FAR = 100.F
- static constexpr float DEFAULT_MOVE_SPEED = 3.F
- static constexpr float DEFAULT_LOOK_SPEED = 1.5F
- static constexpr uint32_t DEFAULT_MAX_SETS = 1000
- static constexpr float EPSILON = std::numeric_limits<float>::epsilon()
- static constexpr KeyMappings DEFAULT_KEY_MAPPINGS {}
- static constexpr float DEFAULT_AMBIENT_LIGHT_INTENSITY = .2F
- static constexpr glm::vec4 DEFAULT_AMBIENT_LIGHT_COLOR = {glm::vec3(1.F), DEFAULT_AMBIENT_LIGHT_INTENSITY}
- static constexpr uint16_t DESCRIPTOR_COUNT = 1000
- static constexpr float DEFAULT_LIGHT_INTENSITY = .2F
- static constexpr float DEFAULT_LIGHT_RADIUS = 0.1F
- static constexpr float DEFAULT_SHININESS = 32.F
- static constexpr glm::vec4 DEFAULT_LIGHT_COLOR = {glm::vec3(1.F), DEFAULT_LIGHT_INTENSITY}
- static constexpr uint8_t MAX_LIGHTS = 10
- static constexpr uint16_t MAX_OBJECTS = 1000
- static constexpr VkClearColorValue DEFAULT_CLEAR_COLOR = {{0.0F, 0.0F, 0.0F, 1.0F}}
- static constexpr VkClearDepthStencilValue DEFAULT_CLEAR_DEPTH = {1.0F, 0}
- static constexpr std::string_view SHADERS_BIN_PATH = "build/shaders/"
- static constexpr int MAX_FRAMES_IN_FLIGHT = 2
- static constexpr float COLOR_MAX = 255.0F
- static constexpr uint32_t DEFAULT_WIDTH = 1920
- static constexpr uint32_t DEFAULT_HEIGHT = 1080
- static constexpr std::string_view DEFAULT_TITLE = "VEngine"

6.1.1 Typedef Documentation

6.1.1.1 TimePoint

```
using ven::TimePoint = std::chrono::time_point<std::chrono::high_resolution_clock>
```

Definition at line 13 of file Clock.hpp.

6.1.2 Enumeration Type Documentation

6.1.2.1 ENGINE_STATE

```
enum ven::ENGINE_STATE : uint8_t
```

Enumerator

EDITOR	
GAME	
PAUSED	
EXIT	

Definition at line 20 of file Engine.hpp.

6.1.2.2 GUI_STATE

```
enum ven::GUI_STATE : uint8_t
```

Enumerator

VISIBLE	
HIDDEN	

Definition at line 20 of file Gui.hpp.

6.1.3 Function Documentation

6.1.3.1 hashCombine()

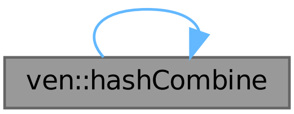
```
template<typename T , typename...  Rest>
void ven::hashCombine (
             std::size_t & seed,
             const T & v,
             const Rest &...  rest)
```

Definition at line 14 of file HashCombine.hpp.

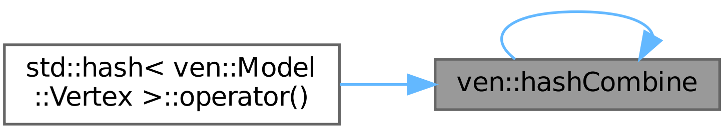
References hashCombine().

Referenced by hashCombine(), and std::hash< ven::Model::Vertex >::operator()().

Here is the call graph for this function:



Here is the caller graph for this function:



6.1.4 Variable Documentation

6.1.4.1 COLOR_MAX

```
float ven::COLOR_MAX = 255.0F [static], [constexpr]
```

Definition at line 15 of file Colors.hpp.

6.1.4.2 DEFAULT_AMBIENT_LIGHT_COLOR

```
glm::vec4 ven::DEFAULT_AMBIENT_LIGHT_COLOR = {glm::vec3(1.F), DEFAULT_AMBIENT_LIGHT_INTENSITY}
[static], [constexpr]
```

Definition at line 19 of file FrameInfo.hpp.

6.1.4.3 DEFAULT_AMBIENT_LIGHT_INTENSITY

```
float ven::DEFAULT_AMBIENT_LIGHT_INTENSITY = .2F [static], [constexpr]
```

Definition at line 18 of file FrameInfo.hpp.

Referenced by ven::Gui::rendererSection().

6.1.4.4 DEFAULT_CLEAR_COLOR

```
VkClearColorValue ven::DEFAULT_CLEAR_COLOR = {{0.0F, 0.0F, 0.0F, 1.0F}} [static], [constexpr]
```

Definition at line 20 of file Renderer.hpp.

6.1.4.5 DEFAULT_CLEAR_DEPTH

```
VkClearDepthStencilValue ven::DEFAULT_CLEAR_DEPTH = {1.0F, 0} [static], [constexpr]
```

Definition at line 21 of file Renderer.hpp.

6.1.4.6 DEFAULT_FAR

```
float ven::DEFAULT_FAR = 100.F [static], [constexpr]
```

Definition at line 18 of file Camera.hpp.

Referenced by ven::Gui::cameraSection().

6.1.4.7 DEFAULT_FOV

`float ven::DEFAULT_FOV = glm::radians(50.0F) [static], [constexpr]`

Definition at line 16 of file Camera.hpp.

Referenced by ven::Gui::cameraSection().

6.1.4.8 DEFAULT_HEIGHT

`uint32_t ven::DEFAULT_HEIGHT = 1080 [static], [constexpr]`

Definition at line 18 of file Window.hpp.

6.1.4.9 DEFAULT_KEY_MAPPINGS

`KeyMappings ven::DEFAULT_KEY_MAPPINGS {} [static], [constexpr]`

Definition at line 34 of file EventManager.hpp.

Referenced by ven::EventManager::handleEvents(), and ven::EventManager::moveCamera().

6.1.4.10 DEFAULT_LIGHT_COLOR

`glm::vec4 ven::DEFAULT_LIGHT_COLOR = {glm::vec3(1.F), DEFAULT_LIGHT_INTENSITY} [static], [constexpr]`

Definition at line 19 of file Light.hpp.

6.1.4.11 DEFAULT_LIGHT_INTENSITY

`float ven::DEFAULT_LIGHT_INTENSITY = .2F [static], [constexpr]`

Definition at line 16 of file Light.hpp.

Referenced by ven::Gui::lightsSection().

6.1.4.12 DEFAULT_LIGHT_RADIUS

`float ven::DEFAULT_LIGHT_RADIUS = 0.1F [static], [constexpr]`

Definition at line 17 of file Light.hpp.

6.1.4.13 DEFAULT_LOOK_SPEED

`float ven::DEFAULT_LOOK_SPEED = 1.5F [static], [constexpr]`

Definition at line 21 of file Camera.hpp.

Referenced by ven::Gui::cameraSection().

6.1.4.14 DEFAULT_MAX_SETS

```
uint32_t ven::DEFAULT_MAX_SETS = 1000  [static], [constexpr]
```

Definition at line 15 of file DescriptorPool.hpp.

6.1.4.15 DEFAULT_MOVE_SPEED

```
float ven::DEFAULT_MOVE_SPEED = 3.F  [static], [constexpr]
```

Definition at line 20 of file Camera.hpp.

Referenced by ven::Gui::cameraSection().

6.1.4.16 DEFAULT_NEAR

```
float ven::DEFAULT_NEAR = 0.1F  [static], [constexpr]
```

Definition at line 17 of file Camera.hpp.

Referenced by ven::Gui::cameraSection().

6.1.4.17 DEFAULT_POSITION

```
glm::vec3 ven::DEFAULT_POSITION {0.F, 0.F, -2.5F}  [static], [constexpr]
```

Definition at line 13 of file Camera.hpp.

Referenced by ven::Gui::cameraSection().

6.1.4.18 DEFAULT_ROTATION

```
glm::vec3 ven::DEFAULT_ROTATION {0.F, 0.F, 0.F}  [static], [constexpr]
```

Definition at line 14 of file Camera.hpp.

Referenced by ven::Gui::cameraSection().

6.1.4.19 DEFAULT_SHININESS

```
float ven::DEFAULT_SHININESS = 32.F  [static], [constexpr]
```

Definition at line 18 of file Light.hpp.

Referenced by ven::Gui::lightsSection().

6.1.4.20 DEFAULT_TITLE

```
std::string_view ven::DEFAULT_TITLE = "VEngine"  [static], [constexpr]
```

Definition at line 19 of file Window.hpp.

6.1.4.21 DEFAULT_WIDTH

```
uint32_t ven::DEFAULT_WIDTH = 1920  [static], [constexpr]
```

Definition at line 17 of file Window.hpp.

6.1.4.22 DESCRIPTOR_COUNT

```
uint16_t ven::DESCRIPTOR_COUNT = 1000  [static], [constexpr]
```

Definition at line 18 of file Gui.hpp.

Referenced by ven::Gui::init().

6.1.4.23 EPSILON

```
float ven::EPSILON = std::numeric_limits<float>::epsilon()  [static], [constexpr]
```

Definition at line 33 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

6.1.4.24 MAX_FRAMES_IN_FLIGHT

```
int ven::MAX_FRAMES_IN_FLIGHT = 2  [static], [constexpr]
```

Definition at line 16 of file SwapChain.hpp.

Referenced by ven::Renderer::createCommandBuffers(), ven::SwapChain::createSyncObjects(), ven::Renderer::endFrame(), ven::Engine::Engine(), ven::Engine::mainLoop(), ven::SwapChain::submitCommandBuffers(), and ven::SwapChain::∼SwapChain().

6.1.4.25 MAX_LIGHTS

```
uint8_t ven::MAX_LIGHTS = 10  [static], [constexpr]
```

Definition at line 21 of file Light.hpp.

Referenced by ven::SceneManager::createLight().

6.1.4.26 MAX_OBJECTS

```
uint16_t ven::MAX_OBJECTS = 1000  [static], [constexpr]
```

Definition at line 21 of file Object.hpp.

Referenced by ven::SceneManager::createObject(), and ven::SceneManager::SceneManager().

6.1.4.27 SHADERS_BIN_PATH

```
std::string_view ven::SHADERS_BIN_PATH = "build/shaders/"  [static], [constexpr]
```

Definition at line 17 of file Shaders.hpp.

Referenced by ven::ObjectRenderSystem::ObjectRenderSystem(), and ven::PointLightRenderSystem::PointLightRenderSystem().

Chapter 7

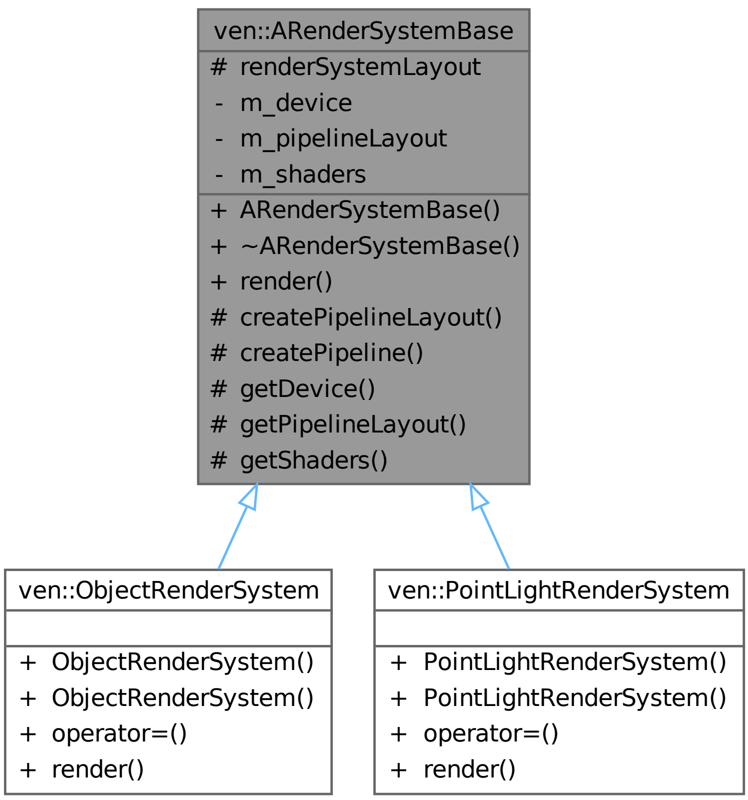
Class Documentation

7.1 ven::ARenderSystemBase Class Reference

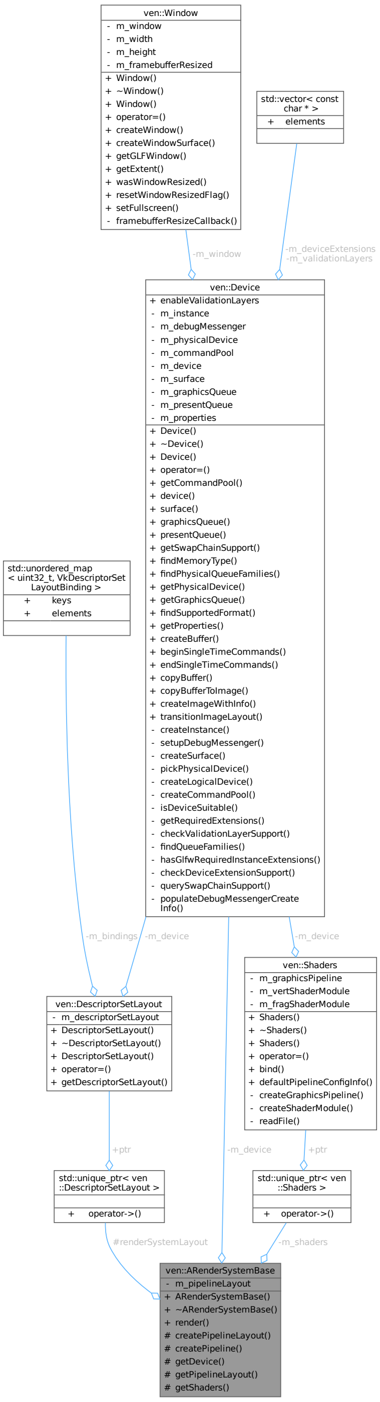
Abstract class for render system base.

`#include <ARenderSystemBase.hpp>`

Inheritance diagram for ven::ARenderSystemBase:



Collaboration diagram for ven::ARenderSystemBase:



Public Member Functions

- ARenderSystemBase (Device &device)
- virtual ∼ARenderSystemBase ()
- virtual void render (const FrameInfo &frameInfo) const =0

Protected Member Functions

- void createPipelineLayout (VkDescriptorSetLayout globalSetLayout, uint32_t pushConstantSize)
- void createPipeline (VkRenderPass renderPass, const std::string &shadersVertPath, const std::string &shadersFragPath, bool isLight)
- Device & getDevice () const
- VkPipelineLayout getPipelineLayout () const
- const std::unique_ptr< Shaders > & getShaders () const

Protected Attributes

- std::unique_ptr< DescriptorSetLayout > renderSystemLayout

Private Attributes

- Device & m_device
- VkPipelineLayout m_pipelineLayout {nullptr}
- std::unique_ptr< Shaders > m_shaders

7.1.1 Detailed Description

Abstract class for render system base.

Definition at line 23 of file ARenderSystemBase.hpp.

7.1.2 Constructor & Destructor Documentation

7.1.2.1 ARenderSystemBase()

```
ven::ARenderSystemBase::ARenderSystemBase (
            Device & device)  [inline], [explicit]
```

Definition at line 27 of file ARenderSystemBase.hpp.

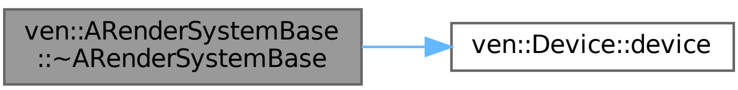
7.1.2.2 ∼ARenderSystemBase()

```
virtual ven::ARenderSystemBase::~ARenderSystemBase ()  [inline], [virtual]
```

Definition at line 28 of file ARenderSystemBase.hpp.

References ven::Device::device(), m_device, and m_pipelineLayout.

Here is the call graph for this function:



7.1.3 Member Function Documentation

7.1.3.1 createPipeline()

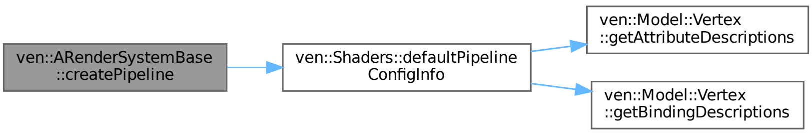
```
void ven::ARenderSystemBase::createPipeline (
            VkRenderPass renderPass,
            const std::string & shadersVertPath,
            const std::string & shadersFragPath,
            bool isLight) [protected]
```

Definition at line 38 of file renderSystemBase.cpp.

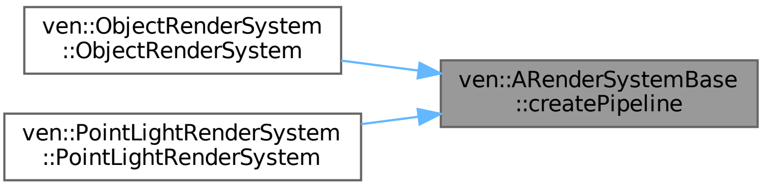
References ven::Shaders::defaultPipelineConfigInfo().

Referenced by ven::ObjectRenderSystem::ObjectRenderSystem(), and ven::PointLightRenderSystem::PointLightRenderSystem().

Here is the call graph for this function:



Here is the caller graph for this function:



7.1.3.2 createPipelineLayout()

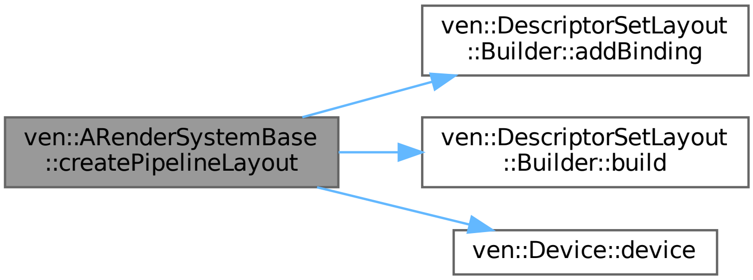
```
void ven::ARenderSystemBase::createPipelineLayout (
            VkDescriptorSetLayout globalSetLayout,
            uint32_t pushConstantSize) [protected]
```

Definition at line 6 of file renderSystemBase.cpp.

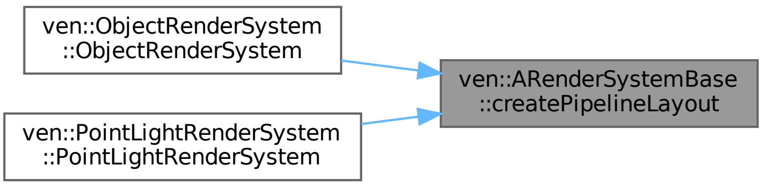
References ven::DescriptorSetLayout::Builder::addBinding(), ven::DescriptorSetLayout::Builder::build(), ven::Device::device(), m_device, m_pipelineLayout, and renderSystemLayout.

Referenced by ven::ObjectRenderSystem::ObjectRenderSystem(), and ven::PointLightRenderSystem::PointLightRenderSystem().

Here is the call graph for this function:



Here is the caller graph for this function:



7.1.3.3 getDevice()

```
Device & ven::ARenderSystemBase::getDevice () const  [inline], [nodiscard], [protected]
```

Definition at line 37 of file ARenderSystemBase.hpp.

References m_device.

7.1.3.4 getPipelineLayout()

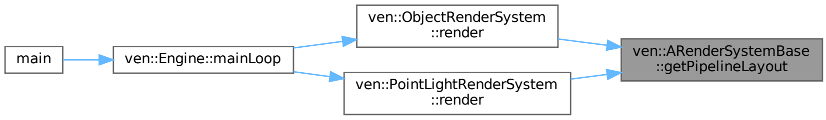
```
VkPipelineLayout ven::ARenderSystemBase::getPipelineLayout () const  [inline], [nodiscard],
[protected]
```

Definition at line 38 of file ARenderSystemBase.hpp.

References m_pipelineLayout.

Referenced by ven::ObjectRenderSystem::render(), and ven::PointLightRenderSystem::render().

Here is the caller graph for this function:



7.1.3.5 getShaders()

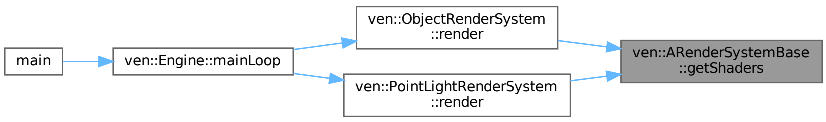
```
const std::unique_ptr< Shaders > & ven::ARenderSystemBase::getShaders () const [inline],
[nodiscard], [protected]
```

Definition at line 39 of file ARenderSystemBase.hpp.

References m_shaders.

Referenced by ven::ObjectRenderSystem::render(), and ven::PointLightRenderSystem::render().

Here is the caller graph for this function:



7.1.3.6 render()

```
virtual void ven::ARenderSystemBase::render (
            const FrameInfo & frameInfo) const [pure virtual]
```

Implemented in ven::ObjectRenderSystem, and ven::PointLightRenderSystem.

7.1.4 Member Data Documentation

7.1.4.1 m_device

```
Device& ven::ARenderSystemBase::m_device [private]
```

Definition at line 45 of file ARenderSystemBase.hpp.

Referenced by createPipelineLayout(), getDevice(), and ∼ARenderSystemBase().

7.1.4.2 m_pipelineLayout

`VkPipelineLayout ven::ARenderSystemBase::m_pipelineLayout {nullptr} [private]`

Definition at line 46 of file ARenderSystemBase.hpp.

Referenced by createPipelineLayout(), getPipelineLayout(), and ∼ARenderSystemBase().

7.1.4.3 m_shaders

`std::unique_ptr<Shaders> ven::ARenderSystemBase::m_shaders [private]`

Definition at line 47 of file ARenderSystemBase.hpp.

Referenced by getShaders().

7.1.4.4 renderSystemLayout

`std::unique_ptr<DescriptorSetLayout> ven::ARenderSystemBase::renderSystemLayout [protected]`

Definition at line 41 of file ARenderSystemBase.hpp.

Referenced by createPipelineLayout(), and ven::ObjectRenderSystem::render().

The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/RenderSystem/ARenderSystemBase.hpp
- /home/runner/work/VEngine/VEngine/src/system/renderSystemBase.cpp

7.2 ven::Buffer Class Reference

Class for buffer.

`#include <Buffer.hpp>`

Collaboration diagram for ven::Buffer:

Public Member Functions

- Buffer (Device &device, VkDeviceSize instanceSize, uint32_t instanceCount, VkBufferUsageFlags usageFlags, VkMemoryPropertyFlags memoryPropertyFlags, VkDeviceSize minOffsetAlignment=1)
- ∼Buffer ()
- Buffer (const Buffer &)=delete
- Buffer & operator= (const Buffer &)=delete

- VkResult map (VkDeviceSize size=VK_WHOLE_SIZE, VkDeviceSize offset=0)

  Map a memory range of this buffer.
- void unmap ()

  Unmap a mapped memory range.
- void writeToBuffer (const void *data, VkDeviceSize size=VK_WHOLE_SIZE, VkDeviceSize offset=0) const

  Copies the specified data to the mapped buffer.
- VkResult flush (VkDeviceSize size=VK_WHOLE_SIZE, VkDeviceSize offset=0) const

  Flush a memory range of the buffer to make it visible to the device.
- VkDescriptorBufferInfo descriptorInfo (const VkDeviceSize size=VK_WHOLE_SIZE, const VkDeviceSize offset=0) const

  Create a buffer info descriptor.
- VkResult invalidate (VkDeviceSize size=VK_WHOLE_SIZE, VkDeviceSize offset=0) const

  Invalidate a memory range of the buffer to make it visible to the host.
- void writeToIndex (const void *data, const VkDeviceSize index) const

  *Copies "instanceSize" bytes of data to the mapped buffer at an offset of index * alignmentSize.*
- VkResult flushIndex (const VkDeviceSize index) const

  *Flush the memory range at index * alignmentSize of the buffer to make it visible to the device.*
- VkDescriptorBufferInfo descriptorInfoForIndex (const VkDeviceSize index) const

  Create a buffer info descriptor.
- VkResult invalidateIndex (const VkDeviceSize index) const

  Invalidate a memory range of the buffer to make it visible to the host.
- VkBuffer getBuffer () const
- void * getMappedMemory () const
- uint32_t getInstanceCount () const
- VkDeviceSize getInstanceSize () const
- VkDeviceSize getAlignmentSize () const
- VkBufferUsageFlags getUsageFlags () const
- VkMemoryPropertyFlags getMemoryPropertyFlags () const
- VkDeviceSize getBufferSize () const

Static Private Member Functions

- static VkDeviceSize getAlignment (const VkDeviceSize instanceSize, const VkDeviceSize minOffsetAlignment)

  Returns the minimum instance size required to be compatible with devices minOffsetAlignment.

Private Attributes

- Device & m_device
- void * m_mapped = nullptr
- VkBuffer m_buffer = VK_NULL_HANDLE
- VkDeviceMemory m_memory = VK_NULL_HANDLE
- VkDeviceSize m_bufferSize
- VkDeviceSize m_instanceSize
- uint32_t m_instanceCount
- VkDeviceSize m_alignmentSize
- VkBufferUsageFlags m_usageFlags
- VkMemoryPropertyFlags m_memoryPropertyFlags

7.2.1 Detailed Description

Class for buffer.

Definition at line 18 of file Buffer.hpp.

7.2.2 Constructor & Destructor Documentation

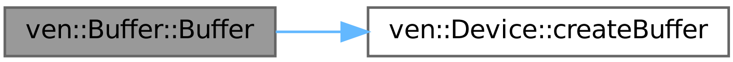
7.2.2.1 Buffer() [1/2]

```
ven::Buffer::Buffer (
            Device & device,
            VkDeviceSize instanceSize,
            uint32_t instanceCount,
            VkBufferUsageFlags usageFlags,
            VkMemoryPropertyFlags memoryPropertyFlags,
            VkDeviceSize minOffsetAlignment = 1)
```

Definition at line 6 of file buffer.cpp.

References ven::Device::createBuffer(), m_alignmentSize, m_buffer, m_bufferSize, m_instanceCount, m_memory, m_memoryPropertyFlags, and m_usageFlags.

Here is the call graph for this function:



7.2.2.2 ∼Buffer()

```
ven::Buffer::~Buffer ()
```

Definition at line 12 of file buffer.cpp.

7.2.2.3 Buffer() [2/2]

```
ven::Buffer::Buffer (
            const Buffer & )  [delete]
```

7.2.3 Member Function Documentation

7.2.3.1 descriptorInfo()

```
VkDescriptorBufferInfo ven::Buffer::descriptorInfo (
            const VkDeviceSize size = VK_WHOLE_SIZE,
            const VkDeviceSize offset = 0) const  [inline], [nodiscard]
```

Create a buffer info descriptor.

Parameters

size	(Optional) Size of the memory range of the descriptor
offset	(Optional) Byte offset from beginning

Returns

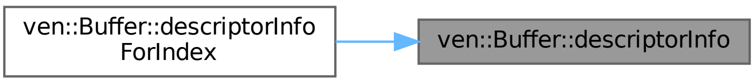
VkDescriptorBufferInfo of specified offset and range

Definition at line 74 of file Buffer.hpp.

References m_buffer.

Referenced by descriptorInfoForIndex().

Here is the caller graph for this function:



7.2.3.2 descriptorInfoForIndex()

```
VkDescriptorBufferInfo ven::Buffer::descriptorInfoForIndex (
             const VkDeviceSize index) const  [inline], [nodiscard]
```

Create a buffer info descriptor.

Parameters

index	Specifies the region given by index $*$ alignmentSize

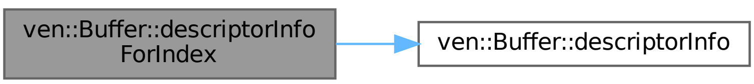
Returns

VkDescriptorBufferInfo for instance at index

Definition at line 113 of file Buffer.hpp.

References descriptorInfo(), and m_alignmentSize.

Here is the call graph for this function:



7.2.3.3 flush()

```
VkResult ven::Buffer::flush (
            VkDeviceSize size = VK_WHOLE_SIZE,
            VkDeviceSize offset = 0) const
```

Flush a memory range of the buffer to make it visible to the device.

Note

Only required for non-coherent memory

Parameters

size	(Optional) Size of the memory range to flush. Pass VK_WHOLE_SIZE to flush the complete buffer range.
offset	(Optional) Byte offset from beginning

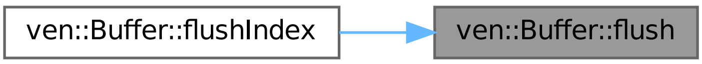
Returns

VkResult of the flush call

Definition at line 46 of file buffer.cpp.

Referenced by flushIndex().

Here is the caller graph for this function:



7.2.3.4 flushIndex()

```
VkResult ven::Buffer::flushIndex (
            const VkDeviceSize index) const [inline], [nodiscard]
```

Flush the memory range at index $*$ alignmentSize of the buffer to make it visible to the device.

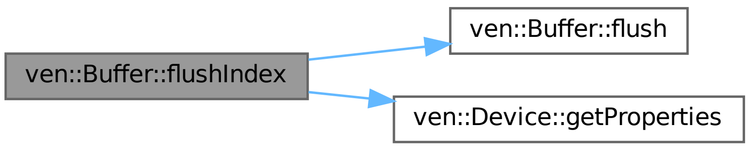
Parameters

index	Used in offset calculation

Definition at line 103 of file Buffer.hpp.

References flush(), ven::Device::getProperties(), m_alignmentSize, and m_device.

Here is the call graph for this function:



7.2.3.5 getAlignment()

```
static VkDeviceSize ven::Buffer::getAlignment (
            const VkDeviceSize instanceSize,
            const VkDeviceSize minOffsetAlignment) [inline], [static], [private]
```

Returns the minimum instance size required to be compatible with devices minOffsetAlignment.

Parameters

instanceSize	The size of an instance
minOffsetAlignment	The minimum required alignment, in bytes, for the offset member (eg minUniformBufferOffsetAlignment)

Returns

VkResult of the buffer mapping call

Definition at line 145 of file Buffer.hpp.

7.2.3.6 getAlignmentSize()

```
VkDeviceSize ven::Buffer::getAlignmentSize () const [inline], [nodiscard]
```

Definition at line 130 of file Buffer.hpp.

References m_alignmentSize.

7.2.3.7 getBuffer()

`VkBuffer ven::Buffer::getBuffer () const [inline], [nodiscard]`

Definition at line 126 of file Buffer.hpp.

References m_buffer.

7.2.3.8 getBufferSize()

`VkDeviceSize ven::Buffer::getBufferSize () const [inline], [nodiscard]`

Definition at line 133 of file Buffer.hpp.

References m_bufferSize.

7.2.3.9 getInstanceCount()

`uint32_t ven::Buffer::getInstanceCount () const [inline], [nodiscard]`

Definition at line 128 of file Buffer.hpp.

References m_instanceCount.

7.2.3.10 getInstanceSize()

`VkDeviceSize ven::Buffer::getInstanceSize () const [inline], [nodiscard]`

Definition at line 129 of file Buffer.hpp.

References m_instanceSize.

7.2.3.11 getMappedMemory()

`void * ven::Buffer::getMappedMemory () const [inline], [nodiscard]`

Definition at line 127 of file Buffer.hpp.

References m_mapped.

7.2.3.12 getMemoryPropertyFlags()

`VkMemoryPropertyFlags ven::Buffer::getMemoryPropertyFlags () const [inline], [nodiscard]`

Definition at line 132 of file Buffer.hpp.

References m_memoryPropertyFlags.

7.2.3.13 getUsageFlags()

```
VkBufferUsageFlags ven::Buffer::getUsageFlags () const  [inline], [nodiscard]
```

Definition at line 131 of file Buffer.hpp.

References m_usageFlags.

7.2.3.14 invalidate()

```
VkResult ven::Buffer::invalidate (
            VkDeviceSize size = VK_WHOLE_SIZE,
            VkDeviceSize offset = 0) const  [nodiscard]
```

Invalidate a memory range of the buffer to make it visible to the host.

Note

Only required for non-coherent memory

Parameters

size	(Optional) Size of the memory range to invalidate. Pass VK_WHOLE_SIZE to invalidate the complete buffer range.
offset	(Optional) Byte offset from beginning

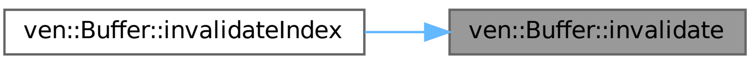
Returns

VkResult of the invalidate call

Definition at line 56 of file buffer.cpp.

Referenced by invalidateIndex().

Here is the caller graph for this function:



7.2.3.15 invalidateIndex()

```
VkResult ven::Buffer::invalidateIndex (
            const VkDeviceSize index) const  [inline], [nodiscard]
```

Invalidate a memory range of the buffer to make it visible to the host.

Note

Only required for non-coherent memory

Parameters

index	Specifies the region to invalidate: index ∗ alignmentSize

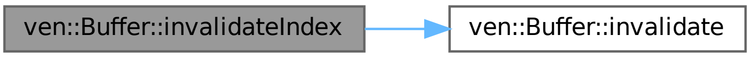
Returns

VkResult of the invalidate call

Definition at line 124 of file Buffer.hpp.

References invalidate(), and m_alignmentSize.

Here is the call graph for this function:



7.2.3.16 map()

```
VkResult ven::Buffer::map (
            VkDeviceSize size = VK_WHOLE_SIZE,
            VkDeviceSize offset = 0)
```

Map a memory range of this buffer.

If successful, mapped points to the specified buffer range.

Parameters

size	(Optional) Size of the memory range to map. Pass VK_WHOLE_SIZE to map the complete buffer range.
offset	(Optional) Byte offset from beginning

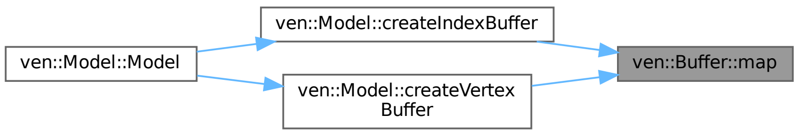
Returns

VkResult of the buffer mapping call

Definition at line 19 of file buffer.cpp.

Referenced by ven::Model::createIndexBuffer(), and ven::Model::createVertexBuffer().

Here is the caller graph for this function:



7.2.3.17 operator=()

```
Buffer & ven::Buffer::operator= (
            const Buffer & )  [delete]
```

7.2.3.18 unmap()

```
void ven::Buffer::unmap ()
```

Unmap a mapped memory range.

Note

Does not return a result as vkUnmapMemory can't fail

Definition at line 25 of file buffer.cpp.

7.2.3.19 writeToBuffer()

```
void ven::Buffer::writeToBuffer (
            const void * data,
            VkDeviceSize size = VK_WHOLE_SIZE,
            VkDeviceSize offset = 0) const
```

Copies the specified data to the mapped buffer.

Default value writes whole buffer range

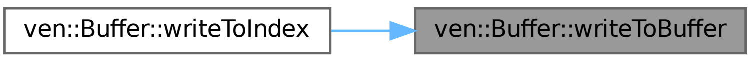
Parameters

data	Pointer to the data to copy
size	(Optional) Size of the data to copy. Pass VK_WHOLE_SIZE to flush the complete buffer range.
offset	(Optional) Byte offset from beginning of mapped region

Definition at line 33 of file buffer.cpp.

Referenced by writeToIndex().

Here is the caller graph for this function:



7.2.3.20 writeToIndex()

```
void ven::Buffer::writeToIndex (
            const void * data,
            const VkDeviceSize index) const  [inline]
```

Copies "instanceSize" bytes of data to the mapped buffer at an offset of index ∗ alignmentSize.

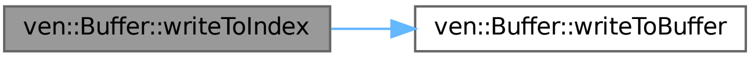
Parameters

data	Pointer to the data to copy
index	Used in offset calculation

Definition at line 96 of file Buffer.hpp.

References m_alignmentSize, m_instanceSize, and writeToBuffer().

Here is the call graph for this function:



7.2.4 Member Data Documentation

7.2.4.1 m_alignmentSize

```
VkDeviceSize ven::Buffer::m_alignmentSize  [private]
```

Definition at line 155 of file Buffer.hpp.

Referenced by Buffer(), descriptorInfoForIndex(), flushIndex(), getAlignmentSize(), invalidateIndex(), and writeToIndex().

7.2.4.2 m_buffer

```
VkBuffer ven::Buffer::m_buffer = VK_NULL_HANDLE  [private]
```

Definition at line 149 of file Buffer.hpp.

Referenced by Buffer(), descriptorInfo(), and getBuffer().

7.2.4.3 m_bufferSize

```
VkDeviceSize ven::Buffer::m_bufferSize  [private]
```

Definition at line 152 of file Buffer.hpp.

Referenced by Buffer(), and getBufferSize().

7.2.4.4 m_device

```
Device& ven::Buffer::m_device [private]
```

Definition at line 147 of file Buffer.hpp.

Referenced by flushIndex().

7.2.4.5 m_instanceCount

```
uint32_t ven::Buffer::m_instanceCount [private]
```

Definition at line 154 of file Buffer.hpp.

Referenced by Buffer(), and getInstanceCount().

7.2.4.6 m_instanceSize

```
VkDeviceSize ven::Buffer::m_instanceSize [private]
```

Definition at line 153 of file Buffer.hpp.

Referenced by getInstanceSize(), and writeToIndex().

7.2.4.7 m_mapped

```
void* ven::Buffer::m_mapped = nullptr [private]
```

Definition at line 148 of file Buffer.hpp.

Referenced by getMappedMemory().

7.2.4.8 m_memory

```
VkDeviceMemory ven::Buffer::m_memory = VK_NULL_HANDLE [private]
```

Definition at line 150 of file Buffer.hpp.

Referenced by Buffer().

7.2.4.9 m_memoryPropertyFlags

```
VkMemoryPropertyFlags ven::Buffer::m_memoryPropertyFlags [private]
```

Definition at line 157 of file Buffer.hpp.

Referenced by Buffer(), and getMemoryPropertyFlags().

7.2.4.10 m_usageFlags

```
VkBufferUsageFlags ven::Buffer::m_usageFlags  [private]
```

Definition at line 156 of file Buffer.hpp.

Referenced by Buffer(), and getUsageFlags().

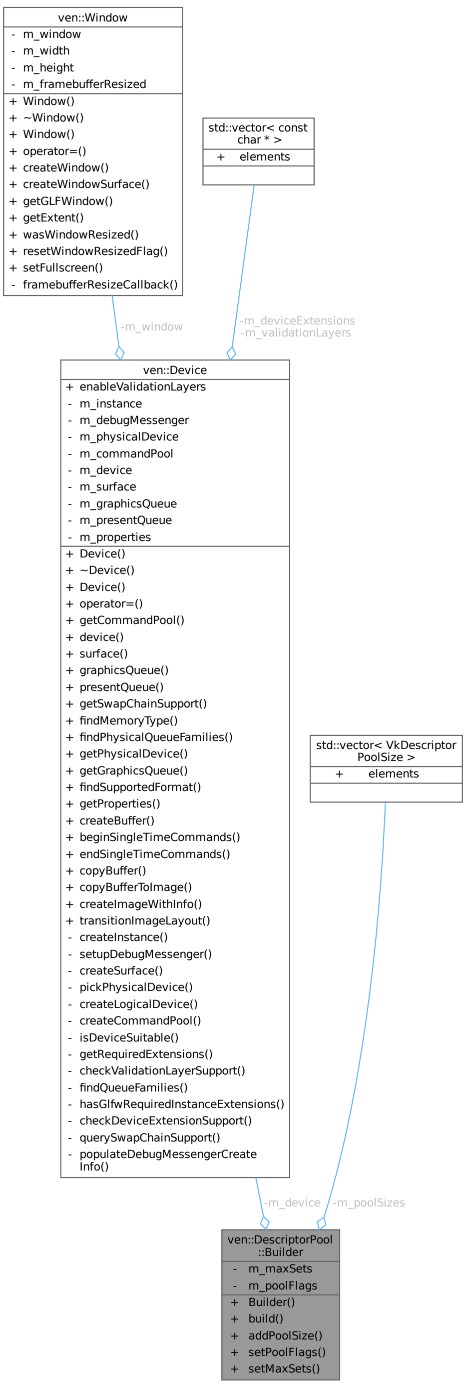
The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/Buffer.hpp
- /home/runner/work/VEngine/VEngine/src/buffer.cpp

7.3 ven::DescriptorPool::Builder Class Reference

```
#include <DescriptorPool.hpp>
```

Collaboration diagram for ven::DescriptorPool::Builder:



Public Member Functions

- Builder (Device &device)
- std::unique_ptr< DescriptorPool > build () const
- Builder & addPoolSize (const VkDescriptorType descriptorType, const uint32_t count)
- Builder & setPoolFlags (const VkDescriptorPoolCreateFlags flags)
- Builder & setMaxSets (const uint32_t count)

Private Attributes

- Device & m_device
- std::vector< VkDescriptorPoolSize > m_poolSizes
- uint32_t m_maxSets {DEFAULT_MAX_SETS}
- VkDescriptorPoolCreateFlags m_poolFlags {0}

7.3.1 Detailed Description

Definition at line 26 of file DescriptorPool.hpp.

7.3.2 Constructor & Destructor Documentation

7.3.2.1 Builder()

```
ven::DescriptorPool::Builder::Builder (
            Device & device)  [inline], [explicit]
```

Definition at line 30 of file DescriptorPool.hpp.

7.3.3 Member Function Documentation

7.3.3.1 addPoolSize()

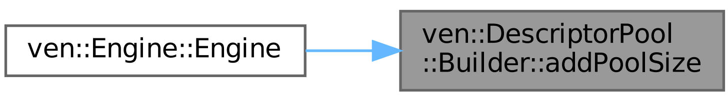
```
Builder & ven::DescriptorPool::Builder::addPoolSize (
            const VkDescriptorType descriptorType,
            const uint32_t count)  [inline]
```

Definition at line 34 of file DescriptorPool.hpp.

References m_poolSizes.

Referenced by ven::Engine::Engine().

Here is the caller graph for this function:



7.3.3.2 build()

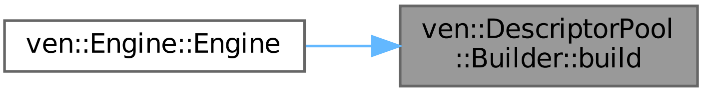
```
std::unique_ptr< DescriptorPool > ven::DescriptorPool::Builder::build () const  [inline],
[nodiscard]
```

Definition at line 32 of file DescriptorPool.hpp.

References m_device, m_maxSets, m_poolFlags, and m_poolSizes.

Referenced by ven::Engine::Engine().

Here is the caller graph for this function:



7.3.3.3 setMaxSets()

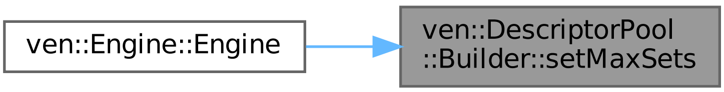
```
Builder & ven::DescriptorPool::Builder::setMaxSets (
            const uint32_t count)  [inline]
```

Definition at line 36 of file DescriptorPool.hpp.

References m_maxSets.

Referenced by ven::Engine::Engine().

Here is the caller graph for this function:



7.3.3.4 setPoolFlags()

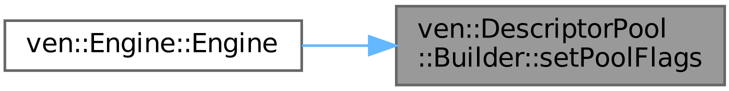
```
Builder & ven::DescriptorPool::Builder::setPoolFlags (
            const VkDescriptorPoolCreateFlags flags)  [inline]
```

Definition at line 35 of file DescriptorPool.hpp.

References m_poolFlags.

Referenced by ven::Engine::Engine().

Here is the caller graph for this function:



7.3.4 Member Data Documentation

7.3.4.1 m_device

```
Device& ven::DescriptorPool::Builder::m_device  [private]
```

Definition at line 40 of file DescriptorPool.hpp.

Referenced by build().

7.3.4.2 m_maxSets

```
uint32_t ven::DescriptorPool::Builder::m_maxSets {DEFAULT_MAX_SETS}  [private]
```

Definition at line 42 of file DescriptorPool.hpp.

Referenced by build(), and setMaxSets().

7.3.4.3 m_poolFlags

```
VkDescriptorPoolCreateFlags ven::DescriptorPool::Builder::m_poolFlags {0}  [private]
```

Definition at line 43 of file DescriptorPool.hpp.

Referenced by build(), and setPoolFlags().

7.3.4.4 m_poolSizes

`std::vector<VkDescriptorPoolSize> ven::DescriptorPool::Builder::m_poolSizes [private]`

Definition at line 41 of file DescriptorPool.hpp.

Referenced by addPoolSize(), and build().

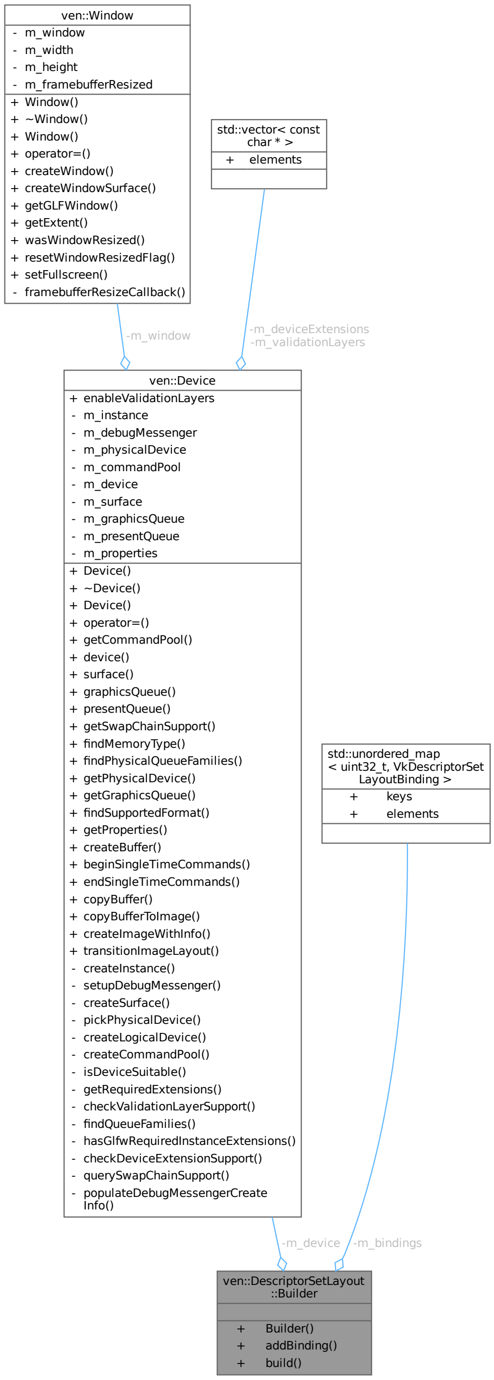
The documentation for this class was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/Descriptors/DescriptorPool.hpp

7.4 ven::DescriptorSetLayout::Builder Class Reference

`#include <DescriptorSetLayout.hpp>`

Collaboration diagram for ven::DescriptorSetLayout::Builder:



Public Member Functions

- Builder (Device &device)
- Builder & addBinding (uint32_t binding, VkDescriptorType descriptorType, VkShaderStageFlags stageFlags, uint32_t count=1)
- std::unique_ptr< DescriptorSetLayout > build () const

Private Attributes

- Device & m_device
- std::unordered_map< uint32_t, VkDescriptorSetLayoutBinding > m_bindings

7.4.1 Detailed Description

Definition at line 25 of file DescriptorSetLayout.hpp.

7.4.2 Constructor & Destructor Documentation

7.4.2.1 Builder()

```
ven::DescriptorSetLayout::Builder::Builder (
            Device & device)  [inline], [explicit]
```

Definition at line 29 of file DescriptorSetLayout.hpp.

7.4.3 Member Function Documentation

7.4.3.1 addBinding()

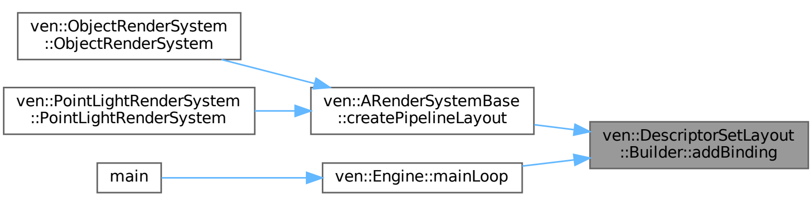
```
ven::DescriptorSetLayout::Builder & ven::DescriptorSetLayout::Builder::addBinding (
            uint32_t binding,
            VkDescriptorType descriptorType,
            VkShaderStageFlags stageFlags,
            uint32_t count = 1)
```

Definition at line 5 of file descriptorSetLayout.cpp.

References m_bindings.

Referenced by ven::ARenderSystemBase::createPipelineLayout(), and ven::Engine::mainLoop().

Here is the caller graph for this function:



7.4.3.2 build()

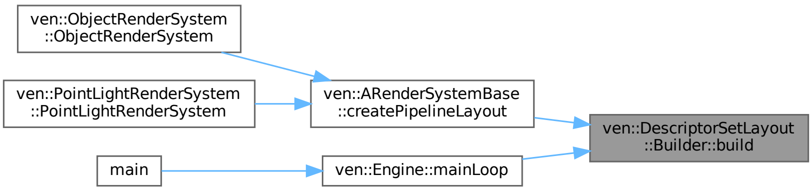
```
std::unique_ptr< DescriptorSetLayout > ven::DescriptorSetLayout::Builder::build () const
[inline]
```

Definition at line 32 of file DescriptorSetLayout.hpp.

References m_bindings, and m_device.

Referenced by ven::ARenderSystemBase::createPipelineLayout(), and ven::Engine::mainLoop().

Here is the caller graph for this function:



7.4.4 Member Data Documentation

7.4.4.1 m_bindings

```
std::unordered_map<uint32_t, VkDescriptorSetLayoutBinding> ven::DescriptorSetLayout::Builder←
::m_bindings [private]
```

Definition at line 37 of file DescriptorSetLayout.hpp.

Referenced by addBinding(), and build().

7.4.4.2 m_device

```
Device& ven::DescriptorSetLayout::Builder::m_device [private]
```

Definition at line 36 of file DescriptorSetLayout.hpp.

Referenced by build().

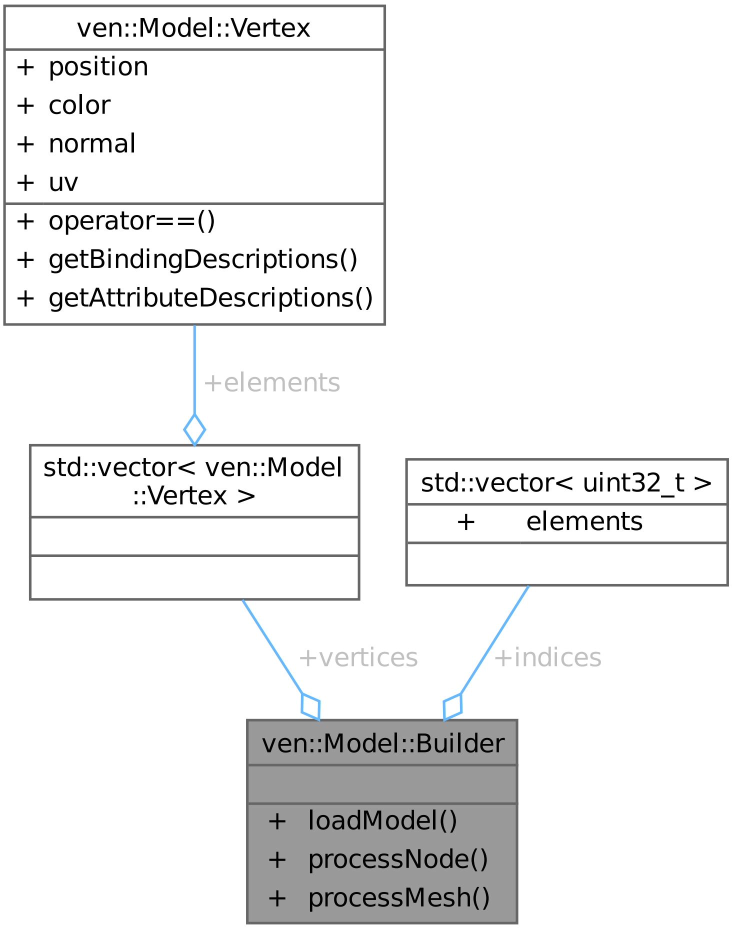
The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/Descriptors/DescriptorSetLayout.hpp
- /home/runner/work/VEngine/VEngine/src/descriptors/descriptorSetLayout.cpp

7.5 ven::Model::Builder Struct Reference

```
#include <Model.hpp>
```

Collaboration diagram for ven::Model::Builder:



Public Member Functions

- void loadModel (const std::string &filename)
- void processNode (const aiNode ∗node, const aiScene ∗scene)
- void processMesh (const aiMesh ∗mesh, const aiScene ∗scene)

Public Attributes

- std::vector< Vertex > vertices
- std::vector< uint32_t > indices

7.5.1 Detailed Description

Definition at line 43 of file Model.hpp.

7.5.2 Member Function Documentation

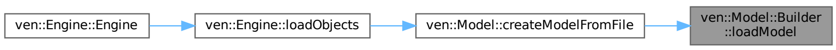
7.5.2.1 loadModel()

```
void ven::Model::Builder::loadModel (
            const std::string & filename)
```

Definition at line 117 of file model.cpp.

Referenced by ven::Model::createModelFromFile().

Here is the caller graph for this function:



7.5.2.2 processMesh()

```
void ven::Model::Builder::processMesh (
            const aiMesh * mesh,
            const aiScene * scene)
```

Definition at line 143 of file model.cpp.

References ven::Colors::BLACK_3, ven::Model::Vertex::position, and ven::Colors::WHITE_3.

7.5.2.3 processNode()

```
void ven::Model::Builder::processNode (
            const aiNode * node,
            const aiScene * scene)
```

Definition at line 132 of file model.cpp.

7.5.3 Member Data Documentation

7.5.3.1 indices

```
std::vector<uint32_t> ven::Model::Builder::indices
```

Definition at line 45 of file Model.hpp.

Referenced by ven::Model::Model().

7.5.3.2 vertices

```
std::vector<Vertex> ven::Model::Builder::vertices
```

Definition at line 44 of file Model.hpp.

Referenced by ven::Model::Model().

The documentation for this struct was generated from the following files:

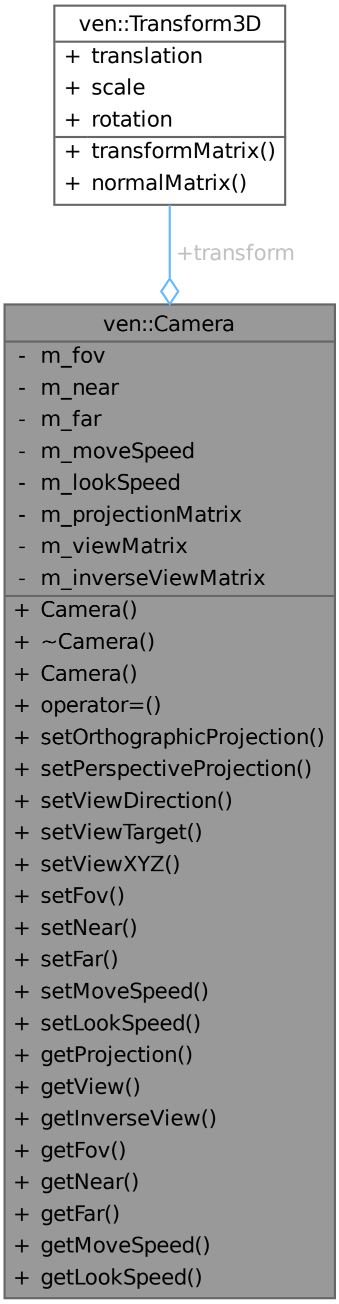
- /home/runner/work/VEngine/VEngine/include/VEngine/Model.hpp
- /home/runner/work/VEngine/VEngine/src/model.cpp

7.6 ven::Camera Class Reference

Class for camera.

```
#include <Camera.hpp>
```

Collaboration diagram for ven::Camera:



Public Member Functions

- Camera ()=default
- ∼Camera ()=default
- Camera (const Camera &)=delete
- Camera & operator= (const Camera &)=delete
- void setOrthographicProjection (float left, float right, float top, float bottom, float near, float far)

- void setPerspectiveProjection (float aspect)
- void setViewDirection (glm::vec3 position, glm::vec3 direction, glm::vec3 up={0.F, -1.F, 0.F})
- void setViewTarget (const glm::vec3 position, const glm::vec3 target, const glm::vec3 up={0.F, -1.F, 0.F})
- void setViewXYZ (glm::vec3 position, glm::vec3 rotation)
- void setFov (const float fov)
- void setNear (const float near)
- void setFar (const float far)
- void setMoveSpeed (const float moveSpeed)
- void setLookSpeed (const float lookSpeed)
- const glm::mat4 & getProjection () const
- const glm::mat4 & getView () const
- const glm::mat4 & getInverseView () const
- float getFov () const
- float getNear () const
- float getFar () const
- float getMoveSpeed () const
- float getLookSpeed () const

Public Attributes

- Transform3D transform {DEFAULT_POSITION, {1.F, 1.F, 1.F}, DEFAULT_ROTATION}

Private Attributes

- float m_fov {DEFAULT_FOV}
- float m_near {DEFAULT_NEAR}
- float m_far {DEFAULT_FAR}
- float m_moveSpeed {DEFAULT_MOVE_SPEED}
- float m_lookSpeed {DEFAULT_LOOK_SPEED}
- glm::mat4 m_projectionMatrix {1.F}
- glm::mat4 m_viewMatrix {1.F}
- glm::mat4 m_inverseViewMatrix {1.F}

7.6.1 Detailed Description

Class for camera.

Definition at line 28 of file Camera.hpp.

7.6.2 Constructor & Destructor Documentation

7.6.2.1 Camera() [1/2]

```
ven::Camera::Camera ()   [default]
```

7.6.2.2 ~Camera()

```
ven::Camera::~Camera ()   [default]
```

7.6.2.3 Camera() [2/2]

```
ven::Camera::Camera (
            const Camera & )  [delete]
```

7.6.3 Member Function Documentation

7.6.3.1 getFar()

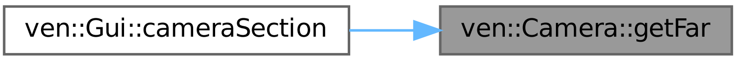
```
float ven::Camera::getFar () const  [inline], [nodiscard]
```

Definition at line 54 of file Camera.hpp.

References m_far.

Referenced by ven::Gui::cameraSection().

Here is the caller graph for this function:



7.6.3.2 getFov()

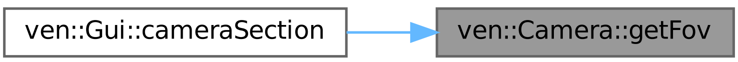
```
float ven::Camera::getFov () const  [inline], [nodiscard]
```

Definition at line 52 of file Camera.hpp.

References m_fov.

Referenced by ven::Gui::cameraSection().

Here is the caller graph for this function:



7.6.3.3 getInverseView()

```
const glm::mat4 & ven::Camera::getInverseView () const  [inline], [nodiscard]
```

Definition at line 51 of file Camera.hpp.

References m_inverseViewMatrix.

7.6.3.4 getLookSpeed()

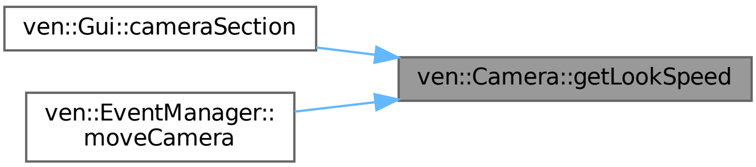
```
float ven::Camera::getLookSpeed () const  [inline], [nodiscard]
```

Definition at line 56 of file Camera.hpp.

References m_lookSpeed.

Referenced by ven::Gui::cameraSection(), and ven::EventManager::moveCamera().

Here is the caller graph for this function:



7.6.3.5 getMoveSpeed()

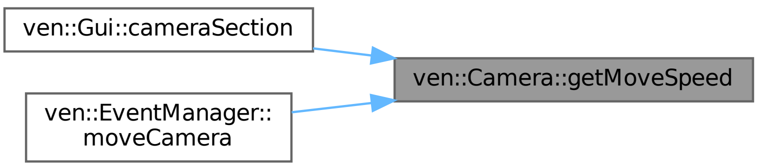
```
float ven::Camera::getMoveSpeed () const  [inline], [nodiscard]
```

Definition at line 55 of file Camera.hpp.

References m_moveSpeed.

Referenced by ven::Gui::cameraSection(), and ven::EventManager::moveCamera().

Here is the caller graph for this function:



7.6.3.6 getNear()

```
float ven::Camera::getNear () const  [inline], [nodiscard]
```

Definition at line 53 of file Camera.hpp.

References m_near.

Referenced by ven::Gui::cameraSection().

Here is the caller graph for this function:

7.6.3.7 getProjection()

```
const glm::mat4 & ven::Camera::getProjection () const  [inline], [nodiscard]
```

Definition at line 49 of file Camera.hpp.

References m_projectionMatrix.

7.6.3.8 getView()

```
const glm::mat4 & ven::Camera::getView () const  [inline], [nodiscard]
```

Definition at line 50 of file Camera.hpp.

References m_viewMatrix.

7.6.3.9 operator=()

```
Camera & ven::Camera::operator= (
            const Camera & )  [delete]
```

7.6.3.10 setFar()

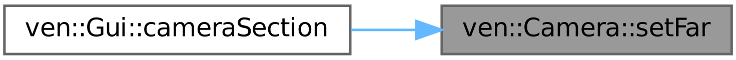
```
void ven::Camera::setFar (
            const float far) [inline]
```

Definition at line 45 of file Camera.hpp.

References m_far.

Referenced by ven::Gui::cameraSection().

Here is the caller graph for this function:



7.6.3.11 setFov()

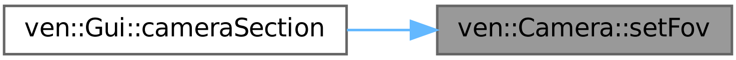
```
void ven::Camera::setFov (
            const float fov) [inline]
```

Definition at line 43 of file Camera.hpp.

References m_fov.

Referenced by ven::Gui::cameraSection().

Here is the caller graph for this function:



7.6.3.12 setLookSpeed()

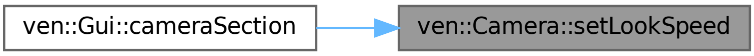
```
void ven::Camera::setLookSpeed (
            const float lookSpeed)  [inline]
```

Definition at line 47 of file Camera.hpp.

References m_lookSpeed.

Referenced by ven::Gui::cameraSection().

Here is the caller graph for this function:



7.6.3.13 setMoveSpeed()

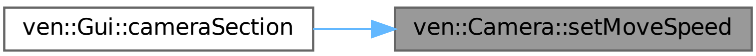
```
void ven::Camera::setMoveSpeed (
            const float moveSpeed)  [inline]
```

Definition at line 46 of file Camera.hpp.

References m_moveSpeed.

Referenced by ven::Gui::cameraSection().

Here is the caller graph for this function:



7.6.3.14 setNear()

```
void ven::Camera::setNear (
            const float near)  [inline]
```

Definition at line 44 of file Camera.hpp.

References m_near.

Referenced by ven::Gui::cameraSection().

Here is the caller graph for this function:

7.6.3.15 setOrthographicProjection()

```
void ven::Camera::setOrthographicProjection (
            float left,
            float right,
            float top,
            float bottom,
            float near,
            float far)
```

Definition at line 6 of file camera.cpp.

References m_projectionMatrix.

7.6.3.16 setPerspectiveProjection()

```
void ven::Camera::setPerspectiveProjection (
            float aspect)
```

Definition at line 17 of file camera.cpp.

7.6.3.17 setViewDirection()

```
void ven::Camera::setViewDirection (
            glm::vec3 position,
            glm::vec3 direction,
            glm::vec3 up = {0.F, -1.F, 0.F})
```

Definition at line 29 of file camera.cpp.

7.6.3.18 setViewTarget()

```
void ven::Camera::setViewTarget (
            const glm::vec3 position,
            const glm::vec3 target,
            const glm::vec3 up = {0.F, -1.F, 0.F}) [inline]
```

Definition at line 41 of file Camera.hpp.

7.6.3.19 setViewXYZ()

```
void ven::Camera::setViewXYZ (
            glm::vec3 position,
            glm::vec3 rotation)
```

Definition at line 64 of file camera.cpp.

7.6.4 Member Data Documentation

7.6.4.1 m_far

```
float ven::Camera::m_far {DEFAULT_FAR} [private]
```

Definition at line 64 of file Camera.hpp.

Referenced by getFar(), and setFar().

7.6.4.2 m_fov

```
float ven::Camera::m_fov {DEFAULT_FOV} [private]
```

Definition at line 62 of file Camera.hpp.

Referenced by getFov(), and setFov().

7.6.4.3 m_inverseViewMatrix

```
glm::mat4 ven::Camera::m_inverseViewMatrix {1.F} [private]
```

Definition at line 69 of file Camera.hpp.

Referenced by getInverseView().

7.6.4.4 m_lookSpeed

```
float ven::Camera::m_lookSpeed {DEFAULT_LOOK_SPEED} [private]
```

Definition at line 66 of file Camera.hpp.

Referenced by getLookSpeed(), and setLookSpeed().

7.6.4.5 m_moveSpeed

`float ven::Camera::m_moveSpeed {DEFAULT_MOVE_SPEED} [private]`

Definition at line 65 of file Camera.hpp.

Referenced by getMoveSpeed(), and setMoveSpeed().

7.6.4.6 m_near

`float ven::Camera::m_near {DEFAULT_NEAR} [private]`

Definition at line 63 of file Camera.hpp.

Referenced by getNear(), and setNear().

7.6.4.7 m_projectionMatrix

`glm::mat4 ven::Camera::m_projectionMatrix {1.F} [private]`

Definition at line 67 of file Camera.hpp.

Referenced by getProjection(), and setOrthographicProjection().

7.6.4.8 m_viewMatrix

`glm::mat4 ven::Camera::m_viewMatrix {1.F} [private]`

Definition at line 68 of file Camera.hpp.

Referenced by getView().

7.6.4.9 transform

`Transform3D ven::Camera::transform {DEFAULT_POSITION, {1.F, 1.F, 1.F}, DEFAULT_ROTATION}`

Definition at line 58 of file Camera.hpp.

Referenced by ven::Gui::cameraSection(), and ven::EventManager::moveCamera().

The documentation for this class was generated from the following files:

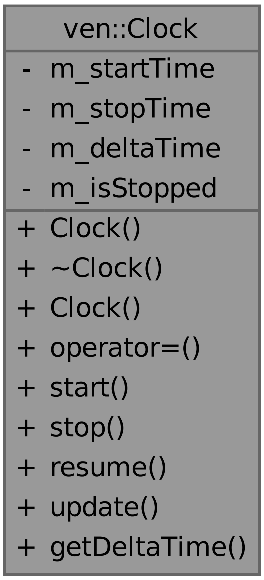
- /home/runner/work/VEngine/VEngine/include/VEngine/Camera.hpp
- /home/runner/work/VEngine/VEngine/src/camera.cpp

7.7 ven::Clock Class Reference

Class for clock.

`#include <Clock.hpp>`

Collaboration diagram for ven::Clock:



Public Member Functions

- Clock ()
- ~Clock ()=default
- Clock (const Clock &)=delete
- Clock & operator= (const Clock &)=delete
- void start ()
- void stop ()
- void resume ()
- void update ()
- float getDeltaTime () const

Private Attributes

- TimePoint m_startTime
- TimePoint m_stopTime
- std::chrono::duration< float > m_deltaTime {0.F}
- bool m_isStopped {false}

7.7.1 Detailed Description

Class for clock.

Definition at line 20 of file Clock.hpp.

7.7.2 Constructor & Destructor Documentation

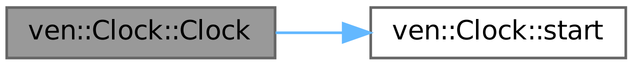
7.7.2.1 Clock() [1/2]

```
ven::Clock::Clock ()  [inline]
```

Definition at line 24 of file Clock.hpp.

References start().

Here is the call graph for this function:



7.7.2.2 ∼Clock()

```
ven::Clock::~Clock ()  [default]
```

7.7.2.3 Clock() [2/2]

```
ven::Clock::Clock (
            const Clock & )  [delete]
```

7.7.3 Member Function Documentation

7.7.3.1 getDeltaTime()

```
float ven::Clock::getDeltaTime () const  [inline], [nodiscard]
```

Definition at line 35 of file Clock.hpp.

References m_deltaTime.

Referenced by ven::Engine::mainLoop().

Here is the caller graph for this function:

7.7.3.2 operator=()

```
Clock & ven::Clock::operator= (
            const Clock & )  [delete]
```

7.7.3.3 resume()

```
void ven::Clock::resume ()
```

Definition at line 20 of file clock.cpp.

7.7.3.4 start()

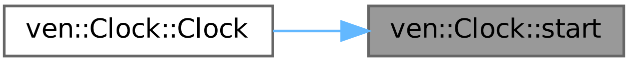
```
void ven::Clock::start ()  [inline]
```

Definition at line 30 of file Clock.hpp.

References m_startTime.

Referenced by Clock().

Here is the caller graph for this function:



7.7.3.5 stop()

```
void ven::Clock::stop ()
```

Definition at line 10 of file clock.cpp.

7.7.3.6 update()

```
void ven::Clock::update ()
```

Definition at line 3 of file clock.cpp.

References m_deltaTime, and m_startTime.

Referenced by ven::Engine::mainLoop().

Here is the caller graph for this function:

7.7.4 Member Data Documentation

7.7.4.1 m_deltaTime

`std::chrono::duration<float> ven::Clock::m_deltaTime {0.F} [private]`

Definition at line 41 of file Clock.hpp.

Referenced by getDeltaTime(), and update().

7.7.4.2 m_isStopped

`bool ven::Clock::m_isStopped {false} [private]`

Definition at line 43 of file Clock.hpp.

7.7.4.3 m_startTime

`TimePoint ven::Clock::m_startTime [private]`

Definition at line 39 of file Clock.hpp.

Referenced by start(), and update().

7.7.4.4 m_stopTime

`TimePoint ven::Clock::m_stopTime [private]`

Definition at line 40 of file Clock.hpp.

The documentation for this class was generated from the following files:

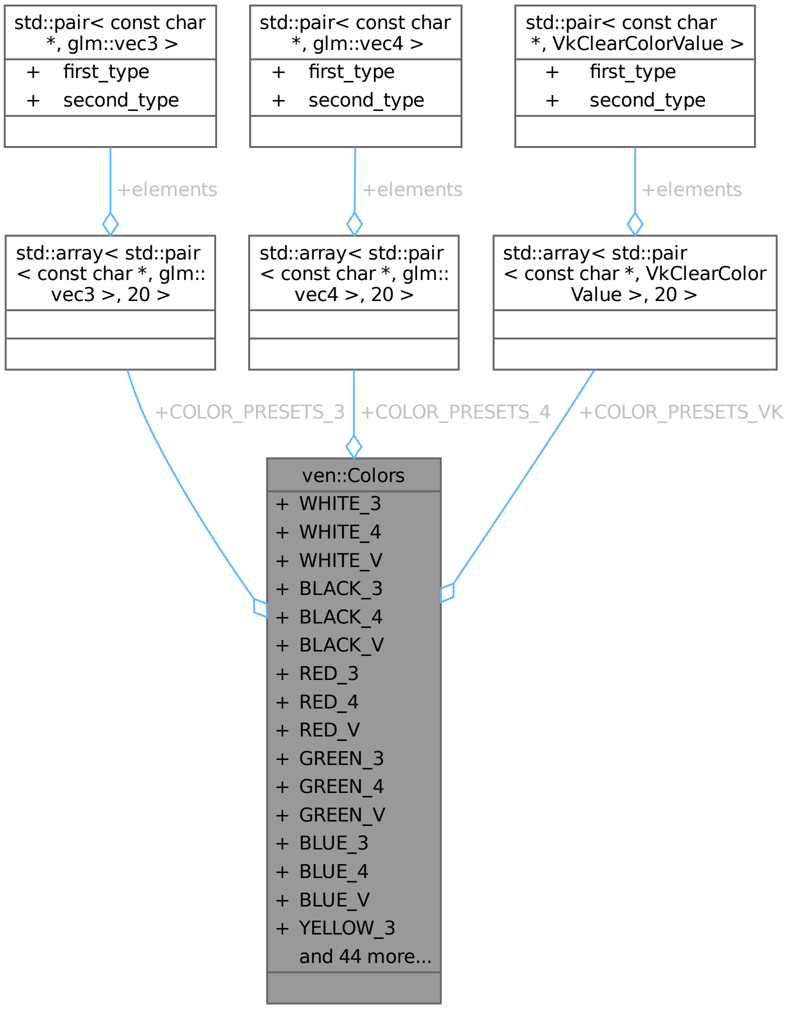
- /home/runner/work/VEngine/VEngine/include/VEngine/Utils/Clock.hpp
- /home/runner/work/VEngine/VEngine/src/utils/clock.cpp

7.8 ven::Colors Class Reference

Class for colors.

`#include <Colors.hpp>`

Collaboration diagram for ven::Colors:



Static Public Attributes

- static constexpr glm::vec3 WHITE_3 = glm::vec3(COLOR_MAX) / COLOR_MAX
- static constexpr glm::vec4 WHITE_4 = { 1.0F, 1.0F, 1.0F, 1.0F }
- static constexpr VkClearColorValue WHITE_V = { { 1.0F, 1.0F, 1.0F, 1.0F } }
- static constexpr glm::vec3 BLACK_3 = glm::vec3(0.0F)
- static constexpr glm::vec4 BLACK_4 = { 0.0F, 0.0F, 0.0F, 1.0F }
- static constexpr VkClearColorValue BLACK_V = { { 0.0F, 0.0F, 0.0F, 1.0F } }
- static constexpr glm::vec3 RED_3 = glm::vec3(COLOR_MAX, 0.0F, 0.0F) / COLOR_MAX
- static constexpr glm::vec4 RED_4 = { 1.0F, 0.0F, 0.0F, 1.0F }

- static constexpr VkClearColorValue RED_V = { { 1.0F, 0.0F, 0.0F, 1.0F } }
- static constexpr glm::vec3 GREEN_3 = glm::vec3(0.0F, COLOR_MAX, 0.0F) / COLOR_MAX
- static constexpr glm::vec4 GREEN_4 = { 0.0F, 1.0F, 0.0F, 1.0F }
- static constexpr VkClearColorValue GREEN_V = { { 0.0F, 1.0F, 0.0F, 1.0F } }
- static constexpr glm::vec3 BLUE_3 = glm::vec3(0.0F, 0.0F, COLOR_MAX) / COLOR_MAX
- static constexpr glm::vec4 BLUE_4 = { 0.0F, 0.0F, 1.0F, 1.0F }
- static constexpr VkClearColorValue BLUE_V = { { 0.0F, 0.0F, 1.0F, 1.0F } }
- static constexpr glm::vec3 YELLOW_3 = glm::vec3(COLOR_MAX, COLOR_MAX, 0.0F) / COLOR_MAX
- static constexpr glm::vec4 YELLOW_4 = { 1.0F, 1.0F, 0.0F, 1.0F }
- static constexpr VkClearColorValue YELLOW_V = { { 1.0F, 1.0F, 0.0F, 1.0F } }
- static constexpr glm::vec3 CYAN_3 = glm::vec3(0.0F, COLOR_MAX, COLOR_MAX) / COLOR_MAX
- static constexpr glm::vec4 CYAN_4 = { 0.0F, 1.0F, 1.0F, 1.0F }
- static constexpr VkClearColorValue CYAN_V = { { 0.0F, 1.0F, 1.0F, 1.0F } }
- static constexpr glm::vec3 MAGENTA_3 = glm::vec3(COLOR_MAX, 0.0F, COLOR_MAX) / COLOR_MAX
- static constexpr glm::vec4 MAGENTA_4 = { 1.0F, 0.0F, 1.0F, 1.0F }
- static constexpr VkClearColorValue MAGENTA_V = { { 1.0F, 0.0F, 1.0F, 1.0F } }
- static constexpr glm::vec3 SILVER_3 = glm::vec3(192.0F, 192.0F, 192.0F) / COLOR_MAX
- static constexpr glm::vec4 SILVER_4 = { 0.75F, 0.75F, 0.75F, 1.0F }
- static constexpr VkClearColorValue SILVER_V = { { 0.75F, 0.75F, 0.75F, 1.0F } }
- static constexpr glm::vec3 GRAY_3 = glm::vec3(128.0F, 128.0F, 128.0F) / COLOR_MAX
- static constexpr glm::vec4 GRAY_4 = { 0.5F, 0.5F, 0.5F, 1.0F }
- static constexpr VkClearColorValue GRAY_V = { { 0.5F, 0.5F, 0.5F, 1.0F } }
- static constexpr glm::vec3 MAROON_3 = glm::vec3(128.0F, 0.0F, 0.0F) / COLOR_MAX
- static constexpr glm::vec4 MAROON_4 = { 0.5F, 0.0F, 0.0F, 1.0F }
- static constexpr VkClearColorValue MAROON_V = { { 0.5F, 0.0F, 0.0F, 1.0F } }
- static constexpr glm::vec3 OLIVE_3 = glm::vec3(128.0F, 128.0F, 0.0F) / COLOR_MAX
- static constexpr glm::vec4 OLIVE_4 = { 0.5F, 0.5F, 0.0F, 1.0F }
- static constexpr VkClearColorValue OLIVE_V = { { 0.5F, 0.5F, 0.0F, 1.0F } }
- static constexpr glm::vec3 LIME_3 = glm::vec3(0.0F, COLOR_MAX, 0.0F) / COLOR_MAX
- static constexpr glm::vec4 LIME_4 = { 0.0F, 1.0F, 0.0F, 1.0F }
- static constexpr VkClearColorValue LIME_V = { { 0.0F, 1.0F, 0.0F, 1.0F } }
- static constexpr glm::vec3 AQUA_3 = glm::vec3(0.0F, COLOR_MAX, COLOR_MAX) / COLOR_MAX
- static constexpr glm::vec4 AQUA_4 = { 0.0F, 1.0F, 1.0F, 1.0F }
- static constexpr VkClearColorValue AQUA_V = { { 0.0F, 1.0F, 1.0F, 1.0F } }
- static constexpr glm::vec3 TEAL_3 = glm::vec3(0.0F, 128.0F, 128.0F) / COLOR_MAX
- static constexpr glm::vec4 TEAL_4 = { 0.0F, 0.5F, 0.5F, 1.0F }
- static constexpr VkClearColorValue TEAL_V = { { 0.0F, 0.5F, 0.5F, 1.0F } }
- static constexpr glm::vec3 NAVY_3 = glm::vec3(0.0F, 0.0F, 128.0F) / COLOR_MAX
- static constexpr glm::vec4 NAVY_4 = { 0.0F, 0.0F, 0.5F, 1.0F }
- static constexpr VkClearColorValue NAVY_V = { { 0.0F, 0.0F, 0.5F, 1.0F } }
- static constexpr glm::vec3 FUCHSIA_3 = glm::vec3(COLOR_MAX, 0.0F, COLOR_MAX) / COLOR_MAX
- static constexpr glm::vec4 FUCHSIA_4 = { 1.0F, 0.0F, 1.0F, 1.0F }
- static constexpr VkClearColorValue FUCHSIA_V = { { 1.0F, 0.0F, 1.0F, 1.0F } }
- static constexpr glm::vec3 NIGHT_BLUE_3 = glm::vec3(25.0F, 25.0F, 112.0F) / COLOR_MAX
- static constexpr glm::vec4 NIGHT_BLUE_4 = { 0.098F, 0.098F, 0.439F, 1.0F }
- static constexpr VkClearColorValue NIGHT_BLUE_V = { { 0.098F, 0.098F, 0.439F, 1.0F } }
- static constexpr glm::vec3 SKY_BLUE_3 = glm::vec3(102.0F, 178.0F, 255.0F) / COLOR_MAX
- static constexpr glm::vec4 SKY_BLUE_4 = { 0.4F, 0.698F, 1.0F, 1.0F }
- static constexpr VkClearColorValue SKY_BLUE_V = { { 0.4F, 0.698F, 1.0F, 1.0F } }
- static constexpr glm::vec3 SUNSET_3 = glm::vec3(255.0F, 128.0F, 0.0F) / COLOR_MAX
- static constexpr glm::vec4 SUNSET_4 = { 1.0F, 0.5F, 0.0F, 1.0F }
- static constexpr VkClearColorValue SUNSET_V = { { 1.0F, 0.5F, 0.0F, 1.0F } }
- static constexpr std::array< std::pair< const char *, glm::vec3 >, 20 > COLOR_PRESETS_3
- static constexpr std::array< std::pair< const char *, glm::vec4 >, 20 > COLOR_PRESETS_4
- static constexpr std::array< std::pair< const char *, VkClearColorValue >, 20 > COLOR_PRESETS_VK

7.8.1 Detailed Description

Class for colors.

Definition at line 22 of file Colors.hpp.

7.8.2 Member Data Documentation

7.8.2.1 AQUA_3

```
glm::vec3 ven::Colors::AQUA_3 = glm::vec3(0.0F, COLOR_MAX, COLOR_MAX) / COLOR_MAX [static],
[constexpr]
```

Definition at line 78 of file Colors.hpp.

7.8.2.2 AQUA_4

```
glm::vec4 ven::Colors::AQUA_4 = { 0.0F, 1.0F, 1.0F, 1.0F } [static], [constexpr]
```

Definition at line 79 of file Colors.hpp.

7.8.2.3 AQUA_V

```
VkClearColorValue ven::Colors::AQUA_V = { { 0.0F, 1.0F, 1.0F, 1.0F } } [static], [constexpr]
```

Definition at line 80 of file Colors.hpp.

7.8.2.4 BLACK_3

```
glm::vec3 ven::Colors::BLACK_3 = glm::vec3(0.0F) [static], [constexpr]
```

Definition at line 30 of file Colors.hpp.

Referenced by ven::Model::Builder::processMesh().

7.8.2.5 BLACK_4

```
glm::vec4 ven::Colors::BLACK_4 = { 0.0F, 0.0F, 0.0F, 1.0F } [static], [constexpr]
```

Definition at line 31 of file Colors.hpp.

7.8.2.6 BLACK_V

```
VkClearColorValue ven::Colors::BLACK_V = { { 0.0F, 0.0F, 0.0F, 1.0F } } [static], [constexpr]
```

Definition at line 32 of file Colors.hpp.

7.8.2.7 BLUE_3

```
glm::vec3 ven::Colors::BLUE_3 = glm::vec3(0.0F, 0.0F, COLOR_MAX) / COLOR_MAX  [static], [constexpr]
```

Definition at line 42 of file Colors.hpp.

7.8.2.8 BLUE_4

```
glm::vec4 ven::Colors::BLUE_4 = { 0.0F, 0.0F, 1.0F, 1.0F }  [static], [constexpr]
```

Definition at line 43 of file Colors.hpp.

Referenced by ven::Engine::loadObjects().

7.8.2.9 BLUE_V

```
VkClearColorValue ven::Colors::BLUE_V = { { 0.0F, 0.0F, 1.0F, 1.0F } }  [static], [constexpr]
```

Definition at line 44 of file Colors.hpp.

7.8.2.10 COLOR_PRESETS_3

```
std::array<std::pair<const char *, glm::vec3>, 20> ven::Colors::COLOR_PRESETS_3  [static],
[constexpr]
```

Initial value:

```
= {{
                {"White", WHITE_3},
                {"Black", BLACK_3},
                {"Red", RED_3},
                {"Green", GREEN_3},
                {"Blue", BLUE_3},
                {"Yellow", YELLOW_3},
                {"Cyan", CYAN_3},
                {"Magenta", MAGENTA_3},
                {"Silver", SILVER_3},
                {"Gray", GRAY_3},
                {"Maroon", MAROON_3},
                {"Olive", OLIVE_3},
                {"Lime", LIME_3},
                {"Aqua", AQUA_3},
                {"Teal", TEAL_3},
                {"Navy", NAVY_3},
                {"Fuchsia", FUCHSIA_3},
                {"Night Blue", NIGHT_BLUE_3},
                {"Sky Blue", SKY_BLUE_3},
                {"Sunset", SUNSET_3}
            }}
```

Definition at line 107 of file Colors.hpp.

Referenced by ven::Gui::lightsSection().

7.8.2.11 COLOR_PRESETS_4

std::array<std::pair<const char *, glm::vec4>, 20> ven::Colors::COLOR_PRESETS_4 [static], [constexpr]

Initial value:

```
= {{
                {"White", WHITE_4},
                {"Black", BLACK_4},
                {"Red", RED_4},
                {"Green", GREEN_4},
                {"Blue", BLUE_4},
                {"Yellow", YELLOW_4},
                {"Cyan", CYAN_4},
                {"Magenta", MAGENTA_4},
                {"Silver", SILVER_4},
                {"Gray", GRAY_4},
                {"Maroon", MAROON_4},
                {"Olive", OLIVE_4},
                {"Lime", LIME_4},
                {"Aqua", AQUA_4},
                {"Teal", TEAL_4},
                {"Navy", NAVY_4},
                {"Fuchsia", FUCHSIA_4},
                {"Night Blue", NIGHT_BLUE_4},
                {"Sky Blue", SKY_BLUE_4},
                {"Sunset", SUNSET_4}
            }}
```

Definition at line 130 of file Colors.hpp.

Referenced by ven::Gui::rendererSection().

7.8.2.12 COLOR_PRESETS_VK

std::array<std::pair<const char *, VkClearColorValue>, 20> ven::Colors::COLOR_PRESETS_VK [static], [constexpr]

Initial value:

```
= {{
                {"White", WHITE_V},
                {"Black", BLACK_V},
                {"Red", RED_V},
                {"Green", GREEN_V},
                {"Blue", BLUE_V},
                {"Yellow", YELLOW_V},
                {"Cyan", CYAN_V},
                {"Magenta", MAGENTA_V},
                {"Silver", SILVER_V},
                {"Gray", GRAY_V},
                {"Maroon", MAROON_V},
                {"Olive", OLIVE_V},
                {"Lime", LIME_V},
                {"Aqua", AQUA_V},
                {"Teal", TEAL_V},
                {"Navy", NAVY_V},
                {"Fuchsia", FUCHSIA_V},
                {"Night Blue", NIGHT_BLUE_V},
                {"Sky Blue", SKY_BLUE_V},
                {"Sunset", SUNSET_V}
            }}
```

Definition at line 153 of file Colors.hpp.

Referenced by ven::Gui::rendererSection().

7.8.2.13 CYAN_3

glm::vec3 ven::Colors::CYAN_3 = glm::vec3(0.0F, COLOR_MAX, COLOR_MAX) / COLOR_MAX [static], [constexpr]

Definition at line 50 of file Colors.hpp.

7.8.2.14 CYAN_4

```
glm::vec4 ven::Colors::CYAN_4 = { 0.0F, 1.0F, 1.0F, 1.0F } [static], [constexpr]
```

Definition at line 51 of file Colors.hpp.

Referenced by ven::Engine::loadObjects().

7.8.2.15 CYAN_V

```
VkClearColorValue ven::Colors::CYAN_V = { { 0.0F, 1.0F, 1.0F, 1.0F } } [static], [constexpr]
```

Definition at line 52 of file Colors.hpp.

7.8.2.16 FUCHSIA_3

```
glm::vec3 ven::Colors::FUCHSIA_3 = glm::vec3(COLOR_MAX, 0.0F, COLOR_MAX) / COLOR_MAX [static],
[constexpr]
```

Definition at line 90 of file Colors.hpp.

7.8.2.17 FUCHSIA_4

```
glm::vec4 ven::Colors::FUCHSIA_4 = { 1.0F, 0.0F, 1.0F, 1.0F } [static], [constexpr]
```

Definition at line 91 of file Colors.hpp.

7.8.2.18 FUCHSIA_V

```
VkClearColorValue ven::Colors::FUCHSIA_V = { { 1.0F, 0.0F, 1.0F, 1.0F } } [static], [constexpr]
```

Definition at line 92 of file Colors.hpp.

7.8.2.19 GRAY_3

```
glm::vec3 ven::Colors::GRAY_3 = glm::vec3(128.0F, 128.0F, 128.0F) / COLOR_MAX [static], [constexpr]
```

Definition at line 62 of file Colors.hpp.

7.8.2.20 GRAY_4

```
glm::vec4 ven::Colors::GRAY_4 = { 0.5F, 0.5F, 0.5F, 1.0F } [static], [constexpr]
```

Definition at line 63 of file Colors.hpp.

Referenced by ven::Gui::objectsSection().

7.8.2.21 GRAY_V

```
VkClearColorValue ven::Colors::GRAY_V = { { 0.5F, 0.5F, 0.5F, 1.0F } }  [static], [constexpr]
```

Definition at line 64 of file Colors.hpp.

7.8.2.22 GREEN_3

```
glm::vec3 ven::Colors::GREEN_3 = glm::vec3(0.0F, COLOR_MAX, 0.0F) / COLOR_MAX  [static], [constexpr]
```

Definition at line 38 of file Colors.hpp.

7.8.2.23 GREEN_4

```
glm::vec4 ven::Colors::GREEN_4 = { 0.0F, 1.0F, 0.0F, 1.0F }  [static], [constexpr]
```

Definition at line 39 of file Colors.hpp.

Referenced by ven::Engine::loadObjects().

7.8.2.24 GREEN_V

```
VkClearColorValue ven::Colors::GREEN_V = { { 0.0F, 1.0F, 0.0F, 1.0F } }  [static], [constexpr]
```

Definition at line 40 of file Colors.hpp.

7.8.2.25 LIME_3

```
glm::vec3 ven::Colors::LIME_3 = glm::vec3(0.0F, COLOR_MAX, 0.0F) / COLOR_MAX  [static], [constexpr]
```

Definition at line 74 of file Colors.hpp.

7.8.2.26 LIME_4

```
glm::vec4 ven::Colors::LIME_4 = { 0.0F, 1.0F, 0.0F, 1.0F }  [static], [constexpr]
```

Definition at line 75 of file Colors.hpp.

7.8.2.27 LIME_V

```
VkClearColorValue ven::Colors::LIME_V = { { 0.0F, 1.0F, 0.0F, 1.0F } }  [static], [constexpr]
```

Definition at line 76 of file Colors.hpp.

7.8.2.28 MAGENTA_3

```
glm::vec3 ven::Colors::MAGENTA_3 = glm::vec3(COLOR_MAX, 0.0F, COLOR_MAX) / COLOR_MAX [static],
[constexpr]
```

Definition at line 54 of file Colors.hpp.

7.8.2.29 MAGENTA_4

```
glm::vec4 ven::Colors::MAGENTA_4 = { 1.0F, 0.0F, 1.0F, 1.0F } [static], [constexpr]
```

Definition at line 55 of file Colors.hpp.

Referenced by ven::Engine::loadObjects().

7.8.2.30 MAGENTA_V

```
VkClearColorValue ven::Colors::MAGENTA_V = { { 1.0F, 0.0F, 1.0F, 1.0F } } [static], [constexpr]
```

Definition at line 56 of file Colors.hpp.

7.8.2.31 MAROON_3

```
glm::vec3 ven::Colors::MAROON_3 = glm::vec3(128.0F, 0.0F, 0.0F) / COLOR_MAX [static], [constexpr]
```

Definition at line 66 of file Colors.hpp.

7.8.2.32 MAROON_4

```
glm::vec4 ven::Colors::MAROON_4 = { 0.5F, 0.0F, 0.0F, 1.0F } [static], [constexpr]
```

Definition at line 67 of file Colors.hpp.

7.8.2.33 MAROON_V

```
VkClearColorValue ven::Colors::MAROON_V = { { 0.5F, 0.0F, 0.0F, 1.0F } } [static], [constexpr]
```

Definition at line 68 of file Colors.hpp.

7.8.2.34 NAVY_3

```
glm::vec3 ven::Colors::NAVY_3 = glm::vec3(0.0F, 0.0F, 128.0F) / COLOR_MAX [static], [constexpr]
```

Definition at line 86 of file Colors.hpp.

7.8.2.35 NAVY_4

```
glm::vec4 ven::Colors::NAVY_4 = { 0.0F, 0.0F, 0.5F, 1.0F }  [static], [constexpr]
```

Definition at line 87 of file Colors.hpp.

7.8.2.36 NAVY_V

```
VkClearColorValue ven::Colors::NAVY_V = { { 0.0F, 0.0F, 0.5F, 1.0F } }  [static], [constexpr]
```

Definition at line 88 of file Colors.hpp.

7.8.2.37 NIGHT_BLUE_3

```
glm::vec3 ven::Colors::NIGHT_BLUE_3 = glm::vec3(25.0F, 25.0F, 112.0F) / COLOR_MAX  [static],
[constexpr]
```

Definition at line 94 of file Colors.hpp.

7.8.2.38 NIGHT_BLUE_4

```
glm::vec4 ven::Colors::NIGHT_BLUE_4 = { 0.098F, 0.098F, 0.439F, 1.0F }  [static], [constexpr]
```

Definition at line 95 of file Colors.hpp.

7.8.2.39 NIGHT_BLUE_V

```
VkClearColorValue ven::Colors::NIGHT_BLUE_V = { { 0.098F, 0.098F, 0.439F, 1.0F } }  [static],
[constexpr]
```

Definition at line 96 of file Colors.hpp.

7.8.2.40 OLIVE_3

```
glm::vec3 ven::Colors::OLIVE_3 = glm::vec3(128.0F, 128.0F, 0.0F) / COLOR_MAX  [static], [constexpr]
```

Definition at line 70 of file Colors.hpp.

7.8.2.41 OLIVE_4

```
glm::vec4 ven::Colors::OLIVE_4 = { 0.5F, 0.5F, 0.0F, 1.0F }  [static], [constexpr]
```

Definition at line 71 of file Colors.hpp.

7.8.2.42 OLIVE_V

```
VkClearColorValue ven::Colors::OLIVE_V = { { 0.5F, 0.5F, 0.0F, 1.0F } } [static], [constexpr]
```

Definition at line 72 of file Colors.hpp.

7.8.2.43 RED_3

```
glm::vec3 ven::Colors::RED_3 = glm::vec3(COLOR_MAX, 0.0F, 0.0F) / COLOR_MAX [static], [constexpr]
```

Definition at line 34 of file Colors.hpp.

7.8.2.44 RED_4

```
glm::vec4 ven::Colors::RED_4 = { 1.0F, 0.0F, 0.0F, 1.0F } [static], [constexpr]
```

Definition at line 35 of file Colors.hpp.

Referenced by ven::Engine::loadObjects().

7.8.2.45 RED_V

```
VkClearColorValue ven::Colors::RED_V = { { 1.0F, 0.0F, 0.0F, 1.0F } } [static], [constexpr]
```

Definition at line 36 of file Colors.hpp.

7.8.2.46 SILVER_3

```
glm::vec3 ven::Colors::SILVER_3 = glm::vec3(192.0F, 192.0F, 192.0F) / COLOR_MAX [static],
[constexpr]
```

Definition at line 58 of file Colors.hpp.

7.8.2.47 SILVER_4

```
glm::vec4 ven::Colors::SILVER_4 = { 0.75F, 0.75F, 0.75F, 1.0F } [static], [constexpr]
```

Definition at line 59 of file Colors.hpp.

7.8.2.48 SILVER_V

```
VkClearColorValue ven::Colors::SILVER_V = { { 0.75F, 0.75F, 0.75F, 1.0F } } [static], [constexpr]
```

Definition at line 60 of file Colors.hpp.

7.8.2.49 SKY_BLUE_3

`glm::vec3 ven::Colors::SKY_BLUE_3 = glm::vec3(102.0F, 178.0F, 255.0F) / COLOR_MAX [static], [constexpr]`

Definition at line 98 of file Colors.hpp.

7.8.2.50 SKY_BLUE_4

`glm::vec4 ven::Colors::SKY_BLUE_4 = { 0.4F, 0.698F, 1.0F, 1.0F } [static], [constexpr]`

Definition at line 99 of file Colors.hpp.

7.8.2.51 SKY_BLUE_V

`VkClearColorValue ven::Colors::SKY_BLUE_V = { { 0.4F, 0.698F, 1.0F, 1.0F } } [static], [constexpr]`

Definition at line 100 of file Colors.hpp.

7.8.2.52 SUNSET_3

`glm::vec3 ven::Colors::SUNSET_3 = glm::vec3(255.0F, 128.0F, 0.0F) / COLOR_MAX [static], [constexpr]`

Definition at line 102 of file Colors.hpp.

7.8.2.53 SUNSET_4

`glm::vec4 ven::Colors::SUNSET_4 = { 1.0F, 0.5F, 0.0F, 1.0F } [static], [constexpr]`

Definition at line 103 of file Colors.hpp.

7.8.2.54 SUNSET_V

`VkClearColorValue ven::Colors::SUNSET_V = { { 1.0F, 0.5F, 0.0F, 1.0F } } [static], [constexpr]`

Definition at line 104 of file Colors.hpp.

7.8.2.55 TEAL_3

`glm::vec3 ven::Colors::TEAL_3 = glm::vec3(0.0F, 128.0F, 128.0F) / COLOR_MAX [static], [constexpr]`

Definition at line 82 of file Colors.hpp.

7.8.2.56 TEAL_4

```
glm::vec4 ven::Colors::TEAL_4 = { 0.0F, 0.5F, 0.5F, 1.0F } [static], [constexpr]
```

Definition at line 83 of file Colors.hpp.

7.8.2.57 TEAL_V

```
VkClearColorValue ven::Colors::TEAL_V = { { 0.0F, 0.5F, 0.5F, 1.0F } } [static], [constexpr]
```

Definition at line 84 of file Colors.hpp.

7.8.2.58 WHITE_3

```
glm::vec3 ven::Colors::WHITE_3 = glm::vec3(COLOR_MAX) / COLOR_MAX [static], [constexpr]
```

Definition at line 26 of file Colors.hpp.

Referenced by ven::Model::Builder::processMesh().

7.8.2.59 WHITE_4

```
glm::vec4 ven::Colors::WHITE_4 = { 1.0F, 1.0F, 1.0F, 1.0F } [static], [constexpr]
```

Definition at line 27 of file Colors.hpp.

7.8.2.60 WHITE_V

```
VkClearColorValue ven::Colors::WHITE_V = { { 1.0F, 1.0F, 1.0F, 1.0F } } [static], [constexpr]
```

Definition at line 28 of file Colors.hpp.

7.8.2.61 YELLOW_3

```
glm::vec3 ven::Colors::YELLOW_3 = glm::vec3(COLOR_MAX, COLOR_MAX, 0.0F) / COLOR_MAX [static],
[constexpr]
```

Definition at line 46 of file Colors.hpp.

7.8.2.62 YELLOW_4

```
glm::vec4 ven::Colors::YELLOW_4 = { 1.0F, 1.0F, 0.0F, 1.0F } [static], [constexpr]
```

Definition at line 47 of file Colors.hpp.

Referenced by ven::Engine::loadObjects().

7.8.2.63 YELLOW_V

```
VkClearColorValue ven::Colors::YELLOW_V = { { 1.0F, 1.0F, 0.0F, 1.0F } }  [static], [constexpr]
```

Definition at line 48 of file Colors.hpp.

The documentation for this class was generated from the following file:

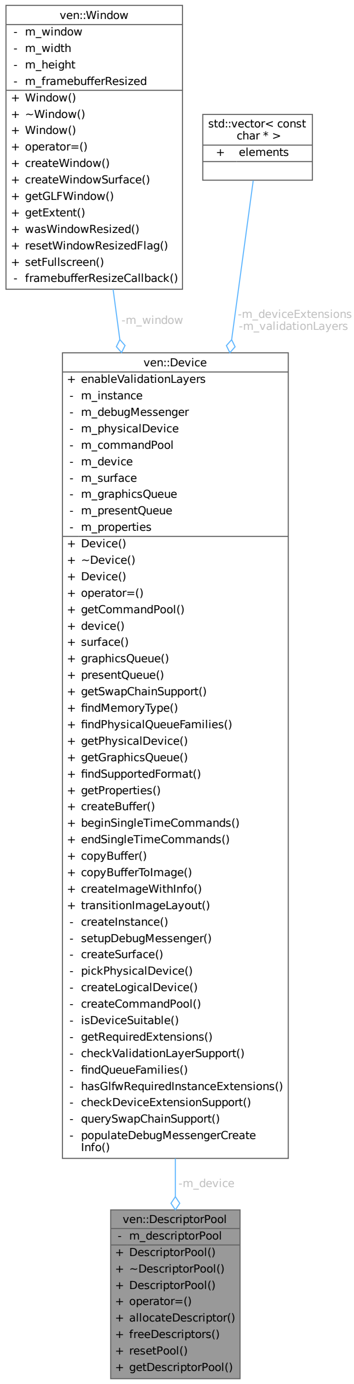
- /home/runner/work/VEngine/VEngine/include/VEngine/Utils/Colors.hpp

7.9 ven::DescriptorPool Class Reference

Class for descriptor pool.

```
#include <DescriptorPool.hpp>
```

Collaboration diagram for ven::DescriptorPool:



Classes

- class Builder

Public Member Functions

- DescriptorPool (Device &device, uint32_t maxSets, VkDescriptorPoolCreateFlags poolFlags, const std::vector< VkDescriptorPoolSize > &poolSizes)

- ∼DescriptorPool ()
- DescriptorPool (const DescriptorPool &)=delete
- DescriptorPool & operator= (const DescriptorPool &)=delete
- bool allocateDescriptor (VkDescriptorSetLayout descriptorSetLayout, VkDescriptorSet &descriptor) const
- void freeDescriptors (const std::vector< VkDescriptorSet > &descriptors) const
- void resetPool () const
- VkDescriptorPool getDescriptorPool () const

Private Attributes

- Device & m_device
- VkDescriptorPool m_descriptorPool

Friends

- class DescriptorWriter

7.9.1 Detailed Description

Class for descriptor pool.

Definition at line 22 of file DescriptorPool.hpp.

7.9.2 Constructor & Destructor Documentation

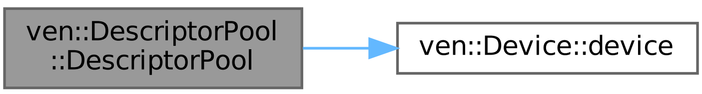
7.9.2.1 DescriptorPool() [1/2]

```
ven::DescriptorPool::DescriptorPool (
            Device & device,
            uint32_t maxSets,
            VkDescriptorPoolCreateFlags poolFlags,
            const std::vector< VkDescriptorPoolSize > & poolSizes)
```

Definition at line 3 of file descriptorPool.cpp.

References ven::Device::device(), m_descriptorPool, and m_device.

Here is the call graph for this function:



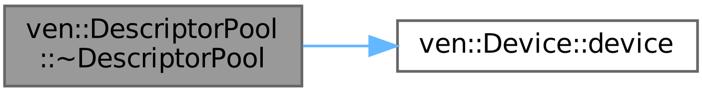
7.9.2.2 ∼DescriptorPool()

```
ven::DescriptorPool::~DescriptorPool ()  [inline]
```

Definition at line 48 of file DescriptorPool.hpp.

References ven::Device::device(), m_descriptorPool, and m_device.

Here is the call graph for this function:



7.9.2.3 DescriptorPool() [2/2]

```
ven::DescriptorPool::DescriptorPool (
            const DescriptorPool & )  [delete]
```

7.9.3 Member Function Documentation

7.9.3.1 allocateDescriptor()

```
bool ven::DescriptorPool::allocateDescriptor (
            VkDescriptorSetLayout descriptorSetLayout,
            VkDescriptorSet & descriptor) const
```

Definition at line 18 of file descriptorPool.cpp.

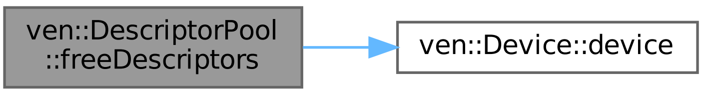
7.9.3.2 freeDescriptors()

```
void ven::DescriptorPool::freeDescriptors (
            const std::vector< VkDescriptorSet > & descriptors) const  [inline]
```

Definition at line 54 of file DescriptorPool.hpp.

References ven::Device::device(), m_descriptorPool, and m_device.

Here is the call graph for this function:



7.9.3.3 getDescriptorPool()

```
VkDescriptorPool ven::DescriptorPool::getDescriptorPool () const  [inline], [nodiscard]
```

Definition at line 57 of file DescriptorPool.hpp.

References m_descriptorPool.

7.9.3.4 operator=()

```
DescriptorPool & ven::DescriptorPool::operator= (
            const DescriptorPool & )  [delete]
```

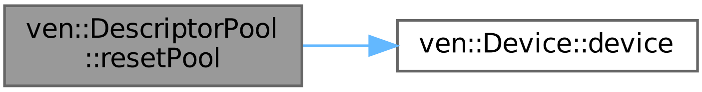
7.9.3.5 resetPool()

```
void ven::DescriptorPool::resetPool () const  [inline]
```

Definition at line 55 of file DescriptorPool.hpp.

References ven::Device::device(), m_descriptorPool, and m_device.

Here is the call graph for this function:



7.9.4 Friends And Related Symbol Documentation

7.9.4.1 DescriptorWriter

```
friend class DescriptorWriter  [friend]
```

Definition at line 63 of file DescriptorPool.hpp.

7.9.5 Member Data Documentation

7.9.5.1 m_descriptorPool

```
VkDescriptorPool ven::DescriptorPool::m_descriptorPool  [private]
```

Definition at line 62 of file DescriptorPool.hpp.

Referenced by DescriptorPool(), freeDescriptors(), getDescriptorPool(), resetPool(), and ~DescriptorPool().

7.9.5.2 m_device

`Device& ven::DescriptorPool::m_device [private]`

Definition at line 61 of file DescriptorPool.hpp.

Referenced by DescriptorPool(), freeDescriptors(), resetPool(), and ∼DescriptorPool().

The documentation for this class was generated from the following files:

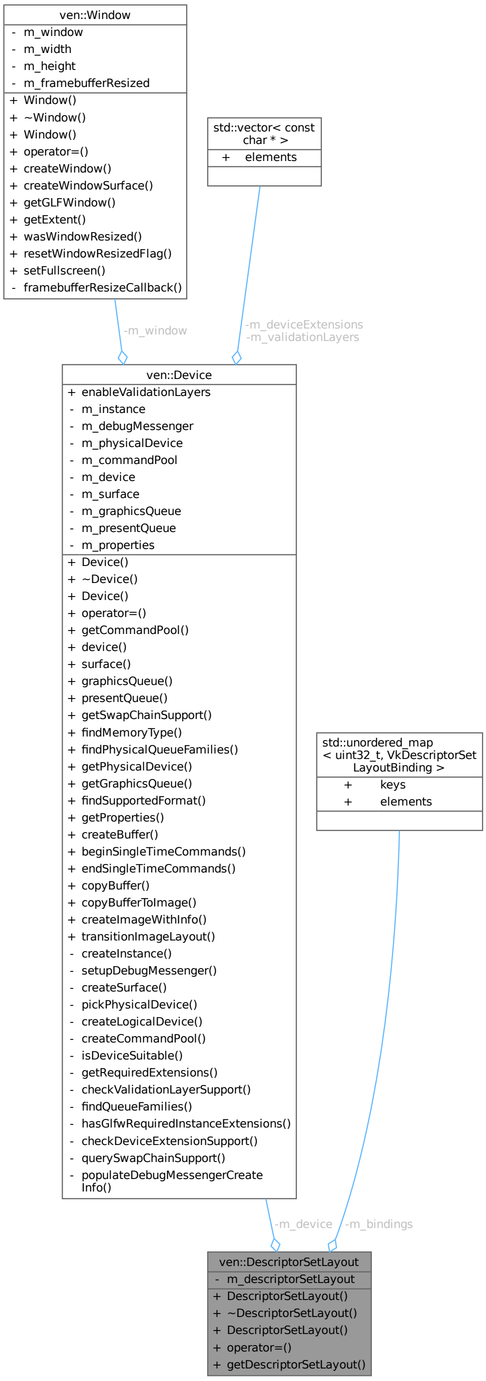
- /home/runner/work/VEngine/VEngine/include/VEngine/Descriptors/DescriptorPool.hpp
- /home/runner/work/VEngine/VEngine/src/descriptors/descriptorPool.cpp

7.10 ven::DescriptorSetLayout Class Reference

Class for descriptor set layout.

`#include <DescriptorSetLayout.hpp>`

Collaboration diagram for ven::DescriptorSetLayout:



Classes

- class Builder

Public Member Functions

- DescriptorSetLayout (Device &device, const std::unordered_map< uint32_t, VkDescriptorSetLayoutBinding > &bindings)

- ∼DescriptorSetLayout ()
- DescriptorSetLayout (const DescriptorSetLayout &)=delete
- DescriptorSetLayout & operator= (const DescriptorSetLayout &)=delete
- VkDescriptorSetLayout getDescriptorSetLayout () const

Private Attributes

- Device & m_device
- VkDescriptorSetLayout m_descriptorSetLayout
- std::unordered_map< uint32_t, VkDescriptorSetLayoutBinding > m_bindings

Friends

- class DescriptorWriter

7.10.1 Detailed Description

Class for descriptor set layout.

Definition at line 21 of file DescriptorSetLayout.hpp.

7.10.2 Constructor & Destructor Documentation

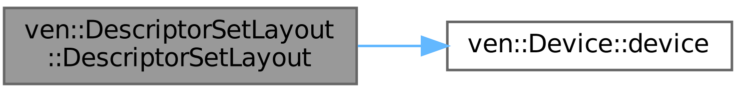
7.10.2.1 DescriptorSetLayout() [1/2]

```
ven::DescriptorSetLayout::DescriptorSetLayout (
            Device & device,
            const std::unordered_map< uint32_t, VkDescriptorSetLayoutBinding > & bindings)
```

Definition at line 17 of file descriptorSetLayout.cpp.

References ven::Device::device(), m_descriptorSetLayout, and m_device.

Here is the call graph for this function:



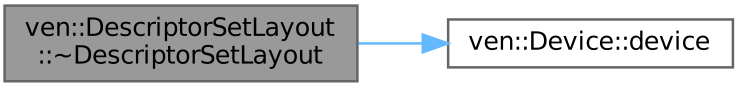
7.10.2.2 ∼DescriptorSetLayout()

```
ven::DescriptorSetLayout::∼DescriptorSetLayout ()  [inline]
```

Definition at line 42 of file DescriptorSetLayout.hpp.

References ven::Device::device(), m_descriptorSetLayout, and m_device.

Here is the call graph for this function:



7.10.2.3 DescriptorSetLayout() [2/2]

```
ven::DescriptorSetLayout::DescriptorSetLayout (
            const DescriptorSetLayout & )  [delete]
```

7.10.3 Member Function Documentation

7.10.3.1 getDescriptorSetLayout()

```
VkDescriptorSetLayout ven::DescriptorSetLayout::getDescriptorSetLayout () const  [inline]
```

Definition at line 47 of file DescriptorSetLayout.hpp.

References m_descriptorSetLayout.

7.10.3.2 operator=()

```
DescriptorSetLayout & ven::DescriptorSetLayout::operator= (
            const DescriptorSetLayout & )  [delete]
```

7.10.4 Friends And Related Symbol Documentation

7.10.4.1 DescriptorWriter

```
friend class DescriptorWriter  [friend]
```

Definition at line 55 of file DescriptorSetLayout.hpp.

7.10.5 Member Data Documentation

7.10.5.1 m_bindings

```
std::unordered_map<uint32_t, VkDescriptorSetLayoutBinding> ven::DescriptorSetLayout::m_↩
bindings [private]
```

Definition at line 53 of file DescriptorSetLayout.hpp.

Referenced by ven::DescriptorWriter::writeBuffer().

7.10.5.2 m_descriptorSetLayout

```
VkDescriptorSetLayout ven::DescriptorSetLayout::m_descriptorSetLayout [private]
```

Definition at line 52 of file DescriptorSetLayout.hpp.

Referenced by DescriptorSetLayout(), getDescriptorSetLayout(), and ∼DescriptorSetLayout().

7.10.5.3 m_device

```
Device& ven::DescriptorSetLayout::m_device [private]
```

Definition at line 51 of file DescriptorSetLayout.hpp.

Referenced by DescriptorSetLayout(), and ∼DescriptorSetLayout().

The documentation for this class was generated from the following files:

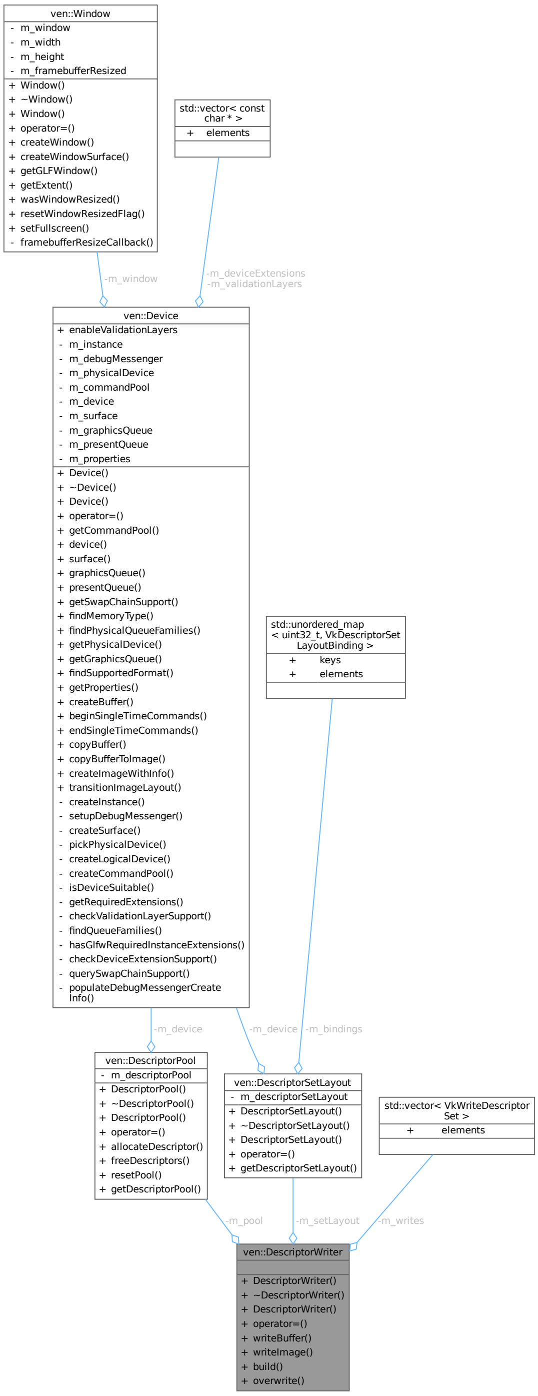
- /home/runner/work/VEngine/VEngine/include/VEngine/Descriptors/DescriptorSetLayout.hpp
- /home/runner/work/VEngine/VEngine/src/descriptors/descriptorSetLayout.cpp

7.11 ven::DescriptorWriter Class Reference

Class for descriptor writer.

```
#include <DescriptorWriter.hpp>
```

Collaboration diagram for ven::DescriptorWriter:



Public Member Functions

- DescriptorWriter (DescriptorSetLayout &setLayout, DescriptorPool &pool)
- ∼DescriptorWriter ()=default
- DescriptorWriter (const DescriptorWriter &)=delete
- DescriptorWriter & operator= (const DescriptorWriter &)=delete
- DescriptorWriter & writeBuffer (uint32_t binding, const VkDescriptorBufferInfo ∗bufferInfo)

- DescriptorWriter & writeImage (uint32_t binding, const VkDescriptorImageInfo *imageInfo)
- bool build (VkDescriptorSet &set)
- void overwrite (const VkDescriptorSet &set)

Private Attributes

- DescriptorSetLayout & m_setLayout
- DescriptorPool & m_pool
- std::vector< VkWriteDescriptorSet > m_writes

7.11.1 Detailed Description

Class for descriptor writer.

Definition at line 21 of file DescriptorWriter.hpp.

7.11.2 Constructor & Destructor Documentation

7.11.2.1 DescriptorWriter() [1/2]

```
ven::DescriptorWriter::DescriptorWriter (
            DescriptorSetLayout & setLayout,
            DescriptorPool & pool)  [inline]
```

Definition at line 25 of file DescriptorWriter.hpp.

7.11.2.2 ∼DescriptorWriter()

```
ven::DescriptorWriter::∼DescriptorWriter ()  [default]
```

7.11.2.3 DescriptorWriter() [2/2]

```
ven::DescriptorWriter::DescriptorWriter (
            const DescriptorWriter & )  [delete]
```

7.11.3 Member Function Documentation

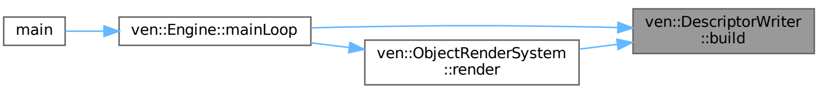
7.11.3.1 build()

```
bool ven::DescriptorWriter::build (
            VkDescriptorSet & set)
```

Definition at line 43 of file descriptorWriter.cpp.

Referenced by ven::Engine::mainLoop(), and ven::ObjectRenderSystem::render().

Here is the caller graph for this function:



7.11.3.2 operator=()

```
DescriptorWriter & ven::DescriptorWriter::operator= (
            const DescriptorWriter & )  [delete]
```

7.11.3.3 overwrite()

```
void ven::DescriptorWriter::overwrite (
            const VkDescriptorSet & set)
```

Definition at line 52 of file descriptorWriter.cpp.

7.11.3.4 writeBuffer()

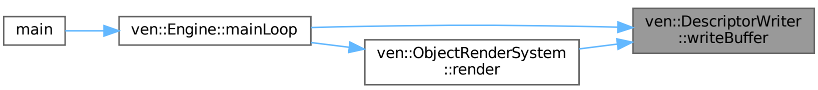
```
ven::DescriptorWriter & ven::DescriptorWriter::writeBuffer (
            uint32_t binding,
            const VkDescriptorBufferInfo * bufferInfo)
```

Definition at line 5 of file descriptorWriter.cpp.

References ven::DescriptorSetLayout::m_bindings, m_setLayout, and m_writes.

Referenced by ven::Engine::mainLoop(), and ven::ObjectRenderSystem::render().

Here is the caller graph for this function:



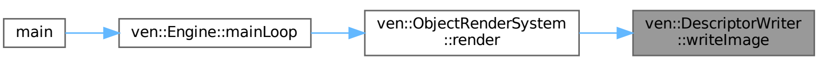
7.11.3.5 writeImage()

```
ven::DescriptorWriter & ven::DescriptorWriter::writeImage (
            uint32_t binding,
            const VkDescriptorImageInfo * imageInfo)
```

Definition at line 24 of file descriptorWriter.cpp.

Referenced by ven::ObjectRenderSystem::render().

Here is the caller graph for this function:



7.11.4 Member Data Documentation

7.11.4.1 m_pool

`DescriptorPool& ven::DescriptorWriter::m_pool [private]`

Definition at line 40 of file DescriptorWriter.hpp.

7.11.4.2 m_setLayout

`DescriptorSetLayout& ven::DescriptorWriter::m_setLayout [private]`

Definition at line 39 of file DescriptorWriter.hpp.

Referenced by writeBuffer().

7.11.4.3 m_writes

`std::vector<VkWriteDescriptorSet> ven::DescriptorWriter::m_writes [private]`

Definition at line 41 of file DescriptorWriter.hpp.

Referenced by writeBuffer().

The documentation for this class was generated from the following files:

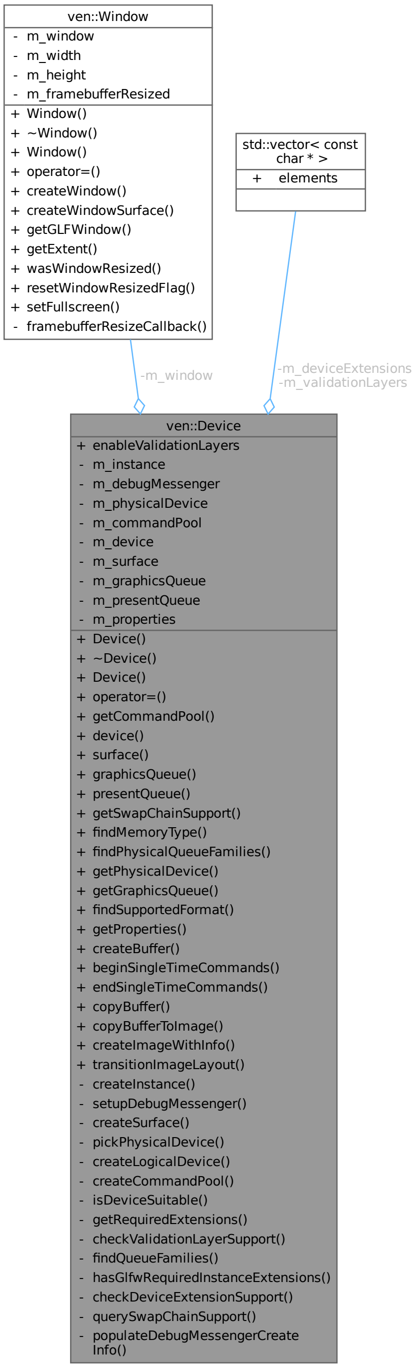
- /home/runner/work/VEngine/VEngine/include/VEngine/Descriptors/DescriptorWriter.hpp
- /home/runner/work/VEngine/VEngine/src/descriptors/descriptorWriter.cpp

7.12 ven::Device Class Reference

Class for device.

`#include <Device.hpp>`

Collaboration diagram for ven::Device:



Public Member Functions

- Device (Window &window)
- ∼Device ()
- Device (const Device &)=delete
- Device & operator= (const Device &)=delete
- VkCommandPool getCommandPool () const

- VkDevice device () const
- VkSurfaceKHR surface () const
- VkQueue graphicsQueue () const
- VkQueue presentQueue () const
- SwapChainSupportDetails getSwapChainSupport () const
- uint32_t findMemoryType (uint32_t typeFilter, VkMemoryPropertyFlags properties) const
- QueueFamilyIndices findPhysicalQueueFamilies () const
- VkPhysicalDevice getPhysicalDevice () const
- VkQueue getGraphicsQueue () const
- VkFormat findSupportedFormat (const std::vector< VkFormat > &candidates, VkImageTiling tiling, Vk↩ FormatFeatureFlags features) const
- VkPhysicalDeviceProperties getProperties () const
- void createBuffer (VkDeviceSize size, VkBufferUsageFlags usage, VkMemoryPropertyFlags properties, Vk↩ Buffer &buffer, VkDeviceMemory &bufferMemory) const
- VkCommandBuffer beginSingleTimeCommands () const
- void endSingleTimeCommands (VkCommandBuffer commandBuffer) const
- void copyBuffer (VkBuffer srcBuffer, VkBuffer dstBuffer, VkDeviceSize size) const
- void copyBufferToImage (VkBuffer buffer, VkImage image, uint32_t width, uint32_t height, uint32_t layer↩ Count) const
- void createImageWithInfo (const VkImageCreateInfo &imageInfo, VkMemoryPropertyFlags properties, Vk↩ Image &image, VkDeviceMemory &imageMemory) const
- void transitionImageLayout (VkImage image, VkFormat format, VkImageLayout oldLayout, VkImageLayout newLayout, uint32_t mipLevels=1, uint32_t layerCount=1) const

Public Attributes

- const bool enableValidationLayers = true

Private Member Functions

- void createInstance ()
- void setupDebugMessenger ()
- void createSurface ()
- void pickPhysicalDevice ()
- void createLogicalDevice ()
- void createCommandPool ()
- bool isDeviceSuitable (VkPhysicalDevice device) const
- std::vector< const char * > getRequiredExtensions () const
- bool checkValidationLayerSupport () const
- QueueFamilyIndices findQueueFamilies (VkPhysicalDevice device) const
- void hasGlfwRequiredInstanceExtensions () const
- bool checkDeviceExtensionSupport (VkPhysicalDevice device) const
- SwapChainSupportDetails querySwapChainSupport (VkPhysicalDevice device) const

Static Private Member Functions

- static void populateDebugMessengerCreateInfo (VkDebugUtilsMessengerCreateInfoEXT &createInfo)

Private Attributes

- VkInstance m_instance
- VkDebugUtilsMessengerEXT m_debugMessenger
- VkPhysicalDevice m_physicalDevice = VK_NULL_HANDLE
- Window & m_window
- VkCommandPool m_commandPool
- VkDevice m_device
- VkSurfaceKHR m_surface
- VkQueue m_graphicsQueue
- VkQueue m_presentQueue
- VkPhysicalDeviceProperties m_properties
- const std::vector< const char * > m_validationLayers = {"VK_LAYER_KHRONOS_validation"}
- const std::vector< const char * > m_deviceExtensions = {VK_KHR_SWAPCHAIN_EXTENSION_NAME}

7.12.1 Detailed Description

Class for device.

Definition at line 34 of file Device.hpp.

7.12.2 Constructor & Destructor Documentation

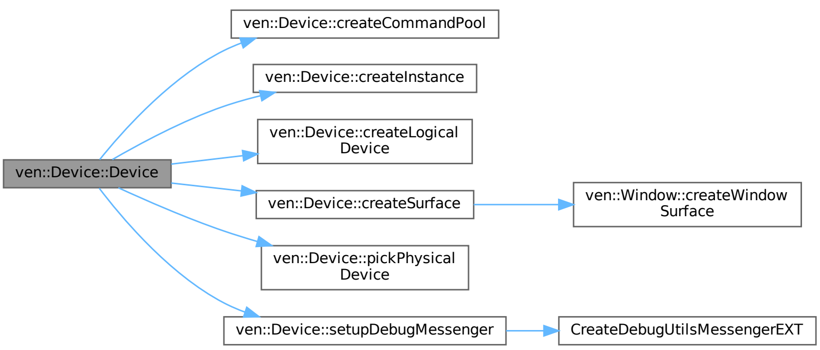
7.12.2.1 Device() [1/2]

```
ven::Device::Device (
            Window & window)  [explicit]
```

Definition at line 32 of file device.cpp.

References createCommandPool(), createInstance(), createLogicalDevice(), createSurface(), pickPhysicalDevice(), and setupDebugMessenger().

Here is the call graph for this function:



7.12.2.2 ∼Device()

```
ven::Device::~Device ()
```

Definition at line 42 of file device.cpp.

References DestroyDebugUtilsMessengerEXT().

Here is the call graph for this function:

7.12.2.3 Device() [2/2]

```
ven::Device::Device (
            const Device & )  [delete]
```

7.12.3 Member Function Documentation

7.12.3.1 beginSingleTimeCommands()

```
VkCommandBuffer ven::Device::beginSingleTimeCommands () const  [nodiscard]
```

Definition at line 413 of file device.cpp.

7.12.3.2 checkDeviceExtensionSupport()

```
bool ven::Device::checkDeviceExtensionSupport (
            VkPhysicalDevice device) const  [private]
```

Definition at line 290 of file device.cpp.

7.12.3.3 checkValidationLayerSupport()

```
bool ven::Device::checkValidationLayerSupport () const  [nodiscard], [private]
```

Definition at line 227 of file device.cpp.

7.12.3.4 copyBuffer()

```
void ven::Device::copyBuffer (
            VkBuffer srcBuffer,
            VkBuffer dstBuffer,
            VkDeviceSize size) const
```

Definition at line 447 of file device.cpp.

7.12.3.5 copyBufferToImage()

```
void ven::Device::copyBufferToImage (
            VkBuffer buffer,
            VkImage image,
            uint32_t width,
            uint32_t height,
            uint32_t layerCount) const
```

Definition at line 460 of file device.cpp.

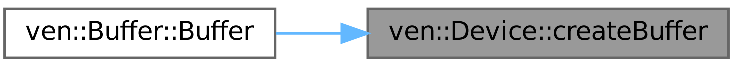
7.12.3.6 createBuffer()

```
void ven::Device::createBuffer (
            VkDeviceSize size,
            VkBufferUsageFlags usage,
            VkMemoryPropertyFlags properties,
            VkBuffer & buffer,
            VkDeviceMemory & bufferMemory) const
```

Definition at line 384 of file device.cpp.

Referenced by ven::Buffer::Buffer().

Here is the caller graph for this function:



7.12.3.7 createCommandPool()

```
void ven::Device::createCommandPool ( )  [private]
```

Definition at line 171 of file device.cpp.

Referenced by Device().

Here is the caller graph for this function:

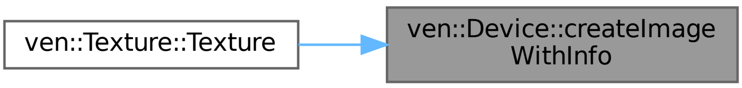
7.12.3.8 createImageWithInfo()

```
void ven::Device::createImageWithInfo (
            const VkImageCreateInfo & imageInfo,
            VkMemoryPropertyFlags properties,
            VkImage & image,
            VkDeviceMemory & imageMemory) const
```

Definition at line 481 of file device.cpp.

Referenced by ven::Texture::Texture().

Here is the caller graph for this function:



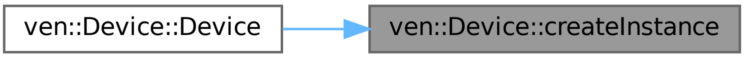
7.12.3.9 createInstance()

```
void ven::Device::createInstance () [private]
```

Definition at line 55 of file device.cpp.

Referenced by Device().

Here is the caller graph for this function:



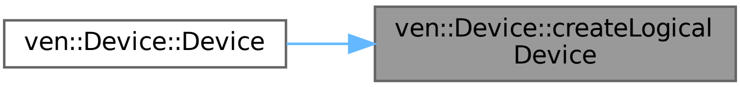
7.12.3.10 createLogicalDevice()

```
void ven::Device::createLogicalDevice () [private]
```

Definition at line 124 of file device.cpp.

Referenced by Device().

Here is the caller graph for this function:



7.12.3.11 createSurface()

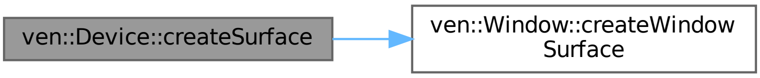
```
void ven::Device::createSurface () [inline], [private]
```

Definition at line 78 of file Device.hpp.

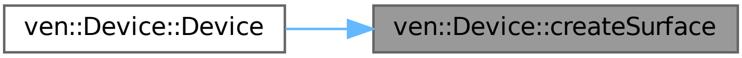
References ven::Window::createWindowSurface(), m_instance, m_surface, and m_window.

Referenced by Device().

Here is the call graph for this function:



Here is the caller graph for this function:



7.12.3.12 device()

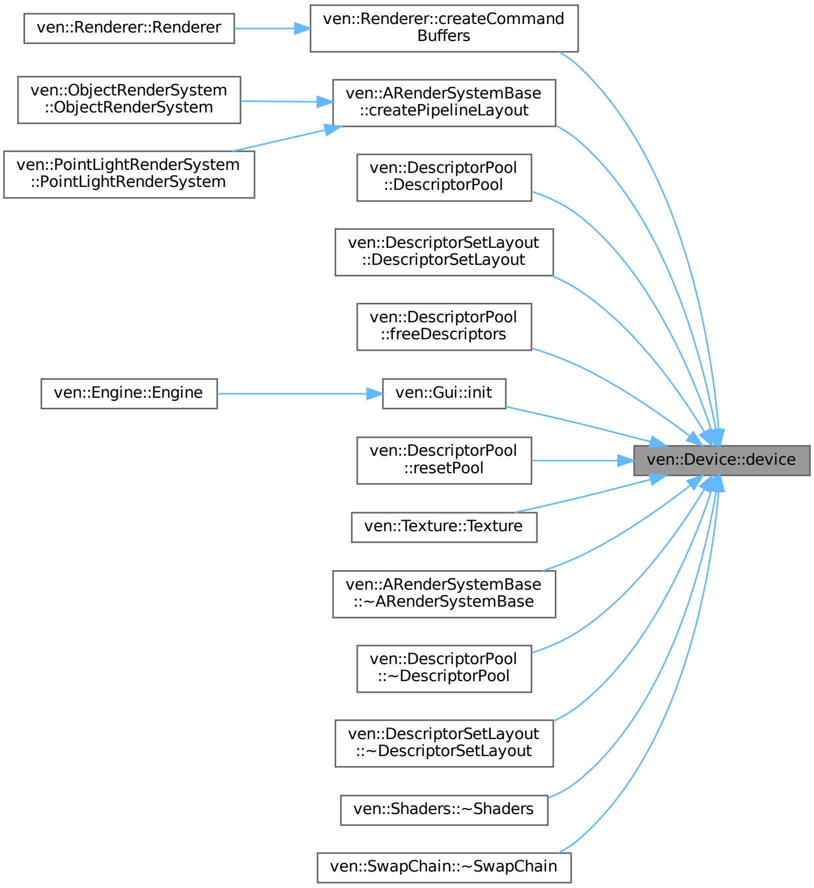
`VkDevice ven::Device::device () const [inline], [nodiscard]`

Definition at line 51 of file Device.hpp.

References m_device.

Referenced by ven::Renderer::createCommandBuffers(), ven::ARenderSystemBase::createPipelineLayout(), ven::DescriptorPool::DescriptorPool(), ven::DescriptorSetLayout::DescriptorSetLayout(), ven::DescriptorPool::freeDescriptors(), ven::Gui::init(), ven::DescriptorPool::resetPool(), ven::Texture::Texture(), ven::ARenderSystemBase::∼ARenderSystemBase(), ven::DescriptorPool::∼DescriptorPool(), ven::DescriptorSetLayout::∼DescriptorSetLayout(), ven::Shaders::∼Shaders(), and ven::SwapChain::∼SwapChain().

Here is the caller graph for this function:



7.12.3.13 endSingleTimeCommands()

```
void ven::Device::endSingleTimeCommands (
            VkCommandBuffer commandBuffer) const
```

Definition at line 432 of file device.cpp.

7.12.3.14 findMemoryType()

```
uint32_t ven::Device::findMemoryType (
            uint32_t typeFilter,
            VkMemoryPropertyFlags properties) const [nodiscard]
```

Definition at line 369 of file device.cpp.

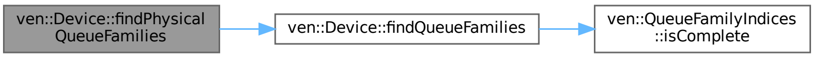
7.12.3.15 findPhysicalQueueFamilies()

```
QueueFamilyIndices ven::Device::findPhysicalQueueFamilies () const  [inline], [nodiscard]
```

Definition at line 58 of file Device.hpp.

References findQueueFamilies(), and m_physicalDevice.

Here is the call graph for this function:



7.12.3.16 findQueueFamilies()

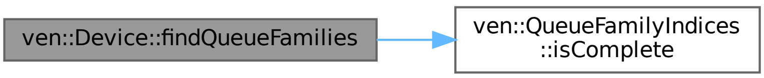
```
ven::QueueFamilyIndices ven::Device::findQueueFamilies (
            VkPhysicalDevice device) const  [private]
```

Definition at line 306 of file device.cpp.

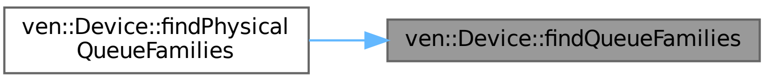
References ven::QueueFamilyIndices::graphicsFamily, ven::QueueFamilyIndices::graphicsFamilyHasValue, ven::QueueFamilyIndices::isComplete(), ven::QueueFamilyIndices::presentFamily, and ven::QueueFamilyIndices::presentFamilyHasV

Referenced by findPhysicalQueueFamilies().

Here is the call graph for this function:



Here is the caller graph for this function:



7.12.3.17 findSupportedFormat()

```
VkFormat ven::Device::findSupportedFormat (
            const std::vector< VkFormat > & candidates,
            VkImageTiling tiling,
            VkFormatFeatureFlags features) const [nodiscard]
```

Definition at line 355 of file device.cpp.

7.12.3.18 getCommandPool()

```
VkCommandPool ven::Device::getCommandPool () const [inline], [nodiscard]
```

Definition at line 50 of file Device.hpp.

References m_commandPool.

Referenced by ven::Renderer::createCommandBuffers().

Here is the caller graph for this function:

7.12.3.19 getGraphicsQueue()

```
VkQueue ven::Device::getGraphicsQueue () const [inline], [nodiscard]
```

Definition at line 60 of file Device.hpp.

References m_graphicsQueue.

7.12.3.20 getPhysicalDevice()

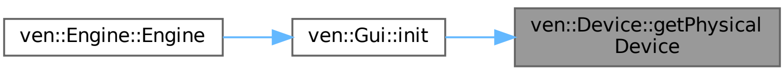
```
VkPhysicalDevice ven::Device::getPhysicalDevice () const [inline], [nodiscard]
```

Definition at line 59 of file Device.hpp.

References m_physicalDevice.

Referenced by ven::Gui::init().

Here is the caller graph for this function:



7.12.3.21 getProperties()

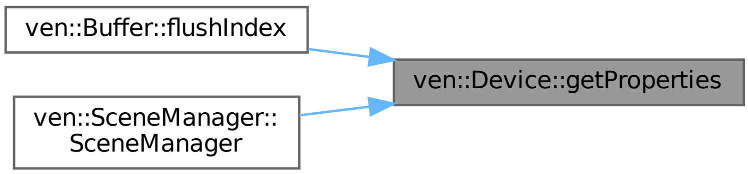
`VkPhysicalDeviceProperties ven::Device::getProperties () const [inline], [nodiscard]`

Definition at line 62 of file Device.hpp.

References m_properties.

Referenced by ven::Buffer::flushIndex(), and ven::SceneManager::SceneManager().

Here is the caller graph for this function:



7.12.3.22 getRequiredExtensions()

`std::vector< const char * > ven::Device::getRequiredExtensions () const [nodiscard], [private]`

Definition at line 252 of file device.cpp.

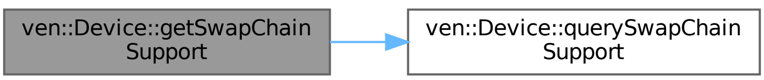
7.12.3.23 getSwapChainSupport()

`SwapChainSupportDetails ven::Device::getSwapChainSupport () const [inline], [nodiscard]`

Definition at line 56 of file Device.hpp.

References m_physicalDevice, and querySwapChainSupport().

Here is the call graph for this function:



7.12.3.24 graphicsQueue()

```
VkQueue ven::Device::graphicsQueue () const  [inline], [nodiscard]
```

Definition at line 53 of file Device.hpp.

References m_graphicsQueue.

Referenced by ven::Gui::init().

Here is the caller graph for this function:

7.12.3.25 hasGlfwRequiredInstanceExtensions()

```
void ven::Device::hasGlfwRequiredInstanceExtensions () const  [private]
```

Definition at line 267 of file device.cpp.

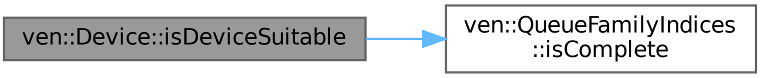
7.12.3.26 isDeviceSuitable()

```
bool ven::Device::isDeviceSuitable (
             VkPhysicalDevice device) const  [private]
```

Definition at line 187 of file device.cpp.

References ven::QueueFamilyIndices::isComplete().

Here is the call graph for this function:



7.12.3.27 operator=()

```
Device & ven::Device::operator= (
             const Device & )  [delete]
```

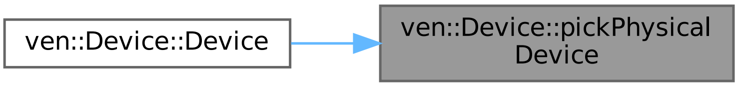
7.12.3.28 pickPhysicalDevice()

```
void ven::Device::pickPhysicalDevice ( )  [private]
```

Definition at line 98 of file device.cpp.

Referenced by Device().

Here is the caller graph for this function:



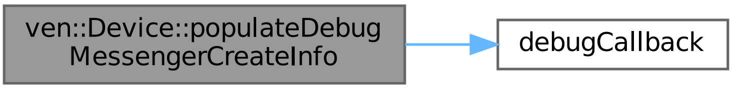
7.12.3.29 populateDebugMessengerCreateInfo()

```
void ven::Device::populateDebugMessengerCreateInfo (
            VkDebugUtilsMessengerCreateInfoEXT & createInfo)  [static], [private]
```

Definition at line 204 of file device.cpp.

References debugCallback().

Here is the call graph for this function:



7.12.3.30 presentQueue()

```
VkQueue ven::Device::presentQueue ( ) const  [inline], [nodiscard]
```

Definition at line 54 of file Device.hpp.

References m_presentQueue.

7.12.3.31 querySwapChainSupport()

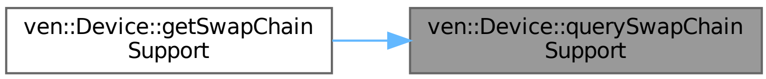
```
ven::SwapChainSupportDetails ven::Device::querySwapChainSupport (
            VkPhysicalDevice device) const  [private]
```

Definition at line 334 of file device.cpp.

References ven::SwapChainSupportDetails::capabilities, ven::SwapChainSupportDetails::formats, and ven::SwapChainSupportDetail

Referenced by getSwapChainSupport().

Here is the caller graph for this function:



7.12.3.32 setupDebugMessenger()

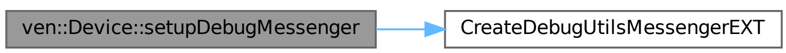
```
void ven::Device::setupDebugMessenger ()  [private]
```

Definition at line 217 of file device.cpp.

References CreateDebugUtilsMessengerEXT().

Referenced by Device().

Here is the call graph for this function:



Here is the caller graph for this function:

7.12.3.33 surface()

```
VkSurfaceKHR ven::Device::surface () const [inline], [nodiscard]
```

Definition at line 52 of file Device.hpp.

References m_surface.

7.12.3.34 transitionImageLayout()

```
void ven::Device::transitionImageLayout (
            VkImage image,
            VkFormat format,
            VkImageLayout oldLayout,
            VkImageLayout newLayout,
            uint32_t mipLevels = 1,
            uint32_t layerCount = 1) const
```

Definition at line 504 of file device.cpp.

7.12.4 Member Data Documentation

7.12.4.1 enableValidationLayers

```
const bool ven::Device::enableValidationLayers = true
```

Definition at line 41 of file Device.hpp.

7.12.4.2 m_commandPool

```
VkCommandPool ven::Device::m_commandPool [private]
```

Definition at line 97 of file Device.hpp.

Referenced by getCommandPool().

7.12.4.3 m_debugMessenger

```
VkDebugUtilsMessengerEXT ven::Device::m_debugMessenger [private]
```

Definition at line 94 of file Device.hpp.

7.12.4.4 m_device

```
VkDevice ven::Device::m_device [private]
```

Definition at line 99 of file Device.hpp.

Referenced by device().

7.12.4.5 m_deviceExtensions

```
const std::vector<const char *> ven::Device::m_deviceExtensions = {VK_KHR_SWAPCHAIN_EXTENSION↵
_NAME} [private]
```

Definition at line 106 of file Device.hpp.

7.12.4.6 m_graphicsQueue

```
VkQueue ven::Device::m_graphicsQueue [private]
```

Definition at line 101 of file Device.hpp.

Referenced by getGraphicsQueue(), and graphicsQueue().

7.12.4.7 m_instance

```
VkInstance ven::Device::m_instance [private]
```

Definition at line 93 of file Device.hpp.

Referenced by createSurface().

7.12.4.8 m_physicalDevice

```
VkPhysicalDevice ven::Device::m_physicalDevice = VK_NULL_HANDLE [private]
```

Definition at line 95 of file Device.hpp.

Referenced by findPhysicalQueueFamilies(), getPhysicalDevice(), and getSwapChainSupport().

7.12.4.9 m_presentQueue

```
VkQueue ven::Device::m_presentQueue [private]
```

Definition at line 102 of file Device.hpp.

Referenced by presentQueue().

7.12.4.10 m_properties

```
VkPhysicalDeviceProperties ven::Device::m_properties [private]
```

Definition at line 103 of file Device.hpp.

Referenced by getProperties().

7.12.4.11 m_surface

```
VkSurfaceKHR ven::Device::m_surface [private]
```

Definition at line 100 of file Device.hpp.

Referenced by createSurface(), and surface().

7.12.4.12 m_validationLayers

```
const std::vector<const char *> ven::Device::m_validationLayers = {"VK_LAYER_KHRONOS_validation"}
[private]
```

Definition at line 105 of file Device.hpp.

7.12.4.13 m_window

```
Window& ven::Device::m_window [private]
```

Definition at line 96 of file Device.hpp.

Referenced by createSurface().

The documentation for this class was generated from the following files:

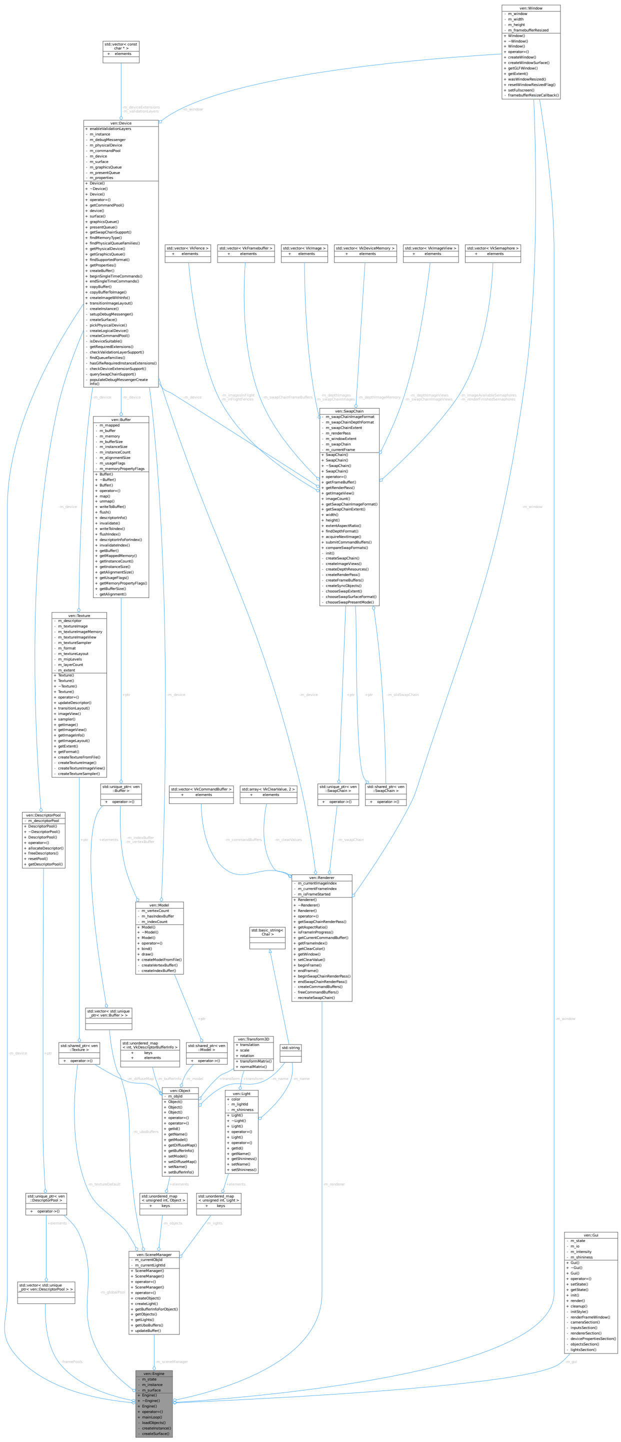
- /home/runner/work/VEngine/VEngine/include/VEngine/Device.hpp
- /home/runner/work/VEngine/VEngine/src/device.cpp

7.13 ven::Engine Class Reference

Class for engine.

```
#include <Engine.hpp>
```

Collaboration diagram for ven::Engine:



Public Member Functions

- Engine (uint32_t=DEFAULT_WIDTH, uint32_t=DEFAULT_HEIGHT, const std::string &title=DEFAULT_↩
TITLE.data())
- ∼Engine ()=default
- Engine (const Engine &)=delete
- Engine operator= (const Engine &)=delete
- void mainLoop ()

Private Member Functions

- void loadObjects ()
- void createInstance ()
- void createSurface ()

Private Attributes

- ENGINE_STATE m_state {EXIT}
- Window m_window
- Device m_device {m_window}
- Renderer m_renderer {m_window, m_device}
- Gui m_gui
- std::unique_ptr< DescriptorPool > m_globalPool
- std::vector< std::unique_ptr< DescriptorPool > > framePools
- SceneManager m_sceneManager {m_device}
- VkInstance m_instance {nullptr}
- VkSurfaceKHR m_surface {nullptr}

7.13.1 Detailed Description

Class for engine.

Definition at line 32 of file Engine.hpp.

7.13.2 Constructor & Destructor Documentation

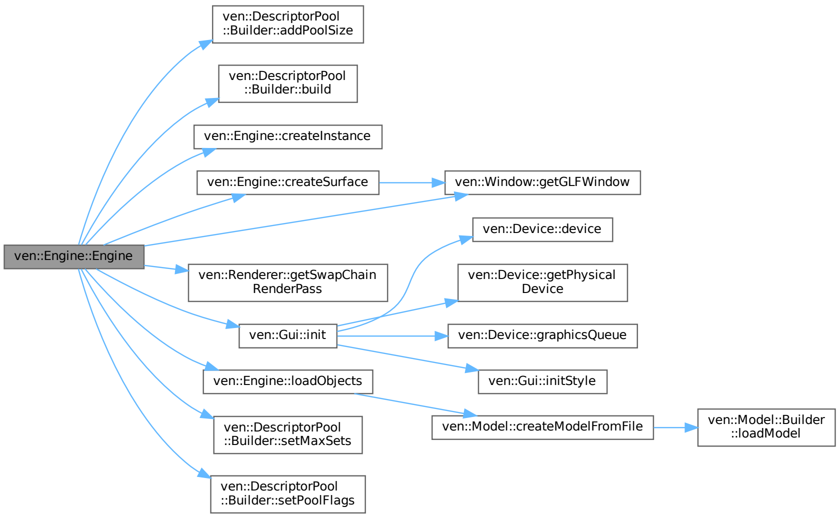
7.13.2.1 Engine() [1/2]

```
ven::Engine::Engine (
            uint32_t width = DEFAULT_WIDTH,
            uint32_t height = DEFAULT_HEIGHT,
            const std::string & title = DEFAULT_TITLE.data())  [explicit]
```

Definition at line 16 of file engine.cpp.

References ven::DescriptorPool::Builder::addPoolSize(), ven::DescriptorPool::Builder::build(), createInstance(), createSurface(), ven::EDITOR, framePools, ven::Window::getGLFWindow(), ven::Renderer::getSwapChainRenderPass(), ven::Gui::init(), loadObjects(), m_device, m_globalPool, m_instance, m_renderer, m_window, ven::MAX_FRAMES_IN_FLIGHT, ven::DescriptorPool::Builder::setMaxSets(), and ven::DescriptorPool::Builder::setPoolFlags().

Here is the call graph for this function:



7.13.2.2 ∼Engine()

```
ven::Engine::∼Engine ( ) [default]
```

7.13.2.3 Engine() [2/2]

```
ven::Engine::Engine (
            const Engine & ) [delete]
```

7.13.3 Member Function Documentation

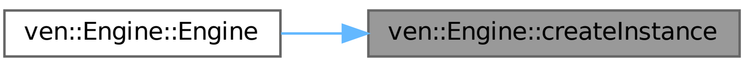
7.13.3.1 createInstance()

```
void ven::Engine::createInstance ( ) [private]
```

Definition at line 35 of file engine.cpp.

Referenced by Engine().

Here is the caller graph for this function:



7.13.3.2 createSurface()

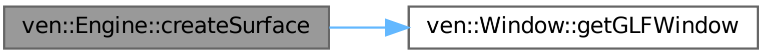
```
void ven::Engine::createSurface ()  [inline], [private]
```

Definition at line 62 of file Engine.hpp.

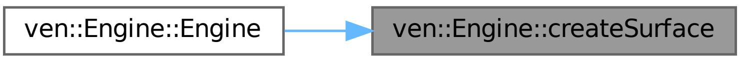
References ven::Window::getGLFWindow(), m_instance, m_surface, and m_window.

Referenced by Engine().

Here is the call graph for this function:



Here is the caller graph for this function:



7.13.3.3 loadObjects()

```
void ven::Engine::loadObjects ()  [private]
```

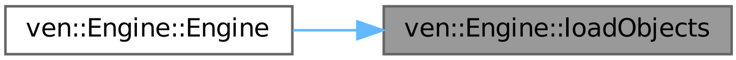
Definition at line 62 of file engine.cpp.

References ven::Colors::BLUE_4, ven::Model::createModelFromFile(), ven::Colors::CYAN_4, ven::Colors::GREEN_4, ven::Colors::MAGENTA_4, ven::Colors::RED_4, and ven::Colors::YELLOW_4.

Referenced by Engine().

Here is the call graph for this function:

Here is the caller graph for this function:



7.13.3.4 mainLoop()

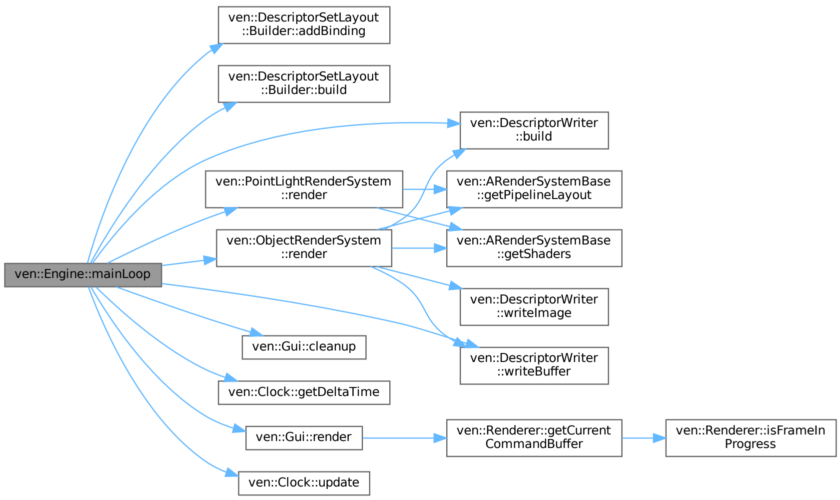
```
void ven::Engine::mainLoop ()
```

Definition at line 103 of file engine.cpp.

References ven::DescriptorSetLayout::Builder::addBinding(), ven::DescriptorSetLayout::Builder::build(), ven::DescriptorWriter::build(), ven::Gui::cleanup(), ven::EXIT, ven::FrameInfo::frameIndex, ven::Clock::getDeltaTime(), ven::MAX_FRAMES_IN_FLIGHT, ven::Gui::render(), ven::ObjectRenderSystem::render(), ven::PointLightRenderSystem::render(), ven::Clock::update(), ven::VISIBLE, and ven::DescriptorWriter::writeBuffer().

Referenced by main().

Here is the call graph for this function:



Here is the caller graph for this function:

7.13.3.5 operator=()

```
Engine ven::Engine::operator= (
            const Engine & )  [delete]
```

7.13.4 Member Data Documentation

7.13.4.1 framePools

```
std::vector<std::unique_ptr<DescriptorPool> > ven::Engine::framePools  [private]
```

Definition at line 55 of file Engine.hpp.

Referenced by Engine().

7.13.4.2 m_device

```
Device ven::Engine::m_device {m_window}  [private]
```

Definition at line 51 of file Engine.hpp.

Referenced by Engine().

7.13.4.3 m_globalPool

```
std::unique_ptr<DescriptorPool> ven::Engine::m_globalPool  [private]
```

Definition at line 54 of file Engine.hpp.

Referenced by Engine().

7.13.4.4 m_gui

```
Gui ven::Engine::m_gui  [private]
```

Definition at line 53 of file Engine.hpp.

7.13.4.5 m_instance

```
VkInstance ven::Engine::m_instance {nullptr}  [private]
```

Definition at line 58 of file Engine.hpp.

Referenced by createSurface(), and Engine().

7.13.4.6 m_renderer

```
Renderer ven::Engine::m_renderer {m_window, m_device} [private]
```

Definition at line 52 of file Engine.hpp.

Referenced by Engine().

7.13.4.7 m_sceneManager

```
SceneManager ven::Engine::m_sceneManager {m_device} [private]
```

Definition at line 56 of file Engine.hpp.

7.13.4.8 m_state

```
ENGINE_STATE ven::Engine::m_state {EXIT} [private]
```

Definition at line 48 of file Engine.hpp.

7.13.4.9 m_surface

```
VkSurfaceKHR ven::Engine::m_surface {nullptr} [private]
```

Definition at line 59 of file Engine.hpp.

Referenced by createSurface().

7.13.4.10 m_window

```
Window ven::Engine::m_window [private]
```

Definition at line 50 of file Engine.hpp.

Referenced by createSurface(), and Engine().

The documentation for this class was generated from the following files:

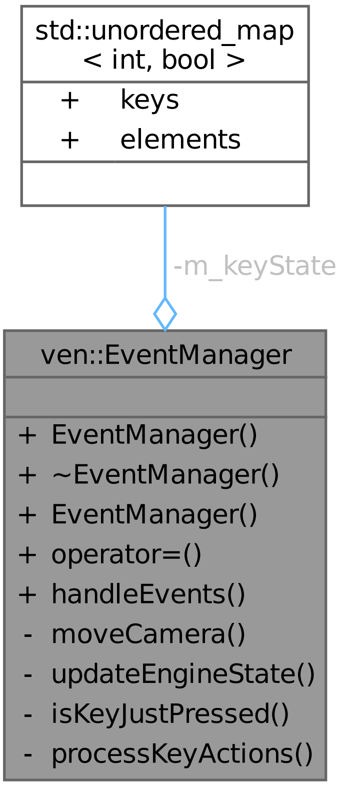
- /home/runner/work/VEngine/VEngine/include/VEngine/Engine.hpp
- /home/runner/work/VEngine/VEngine/src/engine.cpp

7.14 ven::EventManager Class Reference

Class for event manager.

`#include <EventManager.hpp>`

Collaboration diagram for ven::EventManager:



Public Member Functions

- EventManager ()=default
- ∼EventManager ()=default
- EventManager (const EventManager &)=delete
- EventManager & operator= (const EventManager &)=delete
- void handleEvents (GLFWwindow ∗window, ENGINE_STATE ∗engineState, Camera &camera, Gui &gui, float dt) const

Static Private Member Functions

- static void moveCamera (GLFWwindow ∗window, Camera &camera, float dt)
- static void updateEngineState (ENGINE_STATE ∗engineState, const ENGINE_STATE newState)
- static bool isKeyJustPressed (GLFWwindow ∗window, int key, std::unordered_map< int, bool > &keyStates)
- template< typename Iterator >
  static void processKeyActions (GLFWwindow ∗window, Iterator begin, Iterator end)

Private Attributes

- std::unordered_map< int, bool > m_keyState

7.14.1 Detailed Description

Class for event manager.

Definition at line 41 of file EventManager.hpp.

7.14.2 Constructor & Destructor Documentation

7.14.2.1 EventManager() [1/2]

```
ven::EventManager::EventManager ()  [default]
```

7.14.2.2 ∼EventManager()

```
ven::EventManager::∼EventManager ()  [default]
```

7.14.2.3 EventManager() [2/2]

```
ven::EventManager::EventManager (
            const EventManager & )  [delete]
```

7.14.3 Member Function Documentation

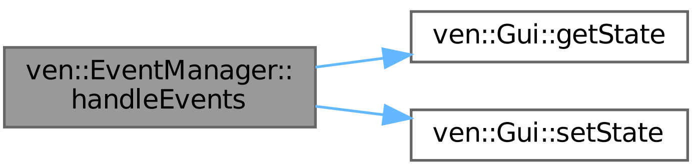
7.14.3.1 handleEvents()

```
void ven::EventManager::handleEvents (
            GLFWwindow * window,
            ENGINE_STATE * engineState,
            Camera & camera,
            Gui & gui,
            float dt) const
```

Definition at line 60 of file eventManager.cpp.

References ven::DEFAULT_KEY_MAPPINGS, ven::EXIT, ven::Gui::getState(), ven::HIDDEN, ven::Gui::setState(), ven::KeyMappings::toggleGui, and ven::VISIBLE.

Here is the call graph for this function:



7.14.3.2 isKeyJustPressed()

```
bool ven::EventManager::isKeyJustPressed (
            GLFWwindow * window,
            int key,
            std::unordered_map< int, bool > & keyStates) [static], [private]
```

Definition at line 6 of file eventManager.cpp.

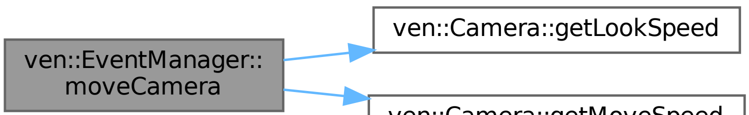
7.14.3.3 moveCamera()

```
void ven::EventManager::moveCamera (
            GLFWwindow * window,
            Camera & camera,
            float dt) [static], [private]
```

Definition at line 26 of file eventManager.cpp.

References ven::DEFAULT_KEY_MAPPINGS, ven::EPSILON, ven::Camera::getLookSpeed(), ven::Camera::getMoveSpeed(), ven::KeyMappings::lookDown, ven::KeyMappings::lookLeft, ven::KeyMappings::lookRight, ven::KeyMappings::lookUp, ven::KeyMappings::moveBackward, ven::KeyMappings::moveDown, ven::KeyMappings::moveForward, ven::KeyMappings::moveLeft, ven::KeyMappings::moveRight, ven::KeyMappings::moveUp, ven::Transform3D::rotation, ven::Camera::transform, and ven::Transform3D::translation.

Here is the call graph for this function:



7.14.3.4 operator=()

```
EventManager & ven::EventManager::operator= (
            const EventManager & ) [delete]
```

7.14.3.5 processKeyActions()

```
template<typename Iterator >
void ven::EventManager::processKeyActions (
            GLFWwindow * window,
            Iterator begin,
            Iterator end) [static], [private]
```

Definition at line 17 of file eventManager.cpp.

7.14.3.6 updateEngineState()

```
static void ven::EventManager::updateEngineState (
            ENGINE_STATE * engineState,
            const ENGINE_STATE newState) [inline], [static], [private]
```

Definition at line 55 of file EventManager.hpp.

7.14.4 Member Data Documentation

7.14.4.1 m_keyState

```
std::unordered_map<int, bool> ven::EventManager::m_keyState [mutable], [private]
```

Definition at line 61 of file EventManager.hpp.

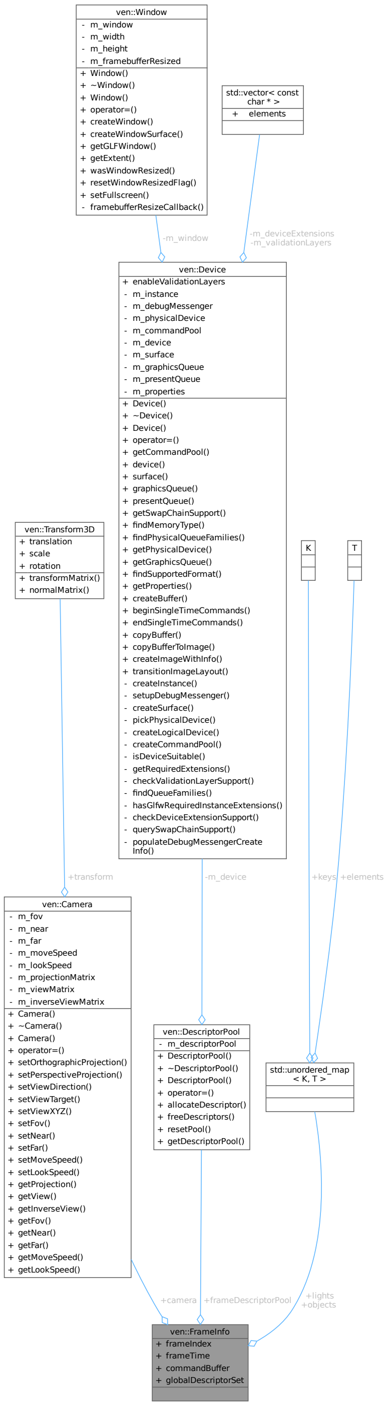
The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/EventManager.hpp
- /home/runner/work/VEngine/VEngine/src/eventManager.cpp

7.15 ven::FrameInfo Struct Reference

```
#include <FrameInfo.hpp>
```

Collaboration diagram for ven::FrameInfo:



Public Attributes

- unsigned long frameIndex
- float frameTime
- VkCommandBuffer commandBuffer
- Camera & camera
- VkDescriptorSet globalDescriptorSet

- DescriptorPool & frameDescriptorPool
- Object::Map & objects
- Light::Map & lights

7.15.1 Detailed Description

Definition at line 39 of file FrameInfo.hpp.

7.15.2 Member Data Documentation

7.15.2.1 camera

`Camera& ven::FrameInfo::camera`

Definition at line 44 of file FrameInfo.hpp.

7.15.2.2 commandBuffer

`VkCommandBuffer ven::FrameInfo::commandBuffer`

Definition at line 43 of file FrameInfo.hpp.

Referenced by ven::ObjectRenderSystem::render(), and ven::PointLightRenderSystem::render().

7.15.2.3 frameDescriptorPool

`DescriptorPool& ven::FrameInfo::frameDescriptorPool`

Definition at line 46 of file FrameInfo.hpp.

Referenced by ven::ObjectRenderSystem::render().

7.15.2.4 frameIndex

`unsigned long ven::FrameInfo::frameIndex`

Definition at line 41 of file FrameInfo.hpp.

Referenced by ven::Engine::mainLoop(), and ven::ObjectRenderSystem::render().

7.15.2.5 frameTime

`float ven::FrameInfo::frameTime`

Definition at line 42 of file FrameInfo.hpp.

7.15.2.6 globalDescriptorSet

`VkDescriptorSet ven::FrameInfo::globalDescriptorSet`

Definition at line 45 of file FrameInfo.hpp.

Referenced by ven::ObjectRenderSystem::render(), and ven::PointLightRenderSystem::render().

7.15.2.7 lights

`Light::Map& ven::FrameInfo::lights`

Definition at line 48 of file FrameInfo.hpp.

Referenced by ven::PointLightRenderSystem::render().

7.15.2.8 objects

`Object::Map& ven::FrameInfo::objects`

Definition at line 47 of file FrameInfo.hpp.

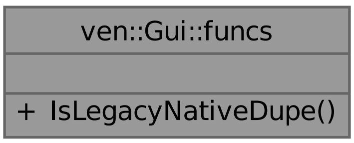
Referenced by ven::ObjectRenderSystem::render().

The documentation for this struct was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/FrameInfo.hpp

7.16 ven::Gui::funcs Struct Reference

Collaboration diagram for ven::Gui::funcs:



Static Public Member Functions

- static bool IsLegacyNativeDupe (const ImGuiKey key)

7.16.1 Detailed Description

Definition at line 60 of file Gui.hpp.

7.16.2 Member Function Documentation

7.16.2.1 IsLegacyNativeDupe()

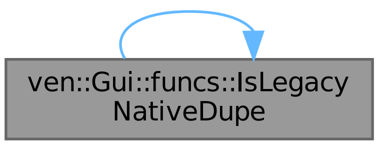
```
static bool ven::Gui::funcs::IsLegacyNativeDupe (
            const ImGuiKey key)  [inline], [static]
```

Definition at line 60 of file Gui.hpp.

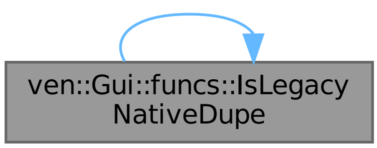
References IsLegacyNativeDupe().

Referenced by IsLegacyNativeDupe().

Here is the call graph for this function:



Here is the caller graph for this function:



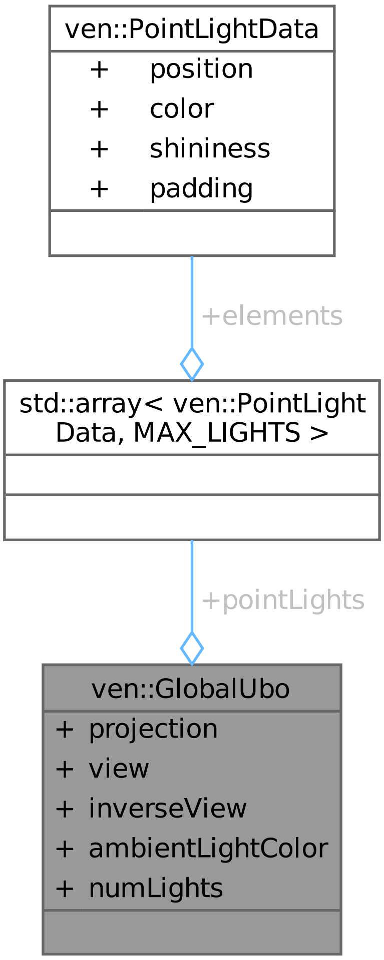
The documentation for this struct was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/Gui.hpp

7.17 ven::GlobalUbo Struct Reference

`#include <FrameInfo.hpp>`

Collaboration diagram for ven::GlobalUbo:



Public Attributes

- glm::mat4 projection {1.F}
- glm::mat4 view {1.F}
- glm::mat4 inverseView {1.F}
- glm::vec4 ambientLightColor {DEFAULT_AMBIENT_LIGHT_COLOR}
- std::array< PointLightData, MAX_LIGHTS > pointLights
- uint8_t numLights

7.17.1 Detailed Description

Definition at line 29 of file FrameInfo.hpp.

7.17.2 Member Data Documentation

7.17.2.1 ambientLightColor

```
glm::vec4 ven::GlobalUbo::ambientLightColor {DEFAULT_AMBIENT_LIGHT_COLOR}
```

Definition at line 34 of file FrameInfo.hpp.

Referenced by ven::Gui::rendererSection().

7.17.2.2 inverseView

```
glm::mat4 ven::GlobalUbo::inverseView {1.F}
```

Definition at line 33 of file FrameInfo.hpp.

7.17.2.3 numLights

```
uint8_t ven::GlobalUbo::numLights
```

Definition at line 36 of file FrameInfo.hpp.

Referenced by ven::SceneManager::updateBuffer().

7.17.2.4 pointLights

```
std::array<PointLightData, MAX_LIGHTS> ven::GlobalUbo::pointLights
```

Definition at line 35 of file FrameInfo.hpp.

Referenced by ven::SceneManager::updateBuffer().

7.17.2.5 projection

```
glm::mat4 ven::GlobalUbo::projection {1.F}
```

Definition at line 31 of file FrameInfo.hpp.

7.17.2.6 view

```
glm::mat4 ven::GlobalUbo::view {1.F}
```

Definition at line 32 of file FrameInfo.hpp.

The documentation for this struct was generated from the following file:

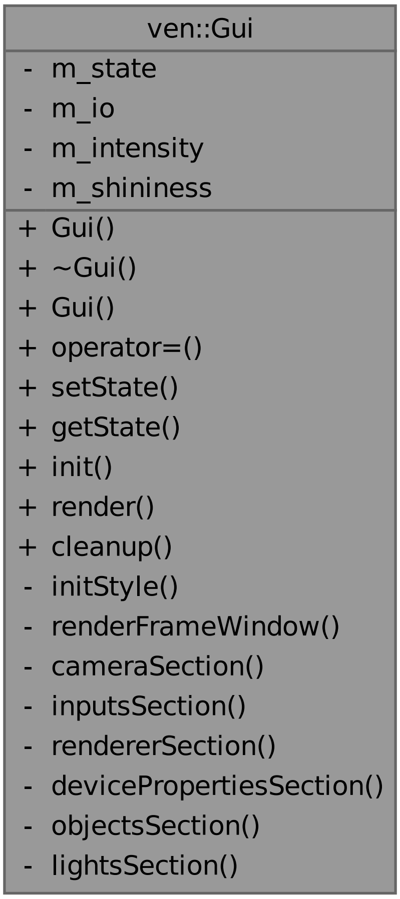
- /home/runner/work/VEngine/VEngine/include/VEngine/FrameInfo.hpp

7.18 ven::Gui Class Reference

Class for Gui.

`#include <Gui.hpp>`

Collaboration diagram for ven::Gui:



Classes

- struct funcs

Public Member Functions

- Gui ()=default
- ∼Gui ()=default
- Gui (const Gui &)=delete
- Gui & operator= (const Gui &)=delete
- void setState (const GUI_STATE state)
- GUI_STATE getState () const

Static Public Member Functions

- static void init (GLFWwindow *window, VkInstance instance, const Device *device, VkRenderPass renderPass)
- static void render (Renderer *renderer, std::unordered_map< unsigned int, Object > &objects, std::unordered_map< unsigned int, Light > &lights, Camera &camera, VkPhysicalDevice physicalDevice, GlobalUbo &ubo)
- static void cleanup ()

Static Private Member Functions

- static void initStyle ()
- static void renderFrameWindow ()
- static void cameraSection (Camera &camera)
- static void inputsSection (const ImGuiIO *io)
- static void rendererSection (Renderer *renderer, GlobalUbo &ubo)
- static void devicePropertiesSection (VkPhysicalDeviceProperties deviceProperties)
- static void objectsSection (std::unordered_map< unsigned int, Object > &objects)
- static void lightsSection (std::unordered_map< unsigned int, Light > &lights)

Private Attributes

- GUI_STATE m_state {VISIBLE}

Static Private Attributes

- static ImGuiIO * m_io = nullptr
- static float m_intensity = 1.0F
- static float m_shininess = DEFAULT_SHININESS

7.18.1 Detailed Description

Class for Gui.

Definition at line 30 of file Gui.hpp.

7.18.2 Constructor & Destructor Documentation

7.18.2.1 Gui() [1/2]

```
ven::Gui::Gui () [default]
```

7.18.2.2 ~Gui()

```
ven::Gui::~Gui () [default]
```

7.18.2.3 Gui() [2/2]

```
ven::Gui::Gui (
            const Gui & )  [delete]
```

7.18.3 Member Function Documentation

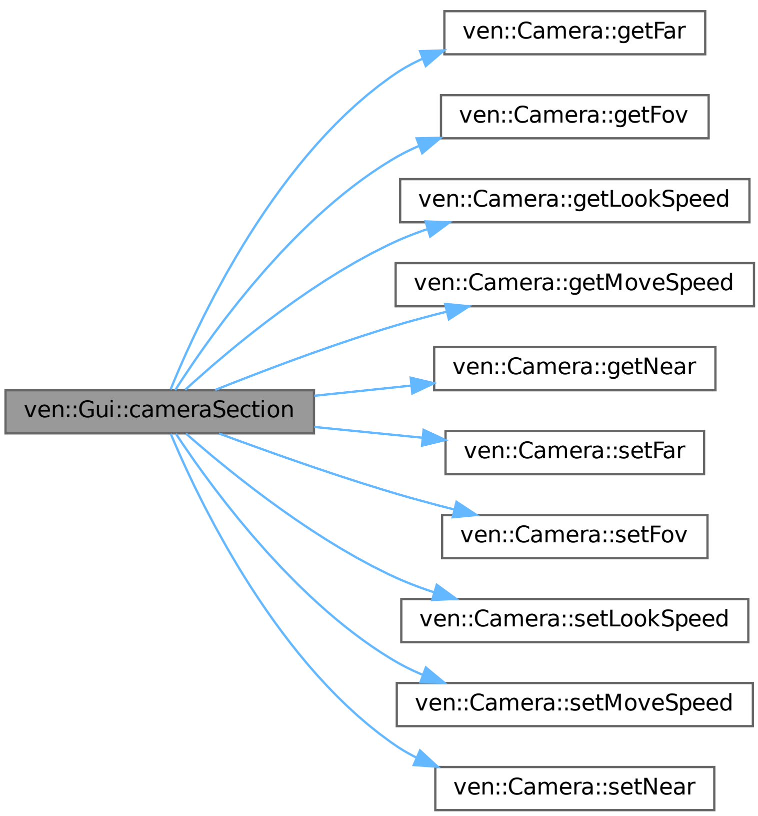
7.18.3.1 cameraSection()

```
void ven::Gui::cameraSection (
            Camera & camera)  [static], [private]
```

Definition at line 109 of file render.cpp.

References ven::DEFAULT_FAR, ven::DEFAULT_FOV, ven::DEFAULT_LOOK_SPEED, ven::DEFAULT_MOVE_SPEED, ven::DEFAULT_NEAR, ven::DEFAULT_POSITION, ven::DEFAULT_ROTATION, ven::Camera::getFar(), ven::Camera::getFov(), ven::Camera::getLookSpeed(), ven::Camera::getMoveSpeed(), ven::Camera::getNear(), ven::Transform3D::rotation, ven::Camera::setFar(), ven::Camera::setFov(), ven::Camera::setLookSpeed(), ven::Camera::setMoveSpeed(), ven::Camera::setNear(), ven::Camera::transform, and ven::Transform3D::translation.

Here is the call graph for this function:



7.18.3.2 cleanup()

```
void ven::Gui::cleanup ( )  [static]
```

Definition at line 9 of file render.cpp.

Referenced by ven::Engine::mainLoop().

Here is the caller graph for this function:

7.18.3.3 devicePropertiesSection()

```
void ven::Gui::devicePropertiesSection (
            VkPhysicalDeviceProperties deviceProperties)  [static], [private]
```

Definition at line 289 of file render.cpp.

7.18.3.4 getState()

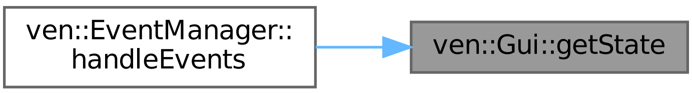
```
GUI_STATE ven::Gui::getState ( ) const  [inline], [nodiscard]
```

Definition at line 46 of file Gui.hpp.

References m_state.

Referenced by ven::EventManager::handleEvents().

Here is the caller graph for this function:



7.18.3.5 init()

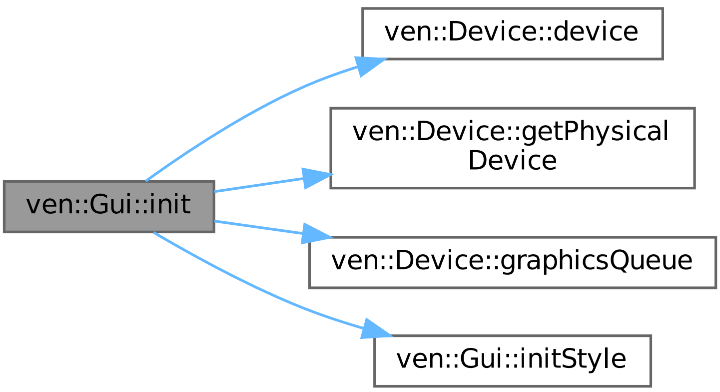
```
void ven::Gui::init (
            GLFWwindow * window,
            VkInstance instance,
            const Device * device,
            VkRenderPass renderPass)  [static]
```

Definition at line 11 of file init.cpp.

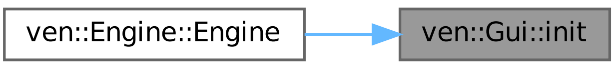
References ven::DESCRIPTOR_COUNT, ven::Device::device(), ven::Device::getPhysicalDevice(), ven::Device::graphicsQueue(), initStyle(), and m_io.

Referenced by ven::Engine::Engine().

Here is the call graph for this function:



Here is the caller graph for this function:



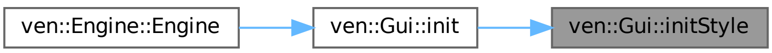
7.18.3.6 initStyle()

```
void ven::Gui::initStyle ( ) [static], [private]
```

Definition at line 60 of file init.cpp.

Referenced by init().

Here is the caller graph for this function:



7.18.3.7 inputsSection()

```
void ven::Gui::inputsSection (
            const ImGuiIO * io) [static], [private]
```

Definition at line 267 of file render.cpp.

7.18.3.8 lightsSection()

```
void ven::Gui::lightsSection (
            std::unordered_map< unsigned int, Light > & lights) [static], [private]
```

Definition at line 177 of file render.cpp.

References ven::Colors::COLOR_PRESETS_3, ven::DEFAULT_LIGHT_INTENSITY, and ven::DEFAULT_SHININESS.

7.18.3.9 objectsSection()

```
void ven::Gui::objectsSection (
            std::unordered_map< unsigned int, Object > & objects) [static], [private]
```

Definition at line 158 of file render.cpp.

References ven::Colors::GRAY_4.

7.18.3.10 operator=()

```
Gui & ven::Gui::operator= (
            const Gui & ) [delete]
```

7.18.3.11 render()

```
void ven::Gui::render (
            Renderer * renderer,
            std::unordered_map< unsigned int, Object > & objects,
            std::unordered_map< unsigned int, Light > & lights,
            Camera & camera,
            VkPhysicalDevice physicalDevice,
            GlobalUbo & ubo) [static]
```

Definition at line 16 of file render.cpp.

References ven::Renderer::getCurrentCommandBuffer().

Referenced by ven::Engine::mainLoop().

Here is the call graph for this function:

Here is the caller graph for this function:

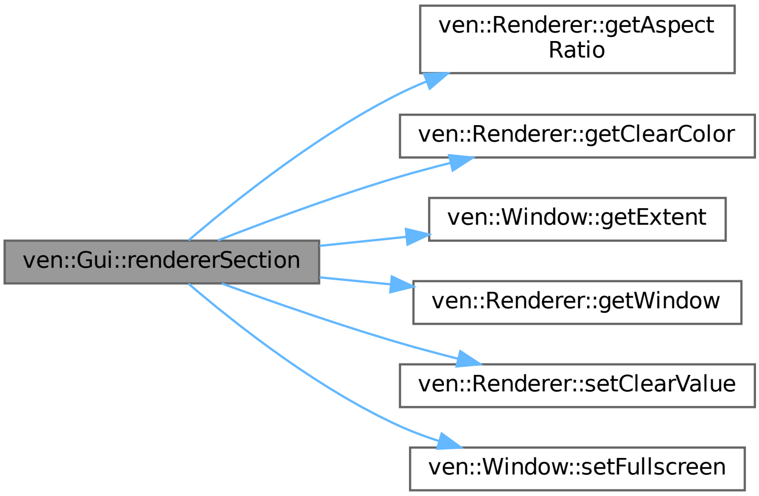
7.18.3.12 rendererSection()

```
void ven::Gui::rendererSection (
            Renderer * renderer,
            GlobalUbo & ubo) [static], [private]
```

Definition at line 50 of file render.cpp.

References ven::GlobalUbo::ambientLightColor, ven::Colors::COLOR_PRESETS_4, ven::Colors::COLOR_PRESETS_VK, ven::DEFAULT_AMBIENT_LIGHT_INTENSITY, ven::Renderer::getAspectRatio(), ven::Renderer::getClearColor(), ven::Window::getExtent(), ven::Renderer::getWindow(), ven::Renderer::setClearValue(), and ven::Window::setFullscreen().

Here is the call graph for this function:



7.18.3.13 renderFrameWindow()

```
void ven::Gui::renderFrameWindow ()  [static], [private]
```

Definition at line 38 of file render.cpp.

7.18.3.14 setState()

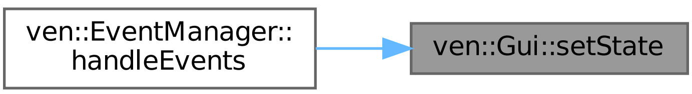
```
void ven::Gui::setState (
            const GUI_STATE state)  [inline]
```

Definition at line 45 of file Gui.hpp.

References m_state.

Referenced by ven::EventManager::handleEvents().

Here is the caller graph for this function:



7.18.4 Member Data Documentation

7.18.4.1 m_intensity

```
float ven::Gui::m_intensity = 1.0F  [static], [private]
```

Definition at line 64 of file Gui.hpp.

7.18.4.2 m_io

```
ImGuiIO * ven::Gui::m_io = nullptr  [static], [private]
```

Definition at line 62 of file Gui.hpp.

Referenced by init().

7.18.4.3 m_shininess

```
float ven::Gui::m_shininess = DEFAULT_SHININESS  [static], [private]
```

Definition at line 65 of file Gui.hpp.

7.18.4.4 m_state

```
GUI_STATE ven::Gui::m_state {VISIBLE}  [private]
```

Definition at line 63 of file Gui.hpp.

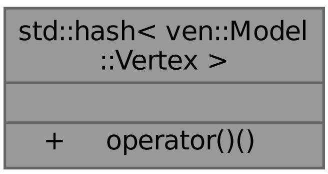
Referenced by getState(), and setState().

The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/Gui.hpp
- /home/runner/work/VEngine/VEngine/src/gui/init.cpp
- /home/runner/work/VEngine/VEngine/src/gui/render.cpp

7.19 std::hash< ven::Model::Vertex > Struct Reference

Collaboration diagram for std::hash< ven::Model::Vertex >:



Public Member Functions

- size_t operator() (ven::Model::Vertex const &vertex) const noexcept

7.19.1 Detailed Description

Definition at line 17 of file model.cpp.

7.19.2 Member Function Documentation

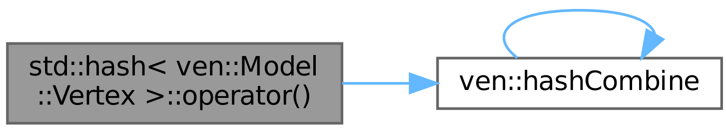
7.19.2.1 operator()()

```
size_t std::hash< ven::Model::Vertex >::operator() (
            ven::Model::Vertex const & vertex) const  [inline], [noexcept]
```

Definition at line 18 of file model.cpp.

References ven::hashCombine().

Here is the call graph for this function:



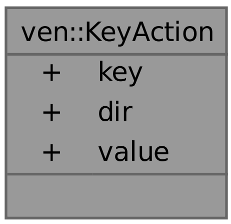
The documentation for this struct was generated from the following file:

- /home/runner/work/VEngine/VEngine/src/model.cpp

7.20 ven::KeyAction Struct Reference

```
#include <EventManager.hpp>
```

Collaboration diagram for ven::KeyAction:



Public Attributes

- uint16_t key
- glm::vec3 ∗ dir
- glm::vec3 value

7.20.1 Detailed Description

Definition at line 13 of file EventManager.hpp.

7.20.2 Member Data Documentation

7.20.2.1 dir

```
glm::vec3* ven::KeyAction::dir
```

Definition at line 15 of file EventManager.hpp.

7.20.2.2 key

```
uint16_t ven::KeyAction::key
```

Definition at line 14 of file EventManager.hpp.

7.20.2.3 value

```
glm::vec3 ven::KeyAction::value
```

Definition at line 16 of file EventManager.hpp.

The documentation for this struct was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/EventManager.hpp

7.21 ven::KeyMappings Struct Reference

```
#include <EventManager.hpp>
```

Collaboration diagram for ven::KeyMappings:

Public Attributes

- uint16_t moveLeft = GLFW_KEY_A
- uint16_t moveRight = GLFW_KEY_D
- uint16_t moveForward = GLFW_KEY_W
- uint16_t moveBackward = GLFW_KEY_S
- uint16_t moveUp = GLFW_KEY_SPACE
- uint16_t moveDown = GLFW_KEY_LEFT_SHIFT
- uint16_t lookLeft = GLFW_KEY_LEFT
- uint16_t lookRight = GLFW_KEY_RIGHT
- uint16_t lookUp = GLFW_KEY_UP
- uint16_t lookDown = GLFW_KEY_DOWN
- uint16_t toggleGui = GLFW_KEY_F1

7.21.1 Detailed Description

Definition at line 19 of file EventManager.hpp.

7.21.2 Member Data Documentation

7.21.2.1 lookDown

```
uint16_t ven::KeyMappings::lookDown = GLFW_KEY_DOWN
```

Definition at line 29 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.2 lookLeft

```
uint16_t ven::KeyMappings::lookLeft = GLFW_KEY_LEFT
```

Definition at line 26 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.3 lookRight

```
uint16_t ven::KeyMappings::lookRight = GLFW_KEY_RIGHT
```

Definition at line 27 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.4 lookUp

```
uint16_t ven::KeyMappings::lookUp = GLFW_KEY_UP
```

Definition at line 28 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.5 moveBackward

```
uint16_t ven::KeyMappings::moveBackward = GLFW_KEY_S
```

Definition at line 23 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.6 moveDown

```
uint16_t ven::KeyMappings::moveDown = GLFW_KEY_LEFT_SHIFT
```

Definition at line 25 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.7 moveForward

`uint16_t ven::KeyMappings::moveForward = GLFW_KEY_W`

Definition at line 22 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.8 moveLeft

`uint16_t ven::KeyMappings::moveLeft = GLFW_KEY_A`

Definition at line 20 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.9 moveRight

`uint16_t ven::KeyMappings::moveRight = GLFW_KEY_D`

Definition at line 21 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.10 moveUp

`uint16_t ven::KeyMappings::moveUp = GLFW_KEY_SPACE`

Definition at line 24 of file EventManager.hpp.

Referenced by ven::EventManager::moveCamera().

7.21.2.11 toggleGui

`uint16_t ven::KeyMappings::toggleGui = GLFW_KEY_F1`

Definition at line 30 of file EventManager.hpp.

Referenced by ven::EventManager::handleEvents().

The documentation for this struct was generated from the following file:

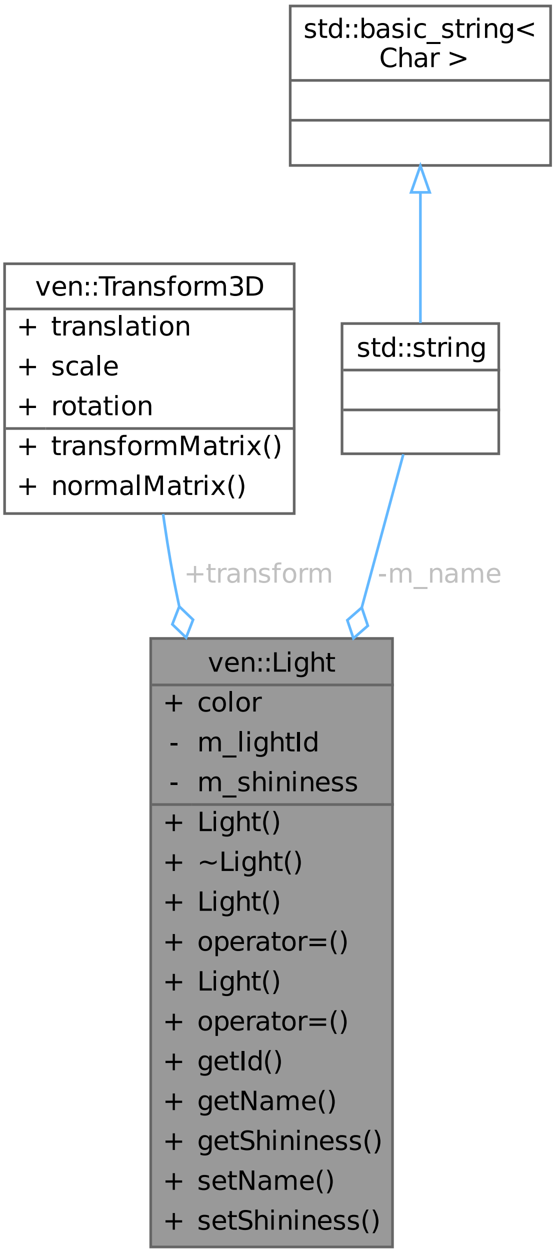
- /home/runner/work/VEngine/VEngine/include/VEngine/EventManager.hpp

7.22 ven::Light Class Reference

Class for light.

`#include <Light.hpp>`

Collaboration diagram for ven::Light:



Public Types

- using Map = std::unordered_map<unsigned int, Light>

Public Member Functions

- Light (const unsigned int objId)
- ∼Light ()=default
- Light (const Light &)=delete
- Light & operator= (const Light &)=delete
- Light (Light &&)=default
- Light & operator= (Light &&)=default
- unsigned int getId () const
- std::string getName () const
- float getShininess () const
- void setName (const std::string &name)
- void setShininess (const float shininess)

Public Attributes

- glm::vec4 color {DEFAULT_LIGHT_COLOR}
- Transform3D transform {}

Private Attributes

- unsigned int m_lightId
- std::string m_name {"point light"}
- float m_shininess {DEFAULT_SHININESS}

7.22.1 Detailed Description

Class for light.

Definition at line 28 of file Light.hpp.

7.22.2 Member Typedef Documentation

7.22.2.1 Map

```
using ven::Light::Map = std::unordered_map<unsigned int, Light>
```

Definition at line 32 of file Light.hpp.

7.22.3 Constructor & Destructor Documentation

7.22.3.1 Light() [1/3]

```
ven::Light::Light (
            const unsigned int objId) [inline], [explicit]
```

Definition at line 34 of file Light.hpp.

7.22.3.2 ∼Light()

```
ven::Light::∼Light ()  [default]
```

7.22.3.3 Light() [2/3]

```
ven::Light::Light (
            const Light & )  [delete]
```

7.22.3.4 Light() [3/3]

```
ven::Light::Light (
            Light && )  [default]
```

7.22.4 Member Function Documentation

7.22.4.1 getId()

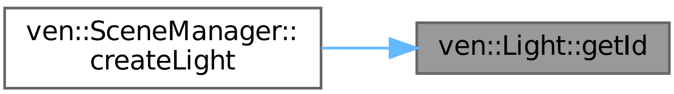
```
unsigned int ven::Light::getId () const  [inline], [nodiscard]
```

Definition at line 43 of file Light.hpp.

References m_lightId.

Referenced by ven::SceneManager::createLight().

Here is the caller graph for this function:



7.22.4.2 getName()

```
std::string ven::Light::getName () const  [inline], [nodiscard]
```

Definition at line 44 of file Light.hpp.

References m_name.

7.22.4.3 getShininess()

```
float ven::Light::getShininess () const  [inline], [nodiscard]
```

Definition at line 45 of file Light.hpp.

References m_shininess.

7.22.4.4 operator=() [1/2]

```
Light & ven::Light::operator= (
            const Light & )  [delete]
```

7.22.4.5 operator=() [2/2]

```
Light & ven::Light::operator= (
            Light && )  [default]
```

7.22.4.6 setName()

```
void ven::Light::setName (
            const std::string & name)  [inline]
```

Definition at line 47 of file Light.hpp.

References m_name.

7.22.4.7 setShininess()

```
void ven::Light::setShininess (
            const float shininess)  [inline]
```

Definition at line 48 of file Light.hpp.

References m_shininess.

7.22.5 Member Data Documentation

7.22.5.1 color

```
glm::vec4 ven::Light::color {DEFAULT_LIGHT_COLOR}
```

Definition at line 50 of file Light.hpp.

Referenced by ven::SceneManager::createLight().

7.22.5.2 m_lightId

```
unsigned int ven::Light::m_lightId  [private]
```

Definition at line 55 of file Light.hpp.

Referenced by getId().

7.22.5.3 m_name

```
std::string ven::Light::m_name {"point light"}  [private]
```

Definition at line 56 of file Light.hpp.

Referenced by getName(), and setName().

7.22.5.4 m_shininess

```
float ven::Light::m_shininess {DEFAULT_SHININESS}  [private]
```

Definition at line 57 of file Light.hpp.

Referenced by getShininess(), and setShininess().

7.22.5.5 transform

```
Transform3D ven::Light::transform {}
```

Definition at line 51 of file Light.hpp.

Referenced by ven::SceneManager::createLight().

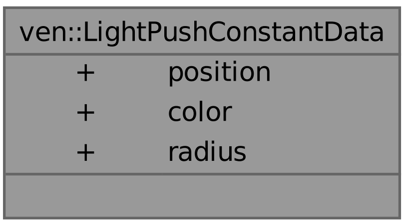
The documentation for this class was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/Light.hpp

7.23 ven::LightPushConstantData Struct Reference

```
#include <PointLightRenderSystem.hpp>
```

Collaboration diagram for ven::LightPushConstantData:



Public Attributes

- glm::vec4 position {}
- glm::vec4 color {}
- float radius

7.23.1 Detailed Description

Definition at line 14 of file PointLightRenderSystem.hpp.

7.23.2 Member Data Documentation

7.23.2.1 color

```
glm::vec4 ven::LightPushConstantData::color {}
```

Definition at line 16 of file PointLightRenderSystem.hpp.

7.23.2.2 position

```
glm::vec4 ven::LightPushConstantData::position {}
```

Definition at line 15 of file PointLightRenderSystem.hpp.

Referenced by ven::PointLightRenderSystem::render().

7.23.2.3 radius

```
float ven::LightPushConstantData::radius
```

Definition at line 17 of file PointLightRenderSystem.hpp.

The documentation for this struct was generated from the following file:

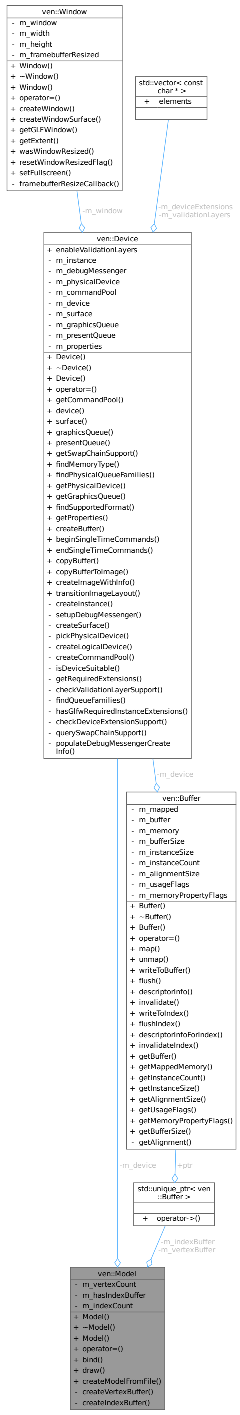
- /home/runner/work/VEngine/VEngine/include/VEngine/RenderSystem/PointLightRenderSystem.hpp

7.24 ven::Model Class Reference

Class for model.

`#include <Model.hpp>`

Collaboration diagram for ven::Model:



Classes

- struct Builder
- struct Vertex

Public Member Functions

- Model (Device &device, const Builder &builder)
- ∼Model ()=default
- Model (const Model &)=delete
- void operator= (const Model &)=delete
- void bind (VkCommandBuffer commandBuffer) const
- void draw (VkCommandBuffer commandBuffer) const

Static Public Member Functions

- static std::unique_ptr< Model > createModelFromFile (Device &device, const std::string &filename)

Private Member Functions

- void createVertexBuffer (const std::vector< Vertex > &vertices)
- void createIndexBuffer (const std::vector< uint32_t > &indices)

Private Attributes

- Device & m_device
- std::unique_ptr< Buffer > m_vertexBuffer
- uint32_t m_vertexCount
- bool m_hasIndexBuffer {false}
- std::unique_ptr< Buffer > m_indexBuffer
- uint32_t m_indexCount

7.24.1 Detailed Description

Class for model.

Definition at line 25 of file Model.hpp.

7.24.2 Constructor & Destructor Documentation

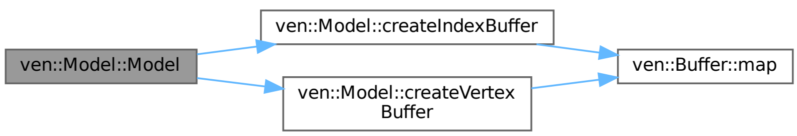
7.24.2.1 Model() [1/2]

```
ven::Model::Model (
            Device & device,
            const Builder & builder)
```

Definition at line 25 of file model.cpp.

References createIndexBuffer(), createVertexBuffer(), ven::Model::Builder::indices, and ven::Model::Builder::vertices.

Here is the call graph for this function:



7.24.2.2 ∼Model()

```
ven::Model::∼Model ()  [default]
```

7.24.2.3 Model() [2/2]

```
ven::Model::Model (
            const Model & )  [delete]
```

7.24.3 Member Function Documentation

7.24.3.1 bind()

```
void ven::Model::bind (
            VkCommandBuffer commandBuffer) const
```

Definition at line 78 of file model.cpp.

7.24.3.2 createIndexBuffer()

```
void ven::Model::createIndexBuffer (
            const std::vector< uint32_t > & indices)  [private]
```

Definition at line 48 of file model.cpp.

References ven::Buffer::map().

Referenced by Model().

Here is the call graph for this function:

Here is the caller graph for this function:

7.24.3.3 createModelFromFile()

```
std::unique_ptr< ven::Model > ven::Model::createModelFromFile (
            Device & device,
            const std::string & filename)  [static]
```

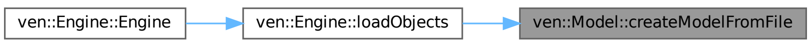
Definition at line 89 of file model.cpp.

References ven::Model::Builder::loadModel().

Referenced by ven::Engine::loadObjects().

Here is the call graph for this function:

Here is the caller graph for this function:



7.24.3.4 createVertexBuffer()

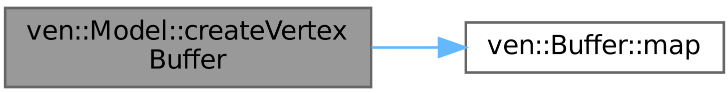
```
void ven::Model::createVertexBuffer (
            const std::vector< Vertex > & vertices)  [private]
```

Definition at line 31 of file model.cpp.

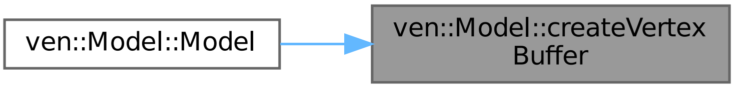
References ven::Buffer::map().

Referenced by Model().

Here is the call graph for this function:



Here is the caller graph for this function:



7.24.3.5 draw()

```
void ven::Model::draw (
            VkCommandBuffer commandBuffer) const
```

Definition at line 69 of file model.cpp.

7.24.3.6 operator=()

```
void ven::Model::operator= (
            const Model & )  [delete]
```

7.24.4 Member Data Documentation

7.24.4.1 m_device

```
Device& ven::Model::m_device  [private]
```

Definition at line 68 of file Model.hpp.

7.24.4.2 m_hasIndexBuffer

```
bool ven::Model::m_hasIndexBuffer {false}  [private]
```

Definition at line 72 of file Model.hpp.

7.24.4.3 m_indexBuffer

```
std::unique_ptr<Buffer> ven::Model::m_indexBuffer  [private]
```

Definition at line 73 of file Model.hpp.

7.24.4.4 m_indexCount

```
uint32_t ven::Model::m_indexCount [private]
```

Definition at line 74 of file Model.hpp.

7.24.4.5 m_vertexBuffer

```
std::unique_ptr<Buffer> ven::Model::m_vertexBuffer [private]
```

Definition at line 69 of file Model.hpp.

7.24.4.6 m_vertexCount

```
uint32_t ven::Model::m_vertexCount [private]
```

Definition at line 70 of file Model.hpp.

The documentation for this class was generated from the following files:

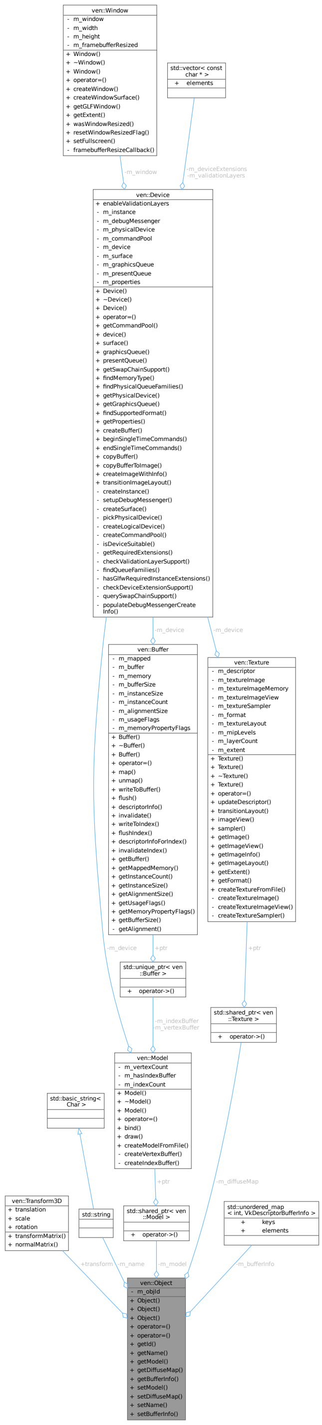
- /home/runner/work/VEngine/VEngine/include/VEngine/Model.hpp
- /home/runner/work/VEngine/VEngine/src/model.cpp

7.25 ven::Object Class Reference

Class for object.

```
#include <Object.hpp>
```

Collaboration diagram for ven::Object:



Public Types

- using Map = std::unordered_map<unsigned int, Object>

Public Member Functions

- Object (const unsigned int objId)

- Object (const Object &)=delete
- Object (Object &&)=default
- Object & operator= (const Object &)=delete
- Object & operator= (Object &&)=delete
- unsigned int getId () const
- std::string getName () const
- std::shared_ptr< Model > getModel () const
- std::shared_ptr< Texture > getDiffuseMap () const
- VkDescriptorBufferInfo getBufferInfo (const int frameIndex) const
- void setModel (const std::shared_ptr< Model > &model)
- void setDiffuseMap (const std::shared_ptr< Texture > &diffuseMap)
- void setName (const std::string &name)
- void setBufferInfo (const int frameIndex, const VkDescriptorBufferInfo &info)

Public Attributes

- Transform3D transform {}

Private Attributes

- unsigned int m_objId
- std::string m_name
- std::shared_ptr< Model > m_model = nullptr
- std::shared_ptr< Texture > m_diffuseMap = nullptr
- std::unordered_map< int, VkDescriptorBufferInfo > m_bufferInfo

7.25.1 Detailed Description

Class for object.

Definition at line 33 of file Object.hpp.

7.25.2 Member Typedef Documentation

7.25.2.1 Map

```
using ven::Object::Map = std::unordered_map<unsigned int, Object>
```

Definition at line 37 of file Object.hpp.

7.25.3 Constructor & Destructor Documentation

7.25.3.1 Object() [1/3]

```
ven::Object::Object (
            const unsigned int objId) [inline], [explicit]
```

Definition at line 39 of file Object.hpp.

7.25.3.2 Object() [2/3]

```
ven::Object::Object (
            const Object & )  [delete]
```

7.25.3.3 Object() [3/3]

```
ven::Object::Object (
            Object && )  [default]
```

7.25.4 Member Function Documentation

7.25.4.1 getBufferInfo()

```
VkDescriptorBufferInfo ven::Object::getBufferInfo (
            const int frameIndex) const  [inline], [nodiscard]
```

Definition at line 49 of file Object.hpp.

References m_bufferInfo.

7.25.4.2 getDiffuseMap()

```
std::shared_ptr< Texture > ven::Object::getDiffuseMap () const  [inline], [nodiscard]
```

Definition at line 48 of file Object.hpp.

References m_diffuseMap.

7.25.4.3 getId()

```
unsigned int ven::Object::getId () const  [inline], [nodiscard]
```

Definition at line 45 of file Object.hpp.

References m_objId.

7.25.4.4 getModel()

```
std::shared_ptr< Model > ven::Object::getModel () const  [inline], [nodiscard]
```

Definition at line 47 of file Object.hpp.

References m_model.

7.25.4.5 getName()

```
std::string ven::Object::getName () const [inline], [nodiscard]
```

Definition at line 46 of file Object.hpp.

References m_name.

7.25.4.6 operator=() [1/2]

```
Object & ven::Object::operator= (
            const Object & ) [delete]
```

7.25.4.7 operator=() [2/2]

```
Object & ven::Object::operator= (
            Object && ) [delete]
```

7.25.4.8 setBufferInfo()

```
void ven::Object::setBufferInfo (
            const int frameIndex,
            const VkDescriptorBufferInfo & info) [inline]
```

Definition at line 53 of file Object.hpp.

References m_bufferInfo.

7.25.4.9 setDiffuseMap()

```
void ven::Object::setDiffuseMap (
            const std::shared_ptr< Texture > & diffuseMap) [inline]
```

Definition at line 51 of file Object.hpp.

References m_diffuseMap.

7.25.4.10 setModel()

```
void ven::Object::setModel (
            const std::shared_ptr< Model > & model) [inline]
```

Definition at line 50 of file Object.hpp.

References m_model.

7.25.4.11 setName()

```
void ven::Object::setName (
            const std::string & name)  [inline]
```

Definition at line 52 of file Object.hpp.

References m_name.

7.25.5 Member Data Documentation

7.25.5.1 m_bufferInfo

```
std::unordered_map<int, VkDescriptorBufferInfo> ven::Object::m_bufferInfo  [private]
```

Definition at line 65 of file Object.hpp.

Referenced by getBufferInfo(), and setBufferInfo().

7.25.5.2 m_diffuseMap

```
std::shared_ptr<Texture> ven::Object::m_diffuseMap = nullptr  [private]
```

Definition at line 64 of file Object.hpp.

Referenced by getDiffuseMap(), and setDiffuseMap().

7.25.5.3 m_model

```
std::shared_ptr<Model> ven::Object::m_model = nullptr  [private]
```

Definition at line 63 of file Object.hpp.

Referenced by getModel(), and setModel().

7.25.5.4 m_name

```
std::string ven::Object::m_name  [private]
```

Definition at line 62 of file Object.hpp.

Referenced by getName(), and setName().

7.25.5.5 m_objId

```
unsigned int ven::Object::m_objId  [private]
```

Definition at line 61 of file Object.hpp.

Referenced by getId().

7.25.5.6 transform

```
Transform3D ven::Object::transform {}
```

Definition at line 57 of file Object.hpp.

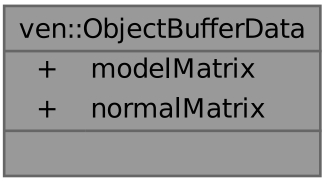
The documentation for this class was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/Object.hpp

7.26 ven::ObjectBufferData Struct Reference

```
#include <Object.hpp>
```

Collaboration diagram for ven::ObjectBufferData:



Public Attributes

- glm::mat4 modelMatrix {1.F}
- glm::mat4 normalMatrix {1.F}

7.26.1 Detailed Description

Definition at line 23 of file Object.hpp.

7.26.2 Member Data Documentation

7.26.2.1 modelMatrix

```
glm::mat4 ven::ObjectBufferData::modelMatrix {1.F}
```

Definition at line 24 of file Object.hpp.

Referenced by ven::SceneManager::updateBuffer().

7.26.2.2 normalMatrix

```
glm::mat4 ven::ObjectBufferData::normalMatrix {1.F}
```

Definition at line 25 of file Object.hpp.

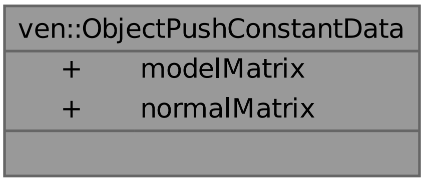
The documentation for this struct was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/Object.hpp

7.27 ven::ObjectPushConstantData Struct Reference

```
#include <ObjectRenderSystem.hpp>
```

Collaboration diagram for ven::ObjectPushConstantData:



Public Attributes

- glm::mat4 modelMatrix {}
- glm::mat4 normalMatrix {}

7.27.1 Detailed Description

Definition at line 14 of file ObjectRenderSystem.hpp.

7.27.2 Member Data Documentation

7.27.2.1 modelMatrix

```
glm::mat4 ven::ObjectPushConstantData::modelMatrix {}
```

Definition at line 15 of file ObjectRenderSystem.hpp.

Referenced by ven::ObjectRenderSystem::render().

7.27.2.2 normalMatrix

```
glm::mat4 ven::ObjectPushConstantData::normalMatrix {}
```

Definition at line 16 of file ObjectRenderSystem.hpp.

The documentation for this struct was generated from the following file:

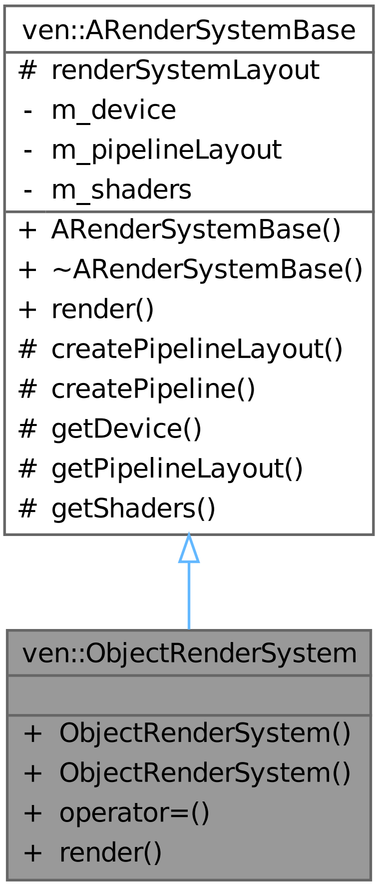
- /home/runner/work/VEngine/VEngine/include/VEngine/RenderSystem/ObjectRenderSystem.hpp

7.28 ven::ObjectRenderSystem Class Reference

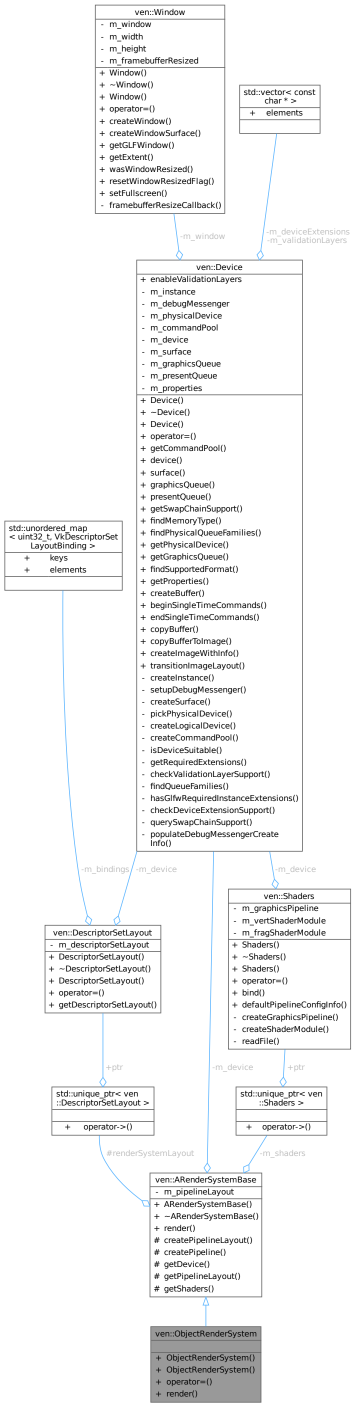
Class for object render system.

```
#include <ObjectRenderSystem.hpp>
```

Inheritance diagram for ven::ObjectRenderSystem:



Collaboration diagram for ven::ObjectRenderSystem:



Public Member Functions

- ObjectRenderSystem (Device &device, const VkRenderPass renderPass, const VkDescriptorSetLayout globalSetLayout)
- ObjectRenderSystem (const ObjectRenderSystem &)=delete
- ObjectRenderSystem & operator= (const ObjectRenderSystem &)=delete
- void render (const FrameInfo &frameInfo) const override

Public Member Functions inherited from ven::ARenderSystemBase

- ARenderSystemBase (Device &device)
- virtual ∼ARenderSystemBase ()

Additional Inherited Members

Protected Member Functions inherited from ven::ARenderSystemBase

- void createPipelineLayout (VkDescriptorSetLayout globalSetLayout, uint32_t pushConstantSize)
- void createPipeline (VkRenderPass renderPass, const std::string &shadersVertPath, const std::string &shadersFragPath, bool isLight)
- Device & getDevice () const
- VkPipelineLayout getPipelineLayout () const
- const std::unique_ptr< Shaders > & getShaders () const

Protected Attributes inherited from ven::ARenderSystemBase

- std::unique_ptr< DescriptorSetLayout > renderSystemLayout

7.28.1 Detailed Description

Class for object render system.

Definition at line 24 of file ObjectRenderSystem.hpp.

7.28.2 Constructor & Destructor Documentation

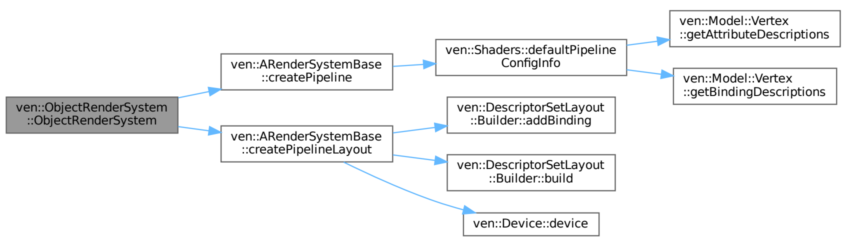
7.28.2.1 ObjectRenderSystem() [1/2]

```
ven::ObjectRenderSystem::ObjectRenderSystem (
            Device & device,
            const VkRenderPass renderPass,
            const VkDescriptorSetLayout globalSetLayout)  [inline], [explicit]
```

Definition at line 28 of file ObjectRenderSystem.hpp.

References ven::ARenderSystemBase::createPipeline(), ven::ARenderSystemBase::createPipelineLayout(), and ven::SHADERS_BIN_PATH.

Here is the call graph for this function:



7.28.2.2 ObjectRenderSystem() [2/2]

```
ven::ObjectRenderSystem::ObjectRenderSystem (
            const ObjectRenderSystem & )  [delete]
```

7.28.3 Member Function Documentation

7.28.3.1 operator=()

```
ObjectRenderSystem & ven::ObjectRenderSystem::operator= (
            const ObjectRenderSystem & )  [delete]
```

7.28.3.2 render()

```
void ven::ObjectRenderSystem::render (
            const FrameInfo & frameInfo) const  [override], [virtual]
```

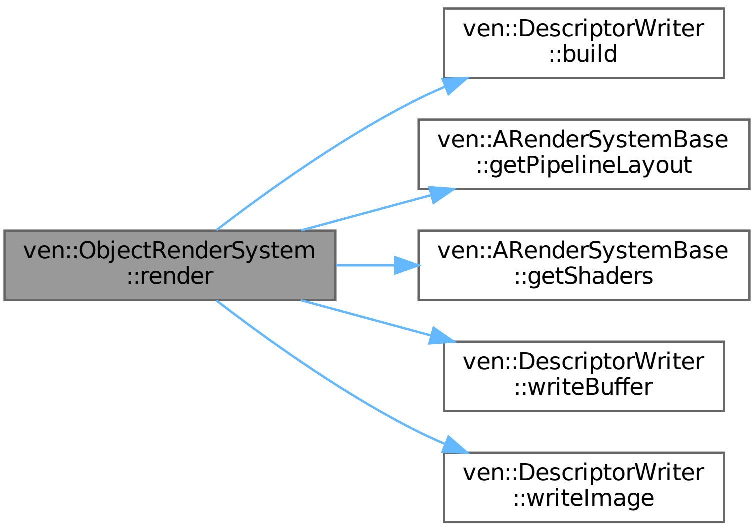
Implements ven::ARenderSystemBase.

Definition at line 6 of file objectRenderSystem.cpp.

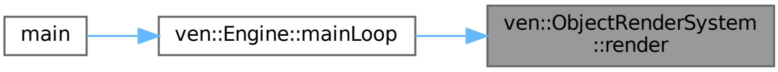
References ven::DescriptorWriter::build(), ven::FrameInfo::commandBuffer, ven::FrameInfo::frameDescriptorPool, ven::FrameInfo::frameIndex, ven::ARenderSystemBase::getPipelineLayout(), ven::ARenderSystemBase::getShaders(), ven::FrameInfo::globalDescriptorSet, ven::ObjectPushConstantData::modelMatrix, ven::FrameInfo::objects, ven::ARenderSystemBase::renderSystemLayout, ven::DescriptorWriter::writeBuffer(), and ven::DescriptorWriter::writeImage().

Referenced by ven::Engine::mainLoop().

Here is the call graph for this function:



Here is the caller graph for this function:



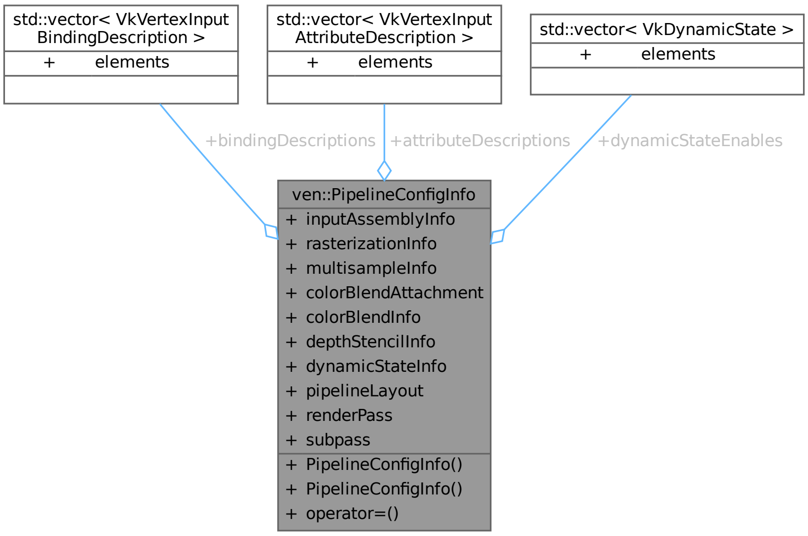
The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/RenderSystem/ObjectRenderSystem.hpp
- /home/runner/work/VEngine/VEngine/src/system/objectRenderSystem.cpp

7.29 ven::PipelineConfigInfo Struct Reference

```
#include <Shaders.hpp>
```

Collaboration diagram for ven::PipelineConfigInfo:



Public Member Functions

- PipelineConfigInfo ()=default
- PipelineConfigInfo (const PipelineConfigInfo &)=delete
- PipelineConfigInfo & operator= (const PipelineConfigInfo &)=delete

Public Attributes

- std::vector< VkVertexInputBindingDescription > bindingDescriptions
- std::vector< VkVertexInputAttributeDescription > attributeDescriptions
- VkPipelineInputAssemblyStateCreateInfo inputAssemblyInfo {}
- VkPipelineRasterizationStateCreateInfo rasterizationInfo {}
- VkPipelineMultisampleStateCreateInfo multisampleInfo {}
- VkPipelineColorBlendAttachmentState colorBlendAttachment {}
- VkPipelineColorBlendStateCreateInfo colorBlendInfo {}
- VkPipelineDepthStencilStateCreateInfo depthStencilInfo {}
- std::vector< VkDynamicState > dynamicStateEnables
- VkPipelineDynamicStateCreateInfo dynamicStateInfo {}
- VkPipelineLayout pipelineLayout = nullptr
- VkRenderPass renderPass = nullptr
- uint32_t subpass = 0

7.29.1 Detailed Description

Definition at line 19 of file Shaders.hpp.

7.29.2 Constructor & Destructor Documentation

7.29.2.1 PipelineConfigInfo() [1/2]

```
ven::PipelineConfigInfo::PipelineConfigInfo ()  [default]
```

7.29.2.2 PipelineConfigInfo() [2/2]

```
ven::PipelineConfigInfo::PipelineConfigInfo (
            const PipelineConfigInfo & )  [delete]
```

7.29.3 Member Function Documentation

7.29.3.1 operator=()

```
PipelineConfigInfo & ven::PipelineConfigInfo::operator= (
            const PipelineConfigInfo & )  [delete]
```

7.29.4 Member Data Documentation

7.29.4.1 attributeDescriptions

```
std::vector<VkVertexInputAttributeDescription> ven::PipelineConfigInfo::attributeDescriptions
```

Definition at line 25 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline(), and ven::Shaders::defaultPipelineConfigInfo().

7.29.4.2 bindingDescriptions

`std::vector<VkVertexInputBindingDescription> ven::PipelineConfigInfo::bindingDescriptions`

Definition at line 24 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline(), and ven::Shaders::defaultPipelineConfigInfo().

7.29.4.3 colorBlendAttachment

`VkPipelineColorBlendAttachmentState ven::PipelineConfigInfo::colorBlendAttachment {}`

Definition at line 29 of file Shaders.hpp.

Referenced by ven::Shaders::defaultPipelineConfigInfo().

7.29.4.4 colorBlendInfo

`VkPipelineColorBlendStateCreateInfo ven::PipelineConfigInfo::colorBlendInfo {}`

Definition at line 30 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline(), and ven::Shaders::defaultPipelineConfigInfo().

7.29.4.5 depthStencilInfo

`VkPipelineDepthStencilStateCreateInfo ven::PipelineConfigInfo::depthStencilInfo {}`

Definition at line 31 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline(), and ven::Shaders::defaultPipelineConfigInfo().

7.29.4.6 dynamicStateEnables

`std::vector<VkDynamicState> ven::PipelineConfigInfo::dynamicStateEnables`

Definition at line 32 of file Shaders.hpp.

Referenced by ven::Shaders::defaultPipelineConfigInfo().

7.29.4.7 dynamicStateInfo

`VkPipelineDynamicStateCreateInfo ven::PipelineConfigInfo::dynamicStateInfo {}`

Definition at line 33 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline(), and ven::Shaders::defaultPipelineConfigInfo().

7.29.4.8 inputAssemblyInfo

```
VkPipelineInputAssemblyStateCreateInfo ven::PipelineConfigInfo::inputAssemblyInfo {}
```

Definition at line 26 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline(), and ven::Shaders::defaultPipelineConfigInfo().

7.29.4.9 multisampleInfo

```
VkPipelineMultisampleStateCreateInfo ven::PipelineConfigInfo::multisampleInfo {}
```

Definition at line 28 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline(), and ven::Shaders::defaultPipelineConfigInfo().

7.29.4.10 pipelineLayout

```
VkPipelineLayout ven::PipelineConfigInfo::pipelineLayout = nullptr
```

Definition at line 34 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline().

7.29.4.11 rasterizationInfo

```
VkPipelineRasterizationStateCreateInfo ven::PipelineConfigInfo::rasterizationInfo {}
```

Definition at line 27 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline(), and ven::Shaders::defaultPipelineConfigInfo().

7.29.4.12 renderPass

```
VkRenderPass ven::PipelineConfigInfo::renderPass = nullptr
```

Definition at line 35 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline().

7.29.4.13 subpass

```
uint32_t ven::PipelineConfigInfo::subpass = 0
```

Definition at line 36 of file Shaders.hpp.

Referenced by ven::Shaders::createGraphicsPipeline().

The documentation for this struct was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/Shaders.hpp

7.30 ven::PointLightData Struct Reference

```
#include <FrameInfo.hpp>
```

Collaboration diagram for ven::PointLightData:

Public Attributes

- glm::vec4 position {}
- glm::vec4 color {}
- float shininess {32.F}
- float padding [3]

7.30.1 Detailed Description

Definition at line 21 of file FrameInfo.hpp.

7.30.2 Member Data Documentation

7.30.2.1 color

```
glm::vec4 ven::PointLightData::color {}
```

Definition at line 24 of file FrameInfo.hpp.

7.30.2.2 padding

```
float ven::PointLightData::padding[3]
```

Definition at line 26 of file FrameInfo.hpp.

7.30.2.3 position

```
glm::vec4 ven::PointLightData::position {}
```

Definition at line 23 of file FrameInfo.hpp.

7.30.2.4 shininess

```
float ven::PointLightData::shininess {32.F}
```

Definition at line 25 of file FrameInfo.hpp.

The documentation for this struct was generated from the following file:

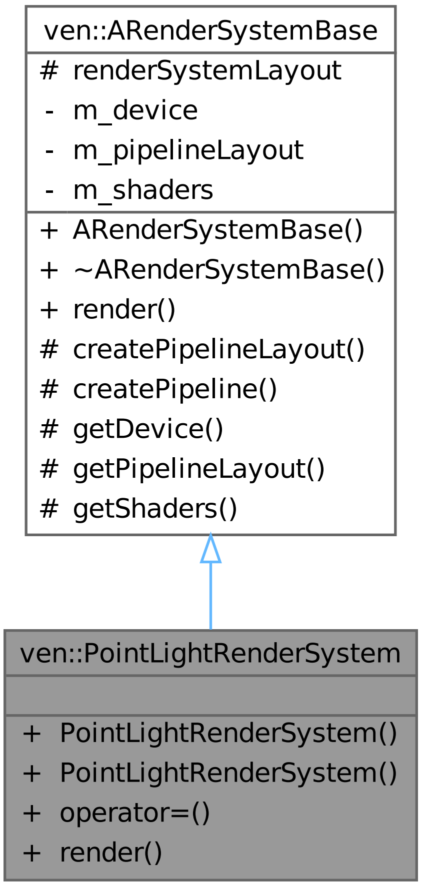
- /home/runner/work/VEngine/VEngine/include/VEngine/FrameInfo.hpp

7.31 ven::PointLightRenderSystem Class Reference

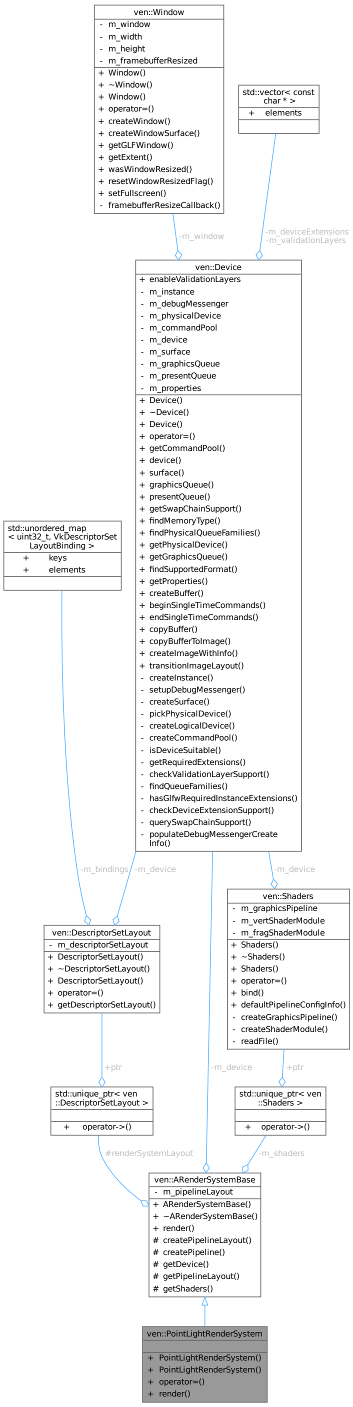
Class for point light system.

```
#include <PointLightRenderSystem.hpp>
```

Inheritance diagram for ven::PointLightRenderSystem:



Collaboration diagram for ven::PointLightRenderSystem:



Public Member Functions

- PointLightRenderSystem (Device &device, const VkRenderPass renderPass, const VkDescriptorSetLayout globalSetLayout)
- PointLightRenderSystem (const PointLightRenderSystem &)=delete
- PointLightRenderSystem & operator= (const PointLightRenderSystem &)=delete
- void render (const FrameInfo &frameInfo) const override

Public Member Functions inherited from ven::ARenderSystemBase

- ARenderSystemBase (Device &device)
- virtual ∼ARenderSystemBase ()

Additional Inherited Members

Protected Member Functions inherited from ven::ARenderSystemBase

- void createPipelineLayout (VkDescriptorSetLayout globalSetLayout, uint32_t pushConstantSize)
- void createPipeline (VkRenderPass renderPass, const std::string &shadersVertPath, const std::string &shadersFragPath, bool isLight)
- Device & getDevice () const
- VkPipelineLayout getPipelineLayout () const
- const std::unique_ptr< Shaders > & getShaders () const

Protected Attributes inherited from ven::ARenderSystemBase

- std::unique_ptr< DescriptorSetLayout > renderSystemLayout

7.31.1 Detailed Description

Class for point light system.

Definition at line 25 of file PointLightRenderSystem.hpp.

7.31.2 Constructor & Destructor Documentation

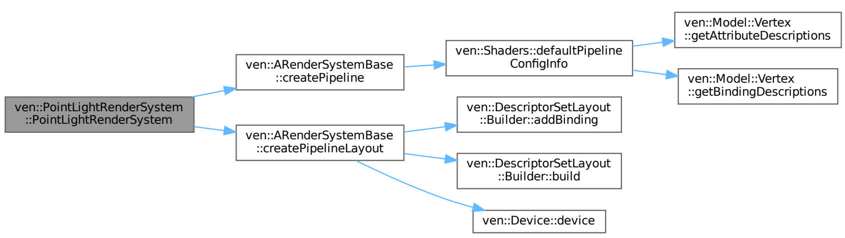
7.31.2.1 PointLightRenderSystem() [1/2]

```
ven::PointLightRenderSystem::PointLightRenderSystem (
            Device & device,
            const VkRenderPass renderPass,
            const VkDescriptorSetLayout globalSetLayout)  [inline], [explicit]
```

Definition at line 29 of file PointLightRenderSystem.hpp.

References ven::ARenderSystemBase::createPipeline(), ven::ARenderSystemBase::createPipelineLayout(), and ven::SHADERS_BIN_PATH.

Here is the call graph for this function:



7.31.2.2 PointLightRenderSystem() [2/2]

```
ven::PointLightRenderSystem::PointLightRenderSystem (
            const PointLightRenderSystem & )  [delete]
```

7.31.3 Member Function Documentation

7.31.3.1 operator=()

```
PointLightRenderSystem & ven::PointLightRenderSystem::operator= (
            const PointLightRenderSystem & )  [delete]
```

7.31.3.2 render()

```
void ven::PointLightRenderSystem::render (
            const FrameInfo & frameInfo) const  [override], [virtual]
```

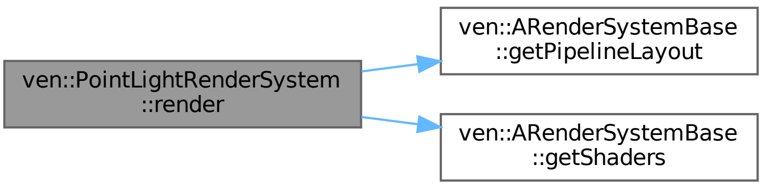
Implements ven::ARenderSystemBase.

Definition at line 5 of file pointLightRenderSystem.cpp.

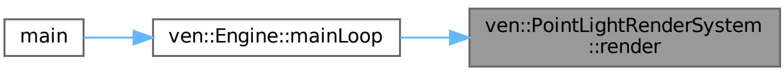
References ven::FrameInfo::commandBuffer, ven::ARenderSystemBase::getPipelineLayout(), ven::ARenderSystemBase::getShaders ven::FrameInfo::globalDescriptorSet, ven::FrameInfo::lights, and ven::LightPushConstantData::position.

Referenced by ven::Engine::mainLoop().

Here is the call graph for this function:



Here is the caller graph for this function:



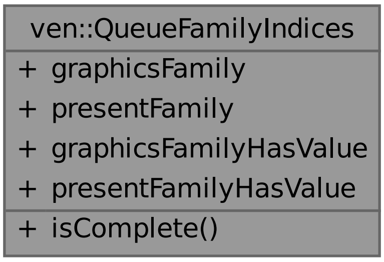
The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/RenderSystem/PointLightRenderSystem.hpp
- /home/runner/work/VEngine/VEngine/src/system/pointLightRenderSystem.cpp

7.32 ven::QueueFamilyIndices Struct Reference

```
#include <Device.hpp>
```

Collaboration diagram for ven::QueueFamilyIndices:



Public Member Functions

- bool isComplete () const

Public Attributes

- uint32_t graphicsFamily {}
- uint32_t presentFamily {}
- bool graphicsFamilyHasValue = false
- bool presentFamilyHasValue = false

7.32.1 Detailed Description

Definition at line 21 of file Device.hpp.

7.32.2 Member Function Documentation

7.32.2.1 isComplete()

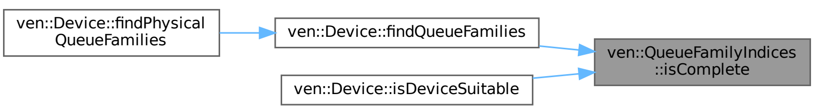
```
bool ven::QueueFamilyIndices::isComplete () const  [inline], [nodiscard]
```

Definition at line 26 of file Device.hpp.

References graphicsFamilyHasValue, and presentFamilyHasValue.

Referenced by ven::Device::findQueueFamilies(), and ven::Device::isDeviceSuitable().

Here is the caller graph for this function:



7.32.3 Member Data Documentation

7.32.3.1 graphicsFamily

```
uint32_t ven::QueueFamilyIndices::graphicsFamily {}
```

Definition at line 22 of file Device.hpp.

Referenced by ven::Device::findQueueFamilies().

7.32.3.2 graphicsFamilyHasValue

```
bool ven::QueueFamilyIndices::graphicsFamilyHasValue = false
```

Definition at line 24 of file Device.hpp.

Referenced by ven::Device::findQueueFamilies(), and isComplete().

7.32.3.3 presentFamily

```
uint32_t ven::QueueFamilyIndices::presentFamily {}
```

Definition at line 23 of file Device.hpp.

Referenced by ven::Device::findQueueFamilies().

7.32.3.4 presentFamilyHasValue

```
bool ven::QueueFamilyIndices::presentFamilyHasValue = false
```

Definition at line 25 of file Device.hpp.

Referenced by ven::Device::findQueueFamilies(), and isComplete().

The documentation for this struct was generated from the following file:

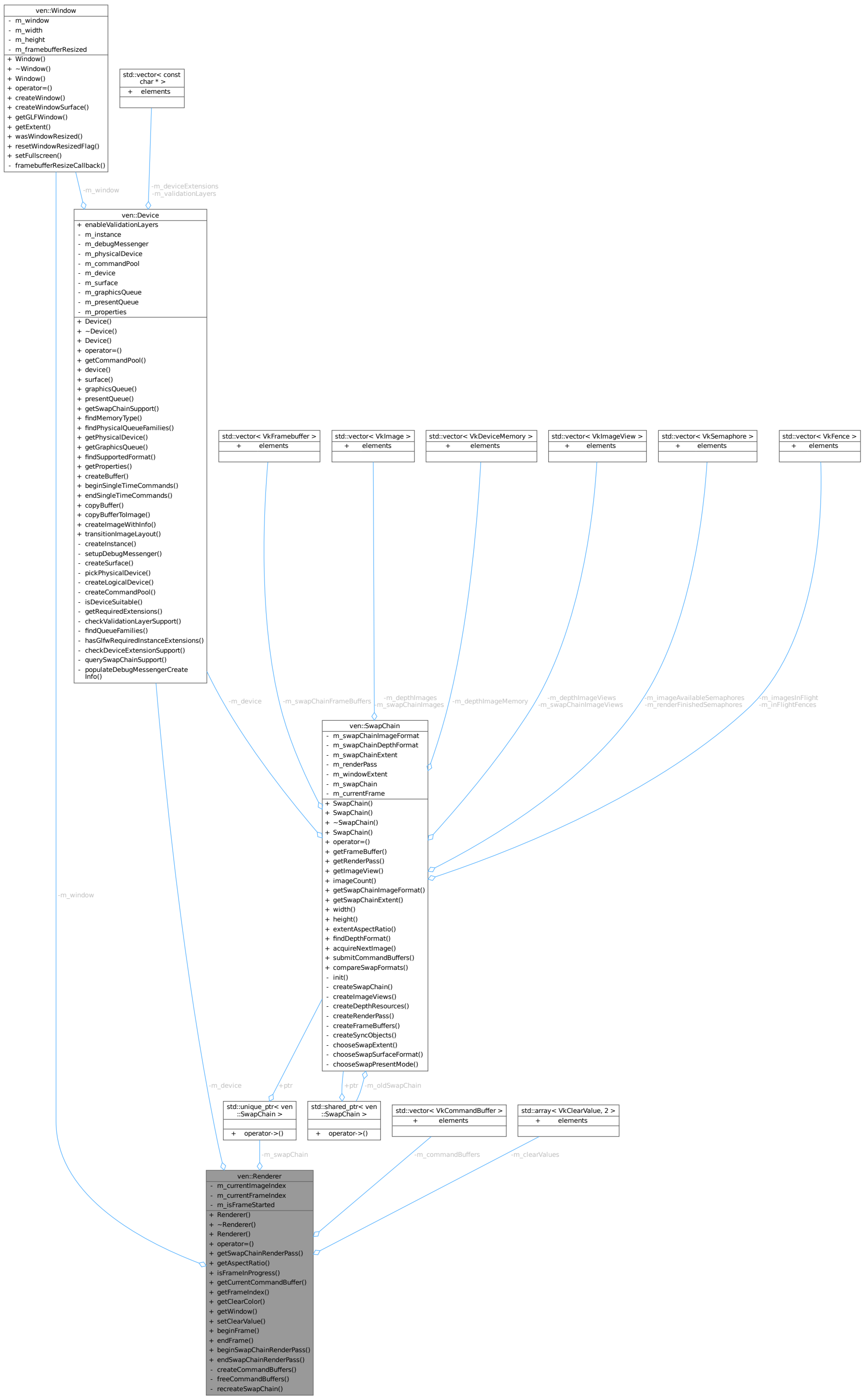
- /home/runner/work/VEngine/VEngine/include/VEngine/Device.hpp

7.33 ven::Renderer Class Reference

Class for renderer.

`#include <Renderer.hpp>`

Collaboration diagram for ven::Renderer:



Public Member Functions

- Renderer (Window &window, Device &device)
- ~Renderer ()
- Renderer (const Renderer &)=delete
- Renderer & operator= (const Renderer &)=delete
- VkRenderPass getSwapChainRenderPass () const
- float getAspectRatio () const
- bool isFrameInProgress () const
- VkCommandBuffer getCurrentCommandBuffer () const
- unsigned long getFrameIndex () const
- std::array< float, 4 > getClearColor () const
- Window & getWindow () const
- void setClearValue (const VkClearColorValue clearColorValue=DEFAULT_CLEAR_COLOR, const VkClear←DepthStencilValue clearDepthValue=DEFAULT_CLEAR_DEPTH)
- VkCommandBuffer beginFrame ()
- void endFrame ()
- void beginSwapChainRenderPass (VkCommandBuffer commandBuffer) const
- void endSwapChainRenderPass (VkCommandBuffer commandBuffer) const

Private Member Functions

- void createCommandBuffers ()
- void freeCommandBuffers ()
- void recreateSwapChain ()

Private Attributes

- Window & m_window
- Device & m_device
- std::unique_ptr< SwapChain > m_swapChain
- std::vector< VkCommandBuffer > m_commandBuffers
- std::array< VkClearValue, 2 > m_clearValues {DEFAULT_CLEAR_COLOR, 1.0F, 0.F}
- uint32_t m_currentImageIndex {0}
- unsigned long m_currentFrameIndex {0}
- bool m_isFrameStarted {false}

7.33.1 Detailed Description

Class for renderer.

Definition at line 28 of file Renderer.hpp.

7.33.2 Constructor & Destructor Documentation

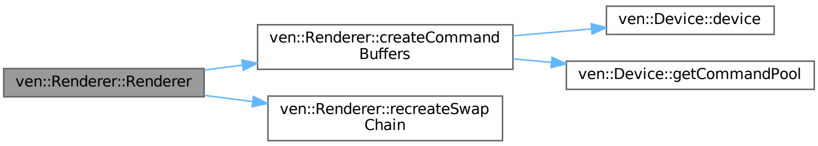
7.33.2.1 Renderer() [1/2]

```
ven::Renderer::Renderer (
            Window & window,
            Device & device)  [inline]
```

Definition at line 32 of file Renderer.hpp.

References createCommandBuffers(), and recreateSwapChain().

Here is the call graph for this function:



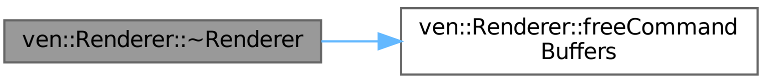
7.33.2.2 ∼Renderer()

```
ven::Renderer::~Renderer ()  [inline]
```

Definition at line 33 of file Renderer.hpp.

References freeCommandBuffers().

Here is the call graph for this function:



7.33.2.3 Renderer() [2/2]

```
ven::Renderer::Renderer (
            const Renderer & )  [delete]
```

7.33.3 Member Function Documentation

7.33.3.1 beginFrame()

```
VkCommandBuffer ven::Renderer::beginFrame ()
```

Definition at line 43 of file renderer.cpp.

7.33.3.2 beginSwapChainRenderPass()

```
void ven::Renderer::beginSwapChainRenderPass (
            VkCommandBuffer commandBuffer) const
```

Definition at line 89 of file renderer.cpp.

7.33.3.3 createCommandBuffers()

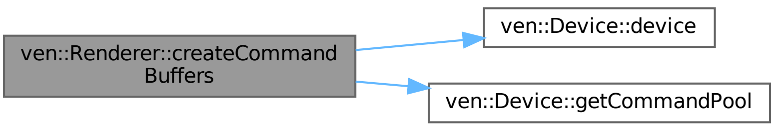
```
void ven::Renderer::createCommandBuffers () [private]
```

Definition at line 3 of file renderer.cpp.

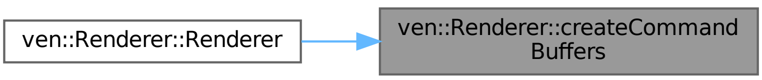
References ven::Device::device(), ven::Device::getCommandPool(), m_commandBuffers, m_device, and ven::MAX_FRAMES_IN_FLIGHT.

Referenced by Renderer().

Here is the call graph for this function:



Here is the caller graph for this function:



7.33.3.4 endFrame()

```
void ven::Renderer::endFrame ()
```

Definition at line 69 of file renderer.cpp.

References ven::MAX_FRAMES_IN_FLIGHT.

7.33.3.5 endSwapChainRenderPass()

```
void ven::Renderer::endSwapChainRenderPass (
            VkCommandBuffer commandBuffer) const
```

Definition at line 119 of file renderer.cpp.

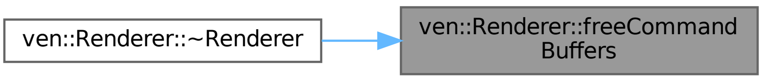
7.33.3.6 freeCommandBuffers()

```
void ven::Renderer::freeCommandBuffers () [private]
```

Definition at line 17 of file renderer.cpp.

Referenced by ∼Renderer().

Here is the caller graph for this function:



7.33.3.7 getAspectRatio()

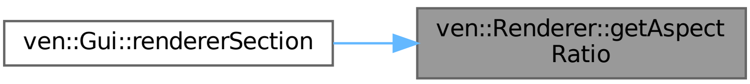
```
float ven::Renderer::getAspectRatio () const [inline], [nodiscard]
```

Definition at line 39 of file Renderer.hpp.

References m_swapChain.

Referenced by ven::Gui::rendererSection().

Here is the caller graph for this function:



7.33.3.8 getClearColor()

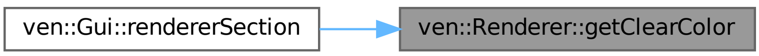
```
std::array< float, 4 > ven::Renderer::getClearColor () const [inline], [nodiscard]
```

Definition at line 44 of file Renderer.hpp.

References m_clearValues.

Referenced by ven::Gui::rendererSection().

Here is the caller graph for this function:



7.33.3.9 getCurrentCommandBuffer()

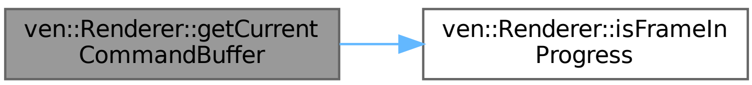
```
VkCommandBuffer ven::Renderer::getCurrentCommandBuffer () const [inline], [nodiscard]
```

Definition at line 41 of file Renderer.hpp.

References isFrameInProgress(), m_commandBuffers, and m_currentFrameIndex.

Referenced by ven::Gui::render().

Here is the call graph for this function:



Here is the caller graph for this function:

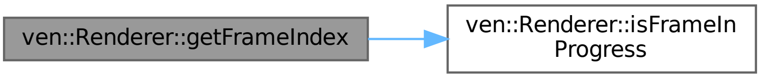
7.33.3.10 getFrameIndex()

`unsigned long ven::Renderer::getFrameIndex () const [inline], [nodiscard]`

Definition at line 43 of file Renderer.hpp.

References isFrameInProgress(), and m_currentFrameIndex.

Here is the call graph for this function:



7.33.3.11 getSwapChainRenderPass()

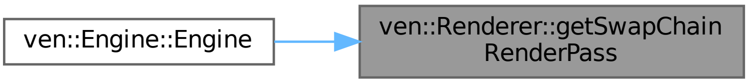
`VkRenderPass ven::Renderer::getSwapChainRenderPass () const [inline], [nodiscard]`

Definition at line 38 of file Renderer.hpp.

References m_swapChain.

Referenced by ven::Engine::Engine().

Here is the caller graph for this function:



7.33.3.12 getWindow()

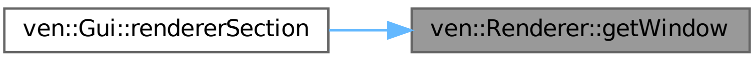
`Window & ven::Renderer::getWindow () const [inline], [nodiscard]`

Definition at line 51 of file Renderer.hpp.

References m_window.

Referenced by ven::Gui::rendererSection().

Here is the caller graph for this function:



7.33.3.13 isFrameInProgress()

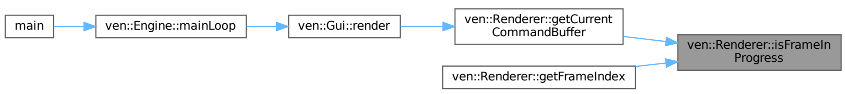
```
bool ven::Renderer::isFrameInProgress () const  [inline], [nodiscard]
```

Definition at line 40 of file Renderer.hpp.

References m_isFrameStarted.

Referenced by getCurrentCommandBuffer(), and getFrameIndex().

Here is the caller graph for this function:



7.33.3.14 operator=()

```
Renderer & ven::Renderer::operator= (
            const Renderer & )  [delete]
```

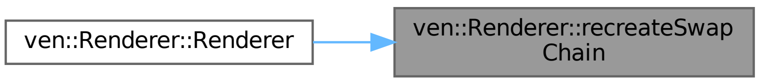
7.33.3.15 recreateSwapChain()

```
void ven::Renderer::recreateSwapChain ()  [private]
```

Definition at line 23 of file renderer.cpp.

Referenced by Renderer().

Here is the caller graph for this function:



7.33.3.16 setClearValue()

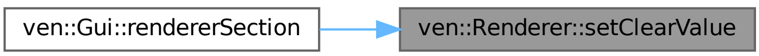
```
void ven::Renderer::setClearValue (
            const VkClearColorValue clearColorValue = DEFAULT_CLEAR_COLOR,
            const VkClearDepthStencilValue clearDepthValue = DEFAULT_CLEAR_DEPTH)  [inline]
```

Definition at line 53 of file Renderer.hpp.

References m_clearValues.

Referenced by ven::Gui::rendererSection().

Here is the caller graph for this function:



7.33.4 Member Data Documentation

7.33.4.1 m_clearValues

```
std::array<VkClearValue, 2> ven::Renderer::m_clearValues {DEFAULT_CLEAR_COLOR, 1.0F, 0.F}
[private]
```

Definition at line 69 of file Renderer.hpp.

Referenced by getClearColor(), and setClearValue().

7.33.4.2 m_commandBuffers

```
std::vector<VkCommandBuffer> ven::Renderer::m_commandBuffers  [private]
```

Definition at line 68 of file Renderer.hpp.

Referenced by createCommandBuffers(), and getCurrentCommandBuffer().

7.33.4.3 m_currentFrameIndex

```
unsigned long ven::Renderer::m_currentFrameIndex {0}  [private]
```

Definition at line 72 of file Renderer.hpp.

Referenced by getCurrentCommandBuffer(), and getFrameIndex().

7.33.4.4 m_currentImageIndex

```
uint32_t ven::Renderer::m_currentImageIndex {0} [private]
```

Definition at line 71 of file Renderer.hpp.

7.33.4.5 m_device

```
Device& ven::Renderer::m_device [private]
```

Definition at line 66 of file Renderer.hpp.

Referenced by createCommandBuffers().

7.33.4.6 m_isFrameStarted

```
bool ven::Renderer::m_isFrameStarted {false} [private]
```

Definition at line 73 of file Renderer.hpp.

Referenced by isFrameInProgress().

7.33.4.7 m_swapChain

```
std::unique_ptr<SwapChain> ven::Renderer::m_swapChain [private]
```

Definition at line 67 of file Renderer.hpp.

Referenced by getAspectRatio(), and getSwapChainRenderPass().

7.33.4.8 m_window

```
Window& ven::Renderer::m_window [private]
```

Definition at line 65 of file Renderer.hpp.

Referenced by getWindow().

The documentation for this class was generated from the following files:

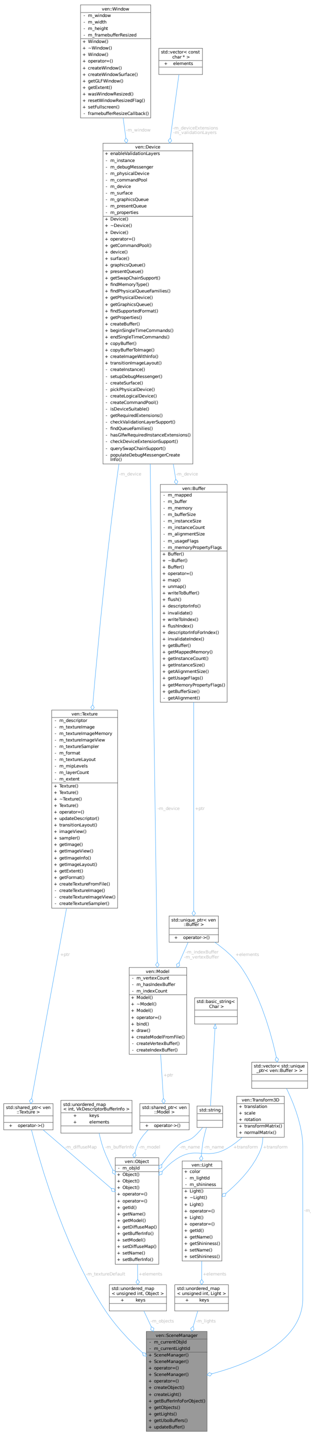
- /home/runner/work/VEngine/VEngine/include/VEngine/Renderer.hpp
- /home/runner/work/VEngine/VEngine/src/renderer.cpp

7.34 ven::SceneManager Class Reference

Class for object manager.

`#include <SceneManager.hpp>`

Collaboration diagram for ven::SceneManager:



Public Member Functions

- SceneManager (Device &device)
- SceneManager (const SceneManager &)=delete
- SceneManager & operator= (const SceneManager &)=delete
- SceneManager (SceneManager &&)=delete
- SceneManager & operator= (SceneManager &&)=delete
- Object & createObject ()
- Light & createLight (float radius=DEFAULT_LIGHT_RADIUS, glm::vec4 color=DEFAULT_LIGHT_COLOR)
- VkDescriptorBufferInfo getBufferInfoForObject (const int frameIndex, const unsigned int objectId) const
- Object::Map & getObjects ()
- Light::Map & getLights ()
- std::vector< std::unique_ptr< Buffer > > & getUboBuffers ()
- void updateBuffer (GlobalUbo &ubo, unsigned long frameIndex, float frameTime)

Private Attributes

- unsigned int m_currentObjId {0}
- unsigned int m_currentLightId {0}
- std::shared_ptr< Texture > m_textureDefault
- Object::Map m_objects
- Light::Map m_lights
- std::vector< std::unique_ptr< Buffer > > m_uboBuffers {MAX_FRAMES_IN_FLIGHT}

7.34.1 Detailed Description

Class for object manager.

Definition at line 20 of file SceneManager.hpp.

7.34.2 Constructor & Destructor Documentation

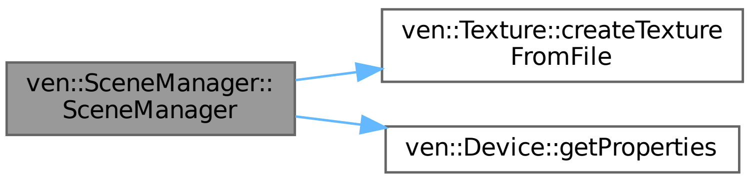
7.34.2.1 SceneManager() [1/3]

```
ven::SceneManager::SceneManager (
            Device & device)  [explicit]
```

Definition at line 7 of file sceneManager.cpp.

References ven::Texture::createTextureFromFile(), ven::Device::getProperties(), m_textureDefault, m_uboBuffers, and ven::MAX_OBJECTS.

Here is the call graph for this function:



7.34.2.2 SceneManager() [2/3]

```
ven::SceneManager::SceneManager (
            const SceneManager & )  [delete]
```

7.34.2.3 SceneManager() [3/3]

```
ven::SceneManager::SceneManager (
            SceneManager && )  [delete]
```

7.34.3 Member Function Documentation

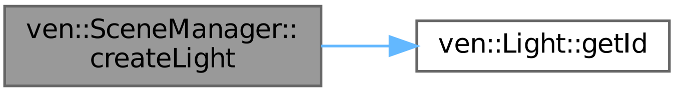
7.34.3.1 createLight()

```
ven::Light & ven::SceneManager::createLight (
            float radius = DEFAULT_LIGHT_RADIUS,
            glm::vec4 color = DEFAULT_LIGHT_COLOR)
```

Definition at line 37 of file sceneManager.cpp.

References ven::Light::color, ven::Light::getId(), ven::MAX_LIGHTS, ven::Transform3D::scale, and ven::Light::transform.

Here is the call graph for this function:



7.34.3.2 createObject()

```
ven::Object & ven::SceneManager::createObject ()
```

Definition at line 27 of file sceneManager.cpp.

References ven::MAX_OBJECTS.

7.34.3.3 getBufferInfoForObject()

```
VkDescriptorBufferInfo ven::SceneManager::getBufferInfoForObject (
            const int frameIndex,
            const unsigned int objectId) const  [inline]
```

Definition at line 34 of file SceneManager.hpp.

References m_uboBuffers.

7.34.3.4 getLights()

```
Light::Map & ven::SceneManager::getLights ()  [inline]
```

Definition at line 36 of file SceneManager.hpp.

References m_lights.

7.34.3.5 getObjects()

```
Object::Map & ven::SceneManager::getObjects ()  [inline]
```

Definition at line 35 of file SceneManager.hpp.

References m_objects.

7.34.3.6 getUboBuffers()

```
std::vector< std::unique_ptr< Buffer > > & ven::SceneManager::getUboBuffers ()  [inline]
```

Definition at line 37 of file SceneManager.hpp.

References m_uboBuffers.

7.34.3.7 operator=() [1/2]

```
SceneManager & ven::SceneManager::operator= (
             const SceneManager & )  [delete]
```

7.34.3.8 operator=() [2/2]

```
SceneManager & ven::SceneManager::operator= (
             SceneManager && )  [delete]
```

7.34.3.9 updateBuffer()

```
void ven::SceneManager::updateBuffer (
             GlobalUbo & ubo,
             unsigned long frameIndex,
             float frameTime)
```

Definition at line 48 of file sceneManager.cpp.

References ven::ObjectBufferData::modelMatrix, ven::GlobalUbo::numLights, and ven::GlobalUbo::pointLights.

7.34.4 Member Data Documentation

7.34.4.1 m_currentLightId

```
unsigned int ven::SceneManager::m_currentLightId {0} [private]
```

Definition at line 44 of file SceneManager.hpp.

7.34.4.2 m_currentObjId

```
unsigned int ven::SceneManager::m_currentObjId {0} [private]
```

Definition at line 43 of file SceneManager.hpp.

7.34.4.3 m_lights

```
Light::Map ven::SceneManager::m_lights [private]
```

Definition at line 47 of file SceneManager.hpp.

Referenced by getLights().

7.34.4.4 m_objects

```
Object::Map ven::SceneManager::m_objects [private]
```

Definition at line 46 of file SceneManager.hpp.

Referenced by getObjects().

7.34.4.5 m_textureDefault

```
std::shared_ptr<Texture> ven::SceneManager::m_textureDefault [private]
```

Definition at line 45 of file SceneManager.hpp.

Referenced by SceneManager().

7.34.4.6 m_uboBuffers

```
std::vector<std::unique_ptr<Buffer> > ven::SceneManager::m_uboBuffers {MAX_FRAMES_IN_FLIGHT}
[private]
```

Definition at line 48 of file SceneManager.hpp.

Referenced by getBufferInfoForObject(), getUboBuffers(), and SceneManager().

The documentation for this class was generated from the following files:

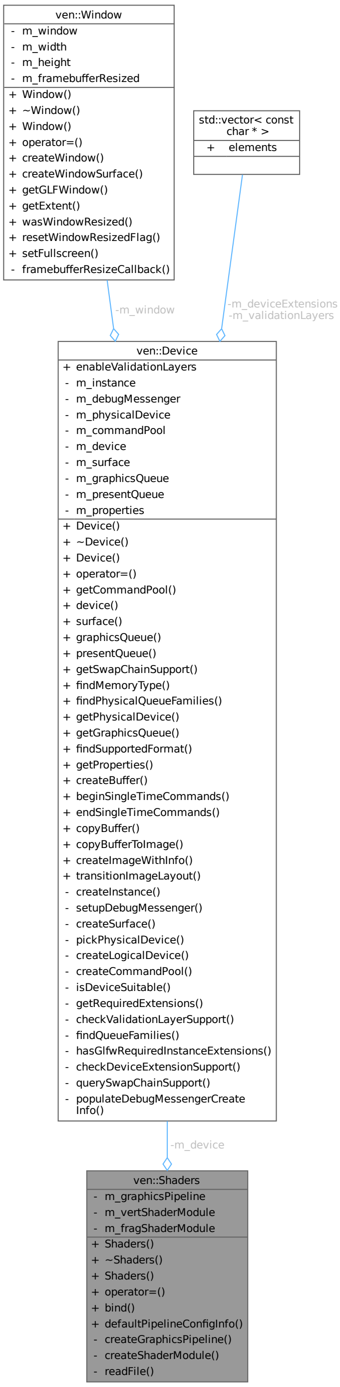
- /home/runner/work/VEngine/VEngine/include/VEngine/SceneManager.hpp
- /home/runner/work/VEngine/VEngine/src/sceneManager.cpp

7.35 ven::Shaders Class Reference

Class for shaders.

`#include <Shaders.hpp>`

Collaboration diagram for ven::Shaders:



Public Member Functions

- Shaders (Device &device, const std::string &vertFilepath, const std::string &fragFilepath, const PipelineConfigInfo &configInfo)
- ∼Shaders ()
- Shaders (const Shaders &)=delete
- Shaders & operator= (const Shaders &)=delete
- void bind (const VkCommandBuffer commandBuffer) const

Static Public Member Functions

- static void defaultPipelineConfigInfo (PipelineConfigInfo &configInfo)

Private Member Functions

- void createGraphicsPipeline (const std::string &vertFilepath, const std::string &fragFilepath, const PipelineConfigInfo &configInfo)
- void createShaderModule (const std::vector< char > &code, VkShaderModule ∗shaderModule) const

Static Private Member Functions

- static std::vector< char > readFile (const std::string &filename)

Private Attributes

- Device & m_device
- VkPipeline m_graphicsPipeline {nullptr}
- VkShaderModule m_vertShaderModule {nullptr}
- VkShaderModule m_fragShaderModule {nullptr}

7.35.1 Detailed Description

Class for shaders.

Definition at line 44 of file Shaders.hpp.

7.35.2 Constructor & Destructor Documentation

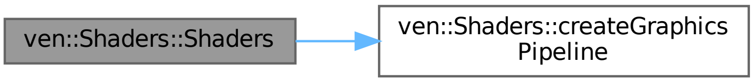
7.35.2.1 Shaders() [1/2]

```
ven::Shaders::Shaders (
            Device & device,
            const std::string & vertFilepath,
            const std::string & fragFilepath,
            const PipelineConfigInfo & configInfo)  [inline]
```

Definition at line 48 of file Shaders.hpp.

References createGraphicsPipeline().

Here is the call graph for this function:



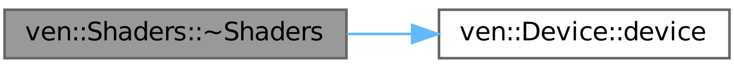
7.35.2.2 ∼Shaders()

```
ven::Shaders::∼Shaders ()
```

Definition at line 8 of file shaders.cpp.

References ven::Device::device(), m_device, m_fragShaderModule, m_graphicsPipeline, and m_vertShaderModule.

Here is the call graph for this function:



7.35.2.3 Shaders() [2/2]

```
ven::Shaders::Shaders (
            const Shaders & )  [delete]
```

7.35.3 Member Function Documentation

7.35.3.1 bind()

```
void ven::Shaders::bind (
            const VkCommandBuffer commandBuffer) const  [inline]
```

Definition at line 55 of file Shaders.hpp.

References m_graphicsPipeline.

7.35.3.2 createGraphicsPipeline()

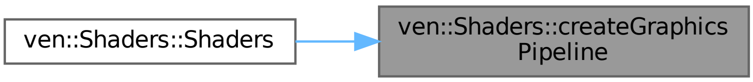
```
void ven::Shaders::createGraphicsPipeline (
            const std::string & vertFilepath,
            const std::string & fragFilepath,
            const PipelineConfigInfo & configInfo)  [private]
```

Definition at line 28 of file shaders.cpp.

References ven::PipelineConfigInfo::attributeDescriptions, ven::PipelineConfigInfo::bindingDescriptions, ven::PipelineConfigInfo::colo ven::PipelineConfigInfo::depthStencilInfo, ven::PipelineConfigInfo::dynamicStateInfo, ven::PipelineConfigInfo::inputAssemblyInfo, ven::PipelineConfigInfo::multisampleInfo, ven::PipelineConfigInfo::pipelineLayout, ven::PipelineConfigInfo::rasterizationInfo, ven::PipelineConfigInfo::renderPass, and ven::PipelineConfigInfo::subpass.

Referenced by Shaders().

Here is the caller graph for this function:



7.35.3.3 createShaderModule()

```
void ven::Shaders::createShaderModule (
            const std::vector< char > & code,
            VkShaderModule * shaderModule) const  [private]
```

Definition at line 97 of file shaders.cpp.

7.35.3.4 defaultPipelineConfigInfo()

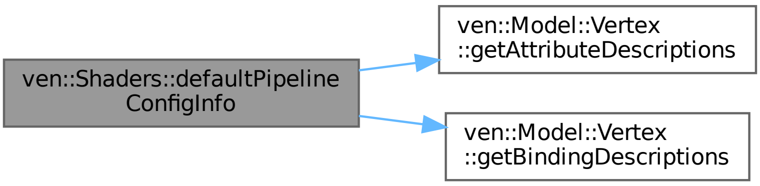
```
void ven::Shaders::defaultPipelineConfigInfo (
            PipelineConfigInfo & configInfo)  [static]
```

Definition at line 109 of file shaders.cpp.

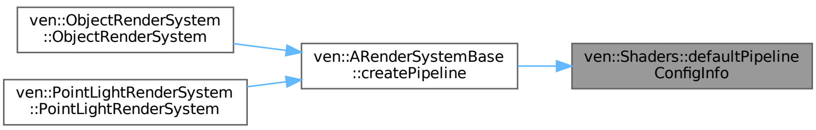
References ven::PipelineConfigInfo::attributeDescriptions, ven::PipelineConfigInfo::bindingDescriptions, ven::PipelineConfigInfo::colo ven::PipelineConfigInfo::colorBlendInfo, ven::PipelineConfigInfo::depthStencilInfo, ven::PipelineConfigInfo::dynamicStateEnables, ven::PipelineConfigInfo::dynamicStateInfo, ven::Model::Vertex::getAttributeDescriptions(), ven::Model::Vertex::getBindingDescriptions ven::PipelineConfigInfo::inputAssemblyInfo, ven::PipelineConfigInfo::multisampleInfo, and ven::PipelineConfigInfo::rasterizationInfo.

Referenced by ven::ARenderSystemBase::createPipeline().

Here is the call graph for this function:



Here is the caller graph for this function:



7.35.3.5 operator=()

```
Shaders & ven::Shaders::operator= (
            const Shaders & )  [delete]
```

7.35.3.6 readFile()

```
std::vector< char > ven::Shaders::readFile (
            const std::string & filename)  [static], [private]
```

Definition at line 15 of file shaders.cpp.

7.35.4 Member Data Documentation

7.35.4.1 m_device

`Device& ven::Shaders::m_device [private]`

Definition at line 63 of file Shaders.hpp.

Referenced by ∼Shaders().

7.35.4.2 m_fragShaderModule

`VkShaderModule ven::Shaders::m_fragShaderModule {nullptr} [private]`

Definition at line 66 of file Shaders.hpp.

Referenced by ∼Shaders().

7.35.4.3 m_graphicsPipeline

`VkPipeline ven::Shaders::m_graphicsPipeline {nullptr} [private]`

Definition at line 64 of file Shaders.hpp.

Referenced by bind(), and ∼Shaders().

7.35.4.4 m_vertShaderModule

`VkShaderModule ven::Shaders::m_vertShaderModule {nullptr} [private]`

Definition at line 65 of file Shaders.hpp.

Referenced by ∼Shaders().

The documentation for this class was generated from the following files:

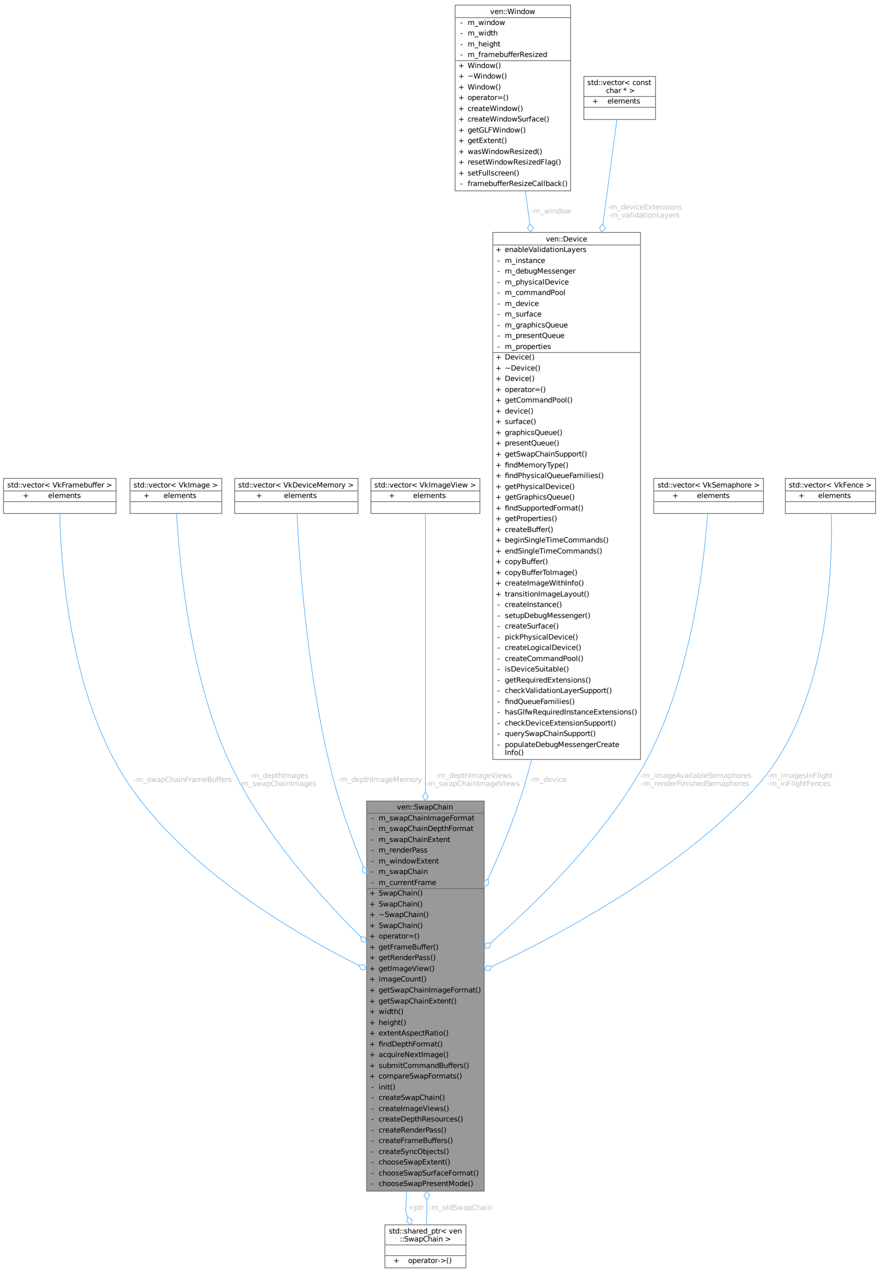
- /home/runner/work/VEngine/VEngine/include/VEngine/Shaders.hpp
- /home/runner/work/VEngine/VEngine/src/shaders.cpp

7.36 ven::SwapChain Class Reference

Class for swap chain.

```
#include <SwapChain.hpp>
```

Collaboration diagram for ven::SwapChain:



Public Member Functions

- SwapChain (Device &deviceRef, const VkExtent2D windowExtentRef)
- SwapChain (Device &deviceRef, const VkExtent2D windowExtentRef, std::shared_ptr< SwapChain > previous)

- ∼SwapChain ()
- SwapChain (const SwapChain &)=delete
- SwapChain & operator= (const SwapChain &)=delete
- VkFramebuffer getFrameBuffer (const unsigned long index) const
- VkRenderPass getRenderPass () const
- VkImageView getImageView (const int index) const
- size_t imageCount () const
- VkFormat getSwapChainImageFormat () const
- VkExtent2D getSwapChainExtent () const
- uint32_t width () const
- uint32_t height () const
- float extentAspectRatio () const
- VkFormat findDepthFormat () const
- VkResult acquireNextImage (uint32_t ∗imageIndex) const
- VkResult submitCommandBuffers (const VkCommandBuffer ∗buffers, const uint32_t ∗imageIndex)
- bool compareSwapFormats (const SwapChain &swapChain) const

Private Member Functions

- void init ()
- void createSwapChain ()
- void createImageViews ()
- void createDepthResources ()
- void createRenderPass ()
- void createFrameBuffers ()
- void createSyncObjects ()
- VkExtent2D chooseSwapExtent (const VkSurfaceCapabilitiesKHR &capabilities) const

Static Private Member Functions

- static VkSurfaceFormatKHR chooseSwapSurfaceFormat (const std::vector< VkSurfaceFormatKHR > &availableFormats)
- static VkPresentModeKHR chooseSwapPresentMode (const std::vector< VkPresentModeKHR > &availablePresentModes)

Private Attributes

- VkFormat m_swapChainImageFormat {}
- VkFormat m_swapChainDepthFormat {}
- VkExtent2D m_swapChainExtent {}
- std::vector< VkFramebuffer > m_swapChainFrameBuffers
- VkRenderPass m_renderPass {}
- std::vector< VkImage > m_depthImages
- std::vector< VkDeviceMemory > m_depthImageMemory
- std::vector< VkImageView > m_depthImageViews
- std::vector< VkImage > m_swapChainImages
- std::vector< VkImageView > m_swapChainImageViews
- Device & m_device
- VkExtent2D m_windowExtent
- VkSwapchainKHR m_swapChain {}
- std::shared_ptr< SwapChain > m_oldSwapChain
- std::vector< VkSemaphore > m_imageAvailableSemaphores
- std::vector< VkSemaphore > m_renderFinishedSemaphores
- std::vector< VkFence > m_inFlightFences
- std::vector< VkFence > m_imagesInFlight
- size_t m_currentFrame {0}

7.36.1 Detailed Description

Class for swap chain.

Definition at line 23 of file SwapChain.hpp.

7.36.2 Constructor & Destructor Documentation

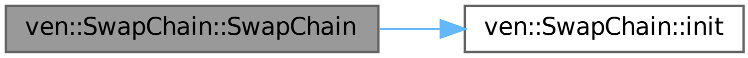
7.36.2.1 SwapChain() [1/3]

```
ven::SwapChain::SwapChain (
            Device & deviceRef,
            const VkExtent2D windowExtentRef)  [inline]
```

Definition at line 27 of file SwapChain.hpp.

References init().

Here is the call graph for this function:



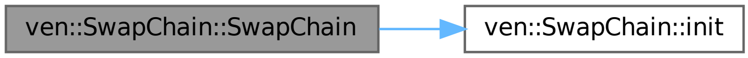
7.36.2.2 SwapChain() [2/3]

```
ven::SwapChain::SwapChain (
            Device & deviceRef,
            const VkExtent2D windowExtentRef,
            std::shared_ptr< SwapChain > previous)  [inline]
```

Definition at line 28 of file SwapChain.hpp.

References init(), and m_oldSwapChain.

Here is the call graph for this function:



7.36.2.3 ∼SwapChain()

```
ven::SwapChain::∼SwapChain ()
```

Definition at line 7 of file swapChain.cpp.

References ven::Device::device(), m_depthImageMemory, m_depthImages, m_depthImageViews, m_device, m_imageAvailableSemaphores, m_inFlightFences, m_renderFinishedSemaphores, m_renderPass, m_swapChain, m_swapChainFrameBuffers, m_swapChainImageViews, and ven::MAX_FRAMES_IN_FLIGHT.

Here is the call graph for this function:

7.36.2.4 SwapChain() [3/3]

```
ven::SwapChain::SwapChain (
            const SwapChain & )  [delete]
```

7.36.3 Member Function Documentation

7.36.3.1 acquireNextImage()

```
VkResult ven::SwapChain::acquireNextImage (
            uint32_t * imageIndex) const
```

Definition at line 49 of file swapChain.cpp.

7.36.3.2 chooseSwapExtent()

```
VkExtent2D ven::SwapChain::chooseSwapExtent (
            const VkSurfaceCapabilitiesKHR & capabilities) const  [nodiscard], [private]
```

Definition at line 362 of file swapChain.cpp.

7.36.3.3 chooseSwapPresentMode()

```
VkPresentModeKHR ven::SwapChain::chooseSwapPresentMode (
            const std::vector< VkPresentModeKHR > & availablePresentModes)  [static], [private]
```

Definition at line 342 of file swapChain.cpp.

7.36.3.4 chooseSwapSurfaceFormat()

```
VkSurfaceFormatKHR ven::SwapChain::chooseSwapSurfaceFormat (
            const std::vector< VkSurfaceFormatKHR > & availableFormats) [static], [private]
```

Definition at line 331 of file swapChain.cpp.

7.36.3.5 compareSwapFormats()

```
bool ven::SwapChain::compareSwapFormats (
            const SwapChain & swapChain) const [inline], [nodiscard]
```

Definition at line 49 of file SwapChain.hpp.

References m_swapChainDepthFormat, and m_swapChainImageFormat.

7.36.3.6 createDepthResources()

```
void ven::SwapChain::createDepthResources () [private]
```

Definition at line 262 of file swapChain.cpp.

7.36.3.7 createFrameBuffers()

```
void ven::SwapChain::createFrameBuffers () [private]
```

Definition at line 240 of file swapChain.cpp.

7.36.3.8 createImageViews()

```
void ven::SwapChain::createImageViews () [private]
```

Definition at line 160 of file swapChain.cpp.

7.36.3.9 createRenderPass()

```
void ven::SwapChain::createRenderPass () [private]
```

Definition at line 181 of file swapChain.cpp.

7.36.3.10 createSwapChain()

```
void ven::SwapChain::createSwapChain () [private]
```

Definition at line 103 of file swapChain.cpp.

7.36.3.11 createSyncObjects()

```
void ven::SwapChain::createSyncObjects () [private]
```

Definition at line 308 of file swapChain.cpp.

References ven::MAX_FRAMES_IN_FLIGHT.

7.36.3.12 extentAspectRatio()

```
float ven::SwapChain::extentAspectRatio () const [inline], [nodiscard]
```

Definition at line 43 of file SwapChain.hpp.

References m_swapChainExtent.

7.36.3.13 findDepthFormat()

```
VkFormat ven::SwapChain::findDepthFormat () const [nodiscard]
```

Definition at line 374 of file swapChain.cpp.

7.36.3.14 getFrameBuffer()

```
VkFramebuffer ven::SwapChain::getFrameBuffer (
            const unsigned long index) const [inline], [nodiscard]
```

Definition at line 34 of file SwapChain.hpp.

References m_swapChainFrameBuffers.

7.36.3.15 getImageView()

```
VkImageView ven::SwapChain::getImageView (
            const int index) const [inline], [nodiscard]
```

Definition at line 36 of file SwapChain.hpp.

References m_swapChainImageViews.

7.36.3.16 getRenderPass()

```
VkRenderPass ven::SwapChain::getRenderPass () const [inline], [nodiscard]
```

Definition at line 35 of file SwapChain.hpp.

References m_renderPass.

7.36.3.17 getSwapChainExtent()

```
VkExtent2D ven::SwapChain::getSwapChainExtent () const [inline], [nodiscard]
```

Definition at line 39 of file SwapChain.hpp.

References m_swapChainExtent.

7.36.3.18 getSwapChainImageFormat()

```
VkFormat ven::SwapChain::getSwapChainImageFormat () const [inline], [nodiscard]
```

Definition at line 38 of file SwapChain.hpp.

References m_swapChainImageFormat.

7.36.3.19 height()

```
uint32_t ven::SwapChain::height () const [inline], [nodiscard]
```

Definition at line 41 of file SwapChain.hpp.

References m_swapChainExtent.

7.36.3.20 imageCount()

```
size_t ven::SwapChain::imageCount () const [inline], [nodiscard]
```

Definition at line 37 of file SwapChain.hpp.

References m_swapChainImages.

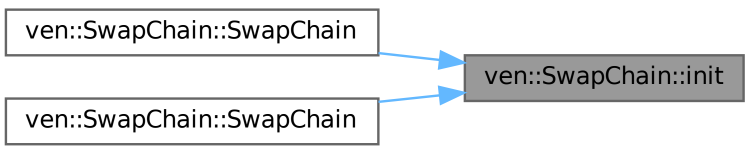
7.36.3.21 init()

```
void ven::SwapChain::init () [private]
```

Definition at line 39 of file swapChain.cpp.

Referenced by SwapChain(), and SwapChain().

Here is the caller graph for this function:



7.36.3.22 operator=()

```
SwapChain & ven::SwapChain::operator= (
            const SwapChain & )  [delete]
```

7.36.3.23 submitCommandBuffers()

```
VkResult ven::SwapChain::submitCommandBuffers (
            const VkCommandBuffer * buffers,
            const uint32_t * imageIndex)
```

Definition at line 56 of file swapChain.cpp.

References ven::MAX_FRAMES_IN_FLIGHT.

7.36.3.24 width()

```
uint32_t ven::SwapChain::width () const  [inline], [nodiscard]
```

Definition at line 40 of file SwapChain.hpp.

References m_swapChainExtent.

7.36.4 Member Data Documentation

7.36.4.1 m_currentFrame

```
size_t ven::SwapChain::m_currentFrame {0}  [private]
```

Definition at line 88 of file SwapChain.hpp.

7.36.4.2 m_depthImageMemory

```
std::vector<VkDeviceMemory> ven::SwapChain::m_depthImageMemory  [private]
```

Definition at line 73 of file SwapChain.hpp.

Referenced by ∼SwapChain().

7.36.4.3 m_depthImages

```
std::vector<VkImage> ven::SwapChain::m_depthImages  [private]
```

Definition at line 72 of file SwapChain.hpp.

Referenced by ∼SwapChain().

7.36.4.4 m_depthImageViews

`std::vector<VkImageView> ven::SwapChain::m_depthImageViews [private]`

Definition at line 74 of file SwapChain.hpp.

Referenced by ~SwapChain().

7.36.4.5 m_device

`Device& ven::SwapChain::m_device [private]`

Definition at line 78 of file SwapChain.hpp.

Referenced by ~SwapChain().

7.36.4.6 m_imageAvailableSemaphores

`std::vector<VkSemaphore> ven::SwapChain::m_imageAvailableSemaphores [private]`

Definition at line 84 of file SwapChain.hpp.

Referenced by ~SwapChain().

7.36.4.7 m_imagesInFlight

`std::vector<VkFence> ven::SwapChain::m_imagesInFlight [private]`

Definition at line 87 of file SwapChain.hpp.

7.36.4.8 m_inFlightFences

`std::vector<VkFence> ven::SwapChain::m_inFlightFences [private]`

Definition at line 86 of file SwapChain.hpp.

Referenced by ~SwapChain().

7.36.4.9 m_oldSwapChain

`std::shared_ptr<SwapChain> ven::SwapChain::m_oldSwapChain [private]`

Definition at line 82 of file SwapChain.hpp.

Referenced by SwapChain().

7.36.4.10 m_renderFinishedSemaphores

```
std::vector<VkSemaphore> ven::SwapChain::m_renderFinishedSemaphores [private]
```

Definition at line 85 of file SwapChain.hpp.

Referenced by ∼SwapChain().

7.36.4.11 m_renderPass

```
VkRenderPass ven::SwapChain::m_renderPass {} [private]
```

Definition at line 70 of file SwapChain.hpp.

Referenced by getRenderPass(), and ∼SwapChain().

7.36.4.12 m_swapChain

```
VkSwapchainKHR ven::SwapChain::m_swapChain {} [private]
```

Definition at line 81 of file SwapChain.hpp.

Referenced by ∼SwapChain().

7.36.4.13 m_swapChainDepthFormat

```
VkFormat ven::SwapChain::m_swapChainDepthFormat {} [private]
```

Definition at line 66 of file SwapChain.hpp.

Referenced by compareSwapFormats().

7.36.4.14 m_swapChainExtent

```
VkExtent2D ven::SwapChain::m_swapChainExtent {} [private]
```

Definition at line 67 of file SwapChain.hpp.

Referenced by extentAspectRatio(), getSwapChainExtent(), height(), and width().

7.36.4.15 m_swapChainFrameBuffers

```
std::vector<VkFramebuffer> ven::SwapChain::m_swapChainFrameBuffers [private]
```

Definition at line 69 of file SwapChain.hpp.

Referenced by getFrameBuffer(), and ∼SwapChain().

7.36.4.16 m_swapChainImageFormat

`VkFormat ven::SwapChain::m_swapChainImageFormat {} [private]`

Definition at line 65 of file SwapChain.hpp.

Referenced by compareSwapFormats(), and getSwapChainImageFormat().

7.36.4.17 m_swapChainImages

`std::vector<VkImage> ven::SwapChain::m_swapChainImages [private]`

Definition at line 75 of file SwapChain.hpp.

Referenced by imageCount().

7.36.4.18 m_swapChainImageViews

`std::vector<VkImageView> ven::SwapChain::m_swapChainImageViews [private]`

Definition at line 76 of file SwapChain.hpp.

Referenced by getImageView(), and ∼SwapChain().

7.36.4.19 m_windowExtent

`VkExtent2D ven::SwapChain::m_windowExtent [private]`

Definition at line 79 of file SwapChain.hpp.

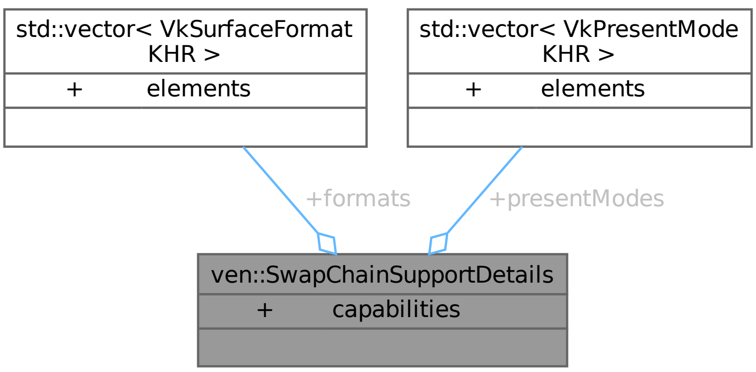
The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/SwapChain.hpp
- /home/runner/work/VEngine/VEngine/src/swapChain.cpp

7.37 ven::SwapChainSupportDetails Struct Reference

`#include <Device.hpp>`

Collaboration diagram for ven::SwapChainSupportDetails:



Public Attributes

- VkSurfaceCapabilitiesKHR capabilities
- std::vector< VkSurfaceFormatKHR > formats
- std::vector< VkPresentModeKHR > presentModes

7.37.1 Detailed Description

Definition at line 15 of file Device.hpp.

7.37.2 Member Data Documentation

7.37.2.1 capabilities

```
VkSurfaceCapabilitiesKHR ven::SwapChainSupportDetails::capabilities
```

Definition at line 16 of file Device.hpp.

Referenced by ven::Device::querySwapChainSupport().

7.37.2.2 formats

```
std::vector<VkSurfaceFormatKHR> ven::SwapChainSupportDetails::formats
```

Definition at line 17 of file Device.hpp.

Referenced by ven::Device::querySwapChainSupport().

7.37.2.3 presentModes

```
std::vector<VkPresentModeKHR> ven::SwapChainSupportDetails::presentModes
```

Definition at line 18 of file Device.hpp.

Referenced by ven::Device::querySwapChainSupport().

The documentation for this struct was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/Device.hpp

7.38 ven::Texture Class Reference

Class for texture.

`#include <Texture.hpp>`

Collaboration diagram for ven::Texture:

Public Member Functions

- Texture (Device &device, const std::string &textureFilepath)
- Texture (Device &device, VkFormat format, VkExtent3D extent, VkImageUsageFlags usage, VkSampleCountFlagBits sampleCount)
- ∼Texture ()
- Texture (const Texture &)=delete
- Texture & operator= (const Texture &)=delete
- void updateDescriptor ()
- void transitionLayout (VkCommandBuffer commandBuffer, VkImageLayout oldLayout, VkImageLayout newLayout) const
- VkImageView imageView () const
- VkSampler sampler () const
- VkImage getImage () const
- VkImageView getImageView () const
- VkDescriptorImageInfo getImageInfo () const
- VkImageLayout getImageLayout () const
- VkExtent3D getExtent () const
- VkFormat getFormat () const

Static Public Member Functions

- static std::unique_ptr< Texture > createTextureFromFile (Device &device, const std::string &filepath)

Private Member Functions

- void createTextureImage (const std::string &filepath)
- void createTextureImageView (VkImageViewType viewType)
- void createTextureSampler ()

Private Attributes

- VkDescriptorImageInfo m_descriptor {}
- Device & m_device
- VkImage m_textureImage = nullptr
- VkDeviceMemory m_textureImageMemory = nullptr
- VkImageView m_textureImageView = nullptr
- VkSampler m_textureSampler = nullptr
- VkFormat m_format
- VkImageLayout m_textureLayout {}
- uint32_t m_mipLevels {1}
- uint32_t m_layerCount {1}
- VkExtent3D m_extent {}

7.38.1 Detailed Description

Class for texture.

Definition at line 23 of file Texture.hpp.

7.38.2 Constructor & Destructor Documentation

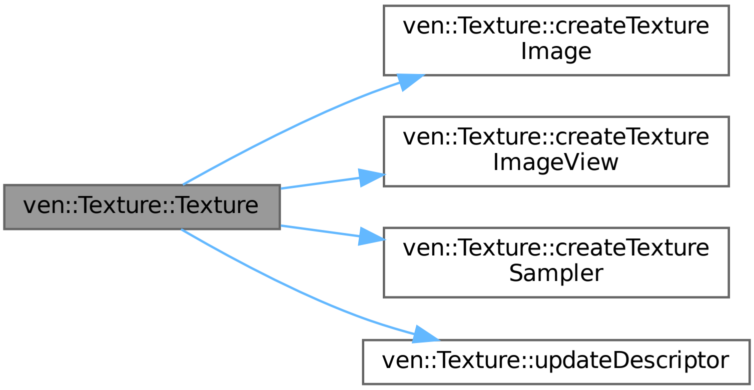
7.38.2.1 Texture() [1/3]

```
ven::Texture::Texture (
            Device & device,
            const std::string & textureFilepath)
```

Definition at line 8 of file texture.cpp.

References createTextureImage(), createTextureImageView(), createTextureSampler(), and updateDescriptor().

Here is the call graph for this function:



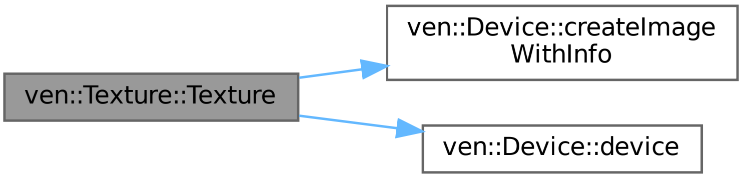
7.38.2.2 Texture() [2/3]

```
ven::Texture::Texture (
            Device & device,
            VkFormat format,
            VkExtent3D extent,
            VkImageUsageFlags usage,
            VkSampleCountFlagBits sampleCount)
```

Definition at line 16 of file texture.cpp.

References ven::Device::createImageWithInfo(), ven::Device::device(), m_descriptor, m_textureImage, m_textureImageMemory, m_textureImageView, and m_textureSampler.

Here is the call graph for this function:



7.38.2.3 ~Texture()

```
ven::Texture::~Texture ()
```

Definition at line 90 of file texture.cpp.

7.38.2.4 Texture() [3/3]

```
ven::Texture::Texture (
            const Texture & )  [delete]
```

7.38.3 Member Function Documentation

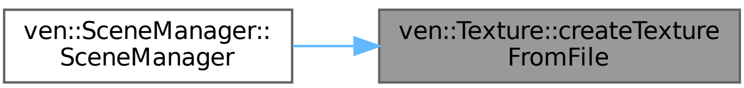
7.38.3.1 createTextureFromFile()

```
static std::unique_ptr< Texture > ven::Texture::createTextureFromFile (
            Device & device,
            const std::string & filepath)  [inline], [static]
```

Definition at line 34 of file Texture.hpp.

Referenced by ven::SceneManager::SceneManager().

Here is the caller graph for this function:



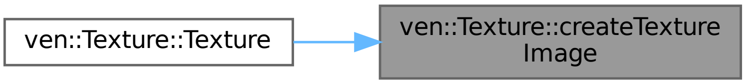
7.38.3.2 createTextureImage()

```
void ven::Texture::createTextureImage (
            const std::string & filepath)  [private]
```

Definition at line 105 of file texture.cpp.

Referenced by Texture().

Here is the caller graph for this function:



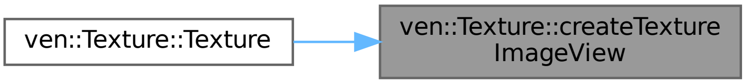
7.38.3.3 createTextureImageView()

```
void ven::Texture::createTextureImageView (
            VkImageViewType viewType)  [private]
```

Definition at line 192 of file texture.cpp.

Referenced by Texture().

Here is the caller graph for this function:



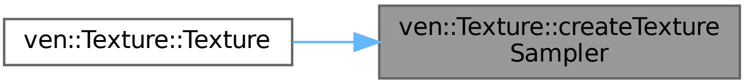
7.38.3.4 createTextureSampler()

```
void ven::Texture::createTextureSampler ()  [private]
```

Definition at line 210 of file texture.cpp.

Referenced by Texture().

Here is the caller graph for this function:



7.38.3.5 getExtent()

```
VkExtent3D ven::Texture::getExtent () const  [inline], [nodiscard]
```

Definition at line 45 of file Texture.hpp.

References m_extent.

7.38.3.6 getFormat()

```
VkFormat ven::Texture::getFormat () const  [inline], [nodiscard]
```

Definition at line 46 of file Texture.hpp.

References m_format.

7.38.3.7 getImage()

```
VkImage ven::Texture::getImage () const  [inline], [nodiscard]
```

Definition at line 41 of file Texture.hpp.

References m_textureImage.

7.38.3.8 getImageInfo()

```
VkDescriptorImageInfo ven::Texture::getImageInfo () const  [inline], [nodiscard]
```

Definition at line 43 of file Texture.hpp.

References m_descriptor.

7.38.3.9 getImageLayout()

```
VkImageLayout ven::Texture::getImageLayout () const  [inline], [nodiscard]
```

Definition at line 44 of file Texture.hpp.

References m_textureLayout.

7.38.3.10 getImageView()

```
VkImageView ven::Texture::getImageView () const  [inline], [nodiscard]
```

Definition at line 42 of file Texture.hpp.

References m_textureImageView.

7.38.3.11 imageView()

```
VkImageView ven::Texture::imageView () const  [inline], [nodiscard]
```

Definition at line 39 of file Texture.hpp.

References m_textureImageView.

7.38.3.12 operator=()

```
Texture & ven::Texture::operator= (
             const Texture & )  [delete]
```

7.38.3.13 sampler()

```
VkSampler ven::Texture::sampler () const  [inline], [nodiscard]
```

Definition at line 40 of file Texture.hpp.

References m_textureSampler.

7.38.3.14 transitionLayout()

```
void ven::Texture::transitionLayout (
             VkCommandBuffer commandBuffer,
             VkImageLayout oldLayout,
             VkImageLayout newLayout) const
```

Definition at line 240 of file texture.cpp.

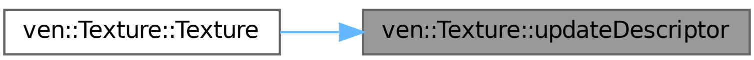
7.38.3.15 updateDescriptor()

```
void ven::Texture::updateDescriptor ()
```

Definition at line 98 of file texture.cpp.

Referenced by Texture().

Here is the caller graph for this function:



7.38.4 Member Data Documentation

7.38.4.1 m_descriptor

`VkDescriptorImageInfo ven::Texture::m_descriptor {} [private]`

Definition at line 54 of file Texture.hpp.

Referenced by getImageInfo(), and Texture().

7.38.4.2 m_device

`Device& ven::Texture::m_device [private]`

Definition at line 55 of file Texture.hpp.

7.38.4.3 m_extent

`VkExtent3D ven::Texture::m_extent {} [private]`

Definition at line 64 of file Texture.hpp.

Referenced by getExtent().

7.38.4.4 m_format

`VkFormat ven::Texture::m_format [private]`

Definition at line 60 of file Texture.hpp.

Referenced by getFormat().

7.38.4.5 m_layerCount

`uint32_t ven::Texture::m_layerCount {1} [private]`

Definition at line 63 of file Texture.hpp.

7.38.4.6 m_mipLevels

`uint32_t ven::Texture::m_mipLevels {1} [private]`

Definition at line 62 of file Texture.hpp.

7.38.4.7 m_textureImage

```
VkImage ven::Texture::m_textureImage = nullptr [private]
```

Definition at line 56 of file Texture.hpp.

Referenced by getImage(), and Texture().

7.38.4.8 m_textureImageMemory

```
VkDeviceMemory ven::Texture::m_textureImageMemory = nullptr [private]
```

Definition at line 57 of file Texture.hpp.

Referenced by Texture().

7.38.4.9 m_textureImageView

```
VkImageView ven::Texture::m_textureImageView = nullptr [private]
```

Definition at line 58 of file Texture.hpp.

Referenced by getImageView(), imageView(), and Texture().

7.38.4.10 m_textureLayout

```
VkImageLayout ven::Texture::m_textureLayout {} [private]
```

Definition at line 61 of file Texture.hpp.

Referenced by getImageLayout().

7.38.4.11 m_textureSampler

```
VkSampler ven::Texture::m_textureSampler = nullptr [private]
```

Definition at line 59 of file Texture.hpp.

Referenced by sampler(), and Texture().

The documentation for this class was generated from the following files:

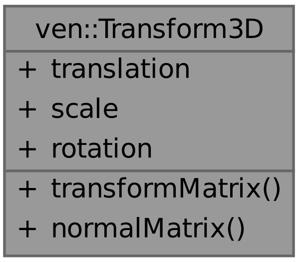
- /home/runner/work/VEngine/VEngine/include/VEngine/Texture.hpp
- /home/runner/work/VEngine/VEngine/src/texture.cpp

7.39 ven::Transform3D Class Reference

Class for 3D transformation.

`#include <Transform3D.hpp>`

Collaboration diagram for ven::Transform3D:



Public Member Functions

- glm::mat4 transformMatrix () const
- glm::mat3 normalMatrix () const

Public Attributes

- glm::vec3 translation {}
- glm::vec3 scale {1.F, 1.F, 1.F}
- glm::vec3 rotation {}

7.39.1 Detailed Description

Class for 3D transformation.

Definition at line 18 of file Transform3D.hpp.

7.39.2 Member Function Documentation

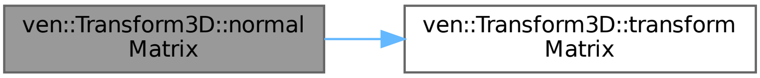
7.39.2.1 normalMatrix()

```
glm::mat3 ven::Transform3D::normalMatrix () const  [inline], [nodiscard]
```

Definition at line 34 of file Transform3D.hpp.

References transformMatrix().

Here is the call graph for this function:



7.39.2.2 transformMatrix()

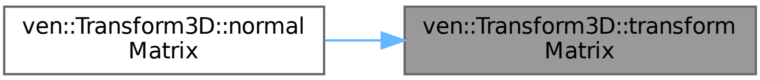
```
glm::mat4 ven::Transform3D::transformMatrix () const  [inline], [nodiscard]
```

Definition at line 22 of file Transform3D.hpp.

References rotation, scale, and translation.

Referenced by normalMatrix().

Here is the caller graph for this function:



7.39.3 Member Data Documentation

7.39.3.1 rotation

```
glm::vec3 ven::Transform3D::rotation {}
```

Definition at line 38 of file Transform3D.hpp.

Referenced by ven::Gui::cameraSection(), ven::EventManager::moveCamera(), and transformMatrix().

7.39.3.2 scale

```
glm::vec3 ven::Transform3D::scale {1.F, 1.F, 1.F}
```

Definition at line 37 of file Transform3D.hpp.

Referenced by ven::SceneManager::createLight(), and transformMatrix().

7.39.3.3 translation

```
glm::vec3 ven::Transform3D::translation {}
```

Definition at line 36 of file Transform3D.hpp.

Referenced by ven::Gui::cameraSection(), ven::EventManager::moveCamera(), and transformMatrix().

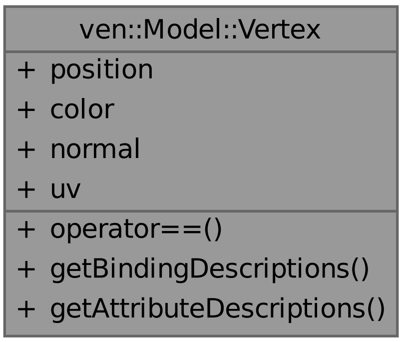
The documentation for this class was generated from the following file:

- /home/runner/work/VEngine/VEngine/include/VEngine/Transform3D.hpp

7.40 ven::Model::Vertex Struct Reference

```
#include <Model.hpp>
```

Collaboration diagram for ven::Model::Vertex:



Public Member Functions

- bool operator== (const Vertex &other) const

Static Public Member Functions

- static std::vector< VkVertexInputBindingDescription > getBindingDescriptions ()
- static std::vector< VkVertexInputAttributeDescription > getAttributeDescriptions ()

Public Attributes

- glm::vec3 position {}
- glm::vec3 color {}
- glm::vec3 normal {}
- glm::vec2 uv {}

7.40.1 Detailed Description

Definition at line 29 of file Model.hpp.

7.40.2 Member Function Documentation

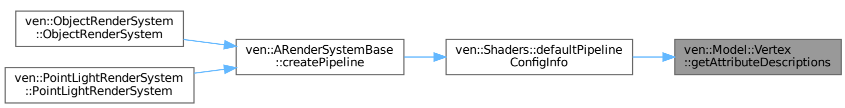
7.40.2.1 getAttributeDescriptions()

```
std::vector< VkVertexInputAttributeDescription > ven::Model::Vertex::getAttributeDescriptions
() [static]
```

Definition at line 105 of file model.cpp.

Referenced by ven::Shaders::defaultPipelineConfigInfo().

Here is the caller graph for this function:



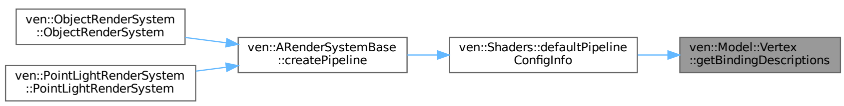
7.40.2.2 getBindingDescriptions()

```
std::vector< VkVertexInputBindingDescription > ven::Model::Vertex::getBindingDescriptions ()
[static]
```

Definition at line 96 of file model.cpp.

Referenced by ven::Shaders::defaultPipelineConfigInfo().

Here is the caller graph for this function:



7.40.2.3 operator==()

```
bool ven::Model::Vertex::operator== (
            const Vertex & other) const  [inline]
```

Definition at line 38 of file Model.hpp.

References color, normal, position, and uv.

7.40.3 Member Data Documentation

7.40.3.1 color

```
glm::vec3 ven::Model::Vertex::color {}
```

Definition at line 31 of file Model.hpp.

Referenced by operator==().

7.40.3.2 normal

```
glm::vec3 ven::Model::Vertex::normal {}
```

Definition at line 32 of file Model.hpp.

Referenced by operator==().

7.40.3.3 position

```
glm::vec3 ven::Model::Vertex::position {}
```

Definition at line 30 of file Model.hpp.

Referenced by operator==(), and ven::Model::Builder::processMesh().

7.40.3.4 uv

```
glm::vec2 ven::Model::Vertex::uv {}
```

Definition at line 33 of file Model.hpp.

Referenced by operator==().

The documentation for this struct was generated from the following files:

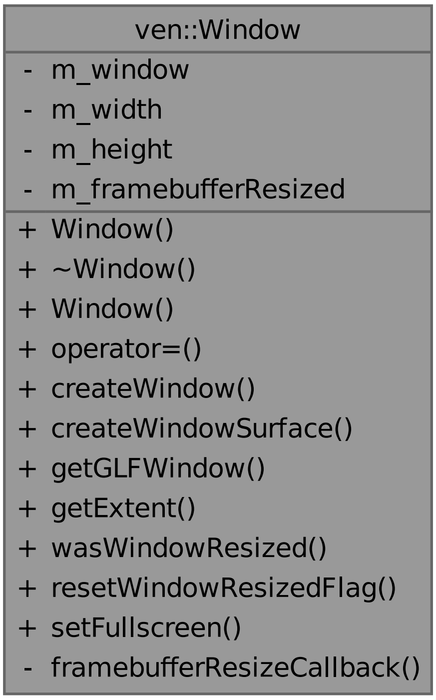
- /home/runner/work/VEngine/VEngine/include/VEngine/Model.hpp
- /home/runner/work/VEngine/VEngine/src/model.cpp

7.41 ven::Window Class Reference

Class for window.

```
#include <Window.hpp>
```

Collaboration diagram for ven::Window:



Public Member Functions

- Window (const uint32_t width=DEFAULT_WIDTH, const uint32_t height=DEFAULT_HEIGHT, const std::string &title=DEFAULT_TITLE.data())
- ~Window ()
- Window (const Window &)=delete
- Window & operator= (const Window &)=delete
- GLFWwindow * createWindow (uint32_t width, uint32_t height, const std::string &title)
- void createWindowSurface (VkInstance instance, VkSurfaceKHR *surface) const
- GLFWwindow * getGLFWindow () const
- VkExtent2D getExtent () const
- bool wasWindowResized () const
- void resetWindowResizedFlag ()
- void setFullscreen (bool fullscreen, uint32_t width, uint32_t height)

Static Private Member Functions

- static void framebufferResizeCallback (GLFWwindow *window, int width, int height)

Private Attributes

- GLFWwindow ∗ m_window {nullptr}
- uint32_t m_width {DEFAULT_WIDTH}
- uint32_t m_height {DEFAULT_HEIGHT}
- bool m_framebufferResized = false

7.41.1 Detailed Description

Class for window.

Definition at line 26 of file Window.hpp.

7.41.2 Constructor & Destructor Documentation

7.41.2.1 Window() [1/2]

```
ven::Window::Window (
            const uint32_t width = DEFAULT_WIDTH,
            const uint32_t height = DEFAULT_HEIGHT,
            const std::string & title = DEFAULT_TITLE.data())  [inline], [explicit]
```

Definition at line 30 of file Window.hpp.

7.41.2.2 ∼Window()

```
ven::Window::∼Window ()  [inline]
```

Definition at line 31 of file Window.hpp.

References m_window.

7.41.2.3 Window() [2/2]

```
ven::Window::Window (
            const Window & )  [delete]
```

7.41.3 Member Function Documentation

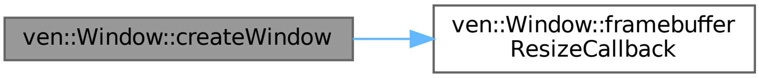
7.41.3.1 createWindow()

```
GLFWwindow * ven::Window::createWindow (
            uint32_t width,
            uint32_t height,
            const std::string & title)  [nodiscard]
```

Definition at line 5 of file window.cpp.

References framebufferResizeCallback().

Here is the call graph for this function:



7.41.3.2 createWindowSurface()

```
void ven::Window::createWindowSurface (
            VkInstance instance,
            VkSurfaceKHR * surface) const
```

Definition at line 24 of file window.cpp.

Referenced by ven::Device::createSurface().

Here is the caller graph for this function:

7.41.3.3 framebufferResizeCallback()

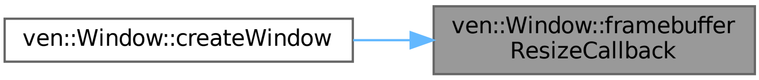
```
void ven::Window::framebufferResizeCallback (
             GLFWwindow * window,
             int width,
             int height)  [static], [private]
```

Definition at line 31 of file window.cpp.

References m_framebufferResized.

Referenced by createWindow().

Here is the caller graph for this function:



7.41.3.4 getExtent()

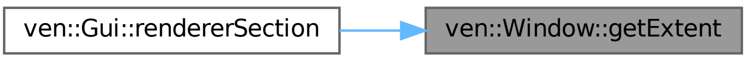
```
VkExtent2D ven::Window::getExtent () const  [inline], [nodiscard]
```

Definition at line 41 of file Window.hpp.

References m_height, and m_width.

Referenced by ven::Gui::rendererSection().

Here is the caller graph for this function:



7.41.3.5 getGLFWindow()

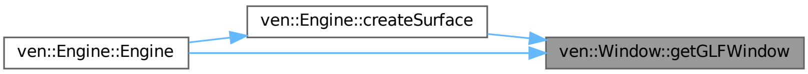
```
GLFWwindow * ven::Window::getGLFWindow () const  [inline], [nodiscard]
```

Definition at line 39 of file Window.hpp.

References m_window.

Referenced by ven::Engine::createSurface(), and ven::Engine::Engine().

Here is the caller graph for this function:



7.41.3.6 operator=()

```
Window & ven::Window::operator= (
             const Window & )  [delete]
```

7.41.3.7 resetWindowResizedFlag()

```
void ven::Window::resetWindowResizedFlag ()  [inline]
```

Definition at line 43 of file Window.hpp.

References m_framebufferResized.

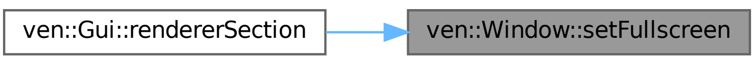
7.41.3.8 setFullscreen()

```
void ven::Window::setFullscreen (
             bool fullscreen,
             uint32_t width,
             uint32_t height)
```

Definition at line 39 of file window.cpp.

Referenced by ven::Gui::rendererSection().

Here is the caller graph for this function:



7.41.3.9 wasWindowResized()

```
bool ven::Window::wasWindowResized () const [inline], [nodiscard]
```

Definition at line 42 of file Window.hpp.

References m_framebufferResized.

7.41.4 Member Data Documentation

7.41.4.1 m_framebufferResized

```
bool ven::Window::m_framebufferResized = false [private]
```

Definition at line 55 of file Window.hpp.

Referenced by framebufferResizeCallback(), resetWindowResizedFlag(), and wasWindowResized().

7.41.4.2 m_height

```
uint32_t ven::Window::m_height {DEFAULT_HEIGHT} [private]
```

Definition at line 53 of file Window.hpp.

Referenced by getExtent().

7.41.4.3 m_width

```
uint32_t ven::Window::m_width {DEFAULT_WIDTH} [private]
```

Definition at line 52 of file Window.hpp.

Referenced by getExtent().

7.41.4.4 m_window

```
GLFWwindow* ven::Window::m_window {nullptr} [private]
```

Definition at line 51 of file Window.hpp.

Referenced by getGLFWindow(), and ∼Window().

The documentation for this class was generated from the following files:

- /home/runner/work/VEngine/VEngine/include/VEngine/Window.hpp
- /home/runner/work/VEngine/VEngine/src/window.cpp

Chapter 8

File Documentation

8.1 /home/runner/work/VEngine/VEngine/assets/shaders/fragment_point_light.frag File Reference

8.2 fragment_point_light.frag

Go to the documentation of this file.

```
#version 450

layout(location = 0) in vec2 fragOffset;
layout(location = 0) out vec4 outColor;

struct PointLight {
    vec4 position; // ignore w
    vec4 color; // w is intensity
    float shininess;
};

layout(set = 0, binding = 0) uniform GlobalUbo {
    mat4 projection;
    mat4 view;
    mat4 invView;
    vec4 ambientLightColor; // w is intensity
    PointLight pointLights[10];
    int numLights;
} ubo;

layout(push_constant) uniform Push {
    vec4 position;
    vec4 color;
    float radius;
} push;

const float M_PI = 3.1415926538;

void main() {
    float dis = length(fragOffset);
    if (dis >= 1.0) {
        discard;
    }

    float cosDis = 0.5 * (cos(dis * M_PI) + 1.0);
    outColor = vec4(push.color.rgb + 0.5 * cosDis, cosDis);
}
```

8.3 /home/runner/work/VEngine/VEngine/assets/shaders/fragment_shader.frag File Reference

8.4 fragment_shader.frag

Go to the documentation of this file.

```
#version 450

layout(location = 0) in vec3 fragColor;
layout(location = 1) in vec3 fragPosWorld;
layout(location = 2) in vec3 fragNormalWorld;
layout(location = 3) in vec2 fragUv;

layout(location = 0) out vec4 outColor;

struct PointLight {
  vec4 position; // ignore w
  vec4 color; // w is intensity
  float shininess;
};

layout(set = 0, binding = 0) uniform GlobalUbo {
  mat4 projection;
  mat4 view;
  mat4 invView;
  vec4 ambientLightColor; // w is intensity
  PointLight pointLights[10];
  int numLights;
} ubo;

layout(set = 1, binding = 1) uniform sampler2D diffuseMap;

layout(push_constant) uniform Push {
  mat4 modelMatrix;
  mat4 normalMatrix;
} push;

void main() {
  vec3 specularLight = vec3(0.0);
  vec3 surfaceNormal = normalize(gl_FrontFacing ? fragNormalWorld : -fragNormalWorld);
  vec3 diffuseLight = ubo.ambientLightColor.rgb * ubo.ambientLightColor.a;

  vec3 cameraPosWorld = ubo.invView[3].xyz;
  vec3 viewDirection = normalize(cameraPosWorld - fragPosWorld);

  for (int i = 0; i < ubo.numLights; i++) {
    PointLight light = ubo.pointLights[i];
    vec3 directionToLight = light.position.xyz - fragPosWorld;
    float distanceSquared = dot(directionToLight, directionToLight);
    float attenuation = distanceSquared > 0.001 ? (light.position.w + 1.0) / distanceSquared : 0.0;
    directionToLight = normalize(directionToLight);

    float cosAngIncidence = max(dot(surfaceNormal, directionToLight), 0);
    vec3 intensity = light.color.rgb * light.color.a * attenuation;

    if (cosAngIncidence > 0) {
      vec3 halfVector = normalize(directionToLight + viewDirection);
      float cosAngHalf = max(dot(surfaceNormal, halfVector), 0);

      float specular = pow(cosAngHalf, light.shininess);

      diffuseLight += intensity * cosAngIncidence;
      specularLight += intensity * specular;
    }
  }

  vec3 color = texture(diffuseMap, fragUv).xyz;
  outColor = vec4(diffuseLight * color + specularLight, 1.0);
}
```

8.5 /home/runner/work/VEngine/VEngine/assets/shaders/vertex_point_light.vert File Reference

8.6 vertex_point_light.vert

Go to the documentation of this file.

```
#version 450

const vec2 OFFSETS[6] = vec2[](
vec2(-1.0, -1.0),
vec2(-1.0, 1.0),
vec2(1.0, -1.0),
vec2(1.0, -1.0),
```

```
vec2(-1.0, 1.0),
vec2(1.0, 1.0)
);

layout(location = 0) out vec2 fragOffset;

struct PointLight {
    vec4 position; // ignore w
    vec4 color; // w is intensity
    float shininess;
};

layout(set = 0, binding = 0) uniform GlobalUbo {
    mat4 projection;
    mat4 view;
    mat4 invView;
    vec4 ambientLightColor; // w is intensity
    PointLight pointLights[10];
    int numLights;
} ubo;

layout(push_constant) uniform Push {
    vec4 position;
    vec4 color;
    float radius;
} push;

void main() {
    fragOffset = OFFSETS[gl_VertexIndex];
    vec3 cameraRightWorld = vec3(ubo.view[0][0], ubo.view[1][0], ubo.view[2][0]);
    vec3 cameraUpWorld = vec3(ubo.view[0][1], ubo.view[1][1], ubo.view[2][1]);

    vec3 positionWorld = push.position.xyz
    + push.radius * fragOffset.x * cameraRightWorld
    + push.radius * fragOffset.y * cameraUpWorld;

    gl_Position = ubo.projection * ubo.view * vec4(positionWorld, 1.0);
}
```

8.7 /home/runner/work/VEngine/VEngine/assets/shaders/vertex_shader.vert File Reference

8.8 vertex_shader.vert

Go to the documentation of this file.

```
#version 450

layout(location = 0) in vec3 position;
layout(location = 1) in vec3 color;
layout(location = 2) in vec3 normal;
layout(location = 3) in vec2 uv;

layout(location = 0) out vec3 fragColor;
layout(location = 1) out vec3 fragPosWorld;
layout(location = 2) out vec3 fragNormalWorld;
layout(location = 3) out vec2 fragUv;

struct PointLight {
  vec4 position; // ignore w
  vec4 color; // w is intensity
  float shininess;
};

layout(set = 0, binding = 0) uniform GlobalUbo {
  mat4 projection;
  mat4 view;
  mat4 invView;
  vec4 ambientLightColor; // w is intensity
  PointLight pointLights[10];
  int numLights;
} ubo;

layout(set = 1, binding = 0) uniform ObjectBufferData {
  mat4 modelMatrix;
  mat4 normalMatrix;
} object;

```

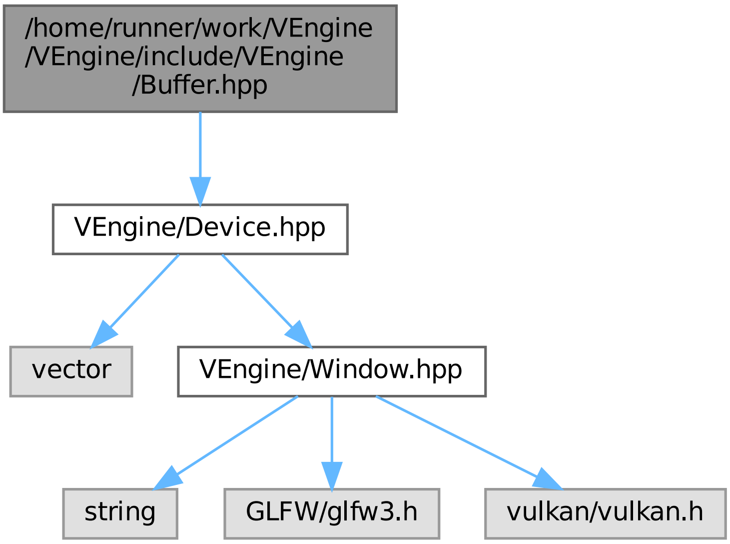
```
layout(push_constant) uniform Push {
  mat4 modelMatrix;
  mat4 normalMatrix;
} push;

void main() {
  vec4 positionWorld = object.modelMatrix * vec4(position, 1.0);
  gl_Position = ubo.projection * ubo.view * positionWorld;
  fragNormalWorld = normalize(mat3(object.normalMatrix) * normal);
  fragPosWorld = positionWorld.xyz;
  fragColor = color;
  fragUv = uv;
}
```

8.9 /home/runner/work/VEngine/VEngine/include/VEngine/Buffer.hpp File Reference

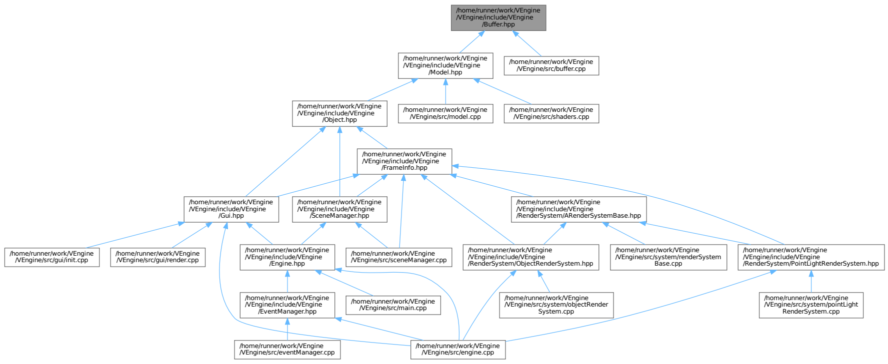
This file contains the Buffer class.

```
#include "VEngine/Device.hpp"
```

Include dependency graph for Buffer.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Buffer

  Class for buffer.

Namespaces

- namespace ven

8.9.1 Detailed Description

This file contains the Buffer class.

Definition in file Buffer.hpp.

8.10 Buffer.hpp

Go to the documentation of this file.

```
///
/// @file Buffer.hpp
/// @brief This file contains the Buffer class
/// @namespace ven
///

#pragma once

#include "VEngine/Device.hpp"

namespace ven {

    ///
    /// @class Buffer
    /// @brief Class for buffer
    /// @namespace ven
    ///
    class Buffer {

        public:

            Buffer(Device& device, VkDeviceSize instanceSize, uint32_t instanceCount,
    VkBufferUsageFlags usageFlags, VkMemoryPropertyFlags memoryPropertyFlags, VkDeviceSize
    minOffsetAlignment = 1);
            ~Buffer();
```

```

            Buffer(const Buffer&) = delete;
            Buffer& operator=(const Buffer&) = delete;

            ///
            /// @brief Map a memory range of this buffer. If successful, mapped points to the specified buffer range.
            ///
            /// @param size (Optional) Size of the memory range to map. Pass VK_WHOLE_SIZE to map the complete buffer range.
            /// @param offset (Optional) Byte offset from beginning
            ///
            /// @return VkResult of the buffer mapping call
            ///
            VkResult map(VkDeviceSize size = VK_WHOLE_SIZE, VkDeviceSize offset = 0);

            ///
            /// @brief Unmap a mapped memory range
            ///
            /// @note Does not return a result as vkUnmapMemory can't fail
            ///
            void unmap();

            ///
            /// @brief Copies the specified data to the mapped buffer. Default value writes whole buffer range
            ///
            /// @param data Pointer to the data to copy
            /// @param size (Optional) Size of the data to copy. Pass VK_WHOLE_SIZE to flush the complete buffer range.
            /// @param offset (Optional) Byte offset from beginning of mapped region
            ///
            void writeToBuffer(const void* data, VkDeviceSize size = VK_WHOLE_SIZE, VkDeviceSize offset = 0) const;

            ///
            /// @brief Flush a memory range of the buffer to make it visible to the device
            ///
            ///  @note Only required for non-coherent memory
            ///
            /// @param size (Optional) Size of the memory range to flush. Pass VK_WHOLE_SIZE to flush the complete buffer range.
            /// @param offset (Optional) Byte offset from beginning
            ///
            /// @return VkResult of the flush call
            ///
            VkResult flush(VkDeviceSize size = VK_WHOLE_SIZE, VkDeviceSize offset = 0) const;

            ///
            /// @brief Create a buffer info descriptor
            ///
            /// @param size (Optional) Size of the memory range of the descriptor
            /// @param offset (Optional) Byte offset from beginning
            ///
            /// @return VkDescriptorBufferInfo of specified offset and range
            ///
            [[nodiscard]] VkDescriptorBufferInfo descriptorInfo(const VkDeviceSize size = VK_WHOLE_SIZE, const VkDeviceSize offset = 0) const { return VkDescriptorBufferInfo{m_buffer, offset, size, }; }

            ///
            /// @brief Invalidate a memory range of the buffer to make it visible to the host
            ///
            /// @note Only required for non-coherent memory
            ///
            /// @param size (Optional) Size of the memory range to invalidate. Pass VK_WHOLE_SIZE to invalidate
            /// the complete buffer range.
            /// @param offset (Optional) Byte offset from beginning
            ///
            /// @return VkResult of the invalidate call
            ///
            [[nodiscard]] VkResult invalidate(VkDeviceSize size = VK_WHOLE_SIZE, VkDeviceSize offset = 0) const;

            ///
            /// Copies "instanceSize" bytes of data to the mapped buffer at an offset of index * alignmentSize
            ///
            /// @param data Pointer to the data to copy
            /// @param index Used in offset calculation
            ///
            ///
            void writeToIndex(const void* data, const VkDeviceSize index) const { writeToBuffer(data, m_instanceSize, index * m_alignmentSize); }

            ///
```

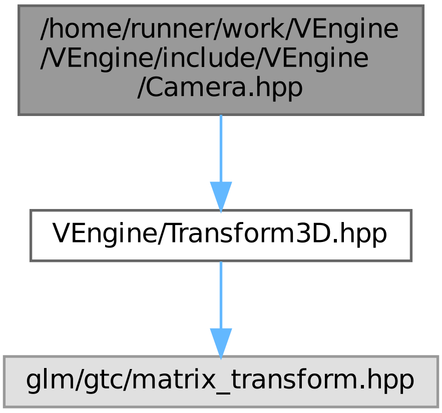
```
            ///  Flush the memory range at index * alignmentSize of the buffer to make it visible to the device
            ///
            /// @param index Used in offset calculation
            ///
            [[nodiscard]] VkResult flushIndex(const VkDeviceSize index) const { assert(m_alignmentSize % m_device.getProperties().limits.nonCoherentAtomSize == 0 && "Cannot use LveBuffer::flushIndex if alignmentSize isn't a multiple of Device Limits nonCoherentAtomSize"); return flush(m_alignmentSize, index * m_alignmentSize); }

            ///
            ///
            /// Create a buffer info descriptor
            ///
            /// @param index Specifies the region given by index * alignmentSize
            ///
            /// @return VkDescriptorBufferInfo for instance at index
            ///
            [[nodiscard]] VkDescriptorBufferInfo descriptorInfoForIndex(const VkDeviceSize index) const { return descriptorInfo(m_alignmentSize, index * m_alignmentSize); }

            ///
            /// Invalidate a memory range of the buffer to make it visible to the host
            ///
            /// @note Only required for non-coherent memory
            ///
            /// @param index Specifies the region to invalidate: index * alignmentSize
            ///
            /// @return VkResult of the invalidate call
            ///
            [[nodiscard]] VkResult invalidateIndex(const VkDeviceSize index) const { return invalidate(m_alignmentSize, index * m_alignmentSize); }

            [[nodiscard]] VkBuffer getBuffer() const { return m_buffer; }
            [[nodiscard]] void* getMappedMemory() const { return m_mapped; }
            [[nodiscard]] uint32_t getInstanceCount() const { return m_instanceCount; }
            [[nodiscard]] VkDeviceSize getInstanceSize() const { return m_instanceSize; }
            [[nodiscard]] VkDeviceSize getAlignmentSize() const { return m_alignmentSize; }
            [[nodiscard]] VkBufferUsageFlags getUsageFlags() const { return m_usageFlags; }
            [[nodiscard]] VkMemoryPropertyFlags getMemoryPropertyFlags() const { return m_memoryPropertyFlags; }
            [[nodiscard]] VkDeviceSize getBufferSize() const { return m_bufferSize; }

        private:
            ///
            /// Returns the minimum instance size required to be compatible with devices minOffsetAlignment
            ///
            /// @param instanceSize The size of an instance
            /// @param minOffsetAlignment The minimum required alignment, in bytes, for the offset member (eg
            /// minUniformBufferOffsetAlignment)
            ///
            /// @return VkResult of the buffer mapping call
            ///
            static VkDeviceSize getAlignment(const VkDeviceSize instanceSize, const VkDeviceSize minOffsetAlignment) { return (minOffsetAlignment > 0) ? (instanceSize + minOffsetAlignment - 1) & ~(minOffsetAlignment - 1) : instanceSize; }

            Device& m_device;
            void* m_mapped = nullptr;
            VkBuffer m_buffer = VK_NULL_HANDLE;
            VkDeviceMemory m_memory = VK_NULL_HANDLE;

            VkDeviceSize m_bufferSize;
            VkDeviceSize m_instanceSize;
            uint32_t m_instanceCount;
            VkDeviceSize m_alignmentSize;
            VkBufferUsageFlags m_usageFlags;
            VkMemoryPropertyFlags m_memoryPropertyFlags;

    }; // class Buffer

} // namespace ven
```

8.11 /home/runner/work/VEngine/VEngine/include/VEngine/Camera.hpp File Reference

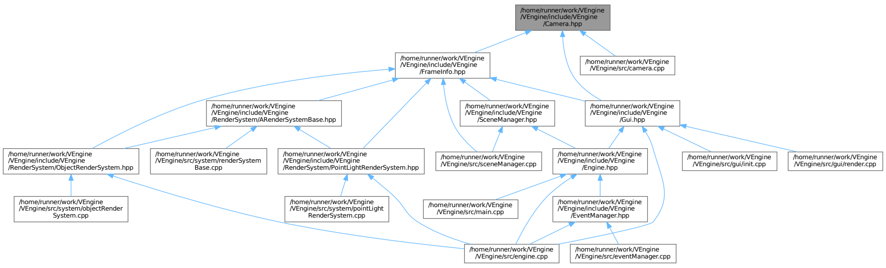
This file contains the Camera class.

`#include "VEngine/Transform3D.hpp"`

Include dependency graph for Camera.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Camera

  Class for camera.

Namespaces

- namespace ven

Variables

- static constexpr glm::vec3 ven::DEFAULT_POSITION {0.F, 0.F, -2.5F}
- static constexpr glm::vec3 ven::DEFAULT_ROTATION {0.F, 0.F, 0.F}
- static constexpr float ven::DEFAULT_FOV = glm::radians(50.0F)
- static constexpr float ven::DEFAULT_NEAR = 0.1F
- static constexpr float ven::DEFAULT_FAR = 100.F
- static constexpr float ven::DEFAULT_MOVE_SPEED = 3.F
- static constexpr float ven::DEFAULT_LOOK_SPEED = 1.5F

8.11.1 Detailed Description

This file contains the Camera class.

Definition in file Camera.hpp.

8.12 Camera.hpp

Go to the documentation of this file.

```
///
/// @file Camera.hpp
/// @brief This file contains the Camera class
/// @namespace ven
///

#pragma once

#include "VEngine/Transform3D.hpp"

namespace ven {

    static constexpr glm::vec3 DEFAULT_POSITION{0.F, 0.F, -2.5F};
    static constexpr glm::vec3 DEFAULT_ROTATION{0.F, 0.F, 0.F};

    static constexpr float DEFAULT_FOV = glm::radians(50.0F);
    static constexpr float DEFAULT_NEAR = 0.1F;
    static constexpr float DEFAULT_FAR = 100.F;

    static constexpr float DEFAULT_MOVE_SPEED = 3.F;
    static constexpr float DEFAULT_LOOK_SPEED = 1.5F;

    ///
    /// @class Camera
    /// @brief Class for camera
    /// @namespace ven
    ///
    class Camera {

        public:

            Camera() = default;
            ~Camera() = default;

            Camera(const Camera&) = delete;
            Camera& operator=(const Camera&) = delete;

            void setOrthographicProjection(float left, float right, float top, float bottom, float near, float far);
            void setPerspectiveProjection(float aspect);
            void setViewDirection(glm::vec3 position, glm::vec3 direction, glm::vec3 up = {0.F, -1.F, 0.F});
            void setViewTarget(const glm::vec3 position, const glm::vec3 target, const glm::vec3 up = {0.F, -1.F, 0.F}) { setViewDirection(position, target - position, up); }
            void setViewXYZ(glm::vec3 position, glm::vec3 rotation);
            void setFov(const float fov) { m_fov = fov; }
            void setNear(const float near) { m_near = near; }
            void setFar(const float far) { m_far = far; }
            void setMoveSpeed(const float moveSpeed) { m_moveSpeed = moveSpeed; }
            void setLookSpeed(const float lookSpeed) { m_lookSpeed = lookSpeed; }

            [[nodiscard]] const glm::mat4& getProjection() const { return m_projectionMatrix; }
            [[nodiscard]] const glm::mat4& getView() const { return m_viewMatrix; }
            [[nodiscard]] const glm::mat4& getInverseView() const { return m_inverseViewMatrix; }
            [[nodiscard]] float getFov() const { return m_fov; }
            [[nodiscard]] float getNear() const { return m_near; }
            [[nodiscard]] float getFar() const { return m_far; }
            [[nodiscard]] float getMoveSpeed() const { return m_moveSpeed; }
            [[nodiscard]] float getLookSpeed() const { return m_lookSpeed; }

            Transform3D transform{DEFAULT_POSITION, {1.F, 1.F, 1.F}, DEFAULT_ROTATION};

        private:

            float m_fov{DEFAULT_FOV};
            float m_near{DEFAULT_NEAR};
            float m_far{DEFAULT_FAR};
            float m_moveSpeed{DEFAULT_MOVE_SPEED};
            float m_lookSpeed{DEFAULT_LOOK_SPEED};
```

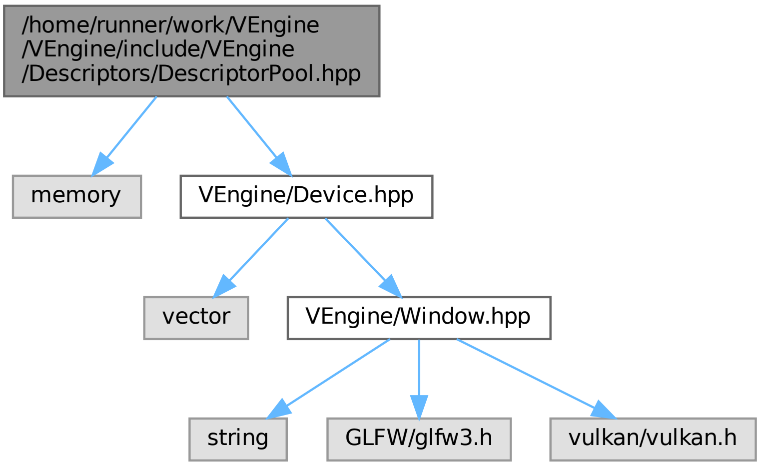
```
            glm::mat4 m_projectionMatrix{1.F};
            glm::mat4 m_viewMatrix{1.F};
            glm::mat4 m_inverseViewMatrix{1.F};

    }; // class Camera

} // namespace ven
```

8.13 /home/runner/work/VEngine/VEngine/include/VEngine/Descriptors/DescriptorPool.hpp File Reference

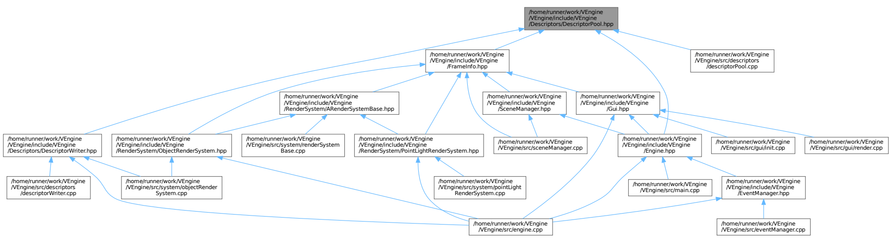
This file contains the DescriptorPool class.

```
#include <memory>
#include "VEngine/Device.hpp"
```

Include dependency graph for DescriptorPool.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::DescriptorPool

  Class for descriptor pool.
- class ven::DescriptorPool::Builder

Namespaces

- namespace ven

Variables

- static constexpr uint32_t ven::DEFAULT_MAX_SETS = 1000

8.13.1 Detailed Description

This file contains the DescriptorPool class.

Definition in file DescriptorPool.hpp.

8.14 DescriptorPool.hpp

Go to the documentation of this file.

```
///
/// @file DescriptorPool.hpp
/// @brief This file contains the DescriptorPool class
/// @namespace ven
///

#pragma once

#include <memory>

#include "VEngine/Device.hpp"

namespace ven {

    static constexpr uint32_t DEFAULT_MAX_SETS = 1000;

    ///
    /// @class DescriptorPool
    /// @brief Class for descriptor pool
    /// @namespace ven
    ///
    class DescriptorPool {

        public:

            class Builder {

                public:

                    explicit Builder(Device &device) : m_device{device} {}

                    [[nodiscard]] std::unique_ptr<DescriptorPool> build() const { return std::make_unique<DescriptorPool>(m_device, m_maxSets, m_poolFlags, m_poolSizes); }

                    Builder &addPoolSize(const VkDescriptorType descriptorType, const uint32_t count) { m_poolSizes.push_back({descriptorType, count}); return *this; }
                    Builder &setPoolFlags(const VkDescriptorPoolCreateFlags flags) { m_poolFlags = flags; return *this; }
                    Builder &setMaxSets(const uint32_t count) { m_maxSets = count; return *this; }

                private:

                    Device &m_device;
                    std::vector<VkDescriptorPoolSize> m_poolSizes;
                    uint32_t m_maxSets{DEFAULT_MAX_SETS};
                    VkDescriptorPoolCreateFlags m_poolFlags{0};

            }; // class Builder

            DescriptorPool(Device &device, uint32_t maxSets, VkDescriptorPoolCreateFlags poolFlags, const std::vector<VkDescriptorPoolSize> &poolSizes);
            ~DescriptorPool() { vkDestroyDescriptorPool(m_device.device(), m_descriptorPool, nullptr); }

```

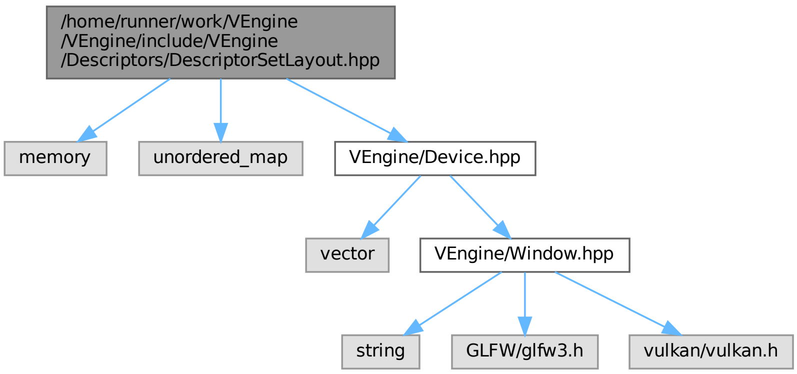
```
            DescriptorPool(const DescriptorPool &) = delete;
            DescriptorPool &operator=(const DescriptorPool &) = delete;

            bool allocateDescriptor(VkDescriptorSetLayout descriptorSetLayout, VkDescriptorSet
    &descriptor) const;
            void freeDescriptors(const std::vector<VkDescriptorSet> &descriptors) const {
    vkFreeDescriptorSets(m_device.device(), m_descriptorPool, static_cast<uint32_t>(descriptors.size()),
    descriptors.data()); }
            void resetPool() const { vkResetDescriptorPool(m_device.device(), m_descriptorPool, 0); }

            [[nodiscard]] VkDescriptorPool getDescriptorPool() const { return m_descriptorPool; }

        private:

            Device &m_device;
            VkDescriptorPool m_descriptorPool;
            friend class DescriptorWriter;

    }; // class DescriptorPool

} // namespace ven
```

8.15 /home/runner/work/VEngine/VEngine/include/VEngine/↩ Descriptors/DescriptorSetLayout.hpp File Reference

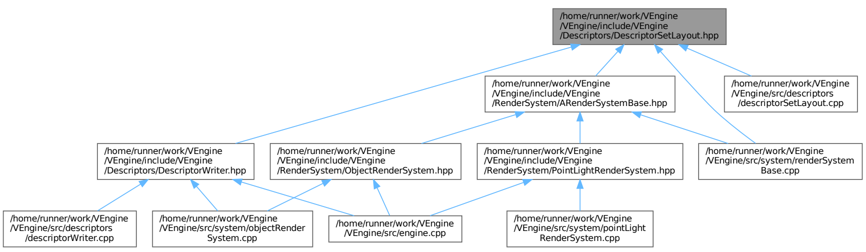
This file contains the DescriptorSetLayout class.

```
#include <memory>
#include <unordered_map>
#include "VEngine/Device.hpp"
```

Include dependency graph for DescriptorSetLayout.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::DescriptorSetLayout

    Class for descriptor set layout.
- class ven::DescriptorSetLayout::Builder

Namespaces

- namespace ven

8.15.1 Detailed Description

This file contains the DescriptorSetLayout class.

Definition in file DescriptorSetLayout.hpp.

8.16 DescriptorSetLayout.hpp

Go to the documentation of this file.

```
///
/// @file DescriptorSetLayout.hpp
/// @brief This file contains the DescriptorSetLayout class
/// @namespace ven
///

#pragma once

#include <memory>
#include <unordered_map>

#include "VEngine/Device.hpp"

namespace ven {

    ///
    /// @class DescriptorSetLayout
    /// @brief Class for descriptor set layout
    /// @namespace ven
    ///
    class DescriptorSetLayout {

        public:

            class Builder {

                public:

                    explicit Builder(Device &device) : m_device{device} {}

                    Builder &addBinding(uint32_t binding, VkDescriptorType descriptorType, VkShaderStageFlags stageFlags, uint32_t count = 1);
                    std::unique_ptr<DescriptorSetLayout> build() const { return std::make_unique<DescriptorSetLayout>(m_device, m_bindings); }

                private:

                    Device &m_device;
                    std::unordered_map<uint32_t, VkDescriptorSetLayoutBinding> m_bindings;

            }; // class Builder

            DescriptorSetLayout(Device &device, const std::unordered_map<uint32_t, VkDescriptorSetLayoutBinding>& bindings);
            ~DescriptorSetLayout() { vkDestroyDescriptorSetLayout(m_device.device(), m_descriptorSetLayout, nullptr); }

            DescriptorSetLayout(const DescriptorSetLayout &) = delete;
            DescriptorSetLayout &operator=(const DescriptorSetLayout &) = delete;

```

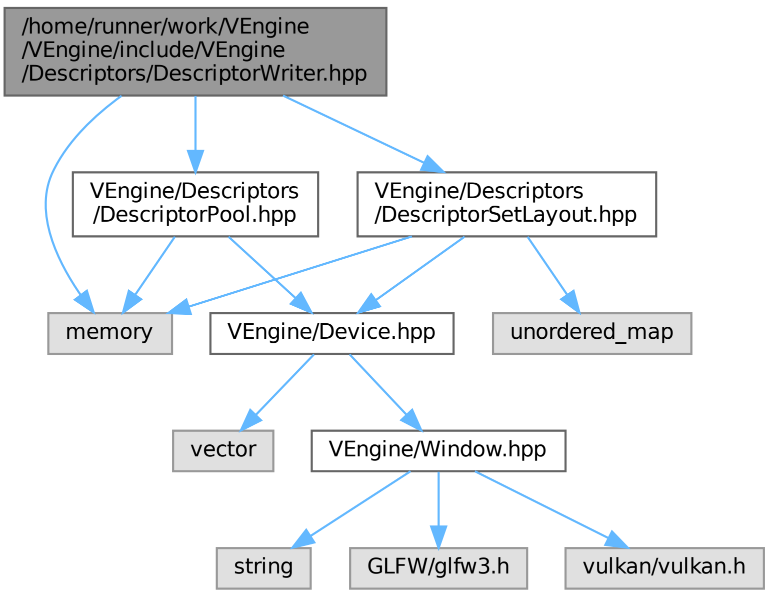
```
            VkDescriptorSetLayout getDescriptorSetLayout() const { return m_descriptorSetLayout; }

        private:

            Device &m_device;
            VkDescriptorSetLayout m_descriptorSetLayout;
            std::unordered_map<uint32_t, VkDescriptorSetLayoutBinding> m_bindings;

            friend class DescriptorWriter;

    }; // class DescriptorSetLayout

} // namespace ven
```

8.17 /home/runner/work/VEngine/VEngine/include/VEngine/↩ Descriptors/DescriptorWriter.hpp File Reference

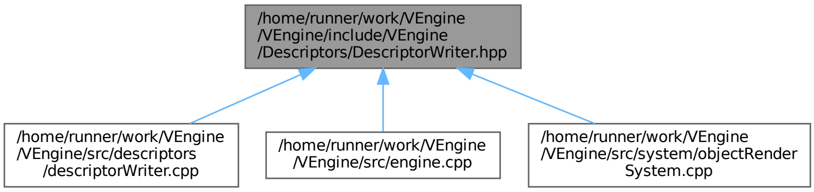
This file contains the DescriptorsWriter class.

```
#include <memory>
#include "VEngine/Descriptors/DescriptorPool.hpp"
#include "VEngine/Descriptors/DescriptorSetLayout.hpp"
```

Include dependency graph for DescriptorWriter.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::DescriptorWriter

    Class for descriptor writer.

Namespaces

- namespace ven

8.17.1 Detailed Description

This file contains the DescriptorsWriter class.

Definition in file DescriptorWriter.hpp.

8.18 DescriptorWriter.hpp

Go to the documentation of this file.

```
///
/// @file DescriptorWriter.hpp
/// @brief This file contains the DescriptorsWriter class
/// @namespace ven
///

#pragma once

#include <memory>

#include "VEngine/Descriptors/DescriptorPool.hpp"
#include "VEngine/Descriptors/DescriptorSetLayout.hpp"

namespace ven {

    ///
    /// @class DescriptorWriter
    /// @brief Class for descriptor writer
    /// @namespace ven
    ///
    class DescriptorWriter {

        public:

            DescriptorWriter(DescriptorSetLayout &setLayout, DescriptorPool &pool) :
    m_setLayout{setLayout}, m_pool{pool} {}
            ~DescriptorWriter() = default;

            DescriptorWriter(const DescriptorWriter &) = delete;
            DescriptorWriter &operator=(const DescriptorWriter &) = delete;
```

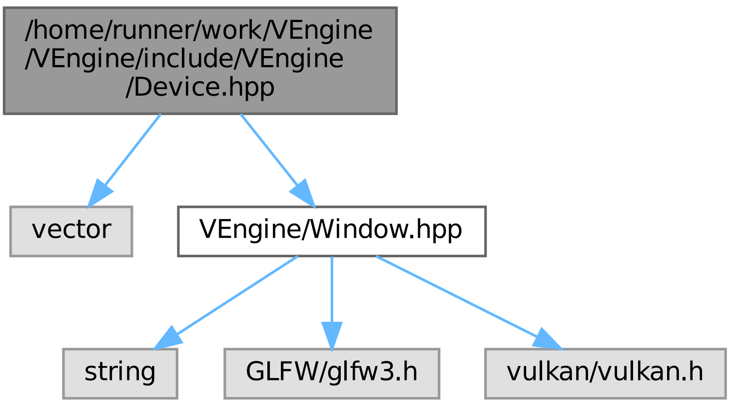
```
            DescriptorWriter &writeBuffer(uint32_t binding, const VkDescriptorBufferInfo *bufferInfo);
            DescriptorWriter &writeImage(uint32_t binding, const VkDescriptorImageInfo *imageInfo);

            bool build(VkDescriptorSet &set);
            void overwrite(const VkDescriptorSet &set);

        private:

            DescriptorSetLayout &m_setLayout;
            DescriptorPool &m_pool;
            std::vector<VkWriteDescriptorSet> m_writes;

    }; // class DescriptorWriter

} // namespace ven
```

8.19 /home/runner/work/VEngine/VEngine/include/VEngine/Device.hpp File Reference

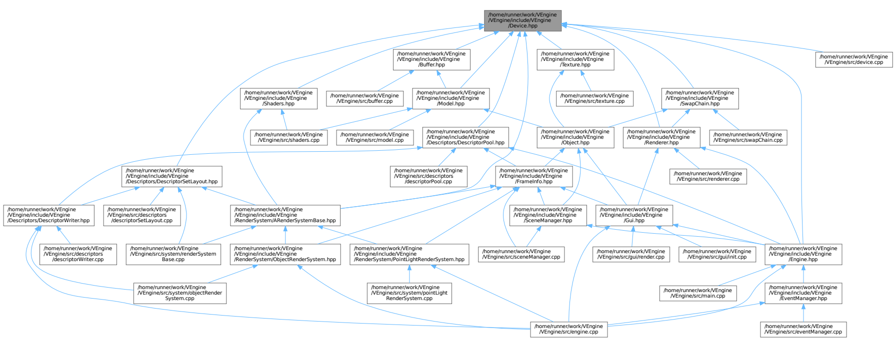
This file contains the Device class.

```
#include <vector>
#include "VEngine/Window.hpp"
```

Include dependency graph for Device.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct ven::SwapChainSupportDetails
- struct ven::QueueFamilyIndices
- class ven::Device

  Class for device.

Namespaces

- namespace ven

8.19.1 Detailed Description

This file contains the Device class.

Definition in file Device.hpp.

8.20 Device.hpp

Go to the documentation of this file.

```
///
/// @file Device.hpp
/// @brief This file contains the Device class
/// @namespace ven
///

#pragma once

#include <vector>

#include "VEngine/Window.hpp"

namespace ven {

    struct SwapChainSupportDetails {
        VkSurfaceCapabilitiesKHR capabilities;
        std::vector<VkSurfaceFormatKHR> formats;
        std::vector<VkPresentModeKHR> presentModes;
    };

    struct QueueFamilyIndices {
        uint32_t graphicsFamily{};
        uint32_t presentFamily{};
        bool graphicsFamilyHasValue = false;
        bool presentFamilyHasValue = false;
        [[nodiscard]] bool isComplete() const { return graphicsFamilyHasValue &&
presentFamilyHasValue; }
    };

    ///
    /// @class Device
    /// @brief Class for device
    /// @namespace ven
    ///
    class Device {

        public:

            #ifdef NDEBUG
                const bool enableValidationLayers = false;
            #else
                const bool enableValidationLayers = true;
            #endif

            explicit Device(Window &window);
            ~Device();

            Device(const Device&) = delete;
            Device& operator=(const Device&) = delete;
```

```cpp

        [[nodiscard]] VkCommandPool getCommandPool() const { return m_commandPool; }
        [[nodiscard]] VkDevice device() const { return m_device; }
        [[nodiscard]] VkSurfaceKHR surface() const { return m_surface; }
        [[nodiscard]] VkQueue graphicsQueue() const { return m_graphicsQueue; }
        [[nodiscard]] VkQueue presentQueue() const { return m_presentQueue; }

        [[nodiscard]] SwapChainSupportDetails getSwapChainSupport() const { return querySwapChainSupport(m_physicalDevice); }
        [[nodiscard]] uint32_t findMemoryType(uint32_t typeFilter, VkMemoryPropertyFlags properties) const;
        [[nodiscard]] QueueFamilyIndices findPhysicalQueueFamilies() const { return findQueueFamilies(m_physicalDevice); }
        [[nodiscard]] VkPhysicalDevice getPhysicalDevice() const { return m_physicalDevice; }
        [[nodiscard]] VkQueue getGraphicsQueue() const { return m_graphicsQueue; }
        [[nodiscard]] VkFormat findSupportedFormat(const std::vector<VkFormat> &candidates, VkImageTiling tiling, VkFormatFeatureFlags features) const;
        [[nodiscard]] VkPhysicalDeviceProperties getProperties() const { return m_properties; }

        // Buffer Helper Functions
        void createBuffer(VkDeviceSize size, VkBufferUsageFlags usage, VkMemoryPropertyFlags properties, VkBuffer &buffer, VkDeviceMemory &bufferMemory) const;
        [[nodiscard]] VkCommandBuffer beginSingleTimeCommands() const;
        void endSingleTimeCommands(VkCommandBuffer commandBuffer) const;
        void copyBuffer(VkBuffer srcBuffer, VkBuffer dstBuffer, VkDeviceSize size) const;
        void copyBufferToImage(VkBuffer buffer, VkImage image, uint32_t width, uint32_t height, uint32_t layerCount) const;

        void createImageWithInfo(const VkImageCreateInfo &imageInfo, VkMemoryPropertyFlags properties, VkImage &image, VkDeviceMemory &imageMemory) const;
        void transitionImageLayout(VkImage image, VkFormat format, VkImageLayout oldLayout, VkImageLayout newLayout, uint32_t mipLevels = 1, uint32_t layerCount = 1) const;

    private:

        void createInstance();
        void setupDebugMessenger();
        void createSurface() { m_window.createWindowSurface(m_instance, &m_surface); };
        void pickPhysicalDevice();
        void createLogicalDevice();
        void createCommandPool();

        // helper functions
        bool isDeviceSuitable(VkPhysicalDevice device) const;
        [[nodiscard]] std::vector<const char *> getRequiredExtensions() const;
        [[nodiscard]] bool checkValidationLayerSupport() const;
        QueueFamilyIndices findQueueFamilies(VkPhysicalDevice device) const;
        static void populateDebugMessengerCreateInfo(VkDebugUtilsMessengerCreateInfoEXT &createInfo);
        void hasGlfwRequiredInstanceExtensions() const;
        bool checkDeviceExtensionSupport(VkPhysicalDevice device) const;
        SwapChainSupportDetails querySwapChainSupport(VkPhysicalDevice device) const;

        VkInstance m_instance;
        VkDebugUtilsMessengerEXT m_debugMessenger;
        VkPhysicalDevice m_physicalDevice = VK_NULL_HANDLE;
        Window &m_window;
        VkCommandPool m_commandPool;

        VkDevice m_device;
        VkSurfaceKHR m_surface;
        VkQueue m_graphicsQueue;
        VkQueue m_presentQueue;
        VkPhysicalDeviceProperties m_properties;

        const std::vector<const char *> m_validationLayers = {"VK_LAYER_KHRONOS_validation"};
        const std::vector<const char *> m_deviceExtensions = {VK_KHR_SWAPCHAIN_EXTENSION_NAME};

    }; // class Device

} // namespace ven
```

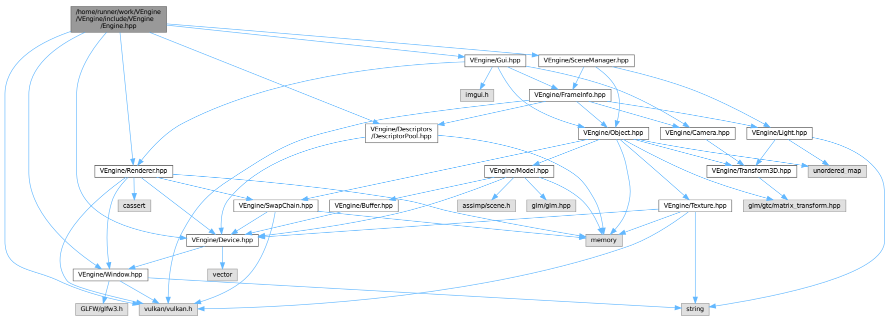
8.21 /home/runner/work/VEngine/VEngine/include/VEngine/Engine.hpp File Reference

This file contains the Engine class.

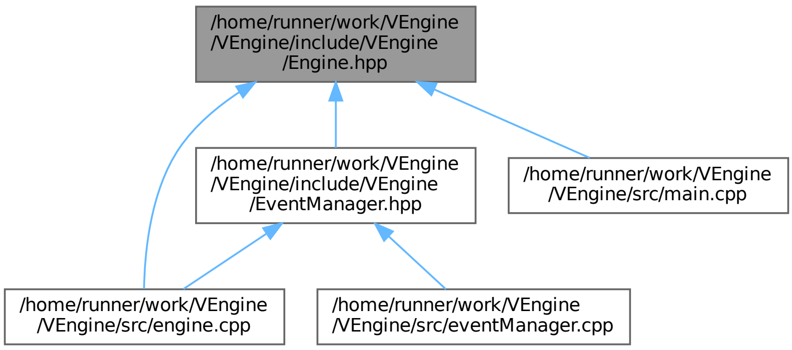
```cpp
#include <vulkan/vulkan.h>
#include "VEngine/Gui.hpp"
```

```
#include "VEngine/Window.hpp"
#include "VEngine/Device.hpp"
#include "VEngine/Renderer.hpp"
#include "VEngine/Descriptors/DescriptorPool.hpp"
#include "VEngine/SceneManager.hpp"
```

Include dependency graph for Engine.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Engine

    Class for engine.

Namespaces

- namespace ven

Enumerations

- enum ven::ENGINE_STATE : uint8_t { ven::EDITOR = 0 , ven::GAME = 1 , ven::PAUSED = 2 , ven::EXIT = 3 }

8.21.1 Detailed Description

This file contains the Engine class.

Definition in file Engine.hpp.

8.22 Engine.hpp

Go to the documentation of this file.

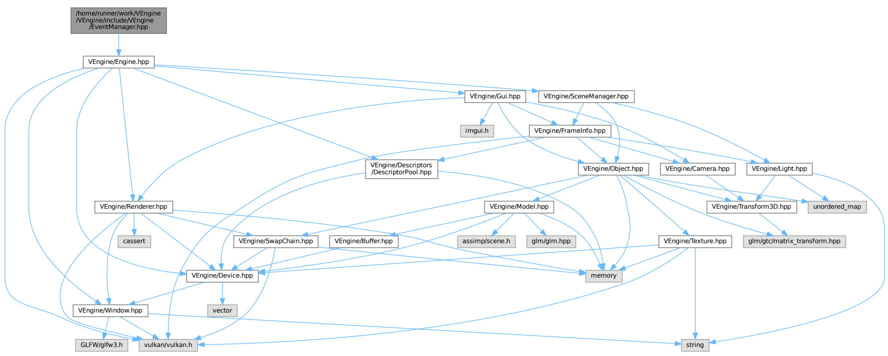
```
///
/// @file Engine.hpp
/// @brief This file contains the Engine class
/// @namespace ven
///

#pragma once

#include <vulkan/vulkan.h>

#include "VEngine/Gui.hpp"
#include "VEngine/Window.hpp"
#include "VEngine/Device.hpp"
#include "VEngine/Renderer.hpp"
#include "VEngine/Descriptors/DescriptorPool.hpp"
#include "VEngine/SceneManager.hpp"

namespace ven {

    enum ENGINE_STATE : uint8_t {
        EDITOR = 0,
        GAME = 1,
        PAUSED = 2,
        EXIT = 3
    };

    ///
    /// @class Engine
    /// @brief Class for engine
    /// @namespace ven
    ///
    class Engine {

        public:

            explicit Engine(uint32_t = DEFAULT_WIDTH, uint32_t = DEFAULT_HEIGHT, const std::string &title = DEFAULT_TITLE.data());
            ~Engine() = default;

            Engine(const Engine&) = delete;
            Engine operator=(const Engine&) = delete;

            void mainLoop();

        private:

            void loadObjects();

            ENGINE_STATE m_state{EXIT};

            Window m_window;
            Device m_device{m_window};
            Renderer m_renderer{m_window, m_device};
            Gui m_gui;
            std::unique_ptr<DescriptorPool> m_globalPool;
            std::vector<std::unique_ptr<DescriptorPool» framePools;
            SceneManager m_sceneManager{m_device};

            VkInstance m_instance{nullptr};
            VkSurfaceKHR m_surface{nullptr};

            void createInstance();
            void createSurface() { if (glfwCreateWindowSurface(m_instance, m_window.getGLFWindow(), nullptr, &m_surface) != VK_SUCCESS) { throw std::runtime_error("Failed to create window surface"); } }

    }; // class Engine

} // namespace ven
```

8.23 /home/runner/work/VEngine/VEngine/include/VEngine/Event↩ Manager.hpp File Reference

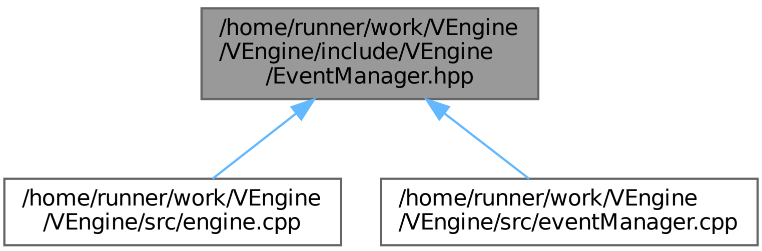
This file contains the EventManager class.

```
#include "VEngine/Engine.hpp"
```

Include dependency graph for EventManager.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct ven::KeyAction
- struct ven::KeyMappings
- class ven::EventManager

    Class for event manager.

Namespaces

- namespace ven

Variables

- static constexpr float ven::EPSILON = std::numeric_limits<float>::epsilon()
- static constexpr KeyMappings ven::DEFAULT_KEY_MAPPINGS {}

8.23.1 Detailed Description

This file contains the EventManager class.

Definition in file EventManager.hpp.

8.24 EventManager.hpp

Go to the documentation of this file.

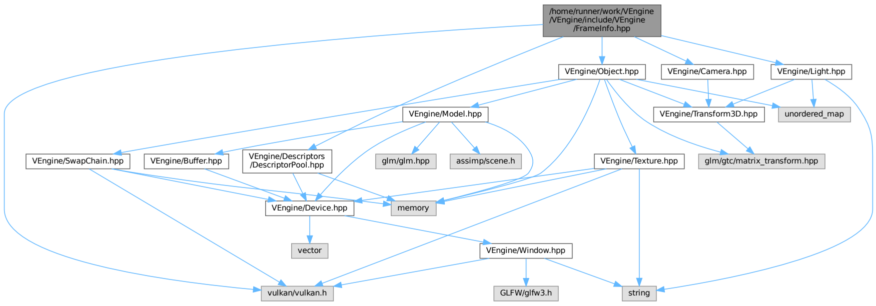
```
///
/// @file EventManager.hpp
/// @brief This file contains the EventManager class
/// @namespace ven
///

#pragma once

#include "VEngine/Engine.hpp"

namespace ven {

    struct KeyAction {
        uint16_t key;
        glm::vec3* dir;
        glm::vec3 value;
    };

    struct KeyMappings {
        uint16_t moveLeft = GLFW_KEY_A;
        uint16_t moveRight = GLFW_KEY_D;
        uint16_t moveForward = GLFW_KEY_W;
        uint16_t moveBackward = GLFW_KEY_S;
        uint16_t moveUp = GLFW_KEY_SPACE;
        uint16_t moveDown = GLFW_KEY_LEFT_SHIFT;
        uint16_t lookLeft = GLFW_KEY_LEFT;
        uint16_t lookRight = GLFW_KEY_RIGHT;
        uint16_t lookUp = GLFW_KEY_UP;
        uint16_t lookDown = GLFW_KEY_DOWN;
        uint16_t toggleGui = GLFW_KEY_F1;
    };

    static constexpr float EPSILON = std::numeric_limits<float>::epsilon();
    static constexpr KeyMappings DEFAULT_KEY_MAPPINGS{};

    ///
    /// @class EventManager
    /// @brief Class for event manager
    /// @namespace ven
    ///
    class EventManager {

        public:

            EventManager() = default;
            ~EventManager() = default;

            EventManager(const EventManager&) = delete;
            EventManager& operator=(const EventManager&) = delete;

            void handleEvents(GLFWwindow *window, ENGINE_STATE *engineState, Camera& camera, Gui& gui, float dt) const;

        private:
            static void moveCamera(GLFWwindow* window, Camera& camera, float dt);
            static void updateEngineState(ENGINE_STATE *engineState, const ENGINE_STATE newState) { *engineState = newState; }
            static bool isKeyJustPressed(GLFWwindow* window, int key, std::unordered_map<int, bool>& keyStates);

            template<typename Iterator>
            static void processKeyActions(GLFWwindow* window, Iterator begin, Iterator end);

            mutable std::unordered_map<int, bool> m_keyState;

    }; // class EventManager

} // namespace ven
```

8.25 /home/runner/work/VEngine/VEngine/include/VEngine/Frame↩ Info.hpp File Reference

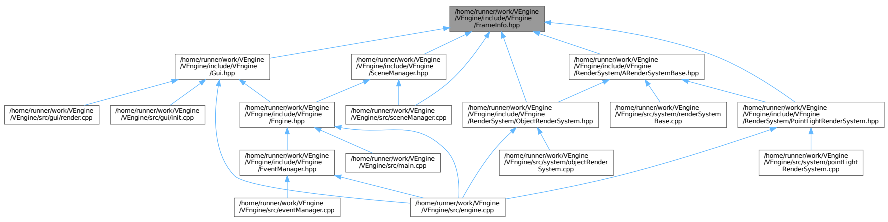
This file contains the FrameInfo class.

```
#include <vulkan/vulkan.h>
#include "VEngine/Descriptors/DescriptorPool.hpp"
#include "VEngine/Camera.hpp"
#include "VEngine/Object.hpp"
#include "VEngine/Light.hpp"
```

Include dependency graph for FrameInfo.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct ven::PointLightData
- struct ven::GlobalUbo
- struct ven::FrameInfo

Namespaces

- namespace ven

Variables

- static constexpr float ven::DEFAULT_AMBIENT_LIGHT_INTENSITY = .2F
- static constexpr glm::vec4 ven::DEFAULT_AMBIENT_LIGHT_COLOR = {glm::vec3(1.F), DEFAULT_AMBIENT_LIGHT_INTENS

8.25.1 Detailed Description

This file contains the FrameInfo class.

Definition in file FrameInfo.hpp.

8.26 FrameInfo.hpp

Go to the documentation of this file.

```
///
/// @file FrameInfo.hpp
/// @brief This file contains the FrameInfo class
/// @namespace ven
///

#pragma once

#include <vulkan/vulkan.h>

#include "VEngine/Descriptors/DescriptorPool.hpp"
#include "VEngine/Camera.hpp"
#include "VEngine/Object.hpp"
#include "VEngine/Light.hpp"

namespace ven {

static constexpr float DEFAULT_AMBIENT_LIGHT_INTENSITY = .2F;
static constexpr glm::vec4 DEFAULT_AMBIENT_LIGHT_COLOR = {glm::vec3(1.F),
DEFAULT_AMBIENT_LIGHT_INTENSITY};

    struct PointLightData
    {
        glm::vec4 position{};
        glm::vec4 color{};
        float shininess{32.F};
        float padding[3]; // Pad to 32 bytes
    };

    struct GlobalUbo
    {
        glm::mat4 projection{1.F};
        glm::mat4 view{1.F};
        glm::mat4 inverseView{1.F};
        glm::vec4 ambientLightColor{DEFAULT_AMBIENT_LIGHT_COLOR};
        std::array<PointLightData, MAX_LIGHTS> pointLights;
        uint8_t numLights;
    };

    struct FrameInfo
    {
        unsigned long frameIndex;
        float frameTime;
        VkCommandBuffer commandBuffer;
        Camera &camera;
        VkDescriptorSet globalDescriptorSet;
        DescriptorPool &frameDescriptorPool;
        Object::Map &objects;
        Light::Map &lights;
    };

} // namespace ven
```

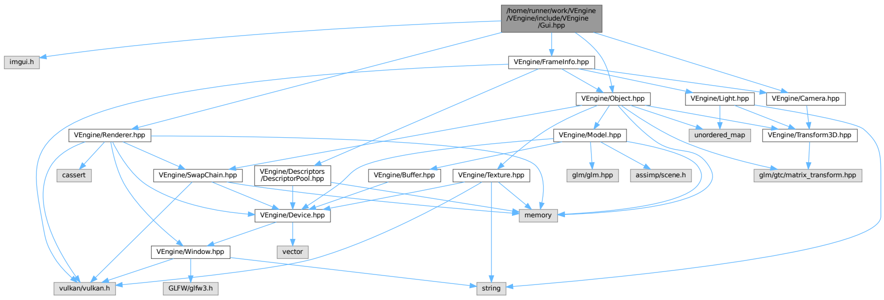
8.27 /home/runner/work/VEngine/VEngine/include/VEngine/Gui.hpp File Reference

This file contains the ImGuiWindowManager class.

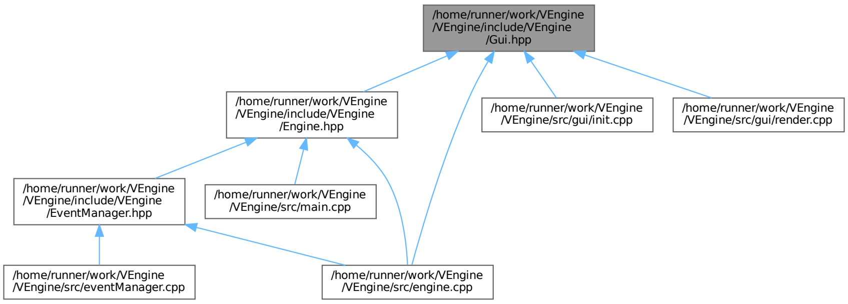
```
#include <imgui.h>
#include "VEngine/Object.hpp"
```

```
#include "VEngine/Renderer.hpp"
#include "VEngine/Camera.hpp"
#include "VEngine/FrameInfo.hpp"
```

Include dependency graph for Gui.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Gui

    Class for Gui.
- struct ven::Gui::funcs

Namespaces

- namespace ven

Enumerations

- enum ven::GUI_STATE : uint8_t { ven::VISIBLE = 0 , ven::HIDDEN = 1 }

Variables

- static constexpr uint16_t ven::DESCRIPTOR_COUNT = 1000

8.27.1 Detailed Description

This file contains the ImGuiWindowManager class.

Definition in file Gui.hpp.

8.28 Gui.hpp

Go to the documentation of this file.

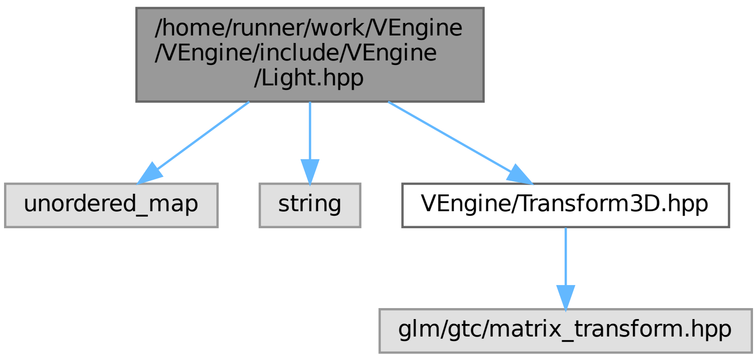
```
///
/// @file Gui.hpp
/// @brief This file contains the ImGuiWindowManager class
/// @namespace ven
///

#pragma once

#include <imgui.h>

#include "VEngine/Object.hpp"
#include "VEngine/Renderer.hpp"
#include "VEngine/Camera.hpp"
#include "VEngine/FrameInfo.hpp"

namespace ven {

    static constexpr uint16_t DESCRIPTOR_COUNT = 1000;

    enum GUI_STATE : uint8_t {
        VISIBLE = 0,
        HIDDEN = 1
    };

    ///
    /// @class Gui
    /// @brief Class for Gui
    /// @namespace ven
    ///
    class Gui {

        public:

            Gui() = default;
            ~Gui() = default;

            Gui(const Gui&) = delete;
            Gui& operator=(const Gui&) = delete;

            static void init(GLFWwindow* window, VkInstance instance, const Device* device, VkRenderPass renderPass);

            static void render(Renderer *renderer, std::unordered_map<unsigned int, Object>& objects, std::unordered_map<unsigned int, Light>& lights, Camera& camera, VkPhysicalDevice physicalDevice, GlobalUbo& ubo);
            static void cleanup();

            void setState(const GUI_STATE state) { m_state = state; }
            [[nodiscard]] GUI_STATE getState() const { return m_state; }

        private:

            static void initStyle();
            static void renderFrameWindow();
            static void cameraSection(Camera& camera);
            static void inputsSection(const ImGuiIO *io);
            static void rendererSection(Renderer *renderer, GlobalUbo& ubo);
            static void devicePropertiesSection(VkPhysicalDeviceProperties deviceProperties);
            static void objectsSection(std::unordered_map<unsigned int, Object>& objects);
            static void lightsSection(std::unordered_map<unsigned int, Light>& lights);


            struct funcs { static bool IsLegacyNativeDupe(const ImGuiKey key) { return key >= 0 && key < 512 && ImGui::GetIO().KeyMap[key] != -1; } }; // Hide Native<>ImGuiKey duplicates when both exist

            static ImGuiIO* m_io;
            GUI_STATE m_state{VISIBLE};
            static float m_intensity;
            static float m_shininess;

    }; // class Gui

} // namespace ven
```

8.29 /home/runner/work/VEngine/VEngine/include/VEngine/Light.hpp File Reference

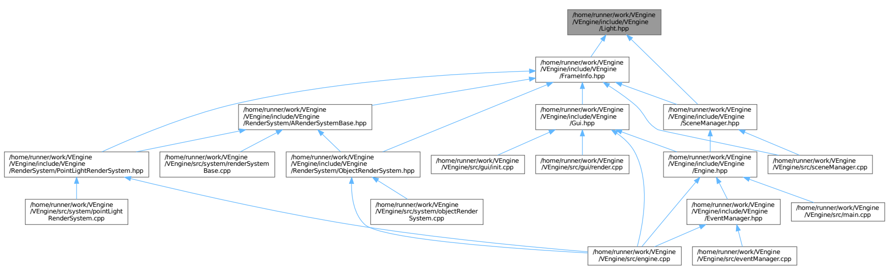
This file contains the Light class.

```
#include <unordered_map>
#include <string>
#include "VEngine/Transform3D.hpp"
```

Include dependency graph for Light.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Light

    Class for light.

Namespaces

- namespace ven

Variables

- static constexpr float ven::DEFAULT_LIGHT_INTENSITY = .2F
- static constexpr float ven::DEFAULT_LIGHT_RADIUS = 0.1F
- static constexpr float ven::DEFAULT_SHININESS = 32.F
- static constexpr glm::vec4 ven::DEFAULT_LIGHT_COLOR = {glm::vec3(1.F), DEFAULT_LIGHT_INTENSITY}
- static constexpr uint8_t ven::MAX_LIGHTS = 10

8.29.1 Detailed Description

This file contains the Light class.

Definition in file Light.hpp.

8.30 Light.hpp

Go to the documentation of this file.

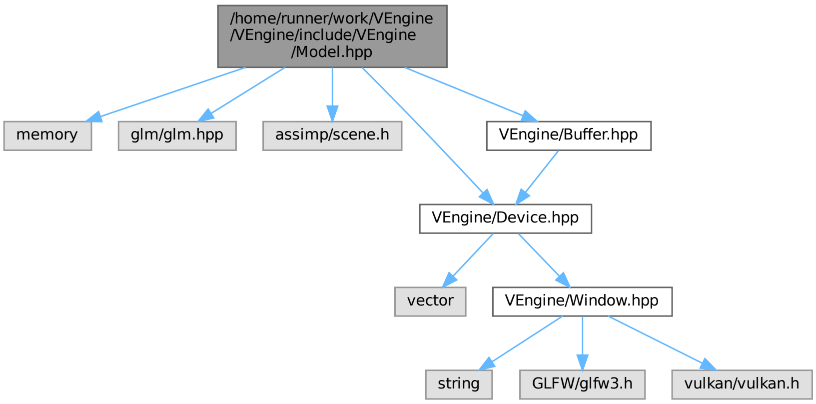
```
///
/// @file Light.hpp
/// @brief This file contains the Light class
/// @namespace ven
///

#pragma once

#include <unordered_map>
#include <string>

#include "VEngine/Transform3D.hpp"

namespace ven {

    static constexpr float DEFAULT_LIGHT_INTENSITY = .2F;
    static constexpr float DEFAULT_LIGHT_RADIUS = 0.1F;
    static constexpr float DEFAULT_SHININESS = 32.F;
    static constexpr glm::vec4 DEFAULT_LIGHT_COLOR = {glm::vec3(1.F), DEFAULT_LIGHT_INTENSITY};

    static constexpr uint8_t MAX_LIGHTS = 10;

    ///
    /// @class Light
    /// @brief Class for light
    /// @namespace ven
    ///
    class Light {

        public:

            using Map = std::unordered_map<unsigned int, Light>;

            explicit Light(const unsigned int objId) : m_lightId{objId} {}

            ~Light() = default;

            Light(const Light&) = delete;
            Light& operator=(const Light&) = delete;
            Light(Light&&) = default;
            Light& operator=(Light&&) = default;

            [[nodiscard]] unsigned int getId() const { return m_lightId; }
            [[nodiscard]] std::string getName() const { return m_name; }
            [[nodiscard]] float getShininess() const { return m_shininess; }

            void setName(const std::string &name) { m_name = name; }
            void setShininess(const float shininess) { m_shininess = shininess; }

            glm::vec4 color{DEFAULT_LIGHT_COLOR};
            Transform3D transform{};

        private:

            unsigned int m_lightId;
            std::string m_name{"point light"};
            float m_shininess{DEFAULT_SHININESS};

    }; // class Light

} // namespace ven
```

8.31 /home/runner/work/VEngine/VEngine/include/VEngine/Model.hpp File Reference

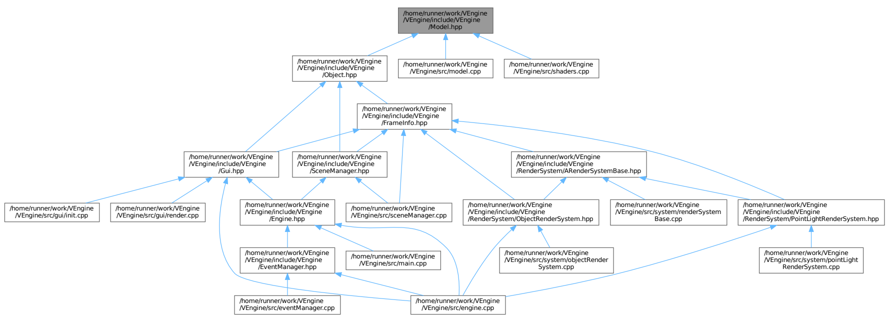
This file contains the Model class.

```
#include <memory>
#include <glm/glm.hpp>
#include <assimp/scene.h>
#include "VEngine/Device.hpp"
#include "VEngine/Buffer.hpp"
```

Include dependency graph for Model.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Model

    Class for model.
- struct ven::Model::Vertex
- struct ven::Model::Builder

Namespaces

- namespace ven

8.31.1 Detailed Description

This file contains the Model class.

Definition in file Model.hpp.

8.32 Model.hpp

Go to the documentation of this file.

```
///
/// @file Model.hpp
/// @brief This file contains the Model class
/// @namespace ven
///

#pragma once

#include <memory>

#include <glm/glm.hpp>

#include <assimp/scene.h>

#include "VEngine/Device.hpp"
#include "VEngine/Buffer.hpp"

namespace ven {

    ///
    /// @class Model
    /// @brief Class for model
    /// @namespace ven
    ///
    class Model {

        public:

            struct Vertex {
                glm::vec3 position{};
                glm::vec3 color{};
                glm::vec3 normal{};
                glm::vec2 uv{};

                static std::vector<VkVertexInputBindingDescription> getBindingDescriptions();
                static std::vector<VkVertexInputAttributeDescription> getAttributeDescriptions();

                bool operator==(const Vertex& other) const {
                    return position == other.position && color == other.color && normal == other.normal && uv == other.uv;
                }
            };

            struct Builder {
                std::vector<Vertex> vertices;
                std::vector<uint32_t> indices;

                void loadModel(const std::string &filename);
                void processNode(const aiNode* node, const aiScene* scene);
                void processMesh(const aiMesh* mesh, const aiScene* scene);
            };

            Model(Device &device, const Builder &builder);
            ~Model() = default;

            Model(const Model&) = delete;
            void operator=(const Model&) = delete;

            static std::unique_ptr<Model> createModelFromFile(Device &device, const std::string &filename);

            void bind(VkCommandBuffer commandBuffer) const;
            void draw(VkCommandBuffer commandBuffer) const;

        private:

            void createVertexBuffer(const std::vector<Vertex>& vertices);
            void createIndexBuffer(const std::vector<uint32_t>& indices);

```

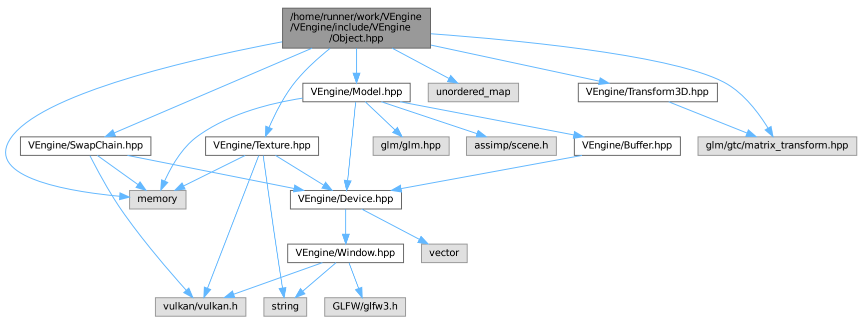
```
            Device& m_device;
            std::unique_ptr<Buffer> m_vertexBuffer;
            uint32_t m_vertexCount;

            bool m_hasIndexBuffer{false};
            std::unique_ptr<Buffer> m_indexBuffer;
            uint32_t m_indexCount;

    }; // class Model

} // namespace ven
```

8.33 /home/runner/work/VEngine/VEngine/include/VEngine/Object.hpp File Reference

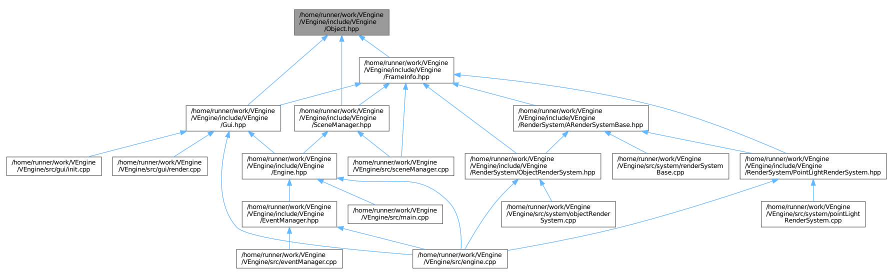
This file contains the Object class.

```
#include <memory>
#include <unordered_map>
#include <glm/gtc/matrix_transform.hpp>
#include "VEngine/SwapChain.hpp"
#include "VEngine/Texture.hpp"
#include "VEngine/Model.hpp"
#include "VEngine/Transform3D.hpp"
```

Include dependency graph for Object.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct ven::ObjectBufferData
- class ven::Object

    Class for object.

Namespaces

- namespace ven

Variables

- static constexpr uint16_t ven::MAX_OBJECTS = 1000

8.33.1 Detailed Description

This file contains the Object class.

Definition in file Object.hpp.

8.34 Object.hpp

Go to the documentation of this file.

```
///
/// @file Object.hpp
/// @brief This file contains the Object class
/// @namespace ven
///

#pragma once

#include <memory>
#include <unordered_map>

#include <glm/gtc/matrix_transform.hpp>

#include "VEngine/SwapChain.hpp"
#include "VEngine/Texture.hpp"
#include "VEngine/Model.hpp"
#include "VEngine/Transform3D.hpp"

namespace ven {

    static constexpr uint16_t MAX_OBJECTS = 1000;

    struct ObjectBufferData {
        glm::mat4 modelMatrix{1.F};
        glm::mat4 normalMatrix{1.F};
    };

    ///
    /// @class Object
    /// @brief Class for object
    /// @namespace ven
    ///
    class Object {

        public:

            using Map = std::unordered_map<unsigned int, Object>;

            explicit Object(const unsigned int objId) : m_objId{objId} {}
            Object(const Object &) = delete;
            Object(Object &&) = default;
            Object &operator=(const Object &) = delete;
            Object &operator=(Object &&) = delete;

            [[nodiscard]] unsigned int getId() const { return m_objId; }
            [[nodiscard]] std::string getName() const { return m_name; }
            [[nodiscard]] std::shared_ptr<Model> getModel() const { return m_model; }
            [[nodiscard]] std::shared_ptr<Texture> getDiffuseMap() const { return m_diffuseMap; }
            [[nodiscard]] VkDescriptorBufferInfo getBufferInfo(const int frameIndex) const { return m_bufferInfo.at(frameIndex); }
            void setModel(const std::shared_ptr<Model> &model) { m_model = model; }
            void setDiffuseMap(const std::shared_ptr<Texture> &diffuseMap) { m_diffuseMap = diffuseMap; }
            void setName(const std::string &name) { m_name = name; }
```

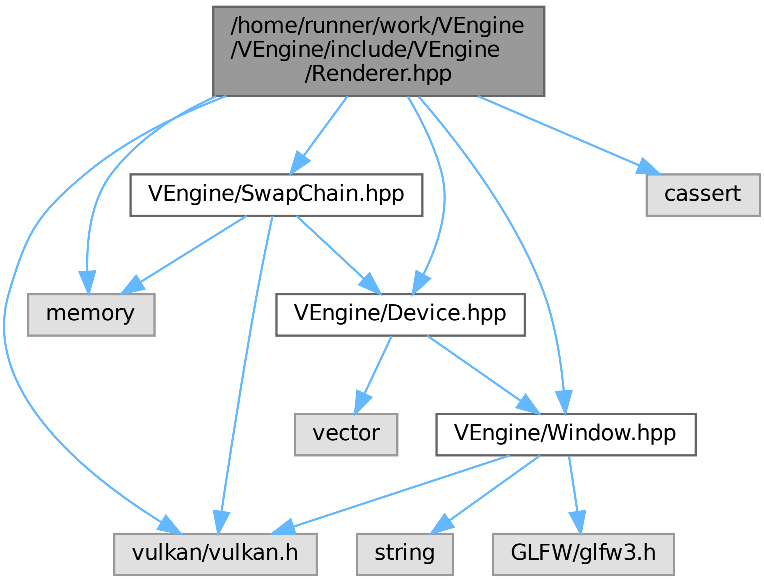
```
            void setBufferInfo(const int frameIndex, const VkDescriptorBufferInfo& info) {
                m_bufferInfo[frameIndex] = info;
            }

            Transform3D transform{};

        private:

            unsigned int m_objId;
            std::string m_name;
            std::shared_ptr<Model> m_model = nullptr;
            std::shared_ptr<Texture> m_diffuseMap = nullptr;
            std::unordered_map<int, VkDescriptorBufferInfo> m_bufferInfo;

    }; // class Object

} // namespace ven
```

8.35 /home/runner/work/VEngine/VEngine/include/VEngine/Renderer.hpp File Reference

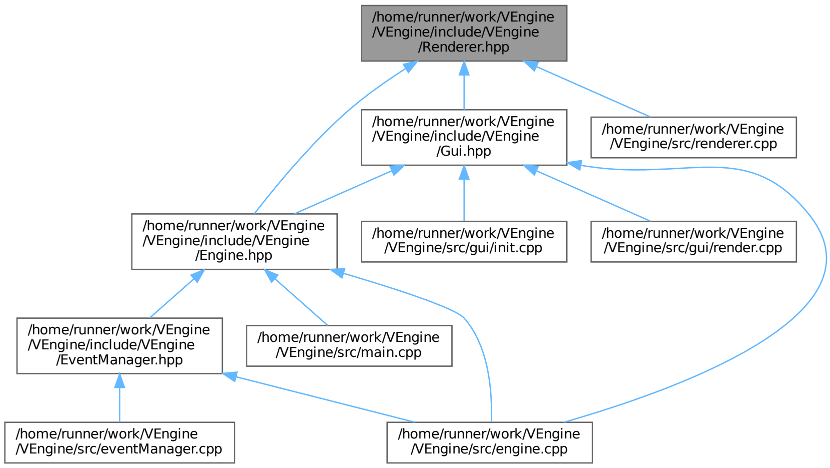
This file contains the Renderer class.

```
#include <memory>
#include <cassert>
#include <vulkan/vulkan.h>
#include "VEngine/Window.hpp"
#include "VEngine/Device.hpp"
#include "VEngine/SwapChain.hpp"
```

Include dependency graph for Renderer.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Renderer

  Class for renderer.

Namespaces

- namespace ven

Variables

- static constexpr VkClearColorValue ven::DEFAULT_CLEAR_COLOR = {{0.0F, 0.0F, 0.0F, 1.0F}}
- static constexpr VkClearDepthStencilValue ven::DEFAULT_CLEAR_DEPTH = {1.0F, 0}

8.35.1 Detailed Description

This file contains the Renderer class.

Definition in file Renderer.hpp.

8.36 Renderer.hpp

Go to the documentation of this file.

```
///
/// @file Renderer.hpp
/// @brief This file contains the Renderer class
/// @namespace ven
///

#pragma once

#include <memory>
#include <cassert>

#include <vulkan/vulkan.h>

#include "VEngine/Window.hpp"
#include "VEngine/Device.hpp"
#include "VEngine/SwapChain.hpp"

namespace ven {

    static constexpr VkClearColorValue DEFAULT_CLEAR_COLOR = {{0.0F, 0.0F, 0.0F, 1.0F}};
    static constexpr VkClearDepthStencilValue DEFAULT_CLEAR_DEPTH = {1.0F, 0};

    ///
    /// @class Renderer
    /// @brief Class for renderer
    /// @namespace ven
    ///
    class Renderer {

        public:

            Renderer(Window &window, Device &device) : m_window{window}, m_device{device} { recreateSwapChain(); createCommandBuffers(); }
            ~Renderer() { freeCommandBuffers(); }

            Renderer(const Renderer &) = delete;
            Renderer& operator=(const Renderer &) = delete;

            [[nodiscard]] VkRenderPass getSwapChainRenderPass() const { return m_swapChain->getRenderPass(); }
            [[nodiscard]] float getAspectRatio() const { return m_swapChain->extentAspectRatio(); }
            [[nodiscard]] bool isFrameInProgress() const { return m_isFrameStarted; }
            [[nodiscard]] VkCommandBuffer getCurrentCommandBuffer() const { assert(isFrameInProgress() && "cannot get command m_buffer when frame not in progress"); return m_commandBuffers[static_cast<unsigned long>(m_currentFrameIndex)]; }

            [[nodiscard]] unsigned long getFrameIndex() const { assert(isFrameInProgress() && "cannot get frame index when frame not in progress"); return m_currentFrameIndex; }
            [[nodiscard]] std::array<float, 4> getClearColor() const { return {
                m_clearValues[0].color.float32[0],
                m_clearValues[0].color.float32[1],
                m_clearValues[0].color.float32[2],
                m_clearValues[0].color.float32[3]
            };}

            [[nodiscard]] Window& getWindow() const { return m_window; }

            void setClearValue(const VkClearColorValue clearColorValue = DEFAULT_CLEAR_COLOR, const VkClearDepthStencilValue clearDepthValue = DEFAULT_CLEAR_DEPTH) { m_clearValues[0].color = clearColorValue; m_clearValues[1].depthStencil = clearDepthValue; }
            VkCommandBuffer beginFrame();
            void endFrame();
            void beginSwapChainRenderPass(VkCommandBuffer commandBuffer) const;
            void endSwapChainRenderPass(VkCommandBuffer commandBuffer) const;

        private:

            void createCommandBuffers();
            void freeCommandBuffers();
            void recreateSwapChain();

            Window &m_window;
            Device &m_device;
            std::unique_ptr<SwapChain> m_swapChain;
            std::vector<VkCommandBuffer> m_commandBuffers;
            std::array<VkClearValue, 2> m_clearValues{DEFAULT_CLEAR_COLOR, 1.0F, 0.F};

            uint32_t m_currentImageIndex{0};
            unsigned long m_currentFrameIndex{0};
            bool m_isFrameStarted{false};

    }; // class Renderer
```

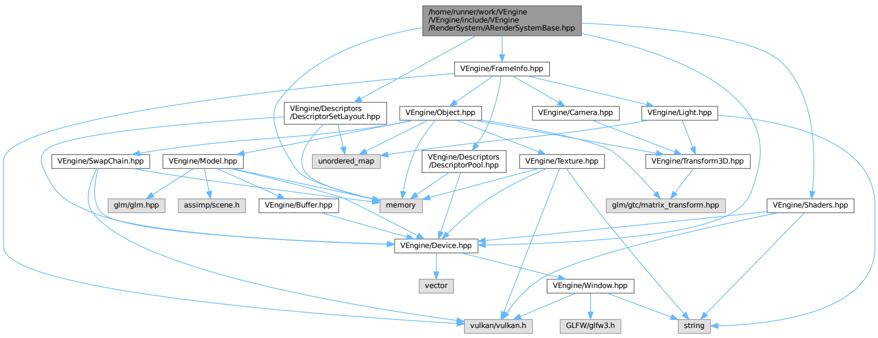
```
00076
00077 } // namespace ven
```

8.37 /home/runner/work/VEngine/VEngine/include/VEngine/Render↩ System/ARenderSystemBase.hpp File Reference

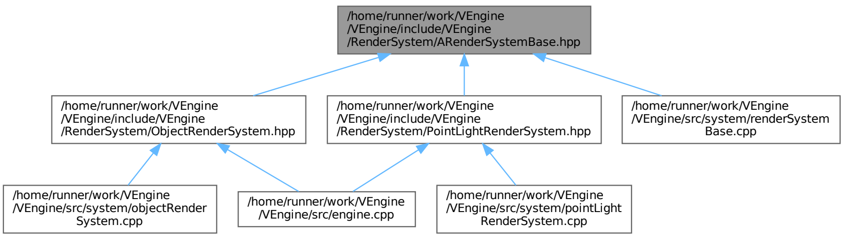
This file contains the ARenderSystemBase class.

```
#include <memory>
#include "VEngine/Descriptors/DescriptorSetLayout.hpp"
#include "VEngine/Device.hpp"
#include "VEngine/Shaders.hpp"
#include "VEngine/FrameInfo.hpp"
```

Include dependency graph for ARenderSystemBase.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::ARenderSystemBase

  Abstract class for render system base.

Namespaces

- namespace ven

8.37.1 Detailed Description

This file contains the ARenderSystemBase class.

Definition in file ARenderSystemBase.hpp.

8.38 ARenderSystemBase.hpp

Go to the documentation of this file.

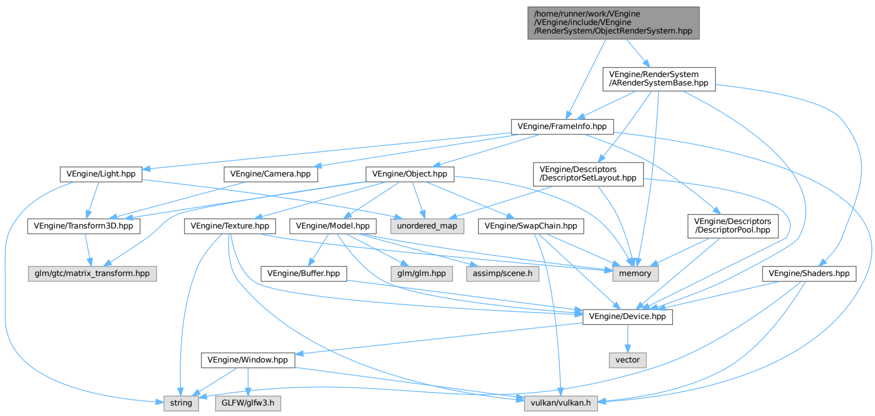
```
///
/// @file ARenderSystemBase.hpp
/// @brief This file contains the ARenderSystemBase class
/// @namespace ven
///

#pragma once

#include <memory>

#include "VEngine/Descriptors/DescriptorSetLayout.hpp"
#include "VEngine/Device.hpp"
#include "VEngine/Shaders.hpp"
#include "VEngine/FrameInfo.hpp"

namespace ven {

    ///
    /// @class ARenderSystemBase
    /// @brief Abstract class for render system base
    /// @namespace ven
    ///
    class ARenderSystemBase {

        public:

            explicit ARenderSystemBase(Device& device) : m_device{device} {}
            virtual ~ARenderSystemBase() { vkDestroyPipelineLayout(m_device.device(), m_pipelineLayout, nullptr); }

            virtual void render(const FrameInfo &frameInfo) const = 0;

        protected:

            void createPipelineLayout(VkDescriptorSetLayout globalSetLayout, uint32_t pushConstantSize);
            void createPipeline(VkRenderPass renderPass, const std::string &shadersVertPath, const std::string &shadersFragPath, bool isLight);

            [[nodiscard]] Device& getDevice() const { return m_device; }
            [[nodiscard]] VkPipelineLayout getPipelineLayout() const { return m_pipelineLayout; }
            [[nodiscard]] const std::unique_ptr<Shaders>& getShaders() const { return m_shaders; }

            std::unique_ptr<DescriptorSetLayout> renderSystemLayout;

        private:

            Device &m_device;
            VkPipelineLayout m_pipelineLayout{nullptr};
            std::unique_ptr<Shaders> m_shaders;


    }; // class ARenderSystemBase

} // namespace ven
```

8.39 /home/runner/work/VEngine/VEngine/include/VEngine/RenderSystem/ObjectRenderSystem.hpp File Reference

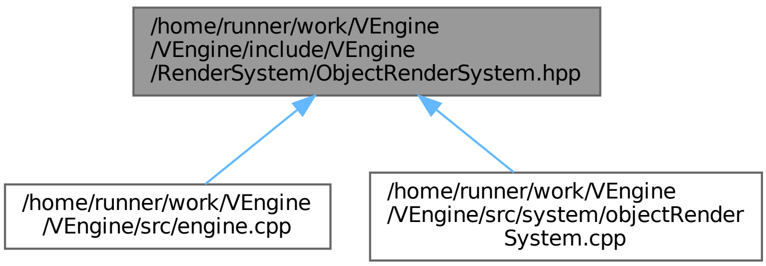
This file contains the ObjectRenderSystem class.

```
#include "VEngine/FrameInfo.hpp"
#include "VEngine/RenderSystem/ARenderSystemBase.hpp"
```

Include dependency graph for ObjectRenderSystem.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct ven::ObjectPushConstantData
- class ven::ObjectRenderSystem

    Class for object render system.

Namespaces

- namespace ven

8.39.1 Detailed Description

This file contains the ObjectRenderSystem class.

Definition in file ObjectRenderSystem.hpp.

8.40 ObjectRenderSystem.hpp

[Go to the documentation of this file.](#)

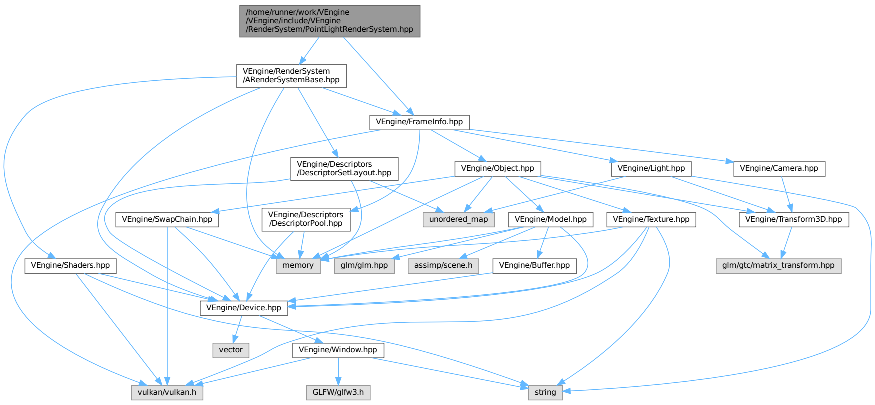
```
///
/// @file ObjectRenderSystem.hpp
/// @brief This file contains the ObjectRenderSystem class
/// @namespace ven
///

#pragma once

#include "VEngine/FrameInfo.hpp"
#include "VEngine/RenderSystem/ARenderSystemBase.hpp"

namespace ven {

    struct ObjectPushConstantData {
        glm::mat4 modelMatrix{};
        glm::mat4 normalMatrix{};
    };

    ///
    /// @class ObjectRenderSystem
    /// @brief Class for object render system
    /// @namespace ven
    ///
    class ObjectRenderSystem final : public ARenderSystemBase {

        public:

            explicit ObjectRenderSystem(Device& device, const VkRenderPass renderPass, const VkDescriptorSetLayout globalSetLayout) : ARenderSystemBase(device) {
                createPipelineLayout(globalSetLayout, sizeof(ObjectPushConstantData));
                createPipeline(renderPass, std::string(SHADERS_BIN_PATH) + "vertex_shader.spv", std::string(SHADERS_BIN_PATH) + "fragment_shader.spv", false);
            }

            ObjectRenderSystem(const ObjectRenderSystem&) = delete;
            ObjectRenderSystem& operator=(const ObjectRenderSystem&) = delete;

            void render(const FrameInfo &frameInfo) const override;

    }; // class ObjectRenderSystem

} // namespace ven
```

8.41 /home/runner/work/VEngine/VEngine/include/VEngine/RenderSystem/PointLightRenderSystem.hpp File Reference

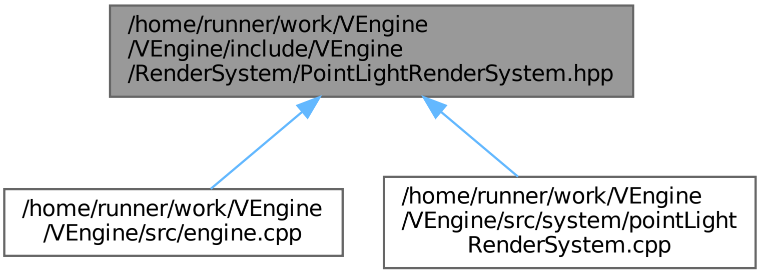
This file contains the PointLightRenderSystem class.

```
#include "VEngine/RenderSystem/ARenderSystemBase.hpp"
#include "VEngine/FrameInfo.hpp"
```

Include dependency graph for PointLightRenderSystem.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct ven::LightPushConstantData
- class ven::PointLightRenderSystem

    Class for point light system.

Namespaces

- namespace ven

8.41.1 Detailed Description

This file contains the PointLightRenderSystem class.

Definition in file PointLightRenderSystem.hpp.

8.42 PointLightRenderSystem.hpp

Go to the documentation of this file.

```
///
/// @file PointLightRenderSystem.hpp
/// @brief This file contains the PointLightRenderSystem class
/// @namespace ven
///

#pragma once

#include "VEngine/RenderSystem/ARenderSystemBase.hpp"
#include "VEngine/FrameInfo.hpp"

namespace ven {

    struct LightPushConstantData {
        glm::vec4 position{};
        glm::vec4 color{};
        float radius;
    };

    ///
    /// @class PointLightRenderSystem
    /// @brief Class for point light system
```

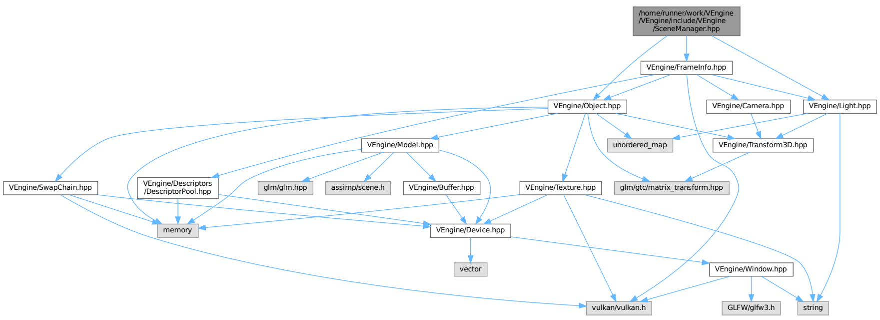
```
    /// @namespace ven
    ///
    class PointLightRenderSystem final : public ARenderSystemBase {

        public:

            explicit PointLightRenderSystem(Device& device, const VkRenderPass renderPass, const
VkDescriptorSetLayout globalSetLayout) : ARenderSystemBase(device) {
                createPipelineLayout(globalSetLayout, sizeof(LightPushConstantData));
                createPipeline(renderPass, std::string(SHADERS_BIN_PATH) + "vertex_point_light.spv",
std::string(SHADERS_BIN_PATH) + "fragment_point_light.spv", true);
            }

            PointLightRenderSystem(const PointLightRenderSystem&) = delete;
            PointLightRenderSystem& operator=(const PointLightRenderSystem&) = delete;

            void render(const FrameInfo &frameInfo) const override;

    }; // class PointLightRenderSystem

} // namespace ven
```

8.43 /home/runner/work/VEngine/VEngine/include/VEngine/SceneManager.hpp File Reference

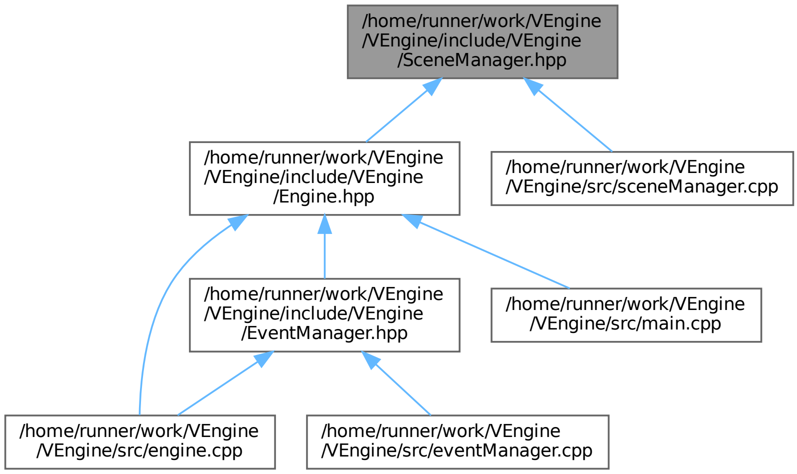
This file contains the SceneManager class.

```
#include "VEngine/FrameInfo.hpp"
#include "VEngine/Object.hpp"
#include "VEngine/Light.hpp"
```

Include dependency graph for SceneManager.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::SceneManager

  Class for object manager.

Namespaces

- namespace ven

8.43.1 Detailed Description

This file contains the SceneManager class.

Definition in file SceneManager.hpp.

8.44 SceneManager.hpp

Go to the documentation of this file.

```
///
/// @file SceneManager.hpp
/// @brief This file contains the SceneManager class
/// @namespace ven
///

#pragma once

#include "VEngine/FrameInfo.hpp"
#include "VEngine/Object.hpp"
#include "VEngine/Light.hpp"

namespace ven {

    ///
```

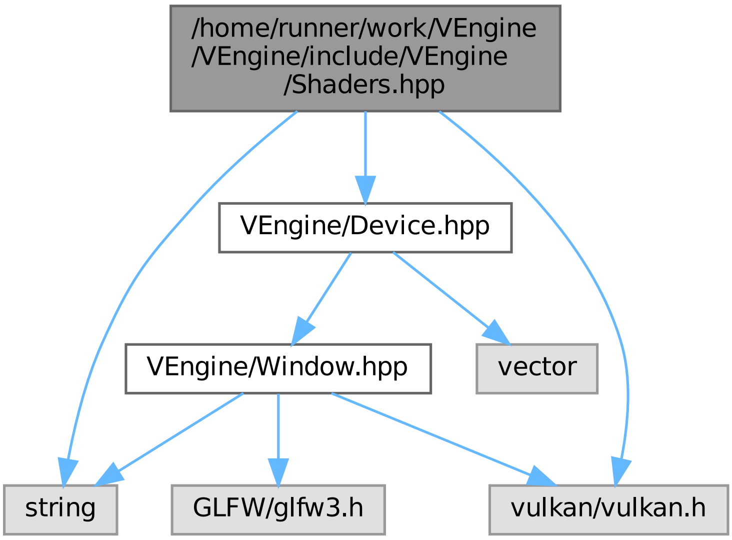
```
    /// @class SceneManager
    /// @brief Class for object manager
    /// @namespace ven
    ///
    class SceneManager {

        public:

            explicit SceneManager(Device &device);

            SceneManager(const SceneManager &) = delete;
            SceneManager &operator=(const SceneManager &) = delete;
            SceneManager(SceneManager &&) = delete;
            SceneManager &operator=(SceneManager &&) = delete;

            Object& createObject();
            Light& createLight(float radius = DEFAULT_LIGHT_RADIUS, glm::vec4 color = DEFAULT_LIGHT_COLOR);

            VkDescriptorBufferInfo getBufferInfoForObject(const int frameIndex, const unsigned int objectId) const { return m_uboBuffers.at(static_cast<long unsigned int>(frameIndex))->descriptorInfoForIndex(objectId); }
            Object::Map& getObjects() { return m_objects; }
            Light::Map& getLights() { return m_lights; }
            std::vector<std::unique_ptr<Buffer>> &getUboBuffers() { return m_uboBuffers; }

            void updateBuffer(GlobalUbo &ubo, unsigned long frameIndex, float frameTime);

        private:

            unsigned int m_currentObjId{0};
            unsigned int m_currentLightId{0};
            std::shared_ptr<Texture> m_textureDefault;
            Object::Map m_objects;
            Light::Map m_lights;
            std::vector<std::unique_ptr<Buffer>> m_uboBuffers{MAX_FRAMES_IN_FLIGHT};

    }; // class SceneManager

} // namespace ven
```

8.45 /home/runner/work/VEngine/VEngine/include/VEngine/Shaders.hpp File Reference

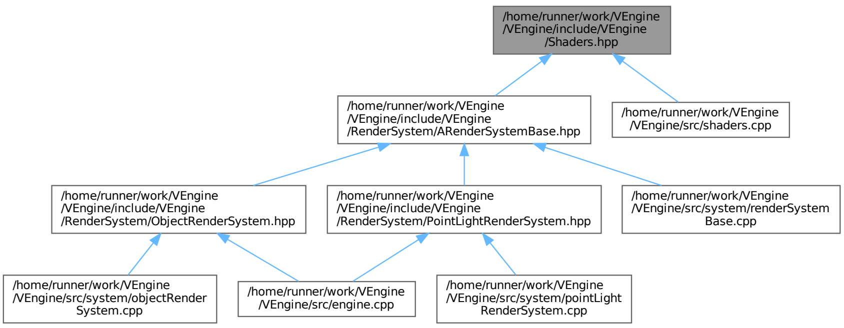
This file contains the Shader class.

```
#include <string>
#include <vulkan/vulkan.h>
#include "VEngine/Device.hpp"
```

Include dependency graph for Shaders.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct ven::PipelineConfigInfo
- class ven::Shaders

    Class for shaders.

Namespaces

- namespace ven

Variables

- static constexpr std::string_view ven::SHADERS_BIN_PATH = "build/shaders/"

8.45.1 Detailed Description

This file contains the Shader class.

Definition in file Shaders.hpp.

8.46 Shaders.hpp

Go to the documentation of this file.

```
///
/// @file Shaders.hpp
/// @brief This file contains the Shader class
/// @namespace ven
///

#pragma once

#include <string>

#include <vulkan/vulkan.h>

#include "VEngine/Device.hpp"

namespace ven {

    static constexpr std::string_view SHADERS_BIN_PATH = "build/shaders/";

    struct PipelineConfigInfo {
        PipelineConfigInfo() = default;
        PipelineConfigInfo(const PipelineConfigInfo&) = delete;
        PipelineConfigInfo& operator=(const PipelineConfigInfo&) = delete;

        std::vector<VkVertexInputBindingDescription> bindingDescriptions;
        std::vector<VkVertexInputAttributeDescription> attributeDescriptions;
        VkPipelineInputAssemblyStateCreateInfo inputAssemblyInfo{};
        VkPipelineRasterizationStateCreateInfo rasterizationInfo{};
        VkPipelineMultisampleStateCreateInfo multisampleInfo{};
        VkPipelineColorBlendAttachmentState colorBlendAttachment{};
        VkPipelineColorBlendStateCreateInfo colorBlendInfo{};
        VkPipelineDepthStencilStateCreateInfo depthStencilInfo{};
        std::vector<VkDynamicState> dynamicStateEnables;
        VkPipelineDynamicStateCreateInfo dynamicStateInfo{};
        VkPipelineLayout pipelineLayout = nullptr;
        VkRenderPass renderPass = nullptr;
        uint32_t subpass = 0;
    };

    ///
    /// @class Shaders
    /// @brief Class for shaders
    /// @namespace ven
    ///
    class Shaders {

        public:

            Shaders(Device &device, const std::string& vertFilepath, const std::string& fragFilepath, const PipelineConfigInfo& configInfo) : m_device{device} { createGraphicsPipeline(vertFilepath, fragFilepath, configInfo); };
            ~Shaders();

            Shaders(const Shaders&) = delete;
            Shaders& operator=(const Shaders&) = delete;

            static void defaultPipelineConfigInfo(PipelineConfigInfo& configInfo);
            void bind(const VkCommandBuffer commandBuffer) const { vkCmdBindPipeline(commandBuffer, VK_PIPELINE_BIND_POINT_GRAPHICS, m_graphicsPipeline); }

        private:

```

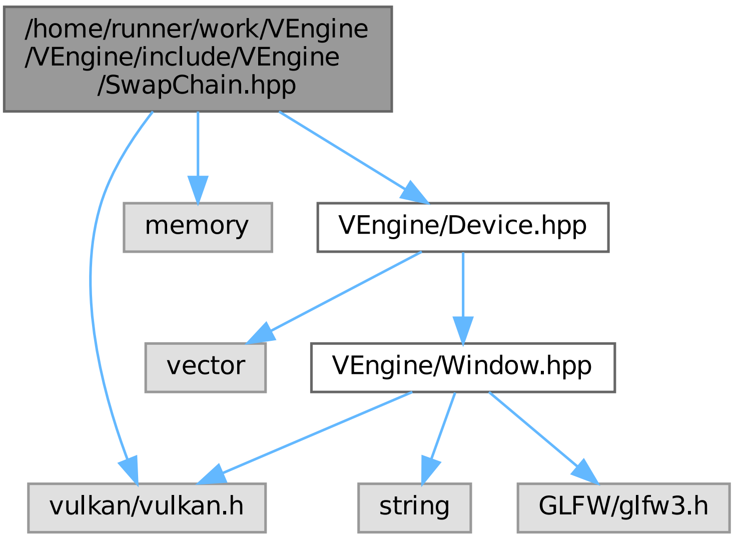
```
            static std::vector<char> readFile(const std::string &filename);
            void createGraphicsPipeline(const std::string& vertFilepath, const std::string&
    fragFilepath, const PipelineConfigInfo& configInfo);
            void createShaderModule(const std::vector<char>& code, VkShaderModule* shaderModule)
    const;

            Device& m_device;
            VkPipeline m_graphicsPipeline{nullptr};
            VkShaderModule m_vertShaderModule{nullptr};
            VkShaderModule m_fragShaderModule{nullptr};

    }; // class Shaders

} // namespace ven
```

8.47 /home/runner/work/VEngine/VEngine/include/VEngine/Swap↵ Chain.hpp File Reference

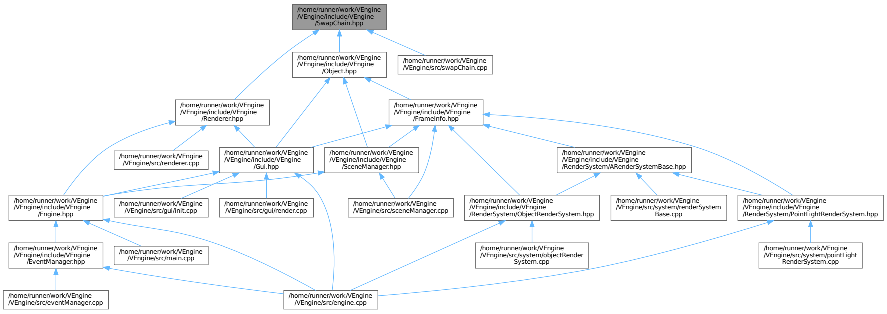
This file contains the Shader class.

```
#include <vulkan/vulkan.h>
#include <memory>
#include "VEngine/Device.hpp"
```

Include dependency graph for SwapChain.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::SwapChain

  Class for swap chain.

Namespaces

- namespace ven

Variables

- static constexpr int ven::MAX_FRAMES_IN_FLIGHT = 2

8.47.1 Detailed Description

This file contains the Shader class.

Definition in file SwapChain.hpp.

8.48 SwapChain.hpp

Go to the documentation of this file.

```
///
/// @file SwapChain.hpp
/// @brief This file contains the Shader class
/// @namespace ven
///

#pragma once

#include <vulkan/vulkan.h>
#include <memory>

#include "VEngine/Device.hpp"

namespace ven {

    static constexpr int MAX_FRAMES_IN_FLIGHT = 2;

    ///
    /// @class SwapChain
```

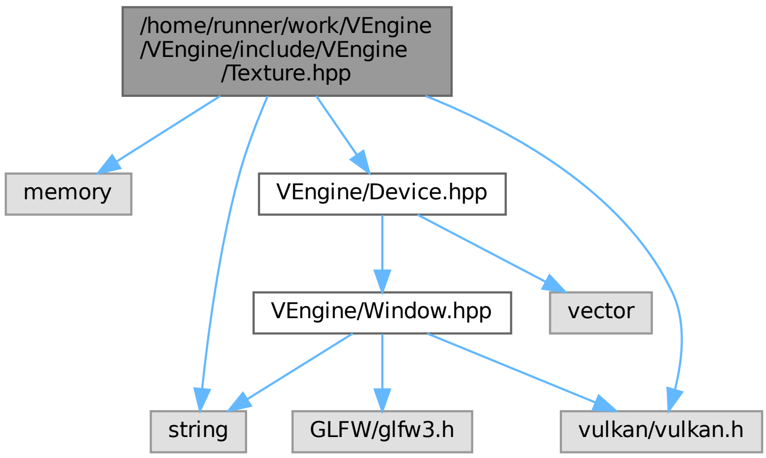
```cpp
    /// @brief Class for swap chain
    /// @namespace ven
    ///
    class SwapChain {

        public:

            SwapChain(Device &deviceRef, const VkExtent2D windowExtentRef) : m_device{deviceRef}, m_windowExtent{windowExtentRef} { init(); }
            SwapChain(Device &deviceRef, const VkExtent2D windowExtentRef, std::shared_ptr<SwapChain> previous) : m_device{deviceRef}, m_windowExtent{windowExtentRef}, m_oldSwapChain{std::move(previous)} { init(); m_oldSwapChain = nullptr; }
            ~SwapChain();

            SwapChain(const SwapChain &) = delete;
            SwapChain& operator=(const SwapChain &) = delete;

            [[nodiscard]] VkFramebuffer getFrameBuffer(const unsigned long index) const { return m_swapChainFrameBuffers[index]; }
            [[nodiscard]] VkRenderPass getRenderPass() const { return m_renderPass; }
            [[nodiscard]] VkImageView getImageView(const int index) const { return m_swapChainImageViews[static_cast<unsigned long>(index)]; }
            [[nodiscard]] size_t imageCount() const { return m_swapChainImages.size(); }
            [[nodiscard]] VkFormat getSwapChainImageFormat() const { return m_swapChainImageFormat; }
            [[nodiscard]] VkExtent2D getSwapChainExtent() const { return m_swapChainExtent; }
            [[nodiscard]] uint32_t width() const { return m_swapChainExtent.width; }
            [[nodiscard]] uint32_t height() const { return m_swapChainExtent.height; }

            [[nodiscard]] float extentAspectRatio() const { return static_cast<float>(m_swapChainExtent.width) / static_cast<float>(m_swapChainExtent.height); }
            [[nodiscard]] VkFormat findDepthFormat() const;

            VkResult acquireNextImage(uint32_t *imageIndex) const;
            VkResult submitCommandBuffers(const VkCommandBuffer *buffers, const uint32_t *imageIndex);

            [[nodiscard]] bool compareSwapFormats(const SwapChain &swapChain) const { return m_swapChainImageFormat == swapChain.m_swapChainImageFormat && m_swapChainDepthFormat == swapChain.m_swapChainDepthFormat; }

        private:

            void init();
            void createSwapChain();
            void createImageViews();
            void createDepthResources();
            void createRenderPass();
            void createFrameBuffers();
            void createSyncObjects();

            static VkSurfaceFormatKHR chooseSwapSurfaceFormat(const std::vector<VkSurfaceFormatKHR> &availableFormats);
            static VkPresentModeKHR chooseSwapPresentMode(const std::vector<VkPresentModeKHR> &availablePresentModes);
            [[nodiscard]] VkExtent2D chooseSwapExtent(const VkSurfaceCapabilitiesKHR &capabilities) const;

            VkFormat m_swapChainImageFormat{};
            VkFormat m_swapChainDepthFormat{};
            VkExtent2D m_swapChainExtent{};

            std::vector<VkFramebuffer> m_swapChainFrameBuffers;
            VkRenderPass m_renderPass{};

            std::vector<VkImage> m_depthImages;
            std::vector<VkDeviceMemory> m_depthImageMemory;
            std::vector<VkImageView> m_depthImageViews;
            std::vector<VkImage> m_swapChainImages;
            std::vector<VkImageView> m_swapChainImageViews;

            Device &m_device;
            VkExtent2D m_windowExtent;

            VkSwapchainKHR m_swapChain{};
            std::shared_ptr<SwapChain> m_oldSwapChain;

            std::vector<VkSemaphore> m_imageAvailableSemaphores;
            std::vector<VkSemaphore> m_renderFinishedSemaphores;
            std::vector<VkFence> m_inFlightFences;
            std::vector<VkFence> m_imagesInFlight;
            size_t m_currentFrame{0};

    }; // class SwapChain

} // namespace ven
```

8.49 /home/runner/work/VEngine/VEngine/include/VEngine/Texture.hpp File Reference

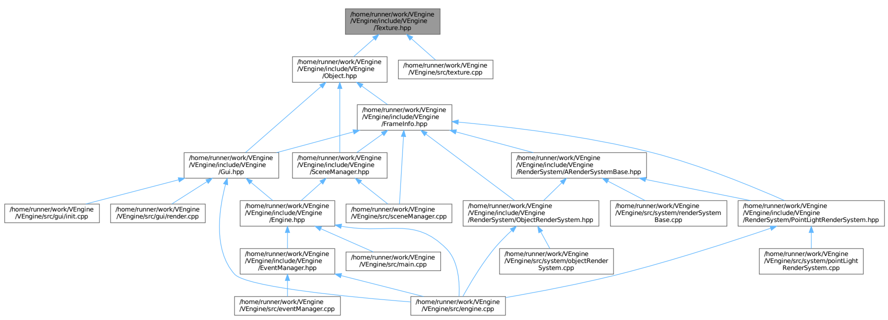
This file contains the Texture class.

```
#include <memory>
#include <string>
#include <vulkan/vulkan.h>
#include "VEngine/Device.hpp"
```

Include dependency graph for Texture.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Texture

  Class for texture.

Namespaces

- namespace ven

8.49.1 Detailed Description

This file contains the Texture class.

Definition in file Texture.hpp.

8.50 Texture.hpp

Go to the documentation of this file.

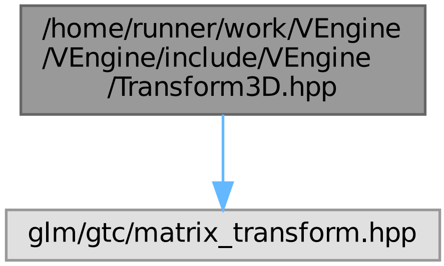
```
///
/// @file Texture.hpp
/// @brief This file contains the Texture class
/// @namespace ven
///

#pragma once

#include <memory>
#include <string>

#include<vulkan/vulkan.h>

#include "VEngine/Device.hpp"

namespace ven {

    ///
    /// @class Texture
    /// @brief Class for texture
    /// @namespace ven
    ///
    class Texture {

        public:

            Texture(Device &device, const std::string &textureFilepath);
            Texture(Device &device, VkFormat format, VkExtent3D extent, VkImageUsageFlags usage, VkSampleCountFlagBits sampleCount);
            ~Texture();

            Texture(const Texture &) = delete;
            Texture &operator=(const Texture &) = delete;

            static std::unique_ptr<Texture> createTextureFromFile(Device &device, const std::string &filepath) { return std::make_unique<Texture>(device, filepath); }

            void updateDescriptor();
            void transitionLayout(VkCommandBuffer commandBuffer, VkImageLayout oldLayout, VkImageLayout newLayout) const;

            [[nodiscard]] VkImageView imageView() const { return m_textureImageView; }
            [[nodiscard]] VkSampler sampler() const { return m_textureSampler; }
            [[nodiscard]] VkImage getImage() const { return m_textureImage; }
            [[nodiscard]] VkImageView getImageView() const { return m_textureImageView; }
            [[nodiscard]] VkDescriptorImageInfo getImageInfo() const { return m_descriptor; }
            [[nodiscard]] VkImageLayout getImageLayout() const { return m_textureLayout; }
            [[nodiscard]] VkExtent3D getExtent() const { return m_extent; }
            [[nodiscard]] VkFormat getFormat() const { return m_format; }

        private:

            void createTextureImage(const std::string &filepath);
            void createTextureImageView(VkImageViewType viewType);
            void createTextureSampler();

            VkDescriptorImageInfo m_descriptor{};
            Device &m_device;
            VkImage m_textureImage = nullptr;
            VkDeviceMemory m_textureImageMemory = nullptr;
            VkImageView m_textureImageView = nullptr;
            VkSampler m_textureSampler = nullptr;
            VkFormat m_format;
            VkImageLayout m_textureLayout{};
            uint32_t m_mipLevels{1};
            uint32_t m_layerCount{1};
            VkExtent3D m_extent{};

    }; // class Texture

} // namespace ven
```

8.51 /home/runner/work/VEngine/VEngine/include/VEngine/↩ Transform3D.hpp File Reference

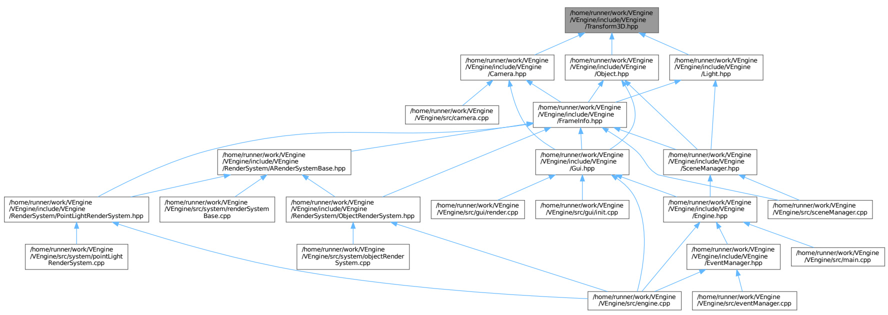
This file contains the Transform3D class.

`#include <glm/gtc/matrix_transform.hpp>`

Include dependency graph for Transform3D.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Transform3D

    Class for 3D transformation.

Namespaces

- namespace ven

8.51.1 Detailed Description

This file contains the Transform3D class.

Definition in file Transform3D.hpp.

8.52 Transform3D.hpp

Go to the documentation of this file.

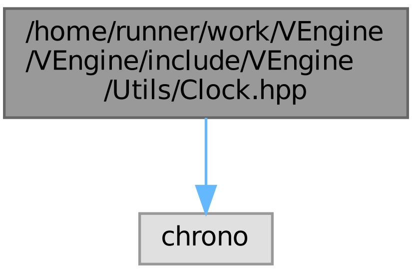
```
///
/// @file Transform3D.hpp
/// @brief This file contains the Transform3D class
/// @namespace ven
///

#pragma once

#include <glm/gtc/matrix_transform.hpp>

namespace ven {

    ///
    /// @class Transform3D
    /// @brief Class for 3D transformation
    /// @namespace ven
    ///
    class Transform3D {

        public:

            [[nodiscard]] glm::mat4 transformMatrix() const {
                auto rotationMatrix = glm::mat4(1.0F);

                rotationMatrix = rotate(rotationMatrix, rotation.x, glm::vec3(1.0F, 0.0F, 0.0F));
                rotationMatrix = rotate(rotationMatrix, rotation.y, glm::vec3(0.0F, 1.0F, 0.0F));
                rotationMatrix = rotate(rotationMatrix, rotation.z, glm::vec3(0.0F, 0.0F, 1.0F));

                const glm::mat4 scaleMatrix = glm::scale(glm::mat4(1.0F), scale);
                const glm::mat4 translationMatrix = translate(glm::mat4(1.0F), translation);

                return translationMatrix * rotationMatrix * scaleMatrix;
            }
            [[nodiscard]] glm::mat3 normalMatrix() const { return
transpose(inverse(glm::mat3(transformMatrix()))); }

            glm::vec3 translation{};
            glm::vec3 scale{1.F, 1.F, 1.F};
            glm::vec3 rotation{};

    }; // class Transform3D

} // namespace ven
```

8.53 /home/runner/work/VEngine/VEngine/include/VEngine/Utils/Clock.hpp File Reference

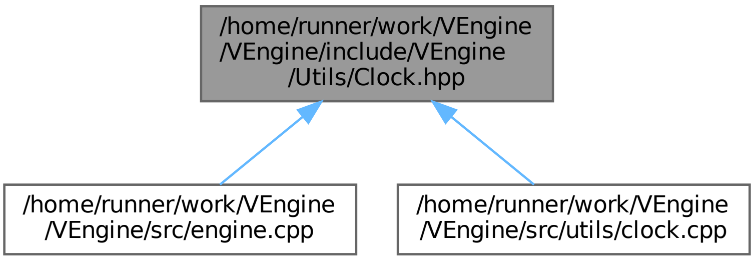
This file contains the Clock class.

`#include <chrono>`

Include dependency graph for Clock.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Clock

  Class for clock.

Namespaces

- namespace ven

Typedefs

- using ven::TimePoint = std::chrono::time_point<std::chrono::high_resolution_clock>

8.53.1 Detailed Description

This file contains the Clock class.

Definition in file Clock.hpp.

8.54 Clock.hpp

Go to the documentation of this file.

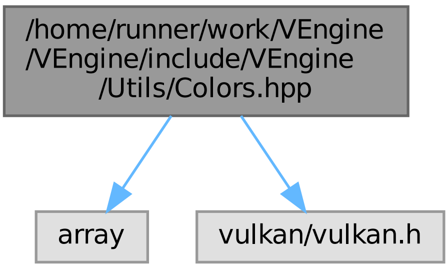
```
///
/// @file Clock.hpp
/// @brief This file contains the Clock class
/// @namespace ven
///

#pragma once

#include <chrono>

namespace ven {

    using TimePoint = std::chrono::time_point<std::chrono::high_resolution_clock>;

    ///
    /// @class Clock
```

```
    /// @brief Class for clock
    /// @namespace ven
    ///
    class Clock {

        public:

            Clock() { start(); }
            ~Clock() = default;

            Clock(const Clock&) = delete;
            Clock& operator=(const Clock&) = delete;

            void start() { m_startTime = std::chrono::high_resolution_clock::now(); }
            void stop();
            void resume();
            void update();

            [[nodiscard]] float getDeltaTime() const { return m_deltaTime.count(); }

        private:

            TimePoint m_startTime;
            TimePoint m_stopTime;
            std::chrono::duration<float> m_deltaTime{0.F};

            bool m_isStopped{false};

    }; // class Clock

} // namespace ven
```

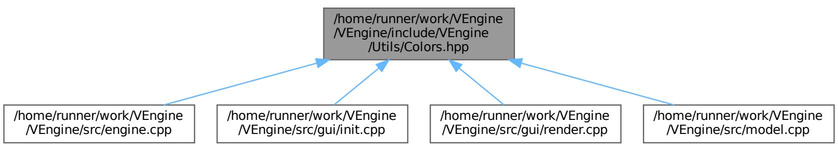
8.55 /home/runner/work/VEngine/VEngine/include/VEngine/Utils/Colors.hpp File Reference

`#include <array>`
`#include <vulkan/vulkan.h>`

Include dependency graph for Colors.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Colors

  Class for colors.

Namespaces

- namespace ven

Variables

- static constexpr float ven::COLOR_MAX = 255.0F

8.56 Colors.hpp

Go to the documentation of this file.

```
///
/// @file Colors.hpp
/// @brief
/// @namespace ven
///

#pragma once

#include <array>

#include <vulkan/vulkan.h>

namespace ven {

    static constexpr float COLOR_MAX = 255.0F;

    ///
    /// @class Colors
    /// @brief Class for colors
    /// @namespace ven
    ///
    class Colors {

        public:

            static constexpr glm::vec3 WHITE_3 = glm::vec3(COLOR_MAX) / COLOR_MAX;
            static constexpr glm::vec4 WHITE_4 = { 1.0F, 1.0F, 1.0F, 1.0F };
            static constexpr VkClearColorValue WHITE_V = { { 1.0F, 1.0F, 1.0F, 1.0F } };

            static constexpr glm::vec3 BLACK_3 = glm::vec3(0.0F);
            static constexpr glm::vec4 BLACK_4 = { 0.0F, 0.0F, 0.0F, 1.0F };
            static constexpr VkClearColorValue BLACK_V = { { 0.0F, 0.0F, 0.0F, 1.0F } };

            static constexpr glm::vec3 RED_3 = glm::vec3(COLOR_MAX, 0.0F, 0.0F) / COLOR_MAX;
            static constexpr glm::vec4 RED_4 = { 1.0F, 0.0F, 0.0F, 1.0F };
            static constexpr VkClearColorValue RED_V = { { 1.0F, 0.0F, 0.0F, 1.0F } };

            static constexpr glm::vec3 GREEN_3 = glm::vec3(0.0F, COLOR_MAX, 0.0F) / COLOR_MAX;
            static constexpr glm::vec4 GREEN_4 = { 0.0F, 1.0F, 0.0F, 1.0F };
            static constexpr VkClearColorValue GREEN_V = { { 0.0F, 1.0F, 0.0F, 1.0F } };

            static constexpr glm::vec3 BLUE_3 = glm::vec3(0.0F, 0.0F, COLOR_MAX) / COLOR_MAX;
            static constexpr glm::vec4 BLUE_4 = { 0.0F, 0.0F, 1.0F, 1.0F };
            static constexpr VkClearColorValue BLUE_V = { { 0.0F, 0.0F, 1.0F, 1.0F } };

            static constexpr glm::vec3 YELLOW_3 = glm::vec3(COLOR_MAX, COLOR_MAX, 0.0F) / COLOR_MAX;
            static constexpr glm::vec4 YELLOW_4 = { 1.0F, 1.0F, 0.0F, 1.0F };
            static constexpr VkClearColorValue YELLOW_V = { { 1.0F, 1.0F, 0.0F, 1.0F } };

            static constexpr glm::vec3 CYAN_3 = glm::vec3(0.0F, COLOR_MAX, COLOR_MAX) / COLOR_MAX;
            static constexpr glm::vec4 CYAN_4 = { 0.0F, 1.0F, 1.0F, 1.0F };
            static constexpr VkClearColorValue CYAN_V = { { 0.0F, 1.0F, 1.0F, 1.0F } };

            static constexpr glm::vec3 MAGENTA_3 = glm::vec3(COLOR_MAX, 0.0F, COLOR_MAX) / COLOR_MAX;
            static constexpr glm::vec4 MAGENTA_4 = { 1.0F, 0.0F, 1.0F, 1.0F };
            static constexpr VkClearColorValue MAGENTA_V = { { 1.0F, 0.0F, 1.0F, 1.0F } };
```

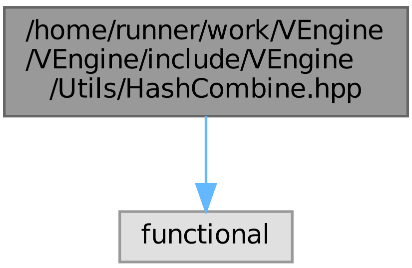
```
        static constexpr glm::vec3 SILVER_3 = glm::vec3(192.0F, 192.0F, 192.0F) / COLOR_MAX;
        static constexpr glm::vec4 SILVER_4 = { 0.75F, 0.75F, 0.75F, 1.0F };
        static constexpr VkClearColorValue SILVER_V = { { 0.75F, 0.75F, 0.75F, 1.0F } };

        static constexpr glm::vec3 GRAY_3 = glm::vec3(128.0F, 128.0F, 128.0F) / COLOR_MAX;
        static constexpr glm::vec4 GRAY_4 = { 0.5F, 0.5F, 0.5F, 1.0F };
        static constexpr VkClearColorValue GRAY_V = { { 0.5F, 0.5F, 0.5F, 1.0F } };

        static constexpr glm::vec3 MAROON_3 = glm::vec3(128.0F, 0.0F, 0.0F) / COLOR_MAX;
        static constexpr glm::vec4 MAROON_4 = { 0.5F, 0.0F, 0.0F, 1.0F };
        static constexpr VkClearColorValue MAROON_V = { { 0.5F, 0.0F, 0.0F, 1.0F } };

        static constexpr glm::vec3 OLIVE_3 = glm::vec3(128.0F, 128.0F, 0.0F) / COLOR_MAX;
        static constexpr glm::vec4 OLIVE_4 = { 0.5F, 0.5F, 0.0F, 1.0F };
        static constexpr VkClearColorValue OLIVE_V = { { 0.5F, 0.5F, 0.0F, 1.0F } };

        static constexpr glm::vec3 LIME_3 = glm::vec3(0.0F, COLOR_MAX, 0.0F) / COLOR_MAX;
        static constexpr glm::vec4 LIME_4 = { 0.0F, 1.0F, 0.0F, 1.0F };
        static constexpr VkClearColorValue LIME_V = { { 0.0F, 1.0F, 0.0F, 1.0F } };

        static constexpr glm::vec3 AQUA_3 = glm::vec3(0.0F, COLOR_MAX, COLOR_MAX) / COLOR_MAX;
        static constexpr glm::vec4 AQUA_4 = { 0.0F, 1.0F, 1.0F, 1.0F };
        static constexpr VkClearColorValue AQUA_V = { { 0.0F, 1.0F, 1.0F, 1.0F } };

        static constexpr glm::vec3 TEAL_3 = glm::vec3(0.0F, 128.0F, 128.0F) / COLOR_MAX;
        static constexpr glm::vec4 TEAL_4 = { 0.0F, 0.5F, 0.5F, 1.0F };
        static constexpr VkClearColorValue TEAL_V = { { 0.0F, 0.5F, 0.5F, 1.0F } };

        static constexpr glm::vec3 NAVY_3 = glm::vec3(0.0F, 0.0F, 128.0F) / COLOR_MAX;
        static constexpr glm::vec4 NAVY_4 = { 0.0F, 0.0F, 0.5F, 1.0F };
        static constexpr VkClearColorValue NAVY_V = { { 0.0F, 0.0F, 0.5F, 1.0F } };

        static constexpr glm::vec3 FUCHSIA_3 = glm::vec3(COLOR_MAX, 0.0F, COLOR_MAX) / COLOR_MAX;
        static constexpr glm::vec4 FUCHSIA_4 = { 1.0F, 0.0F, 1.0F, 1.0F };
        static constexpr VkClearColorValue FUCHSIA_V = { { 1.0F, 0.0F, 1.0F, 1.0F } };

        static constexpr glm::vec3 NIGHT_BLUE_3 = glm::vec3(25.0F, 25.0F, 112.0F) / COLOR_MAX;
        static constexpr glm::vec4 NIGHT_BLUE_4 = { 0.098F, 0.098F, 0.439F, 1.0F };
        static constexpr VkClearColorValue NIGHT_BLUE_V = { { 0.098F, 0.098F, 0.439F, 1.0F } };

        static constexpr glm::vec3 SKY_BLUE_3 = glm::vec3(102.0F, 178.0F, 255.0F) / COLOR_MAX;
        static constexpr glm::vec4 SKY_BLUE_4 = { 0.4F, 0.698F, 1.0F, 1.0F };
        static constexpr VkClearColorValue SKY_BLUE_V = { { 0.4F, 0.698F, 1.0F, 1.0F } };

        static constexpr glm::vec3 SUNSET_3 = glm::vec3(255.0F, 128.0F, 0.0F) / COLOR_MAX;
        static constexpr glm::vec4 SUNSET_4 = { 1.0F, 0.5F, 0.0F, 1.0F };
        static constexpr VkClearColorValue SUNSET_V = { { 1.0F, 0.5F, 0.0F, 1.0F } };


        static constexpr std::array<std::pair<const char *, glm::vec3>, 20> COLOR_PRESETS_3 = {{
            {"White", WHITE_3},
            {"Black", BLACK_3},
            {"Red", RED_3},
            {"Green", GREEN_3},
            {"Blue", BLUE_3},
            {"Yellow", YELLOW_3},
            {"Cyan", CYAN_3},
            {"Magenta", MAGENTA_3},
            {"Silver", SILVER_3},
            {"Gray", GRAY_3},
            {"Maroon", MAROON_3},
            {"Olive", OLIVE_3},
            {"Lime", LIME_3},
            {"Aqua", AQUA_3},
            {"Teal", TEAL_3},
            {"Navy", NAVY_3},
            {"Fuchsia", FUCHSIA_3},
            {"Night Blue", NIGHT_BLUE_3},
            {"Sky Blue", SKY_BLUE_3},
            {"Sunset", SUNSET_3}
        }};

        static constexpr std::array<std::pair<const char *, glm::vec4>, 20> COLOR_PRESETS_4 = {{
            {"White", WHITE_4},
            {"Black", BLACK_4},
            {"Red", RED_4},
            {"Green", GREEN_4},
            {"Blue", BLUE_4},
            {"Yellow", YELLOW_4},
            {"Cyan", CYAN_4},
            {"Magenta", MAGENTA_4},
            {"Silver", SILVER_4},
            {"Gray", GRAY_4},
            {"Maroon", MAROON_4},
            {"Olive", OLIVE_4},
            {"Lime", LIME_4},
```

```
                {"Aqua", AQUA_4},
                {"Teal", TEAL_4},
                {"Navy", NAVY_4},
                {"Fuchsia", FUCHSIA_4},
                {"Night Blue", NIGHT_BLUE_4},
                {"Sky Blue", SKY_BLUE_4},
                {"Sunset", SUNSET_4}
            }};

            static constexpr std::array<std::pair<const char *, VkClearColorValue>, 20> COLOR_PRESETS_VK = {{
                {"White", WHITE_V},
                {"Black", BLACK_V},
                {"Red", RED_V},
                {"Green", GREEN_V},
                {"Blue", BLUE_V},
                {"Yellow", YELLOW_V},
                {"Cyan", CYAN_V},
                {"Magenta", MAGENTA_V},
                {"Silver", SILVER_V},
                {"Gray", GRAY_V},
                {"Maroon", MAROON_V},
                {"Olive", OLIVE_V},
                {"Lime", LIME_V},
                {"Aqua", AQUA_V},
                {"Teal", TEAL_V},
                {"Navy", NAVY_V},
                {"Fuchsia", FUCHSIA_V},
                {"Night Blue", NIGHT_BLUE_V},
                {"Sky Blue", SKY_BLUE_V},
                {"Sunset", SUNSET_V}
            }};

    }; // class Colors

} // namespace ven
```

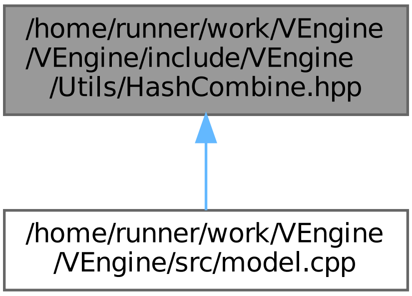
8.57 /home/runner/work/VEngine/VEngine/include/VEngine/Utils/HashCombine.hpp File Reference

`#include <functional>`

Include dependency graph for HashCombine.hpp:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace ven

Functions

- template<typename T , typename... Rest>
  void ven::hashCombine (std::size_t &seed, const T &v, const Rest &... rest)

8.58 HashCombine.hpp

Go to the documentation of this file.

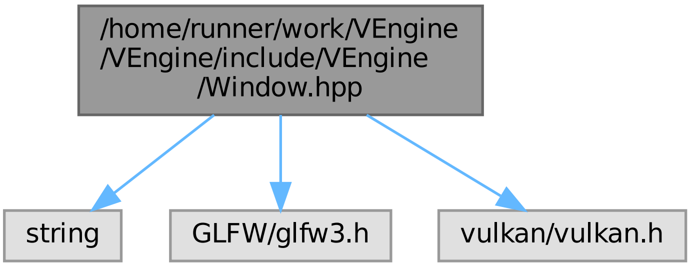
```
///
/// @file HashCombine.hpp
/// @brief
/// @namespace ven
///

#pragma once

#include <functional>

namespace ven {

    template<typename T, typename... Rest>
    void hashCombine(std::size_t& seed, const T& v, const Rest&... rest) {
        seed ^= std::hash<T>{}(v) + 0x9e3779b9 + (seed « 6) + (seed » 2);
        (hashCombine(seed, rest), ...);
    }

} // namespace ven
```

8.59 /home/runner/work/VEngine/VEngine/include/VEngine/Window.hpp File Reference

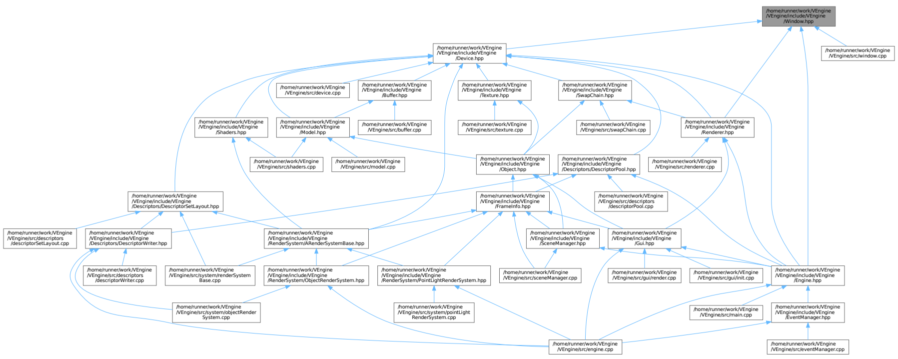
This file contains the Window class.

```
#include <string>
#include <GLFW/glfw3.h>
#include <vulkan/vulkan.h>
```

Include dependency graph for Window.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class ven::Window

    Class for window.

Namespaces

- namespace ven

Macros

- #define GLFW_INCLUDE_VULKAN

Variables

- static constexpr uint32_t ven::DEFAULT_WIDTH = 1920
- static constexpr uint32_t ven::DEFAULT_HEIGHT = 1080
- static constexpr std::string_view ven::DEFAULT_TITLE = "VEngine"

8.59.1 Detailed Description

This file contains the Window class.

Definition in file Window.hpp.

8.59.2 Macro Definition Documentation

8.59.2.1 GLFW_INCLUDE_VULKAN

```
#define GLFW_INCLUDE_VULKAN
```

Definition at line 11 of file Window.hpp.

8.60 Window.hpp

Go to the documentation of this file.

```
00001 ///
00002 /// @file Window.hpp
00003 /// @brief This file contains the Window class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <string>
00010
00011 #define GLFW_INCLUDE_VULKAN
00012 #include <GLFW/glfw3.h>
00013 #include <vulkan/vulkan.h>
00014
00015 namespace ven {
00016
00017     static constexpr uint32_t DEFAULT_WIDTH = 1920;
00018     static constexpr uint32_t DEFAULT_HEIGHT = 1080;
00019     static constexpr std::string_view DEFAULT_TITLE = "VEngine";
00020
00021     ///
00022     /// @class Window
00023     /// @brief Class for window
00024     /// @namespace ven
00025     ///
00026     class Window {
00027
00028         public:
00029
00030             explicit Window(const uint32_t width = DEFAULT_WIDTH, const uint32_t height =
      DEFAULT_HEIGHT, const std::string &title = DEFAULT_TITLE.data()) : m_window(createWindow(width,
      height, title)), m_width(width), m_height(height) {}
00031             ~Window() { glfwDestroyWindow(m_window); glfwTerminate(); m_window = nullptr;};
00032
00033             Window(const Window&) = delete;
00034             Window& operator=(const Window&) = delete;
00035
00036             [[nodiscard]] GLFWwindow* createWindow(uint32_t width, uint32_t height, const std::string
      &title);
00037             void createWindowSurface(VkInstance instance, VkSurfaceKHR* surface) const;
00038
00039             [[nodiscard]] GLFWwindow* getGLFWindow() const { return m_window; }
00040
```

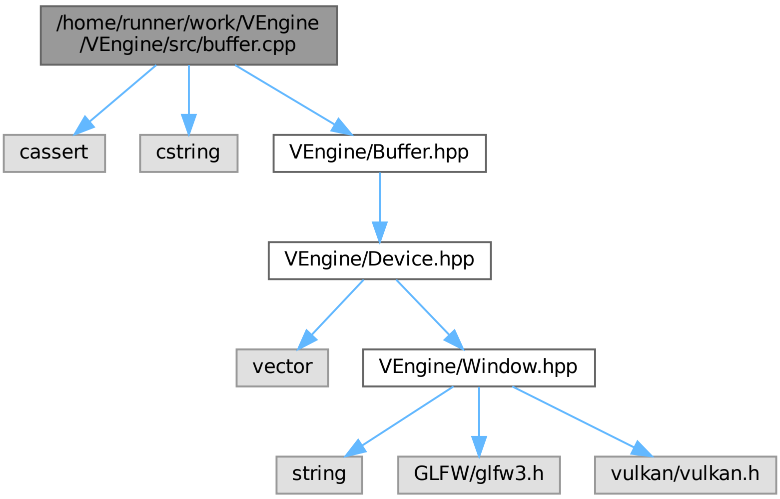
```
        [[nodiscard]] VkExtent2D getExtent() const { return {m_width, m_height}; }
        [[nodiscard]] bool wasWindowResized() const { return m_framebufferResized; }
        void resetWindowResizedFlag() { m_framebufferResized = false; }

        void setFullscreen(bool fullscreen, uint32_t width, uint32_t height);

    private:

        static void framebufferResizeCallback(GLFWwindow* window, int width, int height);

        GLFWwindow* m_window{nullptr};
        uint32_t m_width{DEFAULT_WIDTH};
        uint32_t m_height{DEFAULT_HEIGHT};

        bool m_framebufferResized = false;

    }; // class Window

} // namespace ven
```

8.61 /home/runner/work/VEngine/VEngine/README.md File Reference

8.62 /home/runner/work/VEngine/VEngine/src/buffer.cpp File Reference

```
#include <cassert>
#include <cstring>
#include "VEngine/Buffer.hpp"
```

Include dependency graph for buffer.cpp:



8.63 buffer.cpp

Go to the documentation of this file.

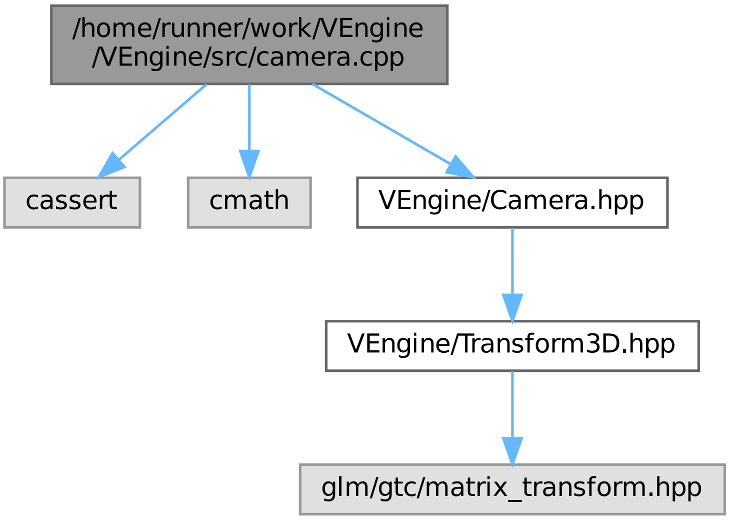
```
#include <cassert>
#include <cstring>

#include "VEngine/Buffer.hpp"

```

```cpp
ven::Buffer::Buffer(Device &device, const VkDeviceSize instanceSize, const uint32_t instanceCount,
    const VkBufferUsageFlags usageFlags, const VkMemoryPropertyFlags memoryPropertyFlags, const
    VkDeviceSize minOffsetAlignment) : m_device{device}, m_instanceSize{instanceSize},
    m_instanceCount{instanceCount}, m_alignmentSize(getAlignment(instanceSize, minOffsetAlignment)),
    m_usageFlags{usageFlags}, m_memoryPropertyFlags{memoryPropertyFlags}
{
    m_bufferSize = m_alignmentSize * m_instanceCount;
    device.createBuffer(m_bufferSize, m_usageFlags, m_memoryPropertyFlags, m_buffer, m_memory);
}

ven::Buffer::~Buffer()
{
    unmap();
    vkDestroyBuffer(m_device.device(), m_buffer, nullptr);
    vkFreeMemory(m_device.device(), m_memory, nullptr);
}

VkResult ven::Buffer::map(const VkDeviceSize size, const VkDeviceSize offset)
{
    assert(m_buffer && m_memory && "Called map on buffer before create");
    return vkMapMemory(m_device.device(), m_memory, offset, size, 0, &m_mapped);
}

void ven::Buffer::unmap()
{
    if (m_mapped != nullptr) {
        vkUnmapMemory(m_device.device(), m_memory);
        m_mapped = nullptr;
    }
}

void ven::Buffer::writeToBuffer(const void *data, const VkDeviceSize size, const VkDeviceSize offset)
    const
{
    assert(m_mapped && "Cannot copy to unmapped buffer");

    if (size == VK_WHOLE_SIZE) {
        memcpy(m_mapped, data, m_bufferSize);
    } else {
        auto memOffset = static_cast<char *>(m_mapped);
        memOffset += offset;
        memcpy(memOffset, data, size);
    }
}

VkResult ven::Buffer::flush(const VkDeviceSize size, const VkDeviceSize offset) const
{
    VkMappedMemoryRange mappedRange = {};
    mappedRange.sType = VK_STRUCTURE_TYPE_MAPPED_MEMORY_RANGE;
    mappedRange.memory = m_memory;
    mappedRange.offset = offset;
    mappedRange.size = size;
    return vkFlushMappedMemoryRanges(m_device.device(), 1, &mappedRange);
}

VkResult ven::Buffer::invalidate(const VkDeviceSize size, const VkDeviceSize offset) const
{
    VkMappedMemoryRange mappedRange = {};
    mappedRange.sType = VK_STRUCTURE_TYPE_MAPPED_MEMORY_RANGE;
    mappedRange.memory = m_memory;
    mappedRange.offset = offset;
    mappedRange.size = size;
    return vkInvalidateMappedMemoryRanges(m_device.device(), 1, &mappedRange);
}
```

8.64 /home/runner/work/VEngine/VEngine/src/camera.cpp File Reference

```cpp
#include <cassert>
#include <cmath>
#include "VEngine/Camera.hpp"
```

Include dependency graph for camera.cpp:



8.65 camera.cpp

Go to the documentation of this file.

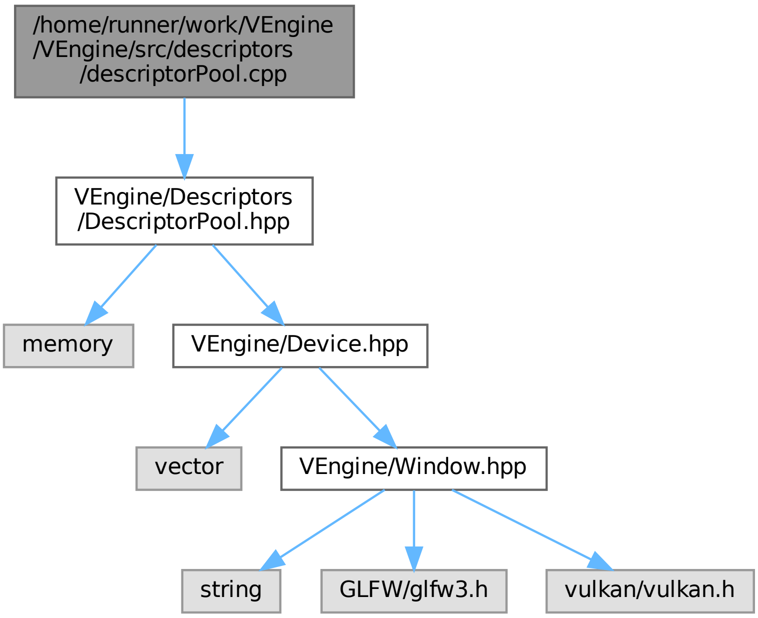
```
#include <cassert>
#include <cmath>

#include "VEngine/Camera.hpp"

void ven::Camera::setOrthographicProjection(const float left, const float right, const float top,
    const float bottom, const float near, const float far)
{
    m_projectionMatrix = glm::mat4{1.0F};
    m_projectionMatrix[0][0] = 2.F / (right - left);
    m_projectionMatrix[1][1] = 2.F / (top - bottom);
    m_projectionMatrix[2][2] = 1.F / (far - near);
    m_projectionMatrix[3][0] = -(right + left) / (right - left);
    m_projectionMatrix[3][1] = -(bottom + top) / (top - bottom);
    m_projectionMatrix[3][2] = -near / (far - near);
}

void ven::Camera::setPerspectiveProjection(const float aspect)
{
    assert(glm::abs(aspect - std::numeric_limits<float>::epsilon()) > 0.0F);
    const float tanHalfFov = std::tan(m_fov / 2.F);
    m_projectionMatrix = glm::mat4{0.0F};
    m_projectionMatrix[0][0] = 1.F / (aspect * tanHalfFov);
    m_projectionMatrix[1][1] = 1.F / (tanHalfFov);
    m_projectionMatrix[2][2] = m_far / (m_far - m_near);
    m_projectionMatrix[2][3] = 1.F;
    m_projectionMatrix[3][2] = -(m_far * m_near) / (m_far - m_near);
}

void ven::Camera::setViewDirection(const glm::vec3 position, const glm::vec3 direction, const
    glm::vec3 up)
{
    const glm::vec3 w{normalize(direction)};
    const glm::vec3 u{normalize(cross(w, up))};
    const glm::vec3 v{cross(w, u)};

    m_viewMatrix = glm::mat4{1.F};
    m_viewMatrix[0][0] = u.x;
    m_viewMatrix[1][0] = u.y;
```

```
    m_viewMatrix[2][0] = u.z;
    m_viewMatrix[0][1] = v.x;
    m_viewMatrix[1][1] = v.y;
    m_viewMatrix[2][1] = v.z;
    m_viewMatrix[0][2] = w.x;
    m_viewMatrix[1][2] = w.y;
    m_viewMatrix[2][2] = w.z;
    m_viewMatrix[3][0] = -dot(u, position);
    m_viewMatrix[3][1] = -dot(v, position);
    m_viewMatrix[3][2] = -dot(w, position);

    m_inverseViewMatrix = glm::mat4{1.F};
    m_inverseViewMatrix[0][0] = u.x;
    m_inverseViewMatrix[0][1] = u.y;
    m_inverseViewMatrix[0][2] = u.z;
    m_inverseViewMatrix[1][0] = v.x;
    m_inverseViewMatrix[1][1] = v.y;
    m_inverseViewMatrix[1][2] = v.z;
    m_inverseViewMatrix[2][0] = w.x;
    m_inverseViewMatrix[2][1] = w.y;
    m_inverseViewMatrix[2][2] = w.z;
    m_inverseViewMatrix[3][0] = position.x;
    m_inverseViewMatrix[3][1] = position.y;
    m_inverseViewMatrix[3][2] = position.z;
}

void ven::Camera::setViewXYZ(const glm::vec3 position, const glm::vec3 rotation)
{
    const float c3 = glm::cos(rotation.z);
    const float s3 = glm::sin(rotation.z);
    const float c2 = glm::cos(rotation.x);
    const float s2 = glm::sin(rotation.x);
    const float c1 = glm::cos(rotation.y);
    const float s1 = glm::sin(rotation.y);
    const glm::vec3 u{(c1 * c3 + s1 * s2 * s3), (c2 * s3), (c1 * s2 * s3 - c3 * s1)};
    const glm::vec3 v{(c3 * s1 * s2 - c1 * s3), (c2 * c3), (c1 * c3 * s2 + s1 * s3)};
    const glm::vec3 w{(c2 * s1), (-s2), (c1 * c2)};
    m_viewMatrix = glm::mat4{1.F};
    m_viewMatrix[0][0] = u.x;
    m_viewMatrix[1][0] = u.y;
    m_viewMatrix[2][0] = u.z;
    m_viewMatrix[0][1] = v.x;
    m_viewMatrix[1][1] = v.y;
    m_viewMatrix[2][1] = v.z;
    m_viewMatrix[0][2] = w.x;
    m_viewMatrix[1][2] = w.y;
    m_viewMatrix[2][2] = w.z;
    m_viewMatrix[3][0] = -dot(u, position);
    m_viewMatrix[3][1] = -dot(v, position);
    m_viewMatrix[3][2] = -dot(w, position);

    m_inverseViewMatrix = glm::mat4{1.F};
    m_inverseViewMatrix[0][0] = u.x;
    m_inverseViewMatrix[0][1] = u.y;
    m_inverseViewMatrix[0][2] = u.z;
    m_inverseViewMatrix[1][0] = v.x;
    m_inverseViewMatrix[1][1] = v.y;
    m_inverseViewMatrix[1][2] = v.z;
    m_inverseViewMatrix[2][0] = w.x;
    m_inverseViewMatrix[2][1] = w.y;
    m_inverseViewMatrix[2][2] = w.z;
    m_inverseViewMatrix[3][0] = position.x;
    m_inverseViewMatrix[3][1] = position.y;
    m_inverseViewMatrix[3][2] = position.z;
}
```

8.66 /home/runner/work/VEngine/VEngine/src/descriptors/descriptor↩ Pool.cpp File Reference

`#include "VEngine/Descriptors/DescriptorPool.hpp"`

Include dependency graph for descriptorPool.cpp:



8.67 descriptorPool.cpp

Go to the documentation of this file.

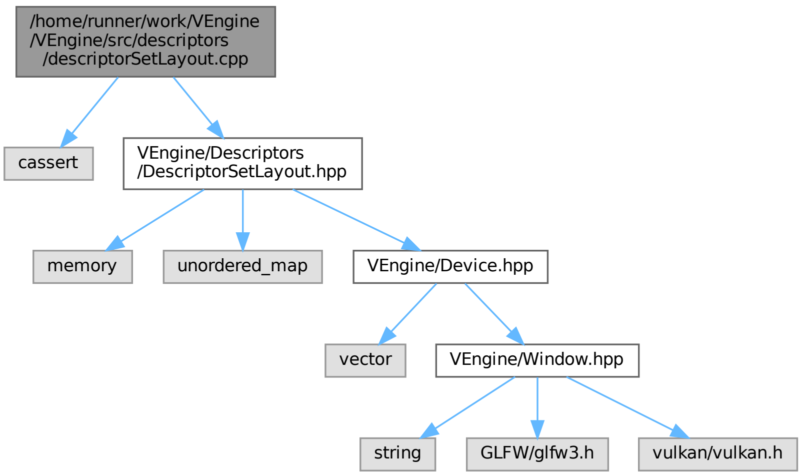
```
#include "VEngine/Descriptors/DescriptorPool.hpp"

ven::DescriptorPool::DescriptorPool(Device &device, const uint32_t maxSets, const
    VkDescriptorPoolCreateFlags poolFlags, const std::vector<VkDescriptorPoolSize> &poolSizes) :
    m_device{device}
{
    VkDescriptorPoolCreateInfo descriptorPoolInfo{};
    descriptorPoolInfo.sType = VK_STRUCTURE_TYPE_DESCRIPTOR_POOL_CREATE_INFO;
    descriptorPoolInfo.poolSizeCount = static_cast<uint32_t>(poolSizes.size());
    descriptorPoolInfo.pPoolSizes = poolSizes.data();
    descriptorPoolInfo.maxSets = maxSets;
    descriptorPoolInfo.flags = poolFlags;

    if (vkCreateDescriptorPool(m_device.device(), &descriptorPoolInfo, nullptr, &m_descriptorPool) !=
        VK_SUCCESS) {
        throw std::runtime_error("failed to create descriptor pool!");
    }
}

bool ven::DescriptorPool::allocateDescriptor(const VkDescriptorSetLayout descriptorSetLayout,
    VkDescriptorSet &descriptor) const
{
    VkDescriptorSetAllocateInfo allocInfo{};
    allocInfo.sType = VK_STRUCTURE_TYPE_DESCRIPTOR_SET_ALLOCATE_INFO;
    allocInfo.descriptorPool = m_descriptorPool;
    allocInfo.pSetLayouts = &descriptorSetLayout;
    allocInfo.descriptorSetCount = 1;

```

```
    // Might want to create a "DescriptorPoolManager" class that handles this case, and builds
    // a new pool whenever an old pool fills up. But this is beyond our current scope
    return vkAllocateDescriptorSets(m_device.device(), &allocInfo, &descriptor) == VK_SUCCESS;
}
```

8.68 /home/runner/work/VEngine/VEngine/src/descriptors/descriptor↵ SetLayout.cpp File Reference

`#include <cassert>`
`#include "VEngine/Descriptors/DescriptorSetLayout.hpp"`

Include dependency graph for descriptorSetLayout.cpp:



8.69 descriptorSetLayout.cpp

Go to the documentation of this file.

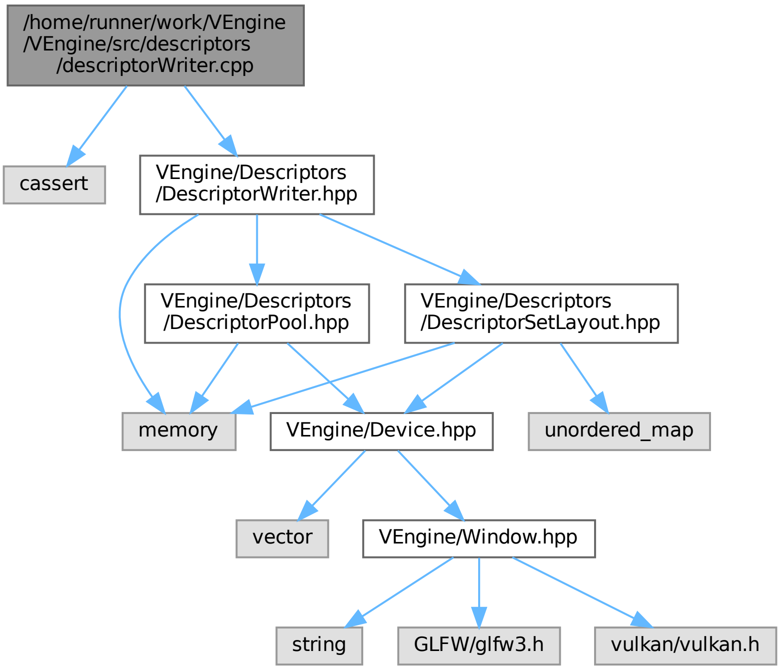
```
#include <cassert>

#include "VEngine/Descriptors/DescriptorSetLayout.hpp"

ven::DescriptorSetLayout::Builder &ven::DescriptorSetLayout::Builder::addBinding(const uint32_t
    binding, const VkDescriptorType descriptorType, const VkShaderStageFlags stageFlags, const uint32_t
    count)
{
    assert(m_bindings.contains(binding) == 0 && "Binding already exists in layout");
    VkDescriptorSetLayoutBinding layoutBinding{};
    layoutBinding.binding = binding;
    layoutBinding.descriptorType = descriptorType;
    layoutBinding.descriptorCount = count;
    layoutBinding.stageFlags = stageFlags;
    m_bindings[binding] = layoutBinding;
    return *this;
}

ven::DescriptorSetLayout::DescriptorSetLayout(Device &device, const std::unordered_map<uint32_t,
    VkDescriptorSetLayoutBinding>& bindings) : m_device{device}, m_bindings{bindings}
{
    std::vector<VkDescriptorSetLayoutBinding> setLayoutBindings{};
    setLayoutBindings.reserve(bindings.size());
    for (auto [fst, snd] : bindings) {
        setLayoutBindings.push_back(snd);
    }

```

```
    VkDescriptorSetLayoutCreateInfo descriptorSetLayoutInfo{};
    descriptorSetLayoutInfo.sType = VK_STRUCTURE_TYPE_DESCRIPTOR_SET_LAYOUT_CREATE_INFO;
    descriptorSetLayoutInfo.bindingCount = static_cast<uint32_t>(setLayoutBindings.size());
    descriptorSetLayoutInfo.pBindings = setLayoutBindings.data();

    if (vkCreateDescriptorSetLayout(
            m_device.device(),
            &descriptorSetLayoutInfo,
            nullptr,
            &m_descriptorSetLayout) != VK_SUCCESS) {
        throw std::runtime_error("failed to create descriptor set layout!");
    }
}
```

8.70 /home/runner/work/VEngine/VEngine/src/descriptors/descriptor↩ Writer.cpp File Reference

```
#include <cassert>
#include "VEngine/Descriptors/DescriptorWriter.hpp"
```

Include dependency graph for descriptorWriter.cpp:



8.71 descriptorWriter.cpp

Go to the documentation of this file.

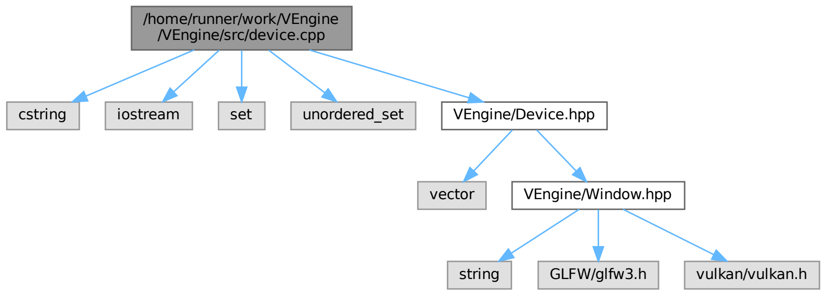
```
#include <cassert>

#include "VEngine/Descriptors/DescriptorWriter.hpp"

ven::DescriptorWriter &ven::DescriptorWriter::writeBuffer(const uint32_t binding, const
    VkDescriptorBufferInfo *bufferInfo)
{
```

```
    assert(m_setLayout.m_bindings.count(binding) == 1 && "Layout does not contain specified binding");

    const auto &bindingDescription = m_setLayout.m_bindings.at(binding);

    assert(bindingDescription.descriptorCount == 1 && "Binding single descriptor info, but binding expects multiple");

    VkWriteDescriptorSet write{};
    write.sType = VK_STRUCTURE_TYPE_WRITE_DESCRIPTOR_SET;
    write.descriptorType = bindingDescription.descriptorType;
    write.dstBinding = binding;
    write.pBufferInfo = bufferInfo;
    write.descriptorCount = 1;

    m_writes.push_back(write);
    return *this;
}

ven::DescriptorWriter &ven::DescriptorWriter::writeImage(const uint32_t binding, const VkDescriptorImageInfo *imageInfo)
{
    assert(m_setLayout.m_bindings.count(binding) == 1 && "Layout does not contain specified binding");

    const VkDescriptorSetLayoutBinding &bindingDescription = m_setLayout.m_bindings.at(binding);

    assert(bindingDescription.descriptorCount == 1 && "Binding single descriptor info, but binding expects multiple");

    VkWriteDescriptorSet write{};
    write.sType = VK_STRUCTURE_TYPE_WRITE_DESCRIPTOR_SET;
    write.descriptorType = bindingDescription.descriptorType;
    write.dstBinding = binding;
    write.pImageInfo = imageInfo;
    write.descriptorCount = 1;

    m_writes.push_back(write);
    return *this;
}

bool ven::DescriptorWriter::build(VkDescriptorSet &set)
{
    if (!m_pool.allocateDescriptor(m_setLayout.getDescriptorSetLayout(), set)) {
        return false;
    }
    overwrite(set);
    return true;
}

void ven::DescriptorWriter::overwrite(const VkDescriptorSet &set) {
    for (auto &[sType, pNext, dstSet, dstBinding, dstArrayElement, descriptorCount, descriptorType, pImageInfo, pBufferInfo, pTexelBufferView] : m_writes) {
        dstSet = set;
    }
    vkUpdateDescriptorSets(m_pool.m_device.device(), static_cast<unsigned int>(m_writes.size()), m_writes.data(), 0, nullptr);
}
```

8.72 /home/runner/work/VEngine/VEngine/src/device.cpp File Reference

```
#include <cstring>
#include <iostream>
#include <set>
#include <unordered_set>
#include "VEngine/Device.hpp"
```

Include dependency graph for device.cpp:



Functions

- static VKAPI_ATTR VkBool32 VKAPI_CALL debugCallback (const VkDebugUtilsMessageSeverityFlagBitsEXT messageSeverity, const VkDebugUtilsMessageTypeFlagsEXT messageType, const VkDebugUtilsMessengerCallbackDataEXT *pCallbackData, void *pUserData)
- VkResult CreateDebugUtilsMessengerEXT (const VkInstance instance, const VkDebugUtilsMessengerCreateInfoEXT *pCreateInfo, const VkAllocationCallbacks *pAllocator, VkDebugUtilsMessengerEXT *pDebugMessenger)
- void DestroyDebugUtilsMessengerEXT (const VkInstance instance, const VkDebugUtilsMessengerEXT debugMessenger, const VkAllocationCallbacks *pAllocator)

8.72.1 Function Documentation

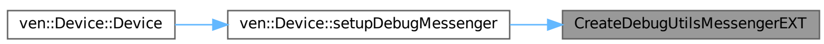
8.72.1.1 CreateDebugUtilsMessengerEXT()

```
VkResult CreateDebugUtilsMessengerEXT (
            const VkInstance instance,
            const VkDebugUtilsMessengerCreateInfoEXT * pCreateInfo,
            const VkAllocationCallbacks * pAllocator,
            VkDebugUtilsMessengerEXT * pDebugMessenger)
```

Definition at line 16 of file device.cpp.

Referenced by ven::Device::setupDebugMessenger().

Here is the caller graph for this function:



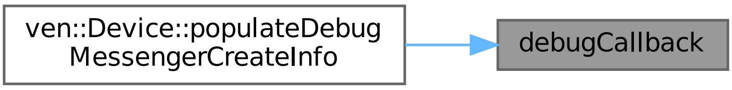
8.72.1.2 debugCallback()

```
static VKAPI_ATTR VkBool32 VKAPI_CALL debugCallback (
             const VkDebugUtilsMessageSeverityFlagBitsEXT messageSeverity,
             const VkDebugUtilsMessageTypeFlagsEXT messageType,
             const VkDebugUtilsMessengerCallbackDataEXT * pCallbackData,
             void * pUserData)  [static]
```

Definition at line 8 of file device.cpp.

Referenced by ven::Device::populateDebugMessengerCreateInfo().

Here is the caller graph for this function:



8.72.1.3 DestroyDebugUtilsMessengerEXT()

```
void DestroyDebugUtilsMessengerEXT (
             const VkInstance instance,
             const VkDebugUtilsMessengerEXT debugMessenger,
             const VkAllocationCallbacks * pAllocator)
```

Definition at line 25 of file device.cpp.

Referenced by ven::Device::∼Device().

Here is the caller graph for this function:

8.73 device.cpp

Go to the documentation of this file.

```
#include <cstring>
#include <iostream>
#include <set>
#include <unordered_set>

#include "VEngine/Device.hpp"

static VKAPI_ATTR VkBool32 VKAPI_CALL debugCallback(const VkDebugUtilsMessageSeverityFlagBitsEXT messageSeverity, const VkDebugUtilsMessageTypeFlagsEXT messageType, const VkDebugUtilsMessengerCallbackDataEXT *pCallbackData, void *pUserData)
{
    (void) pUserData; (void) messageSeverity; (void) messageType;

    std::cerr « "validation layer: " « pCallbackData->pMessage « '\n';
    return VK_FALSE;
}

VkResult CreateDebugUtilsMessengerEXT(const VkInstance instance, const VkDebugUtilsMessengerCreateInfoEXT *pCreateInfo, const VkAllocationCallbacks *pAllocator, VkDebugUtilsMessengerEXT *pDebugMessenger)
{
    if (const auto func = reinterpret_cast<PFN_vkCreateDebugUtilsMessengerEXT>(vkGetInstanceProcAddr(instance, "vkCreateDebugUtilsMessengerEXT")); func != nullptr) {
        return func(instance, pCreateInfo, pAllocator, pDebugMessenger);
    }

    return VK_ERROR_EXTENSION_NOT_PRESENT;
}

void DestroyDebugUtilsMessengerEXT(const VkInstance instance, const VkDebugUtilsMessengerEXT debugMessenger, const VkAllocationCallbacks *pAllocator)
{
    if (const auto func = reinterpret_cast<PFN_vkDestroyDebugUtilsMessengerEXT>(vkGetInstanceProcAddr(instance, "vkDestroyDebugUtilsMessengerEXT")); func != nullptr) {
        func(instance, debugMessenger, pAllocator);
    }
}

ven::Device::Device(Window &window) : m_window{window}
{
    createInstance();
    setupDebugMessenger();
    createSurface();
    pickPhysicalDevice();
    createLogicalDevice();
    createCommandPool();
}

ven::Device::~Device()
{
    vkDestroyCommandPool(m_device, m_commandPool, nullptr);
    vkDestroyDevice(m_device, nullptr);

    if (enableValidationLayers) {
        DestroyDebugUtilsMessengerEXT(m_instance, m_debugMessenger, nullptr);
    }

    vkDestroySurfaceKHR(m_instance, m_surface, nullptr);
    vkDestroyInstance(m_instance, nullptr);
}

void ven::Device::createInstance()
{
    if (enableValidationLayers && !checkValidationLayerSupport()) {
        throw std::runtime_error("validation layers requested, but not available!");
    }

    constexpr VkApplicationInfo appInfo = {
        .sType = VK_STRUCTURE_TYPE_APPLICATION_INFO,
        .pNext = nullptr,
        .pApplicationName = "VEngine App",
        .applicationVersion = VK_MAKE_VERSION(1, 0, 0),
        .pEngineName = "VEngine",
        .engineVersion = VK_MAKE_VERSION(1, 0, 0),
        .apiVersion = VK_API_VERSION_1_0
    };

    VkInstanceCreateInfo createInfo = {};
    createInfo.sType = VK_STRUCTURE_TYPE_INSTANCE_CREATE_INFO;
    createInfo.pApplicationInfo = &appInfo;
```

```cpp

    const std::vector<const char *> extensions = getRequiredExtensions();
    createInfo.enabledExtensionCount = static_cast<uint32_t>(extensions.size());
    createInfo.ppEnabledExtensionNames = extensions.data();

    VkDebugUtilsMessengerCreateInfoEXT debugCreateInfo;
    if (enableValidationLayers) {
        createInfo.enabledLayerCount = static_cast<uint32_t>(m_validationLayers.size());
        createInfo.ppEnabledLayerNames = m_validationLayers.data();

        populateDebugMessengerCreateInfo(debugCreateInfo);
        createInfo.pNext = &debugCreateInfo;
    } else {
        createInfo.enabledLayerCount = 0;
        createInfo.pNext = nullptr;
    }

    if (vkCreateInstance(&createInfo, nullptr, &m_instance) != VK_SUCCESS) {
        throw std::runtime_error("failed to create instance!");
    }

    hasGlfwRequiredInstanceExtensions();
}

void ven::Device::pickPhysicalDevice()
{
    uint32_t deviceCount = 0;
    vkEnumeratePhysicalDevices(m_instance, &deviceCount, nullptr);
    if (deviceCount == 0) {
        throw std::runtime_error("failed to find GPUs with Vulkan support!");
    }
    std::cout « "Device count: " « deviceCount « '\n';
    std::vector<VkPhysicalDevice> devices(deviceCount);
    vkEnumeratePhysicalDevices(m_instance, &deviceCount, devices.data());

    for (const auto &device : devices) {
        if (isDeviceSuitable(device)) {
            m_physicalDevice = device;
            break;
        }
    }

    if (m_physicalDevice == VK_NULL_HANDLE) {
        throw std::runtime_error("failed to find a suitable GPU!");
    }

    vkGetPhysicalDeviceProperties(m_physicalDevice, &m_properties);
    std::cout « "physical device: " « m_properties.deviceName « '\n';
}

void ven::Device::createLogicalDevice()
{
    const auto [graphicsFamily, presentFamily, graphicsFamilyHasValue, presentFamilyHasValue] = findQueueFamilies(m_physicalDevice);

    std::vector<VkDeviceQueueCreateInfo> queueCreateInfos;
    const std::set<uint32_t> uniqueQueueFamilies = {graphicsFamily, presentFamily};
    float queuePriority = 1.0F;

    for (const uint32_t queueFamily : uniqueQueueFamilies) {
        VkDeviceQueueCreateInfo queueCreateInfo = {};
        queueCreateInfo.sType = VK_STRUCTURE_TYPE_DEVICE_QUEUE_CREATE_INFO;
        queueCreateInfo.queueFamilyIndex = queueFamily;
        queueCreateInfo.queueCount = 1;
        queueCreateInfo.pQueuePriorities = &queuePriority;
        queueCreateInfos.push_back(queueCreateInfo);
    }

    VkPhysicalDeviceFeatures deviceFeatures = {};
    deviceFeatures.samplerAnisotropy = VK_TRUE;

    VkDeviceCreateInfo createInfo = {};
    createInfo.sType = VK_STRUCTURE_TYPE_DEVICE_CREATE_INFO;

    createInfo.queueCreateInfoCount = static_cast<uint32_t>(queueCreateInfos.size());
    createInfo.pQueueCreateInfos = queueCreateInfos.data();

    createInfo.pEnabledFeatures = &deviceFeatures;
    createInfo.enabledExtensionCount = static_cast<uint32_t>(m_deviceExtensions.size());
    createInfo.ppEnabledExtensionNames = m_deviceExtensions.data();

        // might not really be necessary anymore because device specific validation layers
        // have been deprecated
    if (enableValidationLayers) {
        createInfo.enabledLayerCount = static_cast<uint32_t>(m_validationLayers.size());
        createInfo.ppEnabledLayerNames = m_validationLayers.data();
    } else {
```

```
        createInfo.enabledLayerCount = 0;
    }

    if (vkCreateDevice(m_physicalDevice, &createInfo, nullptr, &m_device) != VK_SUCCESS) {
        throw std::runtime_error("failed to create logical device!");
    }

    vkGetDeviceQueue(m_device, graphicsFamily, 0, &m_graphicsQueue);
    vkGetDeviceQueue(m_device, presentFamily, 0, &m_presentQueue);
}

void ven::Device::createCommandPool()
{
    const auto [graphicsFamily, presentFamily, graphicsFamilyHasValue, presentFamilyHasValue] = findPhysicalQueueFamilies();

    const VkCommandPoolCreateInfo poolInfo = {
        .sType = VK_STRUCTURE_TYPE_COMMAND_POOL_CREATE_INFO,
        .pNext = nullptr,
        .flags = VK_COMMAND_POOL_CREATE_TRANSIENT_BIT | VK_COMMAND_POOL_CREATE_RESET_COMMAND_BUFFER_BIT,
        .queueFamilyIndex = graphicsFamily
    };

    if (vkCreateCommandPool(m_device, &poolInfo, nullptr, &m_commandPool) != VK_SUCCESS) {
        throw std::runtime_error("failed to create command pool!");
    }
}

bool ven::Device::isDeviceSuitable(const VkPhysicalDevice device) const
{
    const QueueFamilyIndices indices = findQueueFamilies(device);
    const bool extensionsSupported = checkDeviceExtensionSupport(device);
    bool swapChainAdequate = false;

    if (extensionsSupported) {
        auto [capabilities, formats, presentModes] = querySwapChainSupport(device);
        swapChainAdequate = !formats.empty() && !presentModes.empty();
    }

    VkPhysicalDeviceFeatures supportedFeatures;
    vkGetPhysicalDeviceFeatures(device, &supportedFeatures);

    return indices.isComplete() && extensionsSupported && swapChainAdequate && (supportedFeatures.samplerAnisotropy != 0U);
}

void ven::Device::populateDebugMessengerCreateInfo(VkDebugUtilsMessengerCreateInfoEXT &createInfo)
{
    createInfo = {};
    createInfo.sType = VK_STRUCTURE_TYPE_DEBUG_UTILS_MESSENGER_CREATE_INFO_EXT;
    createInfo.messageSeverity = VK_DEBUG_UTILS_MESSAGE_SEVERITY_WARNING_BIT_EXT |
                                 VK_DEBUG_UTILS_MESSAGE_SEVERITY_ERROR_BIT_EXT;
    createInfo.messageType = VK_DEBUG_UTILS_MESSAGE_TYPE_GENERAL_BIT_EXT |
                             VK_DEBUG_UTILS_MESSAGE_TYPE_VALIDATION_BIT_EXT |
                             VK_DEBUG_UTILS_MESSAGE_TYPE_PERFORMANCE_BIT_EXT;
    createInfo.pfnUserCallback = debugCallback;
    createInfo.pUserData = nullptr;  // Optional
}

void ven::Device::setupDebugMessenger()
{
    if (!enableValidationLayers) { return; }
    VkDebugUtilsMessengerCreateInfoEXT createInfo;
    populateDebugMessengerCreateInfo(createInfo);
    if (CreateDebugUtilsMessengerEXT(m_instance, &createInfo, nullptr, &m_debugMessenger) != VK_SUCCESS) {
        throw std::runtime_error("failed to set up debug messenger!");
    }
}

bool ven::Device::checkValidationLayerSupport() const
{
    uint32_t layerCount = 0;
    vkEnumerateInstanceLayerProperties(&layerCount, nullptr);

    std::vector<VkLayerProperties> availableLayers(layerCount);
    vkEnumerateInstanceLayerProperties(&layerCount, availableLayers.data());

    for (const char *validationLayer : m_validationLayers) {
        bool layerFound = false;

        for (const auto &[layerName, specVersion, implementationVersion, description] : availableLayers) {
            if (strcmp(layerName, validationLayer) == 0) {
                layerFound = true;
                break;
```

```
            }
        }
        if (!layerFound) {
            return false;
        }
    }

    return true;
}

std::vector<const char *> ven::Device::getRequiredExtensions() const
{
    uint32_t glfwExtensionCount = 0;
    const char **glfwExtensions = nullptr;
    glfwExtensions = glfwGetRequiredInstanceExtensions(&glfwExtensionCount);

    std::vector<const char *> extensions(glfwExtensions, glfwExtensions + glfwExtensionCount);

    if (enableValidationLayers) {
        extensions.push_back(VK_EXT_DEBUG_UTILS_EXTENSION_NAME);
    }

    return extensions;
}

void ven::Device::hasGlfwRequiredInstanceExtensions() const
{
    uint32_t extensionCount = 0;
    vkEnumerateInstanceExtensionProperties(nullptr, &extensionCount, nullptr);
    std::vector<VkExtensionProperties> extensions(extensionCount);
    vkEnumerateInstanceExtensionProperties(nullptr, &extensionCount, extensions.data());

    std::cout « "available extensions:\n";
    std::unordered_set<std::string> available;
    for (const auto &[extensionName, specVersion] : extensions) {
        std::cout « '\t' « extensionName « '\n';
        available.insert(extensionName);
    }

    std::cout « "required extensions:\n";
    for (const std::vector<const char *> requiredExtensions = getRequiredExtensions(); const auto &required : requiredExtensions) {
        std::cout « "\t" « required « '\n';
        if (!available.contains(required)) {
            throw std::runtime_error("Missing required glfw extension");
        }
    }
}

bool ven::Device::checkDeviceExtensionSupport(const VkPhysicalDevice device) const
{
    uint32_t extensionCount = 0;
    vkEnumerateDeviceExtensionProperties(device, nullptr, &extensionCount, nullptr);

    std::vector<VkExtensionProperties> availableExtensions(extensionCount);
    vkEnumerateDeviceExtensionProperties(device, nullptr, &extensionCount, availableExtensions.data());

    std::set<std::string> requiredExtensions(m_deviceExtensions.begin(), m_deviceExtensions.end());
     for (const auto &[extensionName, specVersion] : availableExtensions) {
         requiredExtensions.erase(extensionName);
     }

     return requiredExtensions.empty();
}

ven::QueueFamilyIndices ven::Device::findQueueFamilies(const VkPhysicalDevice device) const
{
    QueueFamilyIndices indices;
    uint32_t queueFamilyCount = 0;
    uint32_t index = 0;
    vkGetPhysicalDeviceQueueFamilyProperties(device, &queueFamilyCount, nullptr);
    std::vector<VkQueueFamilyProperties> queueFamilies(queueFamilyCount);
    vkGetPhysicalDeviceQueueFamilyProperties(device, &queueFamilyCount, queueFamilies.data());

    for (const auto &[queueFlags, queueCount, timestampValidBits, minImageTransferGranularity] : queueFamilies) {
        if (queueCount > 0 && ((queueFlags & VK_QUEUE_GRAPHICS_BIT) != 0U)) {
            indices.graphicsFamily = index;
            indices.graphicsFamilyHasValue = true;
        }
        VkBool32 presentSupport = 0U;
        vkGetPhysicalDeviceSurfaceSupportKHR(device, index, m_surface, &presentSupport);
        if (queueCount > 0 && (presentSupport != 0U)) {
            indices.presentFamily = index;
            indices.presentFamilyHasValue = true;
        }
```

```
        if (indices.isComplete()) {
            break;
        }
        index++;
    }
    return indices;
}

ven::SwapChainSupportDetails ven::Device::querySwapChainSupport(const VkPhysicalDevice device) const
{
    uint32_t formatCount = 0;
    uint32_t presentModeCount = 0;
    SwapChainSupportDetails details;
    vkGetPhysicalDeviceSurfaceCapabilitiesKHR(device, m_surface, &details.capabilities);

    vkGetPhysicalDeviceSurfaceFormatsKHR(device, m_surface, &formatCount, nullptr);
    if (formatCount != 0) {
        details.formats.resize(formatCount);
        vkGetPhysicalDeviceSurfaceFormatsKHR(device, m_surface, &formatCount, details.formats.data());
    }
    vkGetPhysicalDeviceSurfacePresentModesKHR(device, m_surface, &presentModeCount, nullptr);
    if (presentModeCount != 0) {
        details.presentModes.resize(presentModeCount);
        vkGetPhysicalDeviceSurfacePresentModesKHR(device, m_surface, &presentModeCount, details.presentModes.data());
    }

    return details;
}

VkFormat ven::Device::findSupportedFormat(const std::vector<VkFormat> &candidates, const VkImageTiling tiling, const VkFormatFeatureFlags features) const
{
    for (const VkFormat format : candidates) {
        VkFormatProperties props;
        vkGetPhysicalDeviceFormatProperties(m_physicalDevice, format, &props);
        if (tiling == VK_IMAGE_TILING_LINEAR && (props.linearTilingFeatures & features) == features) {
            return format;
        } if (tiling == VK_IMAGE_TILING_OPTIMAL && (props.optimalTilingFeatures & features) == features) {
            return format;
        }
    }
    throw std::runtime_error("failed to find supported format!");
}

uint32_t ven::Device::findMemoryType(const uint32_t typeFilter, const VkMemoryPropertyFlags properties) const
{
    VkPhysicalDeviceMemoryProperties memProperties;
    vkGetPhysicalDeviceMemoryProperties(m_physicalDevice, &memProperties);

    for (uint32_t i = 0; i < memProperties.memoryTypeCount; i++) {
        if (((typeFilter & (1 « i)) != 0U) &&
        (memProperties.memoryTypes[i].propertyFlags & properties) == properties) {
            return i;
        }
    }

    throw std::runtime_error("failed to find suitable m_memory type!");
}

void ven::Device::createBuffer(const VkDeviceSize size, const VkBufferUsageFlags usage, const VkMemoryPropertyFlags properties, VkBuffer &buffer, VkDeviceMemory &bufferMemory) const
{
    VkBufferCreateInfo bufferInfo{};
    bufferInfo.sType = VK_STRUCTURE_TYPE_BUFFER_CREATE_INFO;
    bufferInfo.size = size;
    bufferInfo.usage = usage;
    bufferInfo.sharingMode = VK_SHARING_MODE_EXCLUSIVE;

    if (vkCreateBuffer(m_device, &bufferInfo, nullptr, &buffer) != VK_SUCCESS) {
        throw std::runtime_error("failed to create vertex m_buffer!");
    }

    VkMemoryRequirements memRequirements;
    vkGetBufferMemoryRequirements(m_device, buffer, &memRequirements);

    const VkMemoryAllocateInfo allocInfo{
        .sType = VK_STRUCTURE_TYPE_MEMORY_ALLOCATE_INFO,
        .pNext = nullptr,
        .allocationSize = memRequirements.size,
        .memoryTypeIndex = findMemoryType(memRequirements.memoryTypeBits, properties)
    };

    if (vkAllocateMemory(m_device, &allocInfo, nullptr, &bufferMemory) != VK_SUCCESS) {
        throw std::runtime_error("failed to allocate vertex m_buffer m_memory!");
```

```
    }

    vkBindBufferMemory(m_device, buffer, bufferMemory, 0);
}

VkCommandBuffer ven::Device::beginSingleTimeCommands() const
{
    VkCommandBufferAllocateInfo allocInfo{};
    allocInfo.sType = VK_STRUCTURE_TYPE_COMMAND_BUFFER_ALLOCATE_INFO;
    allocInfo.level = VK_COMMAND_BUFFER_LEVEL_PRIMARY;
    allocInfo.commandPool = m_commandPool;
    allocInfo.commandBufferCount = 1;

    VkCommandBuffer commandBuffer = nullptr;
    vkAllocateCommandBuffers(m_device, &allocInfo, &commandBuffer);

    VkCommandBufferBeginInfo beginInfo{};
    beginInfo.sType = VK_STRUCTURE_TYPE_COMMAND_BUFFER_BEGIN_INFO;
    beginInfo.flags = VK_COMMAND_BUFFER_USAGE_ONE_TIME_SUBMIT_BIT;

    vkBeginCommandBuffer(commandBuffer, &beginInfo);
    return commandBuffer;
}

void ven::Device::endSingleTimeCommands(const VkCommandBuffer commandBuffer) const
{
    vkEndCommandBuffer(commandBuffer);

    VkSubmitInfo submitInfo{};
    submitInfo.sType = VK_STRUCTURE_TYPE_SUBMIT_INFO;
    submitInfo.commandBufferCount = 1;
    submitInfo.pCommandBuffers = &commandBuffer;

    vkQueueSubmit(m_graphicsQueue, 1, &submitInfo, VK_NULL_HANDLE);
    vkQueueWaitIdle(m_graphicsQueue);

    vkFreeCommandBuffers(m_device, m_commandPool, 1, &commandBuffer);
}

void ven::Device::copyBuffer(const VkBuffer srcBuffer, const VkBuffer dstBuffer, const VkDeviceSize
size) const
{
    const VkCommandBuffer commandBuffer = beginSingleTimeCommands();

    VkBufferCopy copyRegion{};
    copyRegion.srcOffset = 0;  // Optional
    copyRegion.dstOffset = 0;  // Optional
    copyRegion.size = size;
    vkCmdCopyBuffer(commandBuffer, srcBuffer, dstBuffer, 1, &copyRegion);

    endSingleTimeCommands(commandBuffer);
}

void ven::Device::copyBufferToImage(const VkBuffer buffer, const VkImage image, const uint32_t width,
const uint32_t height, const uint32_t layerCount) const
{
    const VkCommandBuffer commandBuffer = beginSingleTimeCommands();
    const VkBufferImageCopy region{
        .bufferOffset = 0,
        .bufferRowLength = 0,
        .bufferImageHeight = 0,
        .imageSubresource = {
            .aspectMask = VK_IMAGE_ASPECT_COLOR_BIT,
            .mipLevel = 0,
            .baseArrayLayer = 0,
            .layerCount = layerCount
        },
        .imageOffset = {0, 0, 0},
        .imageExtent = {width, height, 1}
    };

    vkCmdCopyBufferToImage(commandBuffer, buffer, image, VK_IMAGE_LAYOUT_TRANSFER_DST_OPTIMAL, 1,
&region);
    endSingleTimeCommands(commandBuffer);
}

void ven::Device::createImageWithInfo(const VkImageCreateInfo &imageInfo, const VkMemoryPropertyFlags
properties, VkImage &image, VkDeviceMemory &imageMemory) const
{
    if (vkCreateImage(m_device, &imageInfo, nullptr, &image) != VK_SUCCESS) {
        throw std::runtime_error("failed to create image!");
    }

    VkMemoryRequirements memRequirements;
    vkGetImageMemoryRequirements(m_device, image, &memRequirements);

    VkMemoryAllocateInfo allocInfo{};
```

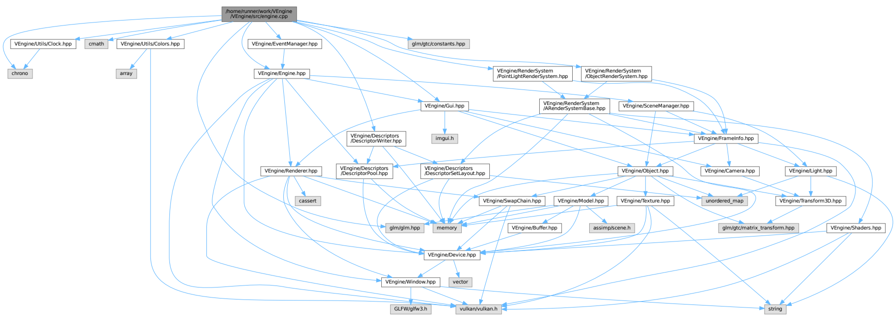
```cpp
    allocInfo.sType = VK_STRUCTURE_TYPE_MEMORY_ALLOCATE_INFO;
    allocInfo.allocationSize = memRequirements.size;
    allocInfo.memoryTypeIndex = findMemoryType(memRequirements.memoryTypeBits, properties);

    if (vkAllocateMemory(m_device, &allocInfo, nullptr, &imageMemory) != VK_SUCCESS) {
        throw std::runtime_error("failed to allocate image memory!");
    }

    if (vkBindImageMemory(m_device, image, imageMemory, 0) != VK_SUCCESS) {
        throw std::runtime_error("failed to bind image memory!");
    }
}

void ven::Device::transitionImageLayout(const VkImage image, const VkFormat format, const
VkImageLayout oldLayout, const VkImageLayout newLayout, const uint32_t mipLevels, const uint32_t
layerCount) const {
  // uses an image memory barrier transition image layouts and transfer queue
  // family ownership when VK_SHARING_MODE_EXCLUSIVE is used. There is an
  // equivalent buffer memory barrier to do this for buffers
  const VkCommandBuffer commandBuffer = beginSingleTimeCommands();

  VkImageMemoryBarrier barrier{};
  barrier.sType = VK_STRUCTURE_TYPE_IMAGE_MEMORY_BARRIER;
  barrier.oldLayout = oldLayout;
  barrier.newLayout = newLayout;

  barrier.srcQueueFamilyIndex = VK_QUEUE_FAMILY_IGNORED;
  barrier.dstQueueFamilyIndex = VK_QUEUE_FAMILY_IGNORED;

  barrier.image = image;
  barrier.subresourceRange.baseMipLevel = 0;
  barrier.subresourceRange.levelCount = mipLevels;
  barrier.subresourceRange.baseArrayLayer = 0;
  barrier.subresourceRange.layerCount = layerCount;

  if (newLayout == VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL) {
    barrier.subresourceRange.aspectMask = VK_IMAGE_ASPECT_DEPTH_BIT;
    if (format == VK_FORMAT_D32_SFLOAT_S8_UINT || format == VK_FORMAT_D24_UNORM_S8_UINT) {
      barrier.subresourceRange.aspectMask |= VK_IMAGE_ASPECT_STENCIL_BIT;
    }
  } else {
    barrier.subresourceRange.aspectMask = VK_IMAGE_ASPECT_COLOR_BIT;
  }

  VkPipelineStageFlags sourceStage = 0;
  VkPipelineStageFlags destinationStage = 0;

  if (oldLayout == VK_IMAGE_LAYOUT_UNDEFINED && newLayout == VK_IMAGE_LAYOUT_TRANSFER_DST_OPTIMAL) {
    barrier.srcAccessMask = 0;
    barrier.dstAccessMask = VK_ACCESS_TRANSFER_WRITE_BIT;

    sourceStage = VK_PIPELINE_STAGE_TOP_OF_PIPE_BIT;
    destinationStage = VK_PIPELINE_STAGE_TRANSFER_BIT;
  } else if (
      oldLayout == VK_IMAGE_LAYOUT_UNDEFINED && newLayout == VK_IMAGE_LAYOUT_TRANSFER_SRC_OPTIMAL) {
    barrier.srcAccessMask = 0;
    barrier.dstAccessMask = VK_ACCESS_TRANSFER_WRITE_BIT;

    sourceStage = VK_PIPELINE_STAGE_TOP_OF_PIPE_BIT;
    destinationStage = VK_PIPELINE_STAGE_TRANSFER_BIT;
  } else if (
      oldLayout == VK_IMAGE_LAYOUT_TRANSFER_DST_OPTIMAL &&
      newLayout == VK_IMAGE_LAYOUT_SHADER_READ_ONLY_OPTIMAL) {
    barrier.srcAccessMask = VK_ACCESS_TRANSFER_WRITE_BIT;
    barrier.dstAccessMask = VK_ACCESS_SHADER_READ_BIT;

    sourceStage = VK_PIPELINE_STAGE_TRANSFER_BIT;
    destinationStage = VK_PIPELINE_STAGE_FRAGMENT_SHADER_BIT;
  } else if (
      oldLayout == VK_IMAGE_LAYOUT_UNDEFINED &&
      newLayout == VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL) {
    barrier.srcAccessMask = 0;
    barrier.dstAccessMask =
        VK_ACCESS_DEPTH_STENCIL_ATTACHMENT_READ_BIT | VK_ACCESS_DEPTH_STENCIL_ATTACHMENT_WRITE_BIT;

    sourceStage = VK_PIPELINE_STAGE_TOP_OF_PIPE_BIT;
    destinationStage = VK_PIPELINE_STAGE_EARLY_FRAGMENT_TESTS_BIT;
  } else {
    throw std::invalid_argument("unsupported layout transition!");
  }
  vkCmdPipelineBarrier(
      commandBuffer,
      sourceStage,
      destinationStage,
      0,
      0,
      nullptr,
```

```
        0,
        nullptr,
        1,
        &barrier);

    endSingleTimeCommands(commandBuffer);
}
```

8.74 /home/runner/work/VEngine/VEngine/src/engine.cpp File Reference

```
#include <chrono>
#include <cmath>
#include <glm/glm.hpp>
#include <glm/gtc/constants.hpp>
#include <VEngine/EventManager.hpp>
#include "VEngine/Engine.hpp"
#include "VEngine/RenderSystem/ObjectRenderSystem.hpp"
#include "VEngine/RenderSystem/PointLightRenderSystem.hpp"
#include "VEngine/Descriptors/DescriptorWriter.hpp"
#include "VEngine/Gui.hpp"
#include "VEngine/Utils/Colors.hpp"
#include "VEngine/Utils/Clock.hpp"
```

Include dependency graph for engine.cpp:



8.75 engine.cpp

Go to the documentation of this file.

```
#include <chrono>
#include <cmath>

#include <glm/glm.hpp>
#include <glm/gtc/constants.hpp>
#include <VEngine/EventManager.hpp>

#include "VEngine/Engine.hpp"
#include "VEngine/RenderSystem/ObjectRenderSystem.hpp"
#include "VEngine/RenderSystem/PointLightRenderSystem.hpp"
#include "VEngine/Descriptors/DescriptorWriter.hpp"
#include "VEngine/Gui.hpp"
#include "VEngine/Utils/Colors.hpp"
#include "VEngine/Utils/Clock.hpp"

ven::Engine::Engine(const uint32_t width, const uint32_t height, const std::string &title) :
    m_state(EDITOR), m_window(width, height, title) {
    createInstance();
    createSurface();
    Gui::init(m_window.getGLFWindow(), m_instance, &m_device, m_renderer.getSwapChainRenderPass());
    m_globalPool =
    DescriptorPool::Builder(m_device).setMaxSets(MAX_FRAMES_IN_FLIGHT).addPoolSize(VK_DESCRIPTOR_TYPE_UNIFORM_BUFFER,
    MAX_FRAMES_IN_FLIGHT).build();
```

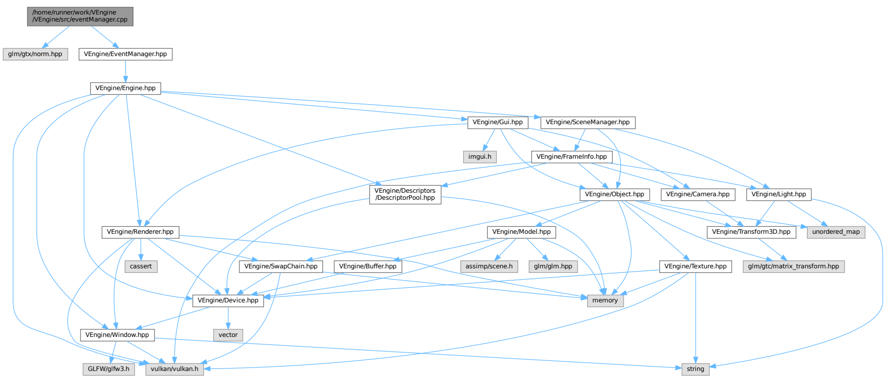
```

    framePools.resize(MAX_FRAMES_IN_FLIGHT);
    const auto framePoolBuilder = DescriptorPool::Builder(m_device)
                                  .setMaxSets(1000)
                                  .addPoolSize(VK_DESCRIPTOR_TYPE_COMBINED_IMAGE_SAMPLER, 1000)
                                  .addPoolSize(VK_DESCRIPTOR_TYPE_UNIFORM_BUFFER, 1000)
                                  .setPoolFlags(VK_DESCRIPTOR_POOL_CREATE_FREE_DESCRIPTOR_SET_BIT);
    for (auto & framePool : framePools) {
        framePool = framePoolBuilder.build();
    }

    loadObjects();
}

void ven::Engine::createInstance()
{
    uint32_t glfwExtensionCount = 0;
    const char** glfwExtensions = nullptr;
    VkInstanceCreateInfo createInfo{};
    constexpr VkApplicationInfo appInfo{
        .sType = VK_STRUCTURE_TYPE_APPLICATION_INFO,
        .pNext = nullptr,
        .pApplicationName = "VEngine App",
        .applicationVersion = VK_MAKE_API_VERSION(0, 1, 0, 0),
        .pEngineName = "VEngine",
        .engineVersion = VK_MAKE_API_VERSION(0, 1, 0, 0),
        .apiVersion = VK_API_VERSION_1_0
    };

    createInfo.sType = VK_STRUCTURE_TYPE_INSTANCE_CREATE_INFO;
    createInfo.pApplicationInfo = &appInfo;
    glfwExtensions = glfwGetRequiredInstanceExtensions(&glfwExtensionCount);
    createInfo.enabledExtensionCount = glfwExtensionCount;
    createInfo.ppEnabledExtensionNames = glfwExtensions;

    if (vkCreateInstance(&createInfo, nullptr, &m_instance) != VK_SUCCESS)
    {
        throw std::runtime_error("Failed to create Vulkan instance");
    }
}

void ven::Engine::loadObjects()
{
    constexpr std::array lightColors{
        Colors::RED_4,
        Colors::GREEN_4,
        Colors::BLUE_4,
        Colors::YELLOW_4,
        Colors::CYAN_4,
        Colors::MAGENTA_4
    };
    auto& quad = m_sceneManager.createObject();
    quad.setName("quad");
    quad.setModel(Model::createModelFromFile(m_device, "assets/models/quad.obj"));
    quad.transform.translation = {0.F, .5F, 0.F};
    quad.transform.scale = {3.F, 1.F, 3.F};

    auto& flatVase = m_sceneManager.createObject();
    flatVase.setName("flat vase");
    flatVase.setModel(Model::createModelFromFile(m_device, "assets/models/flat_vase.obj"));
    flatVase.transform.translation = {-.5F, .5F, 0.F};
    flatVase.transform.scale = {3.F, 1.5F, 3.F};

    auto& smoothVase = m_sceneManager.createObject();
    smoothVase.setName("smooth vase");
    smoothVase.setModel(Model::createModelFromFile(m_device, "assets/models/smooth_vase.obj"));
    smoothVase.transform.translation = {.5F, .5F, 0.F};
    smoothVase.transform.scale = {3.F, 1.5F, 3.F};

    for (std::size_t i = 0; i < lightColors.size(); i++)
    {
        glm::mat4 rotateLight = rotate(
            glm::mat4(1.F),
            static_cast<float>(i) * glm::two_pi<float>() / static_cast<float>(lightColors.size()),
            {0.F, -1.F, 0.F}
        );
        auto& pointLight = m_sceneManager.createLight();
        pointLight.color = lightColors.at(i);
        pointLight.transform.translation = glm::vec3(rotateLight * glm::vec4(-1.F, -1.F, -1.F, 1.F));
    }
}

void ven::Engine::mainLoop()
{
    Clock clock;
    GlobalUbo ubo{};
    Camera camera{};
```

```
    EventManager eventManager{};
    VkCommandBuffer_T *commandBuffer = nullptr;
    float frameTime = 0.0F;
    unsigned long frameIndex = 0;
    std::unique_ptr<DescriptorSetLayout> globalSetLayout =
        DescriptorSetLayout::Builder(m_device).addBinding(0, VK_DESCRIPTOR_TYPE_UNIFORM_BUFFER,
VK_SHADER_STAGE_ALL_GRAPHICS).build();
    std::vector<std::unique_ptr<Buffer» uboBuffers(MAX_FRAMES_IN_FLIGHT);
    std::vector<VkDescriptorSet> globalDescriptorSets(MAX_FRAMES_IN_FLIGHT);
    ObjectRenderSystem objectRenderSystem(m_device, m_renderer.getSwapChainRenderPass(),
globalSetLayout->getDescriptorSetLayout());
    PointLightRenderSystem pointLightRenderSystem(m_device, m_renderer.getSwapChainRenderPass(),
globalSetLayout->getDescriptorSetLayout());
    VkDescriptorBufferInfo bufferInfo{};

    for (auto& uboBuffer : uboBuffers)
    {
        uboBuffer = std::make_unique<Buffer>(m_device, sizeof(GlobalUbo), 1,
VK_BUFFER_USAGE_UNIFORM_BUFFER_BIT, VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT);
        uboBuffer->map();
    }
    for (std::size_t i = 0; i < globalDescriptorSets.size(); i++) {
        bufferInfo = uboBuffers[i]->descriptorInfo();
        DescriptorWriter(*globalSetLayout, *m_globalPool).writeBuffer(0,
&bufferInfo).build(globalDescriptorSets[i]);
    }

    while (m_state != EXIT)
    {
        clock.update();
        frameTime = clock.getDeltaTime();
        eventManager.handleEvents(m_window.getGLFWindow(), &m_state, camera, m_gui, frameTime);
        commandBuffer = m_renderer.beginFrame();

        camera.setViewXYZ(camera.transform.translation, camera.transform.rotation);
        camera.setPerspectiveProjection(m_renderer.getAspectRatio());

        if (commandBuffer != nullptr) {
            frameIndex = m_renderer.getFrameIndex();
            framePools[frameIndex]->resetPool();
            FrameInfo frameInfo{.frameIndex=frameIndex,
                .frameTime=frameTime,
                .commandBuffer=commandBuffer,
                .camera=camera,
                .globalDescriptorSet=globalDescriptorSets[frameIndex],
                .frameDescriptorPool=*framePools[frameIndex],
                .objects=m_sceneManager.getObjects(),
                .lights=m_sceneManager.getLights()
            };
            ubo.projection = camera.getProjection();
            ubo.view = camera.getView();
            ubo.inverseView = camera.getInverseView();
            m_sceneManager.updateBuffer(ubo, frameIndex, frameTime);
            uboBuffers.at(frameIndex)->writeToBuffer(&ubo);
            uboBuffers.at(frameIndex)->flush();

            m_renderer.beginSwapChainRenderPass(frameInfo.commandBuffer);
            objectRenderSystem.render(frameInfo);
            pointLightRenderSystem.render(frameInfo);

            if (m_gui.getState() == VISIBLE) {
                Gui::render(
                    &m_renderer,
                    m_sceneManager.getObjects(),
                    m_sceneManager.getLights(),
                    camera,
                    m_device.getPhysicalDevice(),
                    ubo
                    );
            }

            m_renderer.endSwapChainRenderPass(commandBuffer);
            m_renderer.endFrame();
            commandBuffer = nullptr;
        }
    }
    Gui::cleanup();
    vkDeviceWaitIdle(m_device.device());
}
```

8.76 /home/runner/work/VEngine/VEngine/src/eventManager.cpp File Reference

```
#include <glm/gtx/norm.hpp>
#include "VEngine/EventManager.hpp"
```

Include dependency graph for eventManager.cpp:



Macros

- #define GLM_ENABLE_EXPERIMENTAL

8.76.1 Macro Definition Documentation

8.76.1.1 GLM_ENABLE_EXPERIMENTAL

```
#define GLM_ENABLE_EXPERIMENTAL
```

Definition at line 1 of file eventManager.cpp.

8.77 eventManager.cpp

Go to the documentation of this file.

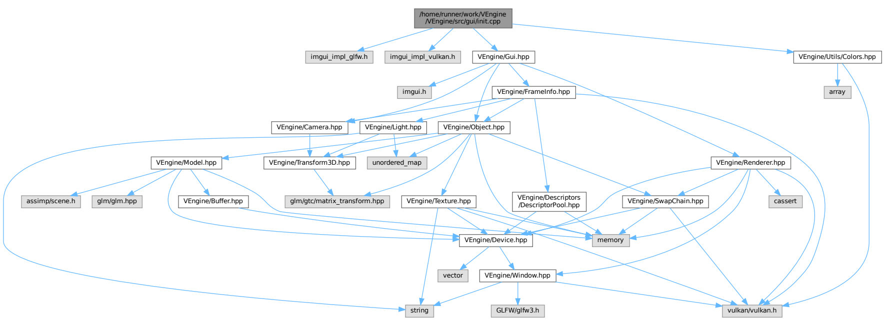
```
#define GLM_ENABLE_EXPERIMENTAL
#include <glm/gtx/norm.hpp>

#include "VEngine/EventManager.hpp"

bool ven::EventManager::isKeyJustPressed(GLFWwindow* window, const int key, std::unordered_map<int, bool>& keyStates)
{
    const bool isPressed = glfwGetKey(window, key) == GLFW_PRESS;
    const bool wasPressed = keyStates[key];

    keyStates[key] = isPressed;

    return isPressed && !wasPressed;
}

template<typename Iterator>
void ven::EventManager::processKeyActions(GLFWwindow* window, Iterator begin, Iterator end)
{
    for (auto it = begin; it != end; ++it) {
```

```
        if (glfwGetKey(window, it->key) == GLFW_PRESS) {
            *it->dir += it->value;
        }
    }
}

void ven::EventManager::moveCamera(GLFWwindow* window, Camera& camera, const float dt)
{
    glm::vec3 rotate{0};
    glm::vec3 moveDir{0.F};
    static constexpr glm::vec3 upDir{0.F, -1.F, 0.F};
    const float yaw = camera.transform.rotation.y;
    const glm::vec3 forwardDir{std::sin(yaw), 0.F, std::cos(yaw)};
    const glm::vec3 rightDir{forwardDir.z, 0.F, -forwardDir.x};
    const std::array<KeyAction, 10> moveActions = {{
        {.key=DEFAULT_KEY_MAPPINGS.lookLeft, .dir=&rotate, .value={0.F, -1.F, 0.F}},
        {.key=DEFAULT_KEY_MAPPINGS.lookRight, .dir=&rotate, .value={0.F, 1.F, 0.F}},
        {.key=DEFAULT_KEY_MAPPINGS.lookUp, .dir=&rotate, .value={1.F, 0.F, 0.F}},
        {.key=DEFAULT_KEY_MAPPINGS.lookDown, .dir=&rotate, .value={-1.F, 0.F, 0.F}},
        {.key=DEFAULT_KEY_MAPPINGS.moveForward, .dir=&moveDir, .value=forwardDir},
        {.key=DEFAULT_KEY_MAPPINGS.moveBackward, .dir=&moveDir, .value=-forwardDir},
        {.key=DEFAULT_KEY_MAPPINGS.moveRight, .dir=&moveDir, .value=rightDir},
        {.key=DEFAULT_KEY_MAPPINGS.moveLeft, .dir=&moveDir, .value=-rightDir},
        {.key=DEFAULT_KEY_MAPPINGS.moveUp, .dir=&moveDir, .value=upDir},
        {.key=DEFAULT_KEY_MAPPINGS.moveDown, .dir=&moveDir, .value=-upDir}
    }};

    processKeyActions(window, moveActions.begin(), moveActions.end());

    if (length2(rotate) > EPSILON) {
        camera.transform.rotation += camera.getLookSpeed() * dt * normalize(rotate);
    }
    if (length2(moveDir) > EPSILON) {
        camera.transform.translation += camera.getMoveSpeed() * dt * normalize(moveDir);
    }

    camera.transform.rotation.x = glm::clamp(camera.transform.rotation.x, -1.5F, 1.5F);
    camera.transform.rotation.y = glm::mod(camera.transform.rotation.y, glm::two_pi<float>());
}

void ven::EventManager::handleEvents(GLFWwindow *window, ENGINE_STATE *engineState, Camera& camera,
      Gui& gui, const float dt) const
{
    glfwPollEvents();
    if (glfwWindowShouldClose(window) == GLFW_TRUE) {
        updateEngineState(engineState, EXIT);
    }
    if (isKeyJustPressed(window, DEFAULT_KEY_MAPPINGS.toggleGui, m_keyState)) {
        gui.getState() == HIDDEN ? gui.setState(VISIBLE) : gui.setState(HIDDEN);
    }
    moveCamera(window, camera, dt);
}
```

8.78 /home/runner/work/VEngine/VEngine/src/gui/init.cpp File Reference

```
#include <imgui_impl_glfw.h>
#include <imgui_impl_vulkan.h>
#include "VEngine/Gui.hpp"
#include "VEngine/Utils/Colors.hpp"
```

Include dependency graph for init.cpp:



8.79 init.cpp

Go to the documentation of this file.

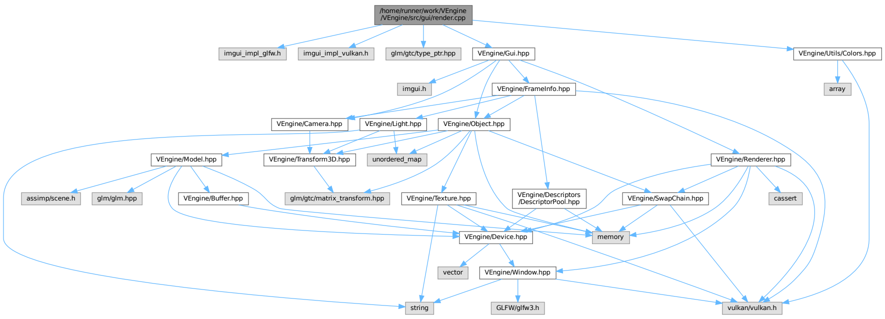
```cpp
#include <imgui_impl_glfw.h>
#include <imgui_impl_vulkan.h>

#include "VEngine/Gui.hpp"
#include "VEngine/Utils/Colors.hpp"

ImGuiIO *ven::Gui::m_io = nullptr;
float ven::Gui::m_intensity = 1.0F;
float ven::Gui::m_shininess = DEFAULT_SHININESS;

void ven::Gui::init(GLFWwindow* window, const VkInstance instance, const Device* device, const
VkRenderPass renderPass)
{
    VkDescriptorPool pool = nullptr;
    ImGui_ImplVulkan_InitInfo init_info{};
    ImGui::CreateContext();
    m_io = &ImGui::GetIO();
    m_io->IniFilename = "assets/imgui-config.txt";
    // ImGui::StyleColorsDark();

    std::array<VkDescriptorPoolSize, 11> pool_sizes = {{
            { .type=VK_DESCRIPTOR_TYPE_SAMPLER, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_COMBINED_IMAGE_SAMPLER, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_SAMPLED_IMAGE, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_STORAGE_IMAGE, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_UNIFORM_TEXEL_BUFFER, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_STORAGE_TEXEL_BUFFER, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_UNIFORM_BUFFER, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_STORAGE_BUFFER, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_UNIFORM_BUFFER_DYNAMIC, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_STORAGE_BUFFER_DYNAMIC, .descriptorCount=DESCRIPTOR_COUNT },
            { .type=VK_DESCRIPTOR_TYPE_INPUT_ATTACHMENT, .descriptorCount=DESCRIPTOR_COUNT }
    }};
    const VkDescriptorPoolCreateInfo pool_info = {
            VK_STRUCTURE_TYPE_DESCRIPTOR_POOL_CREATE_INFO,
            nullptr,
            VK_DESCRIPTOR_POOL_CREATE_FREE_DESCRIPTOR_SET_BIT,
            DESCRIPTOR_COUNT,
            std::size(pool_sizes),
            pool_sizes.data()
    };

    if (vkCreateDescriptorPool(device->device(), &pool_info, nullptr, &pool) != VK_SUCCESS) {
        throw std::runtime_error("Failed to create ImGui descriptor pool");
    }

    init_info.Instance = instance;
    init_info.PhysicalDevice = device->getPhysicalDevice();
    init_info.Device = device->device();
    init_info.Queue = device->graphicsQueue();
    init_info.DescriptorPool = pool;
    init_info.MinImageCount = 3;
    init_info.ImageCount = 3;
    init_info.MSAASamples = VK_SAMPLE_COUNT_1_BIT;

    ImGui_ImplGlfw_InitForVulkan(window, true);
    ImGui_ImplVulkan_Init(&init_info, renderPass);
    initStyle();
}

void ven::Gui::initStyle()
{
    ImGuiStyle& style = ImGui::GetStyle();
    style.Alpha = 1.0;
    style.WindowRounding = 3;
    style.GrabRounding = 1;
    style.GrabMinSize = 20;
    style.FrameRounding = 3;

    style.Colors[ImGuiCol_Text] = ImVec4(0.00F, 1.00F, 1.00F, 1.00F);
    style.Colors[ImGuiCol_TextDisabled] = ImVec4(0.00F, 0.40F, 0.41F, 1.00F);
    style.Colors[ImGuiCol_WindowBg] = ImVec4(0.1F, 0.1F, 0.1F, 0.70F);
    style.Colors[ImGuiCol_Border] = ImVec4(0.00F, 1.00F, 1.00F, 0.35F);
    style.Colors[ImGuiCol_BorderShadow] = ImVec4(0.00F, 0.00F, 0.00F, 0.00F);
    style.Colors[ImGuiCol_FrameBg] = ImVec4(0.44F, 0.80F, 0.80F, 0.18F);
    style.Colors[ImGuiCol_FrameBgHovered] = ImVec4(0.44F, 0.80F, 0.80F, 0.27F);
    style.Colors[ImGuiCol_FrameBgActive] = ImVec4(0.44F, 0.81F, 0.86F, 0.66F);
    style.Colors[ImGuiCol_TitleBg] = ImVec4(0.14F, 0.18F, 0.21F, 0.73F);
    style.Colors[ImGuiCol_TitleBgCollapsed] = ImVec4(0.00F, 0.00F, 0.00F, 0.54F);
    style.Colors[ImGuiCol_TitleBgActive] = ImVec4(0.00F, 1.00F, 1.00F, 0.27F);
    style.Colors[ImGuiCol_MenuBarBg] = ImVec4(0.00F, 0.00F, 0.00F, 0.20F);
    style.Colors[ImGuiCol_ScrollbarBg] = ImVec4(0.22F, 0.29F, 0.30F, 0.71F);
```

```
    style.Colors[ImGuiCol_ScrollbarGrab] = ImVec4(0.00F, 1.00F, 1.00F, 0.44F);
    style.Colors[ImGuiCol_ScrollbarGrabHovered] = ImVec4(0.00F, 1.00F, 1.00F, 0.74F);
    style.Colors[ImGuiCol_ScrollbarGrabActive] = ImVec4(0.00F, 1.00F, 1.00F, 1.00F);
    style.Colors[ImGuiCol_CheckMark] = ImVec4(0.00F, 1.00F, 1.00F, 0.68F);
    style.Colors[ImGuiCol_SliderGrab] = ImVec4(0.00F, 1.00F, 1.00F, 0.36F);
    style.Colors[ImGuiCol_SliderGrabActive] = ImVec4(0.00F, 1.00F, 1.00F, 0.76F);
    style.Colors[ImGuiCol_Button] = ImVec4(0.00F, 0.65F, 0.65F, 0.46F);
    style.Colors[ImGuiCol_ButtonHovered] = ImVec4(0.01F, 1.00F, 1.00F, 0.43F);
    style.Colors[ImGuiCol_ButtonActive] = ImVec4(0.00F, 1.00F, 1.00F, 0.62F);
    style.Colors[ImGuiCol_Header] = ImVec4(0.00F, 1.00F, 1.00F, 0.33F);
    style.Colors[ImGuiCol_HeaderHovered] = ImVec4(0.00F, 1.00F, 1.00F, 0.42F);
    style.Colors[ImGuiCol_HeaderActive] = ImVec4(0.00F, 1.00F, 1.00F, 0.54F);
    style.Colors[ImGuiCol_ResizeGrip] = ImVec4(0.00F, 1.00F, 1.00F, 0.54F);
    style.Colors[ImGuiCol_ResizeGripHovered] = ImVec4(0.00F, 1.00F, 1.00F, 0.74F);
    style.Colors[ImGuiCol_ResizeGripActive] = ImVec4(0.00F, 1.00F, 1.00F, 1.00F);
    style.Colors[ImGuiCol_PlotLines] = ImVec4(0.00F, 1.00F, 1.00F, 1.00F);
    style.Colors[ImGuiCol_PlotLinesHovered] = ImVec4(0.00F, 1.00F, 1.00F, 1.00F);
    style.Colors[ImGuiCol_PlotHistogram] = ImVec4(0.00F, 1.00F, 1.00F, 1.00F);
    style.Colors[ImGuiCol_PlotHistogramHovered] = ImVec4(0.00F, 1.00F, 1.00F, 1.00F);
    style.Colors[ImGuiCol_TextSelectedBg] = ImVec4(0.00F, 1.00F, 1.00F, 0.22F);
}
```

8.80 /home/runner/work/VEngine/VEngine/src/gui/render.cpp File Reference

```
#include <imgui_impl_glfw.h>
#include <imgui_impl_vulkan.h>
#include <glm/gtc/type_ptr.hpp>
#include "VEngine/Gui.hpp"
#include "VEngine/Utils/Colors.hpp"
```

Include dependency graph for render.cpp:



8.81 render.cpp

Go to the documentation of this file.

```
#include <imgui_impl_glfw.h>
#include <imgui_impl_vulkan.h>

#include <glm/gtc/type_ptr.hpp>

#include "VEngine/Gui.hpp"
#include "VEngine/Utils/Colors.hpp"

void ven::Gui::cleanup()
{
    ImGui_ImplVulkan_Shutdown();
    ImGui_ImplGlfw_Shutdown();
    ImGui::DestroyContext();
}

```

```cpp
void ven::Gui::render(Renderer* renderer, std::unordered_map<unsigned int, Object>& objects, std::unordered_map<unsigned int, Light>& lights, Camera& camera, const VkPhysicalDevice physicalDevice, GlobalUbo& ubo)
{
    VkPhysicalDeviceProperties deviceProperties;
    vkGetPhysicalDeviceProperties(physicalDevice, &deviceProperties);
    ImGui_ImplVulkan_NewFrame();
    ImGui_ImplGlfw_NewFrame();
    ImGui::NewFrame();
    renderFrameWindow();

    ImGui::Begin("Debug Window");
    rendererSection(renderer, ubo);
    cameraSection(camera);
    objectsSection(objects);
    lightsSection(lights);
    inputsSection(m_io);
    devicePropertiesSection(deviceProperties);

    ImGui::End();
    ImGui::Render();
    ImGui_ImplVulkan_RenderDrawData(ImGui::GetDrawData(), renderer->getCurrentCommandBuffer());
}

void ven::Gui::renderFrameWindow()
{
    const float framerate = m_io->Framerate;
    const float frametime = 1000.0F / framerate;

    ImGui::SetNextWindowPos(ImVec2(0.0F, 0.0F), ImGuiCond_Always, ImVec2(0.0F, 0.0F));
    ImGui::Begin("Application Info", nullptr, ImGuiWindowFlags_NoDecoration | ImGuiWindowFlags_NoMove | ImGuiWindowFlags_NoResize | ImGuiWindowFlags_NoSavedSettings | ImGuiWindowFlags_NoFocusOnAppearing | ImGuiWindowFlags_NoNav);
    ImGui::Text("FPS: %.1f", framerate);
    ImGui::Text("Frame time: %.3fms", frametime);
    ImGui::End();
}

void ven::Gui::rendererSection(Renderer *renderer, GlobalUbo& ubo)
{
    if (ImGui::CollapsingHeader("Renderer")) {
        ImGui::Text("Aspect Ratio: %.2f", renderer->getAspectRatio());

        if (ImGui::BeginTable("ClearColorTable", 2)) {
            ImGui::TableNextColumn();
            std::array<float, 4> clearColor = renderer->getClearColor();

            if (ImGui::ColorEdit4("Clear Color", clearColor.data())) {
                const VkClearColorValue clearColorValue = {{clearColor[0], clearColor[1], clearColor[2], clearColor[3]}};
                renderer->setClearValue(clearColorValue);
            }

            ImGui::TableNextColumn();
            static int item_current = 0;

            if (ImGui::Combo("Color Presets##clearColor",
                             &item_current,
                             [](void*, const int idx, const char** out_text) -> bool {
                                 if (idx < 0 || idx >= static_cast<int>(std::size(Colors::COLOR_PRESETS_VK))) { return false; }
                                 *out_text = Colors::COLOR_PRESETS_VK.at(static_cast<unsigned long>(idx)).first;
                                 return true;
                             },
                             nullptr,
                             std::size(Colors::COLOR_PRESETS_VK))) {
                renderer->setClearValue(Colors::COLOR_PRESETS_VK.at(static_cast<unsigned long>(item_current)).second);
                             }

            ImGui::TableNextColumn();
            ImGui::ColorEdit4("Ambient Light Color", glm::value_ptr(ubo.ambientLightColor));
            ImGui::TableNextColumn();
            if (ImGui::Combo("Color Presets##ambientColor",
                             &item_current,
                             [](void*, const int idx, const char** out_text) -> bool {
                                 if (idx < 0 || idx >= static_cast<int>(std::size(Colors::COLOR_PRESETS_4))) { return false; }
                                 *out_text = Colors::COLOR_PRESETS_4.at(static_cast<unsigned long>(idx)).first;
                                 return true;
                             },
                             nullptr,
                             std::size(Colors::COLOR_PRESETS_4))) {
                ubo.ambientLightColor = Colors::COLOR_PRESETS_4.at(static_cast<unsigned long>(item_current)).second;
```

```
                            }

            ImGui::TableNextColumn();
            ImGui::SliderFloat(("Intensity##" + std::to_string(0)).c_str(), &ubo.ambientLightColor.a, 0.0F, 1.0F);
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset##ambientIntensity")) { ubo.ambientLightColor.a = DEFAULT_AMBIENT_LIGHT_INTENSITY; }

            ImGui::EndTable();
        }

        static bool fullscreen = false;
        if (ImGui::Checkbox("Fullscreen", &fullscreen)) {
            renderer->getWindow().setFullscreen(fullscreen, renderer->getWindow().getExtent().width, renderer->getWindow().getExtent().height);
        }
    }
}

void ven::Gui::cameraSection(Camera &camera)
{
    if (ImGui::CollapsingHeader("Camera")) {
        float fov = camera.getFov();
        float near = camera.getNear();
        float far = camera.getFar();
        if (ImGui::BeginTable("CameraTable", 2)) {
            ImGui::TableNextColumn();
            ImGui::DragFloat3("Position", glm::value_ptr(camera.transform.translation), 0.1F);
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset##position")) { camera.transform.translation = DEFAULT_POSITION; }

            ImGui::TableNextColumn();
            ImGui::DragFloat3("Rotation", glm::value_ptr(camera.transform.rotation), 0.1F);
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset##rotation")) { camera.transform.rotation = DEFAULT_ROTATION; }

            ImGui::TableNextColumn();
            if (ImGui::SliderFloat("FOV", &fov, glm::radians(0.1F), glm::radians(180.0F))) { camera.setFov(fov); }
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset##fov")) { camera.setFov(DEFAULT_FOV); }

            ImGui::TableNextColumn();
            if (ImGui::SliderFloat("Near", &near, 0.001F, 10.0F)) { camera.setNear(near); }
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset##near")) { camera.setNear(DEFAULT_NEAR); }

            ImGui::TableNextColumn();
            if (ImGui::SliderFloat("Far", &far, 1.F, 1000.0F)) { camera.setFar(far); }
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset##far")) { camera.setFar(DEFAULT_FAR); }

            ImGui::TableNextColumn();
            float moveSpeed = camera.getMoveSpeed();
            if (ImGui::SliderFloat("Move speed", &moveSpeed, 0.1F, 10.0F)) { camera.setMoveSpeed(moveSpeed); }
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset##moveSpeed")) { camera.setMoveSpeed(DEFAULT_MOVE_SPEED); }

            ImGui::TableNextColumn();
            float lookSpeed = camera.getLookSpeed();
            if (ImGui::SliderFloat("Look speed", &lookSpeed, 0.1F, 10.0F)) { camera.setLookSpeed(lookSpeed); }
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset##lookSpeed")) { camera.setLookSpeed(DEFAULT_LOOK_SPEED); }

            ImGui::EndTable();
        }
    }
}

void ven::Gui::objectsSection(std::unordered_map<unsigned int, Object>& objects)
{
    if (ImGui::CollapsingHeader("Objects")) {
        bool open = false;
        for (auto& [id, object] : objects) {
            ImGui::PushStyleColor(ImGuiCol_Text, { Colors::GRAY_4.r, Colors::GRAY_4.g, Colors::GRAY_4.b, 1.0F });
            open = ImGui::TreeNode(std::string(object.getName() + " [" + std::to_string(object.getId()) + "]").c_str());
            ImGui::PopStyleColor(1);
            if (open) {
                ImGui::DragFloat3(("Position##" + object.getName()).c_str(), glm::value_ptr(object.transform.translation), 0.1F);
                ImGui::DragFloat3(("Rotation##" + object.getName()).c_str(), glm::value_ptr(object.transform.rotation), 0.1F);
```

```
                ImGui::DragFloat3(("Scale##" + object.getName()).c_str(), glm::value_ptr(object.transform.scale), 0.1F);
                ImGui::Text("Address: %p", &object);
                ImGui::TreePop();
            }
        }
    }
}

void ven::Gui::lightsSection(std::unordered_map<unsigned int, Light> &lights)
{
    if (ImGui::CollapsingHeader("Lights")) {
        bool open = false;

        float tempIntensity = m_intensity;
        float tempShininess = m_shininess;

        if (ImGui::BeginTable("LightTable", 2)) {
            ImGui::TableNextColumn();
            if (ImGui::SliderFloat("Global Intensity", &tempIntensity, 0.0F, 5.F)) {
                m_intensity = tempIntensity;
                for (auto&[fst, snd] : lights) {
                    snd.color.a = m_intensity;
                }
            }
            ImGui::TableNextColumn();
            if (ImGui::Button("Reset")) {
                m_intensity = DEFAULT_LIGHT_INTENSITY;
                tempIntensity = m_intensity;
                for (auto&[fst, snd] : lights) {
                    snd.color.a = m_intensity;
                }
            }

            ImGui::TableNextColumn();
            if (ImGui::SliderFloat("Global Shininess", &tempShininess, 0.0F, 512.F)) {
                m_shininess = tempShininess;
                for (auto&[fst, snd] : lights) {
                    snd.setShininess(m_shininess);
                }
            }

            ImGui::TableNextColumn();
            if (ImGui::Button("Reset")) {
                m_shininess = DEFAULT_SHININESS;
                tempShininess = m_shininess;
                for (auto&[fst, snd] : lights) {
                    snd.setShininess(m_shininess);
                }
            }
            ImGui::EndTable();
        }

        for (auto& [id, light] : lights) {
            ImGui::PushStyleColor(ImGuiCol_Text, {light.color.r, light.color.g, light.color.b, 1.0F});
            open = ImGui::TreeNode(std::string(light.getName() + " [" + std::to_string(light.getId()) + "]").c_str());
            ImGui::PopStyleColor(1);
            if (open) {
                ImGui::Text("Address: %p", &light);
                ImGui::DragFloat3(("Position##" + std::to_string(light.getId())).c_str(), glm::value_ptr(light.transform.translation), 0.1F);
                ImGui::DragFloat3(("Rotation##" + std::to_string(light.getId())).c_str(), glm::value_ptr(light.transform.rotation), 0.1F);
                ImGui::DragFloat3(("Scale##" + std::to_string(light.getId())).c_str(), glm::value_ptr(light.transform.scale), 0.1F);
                if (ImGui::BeginTable("ColorTable", 2)) {
                    ImGui::TableNextColumn(); ImGui::ColorEdit4(("Color##" + std::to_string(light.getId())).c_str(), glm::value_ptr(light.color));

                    ImGui::TableNextColumn();
                    static int item_current = 0;
                    if (ImGui::Combo("Color Presets",
                                     &item_current,
                                     [](void*, const int idx, const char** out_text) -> bool {
                                         if (idx < 0 || idx >= static_cast<int>(std::size(Colors::COLOR_PRESETS_3))) { return false; }
                                         *out_text = Colors::COLOR_PRESETS_3.at(static_cast<unsigned long>(idx)).first;
                                         return true;
                                     },
                                     nullptr,
                                     std::size(Colors::COLOR_PRESETS_3))) {
                        light.color = {Colors::COLOR_PRESETS_3.at(static_cast<unsigned long>(item_current)).second, light.color.a};
                    }

```

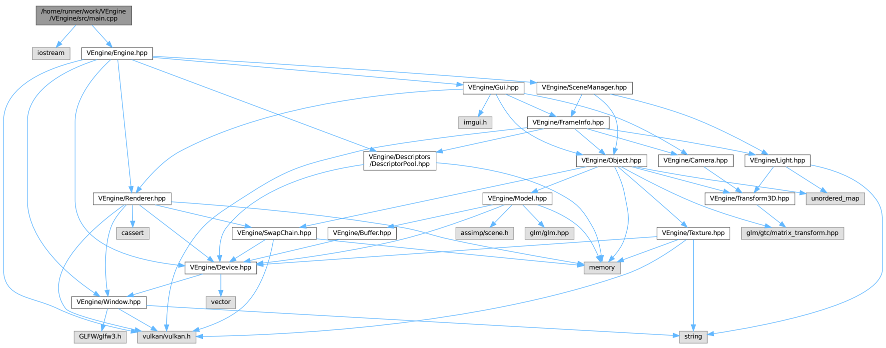
```
                    ImGui::TableNextColumn();
                    ImGui::SliderFloat(("Intensity##" + std::to_string(light.getId())).c_str(), &light.color.a, 0.0F, 5.F);
                    ImGui::TableNextColumn();
                    if (ImGui::Button(("Reset##" + std::to_string(light.getId())).c_str())) { light.color.a = DEFAULT_LIGHT_INTENSITY; }
                    ImGui::TableNextColumn();
                    float shininess = light.getShininess();
                    if (ImGui::SliderFloat("Shininess", &shininess, 0.0F, 512.F)) {
                        light.setShininess(shininess);
                    }
                    ImGui::TableNextColumn();
                    if (ImGui::Button("Reset##shininess")) { light.setShininess(DEFAULT_SHININESS); }

                    ImGui::EndTable();
                }
                ImGui::TreePop();
            }
        }
    }
}

void ven::Gui::inputsSection(const ImGuiIO* io)
{
    if (ImGui::CollapsingHeader("Input")) {
        ImGui::IsMousePosValid() ? ImGui::Text("Mouse pos: (%g, %g)", io->MousePos.x, io->MousePos.y) : ImGui::Text("Mouse pos: <INVALID>");
        ImGui::Text("Mouse delta: (%g, %g)", io->MouseDelta.x, io->MouseDelta.y);
        ImGui::Text("Mouse down:");
        for (int i = 0; i < static_cast<int>(std::size(io->MouseDown)); i++) {
            if (ImGui::IsMouseDown(i)) {
                ImGui::SameLine();
                ImGui::Text("b%d (%.02f secs)", i, io->MouseDownDuration[i]);
            }
        }
        ImGui::Text("Mouse wheel: %.1f", io->MouseWheel);
        ImGui::Text("Keys down:");
        for (auto key = static_cast<ImGuiKey>(0); key < ImGuiKey_NamedKey_END; key = static_cast<ImGuiKey>(key + 1)) {
            if (funcs::IsLegacyNativeDupe(key) || !ImGui::IsKeyDown(key)) { continue; }
            ImGui::SameLine();
            ImGui::Text((key < ImGuiKey_NamedKey_BEGIN) ? "\"%s\"" : "\"%s\" %d", ImGui::GetKeyName(key), key);
        }
    }
}

void ven::Gui::devicePropertiesSection(VkPhysicalDeviceProperties deviceProperties)
{
    if (ImGui::CollapsingHeader("Device Properties")) {
        if (ImGui::BeginTable("DevicePropertiesTable", 2)) {

            ImGui::TableNextColumn(); ImGui::Text("Device Name: %s", deviceProperties.deviceName);
            ImGui::TableNextColumn(); ImGui::Text("API Version: %d.%d.%d", VK_VERSION_MAJOR(deviceProperties.apiVersion), VK_VERSION_MINOR(deviceProperties.apiVersion), VK_VERSION_PATCH(deviceProperties.apiVersion));
            ImGui::TableNextColumn(); ImGui::Text("Driver Version: %d.%d.%d", VK_VERSION_MAJOR(deviceProperties.driverVersion), VK_VERSION_MINOR(deviceProperties.driverVersion), VK_VERSION_PATCH(deviceProperties.driverVersion));
            ImGui::TableNextColumn();  ImGui::Text("Vendor ID: %d", deviceProperties.vendorID);
            ImGui::TableNextColumn(); ImGui::Text("Device ID: %d", deviceProperties.deviceID);
            ImGui::TableNextColumn(); ImGui::Text("Device Type: %d", deviceProperties.deviceType);
            ImGui::TableNextColumn(); ImGui::Text("Discrete Queue Priorities: %d", deviceProperties.limits.discreteQueuePriorities);
            ImGui::TableNextColumn(); ImGui::Text("Max Push Constants Size: %d", deviceProperties.limits.maxPushConstantsSize);
            ImGui::TableNextColumn(); ImGui::Text("Max Memory Allocation Count: %d", deviceProperties.limits.maxMemoryAllocationCount);
            ImGui::TableNextColumn(); ImGui::Text("Max Image Dimension 1D: %d", deviceProperties.limits.maxImageDimension1D);
            ImGui::TableNextColumn(); ImGui::Text("Max Image Dimension 2D: %d", deviceProperties.limits.maxImageDimension2D);
            ImGui::TableNextColumn(); ImGui::Text("Max Image Dimension 3D: %d", deviceProperties.limits.maxImageDimension3D);
            ImGui::TableNextColumn(); ImGui::Text("Max Image Dimension Cube: %d", deviceProperties.limits.maxImageDimensionCube);
            ImGui::TableNextColumn(); ImGui::Text("Max Image Array Layers: %d", deviceProperties.limits.maxImageArrayLayers);
            ImGui::TableNextColumn(); ImGui::Text("Max Texel Buffer Elements: %d", deviceProperties.limits.maxTexelBufferElements);
            ImGui::TableNextColumn(); ImGui::Text("Max Uniform Buffer Range: %d", deviceProperties.limits.maxUniformBufferRange);
            ImGui::TableNextColumn(); ImGui::Text("Max Storage Buffer Range: %d", deviceProperties.limits.maxStorageBufferRange);
            ImGui::EndTable();
        }
    }
```

```
00314 }
```

8.82 /home/runner/work/VEngine/VEngine/src/main.cpp File Reference

```
#include <iostream>
#include "VEngine/Engine.hpp"
```

Include dependency graph for main.cpp:



Functions

- int main ()

8.82.1 Function Documentation

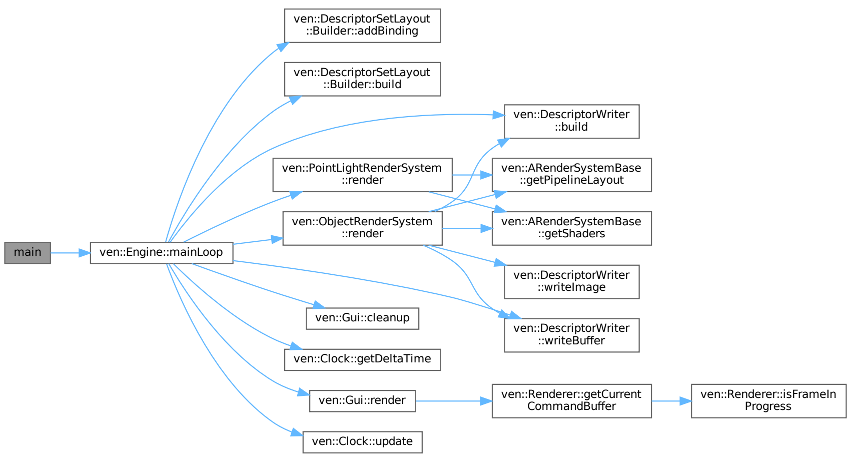
8.82.1.1 main()

```
int main ()
```

Definition at line 7 of file main.cpp.

References ven::Engine::mainLoop().

Here is the call graph for this function:



8.83 main.cpp

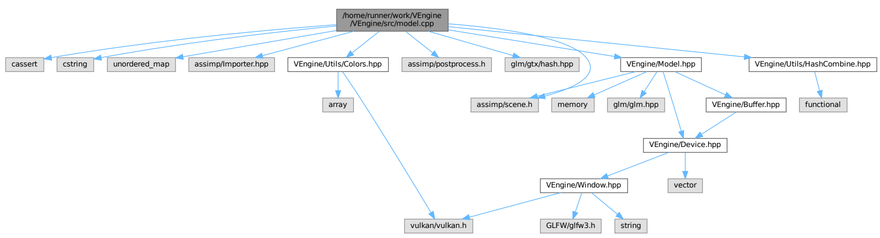
Go to the documentation of this file.

```
#include <iostream>

#include "VEngine/Engine.hpp"

using namespace ven;

int main()
{
    try {
        Engine engine{};
        engine.mainLoop();
    } catch (const std::exception &e) {
        std::cerr « "std exception: " « e.what() « '\n';
        return EXIT_FAILURE;
    } catch (...) {
        std::cerr « "Unknown error\n";
        return EXIT_SUCCESS;
    }
    return EXIT_SUCCESS;
}
```

8.84 /home/runner/work/VEngine/VEngine/src/model.cpp File Reference

```
#include <cassert>
#include <cstring>
#include <unordered_map>
#include <assimp/Importer.hpp>
#include <assimp/scene.h>
#include <assimp/postprocess.h>
#include <glm/gtx/hash.hpp>
#include "VEngine/Utils/Colors.hpp"
#include "VEngine/Model.hpp"
#include "VEngine/Utils/HashCombine.hpp"
```

Include dependency graph for model.cpp:



Classes

- struct std::hash< ven::Model::Vertex >

Macros

- #define GLM_ENABLE_EXPERIMENTAL

8.84.1 Macro Definition Documentation

8.84.1.1 GLM_ENABLE_EXPERIMENTAL

```
#define GLM_ENABLE_EXPERIMENTAL
```

Definition at line 9 of file model.cpp.

8.85 model.cpp

Go to the documentation of this file.

```
00001 #include <cassert>
00002 #include <cstring>
00003 #include <unordered_map>
00004
00005 #include <assimp/Importer.hpp>
00006 #include <assimp/scene.h>
00007 #include <assimp/postprocess.h>
00008
00009 #define GLM_ENABLE_EXPERIMENTAL
00010 #include <glm/gtx/hash.hpp>
00011
00012 #include "VEngine/Utils/Colors.hpp"
00013 #include "VEngine/Model.hpp"
00014 #include "VEngine/Utils/HashCombine.hpp"
00015
00016 template<>
00017 struct std::hash<ven::Model::Vertex> {
00018     size_t operator()(ven::Model::Vertex const &vertex) const noexcept {
00019         size_t seed = 0;
00020         ven::hashCombine(seed, vertex.position, vertex.color, vertex.normal, vertex.uv);
00021         return seed;
00022     }
00023 };
00024
00025 ven::Model::Model(Device &device, const Builder &builder) : m_device{device}, m_vertexCount(0),
      m_indexCount(0)
00026 {
00027     createVertexBuffer(builder.vertices);
00028     createIndexBuffer(builder.indices);
00029 }
00030
00031 void ven::Model::createVertexBuffer(const std::vector<Vertex> &vertices)
00032 {
00033     m_vertexCount = static_cast<uint32_t>(vertices.size());
00034     assert(m_vertexCount >= 3 && "Vertex count must be at least 3");
00035     const VkDeviceSize bufferSize = sizeof(vertices[0]) * m_vertexCount;
00036     uint32_t vertexSize = sizeof(vertices[0]);
00037
00038     Buffer stagingBuffer{m_device, vertexSize, m_vertexCount, VK_BUFFER_USAGE_TRANSFER_SRC_BIT,
      VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT | VK_MEMORY_PROPERTY_HOST_COHERENT_BIT};
00039
00040     stagingBuffer.map();
00041     stagingBuffer.writeToBuffer(vertices.data());
00042
00043     m_vertexBuffer = std::make_unique<Buffer>(m_device, vertexSize, m_vertexCount,
      VK_BUFFER_USAGE_VERTEX_BUFFER_BIT | VK_BUFFER_USAGE_TRANSFER_DST_BIT,
      VK_MEMORY_PROPERTY_DEVICE_LOCAL_BIT);
00044
00045     m_device.copyBuffer(stagingBuffer.getBuffer(), m_vertexBuffer->getBuffer(), bufferSize);
00046 }
00047
00048 void ven::Model::createIndexBuffer(const std::vector<uint32_t> &indices)
00049 {
00050     m_indexCount = static_cast<uint32_t>(indices.size());
00051     m_hasIndexBuffer = m_indexCount > 0;
00052
00053     if (!m_hasIndexBuffer) {
00054         return;
00055     }
00056
00057     uint32_t indexSize = sizeof(indices[0]);
00058
00059     Buffer stagingBuffer{m_device, indexSize, m_indexCount, VK_BUFFER_USAGE_TRANSFER_SRC_BIT,
      VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT | VK_MEMORY_PROPERTY_HOST_COHERENT_BIT};
00060
00061     stagingBuffer.map();
```

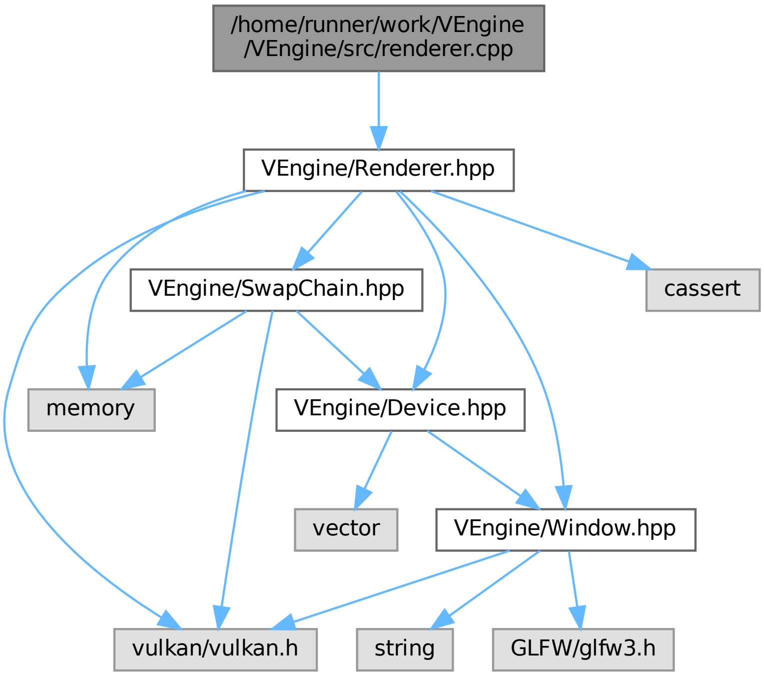
```
    stagingBuffer.writeToBuffer(indices.data());

    m_indexBuffer = std::make_unique<Buffer>(m_device, indexSize, m_indexCount,
VK_BUFFER_USAGE_INDEX_BUFFER_BIT | VK_BUFFER_USAGE_TRANSFER_DST_BIT,
VK_MEMORY_PROPERTY_DEVICE_LOCAL_BIT);

    m_device.copyBuffer(stagingBuffer.getBuffer(), m_indexBuffer->getBuffer(), sizeof(indices[0]) *
m_indexCount);
}

void ven::Model::draw(const VkCommandBuffer commandBuffer) const
{
    if (m_hasIndexBuffer) {
        vkCmdDrawIndexed(commandBuffer, m_indexCount, 1, 0, 0, 0);
    } else {
        vkCmdDraw(commandBuffer, m_vertexCount, 1, 0, 0);
    }
}

void ven::Model::bind(const VkCommandBuffer commandBuffer) const
{
    const std::array buffers{m_vertexBuffer->getBuffer()};
    constexpr std::array<VkDeviceSize, 1> offsets{0};
    vkCmdBindVertexBuffers(commandBuffer, 0, 1, buffers.data(), offsets.data());

    if (m_hasIndexBuffer) {
        vkCmdBindIndexBuffer(commandBuffer, m_indexBuffer->getBuffer(), 0, VK_INDEX_TYPE_UINT32);
    }
}

std::unique_ptr<ven::Model> ven::Model::createModelFromFile(Device &device, const std::string
&filename)
{
    Builder builder{};
    builder.loadModel(filename);
    return std::make_unique<Model>(device, builder);
}

std::vector<VkVertexInputBindingDescription> ven::Model::Vertex::getBindingDescriptions()
{
    std::vector<VkVertexInputBindingDescription> bindingDescriptions(1);
    bindingDescriptions[0].binding = 0;
    bindingDescriptions[0].stride = sizeof(Vertex);
    bindingDescriptions[0].inputRate = VK_VERTEX_INPUT_RATE_VERTEX;
    return bindingDescriptions;
}

std::vector<VkVertexInputAttributeDescription> ven::Model::Vertex::getAttributeDescriptions()
{
    std::vector<VkVertexInputAttributeDescription> attributeDescriptions{};

    attributeDescriptions.push_back({0, 0, VK_FORMAT_R32G32B32_SFLOAT, offsetof(Vertex, position)});
    attributeDescriptions.push_back({1, 0, VK_FORMAT_R32G32B32_SFLOAT, offsetof(Vertex, color)});
    attributeDescriptions.push_back({2, 0, VK_FORMAT_R32G32B32_SFLOAT, offsetof(Vertex, normal)});
    attributeDescriptions.push_back({3, 0, VK_FORMAT_R32G32_SFLOAT, offsetof(Vertex, uv)});

    return attributeDescriptions;
}

void ven::Model::Builder::loadModel(const std::string &filename) {
    Assimp::Importer importer;

    const aiScene* scene = importer.ReadFile(filename, aiProcess_Triangulate | aiProcess_FlipUVs |
aiProcess_CalcTangentSpace | aiProcess_GenNormals);

    if ((scene == nullptr) || ((scene->mFlags & AI_SCENE_FLAGS_INCOMPLETE) != 0U) ||
!scene->mRootNode) {
        throw std::runtime_error("Failed to load model with Assimp: " +
std::string(importer.GetErrorString()));
    }

    vertices.clear();
    indices.clear();

    processNode(scene->mRootNode, scene);
}

void ven::Model::Builder::processNode(const aiNode* node, const aiScene* scene) {
    for (unsigned int i = 0; i < node->mNumMeshes; i++) {
        const aiMesh* mesh = scene->mMeshes[node->mMeshes[i]];
        processMesh(mesh, scene);
    }

    for (unsigned int i = 0; i < node->mNumChildren; i++) {
        processNode(node->mChildren[i], scene);
    }
}
```

```
void ven::Model::Builder::processMesh(const aiMesh* mesh, const aiScene* scene) {
    std::unordered_map<Vertex, uint32_t> uniqueVertices;

    for (unsigned int i = 0; i < mesh->mNumVertices; i++) {
        Vertex vertex{};

        vertex.position = glm::vec3(
            mesh->mVertices[i].x,
            mesh->mVertices[i].y,
            mesh->mVertices[i].z
        );

        if (mesh->HasNormals()) {
            vertex.normal = glm::vec3(
                mesh->mNormals[i].x,
                mesh->mNormals[i].y,
                mesh->mNormals[i].z
            );
        }

        if (mesh->mTextureCoords[0] != nullptr) {
            vertex.uv = glm::vec2(
                mesh->mTextureCoords[0][i].x,
                mesh->mTextureCoords[0][i].y
            );
        } else {
            vertex.uv = glm::vec2(0.0F, 0.0F);
        }

        if (vertex.color == Colors::BLACK_3) {
            vertex.color = Colors::WHITE_3;
        }

        if (!uniqueVertices.contains(vertex)) {
            uniqueVertices[vertex] = static_cast<uint32_t>(vertices.size());
            vertices.push_back(vertex);
        }

        indices.push_back(uniqueVertices[vertex]);
    }
}
```

8.86 /home/runner/work/VEngine/VEngine/src/renderer.cpp File Reference

`#include "VEngine/Renderer.hpp"`

Include dependency graph for renderer.cpp:



8.87 renderer.cpp

Go to the documentation of this file.

```
#include "VEngine/Renderer.hpp"

void ven::Renderer::createCommandBuffers()
{
    m_commandBuffers.resize(MAX_FRAMES_IN_FLIGHT);
    VkCommandBufferAllocateInfo allocInfo{};
    allocInfo.sType = VK_STRUCTURE_TYPE_COMMAND_BUFFER_ALLOCATE_INFO;
    allocInfo.level = VK_COMMAND_BUFFER_LEVEL_PRIMARY;
    allocInfo.commandPool = m_device.getCommandPool();
    allocInfo.commandBufferCount = static_cast<uint32_t>(m_commandBuffers.size());

    if (vkAllocateCommandBuffers(m_device.device(), &allocInfo, m_commandBuffers.data()) !=
VK_SUCCESS) {
        throw std::runtime_error("Failed to allocate command buffers");
    }
}

void ven::Renderer::freeCommandBuffers()
{
    vkFreeCommandBuffers(m_device.device(), m_device.getCommandPool(),
static_cast<uint32_t>(m_commandBuffers.size()), m_commandBuffers.data());
    m_commandBuffers.clear();
}

void ven::Renderer::recreateSwapChain()
{
```

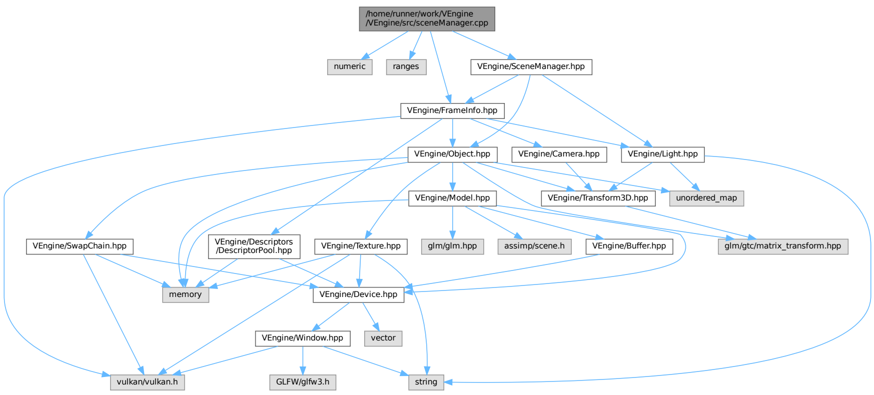
```cpp
    VkExtent2D extent = m_window.getExtent();
    while (extent.width == 0 || extent.height == 0) {
        extent = m_window.getExtent();
        glfwWaitEvents();
    }
    vkDeviceWaitIdle(m_device.device());
    if (m_swapChain == nullptr) {
        m_swapChain = std::make_unique<SwapChain>(m_device, extent);
    } else {
        std::shared_ptr<SwapChain> oldSwapChain = std::move(m_swapChain);
        m_swapChain = std::make_unique<SwapChain>(m_device, extent, oldSwapChain);
        if (!oldSwapChain->compareSwapFormats(*m_swapChain)) {
            throw std::runtime_error("Swap chain image/depth format changed");
        }
    }
    // well be back
}

VkCommandBuffer ven::Renderer::beginFrame()
{
    assert(!m_isFrameStarted && "Can't start new frame while previous one is still in progress");

    const VkResult result = m_swapChain->acquireNextImage(&m_currentImageIndex);
    if (result == VK_ERROR_OUT_OF_DATE_KHR) {
        recreateSwapChain();
        return nullptr;
    }

    if (result != VK_SUCCESS && result != VK_SUBOPTIMAL_KHR) {
        throw std::runtime_error("Failed to acquire swap chain image");
    }

    m_isFrameStarted = true;

    VkCommandBuffer_T *commandBuffer = getCurrentCommandBuffer();
    VkCommandBufferBeginInfo beginInfo{};
    beginInfo.sType = VK_STRUCTURE_TYPE_COMMAND_BUFFER_BEGIN_INFO;

    if (vkBeginCommandBuffer(commandBuffer, &beginInfo) != VK_SUCCESS) {
        throw std::runtime_error("Failed to begin recording command m_buffer");
    }
    return commandBuffer;
}

void ven::Renderer::endFrame()
{
    assert(m_isFrameStarted && "Can't end frame that hasn't been started");

    VkCommandBuffer_T *commandBuffer = getCurrentCommandBuffer();
    if (vkEndCommandBuffer(commandBuffer) != VK_SUCCESS) {
        throw std::runtime_error("Failed to record command buffer");
    }
    if (const VkResult result = m_swapChain->submitCommandBuffers(&commandBuffer, &m_currentImageIndex); result == VK_ERROR_OUT_OF_DATE_KHR || result == VK_SUBOPTIMAL_KHR || m_window.wasWindowResized()) {
        m_window.resetWindowResizedFlag();
        recreateSwapChain();
    }
    else if (result != VK_SUCCESS) {
        throw std::runtime_error("Failed to submit command buffer");
    }

    m_isFrameStarted = false;
    m_currentFrameIndex = (m_currentFrameIndex + 1) % MAX_FRAMES_IN_FLIGHT;
}

void ven::Renderer::beginSwapChainRenderPass(const VkCommandBuffer commandBuffer) const
{
    assert(m_isFrameStarted && "Can't begin render pass when frame not in progress");
    assert(commandBuffer == getCurrentCommandBuffer() && "Can't begin render pass on command m_buffer from a different frame");

    VkRenderPassBeginInfo renderPassInfo{};
    renderPassInfo.sType = VK_STRUCTURE_TYPE_RENDER_PASS_BEGIN_INFO;
    renderPassInfo.renderPass = m_swapChain->getRenderPass();
    renderPassInfo.framebuffer = m_swapChain->getFrameBuffer(m_currentImageIndex);

    renderPassInfo.renderArea.offset = {.x=0, .y=0};
    renderPassInfo.renderArea.extent = m_swapChain->getSwapChainExtent();

    renderPassInfo.clearValueCount = static_cast<uint32_t>(m_clearValues.size());
    renderPassInfo.pClearValues = m_clearValues.data();

    vkCmdBeginRenderPass(commandBuffer, &renderPassInfo, VK_SUBPASS_CONTENTS_INLINE);

    VkViewport viewport{};
    viewport.x = 0.0F;
```

```
    viewport.y = 0.0F;
    viewport.width = static_cast<float>(m_swapChain->getSwapChainExtent().width);
    viewport.height = static_cast<float>(m_swapChain->getSwapChainExtent().height);
    viewport.minDepth = 0.0F;
    viewport.maxDepth = 1.0F;
    const VkRect2D scissor{{0, 0}, m_swapChain->getSwapChainExtent()};
    vkCmdSetViewport(commandBuffer, 0, 1, &viewport);
    vkCmdSetScissor(commandBuffer, 0, 1, &scissor);
}

void ven::Renderer::endSwapChainRenderPass(const VkCommandBuffer commandBuffer) const
{
    assert(m_isFrameStarted && "Can't end render pass when frame not in progress");
    assert(commandBuffer == getCurrentCommandBuffer() && "Can't end render pass on command m_buffer from a different frame");

    vkCmdEndRenderPass(commandBuffer);
}
```

8.88 /home/runner/work/VEngine/VEngine/src/sceneManager.cpp File Reference

```
#include <numeric>
#include <ranges>
#include "VEngine/SceneManager.hpp"
#include "VEngine/FrameInfo.hpp"
```

Include dependency graph for sceneManager.cpp:



8.89 sceneManager.cpp

Go to the documentation of this file.

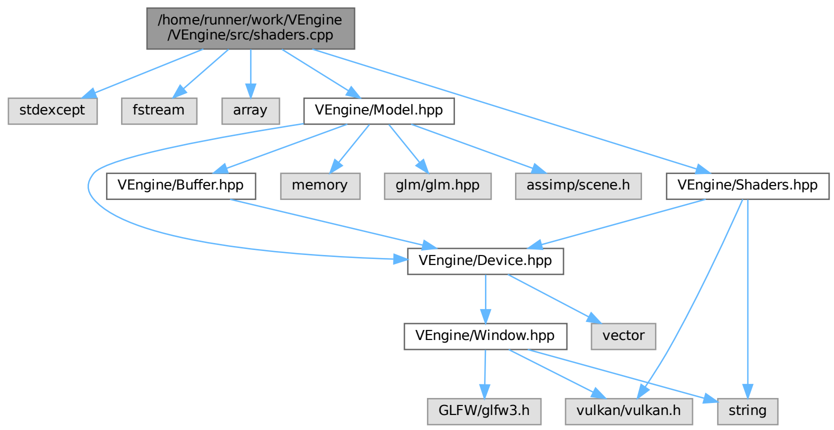
```
#include <numeric>
#include <ranges>

#include "VEngine/SceneManager.hpp"
#include "VEngine/FrameInfo.hpp"

ven::SceneManager::SceneManager(Device& device)
{
    // including nonCoherentAtomSize allows us to flush a specific index at once
    unsigned long alignment = std::lcm(
        device.getProperties().limits.nonCoherentAtomSize,
        device.getProperties().limits.minUniformBufferOffsetAlignment
    );
    for (auto & uboBuffer : m_uboBuffers) {
        uboBuffer = std::make_unique<Buffer>(
            device,
            sizeof(ObjectBufferData),
```

```
            MAX_OBJECTS,
            VK_BUFFER_USAGE_UNIFORM_BUFFER_BIT,
            VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT,
            alignment);
        uboBuffer->map();
    }
    m_textureDefault = Texture::createTextureFromFile(device, "assets/textures/default.png");
}

ven::Object& ven::SceneManager::createObject()
{
    assert(m_currentObjId < MAX_OBJECTS && "Max object count exceeded!");
    Object object(m_currentObjId++);
    const unsigned int objId = object.getId();
    object.setDiffuseMap(m_textureDefault);
    m_objects.emplace(objId, std::move(object));
    return m_objects.at(objId);
}

ven::Light& ven::SceneManager::createLight(const float radius, const glm::vec4 color)
{
    assert(m_currentLightId < MAX_LIGHTS && "Max light count exceeded!");
    Light light(m_currentLightId++);
    const unsigned int lightId = light.getId();
    light.color = color;
    light.transform.scale.x = radius;
    m_lights.emplace(lightId, std::move(light));
    return m_lights.at(lightId);
}

void ven::SceneManager::updateBuffer(GlobalUbo &ubo, const unsigned long frameIndex, const float
frameTime)
{
    uint8_t lightIndex = 0;
    const glm::mat4 rotateLight = rotate(glm::mat4(1.F), frameTime, {0.F, -1.F, 0.F});

    for (auto& [id, object] : m_objects) {
        const ObjectBufferData data{
            .modelMatrix = object.transform.transformMatrix(),
            .normalMatrix = object.transform.normalMatrix()
        };
        m_uboBuffers.at(frameIndex)->writeToIndex(&data, id);
        object.setBufferInfo(static_cast<int>(frameIndex),
m_uboBuffers.at(frameIndex)->descriptorInfoForIndex(id));
    }

    for (Light &light : m_lights | std::views::values) {
        auto&[position, color, shininess, padding] = ubo.pointLights.at(lightIndex);
        light.transform.translation = glm::vec3(rotateLight * glm::vec4(light.transform.translation,
light.transform.scale.x));
        position = glm::vec4(light.transform.translation, light.transform.scale.x);
        color = light.color;
        shininess = light.getShininess();
        lightIndex++;
    }
    ubo.numLights = lightIndex;
}
```

8.90 /home/runner/work/VEngine/VEngine/src/shaders.cpp File Reference

```
#include <stdexcept>
#include <fstream>
#include <array>
#include "VEngine/Model.hpp"
#include "VEngine/Shaders.hpp"
```

Include dependency graph for shaders.cpp:



8.91 shaders.cpp

Go to the documentation of this file.

```
#include <stdexcept>
#include <fstream>
#include <array>

#include "VEngine/Model.hpp"
#include "VEngine/Shaders.hpp"

ven::Shaders::~Shaders()
{
    vkDestroyShaderModule(m_device.device(), m_vertShaderModule, nullptr);
    vkDestroyShaderModule(m_device.device(), m_fragShaderModule, nullptr);
    vkDestroyPipeline(m_device.device(), m_graphicsPipeline, nullptr);
}

std::vector<char> ven::Shaders::readFile(const std::string &filename) {
    std::ifstream file(filename, std::ios::binary | std::ios::ate);
    if (!file.is_open()) {
        throw std::runtime_error("failed to open file!");
    }

    const long int fileSize = file.tellg();
    std::vector<char> buffer(static_cast<long unsigned int>(fileSize));
    file.seekg(0);
    file.read(buffer.data(), fileSize);
    return buffer;
}

void ven::Shaders::createGraphicsPipeline(const std::string& vertFilepath, const std::string& fragFilepath, const PipelineConfigInfo& configInfo)
{
    const std::vector<char> vertCode = readFile(vertFilepath);
    const std::vector<char> fragCode = readFile(fragFilepath);

    createShaderModule(vertCode, &m_vertShaderModule);
    createShaderModule(fragCode, &m_fragShaderModule);

    std::array<VkPipelineShaderStageCreateInfo, 2> shaderStages{};
    shaderStages[0].sType = VK_STRUCTURE_TYPE_PIPELINE_SHADER_STAGE_CREATE_INFO;
    shaderStages[0].stage = VK_SHADER_STAGE_VERTEX_BIT;
    shaderStages[0].module = m_vertShaderModule;
    shaderStages[0].pName = "main";
    shaderStages[0].flags = 0;
    shaderStages[0].pNext = nullptr;
    shaderStages[0].pSpecializationInfo = nullptr;

    shaderStages[1].sType = VK_STRUCTURE_TYPE_PIPELINE_SHADER_STAGE_CREATE_INFO;
    shaderStages[1].stage = VK_SHADER_STAGE_FRAGMENT_BIT;
    shaderStages[1].module = m_fragShaderModule;
```

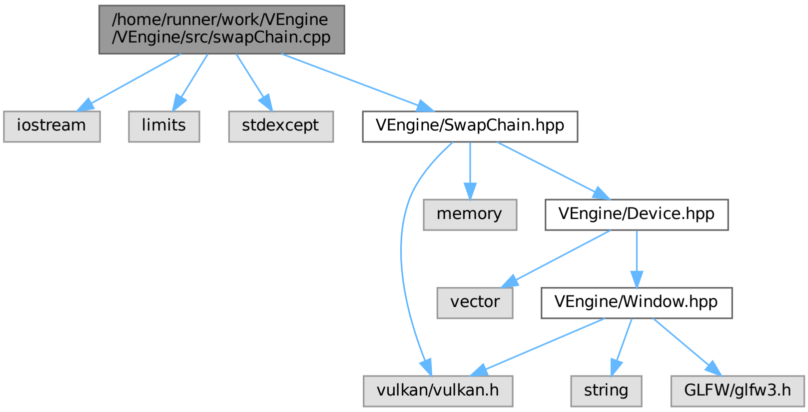
```cpp
    shaderStages[1].pName = "main";
    shaderStages[1].flags = 0;
    shaderStages[1].pNext = nullptr;
    shaderStages[1].pSpecializationInfo = nullptr;

    const auto& bindingDescriptions = configInfo.bindingDescriptions;
    const auto& attributeDescriptions = configInfo.attributeDescriptions;
    VkPipelineVertexInputStateCreateInfo vertexInputInfo{};
    vertexInputInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_VERTEX_INPUT_STATE_CREATE_INFO;
    vertexInputInfo.vertexAttributeDescriptionCount = static_cast<uint32_t>(attributeDescriptions.size());
    vertexInputInfo.vertexBindingDescriptionCount = static_cast<uint32_t>(bindingDescriptions.size());
    vertexInputInfo.pVertexAttributeDescriptions = attributeDescriptions.data();
    vertexInputInfo.pVertexBindingDescriptions = bindingDescriptions.data();


    VkPipelineViewportStateCreateInfo viewportInfo{};
    viewportInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_VIEWPORT_STATE_CREATE_INFO;
    viewportInfo.viewportCount = 1;
    viewportInfo.pViewports = nullptr;
    viewportInfo.scissorCount = 1;
    viewportInfo.pScissors = nullptr;


    VkGraphicsPipelineCreateInfo pipelineInfo{};
    pipelineInfo.sType = VK_STRUCTURE_TYPE_GRAPHICS_PIPELINE_CREATE_INFO;
    pipelineInfo.stageCount = 2;
    pipelineInfo.pStages = shaderStages.data();
    pipelineInfo.pVertexInputState = &vertexInputInfo;
    pipelineInfo.pInputAssemblyState = &configInfo.inputAssemblyInfo;
    pipelineInfo.pViewportState = &viewportInfo;
    pipelineInfo.pRasterizationState = &configInfo.rasterizationInfo;
    pipelineInfo.pMultisampleState = &configInfo.multisampleInfo;

    pipelineInfo.pColorBlendState = &configInfo.colorBlendInfo;
    pipelineInfo.pDepthStencilState = &configInfo.depthStencilInfo;
    pipelineInfo.pDynamicState = &configInfo.dynamicStateInfo;

    pipelineInfo.layout = configInfo.pipelineLayout;
    pipelineInfo.renderPass = configInfo.renderPass;
    pipelineInfo.subpass = configInfo.subpass;

    pipelineInfo.basePipelineIndex = -1;
    pipelineInfo.basePipelineHandle = VK_NULL_HANDLE;

    if (vkCreateGraphicsPipelines(m_device.device(), VK_NULL_HANDLE, 1, &pipelineInfo, nullptr, &m_graphicsPipeline) != VK_SUCCESS) {
        throw std::runtime_error("failed to create graphics pipeline");
    }
}

void ven::Shaders::createShaderModule(const std::vector<char> &code, VkShaderModule *shaderModule) const
{
    VkShaderModuleCreateInfo createInfo{};
    createInfo.sType = VK_STRUCTURE_TYPE_SHADER_MODULE_CREATE_INFO;
    createInfo.codeSize = code.size();
    createInfo.pCode = reinterpret_cast<const uint32_t*>(code.data());

    if (vkCreateShaderModule(m_device.device(), &createInfo, nullptr, shaderModule) != VK_SUCCESS) {
        throw std::runtime_error("failed to create shader module");
    }
}

void ven::Shaders::defaultPipelineConfigInfo(PipelineConfigInfo& configInfo)
{
    configInfo.inputAssemblyInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_INPUT_ASSEMBLY_STATE_CREATE_INFO;
    configInfo.inputAssemblyInfo.topology = VK_PRIMITIVE_TOPOLOGY_TRIANGLE_LIST;
    configInfo.inputAssemblyInfo.primitiveRestartEnable = VK_FALSE;

    configInfo.rasterizationInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_RASTERIZATION_STATE_CREATE_INFO;
    configInfo.rasterizationInfo.depthClampEnable = VK_FALSE;
    configInfo.rasterizationInfo.rasterizerDiscardEnable = VK_FALSE;
    configInfo.rasterizationInfo.polygonMode = VK_POLYGON_MODE_FILL;
    configInfo.rasterizationInfo.lineWidth = 1.0F;
    configInfo.rasterizationInfo.cullMode = VK_CULL_MODE_NONE; // to enable later (VK_CULL_MODE_BACK_BIT) back-face culling
    configInfo.rasterizationInfo.frontFace = VK_FRONT_FACE_COUNTER_CLOCKWISE;
    configInfo.rasterizationInfo.depthBiasEnable = VK_FALSE;
    configInfo.rasterizationInfo.depthBiasConstantFactor = 0.0F;
    configInfo.rasterizationInfo.depthBiasClamp = 0.0F;
    configInfo.rasterizationInfo.depthBiasSlopeFactor = 0.0F;

    configInfo.multisampleInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_MULTISAMPLE_STATE_CREATE_INFO;
    configInfo.multisampleInfo.sampleShadingEnable = VK_FALSE;
    configInfo.multisampleInfo.rasterizationSamples = VK_SAMPLE_COUNT_1_BIT;
    configInfo.multisampleInfo.minSampleShading = 1.0F;
```

```
    configInfo.multisampleInfo.pSampleMask = nullptr;
    configInfo.multisampleInfo.alphaToCoverageEnable = VK_FALSE;
    configInfo.multisampleInfo.alphaToOneEnable = VK_FALSE;

    configInfo.colorBlendAttachment.colorWriteMask = VK_COLOR_COMPONENT_R_BIT | VK_COLOR_COMPONENT_G_BIT | VK_COLOR_COMPONENT_B_BIT | VK_COLOR_COMPONENT_A_BIT;
    configInfo.colorBlendAttachment.blendEnable = VK_FALSE;
    configInfo.colorBlendAttachment.srcColorBlendFactor = VK_BLEND_FACTOR_ONE;
    configInfo.colorBlendAttachment.dstColorBlendFactor = VK_BLEND_FACTOR_ZERO;
    configInfo.colorBlendAttachment.colorBlendOp = VK_BLEND_OP_ADD;
    configInfo.colorBlendAttachment.srcAlphaBlendFactor = VK_BLEND_FACTOR_ONE;
    configInfo.colorBlendAttachment.dstAlphaBlendFactor = VK_BLEND_FACTOR_ZERO;
    configInfo.colorBlendAttachment.alphaBlendOp = VK_BLEND_OP_ADD;

    configInfo.colorBlendInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_COLOR_BLEND_STATE_CREATE_INFO;
    configInfo.colorBlendInfo.logicOpEnable = VK_FALSE;
    configInfo.colorBlendInfo.logicOp = VK_LOGIC_OP_COPY;
    configInfo.colorBlendInfo.attachmentCount = 1;
    configInfo.colorBlendInfo.pAttachments = &configInfo.colorBlendAttachment;
    configInfo.colorBlendInfo.blendConstants[0] = 0.0F;
    configInfo.colorBlendInfo.blendConstants[1] = 0.0F;
    configInfo.colorBlendInfo.blendConstants[2] = 0.0F;
    configInfo.colorBlendInfo.blendConstants[3] = 0.0F;

    configInfo.depthStencilInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_DEPTH_STENCIL_STATE_CREATE_INFO;
    configInfo.depthStencilInfo.depthTestEnable = VK_TRUE;
    configInfo.depthStencilInfo.depthWriteEnable = VK_TRUE;
    configInfo.depthStencilInfo.depthCompareOp = VK_COMPARE_OP_LESS;
    configInfo.depthStencilInfo.depthBoundsTestEnable = VK_FALSE;
    configInfo.depthStencilInfo.minDepthBounds = 0.0F;
    configInfo.depthStencilInfo.maxDepthBounds = 1.0F;
    configInfo.depthStencilInfo.stencilTestEnable = VK_FALSE;
    configInfo.depthStencilInfo.front = {};
    configInfo.depthStencilInfo.back = {};

    configInfo.dynamicStateEnables = {VK_DYNAMIC_STATE_VIEWPORT, VK_DYNAMIC_STATE_SCISSOR};
    configInfo.dynamicStateInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_DYNAMIC_STATE_CREATE_INFO;
    configInfo.dynamicStateInfo.pDynamicStates = configInfo.dynamicStateEnables.data();
    configInfo.dynamicStateInfo.dynamicStateCount = static_cast<uint32_t>(configInfo.dynamicStateEnables.size());
    configInfo.dynamicStateInfo.flags = 0;
    configInfo.bindingDescriptions = Model::Vertex::getBindingDescriptions();
    configInfo.attributeDescriptions = Model::Vertex::getAttributeDescriptions();
}
```

8.92 /home/runner/work/VEngine/VEngine/src/swapChain.cpp File Reference

```
#include <iostream>
#include <limits>
#include <stdexcept>
#include "VEngine/SwapChain.hpp"
```

Include dependency graph for swapChain.cpp:



8.93 swapChain.cpp

Go to the documentation of this file.

```
#include <iostream>
#include <limits>
#include <stdexcept>

#include "VEngine/SwapChain.hpp"

ven::SwapChain::~SwapChain()
{
    for (VkImageView_T *imageView : m_swapChainImageViews) {
        vkDestroyImageView(m_device.device(), imageView, nullptr);
    }
    m_swapChainImageViews.clear();

    if (m_swapChain != nullptr) {
        vkDestroySwapchainKHR(m_device.device(), m_swapChain, nullptr);
        m_swapChain = nullptr;
    }

    for (size_t i = 0; i < m_depthImages.size(); i++) {
        vkDestroyImageView(m_device.device(), m_depthImageViews[i], nullptr);
        vkDestroyImage(m_device.device(), m_depthImages[i], nullptr);
        vkFreeMemory(m_device.device(), m_depthImageMemory[i], nullptr);
    }

    for (VkFramebuffer_T *framebuffer : m_swapChainFrameBuffers) {
        vkDestroyFramebuffer(m_device.device(), framebuffer, nullptr);
    }

    vkDestroyRenderPass(m_device.device(), m_renderPass, nullptr);

    // cleanup synchronization objects
    for (size_t i = 0; i < MAX_FRAMES_IN_FLIGHT; i++) {
        vkDestroySemaphore(m_device.device(), m_renderFinishedSemaphores[i], nullptr);
        vkDestroySemaphore(m_device.device(), m_imageAvailableSemaphores[i], nullptr);
        vkDestroyFence(m_device.device(), m_inFlightFences[i], nullptr);
    }
}

void ven::SwapChain::init()
{
    createSwapChain();
    createImageViews();
    createRenderPass();
    createDepthResources();
    createFrameBuffers();
    createSyncObjects();
}

```

```
VkResult ven::SwapChain::acquireNextImage(uint32_t *imageIndex) const
{
    vkWaitForFences(m_device.device(), 1, &m_inFlightFences[m_currentFrame], VK_TRUE, std::numeric_limits<uint64_t>::max());

    return vkAcquireNextImageKHR(m_device.device(), m_swapChain, std::numeric_limits<uint64_t>::max(), m_imageAvailableSemaphores[m_currentFrame], VK_NULL_HANDLE, imageIndex);;
}

VkResult ven::SwapChain::submitCommandBuffers(const VkCommandBuffer *buffers, const uint32_t *imageIndex)
{
    if (m_imagesInFlight[*imageIndex] != VK_NULL_HANDLE) {
        vkWaitForFences(m_device.device(), 1, &m_imagesInFlight[*imageIndex], VK_TRUE, UINT64_MAX);
    }
    m_imagesInFlight[*imageIndex] = m_inFlightFences[m_currentFrame];

    VkSubmitInfo submitInfo = {};
    submitInfo.sType = VK_STRUCTURE_TYPE_SUBMIT_INFO;

    const std::array<VkSemaphore, 1> waitSemaphores = {m_imageAvailableSemaphores[m_currentFrame]};
    constexpr std::array<VkPipelineStageFlags, 1> waitStages = {VK_PIPELINE_STAGE_COLOR_ATTACHMENT_OUTPUT_BIT};
    submitInfo.waitSemaphoreCount = 1;
    submitInfo.pWaitSemaphores = waitSemaphores.data();
    submitInfo.pWaitDstStageMask = waitStages.data();

    submitInfo.commandBufferCount = 1;
    submitInfo.pCommandBuffers = buffers;

    const std::array<VkSemaphore, 1> signalSemaphores = {m_renderFinishedSemaphores[m_currentFrame]};
    submitInfo.signalSemaphoreCount = 1;
    submitInfo.pSignalSemaphores = signalSemaphores.data();

    vkResetFences(m_device.device(), 1, &m_inFlightFences[m_currentFrame]);
    if (vkQueueSubmit(m_device.graphicsQueue(), 1, &submitInfo, m_inFlightFences[m_currentFrame]) != VK_SUCCESS) {
        throw std::runtime_error("failed to submit draw command buffer!");
    }

    VkPresentInfoKHR presentInfo = {};
    presentInfo.sType = VK_STRUCTURE_TYPE_PRESENT_INFO_KHR;

    presentInfo.waitSemaphoreCount = 1;
    presentInfo.pWaitSemaphores = signalSemaphores.data();

    const std::array<VkSwapchainKHR, 1> swapChains = {m_swapChain};
    presentInfo.swapchainCount = 1;
    presentInfo.pSwapchains = swapChains.data();

    presentInfo.pImageIndices = imageIndex;

    const VkResult result = vkQueuePresentKHR(m_device.presentQueue(), &presentInfo);

    m_currentFrame = (m_currentFrame + 1) % MAX_FRAMES_IN_FLIGHT;

    return result;
}

void ven::SwapChain::createSwapChain()
{
    const auto [capabilities, formats, presentModes] = m_device.getSwapChainSupport();

    const auto [format, colorSpace] = chooseSwapSurfaceFormat(formats);
    const VkPresentModeKHR presentMode = chooseSwapPresentMode(presentModes);
    const VkExtent2D extent = chooseSwapExtent(capabilities);

    uint32_t imageCount = capabilities.minImageCount + 1;
    if (capabilities.maxImageCount > 0 && imageCount > capabilities.maxImageCount) {
        imageCount = capabilities.maxImageCount;
    }

    VkSwapchainCreateInfoKHR createInfo = {};
    createInfo.sType = VK_STRUCTURE_TYPE_SWAPCHAIN_CREATE_INFO_KHR;
    createInfo.surface = m_device.surface();

    createInfo.minImageCount = imageCount;
    createInfo.imageFormat = format;
    createInfo.imageColorSpace = colorSpace;
    createInfo.imageExtent = extent;
    createInfo.imageArrayLayers = 1;
    createInfo.imageUsage = VK_IMAGE_USAGE_COLOR_ATTACHMENT_BIT;

    const auto [graphicsFamily, presentFamily, graphicsFamilyHasValue, presentFamilyHasValue] = m_device.findPhysicalQueueFamilies();
    const std::array<uint32_t, 2> queueFamilyIndices = {graphicsFamily, presentFamily};

```

```
    if (graphicsFamily != presentFamily) {
        createInfo.imageSharingMode = VK_SHARING_MODE_CONCURRENT;
        createInfo.queueFamilyIndexCount = 2;
        createInfo.pQueueFamilyIndices = queueFamilyIndices.data();
    } else {
        createInfo.imageSharingMode = VK_SHARING_MODE_EXCLUSIVE;
        createInfo.queueFamilyIndexCount = 0;      // Optional
        createInfo.pQueueFamilyIndices = nullptr;  // Optional
    }

    createInfo.preTransform = capabilities.currentTransform;
    createInfo.compositeAlpha = VK_COMPOSITE_ALPHA_OPAQUE_BIT_KHR;

    createInfo.presentMode = presentMode;
    createInfo.clipped = VK_TRUE;

    createInfo.oldSwapchain = m_oldSwapChain == nullptr ? VK_NULL_HANDLE : m_oldSwapChain->m_swapChain;

    if (vkCreateSwapchainKHR(m_device.device(), &createInfo, nullptr, &m_swapChain) != VK_SUCCESS) {
        throw std::runtime_error("failed to create swap chain!");
    }

    vkGetSwapchainImagesKHR(m_device.device(), m_swapChain, &imageCount, nullptr);
    m_swapChainImages.resize(imageCount);
    vkGetSwapchainImagesKHR(m_device.device(), m_swapChain, &imageCount, m_swapChainImages.data());

    m_swapChainImageFormat = format;
    m_swapChainExtent = extent;
}

void ven::SwapChain::createImageViews()
{
    m_swapChainImageViews.resize(m_swapChainImages.size());
    for (size_t i = 0; i < m_swapChainImages.size(); i++) {
        VkImageViewCreateInfo viewInfo{};
        viewInfo.sType = VK_STRUCTURE_TYPE_IMAGE_VIEW_CREATE_INFO;
        viewInfo.image = m_swapChainImages[i];
        viewInfo.viewType = VK_IMAGE_VIEW_TYPE_2D;
        viewInfo.format = m_swapChainImageFormat;
        viewInfo.subresourceRange.aspectMask = VK_IMAGE_ASPECT_COLOR_BIT;
        viewInfo.subresourceRange.baseMipLevel = 0;
        viewInfo.subresourceRange.levelCount = 1;
        viewInfo.subresourceRange.baseArrayLayer = 0;
        viewInfo.subresourceRange.layerCount = 1;

        if (vkCreateImageView(m_device.device(), &viewInfo, nullptr, &m_swapChainImageViews[i]) != VK_SUCCESS) {
            throw std::runtime_error("failed to create texture image view!");
        }
    }
}

void ven::SwapChain::createRenderPass()
{
    VkAttachmentDescription depthAttachment{};
    depthAttachment.format = findDepthFormat();
    depthAttachment.samples = VK_SAMPLE_COUNT_1_BIT;
    depthAttachment.loadOp = VK_ATTACHMENT_LOAD_OP_CLEAR;
    depthAttachment.storeOp = VK_ATTACHMENT_STORE_OP_DONT_CARE;
    depthAttachment.stencilLoadOp = VK_ATTACHMENT_LOAD_OP_DONT_CARE;
    depthAttachment.stencilStoreOp = VK_ATTACHMENT_STORE_OP_DONT_CARE;
    depthAttachment.initialLayout = VK_IMAGE_LAYOUT_UNDEFINED;
    depthAttachment.finalLayout = VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL;

    VkAttachmentReference depthAttachmentRef{};
    depthAttachmentRef.attachment = 1;
    depthAttachmentRef.layout = VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL;

    VkAttachmentDescription colorAttachment = {};
    colorAttachment.format = getSwapChainImageFormat();
    colorAttachment.samples = VK_SAMPLE_COUNT_1_BIT;
    colorAttachment.loadOp = VK_ATTACHMENT_LOAD_OP_CLEAR;
    colorAttachment.storeOp = VK_ATTACHMENT_STORE_OP_STORE;
    colorAttachment.stencilStoreOp = VK_ATTACHMENT_STORE_OP_DONT_CARE;
    colorAttachment.stencilLoadOp = VK_ATTACHMENT_LOAD_OP_DONT_CARE;
    colorAttachment.initialLayout = VK_IMAGE_LAYOUT_UNDEFINED;
    colorAttachment.finalLayout = VK_IMAGE_LAYOUT_PRESENT_SRC_KHR;

    VkAttachmentReference colorAttachmentRef = {};
    colorAttachmentRef.attachment = 0;
    colorAttachmentRef.layout = VK_IMAGE_LAYOUT_COLOR_ATTACHMENT_OPTIMAL;

    VkSubpassDescription subpass = {};
    subpass.pipelineBindPoint = VK_PIPELINE_BIND_POINT_GRAPHICS;
    subpass.colorAttachmentCount = 1;
    subpass.pColorAttachments = &colorAttachmentRef;
```

```cpp
    subpass.pDepthStencilAttachment = &depthAttachmentRef;

    VkSubpassDependency dependency = {};
    dependency.srcSubpass = VK_SUBPASS_EXTERNAL;
    dependency.srcAccessMask = 0;
    dependency.srcStageMask = VK_PIPELINE_STAGE_COLOR_ATTACHMENT_OUTPUT_BIT |
VK_PIPELINE_STAGE_EARLY_FRAGMENT_TESTS_BIT;
    dependency.dstSubpass = 0;
    dependency.dstStageMask = VK_PIPELINE_STAGE_COLOR_ATTACHMENT_OUTPUT_BIT |
VK_PIPELINE_STAGE_EARLY_FRAGMENT_TESTS_BIT;
    dependency.dstAccessMask = VK_ACCESS_COLOR_ATTACHMENT_WRITE_BIT |
VK_ACCESS_DEPTH_STENCIL_ATTACHMENT_WRITE_BIT;

    const std::array<VkAttachmentDescription, 2> attachments = {colorAttachment, depthAttachment};
    VkRenderPassCreateInfo renderPassInfo = {};
    renderPassInfo.sType = VK_STRUCTURE_TYPE_RENDER_PASS_CREATE_INFO;
    renderPassInfo.attachmentCount = static_cast<uint32_t>(attachments.size());
    renderPassInfo.pAttachments = attachments.data();
    renderPassInfo.subpassCount = 1;
    renderPassInfo.pSubpasses = &subpass;
    renderPassInfo.dependencyCount = 1;
    renderPassInfo.pDependencies = &dependency;

    if (vkCreateRenderPass(m_device.device(), &renderPassInfo, nullptr, &m_renderPass) != VK_SUCCESS)
{
        throw std::runtime_error("failed to create render pass!");
    }
}

void ven::SwapChain::createFrameBuffers()
{
    m_swapChainFrameBuffers.resize(imageCount());
    for (size_t i = 0; i < imageCount(); i++) {
        std::array<VkImageView, 2> attachments = {m_swapChainImageViews[i], m_depthImageViews[i]};

        const auto [width, height] = getSwapChainExtent();
        VkFramebufferCreateInfo framebufferInfo = {};
        framebufferInfo.sType = VK_STRUCTURE_TYPE_FRAMEBUFFER_CREATE_INFO;
        framebufferInfo.renderPass = m_renderPass;
        framebufferInfo.attachmentCount = static_cast<uint32_t>(attachments.size());
        framebufferInfo.pAttachments = attachments.data();
        framebufferInfo.width = width;
        framebufferInfo.height = height;
        framebufferInfo.layers = 1;

        if (vkCreateFramebuffer(m_device.device(), &framebufferInfo, nullptr,
&m_swapChainFrameBuffers[i]) != VK_SUCCESS) {
            throw std::runtime_error("failed to create framebuffer!");
        }
    }
}

void ven::SwapChain::createDepthResources()
{
    const VkFormat depthFormat = findDepthFormat();
    const auto [width, height] = getSwapChainExtent();

    m_swapChainDepthFormat = depthFormat;
    m_depthImages.resize(imageCount());
    m_depthImageMemory.resize(imageCount());
    m_depthImageViews.resize(imageCount());

    for (size_t i = 0; i < m_depthImages.size(); i++) {
        VkImageCreateInfo imageInfo{};
        imageInfo.sType = VK_STRUCTURE_TYPE_IMAGE_CREATE_INFO;
        imageInfo.imageType = VK_IMAGE_TYPE_2D;
        imageInfo.extent.width = width;
        imageInfo.extent.height = height;
        imageInfo.extent.depth = 1;
        imageInfo.mipLevels = 1;
        imageInfo.arrayLayers = 1;
        imageInfo.format = depthFormat;
        imageInfo.tiling = VK_IMAGE_TILING_OPTIMAL;
        imageInfo.initialLayout = VK_IMAGE_LAYOUT_UNDEFINED;
        imageInfo.usage = VK_IMAGE_USAGE_DEPTH_STENCIL_ATTACHMENT_BIT;
        imageInfo.samples = VK_SAMPLE_COUNT_1_BIT;
        imageInfo.sharingMode = VK_SHARING_MODE_EXCLUSIVE;
        imageInfo.flags = 0;

        m_device.createImageWithInfo(imageInfo, VK_MEMORY_PROPERTY_DEVICE_LOCAL_BIT, m_depthImages[i],
m_depthImageMemory[i]);

        VkImageViewCreateInfo viewInfo{};
        viewInfo.sType = VK_STRUCTURE_TYPE_IMAGE_VIEW_CREATE_INFO;
        viewInfo.image = m_depthImages[i];
        viewInfo.viewType = VK_IMAGE_VIEW_TYPE_2D;
        viewInfo.format = depthFormat;
```

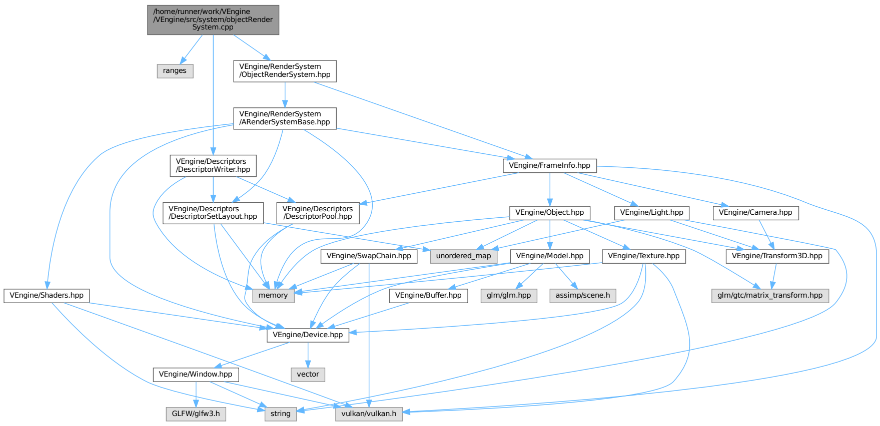
```
        viewInfo.subresourceRange.aspectMask = VK_IMAGE_ASPECT_DEPTH_BIT;
        viewInfo.subresourceRange.baseMipLevel = 0;
        viewInfo.subresourceRange.levelCount = 1;
        viewInfo.subresourceRange.baseArrayLayer = 0;
        viewInfo.subresourceRange.layerCount = 1;

        if (vkCreateImageView(m_device.device(), &viewInfo, nullptr, &m_depthImageViews[i]) != VK_SUCCESS) {
            throw std::runtime_error("failed to create texture image view!");
        }
    }
}

void ven::SwapChain::createSyncObjects()
{
    m_imageAvailableSemaphores.resize(MAX_FRAMES_IN_FLIGHT);
    m_renderFinishedSemaphores.resize(MAX_FRAMES_IN_FLIGHT);
    m_inFlightFences.resize(MAX_FRAMES_IN_FLIGHT);
    m_imagesInFlight.resize(imageCount(), VK_NULL_HANDLE);

    VkSemaphoreCreateInfo semaphoreInfo = {};
    semaphoreInfo.sType = VK_STRUCTURE_TYPE_SEMAPHORE_CREATE_INFO;

    VkFenceCreateInfo fenceInfo = {};
    fenceInfo.sType = VK_STRUCTURE_TYPE_FENCE_CREATE_INFO;
    fenceInfo.flags = VK_FENCE_CREATE_SIGNALED_BIT;

    for (size_t i = 0; i < MAX_FRAMES_IN_FLIGHT; i++) {
        if (vkCreateSemaphore(m_device.device(), &semaphoreInfo, nullptr, &m_imageAvailableSemaphores[i]) != VK_SUCCESS ||
            vkCreateSemaphore(m_device.device(), &semaphoreInfo, nullptr, &m_renderFinishedSemaphores[i]) != VK_SUCCESS ||
            vkCreateFence(m_device.device(), &fenceInfo, nullptr, &m_inFlightFences[i]) != VK_SUCCESS) {
                throw std::runtime_error("failed to create synchronization objects for a frame!");
        }
    }
}

VkSurfaceFormatKHR ven::SwapChain::chooseSwapSurfaceFormat(const std::vector<VkSurfaceFormatKHR> &availableFormats)
{
    for (const auto &availableFormat : availableFormats) {
        if (availableFormat.format == VK_FORMAT_B8G8R8A8_UNORM && availableFormat.colorSpace == VK_COLOR_SPACE_SRGB_NONLINEAR_KHR) {
            return availableFormat;
        }
    }

    return availableFormats[0];
}

VkPresentModeKHR ven::SwapChain::chooseSwapPresentMode(const std::vector<VkPresentModeKHR> &availablePresentModes)
{
    for (const auto &availablePresentMode : availablePresentModes) {
        if (availablePresentMode == VK_PRESENT_MODE_MAILBOX_KHR) {
            std::cout « "Present mode: Mailbox\n";
            return availablePresentMode;
        }
    }

   for (const auto &availablePresentMode : availablePresentModes) {
     if (availablePresentMode == VK_PRESENT_MODE_IMMEDIATE_KHR) {
       std::cout « "Present mode: Immediate" « '\n';
       return availablePresentMode;
     }
   }

  std::cout « "Present mode: V-Sync\n";
  return VK_PRESENT_MODE_FIFO_KHR;
}

VkExtent2D ven::SwapChain::chooseSwapExtent(const VkSurfaceCapabilitiesKHR &capabilities) const
{
    if (capabilities.currentExtent.width != std::numeric_limits<uint32_t>::max()) {
        return capabilities.currentExtent;
    }
    VkExtent2D actualExtent = m_windowExtent;
    actualExtent.width = std::max(capabilities.minImageExtent.width, std::min(capabilities.maxImageExtent.width, actualExtent.width));
    actualExtent.height = std::max(capabilities.minImageExtent.height, std::min(capabilities.maxImageExtent.height, actualExtent.height));

    return actualExtent;
}

```

```
VkFormat ven::SwapChain::findDepthFormat() const
{
    return m_device.findSupportedFormat(
        {VK_FORMAT_D32_SFLOAT, VK_FORMAT_D32_SFLOAT_S8_UINT, VK_FORMAT_D24_UNORM_S8_UINT},
        VK_IMAGE_TILING_OPTIMAL,
        VK_FORMAT_FEATURE_DEPTH_STENCIL_ATTACHMENT_BIT);
}
```

8.94 /home/runner/work/VEngine/VEngine/src/system/objectRender↩ System.cpp File Reference

```
#include <ranges>
#include <VEngine/Descriptors/DescriptorWriter.hpp>
#include "VEngine/RenderSystem/ObjectRenderSystem.hpp"
```

Include dependency graph for objectRenderSystem.cpp:



8.95 objectRenderSystem.cpp

Go to the documentation of this file.

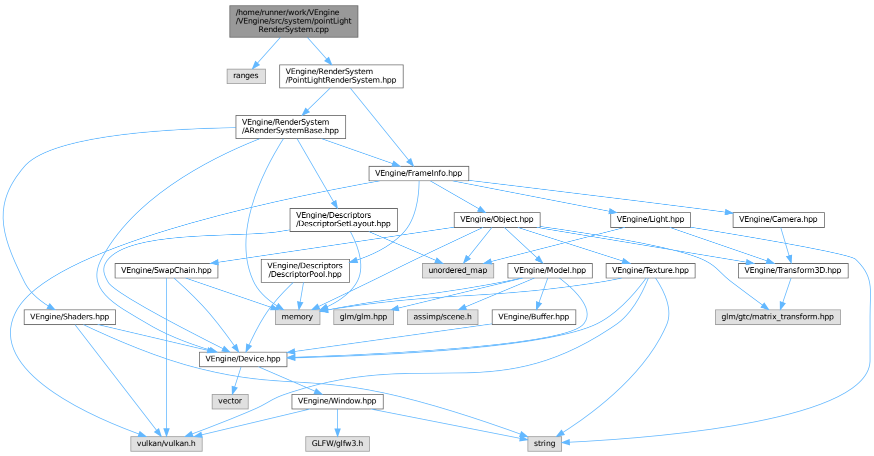
```
#include <ranges>

#include <VEngine/Descriptors/DescriptorWriter.hpp>
#include "VEngine/RenderSystem/ObjectRenderSystem.hpp"

void ven::ObjectRenderSystem::render(const FrameInfo &frameInfo) const
{
    getShaders()->bind(frameInfo.commandBuffer);

    vkCmdBindDescriptorSets(frameInfo.commandBuffer, VK_PIPELINE_BIND_POINT_GRAPHICS,
getPipelineLayout(), 0, 1, &frameInfo.globalDescriptorSet, 0, nullptr);

    for (Object& object : frameInfo.objects | std::views::values) {
        if (object.getModel() == nullptr) { continue; }
        auto bufferInfo = object.getBufferInfo(static_cast<int>(frameInfo.frameIndex));
        auto imageInfo = object.getDiffuseMap()->getImageInfo();
        VkDescriptorSet objectDescriptorSet = nullptr;
        DescriptorWriter(*renderSystemLayout, frameInfo.frameDescriptorPool)
            .writeBuffer(0, &bufferInfo)
            .writeImage(1, &imageInfo)
            .build(objectDescriptorSet);

        vkCmdBindDescriptorSets(
            frameInfo.commandBuffer,
            VK_PIPELINE_BIND_POINT_GRAPHICS,
            getPipelineLayout(),
            1,  // starting set (0 is the globalDescriptorSet, 1 is the set specific to this system)
            1,  // set count
```

```
            &objectDescriptorSet,
            0,
            nullptr);

        const ObjectPushConstantData push{
            .modelMatrix = object.transform.transformMatrix(),
            .normalMatrix = object.transform.normalMatrix()
        };
        vkCmdPushConstants(frameInfo.commandBuffer, getPipelineLayout(), VK_SHADER_STAGE_VERTEX_BIT |
    VK_SHADER_STAGE_FRAGMENT_BIT, 0, sizeof(ObjectPushConstantData), &push);
        object.getModel()->bind(frameInfo.commandBuffer);
        object.getModel()->draw(frameInfo.commandBuffer);
    }
}
```

8.96 /home/runner/work/VEngine/VEngine/src/system/pointLight↵ RenderSystem.cpp File Reference

`#include <ranges>`
`#include "VEngine/RenderSystem/PointLightRenderSystem.hpp"`

Include dependency graph for pointLightRenderSystem.cpp:



8.97 pointLightRenderSystem.cpp

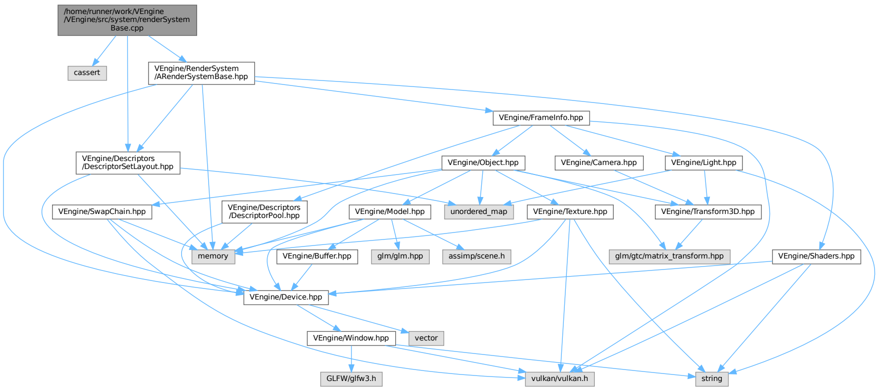
Go to the documentation of this file.

```
#include <ranges>

#include "VEngine/RenderSystem/PointLightRenderSystem.hpp"

void ven::PointLightRenderSystem::render(const FrameInfo &frameInfo) const
{
    getShaders()->bind(frameInfo.commandBuffer);
    vkCmdBindDescriptorSets(frameInfo.commandBuffer, VK_PIPELINE_BIND_POINT_GRAPHICS,
getPipelineLayout(), 0, 1, &frameInfo.globalDescriptorSet, 0, nullptr);

    for (const Light &light : frameInfo.lights | std::views::values) {
        const LightPushConstantData push{
            .position = glm::vec4(light.transform.translation, 1.F),
            .color = light.color,
            .radius = light.transform.scale.x
        };
        vkCmdPushConstants(frameInfo.commandBuffer, getPipelineLayout(), VK_SHADER_STAGE_VERTEX_BIT |
    VK_SHADER_STAGE_FRAGMENT_BIT, 0, sizeof(LightPushConstantData), &push);
        vkCmdDraw(frameInfo.commandBuffer, 6, 1, 0, 0);
    }
}
```

8.98 /home/runner/work/VEngine/VEngine/src/system/renderSystemBase.cpp File Reference

```
#include <cassert>
#include <VEngine/Descriptors/DescriptorSetLayout.hpp>
#include "VEngine/RenderSystem/ARenderSystemBase.hpp"
```

Include dependency graph for renderSystemBase.cpp:



8.99 renderSystemBase.cpp

Go to the documentation of this file.

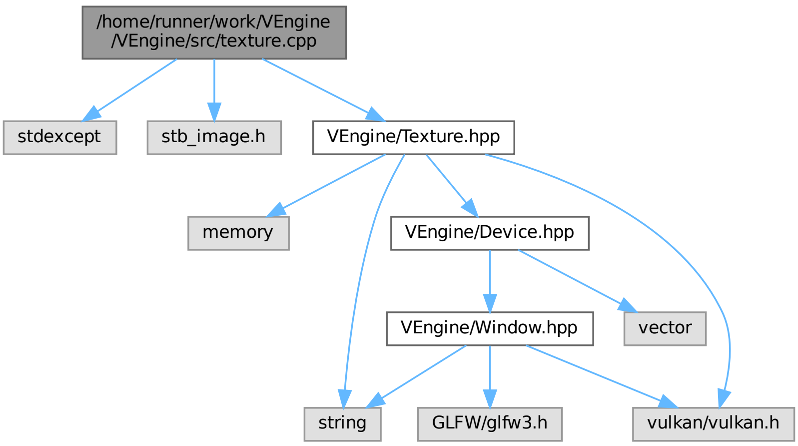
```
#include <cassert>
#include <VEngine/Descriptors/DescriptorSetLayout.hpp>

#include "VEngine/RenderSystem/ARenderSystemBase.hpp"

void ven::ARenderSystemBase::createPipelineLayout(const VkDescriptorSetLayout globalSetLayout, const
    uint32_t pushConstantSize)
{
    VkPushConstantRange pushConstantRange{};
    pushConstantRange.stageFlags = VK_SHADER_STAGE_VERTEX_BIT | VK_SHADER_STAGE_FRAGMENT_BIT;
    pushConstantRange.offset = 0;
    pushConstantRange.size = pushConstantSize;

    renderSystemLayout =
    DescriptorSetLayout::Builder(m_device)
        .addBinding(
            0,
            VK_DESCRIPTOR_TYPE_UNIFORM_BUFFER,
            VK_SHADER_STAGE_VERTEX_BIT | VK_SHADER_STAGE_FRAGMENT_BIT)
        .addBinding(1, VK_DESCRIPTOR_TYPE_COMBINED_IMAGE_SAMPLER, VK_SHADER_STAGE_FRAGMENT_BIT)
        .build();

    const std::vector<VkDescriptorSetLayout> descriptorSetLayouts{
        globalSetLayout,
        renderSystemLayout->getDescriptorSetLayout()};

    VkPipelineLayoutCreateInfo pipelineLayoutInfo{};
    pipelineLayoutInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_LAYOUT_CREATE_INFO;
    pipelineLayoutInfo.setLayoutCount = static_cast<uint32_t>(descriptorSetLayouts.size());
    pipelineLayoutInfo.pSetLayouts = descriptorSetLayouts.data();
    pipelineLayoutInfo.pushConstantRangeCount = 1;
    pipelineLayoutInfo.pPushConstantRanges = &pushConstantRange;
    if (vkCreatePipelineLayout(m_device.device(), &pipelineLayoutInfo, nullptr, &m_pipelineLayout) !=
    VK_SUCCESS)
    {
        throw std::runtime_error("Failed to create pipeline layout");
    }
}

void ven::ARenderSystemBase::createPipeline(const VkRenderPass renderPass, const std::string
    &shadersVertPath, const std::string &shadersFragPath, const bool isLight)
```

```
{
    assert(m_pipelineLayout && "Cannot create pipeline before pipeline layout");
    PipelineConfigInfo pipelineConfig{};
    Shaders::defaultPipelineConfigInfo(pipelineConfig);
    if (isLight) {
        pipelineConfig.attributeDescriptions.clear();
        pipelineConfig.bindingDescriptions.clear();
    }
    pipelineConfig.renderPass = renderPass;
    pipelineConfig.pipelineLayout = m_pipelineLayout;
    m_shaders = std::make_unique<Shaders>(m_device, shadersVertPath, shadersFragPath, pipelineConfig);
}
```

8.100 /home/runner/work/VEngine/VEngine/src/texture.cpp File Reference

```
#include <stdexcept>
#include <stb_image.h>
#include "VEngine/Texture.hpp"
```

Include dependency graph for texture.cpp:



Macros

- #define STB_IMAGE_IMPLEMENTATION

8.100.1 Macro Definition Documentation

8.100.1.1 STB_IMAGE_IMPLEMENTATION

```
#define STB_IMAGE_IMPLEMENTATION
```

Definition at line 3 of file texture.cpp.

8.101 texture.cpp

Go to the documentation of this file.

```cpp
#include <stdexcept>

#define STB_IMAGE_IMPLEMENTATION
#include <stb_image.h>

#include "VEngine/Texture.hpp"

ven::Texture::Texture(Device &device, const std::string &textureFilepath) : m_device{device}
{
    createTextureImage(textureFilepath);
    createTextureImageView(VK_IMAGE_VIEW_TYPE_2D);
    createTextureSampler();
    updateDescriptor();
}

ven::Texture::Texture(Device &device, VkFormat format, VkExtent3D extent, VkImageUsageFlags usage, VkSampleCountFlagBits sampleCount)
  : m_device{device}, m_format(format), m_extent(extent)
{
    VkImageAspectFlags aspectMask = 0;
    VkImageLayout imageLayout;

    if ((usage & VK_IMAGE_USAGE_COLOR_ATTACHMENT_BIT) != 0u) {
        aspectMask = VK_IMAGE_ASPECT_COLOR_BIT;
        imageLayout = VK_IMAGE_LAYOUT_COLOR_ATTACHMENT_OPTIMAL;
    }
    if ((usage & VK_IMAGE_USAGE_DEPTH_STENCIL_ATTACHMENT_BIT) != 0u) {
        aspectMask = VK_IMAGE_ASPECT_DEPTH_BIT;
        imageLayout = VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL;
    }

      // Don't like this, should I be using an image array instead of multiple images?
    VkImageCreateInfo imageInfo{};
    imageInfo.sType = VK_STRUCTURE_TYPE_IMAGE_CREATE_INFO;
    imageInfo.imageType = VK_IMAGE_TYPE_2D;
    imageInfo.format = format;
    imageInfo.extent = extent;
    imageInfo.mipLevels = 1;
    imageInfo.arrayLayers = 1;
    imageInfo.samples = sampleCount;
    imageInfo.tiling = VK_IMAGE_TILING_OPTIMAL;
    imageInfo.usage = usage;
    imageInfo.initialLayout = VK_IMAGE_LAYOUT_UNDEFINED;
    device.createImageWithInfo(imageInfo, VK_MEMORY_PROPERTY_DEVICE_LOCAL_BIT, m_textureImage, m_textureImageMemory);

    VkImageViewCreateInfo viewInfo{};
    viewInfo.sType = VK_STRUCTURE_TYPE_IMAGE_VIEW_CREATE_INFO;
    viewInfo.viewType = VK_IMAGE_VIEW_TYPE_2D;
    viewInfo.format = format;
    viewInfo.subresourceRange = {};
    viewInfo.subresourceRange.aspectMask = aspectMask;
    viewInfo.subresourceRange.baseMipLevel = 0;
    viewInfo.subresourceRange.levelCount = 1;
    viewInfo.subresourceRange.baseArrayLayer = 0;
    viewInfo.subresourceRange.layerCount = 1;
    viewInfo.image = m_textureImage;
    if (vkCreateImageView(device.device(), &viewInfo, nullptr, &m_textureImageView) != VK_SUCCESS) {
        throw std::runtime_error("failed to create texture image view!");
    }

    // Sampler should be seperated out
    if ((usage & VK_IMAGE_USAGE_SAMPLED_BIT) != 0U) {
        // Create sampler to sample from the attachment in the fragment shader
        VkSamplerCreateInfo samplerInfo{};
        samplerInfo.sType = VK_STRUCTURE_TYPE_SAMPLER_CREATE_INFO;
        samplerInfo.magFilter = VK_FILTER_LINEAR;
        samplerInfo.minFilter = VK_FILTER_LINEAR;
        samplerInfo.mipmapMode = VK_SAMPLER_MIPMAP_MODE_LINEAR;
        samplerInfo.addressModeU = VK_SAMPLER_ADDRESS_MODE_CLAMP_TO_BORDER;
        samplerInfo.addressModeV = samplerInfo.addressModeU;
        samplerInfo.addressModeW = samplerInfo.addressModeU;
        samplerInfo.mipLodBias = 0.0F;
        samplerInfo.maxAnisotropy = 1.0F;
        samplerInfo.minLod = 0.0F;
        samplerInfo.maxLod = 1.0F;
        samplerInfo.borderColor = VK_BORDER_COLOR_FLOAT_OPAQUE_BLACK;

        if (vkCreateSampler(device.device(), &samplerInfo, nullptr, &m_textureSampler) != VK_SUCCESS) {
            throw std::runtime_error("failed to create sampler!");
        }
```

```
        VkImageLayout samplerImageLayout = imageLayout == VK_IMAGE_LAYOUT_COLOR_ATTACHMENT_OPTIMAL
                                               ? VK_IMAGE_LAYOUT_SHADER_READ_ONLY_OPTIMAL
                                               : VK_IMAGE_LAYOUT_DEPTH_STENCIL_READ_ONLY_OPTIMAL;
        m_descriptor.sampler = m_textureSampler;
        m_descriptor.imageView = m_textureImageView;
        m_descriptor.imageLayout = samplerImageLayout;
    }
}

ven::Texture::~Texture()
{
    vkDestroySampler(m_device.device(), m_textureSampler, nullptr);
    vkDestroyImageView(m_device.device(), m_textureImageView, nullptr);
    vkDestroyImage(m_device.device(), m_textureImage, nullptr);
    vkFreeMemory(m_device.device(), m_textureImageMemory, nullptr);
}

void ven::Texture::updateDescriptor()
{
    m_descriptor.sampler = m_textureSampler;
    m_descriptor.imageView = m_textureImageView;
    m_descriptor.imageLayout = m_textureLayout;
}

void ven::Texture::createTextureImage(const std::string &filepath)
{
    int texWidth = 0;
    int texHeight = 0;
    int texChannels = 0;
    void *data = nullptr;
    stbi_uc *pixels = nullptr;

    stbi_set_flip_vertically_on_load(1);
    pixels = stbi_load(filepath.c_str(), &texWidth, &texHeight, &texChannels, STBI_rgb_alpha);
    const auto imageSize = static_cast<VkDeviceSize>(texWidth * texHeight * 4);

    if (pixels == nullptr) {
        throw std::runtime_error("failed to load texture image!");
    }

    // mMipLevels = static_cast<uint32_t>(std::floor(std::log2(std::max(texWidth, texHeight)))) + 1;
    m_mipLevels = 1;

    VkBuffer stagingBuffer = nullptr;
    VkDeviceMemory stagingBufferMemory = nullptr;

    m_device.createBuffer(
        imageSize,
        VK_BUFFER_USAGE_TRANSFER_SRC_BIT,
        VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT | VK_MEMORY_PROPERTY_HOST_COHERENT_BIT,
        stagingBuffer,
        stagingBufferMemory);

    vkMapMemory(m_device.device(), stagingBufferMemory, 0, imageSize, 0, &data);
    memcpy(data, pixels, imageSize);
    vkUnmapMemory(m_device.device(), stagingBufferMemory);

    stbi_image_free(pixels);

    m_format = VK_FORMAT_R8G8B8A8_SRGB;
    m_extent = {.width=static_cast<uint32_t>(texWidth), .height=static_cast<uint32_t>(texHeight),
.depth=1};

    VkImageCreateInfo imageInfo{};
    imageInfo.sType = VK_STRUCTURE_TYPE_IMAGE_CREATE_INFO;
    imageInfo.imageType = VK_IMAGE_TYPE_2D;
    imageInfo.extent = m_extent;
    imageInfo.mipLevels = m_mipLevels;
    imageInfo.arrayLayers = m_layerCount;
    imageInfo.format = m_format;
    imageInfo.tiling = VK_IMAGE_TILING_OPTIMAL;
    imageInfo.initialLayout = VK_IMAGE_LAYOUT_UNDEFINED;
    imageInfo.usage = VK_IMAGE_USAGE_TRANSFER_SRC_BIT | VK_IMAGE_USAGE_TRANSFER_DST_BIT |
VK_IMAGE_USAGE_SAMPLED_BIT;
    imageInfo.samples = VK_SAMPLE_COUNT_1_BIT;
    imageInfo.sharingMode = VK_SHARING_MODE_EXCLUSIVE;

    m_device.createImageWithInfo(
        imageInfo,
        VK_MEMORY_PROPERTY_DEVICE_LOCAL_BIT,
        m_textureImage,
        m_textureImageMemory);
    m_device.transitionImageLayout(
        m_textureImage,
        VK_FORMAT_R8G8B8A8_SRGB,
        VK_IMAGE_LAYOUT_UNDEFINED,
```

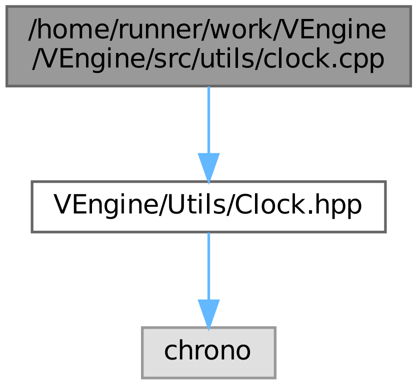
```
        VK_IMAGE_LAYOUT_TRANSFER_DST_OPTIMAL,
        m_mipLevels,
        m_layerCount);
    m_device.copyBufferToImage(
        stagingBuffer,
        m_textureImage,
        static_cast<uint32_t>(texWidth),
        static_cast<uint32_t>(texHeight),
        m_layerCount);

    // comment this out if using mips
    m_device.transitionImageLayout(
        m_textureImage,
        VK_FORMAT_R8G8B8A8_SRGB,
        VK_IMAGE_LAYOUT_TRANSFER_DST_OPTIMAL,
        VK_IMAGE_LAYOUT_SHADER_READ_ONLY_OPTIMAL,
        m_mipLevels,
        m_layerCount);

    // If we generate mip maps then the final image will alerady be READ_ONLY_OPTIMAL
    // mDevice.generateMipmaps(mTextureImage, mFormat, texWidth, texHeight, mMipLevels);
    m_textureLayout = VK_IMAGE_LAYOUT_SHADER_READ_ONLY_OPTIMAL;

    vkDestroyBuffer(m_device.device(), stagingBuffer, nullptr);
    vkFreeMemory(m_device.device(), stagingBufferMemory, nullptr);
}

void ven::Texture::createTextureImageView(const VkImageViewType viewType)
{
    VkImageViewCreateInfo viewInfo{};
    viewInfo.sType = VK_STRUCTURE_TYPE_IMAGE_VIEW_CREATE_INFO;
    viewInfo.image = m_textureImage;
    viewInfo.viewType = viewType;
    viewInfo.format = VK_FORMAT_R8G8B8A8_SRGB;
    viewInfo.subresourceRange.aspectMask = VK_IMAGE_ASPECT_COLOR_BIT;
    viewInfo.subresourceRange.baseMipLevel = 0;
    viewInfo.subresourceRange.levelCount = m_mipLevels;
    viewInfo.subresourceRange.baseArrayLayer = 0;
    viewInfo.subresourceRange.layerCount = m_layerCount;

    if (vkCreateImageView(m_device.device(), &viewInfo, nullptr, &m_textureImageView) != VK_SUCCESS) {
        throw std::runtime_error("failed to create texture image view!");
    }
}

void ven::Texture::createTextureSampler()
{
    VkSamplerCreateInfo samplerInfo{};
    samplerInfo.sType = VK_STRUCTURE_TYPE_SAMPLER_CREATE_INFO;
    samplerInfo.magFilter = VK_FILTER_LINEAR;
    samplerInfo.minFilter = VK_FILTER_LINEAR;

    samplerInfo.addressModeU = VK_SAMPLER_ADDRESS_MODE_REPEAT;
    samplerInfo.addressModeV = VK_SAMPLER_ADDRESS_MODE_REPEAT;
    samplerInfo.addressModeW = VK_SAMPLER_ADDRESS_MODE_REPEAT;

    samplerInfo.anisotropyEnable = VK_TRUE;
    samplerInfo.maxAnisotropy = 16.0F;
    samplerInfo.borderColor = VK_BORDER_COLOR_INT_OPAQUE_BLACK;
    samplerInfo.unnormalizedCoordinates = VK_FALSE;

    // these fields useful for percentage close filtering for shadow maps
    samplerInfo.compareEnable = VK_FALSE;
    samplerInfo.compareOp = VK_COMPARE_OP_ALWAYS;

    samplerInfo.mipmapMode = VK_SAMPLER_MIPMAP_MODE_LINEAR;
    samplerInfo.mipLodBias = 0.0F;
    samplerInfo.minLod = 0.0F;
    samplerInfo.maxLod = static_cast<float>(m_mipLevels);

    if (vkCreateSampler(m_device.device(), &samplerInfo, nullptr, &m_textureSampler) != VK_SUCCESS) {
        throw std::runtime_error("failed to create texture sampler!");
    }
}

void ven::Texture::transitionLayout(const VkCommandBuffer commandBuffer, const VkImageLayout oldLayout, const VkImageLayout newLayout) const
{
    VkPipelineStageFlags sourceStage = 0;
    VkPipelineStageFlags destinationStage = 0;
    VkImageMemoryBarrier barrier{};

    barrier.sType = VK_STRUCTURE_TYPE_IMAGE_MEMORY_BARRIER;
    barrier.oldLayout = oldLayout;
    barrier.newLayout = newLayout;

    barrier.srcQueueFamilyIndex = VK_QUEUE_FAMILY_IGNORED;
```

```
    barrier.dstQueueFamilyIndex = VK_QUEUE_FAMILY_IGNORED;

    barrier.image = m_textureImage;
    barrier.subresourceRange.baseMipLevel = 0;
    barrier.subresourceRange.levelCount = m_mipLevels;
    barrier.subresourceRange.baseArrayLayer = 0;
    barrier.subresourceRange.layerCount = m_layerCount;

    if (newLayout == VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL) {
      barrier.subresourceRange.aspectMask = VK_IMAGE_ASPECT_DEPTH_BIT;
      if (m_format == VK_FORMAT_D32_SFLOAT_S8_UINT || m_format == VK_FORMAT_D24_UNORM_S8_UINT) {
        barrier.subresourceRange.aspectMask |= VK_IMAGE_ASPECT_STENCIL_BIT;
      }
    } else {
      barrier.subresourceRange.aspectMask = VK_IMAGE_ASPECT_COLOR_BIT;
    }
    if (oldLayout == VK_IMAGE_LAYOUT_UNDEFINED && newLayout == VK_IMAGE_LAYOUT_TRANSFER_DST_OPTIMAL) {
      barrier.srcAccessMask = 0;
      barrier.dstAccessMask = VK_ACCESS_TRANSFER_WRITE_BIT;
      sourceStage = VK_PIPELINE_STAGE_TOP_OF_PIPE_BIT;
      destinationStage = VK_PIPELINE_STAGE_TRANSFER_BIT;
    } else if (oldLayout == VK_IMAGE_LAYOUT_UNDEFINED && newLayout ==
VK_IMAGE_LAYOUT_TRANSFER_SRC_OPTIMAL) {
      barrier.srcAccessMask = 0;
      barrier.dstAccessMask = VK_ACCESS_TRANSFER_WRITE_BIT;
      sourceStage = VK_PIPELINE_STAGE_TOP_OF_PIPE_BIT;
      destinationStage = VK_PIPELINE_STAGE_TRANSFER_BIT;
    } else if (oldLayout == VK_IMAGE_LAYOUT_TRANSFER_DST_OPTIMAL && newLayout ==
VK_IMAGE_LAYOUT_SHADER_READ_ONLY_OPTIMAL) {
      barrier.srcAccessMask = VK_ACCESS_TRANSFER_WRITE_BIT;
      barrier.dstAccessMask = VK_ACCESS_SHADER_READ_BIT;

      sourceStage = VK_PIPELINE_STAGE_TRANSFER_BIT;
      destinationStage = VK_PIPELINE_STAGE_FRAGMENT_SHADER_BIT;
    } else if (oldLayout == VK_IMAGE_LAYOUT_UNDEFINED && newLayout ==
VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL) {
      barrier.srcAccessMask = 0;
      barrier.dstAccessMask = VK_ACCESS_DEPTH_STENCIL_ATTACHMENT_READ_BIT |
VK_ACCESS_DEPTH_STENCIL_ATTACHMENT_WRITE_BIT;
      sourceStage = VK_PIPELINE_STAGE_TOP_OF_PIPE_BIT;
      destinationStage = VK_PIPELINE_STAGE_EARLY_FRAGMENT_TESTS_BIT;
    } else if (oldLayout == VK_IMAGE_LAYOUT_SHADER_READ_ONLY_OPTIMAL && newLayout ==
VK_IMAGE_LAYOUT_COLOR_ATTACHMENT_OPTIMAL) {
      // This says that any cmd that acts in color output or after (dstStage)
      // that needs read or write access to a resource
      // must wait until all previous read accesses in fragment shader
      barrier.srcAccessMask = VK_ACCESS_SHADER_READ_BIT | VK_ACCESS_SHADER_WRITE_BIT;
      barrier.dstAccessMask = VK_ACCESS_COLOR_ATTACHMENT_WRITE_BIT |
VK_ACCESS_COLOR_ATTACHMENT_READ_BIT;
      sourceStage = VK_PIPELINE_STAGE_FRAGMENT_SHADER_BIT;
      destinationStage = VK_PIPELINE_STAGE_COLOR_ATTACHMENT_OUTPUT_BIT;
    } else {
      throw std::invalid_argument("unsupported layout transition!");
    }
    vkCmdPipelineBarrier(commandBuffer, sourceStage, destinationStage, 0, 0, nullptr, 0, nullptr, 1,
&barrier);
}
```

8.102 /home/runner/work/VEngine/VEngine/src/utils/clock.cpp File Reference

```
#include "VEngine/Utils/Clock.hpp"
```

Include dependency graph for clock.cpp:



8.103 clock.cpp

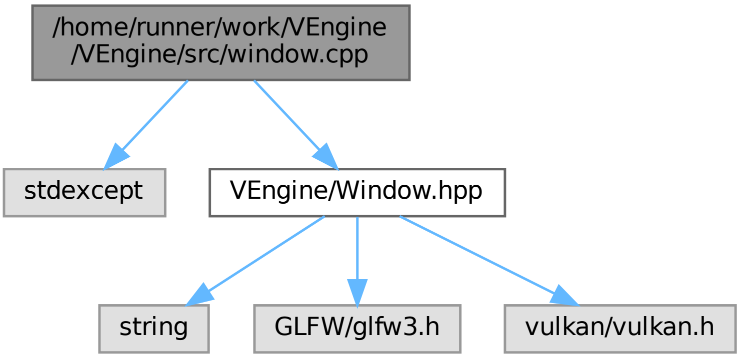
Go to the documentation of this file.

```
#include "VEngine/Utils/Clock.hpp"

void ven::Clock::update()
{
    auto newTime = std::chrono::high_resolution_clock::now();
    m_deltaTime = newTime - m_startTime;
    m_startTime = newTime;
}

void ven::Clock::stop()
{
    if (m_isStopped) {
        return;
    }

    m_stopTime = std::chrono::high_resolution_clock::now();
    m_isStopped = true;
}

void ven::Clock::resume()
{
    if (!m_isStopped) {
        return;
    }

    m_startTime += std::chrono::high_resolution_clock::now() - m_stopTime;
    m_isStopped = false;
}
```

8.104 /home/runner/work/VEngine/VEngine/src/window.cpp File Reference

```
#include <stdexcept>
#include "VEngine/Window.hpp"
```

Include dependency graph for window.cpp:



8.105 window.cpp

Go to the documentation of this file.

```cpp
#include <stdexcept>

#include "VEngine/Window.hpp"

GLFWwindow* ven::Window::createWindow(const uint32_t width, const uint32_t height, const std::string &title)
{
    if (glfwInit() == GLFW_FALSE) {
        throw std::runtime_error("Failed to initialize GLFW");
    }

    glfwWindowHint(GLFW_CLIENT_API, GLFW_NO_API);
    glfwWindowHint(GLFW_RESIZABLE, GLFW_TRUE);

    GLFWwindow *window = glfwCreateWindow(static_cast<int>(width), static_cast<int>(height), title.c_str(), nullptr, nullptr);
    if (window == nullptr) {
        glfwTerminate();
        throw std::runtime_error("Failed to create window");
    }
    glfwSetWindowUserPointer(window, this);
    glfwSetFramebufferSizeCallback(window, framebufferResizeCallback);
    return window;
}

void ven::Window::createWindowSurface(const VkInstance instance, VkSurfaceKHR *surface) const
{
    if (glfwCreateWindowSurface(instance, m_window, nullptr, surface) != VK_SUCCESS) {
        throw std::runtime_error("Failed to create window surface");
    }
}

void ven::Window::framebufferResizeCallback(GLFWwindow *window, const int width, const int height)
{
    auto *app = static_cast<Window *>(glfwGetWindowUserPointer(window));
    app->m_framebufferResized = true;
    app->m_width = static_cast<uint32_t>(width);
    app->m_height = static_cast<uint32_t>(height);
}

void ven::Window::setFullscreen(const bool fullscreen, const uint32_t width, const uint32_t height)
{
    GLFWmonitor* primaryMonitor = glfwGetPrimaryMonitor();
    const GLFWvidmode* mode = glfwGetVideoMode(primaryMonitor);

    /*
    if (fullscreen) {
```

```
        glfwSetWindowMonitor(m_window, primaryMonitor, 0, 0, mode->width, mode->height, mode->refreshRate);
    } else {
        // To restore a window that was originally windowed to its original size and position,
        // save these before making it full screen and then pass them in as above
        glfwSetWindowMonitor(m_window, nullptr, 0, 0, static_cast<int>(width), static_cast<int>(height), mode->refreshRate);

    }

    m_width = width;
    m_height = height;
    */
}
```

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