

vengine

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Chapter 1

vengine

1.1 Description

ACTUALLY WORKING ON IT!

Welcome to **VEngine**, a graphics engine developed with Vulkan. This project aims to provide a robust foundation for game and application developers, focusing on the performance and flexibility offered by Vulkan.

1.2 Prerequisites

- CMake 3.27
- C++20
- Vulkan
- GLM
- assimp (unused ATM)

1.3 Usage

1.3.1 Build

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

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

1.3.2 Run

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

1.3.3 Documentation

The documentation is generated using [Doxygen](#). You can visualize it on [GitHub Pages](#).

1.4 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 |

1.5 License

This project is licensed under the MIT License - see the [LICENSE](#) file for details.

1.6 Acknowledgements

Thanks to [Brendan Galea](#).

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2.1 Namespace List

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Chapter 5

Namespace Documentation

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Class for time management.
- class [Random](#)
Class for random number generation.
- class [Time](#)
Class used for time management.

5.2 std Namespace Reference

STL namespace.

Classes

- class **allocator**
STL class.
- class **array**
STL class.
- class **atomic**
STL class.
- class **atomic_ref**
STL class.
- class **auto_ptr**
STL class.
- class **bad_alloc**
STL class.
- class **bad_cast**
STL class.
- class **bad_exception**

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- class **bad_typeid**
 - STL class.*
- class **basic_fstream**
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- class **basic_ifstream**
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- class **basic_ios**
 - STL class.*
- class **basic_iostream**
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- class **basic_istream**
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- class **basic_istreamstream**
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- class **basic_ofstream**
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- class **basic_ostream**
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- class **basic_ostringstream**
 - STL class.*
- class **basic_string**
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- class **basic_string_view**
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- class **basic_stringstream**
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- class **fstream**
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- struct [hash< ven::Model::Vertex >](#)
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- class **recursive_timed_mutex**
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- class **set**
STL class.
- class **shared_lock**
STL class.
- class **shared_mutex**
STL class.
- class **shared_ptr**
STL class.
- class **shared_timed_mutex**
STL class.
- class **smart_ptr**
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- class **span**
STL class.
- class **stack**
STL class.
- class **string**
STL class.
- class **string_view**
STL class.
- class **stringstream**
STL class.
- class **system_error**
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- class **weak_ptr**
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- class **wfstream**
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- class **wifstream**
- STL class.*
- class **wios**
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- class **wistream**
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- class **wstringstream**
- STL class.*
- class **wofstream**
- STL class.*
- class **wostream**
- STL class.*
- class **wstringstream**
- STL class.*
- class **wstring**
- STL class.*
- class **wstring_view**
- STL class.*
- class **wstringstream**
- STL class.*

5.2.1 Detailed Description

STL namespace.

5.3 ven Namespace Reference

Classes

- class [Buffer](#)
- Class for buffer.*
- class [Camera](#)
- class [DescriptorPool](#)
- Class for descriptor pool.*
- class [DescriptorSetLayout](#)
- Class for descriptor set layout.*
- class [DescriptorWriter](#)

Class for descriptor writer.

- class [Device](#)
- class [Engine](#)
- class [FrameCounter](#)
- struct [FrameInfo](#)
- struct [GlobalUbo](#)
- class [KeyboardController](#)
- class [Model](#)
- class [Object](#)
- struct [PipelineConfigInfo](#)
- struct [PointLight](#)
- struct [PointLightComponent](#)
- class [PointLightSystem](#)

Class for point light system.

- struct [QueueFamilyIndices](#)
- class [Renderer](#)
- class [RenderSystem](#)

Class for render system.

- class [Shaders](#)
- struct [SimplePushConstantData](#)
- class [SwapChain](#)
- struct [SwapChainSupportDetails](#)
- struct [Transform3DComponent](#)
- class [Window](#)

Typedefs

- using [return_type_t](#)
- using [id_t](#) = unsigned int

Functions

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

Variables

- static constexpr uint32_t [DEFAULT_WIDTH](#) = 1920
- static constexpr uint32_t [DEFAULT_HEIGHT](#) = 1080
- static constexpr std::string_view [DEFAULT_TITLE](#) = "VEngine"
- static constexpr std::string_view [SHADERS_BIN_PATH](#) = "shaders/bin/"
- static constexpr std::size_t [MAX_LIGHTS](#) = 10

5.3.1 Typedef Documentation

5.3.1.1 [id_t](#)

using [ven::id_t](#) = unsigned int

Definition at line 18 of file [Object.hpp](#).

5.3.1.2 return_type_t

using [ven::return_type_t](#)

Initial value:

```
enum Returntype : uint8_t {  
    VEN_SUCCESS = 0,  
    VEN_FAILURE = 1  
}
```

Definition at line 17 of file [Constant.hpp](#).

5.3.2 Function Documentation

5.3.2.1 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 [Utils.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:



5.3.3 Variable Documentation

5.3.3.1 DEFAULT_HEIGHT

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

Definition at line 12 of file [Constant.hpp](#).

5.3.3.2 DEFAULT_TITLE

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

Definition at line 14 of file [Constant.hpp](#).

5.3.3.3 DEFAULT_WIDTH

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

Definition at line 11 of file [Constant.hpp](#).

5.3.3.4 MAX_LIGHTS

```
std::size_t ven::MAX_LIGHTS = 10 [static], [constexpr]
```

Definition at line 16 of file [FrameInfo.hpp](#).

Referenced by [ven::PointLightSystem::update\(\)](#).

5.3.3.5 SHADERS_BIN_PATH

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

Definition at line 15 of file [Constant.hpp](#).

Referenced by [ven::PointLightSystem::createPipeline\(\)](#), and [ven::RenderSystem::createPipeline\(\)](#).

Chapter 6

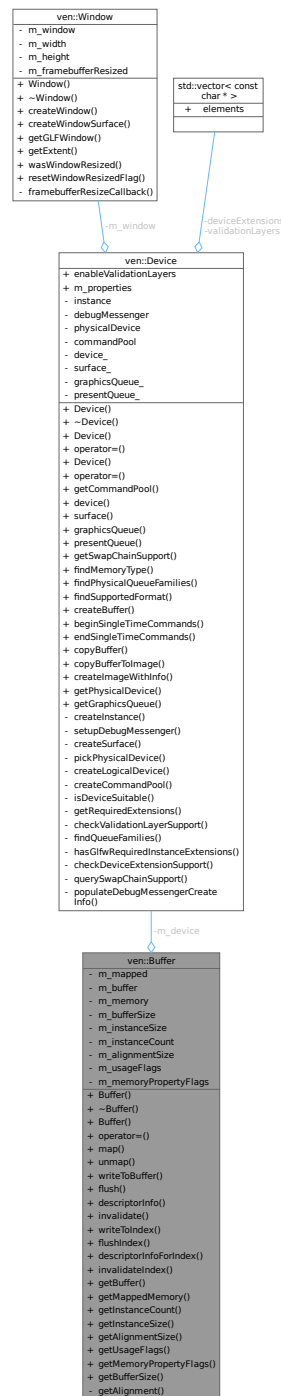
Class Documentation

6.1 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` (`VkDeviceSize` instanceSize, `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`

6.1.1 Detailed Description

Class for buffer.

Definition at line 17 of file [Buffer.hpp](#).

6.1.2 Constructor & Destructor Documentation

6.1.2.1 Buffer() [1/2]

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

Definition at line 13 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:



6.1.2.2 ~Buffer()

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

Definition at line 19 of file [buffer.cpp](#).

6.1.2.3 Buffer() [2/2]

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

6.1.3 Member Function Documentation

6.1.3.1 descriptorInfo()

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

Create a buffer info descriptor.

Parameters

| | |
|---------------|---|
| <i>size</i> | (Optional) Size of the memory range of the descriptor |
| <i>offset</i> | (Optional) Byte offset from beginning |

Returns

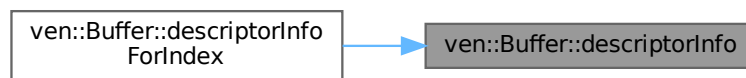
VkDescriptorBufferInfo of specified offset and range

Definition at line 73 of file [Buffer.hpp](#).

References [m_buffer](#).

Referenced by [descriptorInfoForIndex\(\)](#).

Here is the caller graph for this function:



6.1.3.2 descriptorInfoForIndex()

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

Create a buffer info descriptor.

Parameters

| | |
|--------------|--|
| <i>index</i> | Specifies the region given by <code>index * alignmentSize</code> |
|--------------|--|

Returns

VkDescriptorBufferInfo for instance at index

Definition at line 112 of file [Buffer.hpp](#).

References [descriptorInfo\(\)](#), and [m_alignmentSize](#).

Here is the call graph for this function:



6.1.3.3 flush()

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

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

Note

Only required for non-coherent memory

Parameters

| | |
|---------------|--|
| <i>size</i> | (Optional) Size of the memory range to flush. Pass VK_WHOLE_SIZE to flush the complete buffer range. |
| <i>offset</i> | (Optional) Byte offset from beginning |

Returns

VkResult of the flush call

Definition at line 53 of file [buffer.cpp](#).

Referenced by [flushIndex\(\)](#).

Here is the caller graph for this function:



6.1.3.4 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

| | |
|--------------|----------------------------|
| <i>index</i> | Used in offset calculation |
|--------------|----------------------------|

Definition at line 102 of file [Buffer.hpp](#).

References [flush\(\)](#), and [m_alignmentSize](#).

Here is the call graph for this function:



6.1.3.5 `getAlignment()`

```

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

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

Parameters

| | |
|---------------------------|--|
| <i>instanceSize</i> | The size of an instance |
| <i>minOffsetAlignment</i> | The minimum required alignment, in bytes, for the offset member (eg <code>minUniformBufferOffsetAlignment</code>) |

Returns

`VkResult` of the buffer mapping call

Definition at line 6 of file [buffer.cpp](#).

6.1.3.6 `getAlignmentSize()`

```

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

Definition at line 129 of file [Buffer.hpp](#).

References [m_instanceSize](#).

6.1.3.7 getBuffer()

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

Definition at line 125 of file [Buffer.hpp](#).

References [m_buffer](#).

6.1.3.8 getBufferSize()

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

Definition at line 132 of file [Buffer.hpp](#).

References [m_bufferSize](#).

6.1.3.9 getInstanceCount()

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

Definition at line 127 of file [Buffer.hpp](#).

References [m_instanceCount](#).

6.1.3.10 getInstanceSize()

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

Definition at line 128 of file [Buffer.hpp](#).

References [m_instanceSize](#).

6.1.3.11 getMappedMemory()

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

Definition at line 126 of file [Buffer.hpp](#).

References [m_mapped](#).

6.1.3.12 getMemoryPropertyFlags()

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

Definition at line 131 of file [Buffer.hpp](#).

References [m_memoryPropertyFlags](#).

6.1.3.13 `getUsageFlags()`

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

Definition at line 130 of file [Buffer.hpp](#).

References [m_usageFlags](#).

6.1.3.14 `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

| | |
|---------------|--|
| <i>size</i> | (Optional) Size of the memory range to invalidate. Pass VK_WHOLE_SIZE to invalidate the complete buffer range. |
| <i>offset</i> | (Optional) Byte offset from beginning |

Returns

VkResult of the invalidate call

Definition at line 63 of file [buffer.cpp](#).

Referenced by [invalidateIndex\(\)](#).

Here is the caller graph for this function:



6.1.3.15 `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

| | |
|--------------|---|
| <i>index</i> | Specifies the region to invalidate: $\text{index} * \text{alignmentSize}$ |
|--------------|---|

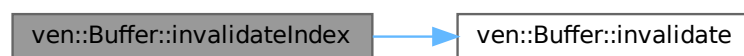
Returns

VkResult of the invalidate call

Definition at line 123 of file [Buffer.hpp](#).

References [invalidate\(\)](#), and [m_alignmentSize](#).

Here is the call graph for this function:



6.1.3.16 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

| | |
|---------------|--|
| <i>size</i> | (Optional) Size of the memory range to map. Pass VK_WHOLE_SIZE to map the complete buffer range. |
| <i>offset</i> | (Optional) Byte offset from beginning |

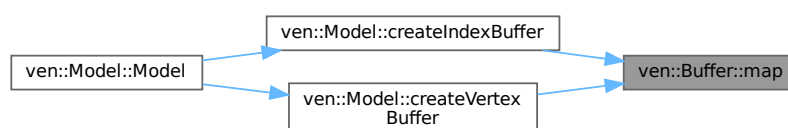
Returns

VkResult of the buffer mapping call

Definition at line 26 of file [buffer.cpp](#).

Referenced by [ven::Model::createIndexBuffer\(\)](#), and [ven::Model::createVertexBuffer\(\)](#).

Here is the caller graph for this function:



6.1.3.17 operator=()

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

6.1.3.18 unmap()

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

Unmap a mapped memory range.

Note

Does not return a result as vkUnmapMemory can't fail

Definition at line 32 of file [buffer.cpp](#).

6.1.3.19 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

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

Definition at line 40 of file [buffer.cpp](#).

Referenced by [writeToIndex\(\)](#).

Here is the caller graph for this function:



6.1.3.20 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

| | |
|--------------|-----------------------------|
| <i>data</i> | Pointer to the data to copy |
| <i>index</i> | Used in offset calculation |

Definition at line 95 of file [Buffer.hpp](#).

References [m_alignmentSize](#), [m_instanceSize](#), and [writeToBuffer\(\)](#).

Here is the call graph for this function:



6.1.4 Member Data Documentation

6.1.4.1 m_alignmentSize

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

Definition at line 154 of file [Buffer.hpp](#).

Referenced by [Buffer\(\)](#), [descriptorInfoForIndex\(\)](#), [flushIndex\(\)](#), [invalidateIndex\(\)](#), and [writeToIndex\(\)](#).

6.1.4.2 m_buffer

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

Definition at line 148 of file [Buffer.hpp](#).

Referenced by [Buffer\(\)](#), [descriptorInfo\(\)](#), and [getBuffer\(\)](#).

6.1.4.3 m_bufferSize

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

Definition at line 151 of file [Buffer.hpp](#).

Referenced by [Buffer\(\)](#), and [getBufferSize\(\)](#).

6.1.4.4 m_device

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

Definition at line 146 of file [Buffer.hpp](#).

6.1.4.5 m_instanceCount

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

Definition at line 153 of file [Buffer.hpp](#).

Referenced by [Buffer\(\)](#), and [getInstanceCount\(\)](#).

6.1.4.6 m_instanceSize

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

Definition at line 152 of file [Buffer.hpp](#).

Referenced by [getAlignmentSize\(\)](#), [getInstanceSize\(\)](#), and [writeToIndex\(\)](#).

6.1.4.7 m_mapped

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

Definition at line 147 of file [Buffer.hpp](#).

Referenced by [getMappedMemory\(\)](#).

6.1.4.8 m_memory

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

Definition at line 149 of file [Buffer.hpp](#).

Referenced by [Buffer\(\)](#).

6.1.4.9 m_memoryPropertyFlags

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

Definition at line 156 of file [Buffer.hpp](#).

Referenced by [Buffer\(\)](#), and [getMemoryPropertyFlags\(\)](#).

6.1.4.10 m_usageFlags

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

Definition at line 155 of file [Buffer.hpp](#).

Referenced by [Buffer\(\)](#), and [getUsageFlags\(\)](#).

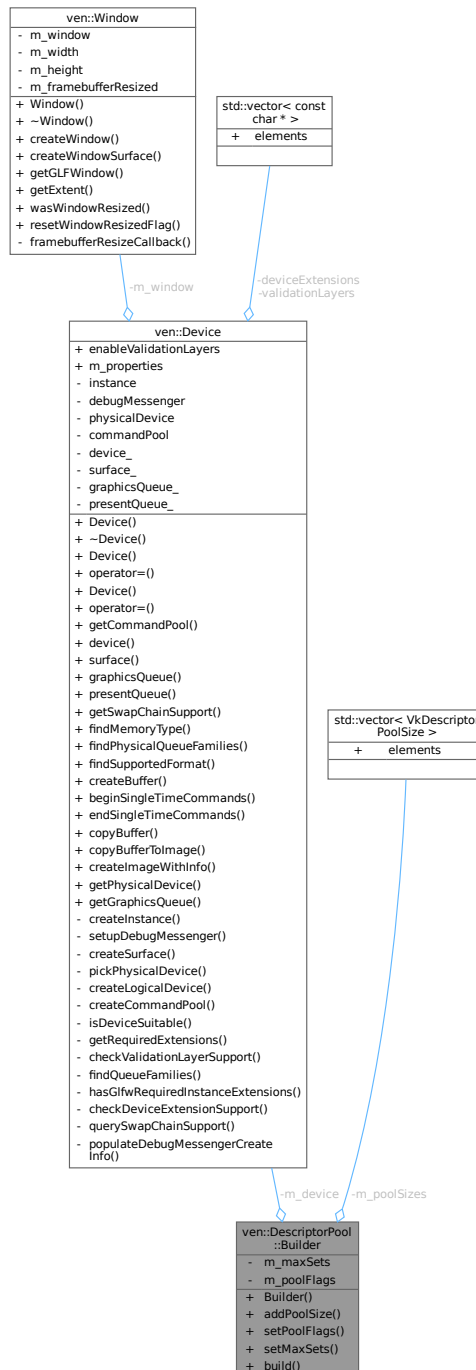
The documentation for this class was generated from the following files:

- [/home/runner/work/VEngine/VEngine/include/VEngine/Buffer.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/buffer.cpp](#)

6.2 ven::DescriptorPool::Builder Class Reference

```
#include <Descriptors.hpp>
```

Collaboration diagram for ven::DescriptorPool::Builder:



Public Member Functions

- [Builder](#) ([Device](#) &device)

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

Private Attributes

- [Device](#) & [m_device](#)
- std::vector< VkDescriptorPoolSize > [m_poolSizes](#)
- uint32_t [m_maxSets](#) = 1000
- VkDescriptorPoolCreateFlags [m_poolFlags](#) = 0

6.2.1 Detailed Description

Definition at line 65 of file [Descriptors.hpp](#).

6.2.2 Constructor & Destructor Documentation

6.2.2.1 Builder()

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

Definition at line 69 of file [Descriptors.hpp](#).

6.2.3 Member Function Documentation

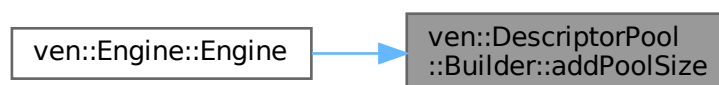
6.2.3.1 addPoolSize()

```
ven::DescriptorPool::Builder & ven::DescriptorPool::Builder::addPoolSize (
    VkDescriptorType descriptorType,
    uint32_t count)
```

Definition at line 39 of file [descriptors.cpp](#).

Referenced by [ven::Engine::Engine\(\)](#).

Here is the caller graph for this function:



6.2.3.2 build()

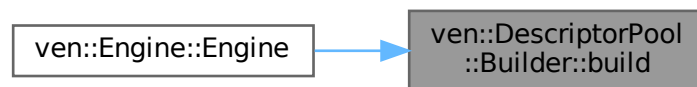
```
std::unique_ptr< DescriptorPool > ven::DescriptorPool::Builder::build () const [inline],
[nodiscard]
```

Definition at line 74 of file [Descriptors.hpp](#).

References [m_device](#), [m_maxSets](#), [m_poolFlags](#), and [m_poolSizes](#).

Referenced by [ven::Engine::Engine\(\)](#).

Here is the caller graph for this function:



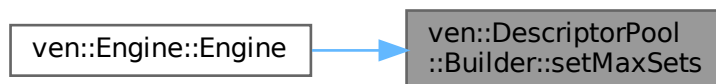
6.2.3.3 setMaxSets()

```
ven::DescriptorPool::Builder & ven::DescriptorPool::Builder::setMaxSets (
    uint32_t count)
```

Definition at line 50 of file [descriptors.cpp](#).

Referenced by [ven::Engine::Engine\(\)](#).

Here is the caller graph for this function:



6.2.3.4 setPoolFlags()

```
ven::DescriptorPool::Builder & ven::DescriptorPool::Builder::setPoolFlags (
    VkDescriptorPoolCreateFlags flags)
```

Definition at line 45 of file [descriptors.cpp](#).

6.2.4 Member Data Documentation

6.2.4.1 m_device

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

Definition at line 78 of file [Descriptors.hpp](#).

Referenced by [build\(\)](#).

6.2.4.2 m_maxSets

`uint32_t ven::DescriptorPool::Builder::m_maxSets = 1000 [private]`

Definition at line 80 of file [Descriptors.hpp](#).

Referenced by [build\(\)](#).

6.2.4.3 m_poolFlags

`VkDescriptorPoolCreateFlags ven::DescriptorPool::Builder::m_poolFlags = 0 [private]`

Definition at line 81 of file [Descriptors.hpp](#).

Referenced by [build\(\)](#).

6.2.4.4 m_poolSizes

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

Definition at line 79 of file [Descriptors.hpp](#).

Referenced by [build\(\)](#).

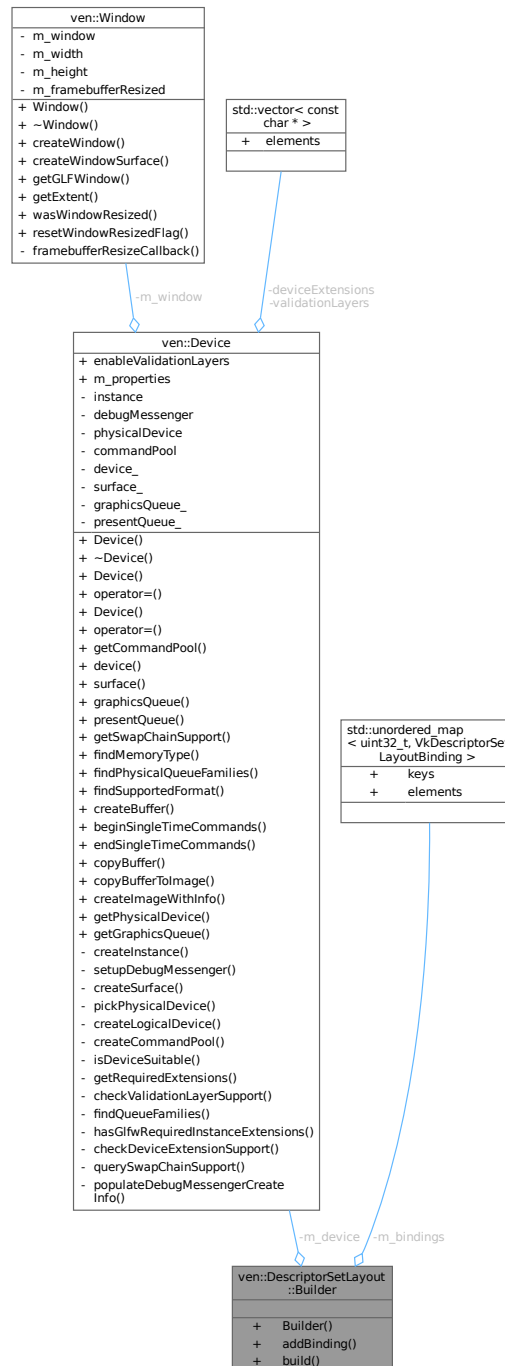
The documentation for this class was generated from the following files:

- [/home/runner/work/VEngine/VEngine/include/VEngine/Descriptors.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/descriptors.cpp](#)

6.3 ven::DescriptorSetLayout::Builder Class Reference

```
#include <Descriptors.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](#)

6.3.1 Detailed Description

Definition at line 25 of file [Descriptors.hpp](#).

6.3.2 Constructor & Destructor Documentation

6.3.2.1 Builder()

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

Definition at line 29 of file [Descriptors.hpp](#).

6.3.3 Member Function Documentation

6.3.3.1 addBinding()

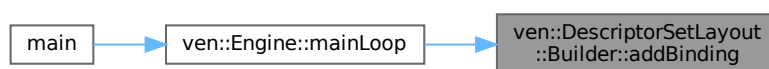
```
ven::DescriptorSetLayout::Builder & ven::DescriptorSetLayout::Builder::addBinding (
    uint32_t binding,
    VkDescriptorType descriptorType,
    VkShaderStageFlags stageFlags,
    uint32_t count = 1)
```

Definition at line 5 of file [descriptors.cpp](#).

References [m_bindings](#).

Referenced by [ven::Engine::mainLoop\(\)](#).

Here is the caller graph for this function:



6.3.3.2 build()

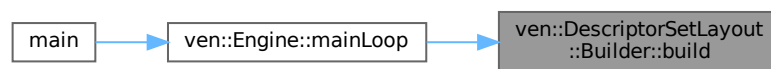
```
std::unique_ptr< DescriptorSetLayout > ven::DescriptorSetLayout::Builder::build () const
[inline]
```

Definition at line 32 of file [Descriptors.hpp](#).

References [m_bindings](#), and [m_device](#).

Referenced by [ven::Engine::mainLoop\(\)](#).

Here is the caller graph for this function:



6.3.4 Member Data Documentation

6.3.4.1 m_bindings

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

Definition at line 36 of file [Descriptors.hpp](#).

Referenced by [addBinding\(\)](#), and [build\(\)](#).

6.3.4.2 m_device

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

Definition at line 35 of file [Descriptors.hpp](#).

Referenced by [build\(\)](#).

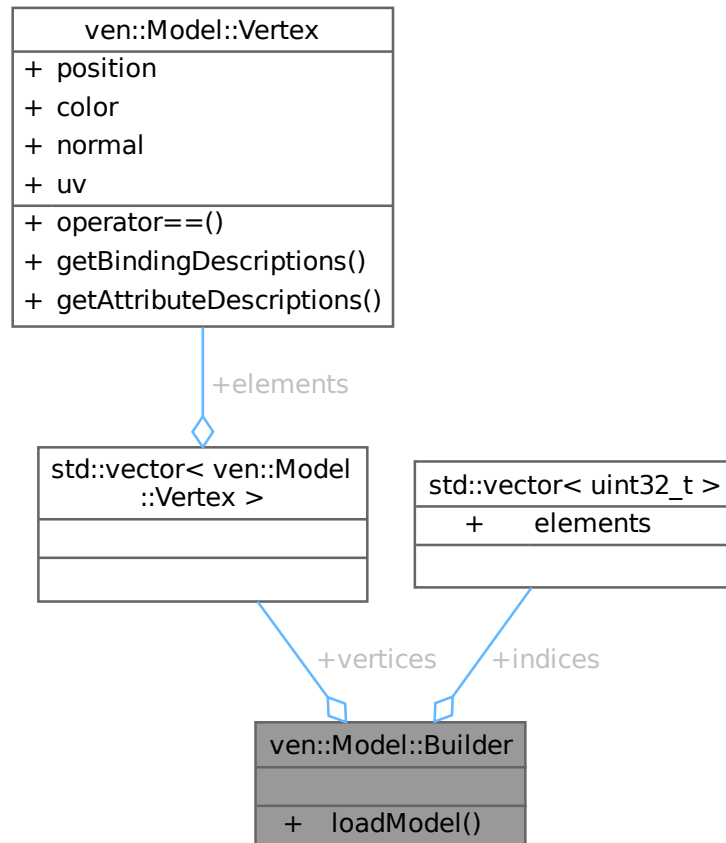
The documentation for this class was generated from the following files:

- [/home/runner/work/VEngine/VEngine/include/VEngine/Descriptors.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/descriptors.cpp](#)

6.4 ven::Model::Builder Struct Reference

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

Collaboration diagram for ven::Model::Builder:



Public Member Functions

- void [loadModel](#) (const std::string &filename)

Public Attributes

- std::vector< [Vertex](#) > [vertices](#)
- std::vector< uint32_t > [indices](#)

6.4.1 Detailed Description

Definition at line 34 of file [Model.hpp](#).

6.4.2 Member Function Documentation

6.4.2.1 loadModel()

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

Definition at line 120 of file [model.cpp](#).

References [ven::Model::Vertex::position](#).

Referenced by [ven::Model::createModelFromFile\(\)](#).

Here is the caller graph for this function:



6.4.3 Member Data Documentation

6.4.3.1 indices

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

Definition at line 36 of file [Model.hpp](#).

Referenced by [ven::Model::Model\(\)](#).

6.4.3.2 vertices

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

Definition at line 35 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](#)

6.5 ven::Camera Class Reference

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

Collaboration diagram for ven::Camera:

| ven::Camera |
|--|
| <ul style="list-style-type: none"> - m_projectionMatrix - m_viewMatrix - m_inverseViewMatrix |
| <ul style="list-style-type: none"> + setOrthographicProjection() + setPerspectiveProjection() + setViewDirection() + setViewTarget() + setViewYXZ() + getProjection() + getView() + getInverseView() |

Public Member Functions

- void [setOrthographicProjection](#) (float left, float right, float top, float bottom, float near, float far)
- void [setPerspectiveProjection](#) (float fovy, float aspect, float near, float far)
- void [setViewDirection](#) (glm::vec3 position, glm::vec3 direction, glm::vec3 up=glm::vec3{0.F, -1.F, 0.F})
- void [setViewTarget](#) (glm::vec3 position, glm::vec3 target, glm::vec3 up=glm::vec3{0.F, -1.F, 0.F})
- void [setViewYXZ](#) (glm::vec3 position, glm::vec3 rotation)
- const glm::mat4 & [getProjection](#) () const
- const glm::mat4 & [getView](#) () const
- const glm::mat4 & [getInverseView](#) () const

Private Attributes

- glm::mat4 [m_projectionMatrix](#) {1.F}
- glm::mat4 [m_viewMatrix](#) {1.F}
- glm::mat4 [m_inverseViewMatrix](#) {1.F}

6.5.1 Detailed Description

Definition at line 17 of file [Camera.hpp](#).

6.5.2 Member Function Documentation

6.5.2.1 getInverseView()

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

Definition at line 29 of file [Camera.hpp](#).

References [m_inverseViewMatrix](#).

6.5.2.2 getProjection()

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

Definition at line 27 of file [Camera.hpp](#).

References [m_projectionMatrix](#).

6.5.2.3 getView()

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

Definition at line 28 of file [Camera.hpp](#).

References [m_viewMatrix](#).

6.5.2.4 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](#).

6.5.2.5 setPerspectiveProjection()

```
void ven::Camera::setPerspectiveProjection (  
    float fovy,  
    float aspect,  
    float near,  
    float far)
```

Definition at line 17 of file [camera.cpp](#).

6.5.2.6 setViewDirection()

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

Definition at line 29 of file [camera.cpp](#).

6.5.2.7 setViewTarget()

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

Definition at line 24 of file [Camera.hpp](#).

6.5.2.8 setViewYXZ()

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

Definition at line 64 of file [camera.cpp](#).

6.5.3 Member Data Documentation

6.5.3.1 m_inverseViewMatrix

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

Definition at line 35 of file [Camera.hpp](#).

Referenced by [getInverseView\(\)](#).

6.5.3.2 m_projectionMatrix

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

Definition at line 33 of file [Camera.hpp](#).

Referenced by [getProjection\(\)](#), and [setOrthographicProjection\(\)](#).

6.5.3.3 m_viewMatrix

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

Definition at line 34 of file [Camera.hpp](#).

Referenced by [getView\(\)](#).

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](#)

6.6 myLib::Clock Class Reference

Class for time management.

`#include <Clock.hpp>`

Collaboration diagram for myLib::Clock:

| myLib::Clock |
|--------------------|
| - m_start |
| - m_pause |
| - m_paused |
| + Clock() |
| + ~Clock() |
| + restart() |
| + pause() |
| + resume() |
| + getElapsedTime() |

Public Member Functions

- [Clock](#) ()
- [~Clock](#) ()=default
- void [restart](#) ()
Restart the clock.
- void [pause](#) ()
Pause the clock.
- void [resume](#) ()
Resume the clock.
- [Time getElapsedTime](#) () const
Get the elapsed time since the last restart.

Private Attributes

- [TimePoint m_start](#)
- [TimePoint m_pause](#)
- `bool m_paused {false}`

6.6.1 Detailed Description

Class for time management.

Definition at line 23 of file [Clock.hpp](#).

6.6.2 Constructor & Destructor Documentation

6.6.2.1 Clock()

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

Definition at line 27 of file [Clock.hpp](#).

6.6.2.2 ~Clock()

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

6.6.3 Member Function Documentation

6.6.3.1 getElapsedTime()

```
myLib::Time myLib::Clock::getElapsedTime () const [nodiscard]
```

Get the elapsed time since the last restart.

Returns

[Time](#) The elapsed time

Definition at line 22 of file [clock.cpp](#).

6.6.3.2 pause()

```
void myLib::Clock::pause ()
```

Pause the clock.

Definition at line 3 of file [clock.cpp](#).

References [m_pause](#), and [m_paused](#).

6.6.3.3 restart()

```
void myLib::Clock::restart () [inline]
```

Restart the clock.

Definition at line 34 of file [Clock.hpp](#).

References [m_start](#).

6.6.3.4 resume()

```
void myLib::Clock::resume ()
```

Resume the clock.

Definition at line 12 of file [clock.cpp](#).

6.6.4 Member Data Documentation

6.6.4.1 m_pause

```
TimePoint myLib::Clock::m_pause [private]
```

Definition at line 62 of file [Clock.hpp](#).

Referenced by [pause\(\)](#).

6.6.4.2 m_paused

```
bool myLib::Clock::m_paused {false} [private]
```

Definition at line 67 of file [Clock.hpp](#).

Referenced by [pause\(\)](#).

6.6.4.3 m_start

```
TimePoint myLib::Clock::m_start [private]
```

Definition at line 57 of file [Clock.hpp](#).

Referenced by [restart\(\)](#).

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

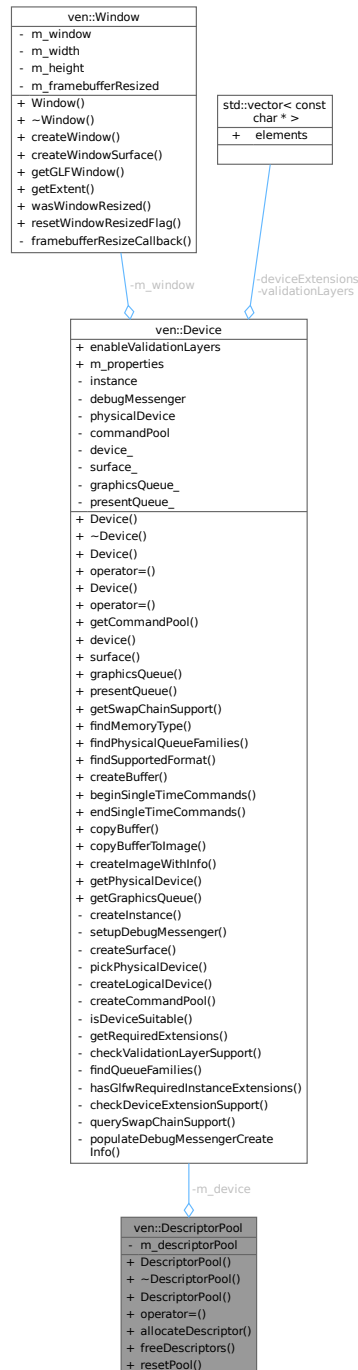
- [/home/runner/work/VEngine/VEngine/lib/local/static/myLib/include/myLib/Clock/Clock.hpp](#)
- [/home/runner/work/VEngine/VEngine/lib/local/static/myLib/src/clock.cpp](#)

6.7 ven::DescriptorPool Class Reference

Class for descriptor pool.

```
#include <Descriptors.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

Private Attributes

- [Device](#) & [m_device](#)
- VkDescriptorPool [m_descriptorPool](#)

Friends

- class [DescriptorWriter](#)

6.7.1 Detailed Description

Class for descriptor pool.

Definition at line 61 of file [Descriptors.hpp](#).

6.7.2 Constructor & Destructor Documentation

6.7.2.1 DescriptorPool() [1/2]

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

Definition at line 56 of file [descriptors.cpp](#).

References [ven::Device::device\(\)](#), [m_descriptorPool](#), and [m_device](#).

Here is the call graph for this function:



6.7.2.2 ~DescriptorPool()

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

Definition at line 85 of file [Descriptors.hpp](#).

References [ven::Device::device\(\)](#), [m_descriptorPool](#), and [m_device](#).

Here is the call graph for this function:



6.7.2.3 DescriptorPool() [2/2]

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

6.7.3 Member Function Documentation

6.7.3.1 allocateDescriptor()

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

Definition at line 71 of file [descriptors.cpp](#).

6.7.3.2 freeDescriptors()

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

Definition at line 91 of file [Descriptors.hpp](#).

References [ven::Device::device\(\)](#), [m_descriptorPool](#), and [m_device](#).

Here is the call graph for this function:



6.7.3.3 operator=()

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

6.7.3.4 resetPool()

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

Definition at line 93 of file [Descriptors.hpp](#).

References [ven::Device::device\(\)](#), [m_descriptorPool](#), and [m_device](#).

Here is the call graph for this function:



6.7.4 Friends And Related Symbol Documentation

6.7.4.1 DescriptorWriter

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

Definition at line 100 of file [Descriptors.hpp](#).

6.7.5 Member Data Documentation

6.7.5.1 m_descriptorPool

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

Definition at line 98 of file [Descriptors.hpp](#).

Referenced by [DescriptorPool\(\)](#), [freeDescriptors\(\)](#), [resetPool\(\)](#), and [~DescriptorPool\(\)](#).

6.7.5.2 m_device

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

Definition at line 97 of file [Descriptors.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.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/descriptors.cpp](#)

6.8 ven::DescriptorSetLayout Class Reference

Class for descriptor set layout.

```
#include <Descriptors.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](#)

6.8.1 Detailed Description

Class for descriptor set layout.

Definition at line 21 of file [Descriptors.hpp](#).

6.8.2 Constructor & Destructor Documentation

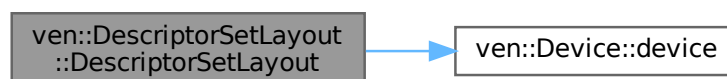
6.8.2.1 DescriptorSetLayout() [1/2]

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

Definition at line 17 of file [descriptors.cpp](#).

References [ven::Device::device\(\)](#), [m_descriptorSetLayout](#), and [m_device](#).

Here is the call graph for this function:



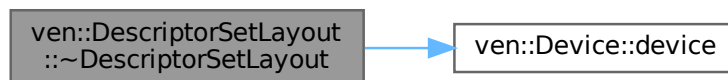
6.8.2.2 ~DescriptorSetLayout()

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

Definition at line 40 of file [Descriptors.hpp](#).

References [ven::Device::device\(\)](#), [m_descriptorSetLayout](#), and [m_device](#).

Here is the call graph for this function:



6.8.2.3 DescriptorSetLayout() [2/2]

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

6.8.3 Member Function Documentation

6.8.3.1 getDescriptorSetLayout()

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

Definition at line 44 of file [Descriptors.hpp](#).

References [m_descriptorSetLayout](#).

6.8.3.2 operator=()

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

6.8.4 Friends And Related Symbol Documentation

6.8.4.1 DescriptorWriter

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

Definition at line 52 of file [Descriptors.hpp](#).

6.8.5 Member Data Documentation

6.8.5.1 m_bindings

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

Definition at line 50 of file [Descriptors.hpp](#).

6.8.5.2 m_descriptorSetLayout

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

Definition at line 49 of file [Descriptors.hpp](#).

Referenced by [DescriptorSetLayout\(\)](#), [getDescriptorSetLayout\(\)](#), and [~DescriptorSetLayout\(\)](#).

6.8.5.3 m_device

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

Definition at line 48 of file [Descriptors.hpp](#).

Referenced by [DescriptorSetLayout\(\)](#), and [~DescriptorSetLayout\(\)](#).

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

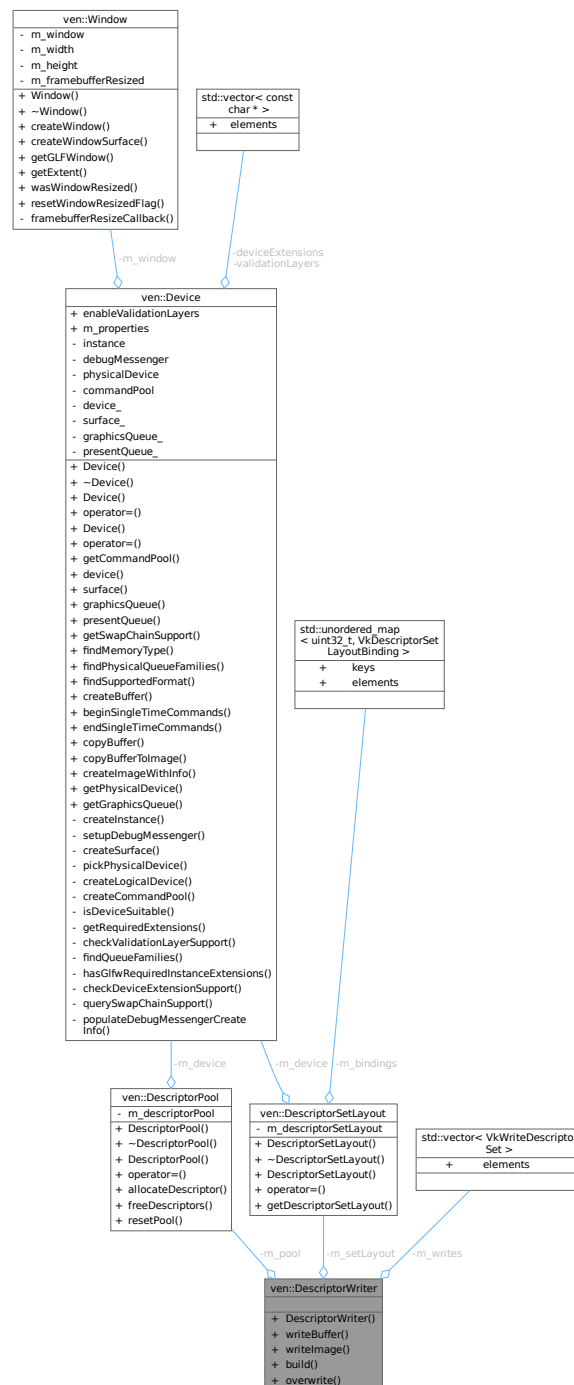
- [/home/runner/work/VEngine/VEngine/include/VEngine/Descriptors.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/descriptors.cpp](#)

6.9 ven::DescriptorWriter Class Reference

Class for descriptor writer.

```
#include <Descriptors.hpp>
```

Collaboration diagram for `ven::DescriptorWriter`:



Public Member Functions

- `DescriptorWriter` (`DescriptorSetLayout` &setLayout, `DescriptorPool` &pool)
- `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](#)

6.9.1 Detailed Description

Class for descriptor writer.

Definition at line 109 of file [Descriptors.hpp](#).

6.9.2 Constructor & Destructor Documentation

6.9.2.1 DescriptorWriter()

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

Definition at line 113 of file [Descriptors.hpp](#).

6.9.3 Member Function Documentation

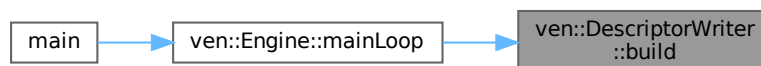
6.9.3.1 build()

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

Definition at line 122 of file [descriptors.cpp](#).

Referenced by [ven::Engine::mainLoop\(\)](#).

Here is the caller graph for this function:



6.9.3.2 overwrite()

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

Definition at line 131 of file [descriptors.cpp](#).

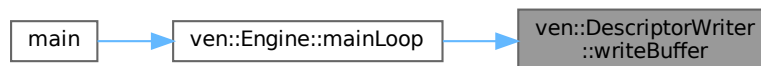
6.9.3.3 writeBuffer()

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

Definition at line 84 of file [descriptors.cpp](#).

Referenced by [ven::Engine::mainLoop\(\)](#).

Here is the caller graph for this function:



6.9.3.4 writeImage()

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

Definition at line 103 of file [descriptors.cpp](#).

6.9.4 Member Data Documentation

6.9.4.1 m_pool

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

Definition at line 124 of file [Descriptors.hpp](#).

6.9.4.2 m_setLayout

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

Definition at line 123 of file [Descriptors.hpp](#).

6.9.4.3 m_writes

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

Definition at line 125 of file [Descriptors.hpp](#).

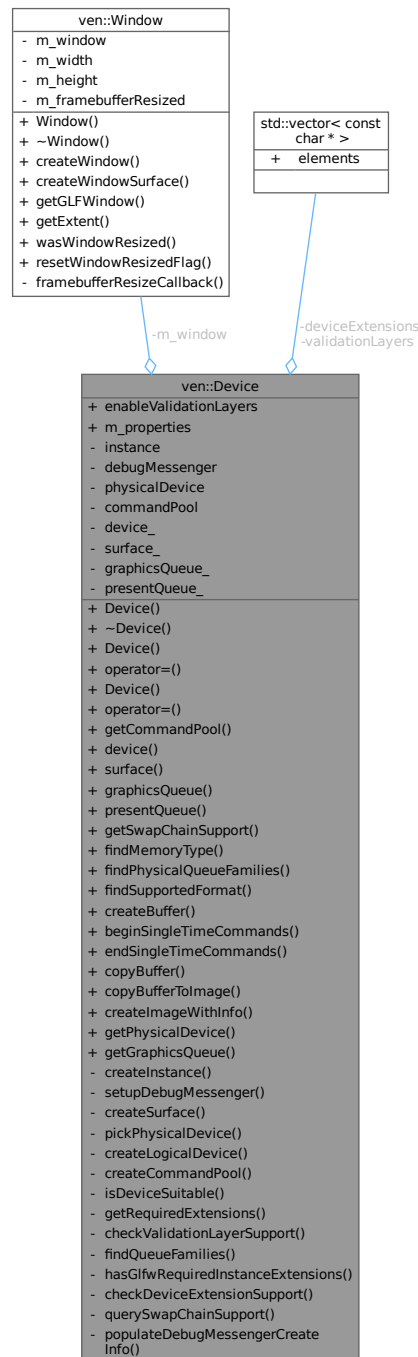
The documentation for this class was generated from the following files:

- [/home/runner/work/VEngine/VEngine/include/VEngine/Descriptors.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/descriptors.cpp](#)

6.10 ven::Device Class Reference

```
#include <Device.hpp>
```

Collaboration diagram for ven::Device:



Public Member Functions

- [Device](#) ([Window](#) &window)

- [~Device](#) ()
- [Device](#) (const [Device](#) &)=delete
- [Device](#) & [operator=](#) (const [Device](#) &)=delete
- [Device](#) ([Device](#) &&)=delete
- [Device](#) & [operator=](#) ([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
- [VkFormat](#) [findSupportedFormat](#) (const [std::vector](#)< [VkFormat](#) > &candidates, [VkImageTiling](#) tiling, [VkFormatFeatureFlags](#) features) const
- [void](#) [createBuffer](#) ([VkDeviceSize](#) size, [VkBufferUsageFlags](#) usage, [VkMemoryPropertyFlags](#) properties, [VkBuffer](#) &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](#) layerCount) const
- [void](#) [createImageWithInfo](#) (const [VkImageCreateInfo](#) &imageInfo, [VkMemoryPropertyFlags](#) properties, [VkImage](#) &image, [VkDeviceMemory](#) &imageMemory) const
- [VkPhysicalDevice](#) [getPhysicalDevice](#) () const
- [VkQueue](#) [getGraphicsQueue](#) () const

Public Attributes

- const bool [enableValidationLayers](#) = true
- [VkPhysicalDeviceProperties](#) [m_properties](#)

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 [instance](#)
- VkDebugUtilsMessengerEXT [debugMessenger](#)
- VkPhysicalDevice [physicalDevice](#) = VK_NULL_HANDLE
- [Window](#) & [m_window](#)
- VkCommandPool [commandPool](#)
- VkDevice [device_](#)
- VkSurfaceKHR [surface_](#)
- VkQueue [graphicsQueue_](#)
- VkQueue [presentQueue_](#)
- const std::vector< const char * > [validationLayers](#) = {"VK_LAYER_KHRONOS_validation"}
- const std::vector< const char * > [deviceExtensions](#) = {VK_KHR_SWAPCHAIN_EXTENSION_NAME}

6.10.1 Detailed Description

Definition at line 29 of file [Device.hpp](#).

6.10.2 Constructor & Destructor Documentation

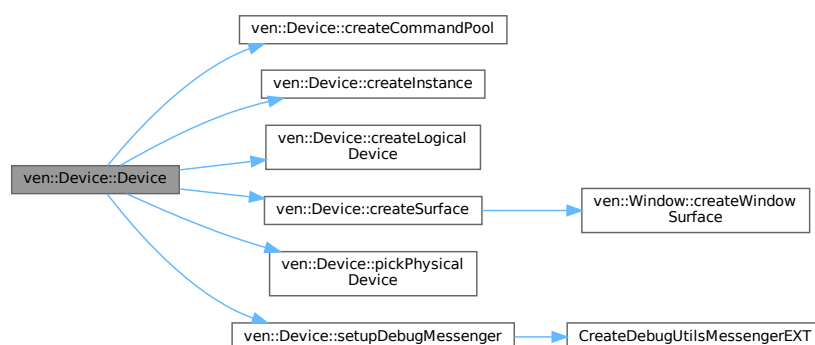
6.10.2.1 Device() [1/3]

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

Definition at line 34 of file [device.cpp](#).

References [createCommandPool\(\)](#), [createInstance\(\)](#), [createLogicalDevice\(\)](#), [createSurface\(\)](#), [pickPhysicalDevice\(\)](#), and [setupDebugMessenger\(\)](#).

Here is the call graph for this function:



6.10.2.2 ~Device()

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

Definition at line 44 of file [device.cpp](#).

References [DestroyDebugUtilsMessengerEXT\(\)](#).

Here is the call graph for this function:



6.10.2.3 Device() [2/3]

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

6.10.2.4 Device() [3/3]

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

6.10.3 Member Function Documentation

6.10.3.1 beginSingleTimeCommands()

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

Definition at line 411 of file [device.cpp](#).

6.10.3.2 checkDeviceExtensionSupport()

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

Definition at line 289 of file [device.cpp](#).

6.10.3.3 checkValidationLayerSupport()

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

Definition at line 225 of file [device.cpp](#).

6.10.3.4 copyBuffer()

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

Definition at line 445 of file [device.cpp](#).

6.10.3.5 copyBufferToImage()

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

Definition at line 458 of file [device.cpp](#).

6.10.3.6 createBuffer()

```
void ven::Device::createBuffer (
    VkDeviceSize size,
    VkBufferUsageFlags usage,
    VkMemoryPropertyFlags propertiesp,
    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:



6.10.3.7 createCommandPool()

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

Definition at line 171 of file [device.cpp](#).

References [ven::QueueFamilyIndices::graphicsFamily](#).

Referenced by [Device\(\)](#).

Here is the caller graph for this function:



6.10.3.8 createImageWithInfo()

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

Definition at line 479 of file [device.cpp](#).

6.10.3.9 createInstance()

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

Definition at line 57 of file [device.cpp](#).

Referenced by [Device\(\)](#).

Here is the caller graph for this function:



6.10.3.10 createLogicalDevice()

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

Definition at line 124 of file [device.cpp](#).

References [ven::QueueFamilyIndices::graphicsFamily](#), and [ven::QueueFamilyIndices::presentFamily](#).

Referenced by [Device\(\)](#).

Here is the caller graph for this function:



6.10.3.11 createSurface()

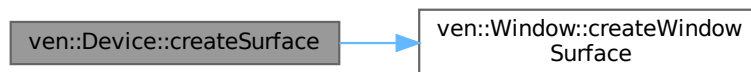
```
void ven::Device::createSurface () [inline], [private]
```

Definition at line 76 of file [Device.hpp](#).

References [ven::Window::createWindowSurface\(\)](#), [instance](#), [m_window](#), and [surface_](#).

Referenced by [Device\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.10.3.12 device()

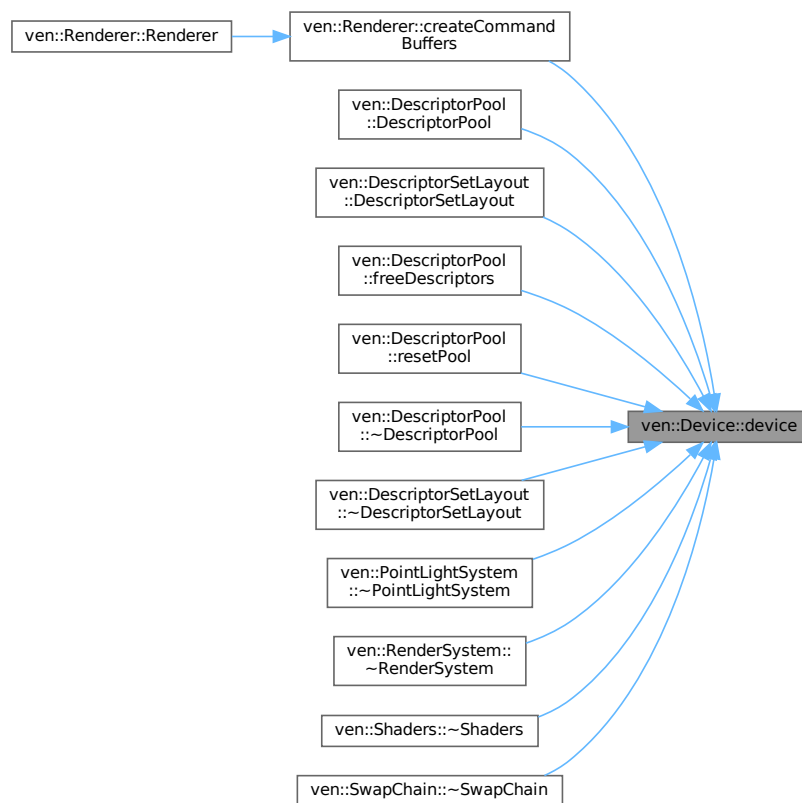
```
VkDevice ven::Device::device () const [inline], [nodiscard]
```

Definition at line 48 of file [Device.hpp](#).

References [device_](#).

Referenced by [ven::Renderer::createCommandBuffers\(\)](#), [ven::DescriptorPool::DescriptorPool\(\)](#), [ven::DescriptorSetLayout::DescriptorSetLayout\(\)](#), [ven::DescriptorPool::freeDescriptors\(\)](#), [ven::DescriptorPool::resetPool\(\)](#), [ven::DescriptorPool::~~DescriptorPool\(\)](#), [ven::DescriptorSetLayout::~~DescriptorSetLayout\(\)](#), [ven::PointLightSystem::~~PointLightSystem\(\)](#), [ven::RenderSystem::~~RenderSystem\(\)](#), [ven::Shaders::~~Shaders\(\)](#), and [ven::SwapChain::~~SwapChain\(\)](#).

Here is the caller graph for this function:



6.10.3.13 endSingleTimeCommands()

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

Definition at line 430 of file [device.cpp](#).

6.10.3.14 findMemoryType()

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

Definition at line 369 of file [device.cpp](#).

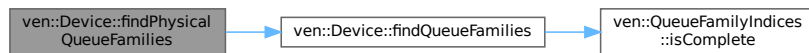
6.10.3.15 findPhysicalQueueFamilies()

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

Definition at line 55 of file [Device.hpp](#).

References [findQueueFamilies\(\)](#), and [physicalDevice](#).

Here is the call graph for this function:



6.10.3.16 findQueueFamilies()

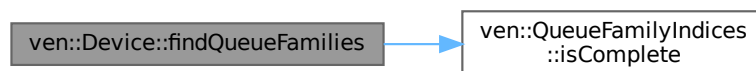
```
ven::QueueFamilyIndices ven::Device::findQueueFamilies (
    VkPhysicalDevice device) const [private]
```

Definition at line 305 of file [device.cpp](#).

References [ven::QueueFamilyIndices::graphicsFamily](#), [ven::QueueFamilyIndices::graphicsFamilyHasValue](#), [ven::QueueFamilyIndices::isComplete\(\)](#), [ven::QueueFamilyIndices::presentFamily](#), and [ven::QueueFamilyIndices::presentFamilyHasValue](#).

Referenced by [findPhysicalQueueFamilies\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.10.3.17 findSupportedFormat()

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

Definition at line 355 of file [device.cpp](#).

6.10.3.18 getCommandPool()

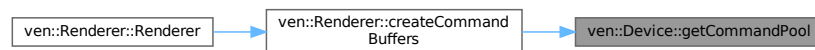
```
VkCommandPool ven::Device::getCommandPool () const [inline], [nodiscard]
```

Definition at line 47 of file [Device.hpp](#).

References [commandPool](#).

Referenced by [ven::Renderer::createCommandBuffers\(\)](#).

Here is the caller graph for this function:



6.10.3.19 getGraphicsQueue()

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

Definition at line 70 of file [Device.hpp](#).

References [graphicsQueue_](#).

6.10.3.20 getPhysicalDevice()

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

Definition at line 69 of file [Device.hpp](#).

References [physicalDevice](#).

6.10.3.21 getRequiredExtensions()

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

Definition at line 250 of file [device.cpp](#).

6.10.3.22 getSwapChainSupport()

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

Definition at line 53 of file [Device.hpp](#).

References [physicalDevice](#), and [querySwapChainSupport\(\)](#).

Here is the call graph for this function:

**6.10.3.23 graphicsQueue()**

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

Definition at line 50 of file [Device.hpp](#).

References [graphicsQueue_](#).

6.10.3.24 hasGlfwRequiredInstanceExtensions()

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

Definition at line 265 of file [device.cpp](#).

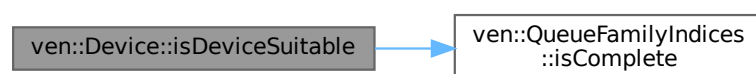
6.10.3.25 isDeviceSuitable()

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

Definition at line 185 of file [device.cpp](#).

References [ven::SwapChainSupportDetails::formats](#), [ven::QueueFamilyIndices::isComplete\(\)](#), and [ven::SwapChainSupportDetails::p](#).

Here is the call graph for this function:



6.10.3.26 operator=() [1/2]

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

6.10.3.27 operator=() [2/2]

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

6.10.3.28 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:



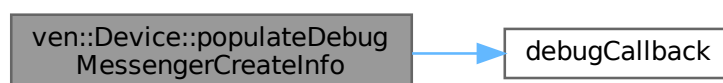
6.10.3.29 populateDebugMessengerCreateInfo()

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

Definition at line 202 of file [device.cpp](#).

References [debugCallback\(\)](#).

Here is the call graph for this function:



6.10.3.30 presentQueue()

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

Definition at line 51 of file [Device.hpp](#).

References [presentQueue_](#).

6.10.3.31 querySwapChainSupport()

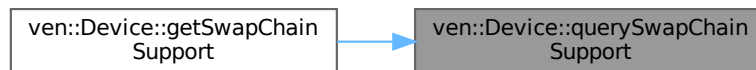
```
ven::SwapChainSupportDetails ven::Device::querySwapChainSupport (  
    VkPhysicalDevice device) const [private]
```

Definition at line 334 of file [device.cpp](#).

References [ven::SwapChainSupportDetails::capabilities](#), [ven::SwapChainSupportDetails::formats](#), and [ven::SwapChainSupportDetails::capabilities](#).

Referenced by [getSwapChainSupport\(\)](#).

Here is the caller graph for this function:



6.10.3.32 setupDebugMessenger()

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

Definition at line 215 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:



6.10.3.33 surface()

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

Definition at line 49 of file [Device.hpp](#).

References [surface_](#).

6.10.4 Member Data Documentation

6.10.4.1 commandPool

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

Definition at line 95 of file [Device.hpp](#).

Referenced by [getCommandPool\(\)](#).

6.10.4.2 debugMessenger

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

Definition at line 92 of file [Device.hpp](#).

6.10.4.3 device_

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

Definition at line 97 of file [Device.hpp](#).

Referenced by [device\(\)](#).

6.10.4.4 deviceExtensions

```
const std::vector<const char *> ven::Device::deviceExtensions = {VK_KHR_SWAPCHAIN_EXTENSION_↵  
NAME} [private]
```

Definition at line 103 of file [Device.hpp](#).

6.10.4.5 enableValidationLayers

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

Definition at line 36 of file [Device.hpp](#).

6.10.4.6 graphicsQueue_

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

Definition at line 99 of file [Device.hpp](#).

Referenced by [getGraphicsQueue\(\)](#), and [graphicsQueue\(\)](#).

6.10.4.7 instance

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

Definition at line 91 of file [Device.hpp](#).

Referenced by [createSurface\(\)](#).

6.10.4.8 m_properties

`VkPhysicalDeviceProperties ven::Device::m_properties`

Definition at line 67 of file [Device.hpp](#).

6.10.4.9 m_window

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

Definition at line 94 of file [Device.hpp](#).

Referenced by [createSurface\(\)](#).

6.10.4.10 physicalDevice

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

Definition at line 93 of file [Device.hpp](#).

Referenced by [findPhysicalQueueFamilies\(\)](#), [getPhysicalDevice\(\)](#), and [getSwapChainSupport\(\)](#).

6.10.4.11 presentQueue_

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

Definition at line 100 of file [Device.hpp](#).

Referenced by [presentQueue\(\)](#).

6.10.4.12 surface_

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

Definition at line 98 of file [Device.hpp](#).

Referenced by [createSurface\(\)](#), and [surface\(\)](#).

6.10.4.13 validationLayers

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

Definition at line 102 of file [Device.hpp](#).

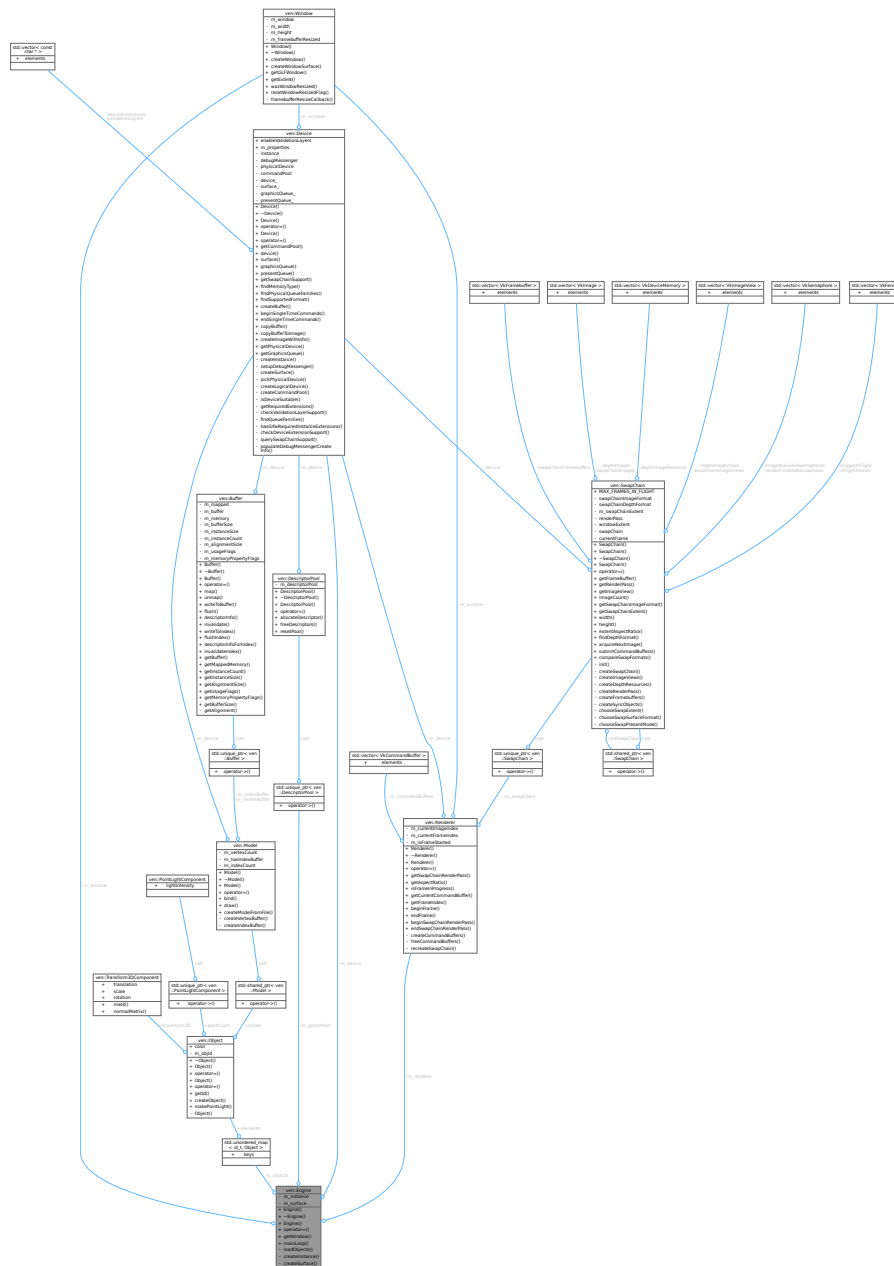
The documentation for this class was generated from the following files:

- [/home/runner/work/VEngine/VEngine/include/VEngine/Device.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/device.cpp](#)

6.11 ven::Engine Class Reference

```
#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
- `Window` & `getWindow` ()
- void `mainLoop` ()

Private Member Functions

- void [loadObjects](#) ()
- void [createInstance](#) ()
- void [createSurface](#) ()

Private Attributes

- [Window](#) [m_window](#)
- [Device](#) [m_device](#) {[m_window](#)}
- [Renderer](#) [m_renderer](#) {[m_window](#), [m_device](#)}
- `std::unique_ptr< DescriptorPool >` [m_globalPool](#)
- [Object::Map](#) [m_objects](#)
- `VkInstance` [m_instance](#) {`nullptr`}
- `VkSurfaceKHR` [m_surface](#) {`nullptr`}

6.11.1 Detailed Description

Definition at line 20 of file [Engine.hpp](#).

6.11.2 Constructor & Destructor Documentation

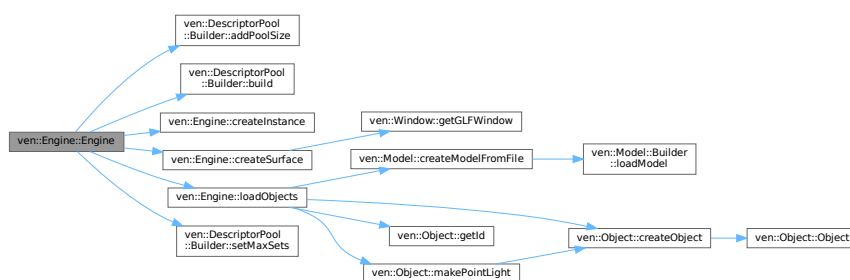
6.11.2.1 Engine() [1/2]

```
ven::Engine::Engine (
    uint32_t width = DEFAULT\_WIDTH,
    uint32_t height = DEFAULT\_HEIGHT,
    const std::string & title = DEFAULT\_TITLE.data()) [explicit]
```

Definition at line 59 of file [engine.cpp](#).

References [ven::DescriptorPool::Builder::addPoolSize\(\)](#), [ven::DescriptorPool::Builder::build\(\)](#), [createInstance\(\)](#), [createSurface\(\)](#), [loadObjects\(\)](#), [m_device](#), [m_globalPool](#), [ven::SwapChain::MAX_FRAMES_IN_FLIGHT](#), and [ven::DescriptorPool::Builder::setMaxSets\(\)](#).

Here is the call graph for this function:



6.11.2.2 ~Engine()

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

6.11.2.3 Engine() [2/2]

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

6.11.3 Member Function Documentation

6.11.3.1 createInstance()

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

Definition at line 133 of file [engine.cpp](#).

Referenced by [Engine\(\)](#).

Here is the caller graph for this function:



6.11.3.2 createSurface()

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

Definition at line 49 of file [Engine.hpp](#).

References [ven::Window::getGLFWWindow\(\)](#), [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:



6.11.3.3 getWindow()

`Window & ven::Engine::getWindow () [inline]`

Definition at line 30 of file [Engine.hpp](#).

References [m_window](#).

6.11.3.4 loadObjects()

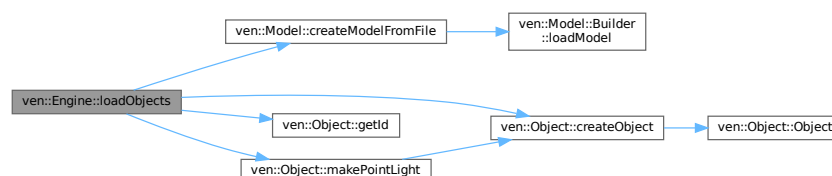
`void ven::Engine::loadObjects () [private]`

Definition at line 16 of file [engine.cpp](#).

References [ven::Object::color](#), [ven::Model::createModelFromFile\(\)](#), [ven::Object::createObject\(\)](#), [ven::Object::getId\(\)](#), [m_device](#), [m_objects](#), [ven::Object::makePointLight\(\)](#), [ven::Object::model](#), [ven::Transform3DComponent::scale](#), [ven::Object::transform3D](#), and [ven::Transform3DComponent::translation](#).

Referenced by [Engine\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.11.3.5 mainLoop()

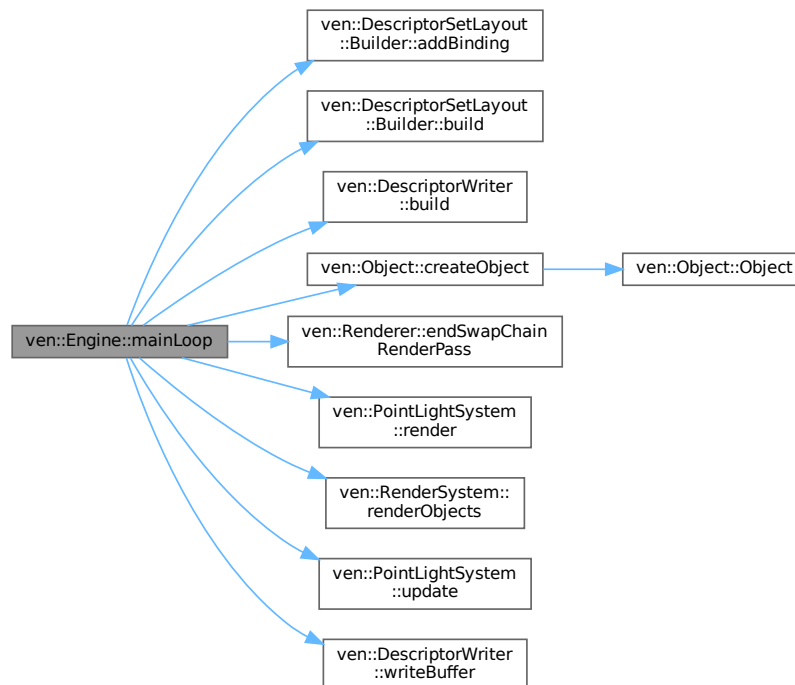
```
void ven::Engine::mainLoop ()
```

Definition at line 67 of file [engine.cpp](#).

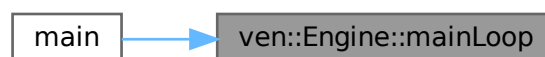
References [ven::DescriptorSetLayout::Builder::addBinding\(\)](#), [ven::DescriptorSetLayout::Builder::build\(\)](#), [ven::DescriptorWriter::build\(\)](#), [ven::Object::createObject\(\)](#), [ven::Renderer::endSwapChainRenderPass\(\)](#), [ven::SwapChain::MAX_FRAMES_IN_FLIGHT](#), [ven::PointLightSystem::render\(\)](#), [ven::RenderSystem::renderObjects\(\)](#), [ven::Transform3DComponent::rotation](#), [ven::Object::transform3D](#), [ven::Transform3DComponent::translation](#), [ven::PointLightSystem::update\(\)](#), and [ven::DescriptorWriter::writeBuffer\(\)](#).

Referenced by [main\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.11.3.6 operator=()

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

6.11.4 Member Data Documentation

6.11.4.1 m_device

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

Definition at line 39 of file [Engine.hpp](#).

Referenced by [Engine\(\)](#), and [loadObjects\(\)](#).

6.11.4.2 m_globalPool

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

Definition at line 42 of file [Engine.hpp](#).

Referenced by [Engine\(\)](#).

6.11.4.3 m_instance

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

Definition at line 45 of file [Engine.hpp](#).

Referenced by [createSurface\(\)](#).

6.11.4.4 m_objects

```
Object::Map ven::Engine::m_objects [private]
```

Definition at line 43 of file [Engine.hpp](#).

Referenced by [loadObjects\(\)](#).

6.11.4.5 m_renderer

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

Definition at line 40 of file [Engine.hpp](#).

6.11.4.6 m_surface

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

Definition at line 46 of file [Engine.hpp](#).

Referenced by [createSurface\(\)](#).

6.11.4.7 m_window

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

Definition at line 38 of file [Engine.hpp](#).

Referenced by [createSurface\(\)](#), and [getWindow\(\)](#).

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](#)

6.12 ven::FrameCounter Class Reference

```
#include <FrameCounter.hpp>
```

Collaboration diagram for ven::FrameCounter:

| ven::FrameCounter |
|---|
| <ul style="list-style-type: none">- m_fps- m_frameTime- m_frameCounter- m_timeCounter |
| <ul style="list-style-type: none">+ FrameCounter()+ ~FrameCounter()+ update()+ getFps()+ getFrameTime() |

Public Member Functions

- [FrameCounter](#) ()=default
- [~FrameCounter](#) ()=default
- void [update](#) (const float deltaTime)
- float [getFps](#) () const
- float [getFrameTime](#) () const

Private Attributes

- float [m_fps](#) {0.F}
- float [m_frameTime](#) {0.F}
- float [m_frameCounter](#) {0.F}
- float [m_timeCounter](#) {0.F}

6.12.1 Detailed Description

Definition at line 13 of file [FrameCounter.hpp](#).

6.12.2 Constructor & Destructor Documentation

6.12.2.1 FrameCounter()

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

6.12.2.2 ~FrameCounter()

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

6.12.3 Member Function Documentation

6.12.3.1 getFps()

```
float ven::FrameCounter::getFps () const [inline], [nodiscard]
```

Definition at line 33 of file [FrameCounter.hpp](#).

References [m_fps](#).

6.12.3.2 getFrameTime()

```
float ven::FrameCounter::getFrameTime () const [inline], [nodiscard]
```

Definition at line 34 of file [FrameCounter.hpp](#).

References [m_frameTime](#).

6.12.3.3 update()

```
void ven::FrameCounter::update (  
    const float deltaTime) [inline]
```

Definition at line 20 of file [FrameCounter.hpp](#).

References [m_fps](#), [m_frameCounter](#), [m_frameTime](#), and [m_timeCounter](#).

6.12.4 Member Data Documentation

6.12.4.1 m_fps

```
float ven::FrameCounter::m_fps {0.F} [private]
```

Definition at line 38 of file [FrameCounter.hpp](#).

Referenced by [getFps\(\)](#), and [update\(\)](#).

6.12.4.2 m_frameCounter

```
float ven::FrameCounter::m_frameCounter {0.F} [private]
```

Definition at line 40 of file [FrameCounter.hpp](#).

Referenced by [update\(\)](#).

6.12.4.3 m_frameTime

```
float ven::FrameCounter::m_frameTime {0.F} [private]
```

Definition at line 39 of file [FrameCounter.hpp](#).

Referenced by [getFrameTime\(\)](#), and [update\(\)](#).

6.12.4.4 m_timeCounter

```
float ven::FrameCounter::m_timeCounter {0.F} [private]
```

Definition at line 41 of file [FrameCounter.hpp](#).

Referenced by [update\(\)](#).

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

- [/home/runner/work/VEngine/VEngine/include/VEngine/FrameCounter.hpp](#)

- float [frameTime](#)
- VkCommandBuffer [commandBuffer](#)
- [Camera](#) & [camera](#)
- VkDescriptorSet [globalDescriptorSet](#)
- [Object::Map](#) & [objects](#)

6.13.1 Detailed Description

Definition at line 34 of file [FrameInfo.hpp](#).

6.13.2 Member Data Documentation

6.13.2.1 camera

```
Camera& ven::FrameInfo::camera
```

Definition at line 39 of file [FrameInfo.hpp](#).

6.13.2.2 commandBuffer

```
VkCommandBuffer ven::FrameInfo::commandBuffer
```

Definition at line 38 of file [FrameInfo.hpp](#).

Referenced by [ven::PointLightSystem::render\(\)](#), and [ven::RenderSystem::renderObjects\(\)](#).

6.13.2.3 frameIndex

```
int ven::FrameInfo::frameIndex
```

Definition at line 36 of file [FrameInfo.hpp](#).

6.13.2.4 frameTime

```
float ven::FrameInfo::frameTime
```

Definition at line 37 of file [FrameInfo.hpp](#).

Referenced by [ven::PointLightSystem::update\(\)](#).

6.13.2.5 globalDescriptorSet

```
VkDescriptorSet ven::FrameInfo::globalDescriptorSet
```

Definition at line 40 of file [FrameInfo.hpp](#).

Referenced by [ven::PointLightSystem::render\(\)](#), and [ven::RenderSystem::renderObjects\(\)](#).

6.13.2.6 objects

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

Definition at line 41 of file [FrameInfo.hpp](#).

Referenced by [ven::PointLightSystem::render\(\)](#), [ven::RenderSystem::renderObjects\(\)](#), and [ven::PointLightSystem::update\(\)](#).

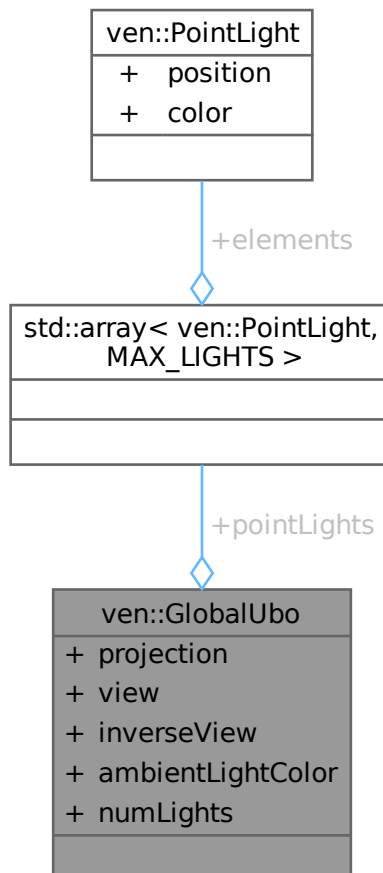
The documentation for this struct was generated from the following file:

- [/home/runner/work/VEngine/VEngine/include/VEngine/FrameInfo.hpp](#)

6.14 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](#) {1.F, 1.F, 1.F, .02F}
- std::array< [PointLight](#), MAX_LIGHTS > [pointLights](#)
- int [numLights](#)

6.14.1 Detailed Description

Definition at line 24 of file [FrameInfo.hpp](#).

6.14.2 Member Data Documentation

6.14.2.1 ambientLightColor

```
glm::vec4 ven::GlobalUbo::ambientLightColor {1.F, 1.F, 1.F, .02F}
```

Definition at line 29 of file [FrameInfo.hpp](#).

6.14.2.2 inverseView

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

Definition at line 28 of file [FrameInfo.hpp](#).

6.14.2.3 numLights

```
int ven::GlobalUbo::numLights
```

Definition at line 31 of file [FrameInfo.hpp](#).

Referenced by [ven::PointLightSystem::update\(\)](#).

6.14.2.4 pointLights

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

Definition at line 30 of file [FrameInfo.hpp](#).

Referenced by [ven::PointLightSystem::update\(\)](#).

6.14.2.5 projection

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

Definition at line 26 of file [FrameInfo.hpp](#).

6.14.2.6 view

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

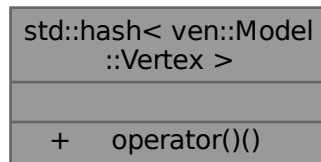
Definition at line 27 of file [FrameInfo.hpp](#).

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

- [/home/runner/work/VEngine/VEngine/include/VEngine/FrameInfo.hpp](#)

6.15 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`

6.15.1 Detailed Description

Definition at line 16 of file [model.cpp](#).

6.15.2 Member Function Documentation

6.15.2.1 operator()()

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

Definition at line 17 of file [model.cpp](#).

References [ven::Model::Vertex::color](#), [ven::hashCombine\(\)](#), [ven::Model::Vertex::normal](#), [ven::Model::Vertex::position](#), and [ven::Model::Vertex::uv](#).

Here is the call graph for this function:



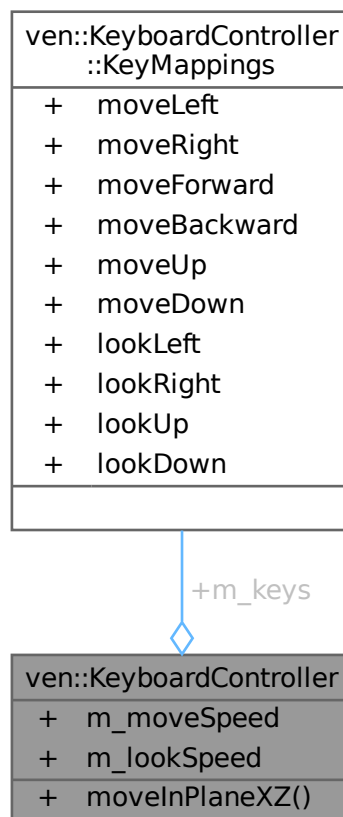
The documentation for this struct was generated from the following file:

- [/home/runner/work/VEngine/VEngine/src/model.cpp](#)

6.16 ven::KeyboardController Class Reference

```
#include <KeyboardController.hpp>
```

Collaboration diagram for ven::KeyboardController:



Classes

- struct [KeyMappings](#)

Public Member Functions

- void [moveInPlaneXZ](#) (GLFWwindow *window, float dt, [Object](#) &object) const

Public Attributes

- [KeyMappings](#) m_keys {}
- float [m_moveSpeed](#) {3.F}
- float [m_lookSpeed](#) {1.5F}

6.16.1 Detailed Description

Definition at line 14 of file [KeyboardController.hpp](#).

6.16.2 Member Function Documentation

6.16.2.1 moveInPlaneXZ()

```
void ven::KeyboardController::moveInPlaneXZ (
    GLFWwindow * window,
    float dt,
    Object & object) const
```

Definition at line 5 of file [keyboardController.cpp](#).

References [ven::KeyboardController::KeyMappings::lookDown](#), [ven::KeyboardController::KeyMappings::lookLeft](#), [ven::KeyboardController::KeyMappings::lookRight](#), [ven::KeyboardController::KeyMappings::lookUp](#), [m_keys](#), [m_lookSpeed](#), [m_moveSpeed](#), [ven::KeyboardController::KeyMappings::moveBackward](#), [ven::KeyboardController::KeyMappings::moveForward](#), [ven::KeyboardController::KeyMappings::moveLeft](#), [ven::KeyboardController::KeyMappings::moveUp](#), and [ven::KeyboardController::KeyMappings::moveUp](#).

6.16.3 Member Data Documentation

6.16.3.1 m_keys

```
KeyMappings ven::KeyboardController::m_keys {}
```

Definition at line 33 of file [KeyboardController.hpp](#).

Referenced by [moveInPlaneXZ\(\)](#).

6.16.3.2 m_lookSpeed

```
float ven::KeyboardController::m_lookSpeed {1.5F}
```

Definition at line 35 of file [KeyboardController.hpp](#).

Referenced by [moveInPlaneXZ\(\)](#).

6.16.3.3 m_moveSpeed

```
float ven::KeyboardController::m_moveSpeed {3.F}
```

Definition at line 34 of file [KeyboardController.hpp](#).

Referenced by [moveInPlaneXZ\(\)](#).

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

- [/home/runner/work/VEngine/VEngine/include/VEngine/KeyboardController.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/keyboardController.cpp](#)

6.17 ven::KeyboardController::KeyMappings Struct Reference

```
#include <KeyboardController.hpp>
```

Collaboration diagram for ven::KeyboardController::KeyMappings:

| ven::KeyboardController ::KeyMappings | |
|--|--------------|
| + | moveLeft |
| + | moveRight |
| + | moveForward |
| + | moveBackward |
| + | moveUp |
| + | moveDown |
| + | lookLeft |
| + | lookRight |
| + | lookUp |
| + | lookDown |
| | |

Public Attributes

- int [moveLeft](#) = GLFW_KEY_A
- int [moveRight](#) = GLFW_KEY_D
- int [moveForward](#) = GLFW_KEY_W
- int [moveBackward](#) = GLFW_KEY_S
- int [moveUp](#) = GLFW_KEY_SPACE
- int [moveDown](#) = GLFW_KEY_LEFT_SHIFT
- int [lookLeft](#) = GLFW_KEY_LEFT
- int [lookRight](#) = GLFW_KEY_RIGHT
- int [lookUp](#) = GLFW_KEY_UP
- int [lookDown](#) = GLFW_KEY_DOWN

6.17.1 Detailed Description

Definition at line 18 of file [KeyboardController.hpp](#).

6.17.2 Member Data Documentation

6.17.2.1 lookDown

```
int ven::KeyboardController::KeyMappings::lookDown = GLFW_KEY_DOWN
```

Definition at line 28 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.2 lookLeft

```
int ven::KeyboardController::KeyMappings::lookLeft = GLFW_KEY_LEFT
```

Definition at line 25 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.3 lookRight

```
int ven::KeyboardController::KeyMappings::lookRight = GLFW_KEY_RIGHT
```

Definition at line 26 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.4 lookUp

```
int ven::KeyboardController::KeyMappings::lookUp = GLFW_KEY_UP
```

Definition at line 27 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.5 moveBackward

```
int ven::KeyboardController::KeyMappings::moveBackward = GLFW_KEY_S
```

Definition at line 22 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.6 moveDown

```
int ven::KeyboardController::KeyMappings::moveDown = GLFW_KEY_LEFT_SHIFT
```

Definition at line 24 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.7 moveForward

```
int ven::KeyboardController::KeyMappings::moveForward = GLFW_KEY_W
```

Definition at line 21 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.8 moveLeft

```
int ven::KeyboardController::KeyMappings::moveLeft = GLFW_KEY_A
```

Definition at line 19 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.9 moveRight

```
int ven::KeyboardController::KeyMappings::moveRight = GLFW_KEY_D
```

Definition at line 20 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

6.17.2.10 moveUp

```
int ven::KeyboardController::KeyMappings::moveUp = GLFW_KEY_SPACE
```

Definition at line 23 of file [KeyboardController.hpp](#).

Referenced by [ven::KeyboardController::moveInPlaneXZ\(\)](#).

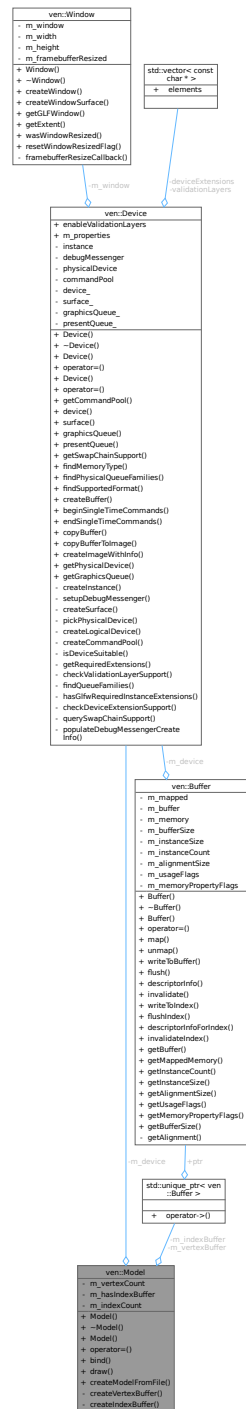
The documentation for this struct was generated from the following file:

- [/home/runner/work/VEngine/VEngine/include/VEngine/KeyboardController.hpp](#)

6.18 ven::Model Class Reference

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

Collaboration diagram for ven::Model:



Classes

- struct [Builder](#)
- struct [Vertex](#)

Public Member Functions

- [Model](#) ([Device](#) &device, const [Builder](#) &builder)
- [~Model](#) ()
- [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](#)

6.18.1 Detailed Description

Definition at line 16 of file [Model.hpp](#).

6.18.2 Constructor & Destructor Documentation

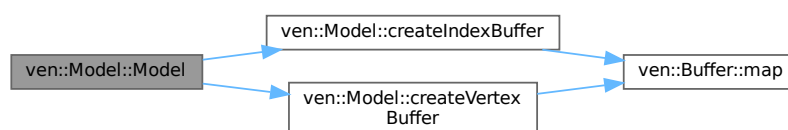
6.18.2.1 [Model](#)() [1/2]

```
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:



6.18.2.2 ~Model()

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

6.18.2.3 Model() [2/2]

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

6.18.3 Member Function Documentation

6.18.3.1 bind()

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

Definition at line 81 of file [model.cpp](#).

6.18.3.2 createIndexBuffer()

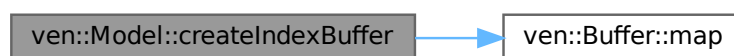
```
void ven::Model::createIndexBuffer (
    const std::vector< uint32_t > & indices) [private]
```

Definition at line 50 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:



6.18.3.3 createModelFromFile()

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

Definition at line 92 of file [model.cpp](#).

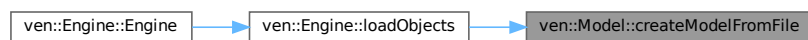
References [ven::Model::Builder::loadModel\(\)](#).

Referenced by [ven::Engine::loadObjects\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.18.3.4 createVertexBuffer()

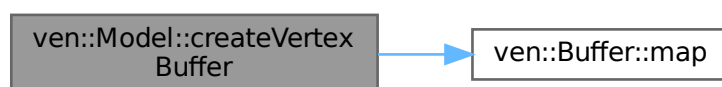
```
void ven::Model::createVertexBuffer (
    const std::vector< Vertex > & vertices) [private]
```

Definition at line 33 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:



6.18.3.5 draw()

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

Definition at line 72 of file [model.cpp](#).

6.18.3.6 operator=()

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

6.18.4 Member Data Documentation

6.18.4.1 m_device

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

Definition at line 57 of file [Model.hpp](#).

6.18.4.2 m_hasIndexBuffer

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

Definition at line 61 of file [Model.hpp](#).

6.18.4.3 m_indexBuffer

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

Definition at line 62 of file [Model.hpp](#).

6.18.4.4 m_indexCount

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

Definition at line 63 of file [Model.hpp](#).

6.18.4.5 m_vertexBuffer

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

Definition at line 58 of file [Model.hpp](#).

6.18.4.6 m_vertexCount

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

Definition at line 59 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](#)

6.19 ven::Object Class Reference

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


- `Object` (const `Object` &)=delete
- `Object` & `operator=` (const `Object` &)=delete
- `Object` (`Object` &&)=default
- `Object` & `operator=` (`Object` &&)=default
- `id_t` `getId` () const

Static Public Member Functions

- static `Object` `createObject` ()
- static `Object` `makePointLight` (float intensity=10.F, float radius=0.1F, glm::vec3 `color`=glm::vec3(1.F))

Public Attributes

- std::shared_ptr< `Model` > `model` {}
- glm::vec3 `color` {}
- `Transform3DComponent` `transform3D` {}
- std::unique_ptr< `PointLightComponent` > `pointLight` = nullptr

Private Member Functions

- `Object` (const `id_t` objId)

Private Attributes

- `id_t` `m_objId`

6.19.1 Detailed Description

Definition at line 33 of file `Object.hpp`.

6.19.2 Member Typedef Documentation

6.19.2.1 Map

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

Definition at line 37 of file `Object.hpp`.

6.19.3 Constructor & Destructor Documentation

6.19.3.1 ~Object()

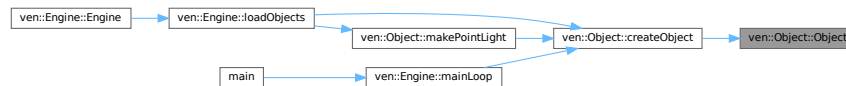
```
ven::Object::~Object () [default]
```

6.19.3.2 `Object()` [1/3]

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

Referenced by [createObject\(\)](#).

Here is the caller graph for this function:



6.19.3.3 `Object()` [2/3]

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

6.19.3.4 `Object()` [3/3]

```
ven::Object::Object (
    const id_t objId) [inline], [explicit], [private]
```

Definition at line 60 of file [Object.hpp](#).

6.19.4 Member Function Documentation

6.19.4.1 `createObject()`

```
static Object ven::Object::createObject () [inline], [static]
```

Definition at line 40 of file [Object.hpp](#).

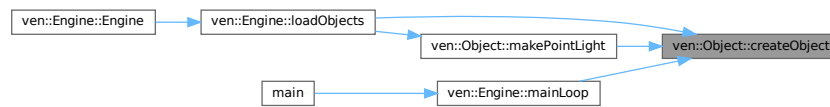
References [Object\(\)](#).

Referenced by [ven::Engine::loadObjects\(\)](#), [ven::Engine::mainLoop\(\)](#), and [makePointLight\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.19.4.2 getId()

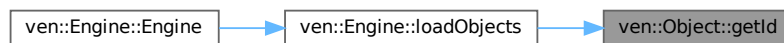
```
id_t ven::Object::getId () const [inline], [nodiscard]
```

Definition at line 51 of file [Object.hpp](#).

References [m_objId](#).

Referenced by [ven::Engine::loadObjects\(\)](#).

Here is the caller graph for this function:



6.19.4.3 makePointLight()

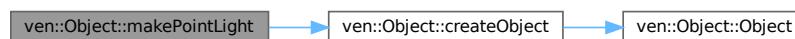
```
ven::Object ven::Object::makePointLight (
    float intensity = 10.F,
    float radius = 0.1F,
    glm::vec3 color = glm::vec3(1.F)) [static]
```

Definition at line 67 of file [object.cpp](#).

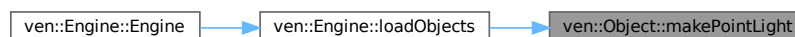
References [color](#), [createObject\(\)](#), [pointLight](#), [ven::Transform3DComponent::scale](#), and [transform3D](#).

Referenced by [ven::Engine::loadObjects\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.19.4.4 operator=() [1/2]

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

6.19.4.5 operator=() [2/2]

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

6.19.5 Member Data Documentation

6.19.5.1 color

```
glm::vec3 ven::Object::color {}
```

Definition at line 54 of file [Object.hpp](#).

Referenced by [ven::Engine::loadObjects\(\)](#), and [makePointLight\(\)](#).

6.19.5.2 m_objId

```
id_t ven::Object::m_objId [private]
```

Definition at line 62 of file [Object.hpp](#).

Referenced by [getId\(\)](#).

6.19.5.3 model

```
std::shared_ptr<Model> ven::Object::model {}
```

Definition at line 53 of file [Object.hpp](#).

Referenced by [ven::Engine::loadObjects\(\)](#).

6.19.5.4 pointLight

```
std::unique_ptr<PointLightComponent> ven::Object::pointLight = nullptr
```

Definition at line 57 of file [Object.hpp](#).

Referenced by [makePointLight\(\)](#).

6.19.5.5 transform3D

`Transform3DComponent` `ven::Object::transform3D {}`

Definition at line 55 of file [Object.hpp](#).

Referenced by [ven::Engine::loadObjects\(\)](#), [ven::Engine::mainLoop\(\)](#), and [makePointLight\(\)](#).

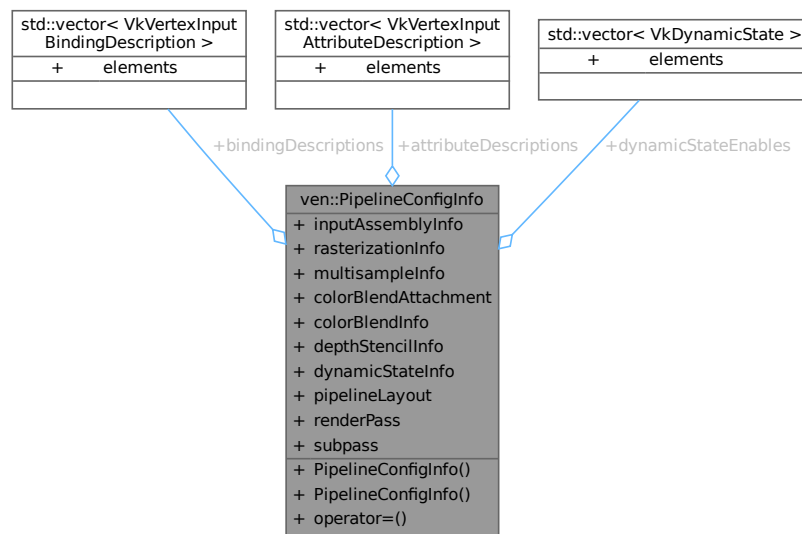
The documentation for this class was generated from the following files:

- [/home/runner/work/VEngine/VEngine/include/VEngine/Object.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/object.cpp](#)

6.20 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

6.20.1 Detailed Description

Definition at line 19 of file [Shaders.hpp](#).

6.20.2 Constructor & Destructor Documentation

6.20.2.1 PipelineConfigInfo() [1/2]

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

6.20.2.2 PipelineConfigInfo() [2/2]

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

6.20.3 Member Function Documentation

6.20.3.1 operator=()

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

6.20.4 Member Data Documentation

6.20.4.1 attributeDescriptions

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

Definition at line 25 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#), and [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.2 bindingDescriptions

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

Definition at line 24 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#), and [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.3 colorBlendAttachment

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

Definition at line 29 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.4 colorBlendInfo

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

Definition at line 30 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#), and [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.5 depthStencilInfo

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

Definition at line 31 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#), and [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.6 dynamicStateEnables

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

Definition at line 32 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.7 dynamicStateInfo

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

Definition at line 33 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#), and [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.8 inputAssemblyInfo

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

Definition at line 26 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#), and [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.9 multisampleInfo

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

Definition at line 28 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#), and [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.10 pipelineLayout

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

Definition at line 34 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#).

6.20.4.11 rasterizationInfo

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

Definition at line 27 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#), and [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

6.20.4.12 renderPass

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

Definition at line 35 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#).

6.20.4.13 subpass

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

Definition at line 36 of file [Shaders.hpp](#).

Referenced by [ven::Shaders::createGraphicsPipeline\(\)](#).

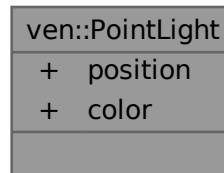
The documentation for this struct was generated from the following file:

- [/home/runner/work/VEngine/VEngine/include/VEngine/Shaders.hpp](#)

6.21 ven::PointLight Struct Reference

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

Collaboration diagram for ven::PointLight:



Public Attributes

- glm::vec4 [position](#) {}
- glm::vec4 [color](#) {}

6.21.1 Detailed Description

Definition at line [18](#) of file [FrameInfo.hpp](#).

6.21.2 Member Data Documentation

6.21.2.1 color

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

Definition at line [21](#) of file [FrameInfo.hpp](#).

6.21.2.2 position

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

Definition at line [20](#) of file [FrameInfo.hpp](#).

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

- [/home/runner/work/VEngine/VEngine/include/VEngine/FrameInfo.hpp](#)

6.22 ven::PointLightComponent Struct Reference

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

Collaboration diagram for ven::PointLightComponent:

| ven::PointLightComponent | |
|--------------------------|----------------|
| + | lightIntensity |
| | |

Public Attributes

- float [lightIntensity](#) = 1.0F

6.22.1 Detailed Description

Definition at line 29 of file [Object.hpp](#).

6.22.2 Member Data Documentation

6.22.2.1 lightIntensity

```
float ven::PointLightComponent::lightIntensity = 1.0F
```

Definition at line 30 of file [Object.hpp](#).

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

- [/home/runner/work/VEngine/VEngine/include/VEngine/Object.hpp](#)

6.23 PointLightPushConstants Struct Reference

Collaboration diagram for PointLightPushConstants:

| PointLightPushConstants | |
|-------------------------|----------|
| + | position |
| + | color |
| + | radius |
| | |

Public Attributes

- glm::vec4 [position](#) {}
- glm::vec4 [color](#) {}
- float [radius](#)

6.23.1 Detailed Description

Definition at line 9 of file [pointLightSystem.cpp](#).

6.23.2 Member Data Documentation

6.23.2.1 color

```
glm::vec4 PointLightPushConstants::color {}
```

Definition at line 11 of file [pointLightSystem.cpp](#).

6.23.2.2 position

```
glm::vec4 PointLightPushConstants::position {}
```

Definition at line 10 of file [pointLightSystem.cpp](#).

Referenced by [ven::PointLightSystem::render\(\)](#).

6.23.2.3 radius

```
float PointLightPushConstants::radius
```

Definition at line 12 of file [pointLightSystem.cpp](#).

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

- [/home/runner/work/VEngine/VEngine/src/system/pointLightSystem.cpp](#)

6.24 ven::PointLightSystem Class Reference

Class for point light system.

```
#include <PointLightSystem.hpp>
```

Collaboration diagram for ven::PointLightSystem:



Public Member Functions

- [PointLightSystem](#) ([Device](#) &device, [VkRenderPass](#) renderPass, [VkDescriptorSetLayout](#) globalSetLayout)
- [~PointLightSystem](#) ()
- [PointLightSystem](#) (const [PointLightSystem](#) &)=delete
- [PointLightSystem](#) & [operator=](#) (const [PointLightSystem](#) &)=delete
- void [render](#) (const [FrameInfo](#) &frameInfo) const

Static Public Member Functions

- static void [update](#) (const [FrameInfo](#) &frameInfo, [GlobalUbo](#) &ubo)

Private Member Functions

- void [createPipelineLayout](#) ([VkDescriptorSetLayout](#) globalSetLayout)
- void [createPipeline](#) ([VkRenderPass](#) renderPass)

Private Attributes

- [Device](#) & [m_device](#)
- [std::unique_ptr< Shaders >](#) [m_shaders](#)
- [VkPipelineLayout](#) [m_pipelineLayout](#) {nullptr}

6.24.1 Detailed Description

Class for point light system.

Definition at line 22 of file [PointLightSystem.hpp](#).

6.24.2 Constructor & Destructor Documentation

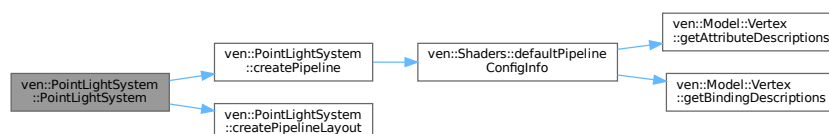
6.24.2.1 PointLightSystem() [1/2]

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

Definition at line 15 of file [pointLightSystem.cpp](#).

References [createPipeline\(\)](#), and [createPipelineLayout\(\)](#).

Here is the call graph for this function:



6.24.2.2 ~PointLightSystem()

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

Definition at line 27 of file [PointLightSystem.hpp](#).

References [ven::Device::device\(\)](#), [m_device](#), and [m_pipelineLayout](#).

Here is the call graph for this function:



6.24.2.3 PointLightSystem() [2/2]

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

6.24.3 Member Function Documentation

6.24.3.1 createPipeline()

```
void ven::PointLightSystem::createPipeline (
    VkRenderPass renderPass) [private]
```

Definition at line 42 of file [pointLightSystem.cpp](#).

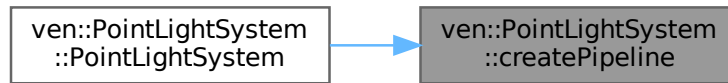
References [ven::Shaders::defaultPipelineConfigInfo\(\)](#), and [ven::SHADERS_BIN_PATH](#).

Referenced by [PointLightSystem\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



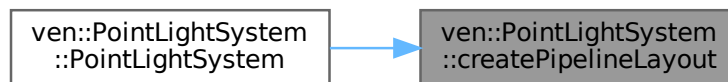
6.24.3.2 createPipelineLayout()

```
void ven::PointLightSystem::createPipelineLayout (
    VkDescriptorSetLayout globalSetLayout) [private]
```

Definition at line 21 of file [pointLightSystem.cpp](#).

Referenced by [PointLightSystem\(\)](#).

Here is the caller graph for this function:



6.24.3.3 operator=()

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

6.24.3.4 render()

```
void ven::PointLightSystem::render (
    const FrameInfo & frameInfo) const
```

Definition at line 53 of file [pointLightSystem.cpp](#).

References [ven::FrameInfo::commandBuffer](#), [ven::FrameInfo::globalDescriptorSet](#), [ven::FrameInfo::objects](#), and [PointLightPushConstants::position](#).

Referenced by [ven::Engine::mainLoop\(\)](#).

Here is the caller graph for this function:



6.24.3.5 update()

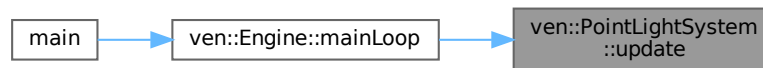
```
void ven::PointLightSystem::update (
    const FrameInfo & frameInfo,
    GlobalUbo & ubo) [static]
```

Definition at line 73 of file [pointLightSystem.cpp](#).

References [ven::FrameInfo::frameTime](#), [ven::MAX_LIGHTS](#), [ven::GlobalUbo::numLights](#), [ven::FrameInfo::objects](#), and [ven::GlobalUbo::pointLights](#).

Referenced by [ven::Engine::mainLoop\(\)](#).

Here is the caller graph for this function:



6.24.4 Member Data Documentation

6.24.4.1 m_device

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

Definition at line 40 of file [PointLightSystem.hpp](#).

Referenced by [~PointLightSystem\(\)](#).

6.24.4.2 m_pipelineLayout

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

Definition at line 43 of file [PointLightSystem.hpp](#).

Referenced by [~PointLightSystem\(\)](#).

6.24.4.3 m_shaders

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

Definition at line 42 of file [PointLightSystem.hpp](#).

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

- /home/runner/work/VEngine/VEngine/include/VEngine/System/[PointLightSystem.hpp](#)
- /home/runner/work/VEngine/VEngine/src/system/[pointLightSystem.cpp](#)

6.25 ven::QueueFamilyIndices Struct Reference

```
#include <Device.hpp>
```

Collaboration diagram for ven::QueueFamilyIndices:

| ven::QueueFamilyIndices |
|--------------------------|
| + graphicsFamily |
| + presentFamily |
| + graphicsFamilyHasValue |
| + presentFamilyHasValue |
| + isComplete() |

Public Member Functions

- bool [isComplete](#) () const

Public Attributes

- uint32_t [graphicsFamily](#) {}
- uint32_t [presentFamily](#) {}
- bool [graphicsFamilyHasValue](#) = false
- bool [presentFamilyHasValue](#) = false

6.25.1 Detailed Description

Definition at line 21 of file [Device.hpp](#).

6.25.2 Member Function Documentation

6.25.2.1 isComplete()

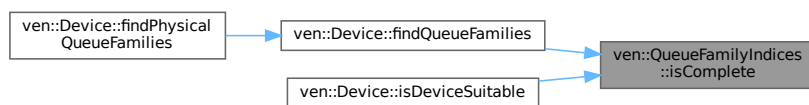
```
bool ven::QueueFamilyIndices::isComplete () const [inline], [nodiscard]
```

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:



6.25.3 Member Data Documentation

6.25.3.1 graphicsFamily

```
uint32_t ven::QueueFamilyIndices::graphicsFamily {}
```

Definition at line 22 of file [Device.hpp](#).

Referenced by [ven::Device::createCommandPool\(\)](#), [ven::Device::createLogicalDevice\(\)](#), [ven::SwapChain::createSwapChain\(\)](#), and [ven::Device::findQueueFamilies\(\)](#).

6.25.3.2 graphicsFamilyHasValue

```
bool ven::QueueFamilyIndices::graphicsFamilyHasValue = false
```

Definition at line 24 of file [Device.hpp](#).

Referenced by [ven::Device::findQueueFamilies\(\)](#), and [isComplete\(\)](#).

6.25.3.3 presentFamily

```
uint32_t ven::QueueFamilyIndices::presentFamily {}
```

Definition at line 23 of file [Device.hpp](#).

Referenced by [ven::Device::createLogicalDevice\(\)](#), [ven::SwapChain::createSwapChain\(\)](#), and [ven::Device::findQueueFamilies\(\)](#).

6.25.3.4 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:

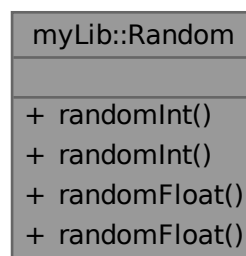
- [/home/runner/work/VEngine/VEngine/include/VEngine/Device.hpp](#)

6.26 myLib::Random Class Reference

Class for random number generation.

```
#include <Random.hpp>
```

Collaboration diagram for myLib::Random:



Static Public Member Functions

- static int [randomInt](#) (int min, int max)
Generate a random integer between min and max.
- static int [randomInt](#) ()
- static float [randomFloat](#) (float min, float max)
- static float [randomFloat](#) ()

6.26.1 Detailed Description

Class for random number generation.

Definition at line 17 of file [Random.hpp](#).

6.26.2 Member Function Documentation

6.26.2.1 randomFloat() [1/2]

```
static float myLib::Random::randomFloat () [inline], [static]
```

Definition at line 36 of file [Random.hpp](#).

References [randomFloat\(\)](#).

Referenced by [randomFloat\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.26.2.2 randomFloat() [2/2]

```
float myLib::Random::randomFloat (  
    float min,  
    float max) [static]
```

Parameters

| | |
|------------|-------------------|
| <i>min</i> | The minimum value |
| <i>max</i> | The maximum value |

Returns

float The random float

Definition at line 10 of file [random.cpp](#).

6.26.2.3 `randomInt()` [1/2]

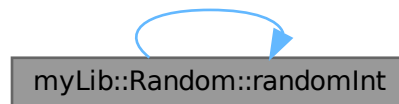
```
static int myLib::Random::randomInt () [inline], [static]
```

Definition at line 28 of file [Random.hpp](#).

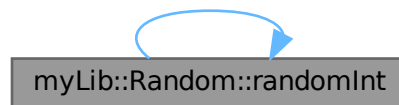
References [randomInt\(\)](#).

Referenced by [randomInt\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:

**6.26.2.4** `randomInt()` [2/2]

```
int myLib::Random::randomInt (
    int min,
    int max) [static]
```

Generate a random integer between min and max.

Parameters

| | |
|------------|-------------------|
| <i>min</i> | The minimum value |
| <i>max</i> | The maximum value |

Returns

int The random integer

Definition at line 3 of file [random.cpp](#).

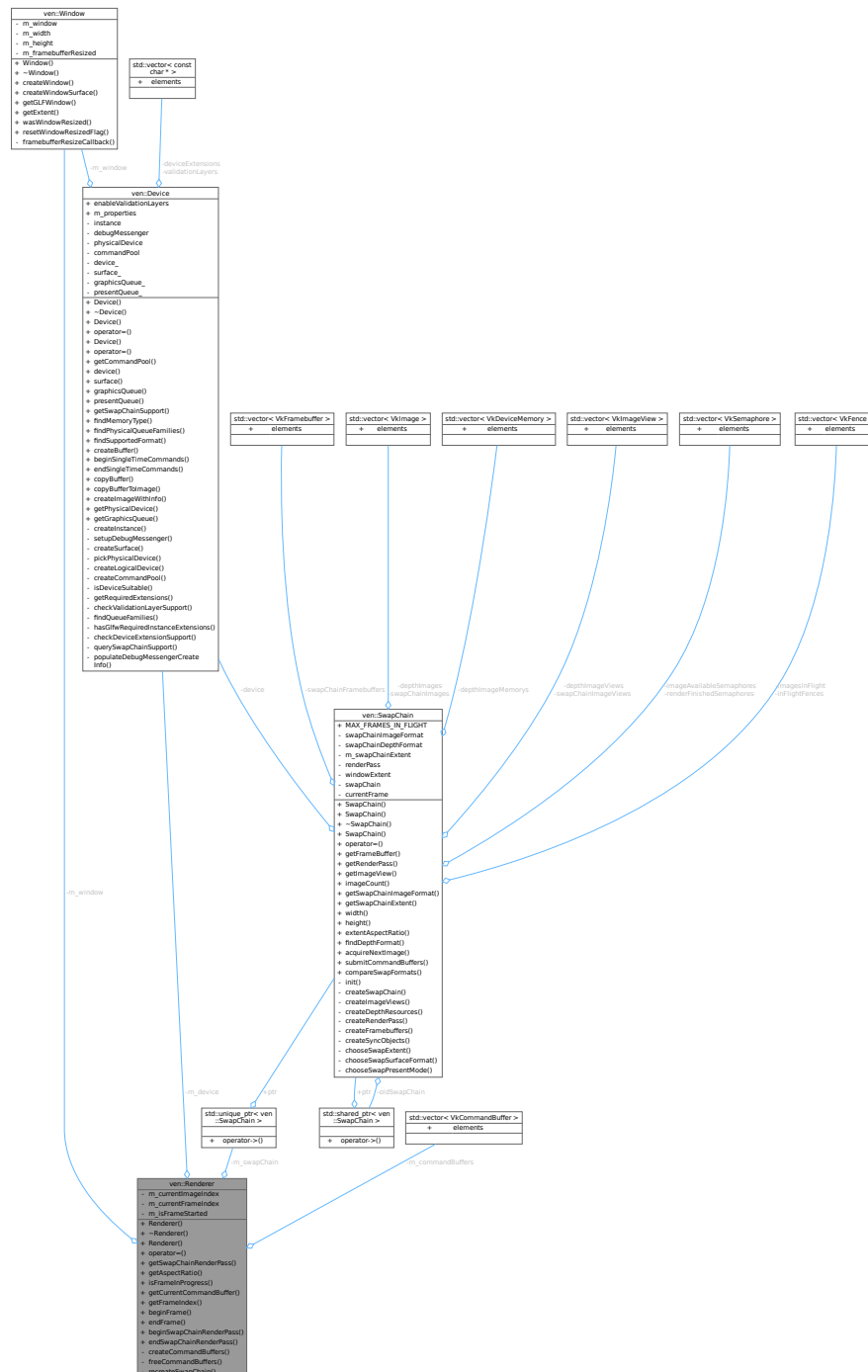
The documentation for this class was generated from the following files:

- `/home/runner/work/VEngine/VEngine/lib/local/static/myLib/include/myLib/Random.hpp`
- `/home/runner/work/VEngine/VEngine/lib/local/static/myLib/src/random.cpp`

6.27 ven::Renderer Class Reference

```
#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
- int [getFrameIndex](#) () const
- [VkCommandBuffer](#) [beginFrame](#) ()
- void [endFrame](#) ()
- void [beginSwapChainRenderPass](#) ([VkCommandBuffer](#) commandBuffer) const

Static Public Member Functions

- static void [endSwapChainRenderPass](#) ([VkCommandBuffer](#) commandBuffer)

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](#)
- uint32_t [m_currentImageIndex](#) {0}
- int [m_currentFrameIndex](#) {0}
- bool [m_isFrameStarted](#) {false}

6.27.1 Detailed Description

Definition at line 20 of file [Renderer.hpp](#).

6.27.2 Constructor & Destructor Documentation

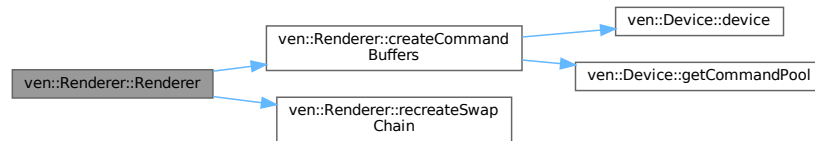
6.27.2.1 [Renderer\(\)](#) [1/2]

```
ven::Renderer::Renderer (
    Window & window,
    Device & device) [inline]
```

Definition at line 24 of file [Renderer.hpp](#).

References [createCommandBuffers\(\)](#), and [recreateSwapChain\(\)](#).

Here is the call graph for this function:



6.27.2.2 ~Renderer()

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

Definition at line 25 of file [Renderer.hpp](#).

References [freeCommandBuffers\(\)](#).

Here is the call graph for this function:



6.27.2.3 Renderer() [2/2]

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

6.27.3 Member Function Documentation

6.27.3.1 beginFrame()

```
VkCommandBuffer ven::Renderer::beginFrame ()
```

Definition at line 43 of file [renderer.cpp](#).

6.27.3.2 beginSwapChainRenderPass()

```
void ven::Renderer::beginSwapChainRenderPass (
    VkCommandBuffer commandBuffer) const
```

Definition at line 90 of file [renderer.cpp](#).

6.27.3.3 createCommandBuffers()

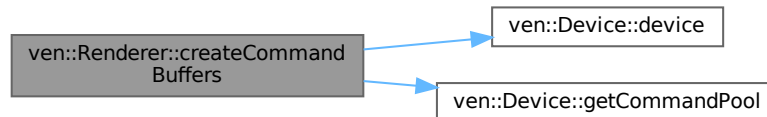
`void ven::Renderer::createCommandBuffers () [private]`

Definition at line 3 of file [renderer.cpp](#).

References [ven::Device::device\(\)](#), [ven::Device::getCommandPool\(\)](#), [m_commandBuffers](#), [m_device](#), and [ven::SwapChain::MAX_FRAMES_IN_FLIGHT](#).

Referenced by [Renderer\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.27.3.4 endFrame()

`void ven::Renderer::endFrame ()`

Definition at line 69 of file [renderer.cpp](#).

References [ven::SwapChain::MAX_FRAMES_IN_FLIGHT](#).

6.27.3.5 endSwapChainRenderPass()

`void ven::Renderer::endSwapChainRenderPass (
 VkCommandBuffer commandBuffer) [static]`

Definition at line 123 of file [renderer.cpp](#).

Referenced by [ven::Engine::mainLoop\(\)](#).

Here is the caller graph for this function:



6.27.3.6 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:



6.27.3.7 getAspectRatio()

```
float ven::Renderer::getAspectRatio () const [inline], [nodiscard]
```

Definition at line 31 of file [Renderer.hpp](#).

References [m_swapChain](#).

6.27.3.8 getCurrentCommandBuffer()

```
VkCommandBuffer ven::Renderer::getCurrentCommandBuffer () const [inline], [nodiscard]
```

Definition at line 33 of file [Renderer.hpp](#).

References [isFrameInProgress\(\)](#), [m_commandBuffers](#), and [m_currentFrameIndex](#).

Here is the call graph for this function:



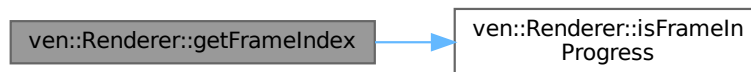
6.27.3.9 getFrameIndex()

```
int ven::Renderer::getFrameIndex () const [inline], [nodiscard]
```

Definition at line 35 of file [Renderer.hpp](#).

References [isFrameInProgress\(\)](#), and [m_currentFrameIndex](#).

Here is the call graph for this function:



6.27.3.10 getSwapChainRenderPass()

```
VkRenderPass ven::Renderer::getSwapChainRenderPass () const [inline], [nodiscard]
```

Definition at line 30 of file [Renderer.hpp](#).

References [m_swapChain](#).

6.27.3.11 isFrameInProgress()

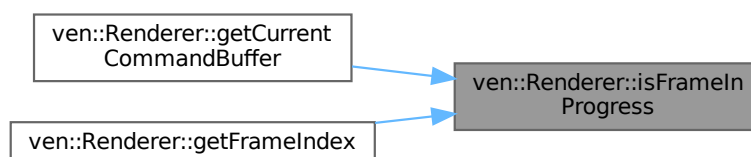
```
bool ven::Renderer::isFrameInProgress () const [inline], [nodiscard]
```

Definition at line 32 of file [Renderer.hpp](#).

References [m_isFrameStarted](#).

Referenced by [getCurrentCommandBuffer\(\)](#), and [getFrameIndex\(\)](#).

Here is the caller graph for this function:



6.27.3.12 operator=()

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

6.27.3.13 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:



6.27.4 Member Data Documentation

6.27.4.1 m_commandBuffers

```
std::vector<VkCommandBuffer> ven::Renderer::m_commandBuffers [private]
```

Definition at line 51 of file [Renderer.hpp](#).

Referenced by [createCommandBuffers\(\)](#), and [getCurrentCommandBuffer\(\)](#).

6.27.4.2 m_currentFrameIndex

```
int ven::Renderer::m_currentFrameIndex {0} [private]
```

Definition at line 54 of file [Renderer.hpp](#).

Referenced by [getCurrentCommandBuffer\(\)](#), and [getFrameIndex\(\)](#).

6.27.4.3 m_currentImageIndex

```
uint32_t ven::Renderer::m_currentImageIndex {0} [private]
```

Definition at line 53 of file [Renderer.hpp](#).

6.27.4.4 m_device

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

Definition at line 49 of file [Renderer.hpp](#).

Referenced by [createCommandBuffers\(\)](#).

6.27.4.5 m_isFrameStarted

```
bool ven::Renderer::m_isFrameStarted {false} [private]
```

Definition at line 55 of file [Renderer.hpp](#).

Referenced by [isFrameInProgress\(\)](#).

6.27.4.6 m_swapChain

```
std::unique_ptr<SwapChain> ven::Renderer::m_swapChain [private]
```

Definition at line 50 of file [Renderer.hpp](#).

Referenced by [getAspectRatio\(\)](#), and [getSwapChainRenderPass\(\)](#).

6.27.4.7 m_window

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

Definition at line 48 of file [Renderer.hpp](#).

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](#)

6.28 ven::RenderSystem Class Reference

Class for render system.

```
#include <RenderSystem.hpp>
```

Collaboration diagram for ven::RenderSystem:



Public Member Functions

- [RenderSystem](#) ([Device](#) &device, VkRenderPass renderPass, VkDescriptorSetLayout globalSetLayout)
- [~RenderSystem](#) ()
- [RenderSystem](#) (const [RenderSystem](#) &)=delete
- [RenderSystem](#) & [operator=](#) (const [RenderSystem](#) &)=delete
- void [renderObjects](#) (const [FrameInfo](#) &frameInfo) const

Private Member Functions

- void [createPipelineLayout](#) (VkDescriptorSetLayout globalSetLayout)
- void [createPipeline](#) (VkRenderPass renderPass)

Private Attributes

- [Device](#) & [m_device](#)
- std::unique_ptr< [Shaders](#) > [m_shaders](#)
- VkPipelineLayout [m_pipelineLayout](#) {nullptr}

6.28.1 Detailed Description

Class for render system.

Definition at line 28 of file [RenderSystem.hpp](#).

6.28.2 Constructor & Destructor Documentation

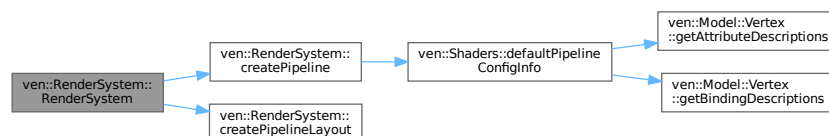
6.28.2.1 RenderSystem() [1/2]

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

Definition at line 5 of file [renderSystem.cpp](#).

References [createPipeline\(\)](#), and [createPipelineLayout\(\)](#).

Here is the call graph for this function:



6.28.2.2 ~RenderSystem()

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

Definition at line 33 of file [RenderSystem.hpp](#).

References [ven::Device::device\(\)](#), [m_device](#), and [m_pipelineLayout](#).

Here is the call graph for this function:



6.28.2.3 RenderSystem() [2/2]

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

6.28.3 Member Function Documentation

6.28.3.1 createPipeline()

```
void ven::RenderSystem::createPipeline (
    VkRenderPass renderPass) [private]
```

Definition at line 32 of file [renderSystem.cpp](#).

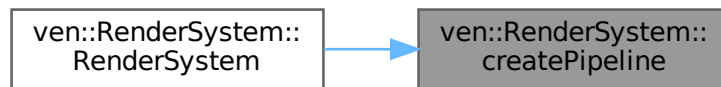
References [ven::Shaders::defaultPipelineConfigInfo\(\)](#), and [ven::SHADERS_BIN_PATH](#).

Referenced by [RenderSystem\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



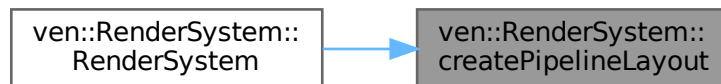
6.28.3.2 createPipelineLayout()

```
void ven::RenderSystem::createPipelineLayout (
    VkDescriptorSetLayout globalSetLayout) [private]
```

Definition at line 11 of file [renderSystem.cpp](#).

Referenced by [RenderSystem\(\)](#).

Here is the caller graph for this function:



6.28.3.3 operator=()

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

6.28.3.4 renderObjects()

```
void ven::RenderSystem::renderObjects (
    const FrameInfo & frameInfo) const
```

Definition at line 41 of file [renderSystem.cpp](#).

References [ven::FrameInfo::commandBuffer](#), [ven::FrameInfo::globalDescriptorSet](#), [ven::SimplePushConstantData::modelMatrix](#), and [ven::FrameInfo::objects](#).

Referenced by [ven::Engine::mainLoop\(\)](#).

Here is the caller graph for this function:



6.28.4 Member Data Documentation

6.28.4.1 m_device

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

Definition at line 45 of file [RenderSystem.hpp](#).

Referenced by [~RenderSystem\(\)](#).

6.28.4.2 m_pipelineLayout

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

Definition at line 48 of file [RenderSystem.hpp](#).

Referenced by [~RenderSystem\(\)](#).

6.28.4.3 m_shaders

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

Definition at line 47 of file [RenderSystem.hpp](#).

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

- [/home/runner/work/VEngine/VEngine/include/VEngine/System/RenderSystem.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/system/renderSystem.cpp](#)

6.29 ven::Shaders Class Reference

```
#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}

6.29.1 Detailed Description

Definition at line 39 of file [Shaders.hpp](#).

6.29.2 Constructor & Destructor Documentation

6.29.2.1 Shaders() [1/2]

```
ven::Shaders::Shaders (
    Device & device,
    const std::string & vertFilepath,
    const std::string & fragFilepath,
    const PipelineConfigInfo & configInfo) [inline]
```

Definition at line 43 of file [Shaders.hpp](#).

References [createGraphicsPipeline\(\)](#).

Here is the call graph for this function:



6.29.2.2 ~Shaders()

```
ven::Shaders::~~Shaders ()
```

Definition at line 6 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:



6.29.2.3 Shaders() [2/2]

```
ven::Shaders::~Shaders (
    const Shaders & ) [delete]
```

6.29.3 Member Function Documentation

6.29.3.1 bind()

```
void ven::Shaders::bind (
    const VkCommandBuffer commandBuffer) const [inline]
```

Definition at line 50 of file [Shaders.hpp](#).

References [m_graphicsPipeline](#).

6.29.3.2 createGraphicsPipeline()

```
void ven::Shaders::createGraphicsPipeline (
    const std::string & vertFilepath,
    const std::string & fragFilepath,
    const PipelineConfigInfo & configInfo) [private]
```

Definition at line 31 of file [shaders.cpp](#).

References [ven::PipelineConfigInfo::attributeDescriptions](#), [ven::PipelineConfigInfo::bindingDescriptions](#), [ven::PipelineConfigInfo::colorBlendState](#), [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:



6.29.3.3 createShaderModule()

```
void ven::Shaders::createShaderModule (
    const std::vector< char > & code,
    VkShaderModule * shaderModule) const [private]
```

Definition at line 100 of file [shaders.cpp](#).

6.29.3.4 defaultPipelineConfigInfo()

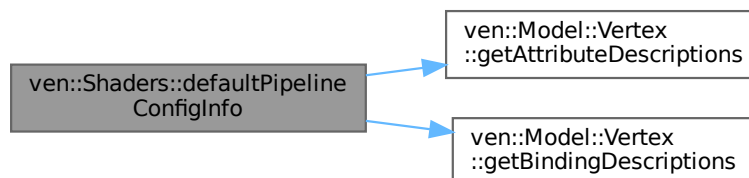
```
void ven::Shaders::defaultPipelineConfigInfo (
    PipelineConfigInfo & configInfo) [static]
```

Definition at line 112 of file [shaders.cpp](#).

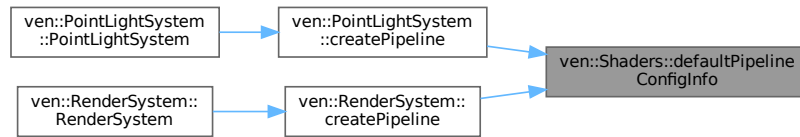
References [ven::PipelineConfigInfo::attributeDescriptions](#), [ven::PipelineConfigInfo::bindingDescriptions](#), [ven::PipelineConfigInfo::colorBlendInfo](#), [ven::PipelineConfigInfo::colorBlendInfo](#), [ven::PipelineConfigInfo::depthStencilInfo](#), [ven::PipelineConfigInfo::dynamicStateEnables](#), [ven::PipelineConfigInfo::dynamicStateInfo](#), [ven::Model::Vertex::getAttributeDescriptions\(\)](#), [ven::Model::Vertex::getBindingDescriptions\(\)](#), [ven::PipelineConfigInfo::inputAssemblyInfo](#), [ven::PipelineConfigInfo::multisampleInfo](#), and [ven::PipelineConfigInfo::rasterizationInfo](#).

Referenced by [ven::PointLightSystem::createPipeline\(\)](#), and [ven::RenderSystem::createPipeline\(\)](#).

Here is the call graph for this function:



Here is the caller graph for this function:



6.29.3.5 operator=()

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

6.29.3.6 readFile()

```
std::vector< char > ven::Shaders::readFile (
    const std::string & filename) [static], [private]
```

Definition at line 13 of file [shaders.cpp](#).

6.29.4 Member Data Documentation

6.29.4.1 m_device

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

Definition at line 58 of file [Shaders.hpp](#).

Referenced by [~Shaders\(\)](#).

6.29.4.2 m_fragShaderModule

```
VkShaderModule ven::Shaders::m_fragShaderModule {nullptr} [private]
```

Definition at line 61 of file [Shaders.hpp](#).

Referenced by [~Shaders\(\)](#).

6.29.4.3 m_graphicsPipeline

```
VkPipeline ven::Shaders::m_graphicsPipeline {nullptr} [private]
```

Definition at line 59 of file [Shaders.hpp](#).

Referenced by [bind\(\)](#), and [~Shaders\(\)](#).

6.29.4.4 m_vertShaderModule

VkShaderModule ven::Shaders::m_vertShaderModule {nullptr} [private]

Definition at line 60 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](#)

6.30 ven::SimplePushConstantData Struct Reference

```
#include <RenderSystem.hpp>
```

Collaboration diagram for ven::SimplePushConstantData:

| ven::SimplePushConstantData | |
|-----------------------------|--------------|
| + | modelMatrix |
| + | normalMatrix |
| | |

Public Attributes

- glm::mat4 [modelMatrix](#) {1.F}
- glm::mat4 [normalMatrix](#) {1.F}

6.30.1 Detailed Description

Definition at line 19 of file [RenderSystem.hpp](#).

6.30.2 Member Data Documentation

6.30.2.1 modelMatrix

glm::mat4 ven::SimplePushConstantData::modelMatrix {1.F}

Definition at line 20 of file [RenderSystem.hpp](#).

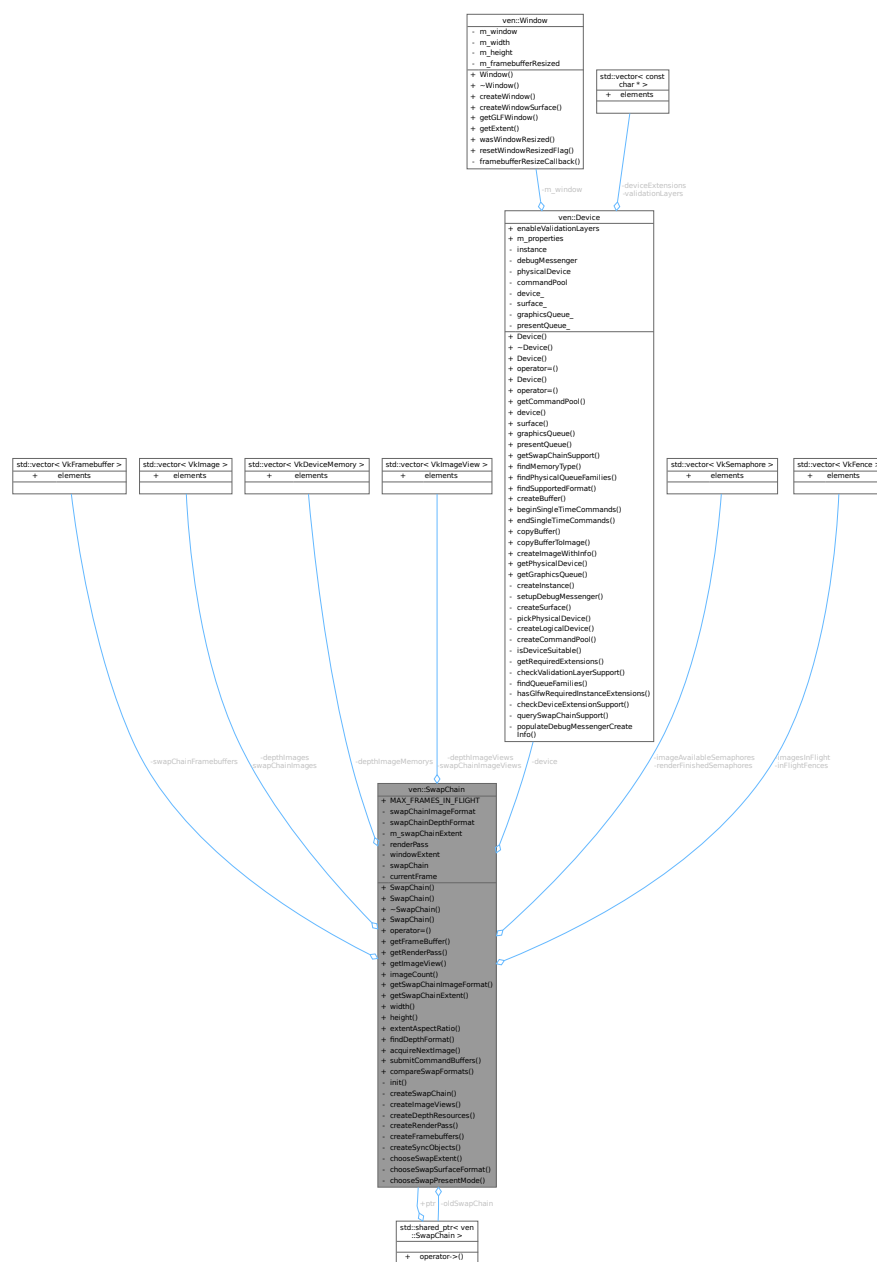
Referenced by [ven::RenderSystem::renderObjects\(\)](#).


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

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

- ### 6.31 ven::SwapChain Class Reference

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](#) &swapChainp) const

Static Public Attributes

- static constexpr int [MAX_FRAMES_IN_FLIGHT](#) = 2

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 [swapChainImageFormat](#) {}
- VkFormat [swapChainDepthFormat](#) {}
- VkExtent2D [m_swapChainExtent](#) {}
- std::vector< VkFramebuffer > [swapChainFramebuffers](#)
- VkRenderPass [renderPass](#) {}
- std::vector< VkImage > [depthImages](#)
- std::vector< VkDeviceMemory > [depthImageMemorys](#)
- std::vector< VkImageView > [depthImageViews](#)
- std::vector< VkImage > [swapChainImages](#)
- std::vector< VkImageView > [swapChainImageViews](#)
- [Device](#) & [device](#)
- VkExtent2D [windowExtent](#)
- VkSwapchainKHR [swapChain](#) {}
- std::shared_ptr< [SwapChain](#) > [oldSwapChain](#)
- std::vector< VkSemaphore > [imageAvailableSemaphores](#)
- std::vector< VkSemaphore > [renderFinishedSemaphores](#)
- std::vector< VkFence > [inFlightFences](#)
- std::vector< VkFence > [imagesInFlight](#)
- size_t [currentFrame](#) = 0

6.31.1 Detailed Description

Definition at line 16 of file [SwapChain.hpp](#).

6.31.2 Constructor & Destructor Documentation

6.31.2.1 SwapChain() [1/3]

```
ven::SwapChain::SwapChain (
    Device & deviceRef,
    const VkExtent2D windowExtentRef) [inline]
```

Definition at line 22 of file [SwapChain.hpp](#).

References [init\(\)](#).

Here is the call graph for this function:



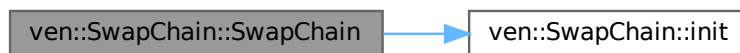
6.31.2.2 SwapChain() [2/3]

```
ven::SwapChain::SwapChain (
    Device & deviceRef,
    const VkExtent2D windowExtentRef,
    std::shared_ptr< SwapChain > previous) [inline]
```

Definition at line 23 of file [SwapChain.hpp](#).

References [init\(\)](#), and [oldSwapChain](#).

Here is the call graph for this function:



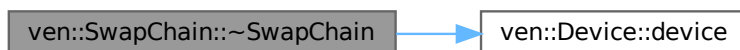
6.31.2.3 ~SwapChain()

```
ven::SwapChain::~~SwapChain ()
```

Definition at line 7 of file [swapChain.cpp](#).

References [depthImageMemorys](#), [depthImages](#), [depthImageViews](#), [ven::Device::device\(\)](#), [device](#), [imageAvailableSemaphores](#), [inFlightFences](#), [MAX_FRAMES_IN_FLIGHT](#), [renderFinishedSemaphores](#), [renderPass](#), [swapChain](#), [swapChainFramebuffers](#), and [swapChainImageViews](#).

Here is the call graph for this function:



6.31.2.4 SwapChain() [3/3]

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

6.31.3 Member Function Documentation

6.31.3.1 acquireNextImage()

```
VkResult ven::SwapChain::acquireNextImage (
    uint32_t * imageIndex) const
```

Definition at line 49 of file [swapChain.cpp](#).

6.31.3.2 chooseSwapExtent()

```
VkExtent2D ven::SwapChain::chooseSwapExtent (
    const VkSurfaceCapabilitiesKHR & capabilities) const [private]
```

Definition at line 366 of file [swapChain.cpp](#).

6.31.3.3 chooseSwapPresentMode()

```
VkPresentModeKHR ven::SwapChain::chooseSwapPresentMode (
    const std::vector< VkPresentModeKHR > & availablePresentModes) [static], [private]
```

Definition at line 346 of file [swapChain.cpp](#).

6.31.3.4 chooseSwapSurfaceFormat()

```
VkSurfaceFormatKHR ven::SwapChain::chooseSwapSurfaceFormat (
    const std::vector< VkSurfaceFormatKHR > & availableFormats) [static], [private]
```

Definition at line 335 of file [swapChain.cpp](#).

6.31.3.5 compareSwapFormats()

```
bool ven::SwapChain::compareSwapFormats (
    const SwapChain & swapChainp) const [inline], [nodiscard]
```

Definition at line 44 of file [SwapChain.hpp](#).

References [swapChainDepthFormat](#), and [swapChainImageFormat](#).

6.31.3.6 createDepthResources()

```
void ven::SwapChain::createDepthResources () [private]
```

Definition at line 266 of file [swapChain.cpp](#).

6.31.3.7 createFramebuffers()

```
void ven::SwapChain::createFramebuffers () [private]
```

Definition at line 244 of file [swapChain.cpp](#).

6.31.3.8 createImageViews()

```
void ven::SwapChain::createImageViews () [private]
```

Definition at line 164 of file [swapChain.cpp](#).

6.31.3.9 createRenderPass()

```
void ven::SwapChain::createRenderPass () [private]
```

Definition at line 185 of file [swapChain.cpp](#).

6.31.3.10 createSwapChain()

```
void ven::SwapChain::createSwapChain () [private]
```

Definition at line 103 of file [swapChain.cpp](#).

References [ven::SwapChainSupportDetails::capabilities](#), [ven::SwapChainSupportDetails::formats](#), [ven::QueueFamilyIndices::graphics](#), [ven::QueueFamilyIndices::presentFamily](#), and [ven::SwapChainSupportDetails::presentModes](#).

6.31.3.11 createSyncObjects()

```
void ven::SwapChain::createSyncObjects () [private]
```

Definition at line 312 of file [swapChain.cpp](#).

6.31.3.12 extentAspectRatio()

```
float ven::SwapChain::extentAspectRatio () const [inline], [nodiscard]
```

Definition at line 38 of file [SwapChain.hpp](#).

References [m_swapChainExtent](#).

6.31.3.13 findDepthFormat()

```
VkFormat ven::SwapChain::findDepthFormat () const
```

Definition at line 378 of file [swapChain.cpp](#).

6.31.3.14 getFramebuffer()

```
VkFramebuffer ven::SwapChain::getFramebuffer (
    const unsigned long index) const [inline], [nodiscard]
```

Definition at line 29 of file [SwapChain.hpp](#).

References [swapChainFramebuffers](#).

6.31.3.15 getImageView()

```
VkImageView ven::SwapChain::getImageView (
    const int index) const [inline], [nodiscard]
```

Definition at line 31 of file [SwapChain.hpp](#).

References [swapChainImageViews](#).

6.31.3.16 getRenderPass()

```
VkRenderPass ven::SwapChain::getRenderPass () const [inline], [nodiscard]
```

Definition at line 30 of file [SwapChain.hpp](#).

References [renderPass](#).

6.31.3.17 getSwapChainExtent()

```
VkExtent2D ven::SwapChain::getSwapChainExtent () const [inline], [nodiscard]
```

Definition at line 34 of file [SwapChain.hpp](#).

References [m_swapChainExtent](#).

6.31.3.18 getSwapChainImageFormat()

```
VkFormat ven::SwapChain::getSwapChainImageFormat () const [inline], [nodiscard]
```

Definition at line 33 of file [SwapChain.hpp](#).

References [swapChainImageFormat](#).

6.31.3.19 height()

```
uint32_t ven::SwapChain::height () const [inline], [nodiscard]
```

Definition at line 36 of file [SwapChain.hpp](#).

References [m_swapChainExtent](#).

6.31.3.20 imageCount()

```
size_t ven::SwapChain::imageCount () const [inline], [nodiscard]
```

Definition at line 32 of file [SwapChain.hpp](#).

References [swapChainImages](#).

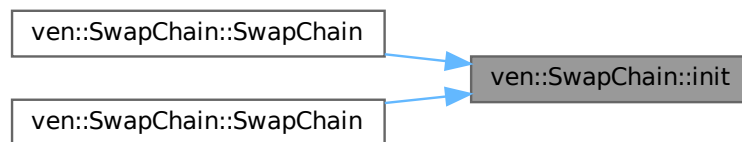
6.31.3.21 init()

```
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:

**6.31.3.22 operator=()**

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

6.31.3.23 submitCommandBuffers()

```
VkResult ven::SwapChain::submitCommandBuffers (
    const VkCommandBuffer * buffers,
    const uint32_t * imageIndex)
```

Definition at line 56 of file [swapChain.cpp](#).

6.31.3.24 width()

```
uint32_t ven::SwapChain::width () const [inline], [nodiscard]
```

Definition at line 35 of file [SwapChain.hpp](#).

References [m_swapChainExtent](#).

6.31.4 Member Data Documentation

6.31.4.1 currentFrame

```
size_t ven::SwapChain::currentFrame = 0 [private]
```

Definition at line 85 of file [SwapChain.hpp](#).

6.31.4.2 depthImageMemorys

```
std::vector<VkDeviceMemory> ven::SwapChain::depthImageMemorys [private]
```

Definition at line 70 of file [SwapChain.hpp](#).

Referenced by [~SwapChain\(\)](#).

6.31.4.3 depthImages

```
std::vector<VkImage> ven::SwapChain::depthImages [private]
```

Definition at line 69 of file [SwapChain.hpp](#).

Referenced by [~SwapChain\(\)](#).

6.31.4.4 depthImageViews

```
std::vector<VkImageView> ven::SwapChain::depthImageViews [private]
```

Definition at line 71 of file [SwapChain.hpp](#).

Referenced by [~SwapChain\(\)](#).

6.31.4.5 device

```
Device& ven::SwapChain::device [private]
```

Definition at line 75 of file [SwapChain.hpp](#).

Referenced by [~SwapChain\(\)](#).

6.31.4.6 imageAvailableSemaphores

```
std::vector<VkSemaphore> ven::SwapChain::imageAvailableSemaphores [private]
```

Definition at line 81 of file [SwapChain.hpp](#).

Referenced by [~SwapChain\(\)](#).

6.31.4.7 imagesInFlight

```
std::vector<VkFence> ven::SwapChain::imagesInFlight [private]
```

Definition at line 84 of file [SwapChain.hpp](#).

6.31.4.8 inFlightFences

```
std::vector<VkFence> ven::SwapChain::inFlightFences [private]
```

Definition at line 83 of file [SwapChain.hpp](#).

Referenced by [~SwapChain\(\)](#).

6.31.4.9 m_swapChainExtent

```
VkExtent2D ven::SwapChain::m_swapChainExtent {} [private]
```

Definition at line 64 of file [SwapChain.hpp](#).

Referenced by [extentAspectRatio\(\)](#), [getSwapChainExtent\(\)](#), [height\(\)](#), and [width\(\)](#).

6.31.4.10 MAX_FRAMES_IN_FLIGHT

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

Definition at line 20 of file [SwapChain.hpp](#).

Referenced by [ven::Renderer::createCommandBuffers\(\)](#), [ven::Renderer::endFrame\(\)](#), [ven::Engine::Engine\(\)](#), [ven::Engine::mainLoop\(\)](#), and [~SwapChain\(\)](#).

6.31.4.11 oldSwapChain

```
std::shared_ptr<SwapChain> ven::SwapChain::oldSwapChain [private]
```

Definition at line 79 of file [SwapChain.hpp](#).

Referenced by [SwapChain\(\)](#).

6.31.4.12 renderFinishedSemaphores

```
std::vector<VkSemaphore> ven::SwapChain::renderFinishedSemaphores [private]
```

Definition at line 82 of file [SwapChain.hpp](#).

Referenced by [~SwapChain\(\)](#).

6.31.4.13 renderPass

```
VkRenderPass ven::SwapChain::renderPass {} [private]
```

Definition at line 67 of file [SwapChain.hpp](#).

Referenced by [getRenderPass\(\)](#), and [~SwapChain\(\)](#).

6.31.4.14 swapChain

```
VkSwapchainKHR ven::SwapChain::swapChain {} [private]
```

Definition at line 78 of file [SwapChain.hpp](#).

Referenced by [~SwapChain\(\)](#).

6.31.4.15 swapChainDepthFormat

```
VkFormat ven::SwapChain::swapChainDepthFormat {} [private]
```

Definition at line 63 of file [SwapChain.hpp](#).

Referenced by [compareSwapFormats\(\)](#).

6.31.4.16 swapChainFramebuffers

```
std::vector<VkFramebuffer> ven::SwapChain::swapChainFramebuffers [private]
```

Definition at line 66 of file [SwapChain.hpp](#).

Referenced by [getFrameBuffer\(\)](#), and [~SwapChain\(\)](#).

6.31.4.17 swapChainImageFormat

```
VkFormat ven::SwapChain::swapChainImageFormat {} [private]
```

Definition at line 62 of file [SwapChain.hpp](#).

Referenced by [compareSwapFormats\(\)](#), and [getSwapChainImageFormat\(\)](#).

6.31.4.18 swapChainImages

```
std::vector<VkImage> ven::SwapChain::swapChainImages [private]
```

Definition at line 72 of file [SwapChain.hpp](#).

Referenced by [imageCount\(\)](#).

6.31.4.19 swapChainImageViews

```
std::vector<VkImageView> ven::SwapChain::swapChainImageViews [private]
```

Definition at line 73 of file [SwapChain.hpp](#).

Referenced by [getImageView\(\)](#), and [~SwapChain\(\)](#).

6.31.4.20 windowExtent

```
VkExtent2D ven::SwapChain::windowExtent [private]
```

Definition at line 76 of file [SwapChain.hpp](#).

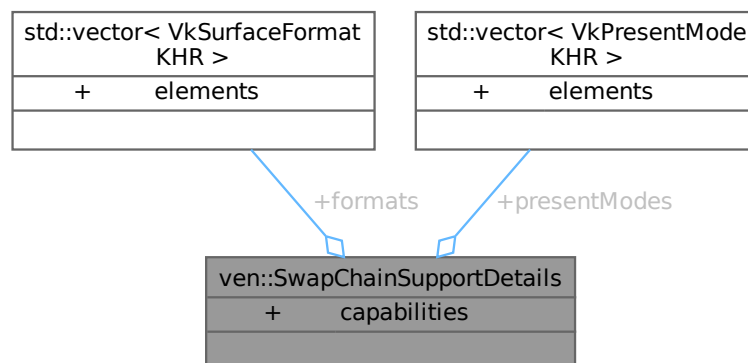
The documentation for this class was generated from the following files:

- [/home/runner/work/VEngine/VEngine/include/VEngine/SwapChain.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/swapChain.cpp](#)

6.32 ven::SwapChainSupportDetails Struct Reference

```
#include <Device.hpp>
```

Collaboration diagram for ven::SwapChainSupportDetails:



Public Attributes

- [VkSurfaceCapabilitiesKHR](#) [capabilities](#)
- [std::vector< VkSurfaceFormatKHR >](#) [formats](#)
- [std::vector< VkPresentModeKHR >](#) [presentModes](#)

6.32.1 Detailed Description

Definition at line 15 of file [Device.hpp](#).

6.32.2 Member Data Documentation

6.32.2.1 capabilities

```
VkSurfaceCapabilitiesKHR ven::SwapChainSupportDetails::capabilities
```

Definition at line 16 of file [Device.hpp](#).

Referenced by [ven::SwapChain::createSwapChain\(\)](#), and [ven::Device::querySwapChainSupport\(\)](#).

6.32.2.2 formats

```
std::vector<VkSurfaceFormatKHR> ven::SwapChainSupportDetails::formats
```

Definition at line 17 of file [Device.hpp](#).

Referenced by [ven::SwapChain::createSwapChain\(\)](#), [ven::Device::isDeviceSuitable\(\)](#), and [ven::Device::querySwapChainSupport\(\)](#).

6.32.2.3 presentModes

```
std::vector<VkPresentModeKHR> ven::SwapChainSupportDetails::presentModes
```

Definition at line 18 of file [Device.hpp](#).

Referenced by [ven::SwapChain::createSwapChain\(\)](#), [ven::Device::isDeviceSuitable\(\)](#), and [ven::Device::querySwapChainSupport\(\)](#).

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

- [/home/runner/work/VEngine/VEngine/include/VEngine/Device.hpp](#)

6.33 myLib::Time Class Reference

Class used for time management.

```
#include <Time.hpp>
```

Collaboration diagram for myLib::Time:



Public Member Functions

- [Time](#) (const double seconds)
Construct a new [Time](#) object.
- int [asSeconds](#) () const
Transform the time to seconds.
- int [asMilliseconds](#) () const
Transform the time to milliseconds.
- int [asMicroseconds](#) () const
Transform the time to microseconds.

Private Attributes

- double [m_seconds](#) {0.0F}

6.33.1 Detailed Description

Class used for time management.

Definition at line 15 of file [Time.hpp](#).

6.33.2 Constructor & Destructor Documentation

6.33.2.1 Time()

```
myLib::Time::Time (  
    const double seconds) [inline], [explicit]
```

Construct a new [Time](#) object.

Definition at line 22 of file [Time.hpp](#).

6.33.3 Member Function Documentation

6.33.3.1 asMicroseconds()

```
int myLib::Time::asMicroseconds () const [inline], [nodiscard]
```

Transform the time to microseconds.

Returns

int The time in microseconds

Definition at line 40 of file [Time.hpp](#).

References [m_seconds](#).

6.33.3.2 asMilliseconds()

```
int myLib::Time::asMilliseconds () const [inline], [nodiscard]
```

Transform the time to milliseconds.

Returns

int The time in milliseconds

Definition at line 34 of file [Time.hpp](#).

References [m_seconds](#).

6.33.3.3 asSeconds()

```
int myLib::Time::asSeconds () const [inline], [nodiscard]
```

Transform the time to seconds.

Returns

int The time in seconds

Definition at line 28 of file [Time.hpp](#).

References [m_seconds](#).

6.33.4 Member Data Documentation

6.33.4.1 m_seconds

```
double myLib::Time::m_seconds {0.0F} [private]
```

Definition at line 47 of file [Time.hpp](#).

Referenced by [asMicroseconds\(\)](#), [asMilliseconds\(\)](#), and [asSeconds\(\)](#).

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

- [/home/runner/work/VEngine/VEngine/lib/local/static/myLib/include/myLib/Clock/Time.hpp](#)

6.34 ven::Transform3DComponent Struct Reference

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

Collaboration diagram for ven::Transform3DComponent:

| ven::Transform3DComponent | |
|---------------------------|----------------|
| + | translation |
| + | scale |
| + | rotation |
| + | mat4() |
| + | normalMatrix() |

Public Member Functions

- glm::mat4 [mat4](#) () const
- glm::mat3 [normalMatrix](#) () const

Public Attributes

- glm::vec3 [translation](#) {}
- glm::vec3 [scale](#) {1.F, 1.F, 1.F}
- glm::vec3 [rotation](#) {}

6.34.1 Detailed Description

Definition at line 20 of file [Object.hpp](#).

6.34.2 Member Function Documentation

6.34.2.1 mat4()

```
glm::mat4 ven::Transform3DComponent::mat4 () const [nodiscard]
```

Definition at line 3 of file [object.cpp](#).

References [rotation](#), [scale](#), and [translation](#).

6.34.2.2 normalMatrix()

```
glm::mat3 ven::Transform3DComponent::normalMatrix () const [nodiscard]
```

Definition at line 38 of file [object.cpp](#).

6.34.3 Member Data Documentation

6.34.3.1 rotation

```
glm::vec3 ven::Transform3DComponent::rotation {}
```

Definition at line 23 of file [Object.hpp](#).

Referenced by [ven::Engine::mainLoop\(\)](#), and [mat4\(\)](#).

6.34.3.2 scale

```
glm::vec3 ven::Transform3DComponent::scale {1.F, 1.F, 1.F}
```

Definition at line 22 of file [Object.hpp](#).

Referenced by [ven::Engine::loadObjects\(\)](#), [ven::Object::makePointLight\(\)](#), and [mat4\(\)](#).

6.34.3.3 translation

```
glm::vec3 ven::Transform3DComponent::translation {}
```

Definition at line 21 of file [Object.hpp](#).

Referenced by [ven::Engine::loadObjects\(\)](#), [ven::Engine::mainLoop\(\)](#), and [mat4\(\)](#).

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

- [/home/runner/work/VEngine/VEngine/include/VEngine/Object.hpp](#)
- [/home/runner/work/VEngine/VEngine/src/object.cpp](#)

6.35 ven::Model::Vertex Struct Reference

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

Collaboration diagram for ven::Model::Vertex:

| ven::Model::Vertex |
|------------------------------|
| + position |
| + color |
| + normal |
| + uv |
| + operator==() |
| + getBindingDescriptions() |
| + getAttributeDescriptions() |

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](#) {}

6.35.1 Detailed Description

Definition at line 20 of file [Model.hpp](#).

6.35.2 Member Function Documentation

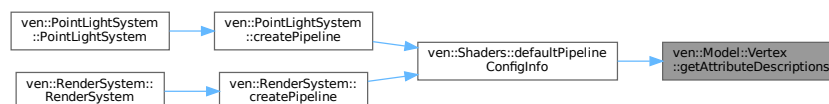
6.35.2.1 `getAttributeDescriptions()`

```
std::vector< VkVertexInputAttributeDescription > ven::Model::Vertex::getAttributeDescriptions
() [static]
```

Definition at line 108 of file [model.cpp](#).

Referenced by [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

Here is the caller graph for this function:



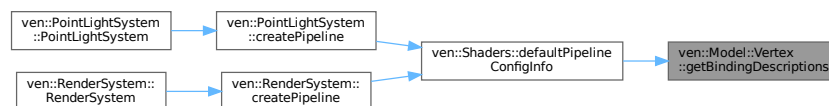
6.35.2.2 getBindingDescriptions()

```
std::vector< VkVertexInputBindingDescription > ven::Model::Vertex::getBindingDescriptions ()
[static]
```

Definition at line 99 of file [model.cpp](#).

Referenced by [ven::Shaders::defaultPipelineConfigInfo\(\)](#).

Here is the caller graph for this function:



6.35.2.3 operator==()

```
bool ven::Model::Vertex::operator== (
    const Vertex & other) const [inline]
```

Definition at line 29 of file [Model.hpp](#).

References [color](#), [normal](#), [position](#), and [uv](#).

6.35.3 Member Data Documentation

6.35.3.1 color

```
glm::vec3 ven::Model::Vertex::color {}
```

Definition at line 22 of file [Model.hpp](#).

Referenced by [std::hash< ven::Model::Vertex >::operator\(\)](#), and [operator==\(\)](#).

6.35.3.2 normal

```
glm::vec3 ven::Model::Vertex::normal {}
```

Definition at line 23 of file [Model.hpp](#).

Referenced by [std::hash< ven::Model::Vertex >::operator\(\)](#), and [operator==\(\)](#).

6.35.3.3 position

```
glm::vec3 ven::Model::Vertex::position {}
```

Definition at line 21 of file [Model.hpp](#).

Referenced by [ven::Model::Builder::loadModel\(\)](#), [std::hash< ven::Model::Vertex >::operator\(\)](#), and [operator==\(\)](#).

6.35.3.4 uv

```
glm::vec2 ven::Model::Vertex::uv {}
```

Definition at line 24 of file [Model.hpp](#).

Referenced by [std::hash< ven::Model::Vertex >::operator\(\)](#), and [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](#)

6.36 ven::Window Class Reference

```
#include <Window.hpp>
```

Collaboration diagram for ven::Window:

| ven::Window |
|---|
| <ul style="list-style-type: none"> - m_window - m_width - m_height - m_framebufferResized |
| <ul style="list-style-type: none"> + Window() + ~Window() + createWindow() + createWindowSurface() + getGLFWWindow() + getExtent() + wasWindowResized() + resetWindowResizedFlag() - framebufferResizeCallback() |

Public Member Functions

- [Window](#) (const uint32_t width, const uint32_t height, const std::string &title)
- [~Window](#) ()
- GLFWwindow * [createWindow](#) (uint32_t width, uint32_t height, const std::string &title)
- void [createWindowSurface](#) (VkInstance instance, VkSurfaceKHR *surface) const
- GLFWwindow * [getGLFWWindow](#) () const
- VkExtent2D [getExtent](#) () const
- bool [wasWindowResized](#) () const
- void [resetWindowResizedFlag](#) ()

Static Private Member Functions

- static void [framebufferResizeCallback](#) (GLFWwindow *window, int width, int height)

Private Attributes

- GLFWwindow * [m_window](#) {nullptr}
- uint32_t [m_width](#)
- uint32_t [m_height](#)
- bool [m_framebufferResized](#) = false

6.36.1 Detailed Description

Definition at line 17 of file [Window.hpp](#).

6.36.2 Constructor & Destructor Documentation

6.36.2.1 Window()

```
ven::Window::Window (  
    const uint32_t width,  
    const uint32_t height,  
    const std::string & title) [inline]
```

Definition at line 21 of file [Window.hpp](#).

6.36.2.2 ~Window()

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

Definition at line 22 of file [Window.hpp](#).

References [m_window](#).

6.36.3 Member Function Documentation

6.36.3.1 `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:



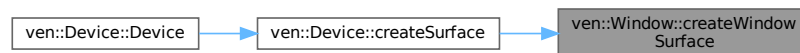
6.36.3.2 `createWindowSurface()`

```
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:



6.36.3.3 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:



6.36.3.4 getExtent()

```
VkExtent2D ven::Window::getExtent () const [inline], [nodiscard]
```

Definition at line 29 of file [Window.hpp](#).

References [m_height](#), and [m_width](#).

6.36.3.5 getGLFWWindow()

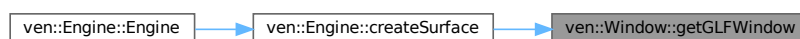
```
GLFWwindow * ven::Window::getGLFWWindow () const [inline], [nodiscard]
```

Definition at line 27 of file [Window.hpp](#).

References [m_window](#).

Referenced by [ven::Engine::createSurface\(\)](#).

Here is the caller graph for this function:



6.36.3.6 resetWindowResizedFlag()

```
void ven::Window::resetWindowResizedFlag () [inline]
```

Definition at line 31 of file [Window.hpp](#).

References [m_framebufferResized](#).

6.36.3.7 wasWindowResized()

```
bool ven::Window::wasWindowResized () const [inline], [nodiscard]
```

Definition at line 30 of file [Window.hpp](#).

References [m_framebufferResized](#).

6.36.4 Member Data Documentation

6.36.4.1 m_framebufferResized

```
bool ven::Window::m_framebufferResized = false [private]
```

Definition at line 41 of file [Window.hpp](#).

Referenced by [framebufferResizeCallback\(\)](#), [resetWindowResizedFlag\(\)](#), and [wasWindowResized\(\)](#).

6.36.4.2 m_height

```
uint32_t ven::Window::m_height [private]
```

Definition at line 39 of file [Window.hpp](#).

Referenced by [getExtent\(\)](#).

6.36.4.3 m_width

```
uint32_t ven::Window::m_width [private]
```

Definition at line 38 of file [Window.hpp](#).

Referenced by [getExtent\(\)](#).

6.36.4.4 m_window

```
GLFWwindow* ven::Window::m_window {nullptr} [private]
```

Definition at line 37 of file [Window.hpp](#).

Referenced by [getGLFWWindow\(\)](#), 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 7

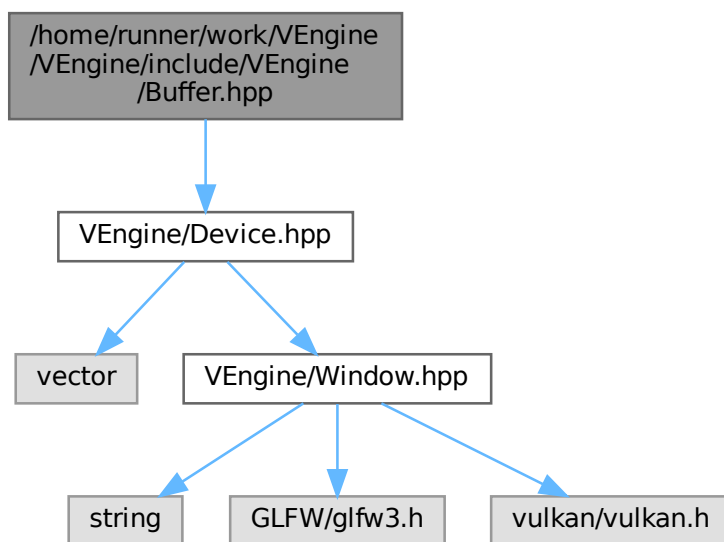
File Documentation

7.1 /home/runner/work/VEngine/VEngine/include/VEngine/Buffer.hpp File Reference

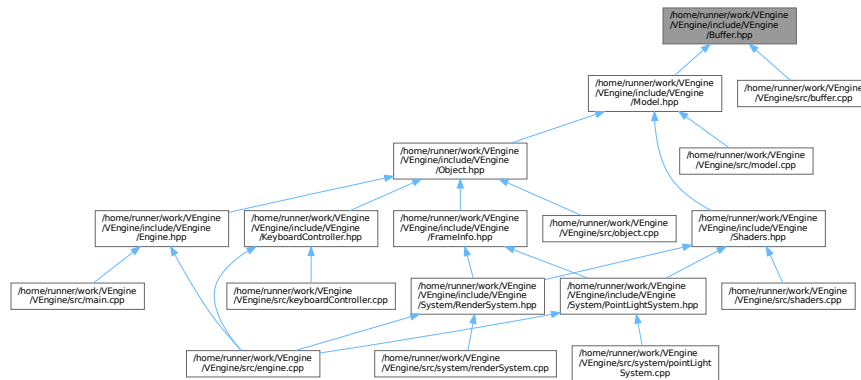
This file contains the Buffer class.

```
#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](#)

7.1.1 Detailed Description

This file contains the Buffer class.

Definition in file [Buffer.hpp](#).

7.2 Buffer.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Buffer.hpp
00003 /// @brief This file contains the Buffer class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include "VEngine/Device.hpp"
00010
00011 namespace ven {
00012
00013     ///
00014     /// @class Buffer
00015     /// @brief Class for buffer
00016     /// @namespace ven
00017     class Buffer {
00018
00019     public:
00020
00021         Buffer(Device& device, VkDeviceSize instanceSize, uint32_t instanceCount,
            VkBufferUsageFlags usageFlags, VkMemoryPropertyFlags memoryPropertyFlags, VkDeviceSize
            minOffsetAlignment = 1);
  
```

```

00022         ~Buffer();
00023
00024         Buffer(const Buffer&) = delete;
00025         Buffer& operator=(const Buffer&) = delete;
00026
00027         ///
00028         /// @brief Map a memory range of this buffer. If successful, mapped points to the
specified buffer range.
00029         ///
00030         /// @param size (Optional) Size of the memory range to map. Pass VK_WHOLE_SIZE to map the
complete buffer range.
00031         /// @param offset (Optional) Byte offset from beginning
00032         ///
00033         /// @return VkResult of the buffer mapping call
00034         ///
00035         VkResult map(VkDeviceSize size = VK_WHOLE_SIZE, VkDeviceSize offset = 0);
00036
00037         ///
00038         /// @brief Unmap a mapped memory range
00039         ///
00040         /// @note Does not return a result as vkUnmapMemory can't fail
00041         ///
00042         void unmap();
00043
00044         ///
00045         /// @brief Copies the specified data to the mapped buffer. Default value writes whole
buffer range
00046         ///
00047         /// @param data Pointer to the data to copy
00048         /// @param size (Optional) Size of the data to copy. Pass VK_WHOLE_SIZE to flush the
complete buffer range.
00049         /// @param offset (Optional) Byte offset from beginning of mapped region
00050         ///
00051         void writeToBuffer(const void* data, VkDeviceSize size = VK_WHOLE_SIZE, VkDeviceSize
offset = 0) const;
00052
00053         ///
00054         /// @brief Flush a memory range of the buffer to make it visible to the device
00055         ///
00056         /// @note Only required for non-coherent memory
00057         ///
00058         /// @param size (Optional) Size of the memory range to flush. Pass VK_WHOLE_SIZE to flush
the complete buffer range.
00059         /// @param offset (Optional) Byte offset from beginning
00060         ///
00061         /// @return VkResult of the flush call
00062         ///
00063         [[nodiscard]] VkResult flush(VkDeviceSize size = VK_WHOLE_SIZE, VkDeviceSize offset = 0)
const;
00064
00065         ///
00066         /// @brief Create a buffer info descriptor
00067         ///
00068         /// @param size (Optional) Size of the memory range of the descriptor
00069         /// @param offset (Optional) Byte offset from beginning
00070         ///
00071         /// @return VkDescriptorBufferInfo of specified offset and range
00072         ///
00073         [[nodiscard]] VkDescriptorBufferInfo descriptorInfo(const VkDeviceSize size =
VK_WHOLE_SIZE, const VkDeviceSize offset = 0) const { return VkDescriptorBufferInfo{m_buffer, offset,
size, }; }
00074
00075         ///
00076         /// @brief Invalidate a memory range of the buffer to make it visible to the host
00077         ///
00078         /// @note Only required for non-coherent memory
00079         ///
00080         /// @param size (Optional) Size of the memory range to invalidate. Pass VK_WHOLE_SIZE to
invalidate
the complete buffer range.
00081         /// @param offset (Optional) Byte offset from beginning
00082         ///
00083         /// @return VkResult of the invalidate call
00084         ///
00085         [[nodiscard]] VkResult invalidate(VkDeviceSize size = VK_WHOLE_SIZE, VkDeviceSize offset =
0) const;
00086
00087         ///
00088         /// Copies "instanceSize" bytes of data to the mapped buffer at an offset of index *
alignmentSize
00089         ///
00090         /// @param data Pointer to the data to copy
00091         /// @param index Used in offset calculation
00092         ///
00093         void writeToIndex(const void* data, const VkDeviceSize index) const { writeToBuffer(data,
m_instanceSize, index * m_alignmentSize); }

```

```

00096
00097     ///
00098     /// Flush the memory range at index * alignmentSize of the buffer to make it visible to
the device
00099     ///
00100     /// @param index Used in offset calculation
00101     ///
00102     [[nodiscard]] VkResult flushIndex(const VkDeviceSize index) const { return
flush(m_alignmentSize, index * m_alignmentSize); }
00103
00104     ///
00105     ///
00106     /// Create a buffer info descriptor
00107     ///
00108     /// @param index Specifies the region given by index * alignmentSize
00109     ///
00110     /// @return VkDescriptorBufferInfo for instance at index
00111     ///
00112     [[nodiscard]] VkDescriptorBufferInfo descriptorInfoForIndex(const VkDeviceSize index)
const { return descriptorInfo(m_alignmentSize, index * m_alignmentSize); }
00113
00114     ///
00115     /// Invalidate a memory range of the buffer to make it visible to the host
00116     ///
00117     /// @note Only required for non-coherent memory
00118     ///
00119     /// @param index Specifies the region to invalidate: index * alignmentSize
00120     ///
00121     /// @return VkResult of the invalidate call
00122     ///
00123     [[nodiscard]] VkResult invalidateIndex(const VkDeviceSize index) const { return
invalidate(m_alignmentSize, index * m_alignmentSize); }
00124
00125     [[nodiscard]] VkBuffer getBuffer() const { return m_buffer; }
00126     [[nodiscard]] void* getMappedMemory() const { return m_mapped; }
00127     [[nodiscard]] uint32_t getInstanceCount() const { return m_instanceCount; }
00128     [[nodiscard]] VkDeviceSize getInstanceSize() const { return m_instanceSize; }
00129     [[nodiscard]] VkDeviceSize getAlignmentSize() const { return m_instanceSize; }
00130     [[nodiscard]] VkBufferUsageFlags getUsageFlags() const { return m_usageFlags; }
00131     [[nodiscard]] VkMemoryPropertyFlags getMemoryPropertyFlags() const { return
m_memoryPropertyFlags; }
00132     [[nodiscard]] VkDeviceSize getBufferSize() const { return m_bufferSize; }
00133
00134     private:
00135     ///
00136     /// Returns the minimum instance size required to be compatible with devices
minOffsetAlignment
00137     ///
00138     /// @param instanceSize The size of an instance
00139     /// @param minOffsetAlignment The minimum required alignment, in bytes, for the offset
member (eg
00140     /// minUniformBufferOffsetAlignment)
00141     ///
00142     /// @return VkResult of the buffer mapping call
00143     ///
00144     static VkDeviceSize getAlignment(VkDeviceSize instanceSize, VkDeviceSize
minOffsetAlignment);
00145
00146     Device& m_device;
00147     void* m_mapped = nullptr;
00148     VkBuffer m_buffer = VK_NULL_HANDLE;
00149     VkDeviceMemory m_memory = VK_NULL_HANDLE;
00150
00151     VkDeviceSize m_bufferSize;
00152     VkDeviceSize m_instanceSize;
00153     uint32_t m_instanceCount;
00154     VkDeviceSize m_alignmentSize;
00155     VkBufferUsageFlags m_usageFlags;
00156     VkMemoryPropertyFlags m_memoryPropertyFlags;
00157
00158 }; // class Buffer
00159
00160 } // namespace ven

```

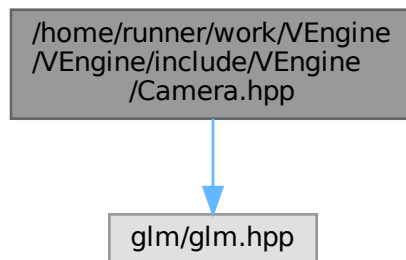
7.3 /home/runner/work/VEngine/VEngine/include/VEngine/Camera.hpp

File Reference

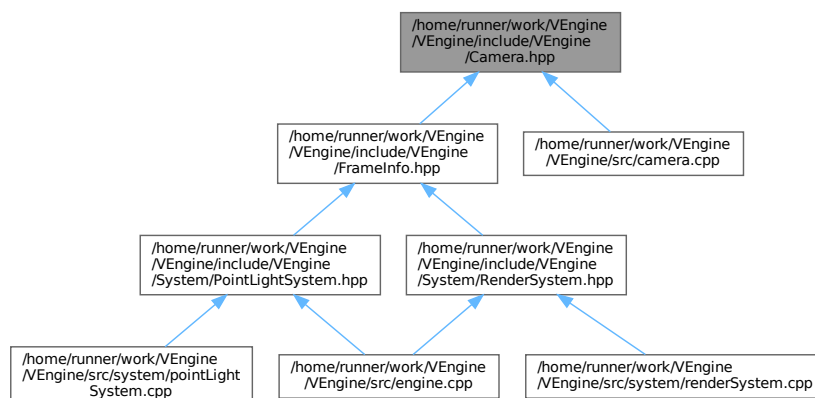
This file contains the Camera class.

```
#include <glm/glm.hpp>
```

Include dependency graph for Camera.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class [ven::Camera](#)

Namespaces

- namespace [ven](#)

Macros

- #define [GLM_FORCE_RADIANS](#)
- #define [GLM_FORCE_DEPTH_ZERO_TO_ONE](#)

7.3.1 Detailed Description

This file contains the Camera class.

This file contains the KeyboardController class.

Definition in file [Camera.hpp](#).

7.3.2 Macro Definition Documentation

7.3.2.1 GLM_FORCE_DEPTH_ZERO_TO_ONE

```
#define GLM_FORCE_DEPTH_ZERO_TO_ONE
```

Definition at line 10 of file [Camera.hpp](#).

7.3.2.2 GLM_FORCE_RADIANS

```
#define GLM_FORCE_RADIANS
```

Definition at line 9 of file [Camera.hpp](#).

7.4 Camera.hpp

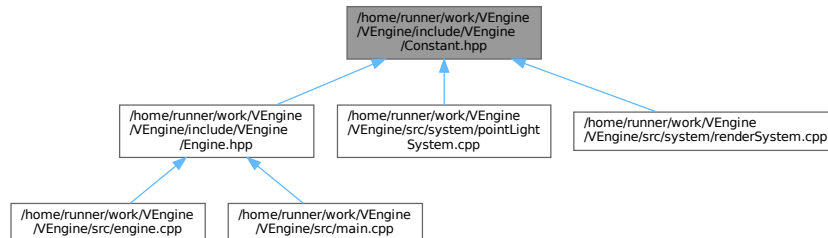
[Go to the documentation of this file.](#)

```
00001 ///
00002 /// @file Camera.hpp
00003 /// @brief This file contains the Camera class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #define GLM_FORCE_RADIANS
00010 #define GLM_FORCE_DEPTH_ZERO_TO_ONE
00011 #include <glm/glm.hpp>
00012
00013 namespace ven {
00014
00015     ///
00016
00017     class Camera {
00018     public:
00019
00020         void setOrthographicProjection(float left, float right, float top, float bottom, float
00021 near, float far);
00022         void setPerspectiveProjection(float fovy, float aspect, float near, float far);
00023         void setViewDirection(glm::vec3 position, glm::vec3 direction, glm::vec3 up =
00024 glm::vec3{0.F, -1.F, 0.F});
00025         void setViewTarget(glm::vec3 position, glm::vec3 target, glm::vec3 up = glm::vec3{0.F,
00026 -1.F, 0.F}) { setViewDirection(position, target - position, up); }
00027         void setViewYZX(glm::vec3 position, glm::vec3 rotation);
00028
00029         [[nodiscard]] const glm::mat4& getProjection() const { return m_projectionMatrix; }
00030         [[nodiscard]] const glm::mat4& getView() const { return m_viewMatrix; }
00031         [[nodiscard]] const glm::mat4& getInverseView() const { return m_inverseViewMatrix; }
00032
00033     private:
00034
00035         glm::mat4 m_projectionMatrix{1.F};
00036         glm::mat4 m_viewMatrix{1.F};
00037         glm::mat4 m_inverseViewMatrix{1.F};
00038
00039     }; // class Camera
00040 } // namespace ven
```

7.5 /home/runner/work/VEngine/VEngine/include/VEngine/Constant.hpp File Reference

This file contains the constant values used in the project.

This graph shows which files directly or indirectly include this file:



Namespaces

- namespace [ven](#)

Typedefs

- using [ven::return_type_t](#)

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"
- static constexpr std::string_view [ven::SHADERS_BIN_PATH](#) = "shaders/bin/"

7.5.1 Detailed Description

This file contains the constant values used in the project.

Definition in file [Constant.hpp](#).

7.6 Constant.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Constant.hpp
00003 /// @brief This file contains the constant values used in the project
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 namespace ven {
00010
00011     static constexpr uint32_t DEFAULT_WIDTH = 1920;
00012     static constexpr uint32_t DEFAULT_HEIGHT = 1080;
00013
00014     static constexpr std::string_view DEFAULT_TITLE = "VEngine";
00015     static constexpr std::string_view SHADERS_BIN_PATH = "shaders/bin/";
00016
00017     using return_type_t = enum Returntype : uint8_t {
00018         VEN_SUCCESS = 0,
00019         VEN_FAILURE = 1
00020     };
00021
00022 } // namespace ven

```

7.7 /home/runner/work/VEngine/VEngine/include/VEngine/Descriptors.hpp File Reference

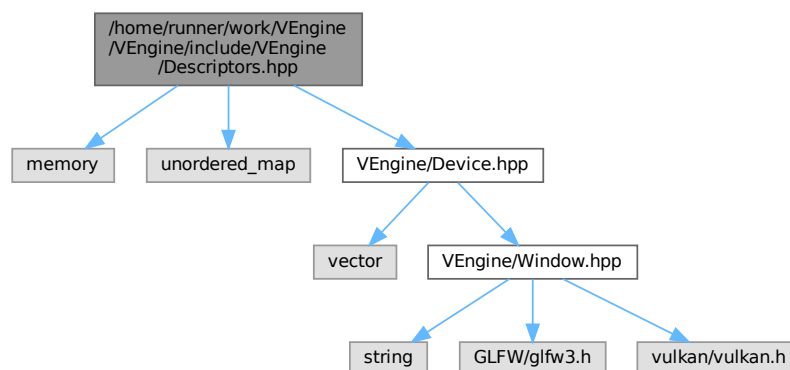
This file contains the Descriptors class.

```

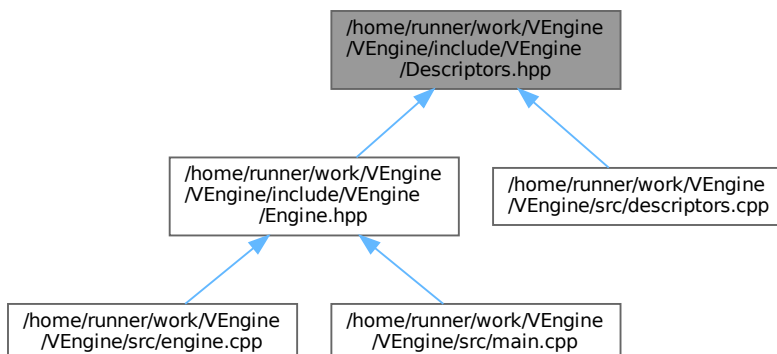
#include <memory>
#include <unordered_map>
#include "VEngine/Device.hpp"

```

Include dependency graph for Descriptors.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](#)
- class [ven::DescriptorPool](#)
Class for descriptor pool.
- class [ven::DescriptorPool::Builder](#)
- class [ven::DescriptorWriter](#)
Class for descriptor writer.

Namespaces

- namespace [ven](#)

7.7.1 Detailed Description

This file contains the Descriptors class.

Definition in file [Descriptors.hpp](#).

7.8 Descriptors.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Descriptors.hpp
00003 /// @brief This file contains the Descriptors class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <memory>
00010 #include <unordered_map>

```

```

00011
00012 #include "VEngine/Device.hpp"
00013
00014 namespace ven {
00015
00016 ///
00017 /// @class DescriptorSetLayout
00018 /// @brief Class for descriptor set layout
00019 /// @namespace ven
00020 ///
00021 class DescriptorSetLayout {
00022
00023 public:
00024
00025     class Builder {
00026
00027     public:
00028
00029         explicit Builder(Device &device) : m_device{device} {}
00030
00031         Builder &addBinding(uint32_t binding, VkDescriptorType descriptorType,
00032                             VkShaderStageFlags stageFlags, uint32_t count = 1);
00033         std::unique_ptr<DescriptorSetLayout> build() const { return
00034             std::make_unique<DescriptorSetLayout>(m_device, m_bindings); }
00035
00036 private:
00037     Device &m_device;
00038     std::unordered_map<uint32_t, VkDescriptorSetLayoutBinding> m_bindings;
00039 };
00040
00041 DescriptorSetLayout(Device &device, const std::unordered_map<uint32_t,
00042                             VkDescriptorSetLayoutBinding>& bindings);
00043 ~DescriptorSetLayout() { vkDestroyDescriptorSetLayout(m_device.device(),
00044     m_descriptorSetLayout, nullptr); }
00045 DescriptorSetLayout(const DescriptorSetLayout &) = delete;
00046 DescriptorSetLayout &operator=(const DescriptorSetLayout &) = delete;
00047
00048 VkDescriptorSetLayout getDescriptorSetLayout() const { return m_descriptorSetLayout; }
00049
00050 private:
00051     Device &m_device;
00052     VkDescriptorSetLayout m_descriptorSetLayout;
00053     std::unordered_map<uint32_t, VkDescriptorSetLayoutBinding> m_bindings;
00054
00055 friend class DescriptorWriter;
00056 }; // class DescriptorSetLayout
00057
00058 ///
00059 /// @class DescriptorPool
00060 /// @brief Class for descriptor pool
00061 /// @namespace ven
00062 ///
00063 class DescriptorPool {
00064
00065 public:
00066
00067     class Builder {
00068
00069     public:
00070
00071         explicit Builder(Device &device) : m_device{device} {}
00072
00073         Builder &addPoolSize(VkDescriptorType descriptorType, uint32_t count);
00074         Builder &setPoolFlags(VkDescriptorPoolCreateFlags flags);
00075         Builder &setMaxSets(uint32_t count);
00076         [[nodiscard]] std::unique_ptr<DescriptorPool> build() const { return
00077             std::make_unique<DescriptorPool>(m_device, m_maxSets, m_poolFlags, m_poolSizes); }
00078
00079 private:
00080     Device &m_device;
00081     std::vector<VkDescriptorPoolSize> m_poolSizes;
00082     uint32_t m_maxSets = 1000;
00083     VkDescriptorPoolCreateFlags m_poolFlags = 0;
00084 };
00085
00086 DescriptorPool(Device &device, uint32_t maxSets, VkDescriptorPoolCreateFlags poolFlags,
00087     const std::vector<VkDescriptorPoolSize> &poolSizes);
00088 ~DescriptorPool() { vkDestroyDescriptorPool(m_device.device(), m_descriptorPool, nullptr); }
00089
00090 DescriptorPool(const DescriptorPool &) = delete;
00091 DescriptorPool &operator=(const DescriptorPool &) = delete;
00092
00093 bool allocateDescriptor(VkDescriptorSetLayout descriptorSetLayout, VkDescriptorSet
00094     &descriptor) const;

```

```

00090
00091     void freeDescriptors(const std::vector<VkDescriptorSet> &descriptors) const {
vkFreeDescriptorSets(m_device.device(), m_descriptorPool, static_cast<uint32_t>(descriptors.size()),
descriptors.data()); }
00092
00093     void resetPool() const { vkResetDescriptorPool(m_device.device(), m_descriptorPool, 0); }
00094
00095     private:
00096
00097         Device &m_device;
00098         VkDescriptorPool m_descriptorPool;
00099
00100         friend class DescriptorWriter;
00101
00102     }; // class DescriptorPool
00103
00104     ///
00105     /// @class DescriptorWriter
00106     /// @brief Class for descriptor writer
00107     /// @namespace ven
00108     ///
00109     class DescriptorWriter {
00110
00111     public:
00112
00113         DescriptorWriter(DescriptorSetLayout &setLayout, DescriptorPool &pool) :
m_setLayout{setLayout}, m_pool{pool} {}
00114
00115         DescriptorWriter &writeBuffer(uint32_t binding, const VkDescriptorBufferInfo *bufferInfo);
00116         DescriptorWriter &writeImage(uint32_t binding, const VkDescriptorImageInfo *imageInfo);
00117
00118         bool build(VkDescriptorSet &set);
00119         void overwrite(const VkDescriptorSet &set);
00120
00121     private:
00122
00123         DescriptorSetLayout &m_setLayout;
00124         DescriptorPool &m_pool;
00125         std::vector<VkWriteDescriptorSet> m_writes;
00126
00127     }; // class DescriptorWriter
00128
00129 } // namespace ven

```

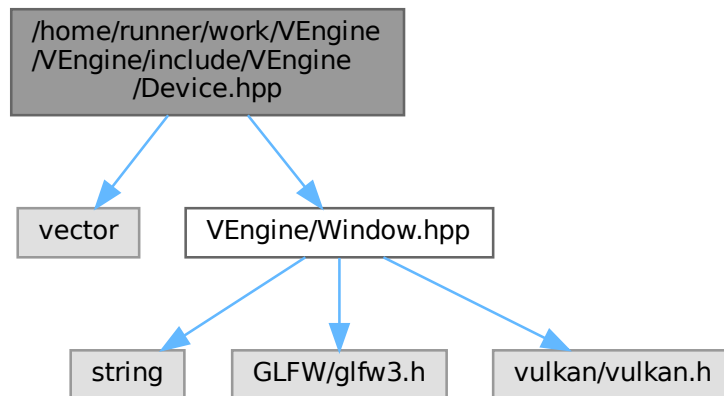
7.9 /home/runner/work/VEngine/VEngine/include/VEngine/Device.hpp File Reference

This file contains the Device class.

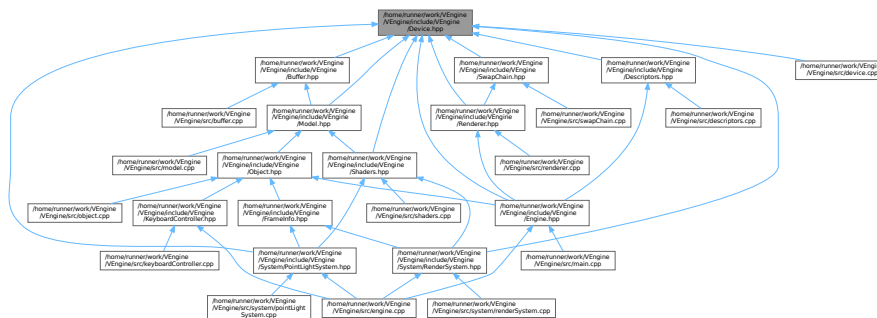
```

#include <vector>
#include "VEngine/Window.hpp"

```



/home/tunnework/Engine



- struct `ven::SwapChainSupportDetails`
- struct `ven::QueueFamilyIndices`
- class `ven::Device`

- namespace **ven**

This file contains the Device class.

Definition in file [Device.hpp](#).

7.10 Device.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Device.hpp
00003 /// @brief This file contains the Device class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <vector>
00010
00011 #include "VEngine/Window.hpp"
00012
00013 namespace ven {
00014
00015     struct SwapChainSupportDetails {
00016         VkSurfaceCapabilitiesKHR capabilities;
00017         std::vector<VkSurfaceFormatKHR> formats;
00018         std::vector<VkPresentModeKHR> presentModes;
00019     };
00020
00021     struct QueueFamilyIndices {
00022         uint32_t graphicsFamily{};
00023         uint32_t presentFamily{};
00024         bool graphicsFamilyHasValue = false;
00025         bool presentFamilyHasValue = false;
00026         [[nodiscard]] bool isComplete() const { return graphicsFamilyHasValue &&
presentFamilyHasValue; }
00027     };
00028
00029     class Device {
00030     public:
00031
00032         #ifdef NDEBUG
00033             const bool enableValidationLayers = false;
00034         #else
00035             const bool enableValidationLayers = true;
00036         #endif
00037
00038         explicit Device(Window &window);
00039         ~Device();
00040
00041         Device(const Device &) = delete;
00042         Device& operator=(const Device &) = delete;
00043         Device(Device &&) = delete;
00044         Device &operator=(Device &&) = delete;
00045
00046         [[nodiscard]] VkCommandPool getCommandPool() const { return commandPool; }
00047         [[nodiscard]] VkDevice device() const { return device_; }
00048         [[nodiscard]] VkSurfaceKHR surface() const { return surface_; }
00049         [[nodiscard]] VkQueue graphicsQueue() const { return graphicsQueue_; }
00050         [[nodiscard]] VkQueue presentQueue() const { return presentQueue_; }
00051
00052         [[nodiscard]] SwapChainSupportDetails getSwapChainSupport() const { return
querySwapChainSupport(physicalDevice); }
00053         [[nodiscard]] uint32_t findMemoryType(uint32_t typeFilter, VkMemoryPropertyFlags propertiesp)
const;
00054         [[nodiscard]] QueueFamilyIndices findPhysicalQueueFamilies() const { return
findQueueFamilies(physicalDevice); }
00055         [[nodiscard]] VkFormat findSupportedFormat(const std::vector<VkFormat> &candidates,
VkImageTiling tiling, VkFormatFeatureFlags features) const;
00056
00057         // Buffer Helper Functions
00058         void createBuffer(VkDeviceSize size, VkBufferUsageFlags usage, VkMemoryPropertyFlags
propertiesp, VkBuffer &buffer, VkDeviceMemory &bufferMemory) const;
00059         [[nodiscard]] VkCommandBuffer beginSingleTimeCommands() const;
00060         void endSingleTimeCommands(VkCommandBuffer commandBuffer) const;
00061         void copyBuffer(VkBuffer srcBuffer, VkBuffer dstBuffer, VkDeviceSize size) const;
00062         void copyBufferToImage(VkBuffer buffer, VkImage image, uint32_t width, uint32_t height,
uint32_t layerCount) const;
00063
00064         void createImageWithInfo(const VkImageCreateInfo &imageInfo, VkMemoryPropertyFlags
properties, VkImage &image, VkDeviceMemory &imageMemory) const;
00065
00066         VkPhysicalDeviceProperties m_properties;
00067
00068         [[nodiscard]] VkPhysicalDevice getPhysicalDevice() const { return physicalDevice; }
00069         [[nodiscard]] VkQueue getGraphicsQueue() const { return graphicsQueue_; }
00070
00071     private:
00072         void createInstance();
00073
00074

```

```

00075         void setupDebugMessenger();
00076         void createSurface() { m_window.createWindowSurface(instance, &surface_); };
00077         void pickPhysicalDevice();
00078         void createLogicalDevice();
00079         void createCommandPool();
00080
00081         // helper functions
00082         bool isDeviceSuitable(VkPhysicalDevice device) const;
00083         [[nodiscard]] std::vector<const char*> getRequiredExtensions() const;
00084         [[nodiscard]] bool checkValidationLayerSupport() const;
00085         QueueFamilyIndices findQueueFamilies(VkPhysicalDevice device) const;
00086         static void populateDebugMessengerCreateInfo(VkDebugUtilsMessengerCreateInfoEXT
&createInfo);
00087         void hasGlfwRequiredInstanceExtensions() const;
00088         bool checkDeviceExtensionSupport(VkPhysicalDevice device) const;
00089         SwapChainSupportDetails querySwapChainSupport(VkPhysicalDevice device) const;
00090
00091         VkInstance instance;
00092         VkDebugUtilsMessengerEXT debugMessenger;
00093         VkPhysicalDevice physicalDevice = VK_NULL_HANDLE;
00094         Window &m_window;
00095         VkCommandPool commandPool;
00096
00097         VkDevice device_;
00098         VkSurfaceKHR surface_;
00099         VkQueue graphicsQueue_;
00100         VkQueue presentQueue_;
00101
00102         const std::vector<const char*> validationLayers = {"VK_LAYER_KHRONOS_validation"};
00103         const std::vector<const char*> deviceExtensions = {VK_KHR_SWAPCHAIN_EXTENSION_NAME};
00104
00105     }; // class Device
00106
00107 } // namespace ven

```

7.11 /home/runner/work/VEngine/VEngine/include/VEngine/Engine.hpp File Reference

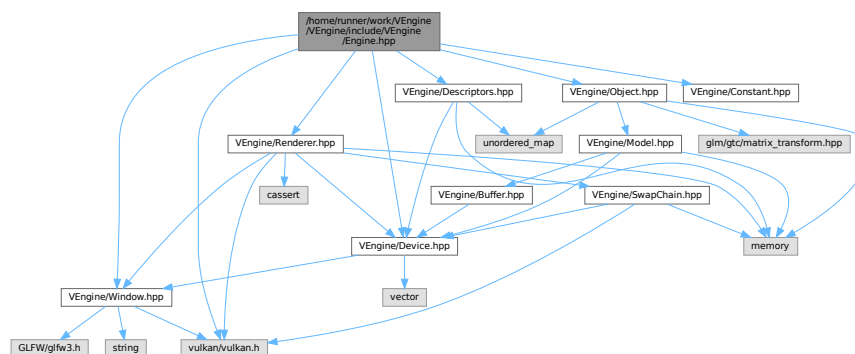
This file contains the Engine class.

```

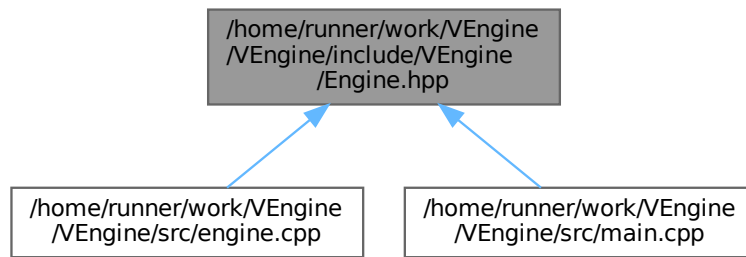
#include <vulkan/vulkan.h>
#include "VEngine/Window.hpp"
#include "VEngine/Constant.hpp"
#include "VEngine/Device.hpp"
#include "VEngine/Object.hpp"
#include "VEngine/Renderer.hpp"
#include "VEngine/Descriptors.hpp"
#include "VEngine/Descriptors.hpp"

```

Include dependency graph for Engine.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class [ven::Engine](#)

Namespaces

- namespace [ven](#)

7.11.1 Detailed Description

This file contains the Engine class.

Definition in file [Engine.hpp](#).

7.12 Engine.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Engine.hpp
00003 /// @brief This file contains the Engine class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <vulkan/vulkan.h>
00010
00011 #include "VEngine/Window.hpp"
00012 #include "VEngine/Constant.hpp"
00013 #include "VEngine/Device.hpp"
00014 #include "VEngine/Object.hpp"
00015 #include "VEngine/Renderer.hpp"
00016 #include "VEngine/Descriptors.hpp"
00017
00018 namespace ven {
00019
00020     class Engine {
00021     public:
00022
00023         explicit Engine(uint32_t = DEFAULT_WIDTH, uint32_t = DEFAULT_HEIGHT, const std::string &title
00024             = DEFAULT_TITLE.data());
  
```

```

00025         ~Engine() = default;
00026
00027         Engine(const Engine &) = delete;
00028         Engine operator=(const Engine &) = delete;
00029
00030         Window &getWindow() { return m_window; };
00031
00032         void mainLoop();
00033
00034     private:
00035
00036         void loadObjects();
00037
00038         Window m_window;
00039         Device m_device{m_window};
00040         Renderer m_renderer{m_window, m_device};
00041
00042         std::unique_ptr<DescriptorPool> m_globalPool;
00043         Object::Map m_objects;
00044
00045         VkInstance m_instance{nullptr};
00046         VkSurfaceKHR m_surface{nullptr};
00047
00048         void createInstance();
00049         void createSurface() { if (glfwCreateWindowSurface(m_instance, m_window.getGLFWWindow(),
00050 nullptr, &m_surface) != VK_SUCCESS) { throw std::runtime_error("Failed to create window surface"); } }
00051     }; // class Engine
00052
00053 } // namespace ven

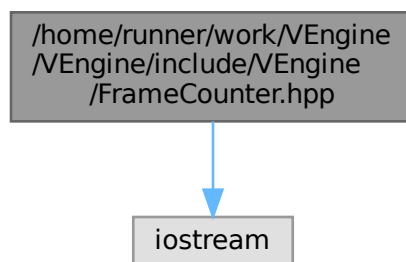
```

7.13 /home/runner/work/VEngine/VEngine/include/VEngine/FrameCounter.hpp File Reference

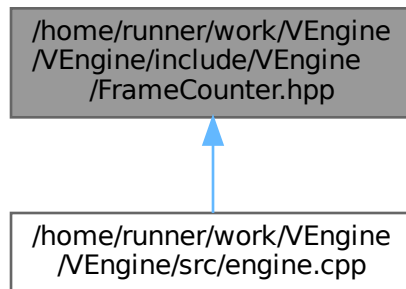
This file contains the FrameCounter class.

```
#include <iostream>
```

Include dependency graph for FrameCounter.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class [ven::FrameCounter](#)

Namespaces

- namespace [ven](#)

7.13.1 Detailed Description

This file contains the FrameCounter class.

Definition in file [FrameCounter.hpp](#).

7.14 FrameCounter.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file FrameCounter.hpp
00003 /// @brief This file contains the FrameCounter class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <iostream>
00010
00011 namespace ven {
00012
00013     class FrameCounter {
00014
00015     public:
00016
00017         FrameCounter() = default;
00018         ~FrameCounter() = default;
00019
00020         void update(const float deltaTime) {
00021             m_frameCounter += 1.F;
00022             m_timeCounter += deltaTime;

```

```

00023
00024         if (m_timeCounter >= 1.F) {
00025             std::cout << "FPS: " << m_frameCounter << '\n';
00026             m_fps = m_frameCounter;
00027             m_frameTime = 1000.F / m_fps;
00028             m_frameCounter = 0.F;
00029             m_timeCounter = 0.F;
00030         }
00031     }
00032
00033     [[nodiscard]] float getFps() const { return m_fps; }
00034     [[nodiscard]] float getFrameTime() const { return m_frameTime; }
00035
00036 private:
00037
00038     float m_fps{0.F};
00039     float m_frameTime{0.F};
00040     float m_frameCounter{0.F};
00041     float m_timeCounter{0.F};
00042
00043 }; // class FrameCounter
00044
00045 } // namespace ven

```

7.15 /home/runner/work/VEngine/VEngine/include/VEngine/FrameInfo.hpp File Reference

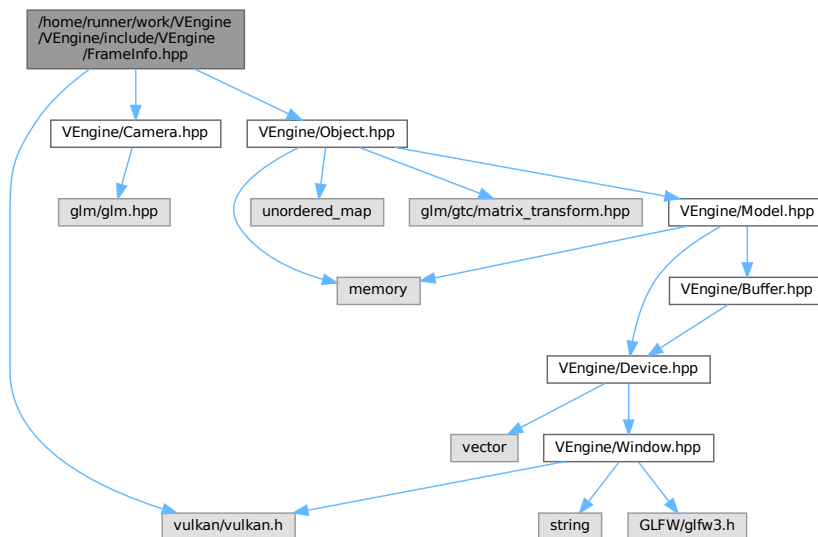
This file contains the FrameInfo class.

```

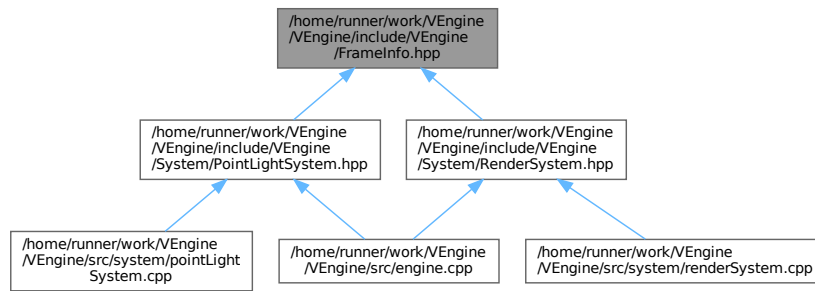
#include <vulkan/vulkan.h>
#include "VEngine/Camera.hpp"
#include "VEngine/Object.hpp"

```

Include dependency graph for FrameInfo.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct [ven::PointLight](#)
- struct [ven::GlobalUbo](#)
- struct [ven::FrameInfo](#)

Namespaces

- namespace [ven](#)

Variables

- static constexpr std::size_t [ven::MAX_LIGHTS](#) = 10

7.15.1 Detailed Description

This file contains the FrameInfo class.

Definition in file [FrameInfo.hpp](#).

7.16 FrameInfo.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file FrameInfo.hpp
00003 /// @brief This file contains the FrameInfo class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <vulkan/vulkan.h>
00010
00011 #include "VEngine/Camera.hpp"
00012 #include "VEngine/Object.hpp"
00013
00014 namespace ven {
00015
00016 static constexpr std::size_t MAX_LIGHTS = 10;

```

```

00017
00018     struct PointLight
00019     {
00020         glm::vec4 position{};
00021         glm::vec4 color{};
00022     };
00023
00024     struct GlobalUbo
00025     {
00026         glm::mat4 projection{1.F};
00027         glm::mat4 view{1.F};
00028         glm::mat4 inverseView{1.F};
00029         glm::vec4 ambientLightColor{1.F, 1.F, 1.F, .02F};
00030         std::array<PointLight, MAX_LIGHTS> pointLights;
00031         int numLights;
00032     };
00033
00034     struct FrameInfo
00035     {
00036         int frameIndex;
00037         float frameTime;
00038         VkCommandBuffer commandBuffer;
00039         Camera &camera;
00040         VkDescriptorSet globalDescriptorSet;
00041         Object::Map &objects;
00042     };
00043
00044 } // namespace ven

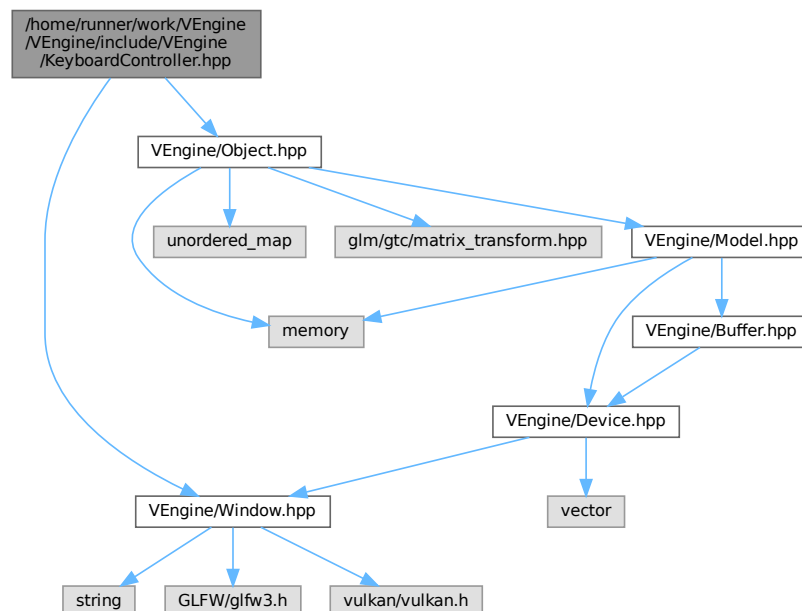
```

7.17 /home/runner/work/VEngine/VEngine/include/VEngine/KeyboardController.hpp File Reference

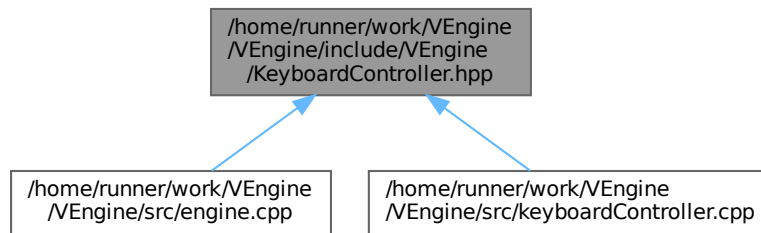
```
#include "VEngine/Window.hpp"
```

```
#include "VEngine/Object.hpp"
```

Include dependency graph for KeyboardController.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class [ven::KeyboardController](#)
- struct [ven::KeyboardController::KeyMappings](#)

Namespaces

- namespace [ven](#)

7.18 KeyboardController.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Camera.hpp
00003 /// @brief This file contains the KeyboardController class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include "VEngine/Window.hpp"
00010 #include "VEngine/Object.hpp"
00011
00012 namespace ven {
00013
00014     class KeyboardController {
00015     public:
00016
00017         struct KeyMappings {
00018             int moveLeft = GLFW_KEY_A;
00019             int moveRight = GLFW_KEY_D;
00020             int moveForward = GLFW_KEY_W;
00021             int moveBackward = GLFW_KEY_S;
00022             int moveUp = GLFW_KEY_SPACE;
00023             int moveDown = GLFW_KEY_LEFT_SHIFT;
00024             int lookLeft = GLFW_KEY_LEFT;
00025             int lookRight = GLFW_KEY_RIGHT;
00026             int lookUp = GLFW_KEY_UP;
00027             int lookDown = GLFW_KEY_DOWN;
00028         };
00029
00030         void moveInPlaneXZ(GLFWwindow* window, float dt, Object& object) const;
00031
00032         KeyMappings m_keys{};
00033         float m_moveSpeed{3.F};
00034         float m_lookSpeed{1.5F};
00035
00036     }; // class KeyboardController
00037
00038 } // namespace ven
00039 
```


Namespaces

- namespace [ven](#)

7.19.1 Detailed Description

This file contains the Model class.

Definition in file [Model.hpp](#).

7.20 Model.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Model.hpp
00003 /// @brief This file contains the Model class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <memory>
00010
00011 #include "VEngine/Device.hpp"
00012 #include "VEngine/Buffer.hpp"
00013
00014 namespace ven {
00015
00016     class Model {
00017
00018     public:
00019
00020         struct Vertex {
00021             glm::vec3 position{};
00022             glm::vec3 color{};
00023             glm::vec3 normal{};
00024             glm::vec2 uv{};
00025
00026             static std::vector<VkVertexInputBindingDescription> getBindingDescriptions();
00027             static std::vector<VkVertexInputAttributeDescription> getAttributeDescriptions();
00028
00029             bool operator==(const Vertex& other) const {
00030                 return position == other.position && color == other.color && normal ==
00031                 other.normal && uv == other.uv;
00032             };
00033
00034             struct Builder {
00035                 std::vector<Vertex> vertices;
00036                 std::vector<uint32_t> indices;
00037
00038                 void loadModel(const std::string &filename);
00039             };
00040
00041             Model(Device &device, const Builder &builder);
00042             ~Model();
00043
00044             Model(const Model&) = delete;
00045             void operator=(const Model&) = delete;
00046
00047             static std::unique_ptr<Model> createModelFromFile(Device &device, const std::string
&filename);
00048
00049             void bind(VkCommandBuffer commandBuffer) const;
00050             void draw(VkCommandBuffer commandBuffer) const;
00051
00052         private:
00053
00054             void createVertexBuffer(const std::vector<Vertex>& vertices);
00055             void createIndexBuffer(const std::vector<uint32_t>& indices);
00056
00057             Device& m_device;
00058             std::unique_ptr<Buffer> m_vertexBuffer;
00059             uint32_t m_vertexCount;

```

```

00060
00061         bool m_hasIndexBuffer{false};
00062         std::unique_ptr<Buffer> m_indexBuffer;
00063         uint32_t m_indexCount;
00064
00065     }; // class Model
00066
00067 } // namespace ven

```

7.21 /home/runner/work/VEngine/VEngine/include/VEngine/Object.hpp File Reference

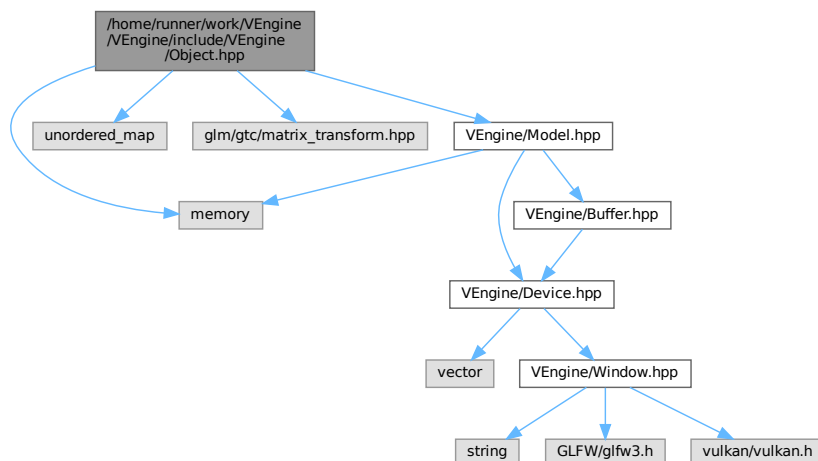
This file contains the Object class.

```

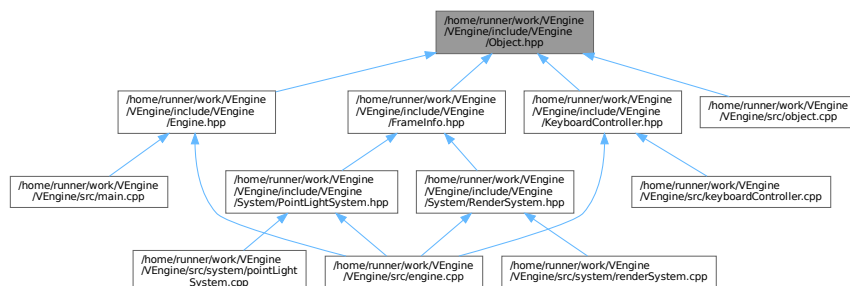
#include <memory>
#include <unordered_map>
#include <glm/gtc/matrix_transform.hpp>
#include "VEngine/Model.hpp"

```

Include dependency graph for Object.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct `ven::Transform3DComponent`
- struct `ven::PointLightComponent`
- class `ven::Object`

Namespaces

- namespace `ven`

Typedefs

- using `ven::id_t` = unsigned int

7.21.1 Detailed Description

This file contains the Object class.

Definition in file [Object.hpp](#).

7.22 Object.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Object.hpp
00003 /// @brief This file contains the Object class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <memory>
00010 #include <unordered_map>
00011
00012 #include <glm/gtc/matrix_transform.hpp>
00013
00014 #include "VEngine/Model.hpp"
00015
00016 namespace ven {
00017
00018     using id_t = unsigned int;
00019
00020     struct Transform3DComponent {
00021         glm::vec3 translation{};
00022         glm::vec3 scale{1.F, 1.F, 1.F};
00023         glm::vec3 rotation{};
00024
00025         [[nodiscard]] glm::mat4 mat4() const;
00026         [[nodiscard]] glm::mat3 normalMatrix() const;
00027     };
00028
00029     struct PointLightComponent {
00030         float lightIntensity = 1.0F;
00031     };
00032
00033     class Object {
00034
00035     public:
00036
00037         using Map = std::unordered_map<id_t, Object>;
00038
00039         static Object createObject() { static id_t objId = 0; return Object(objId++); }
00040
00041         ~Object() = default;
00042
00043     };

```

```

00044         static Object makePointLight(float intensity = 10.F, float radius = 0.1F, glm::vec3 color
= glm::vec3(1.F));
00045
00046         Object(const Object&) = delete;
00047         Object& operator=(const Object&) = delete;
00048         Object(Object&&) = default;
00049         Object& operator=(Object&&) = default;
00050
00051         [[nodiscard]] id_t getId() const { return m_objId; }
00052
00053         std::shared_ptr<Model> model{};
00054         glm::vec3 color{};
00055         Transform3DComponent transform3D{};
00056
00057         std::unique_ptr<PointLightComponent> pointLight = nullptr;
00058
00059     private:
00060         explicit Object(const id_t objId) : m_objId(objId) {}
00061
00062         id_t m_objId;
00063
00064     }; // class Object
00065
00066 } // namespace ven

```

7.23 /home/runner/work/VEngine/VEngine/include/VEngine/Renderer.hpp File Reference

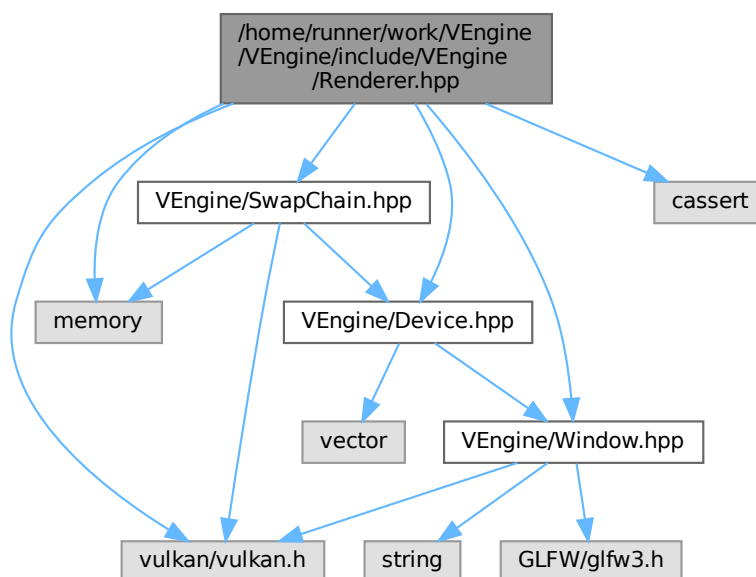
This file contains the Renderer class.

```

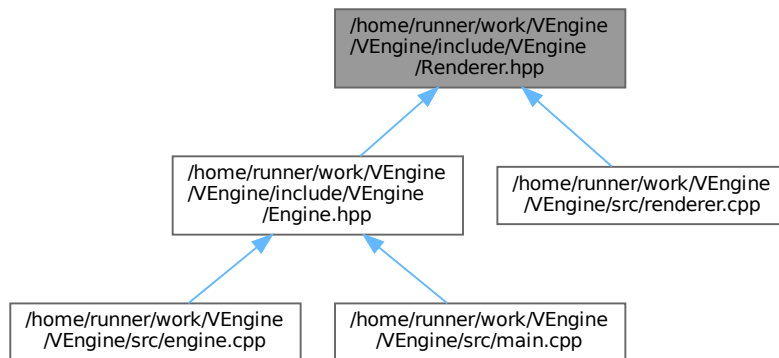
#include <memory>
#include <cassert>
#include <vulkan/vulkan.h>
#include "VEngine/Window.hpp"
#include "VEngine/Device.hpp"
#include "VEngine/SwapChain.hpp"

```

Include dependency graph for Renderer.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class [ven::Renderer](#)

Namespaces

- namespace [ven](#)

7.23.1 Detailed Description

This file contains the `Renderer` class.

Definition in file [Renderer.hpp](#).

7.24 Renderer.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Renderer.hpp
00003 /// @brief This file contains the Renderer class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <memory>
00010 #include <cassert>
00011
00012 #include <vulkan/vulkan.h>
00013
00014 #include "VEngine/Window.hpp"
00015 #include "VEngine/Device.hpp"
00016 #include "VEngine/SwapChain.hpp"
00017
00018 namespace ven {
00019
00020     class Renderer {
00021     public:

```

```

00023
00024     Renderer(Window &window, Device &device) : m_window{window}, m_device{device} {
00025         recreateSwapChain(); createCommandBuffers(); }
00026     ~Renderer() { freeCommandBuffers(); }
00027
00027     Renderer(const Renderer &) = delete;
00028     Renderer& operator=(const Renderer &) = delete;
00029
00030     [[nodiscard]] VkRenderPass getSwapChainRenderPass() const { return
00031         m_swapChain->getRenderPass(); }
00031     [[nodiscard]] float getAspectRatio() const { return m_swapChain->extentAspectRatio(); }
00032     [[nodiscard]] bool isFrameInProgress() const { return m_isFrameStarted; }
00033     [[nodiscard]] VkCommandBuffer getCurrentCommandBuffer() const { assert(isFrameInProgress() &&
00034         "cannot get command m_buffer when frame not in progress"); return
00035         m_commandBuffers[static_cast<unsigned long>(m_currentFrameIndex)]; }
00036
00037     [[nodiscard]] int getFrameIndex() const { assert(isFrameInProgress() && "cannot get frame
00038         index when frame not in progress"); return m_currentFrameIndex; }
00039
00040     VkCommandBuffer beginFrame();
00041     void endFrame();
00042     void beginSwapChainRenderPass(VkCommandBuffer commandBuffer) const;
00043     static void endSwapChainRenderPass(VkCommandBuffer commandBuffer);
00044
00045     private:
00046
00047         void createCommandBuffers();
00048         void freeCommandBuffers();
00049         void recreateSwapChain();
00050
00051         Window &m_window;
00052         Device &m_device;
00053         std::unique_ptr<SwapChain> m_swapChain;
00054         std::vector<VkCommandBuffer> m_commandBuffers;
00055
00056         uint32_t m_currentImageIndex{0};
00057         int m_currentFrameIndex{0};
00058         bool m_isFrameStarted{false};
00059
00060     }; // class Renderer
00061 } // namespace ven

```

7.25 /home/runner/work/VEngine/VEngine/include/VEngine/Shaders.hpp File Reference

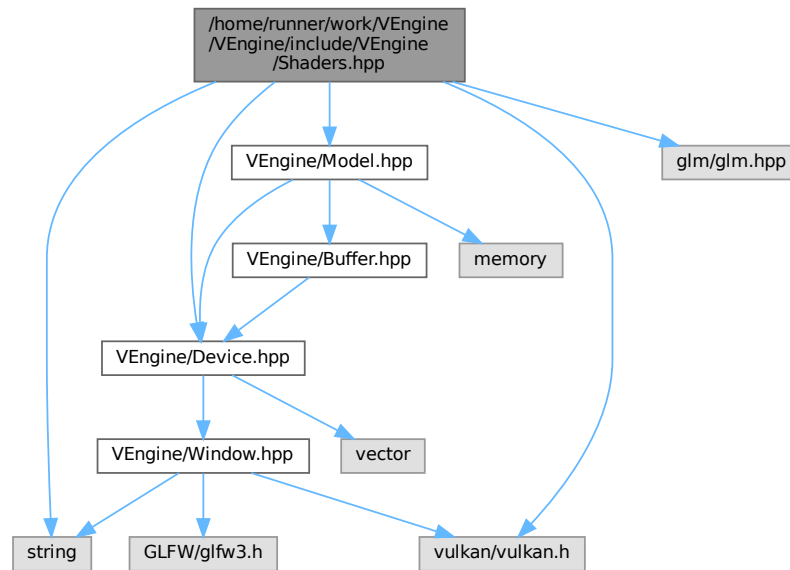
This file contains the Shader class.

```

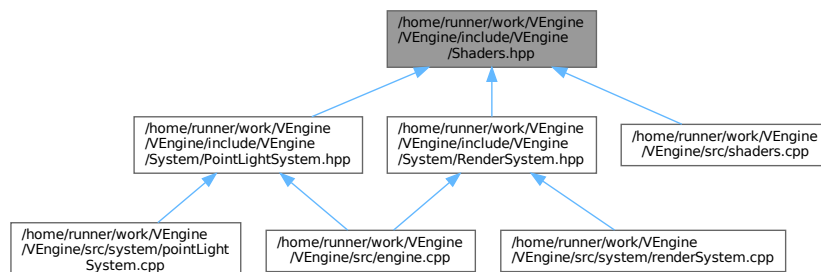
#include <string>
#include <vulkan/vulkan.h>
#include <glm/glm.hpp>
#include "VEngine/Device.hpp"
#include "VEngine/Model.hpp"

```

Include dependency graph for Shaders.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct `ven::PipelineConfigInfo`
- class `ven::Shaders`

Namespaces

- namespace `ven`

7.25.1 Detailed Description

This file contains the Shader class.

Definition in file `Shaders.hpp`.

7.26 Shaders.hpp

[Go to the documentation of this file.](#)

```

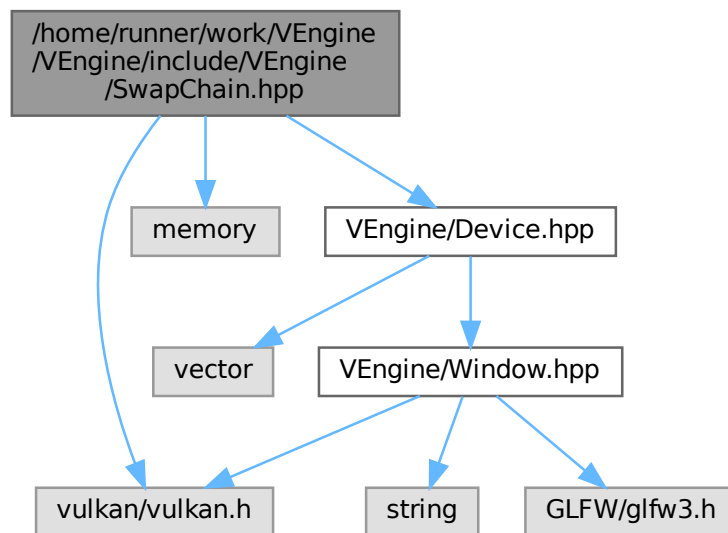
00001 ///
00002 /// @file Shaders.hpp
00003 /// @brief This file contains the Shader class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <string>
00010
00011 #include <vulkan/vulkan.h>
00012 #include <glm/glm.hpp>
00013
00014 #include "VEngine/Device.hpp"
00015 #include "VEngine/Model.hpp"
00016
00017 namespace ven {
00018
00019     struct PipelineConfigInfo {
00020         PipelineConfigInfo() = default;
00021         PipelineConfigInfo(const PipelineConfigInfo&) = delete;
00022         PipelineConfigInfo& operator=(const PipelineConfigInfo&) = delete;
00023
00024         std::vector<VkVertexInputBindingDescription> bindingDescriptions;
00025         std::vector<VkVertexInputAttributeDescription> attributeDescriptions;
00026         VkPipelineInputAssemblyStateCreateInfo inputAssemblyInfo{};
00027         VkPipelineRasterizationStateCreateInfo rasterizationInfo{};
00028         VkPipelineMultisampleStateCreateInfo multisampleInfo{};
00029         VkPipelineColorBlendAttachmentState colorBlendAttachment{};
00030         VkPipelineColorBlendStateCreateInfo colorBlendInfo{};
00031         VkPipelineDepthStencilStateCreateInfo depthStencilInfo{};
00032         std::vector<VkDynamicState> dynamicStateEnables;
00033         VkPipelineDynamicStateCreateInfo dynamicStateInfo{};
00034         VkPipelineLayout pipelineLayout = nullptr;
00035         VkRenderPass renderPass = nullptr;
00036         uint32_t subpass = 0;
00037     };
00038
00039     class Shaders {
00040     public:
00041
00042         Shaders(Device &device, const std::string& vertFilepath, const std::string& fragFilepath,
00043 const PipelineConfigInfo& configInfo) : m_device{device} { createGraphicsPipeline(vertFilepath,
00044 fragFilepath, configInfo); };
00045
00046         Shaders(const Shaders&) = delete;
00047         Shaders& operator=(const Shaders&) = delete;
00048
00049         static void defaultPipelineConfigInfo(PipelineConfigInfo& configInfo);
00050         void bind(const VkCommandBuffer commandBuffer) const { vkCmdBindPipeline(commandBuffer,
00051 VK_PIPELINE_BIND_POINT_GRAPHICS, m_graphicsPipeline); }
00052
00053     private:
00054
00055         static std::vector<char> readFile(const std::string &filename);
00056         void createGraphicsPipeline(const std::string& vertFilepath, const std::string&
00057 fragFilepath, const PipelineConfigInfo& configInfo);
00058         void createShaderModule(const std::vector<char>& code, VkShaderModule* shaderModule)
00059 const;
00060
00061         Device& m_device;
00062         VkPipeline m_graphicsPipeline{nullptr};
00063         VkShaderModule m_vertShaderModule{nullptr};
00064         VkShaderModule m_fragShaderModule{nullptr};
00065     }; // class Shaders
00066 } // namespace ven

```

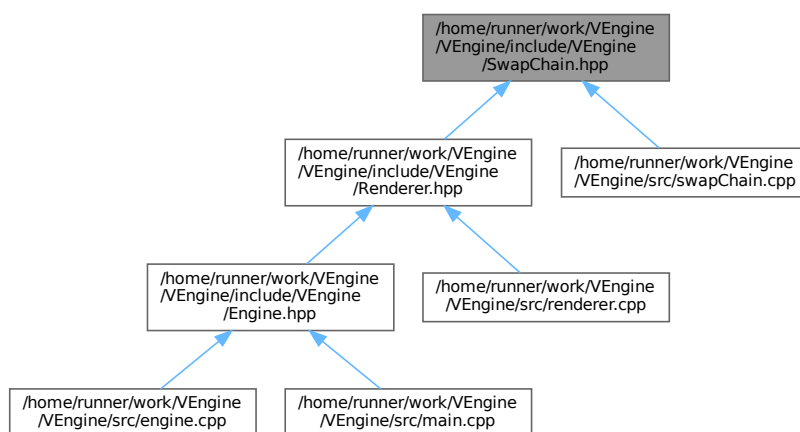
7.27 /home/runner/work/VEngine/VEngine/include/VEngine/SwapChain.hpp File Reference

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](#)

Namespaces

- namespace [ven](#)

7.27.1 Detailed Description

This file contains the Shader class.

Definition in file [SwapChain.hpp](#).

7.28 SwapChain.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file SwapChain.hpp
00003 /// @brief This file contains the Shader class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <vulkan/vulkan.h>
00010 #include <memory>
00011
00012 #include "VEngine/Device.hpp"
00013
00014 namespace ven {
00015
00016     class SwapChain {
00017
00018     public:
00019
00020         static constexpr int MAX_FRAMES_IN_FLIGHT = 2;
00021
00022         SwapChain(Device &deviceRef, const VkExtent2D windowExtentRef) : device{deviceRef},
00023 windowExtent{windowExtentRef} { init(); }
00024
00025         SwapChain(Device &deviceRef, const VkExtent2D windowExtentRef, std::shared_ptr<SwapChain>
00026 previous) : device{deviceRef}, windowExtent{windowExtentRef}, oldSwapChain{std::move(previous)} {
00027 init(); oldSwapChain = nullptr; }
00028
00029         ~SwapChain();
00030
00031         SwapChain(const SwapChain &) = delete;
00032         SwapChain& operator=(const SwapChain &) = delete;
00033
00034         [[nodiscard]] VkFramebuffer getFramebuffer(const unsigned long index) const { return
00035 swapChainFramebuffers[index]; }
00036
00037         [[nodiscard]] VkRenderPass getRenderPass() const { return renderPass; }
00038
00039         [[nodiscard]] VkImageView getImageView(const int index) const { return
00040 swapChainImageViews[static_cast<unsigned long>(index)]; }
00041
00042         [[nodiscard]] size_t imageCount() const { return swapChainImages.size(); }
00043
00044         [[nodiscard]] VkFormat getSwapChainImageFormat() const { return swapChainImageFormat; }
00045
00046         [[nodiscard]] VkExtent2D getSwapChainExtent() const { return m_swapChainExtent; }
00047
00048         [[nodiscard]] uint32_t width() const { return m_swapChainExtent.width; }
00049
00050         [[nodiscard]] uint32_t height() const { return m_swapChainExtent.height; }
00051
00052         [[nodiscard]] float extentAspectRatio() const { return
00053 static_cast<float>(m_swapChainExtent.width) / static_cast<float>(m_swapChainExtent.height); }
00054
00055         [[nodiscard]] VkFormat findDepthFormat() const;
00056
00057         VkResult acquireNextImage(uint32_t *imageIndex) const;
00058         VkResult submitCommandBuffers(const VkCommandBuffer *buffers, const uint32_t *imageIndex);
00059
00060         [[nodiscard]] bool compareSwapFormats(const SwapChain &swapChainp) const {
00061             return swapChainImageFormat == swapChainp.swapChainImageFormat && swapChainDepthFormat
00062 == swapChainp.swapChainDepthFormat;
00063         }
00064
00065     private:
00066
00067         void init();
00068         void createSwapChain();
00069         void createImageViews();
00070         void createDepthResources();
00071         void createRenderPass();

```



```

00055         void createFramebuffers();
00056         void createSyncObjects();
00057
00058         static VkSurfaceFormatKHR chooseSwapSurfaceFormat(const std::vector<VkSurfaceFormatKHR>
&availableFormats);
00059         static VkPresentModeKHR chooseSwapPresentMode(const std::vector<VkPresentModeKHR>
&availablePresentModes);
00060         VkExtent2D chooseSwapExtent(const VkSurfaceCapabilitiesKHR &capabilities) const;
00061
00062         VkFormat swapChainImageFormat{};
00063         VkFormat swapChainDepthFormat{};
00064         VkExtent2D m_swapChainExtent{};
00065
00066         std::vector<VkFramebuffer> swapChainFramebuffers;
00067         VkRenderPass renderPass{};
00068
00069         std::vector<VkImage> depthImages;
00070         std::vector<VkDeviceMemory> depthImageMemorys;
00071         std::vector<VkImageView> depthImageViews;
00072         std::vector<VkImage> swapChainImages;
00073         std::vector<VkImageView> swapChainImageViews;
00074
00075         Device &device;
00076         VkExtent2D windowExtent;
00077
00078         VkSwapchainKHR swapChain{};
00079         std::shared_ptr<SwapChain> oldSwapChain;
00080
00081         std::vector<VkSemaphore> imageAvailableSemaphores;
00082         std::vector<VkSemaphore> renderFinishedSemaphores;
00083         std::vector<VkFence> inFlightFences;
00084         std::vector<VkFence> imagesInFlight;
00085         size_t currentFrame = 0;
00086
00087     }; // class SwapChain
00088
00089 } // namespace ven

```

7.29 /home/runner/work/VEngine/VEngine/include/VEngine/System/PointLightSystem.hpp File Reference

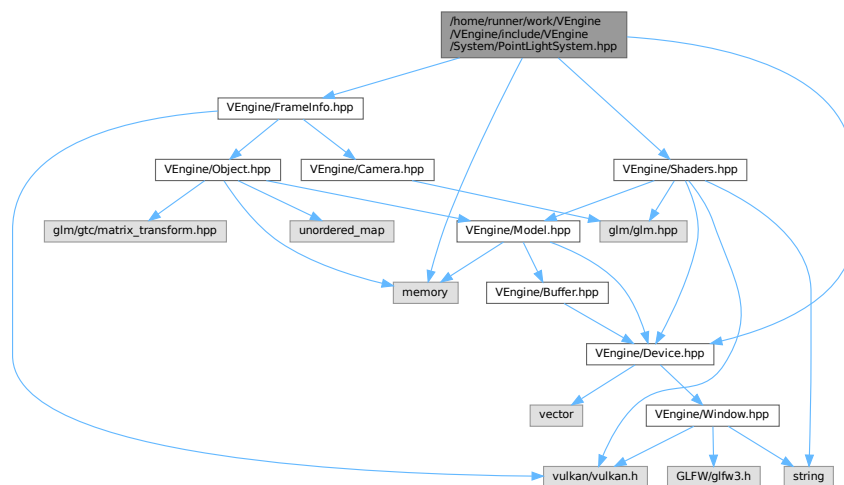
This file contains the PointLightSystem class.

```

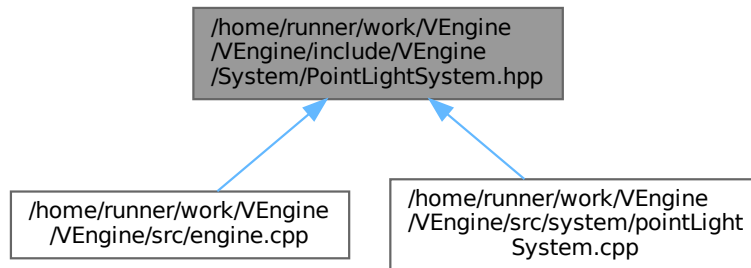
#include <memory>
#include "VEngine/Device.hpp"
#include "VEngine/Shaders.hpp"
#include "VEngine/FrameInfo.hpp"

```

Include dependency graph for PointLightSystem.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class [ven::PointLightSystem](#)
Class for point light system.

Namespaces

- namespace [ven](#)

7.29.1 Detailed Description

This file contains the PointLightSystem class.

Definition in file [PointLightSystem.hpp](#).

7.30 PointLightSystem.hpp

[Go to the documentation of this file.](#)

```

00001 ///  

00002 ///  

00003 ///  

00004 ///  

00005 ///  

00006 ///  

00007 #pragma once  

00008 #include <memory>  

00009 #include "VEngine/Device.hpp"  

00010 #include "VEngine/Shaders.hpp"  

00011 #include "VEngine/FrameInfo.hpp"  

00012 namespace ven {  

00013     ///  

00014     ///  

00015     ///  

00016     ///  

00017     ///  

00018     ///  

00019     ///  

00020     ///  

00021     ///  

00022     class PointLightSystem {  

00023 
```

```

00024     public:
00025
00026         explicit PointLightSystem(Device& device, VkRenderPass renderPass, VkDescriptorSetLayout
globalSetLayout);
00027         ~PointLightSystem() { vkDestroyPipelineLayout(m_device.device(), m_pipelineLayout,
nullptr); }
00028
00029         PointLightSystem(const PointLightSystem&) = delete;
00030         PointLightSystem& operator=(const PointLightSystem&) = delete;
00031
00032         static void update(const FrameInfo &frameInfo, GlobalUbo &ubo);
00033         void render(const FrameInfo &frameInfo) const;
00034
00035     private:
00036
00037         void createPipelineLayout(VkDescriptorSetLayout globalSetLayout);
00038         void createPipeline(VkRenderPass renderPass);
00039
00040         Device &m_device;
00041
00042         std::unique_ptr<Shaders> m_shaders;
00043         VkPipelineLayout m_pipelineLayout{nullptr};
00044
00045 }; // class PointLightSystem
00046
00047 } // namespace ven

```

7.31 /home/runner/work/VEngine/VEngine/include/VEngine/System/RenderSystem.hpp File Reference

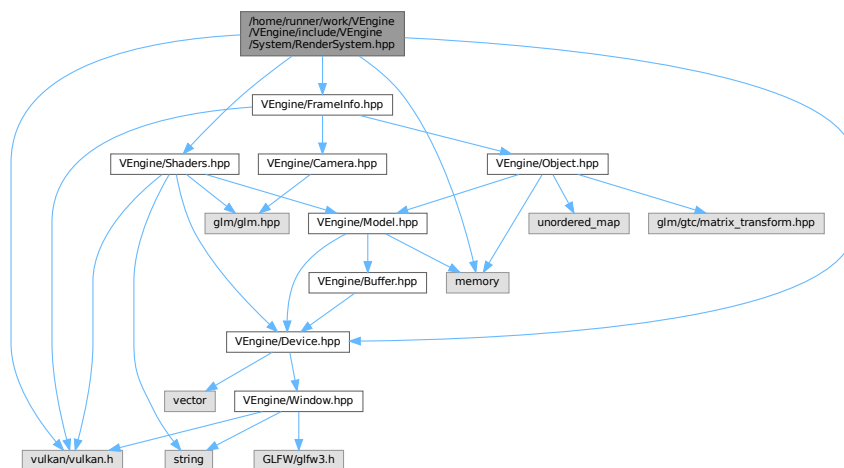
This file contains the RenderSystem class.

```

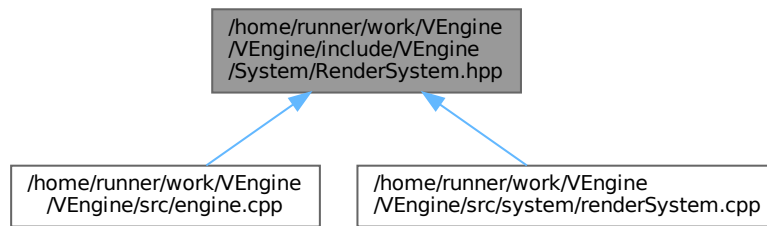
#include <memory>
#include <vulkan/vulkan.h>
#include "VEngine/Device.hpp"
#include "VEngine/Shaders.hpp"
#include "VEngine/FrameInfo.hpp"

```

Include dependency graph for RenderSystem.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- struct [ven::SimplePushConstantData](#)
- class [ven::RenderSystem](#)
Class for render system.

Namespaces

- namespace [ven](#)

7.31.1 Detailed Description

This file contains the RenderSystem class.

Definition in file [RenderSystem.hpp](#).

7.32 RenderSystem.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file RenderSystem.hpp
00003 /// @brief This file contains the RenderSystem class
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <memory>
00010
00011 #include <vulkan/vulkan.h>
00012
00013 #include "VEngine/Device.hpp"
00014 #include "VEngine/Shaders.hpp"
00015 #include "VEngine/FrameInfo.hpp"
00016
00017 namespace ven {
00018
00019     struct SimplePushConstantData {
00020         glm::mat4 modelMatrix{1.F};
00021         glm::mat4 normalMatrix{1.F};
00022     };
00023
00024     ///
  
```

```

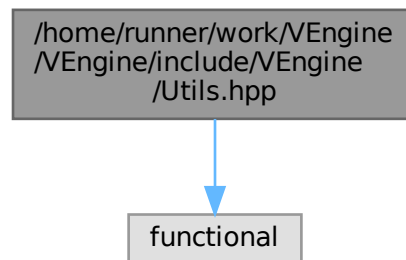
00025     /// @class RenderSystem
00026     /// @brief Class for render system
00027     /// @namespace ven
00028     class RenderSystem {
00029     public:
00030
00031         explicit RenderSystem(Device& device, VkRenderPass renderPass, VkDescriptorSetLayout
00032 globalSetLayout);
00033         ~RenderSystem() { vkDestroyPipelineLayout(m_device.device(), m_pipelineLayout, nullptr); }
00034
00035         RenderSystem(const RenderSystem&) = delete;
00036         RenderSystem& operator=(const RenderSystem&) = delete;
00037
00038         void renderObjects(const FrameInfo &frameInfo) const;
00039
00040     private:
00041
00042         void createPipelineLayout(VkDescriptorSetLayout globalSetLayout);
00043         void createPipeline(VkRenderPass renderPass);
00044
00045         Device &m_device;
00046
00047         std::unique_ptr<Shaders> m_shaders;
00048         VkPipelineLayout m_pipelineLayout{nullptr};
00049     }; // class RenderSystem
00050
00051
00052 } // namespace ven

```

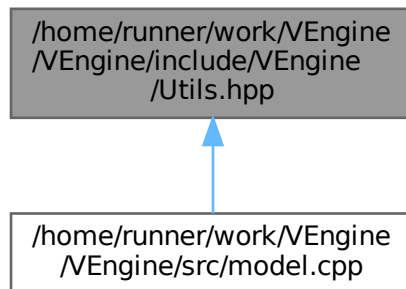
7.33 /home/runner/work/VEngine/VEngine/include/VEngine/Utils.hpp File Reference

#include <functional>

Include dependency graph for Utils.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)`

7.34 Utils.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Utils.hpp
00003 /// @brief
00004 /// @namespace ven
00005 ///
00006
00007 #pragma once
00008
00009 #include <functional>
00010
00011 namespace ven {
00012
00013     template<typename T, typename... Rest>
00014     void hashCombine(std::size_t& seed, const T& v, const Rest&... rest) {
00015         seed ^= std::hash<T>{}(v) + 0x9e3779b9 + (seed << 6) + (seed >> 2);
00016         (hashCombine(seed, rest), ...);
00017     }
00018
00019 } // namespace ven
  
```

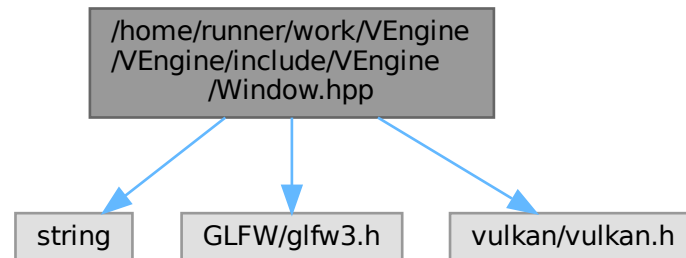
7.35 /home/runner/work/VEngine/VEngine/include/VEngine/Window.hpp

File Reference

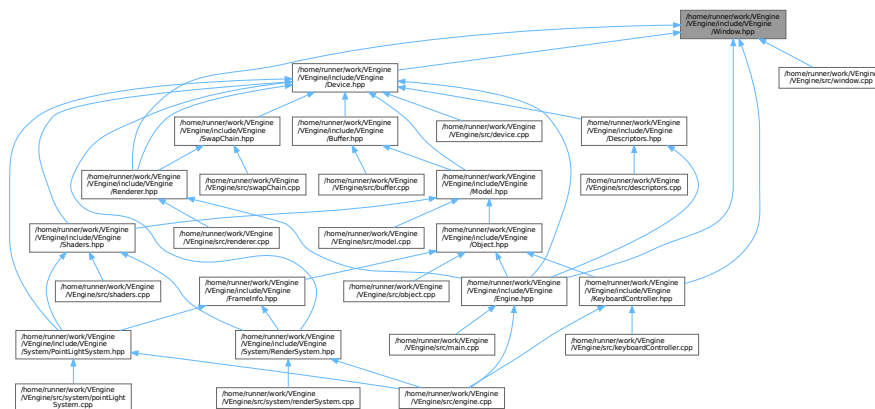
This file contains the Window class.

```
#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](#)

Namespaces

- namespace [ven](#)

Macros

- #define [GLFW_INCLUDE_VULKAN](#)

7.35.1 Detailed Description

This file contains the Window class.

Definition in file [Window.hpp](#).

7.35.2 Macro Definition Documentation

7.35.2.1 GLFW_INCLUDE_VULKAN

```
#define GLFW_INCLUDE_VULKAN
```

Definition at line 11 of file [Window.hpp](#).

7.36 Window.hpp

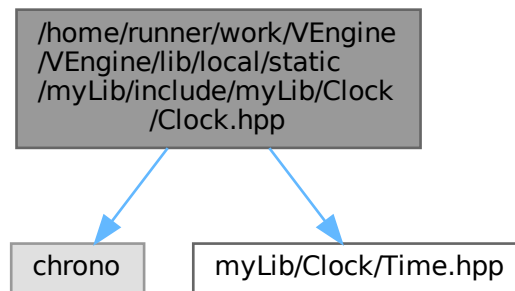
[Go to the documentation of this file.](#)

```
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     class Window {
00018     public:
00019
00020         Window(const uint32_t width, const uint32_t height, const std::string &title) :
00021             m_window(createWindow(width, height, title)), m_width(width), m_height(height) {};
00022         ~Window() { glfwDestroyWindow(m_window); glfwTerminate(); m_window = nullptr; };
00023
00024         [[nodiscard]] GLFWwindow* createWindow(uint32_t width, uint32_t height, const std::string
00025             &title);
00026         void createWindowSurface(VkInstance instance, VkSurfaceKHR* surface) const;
00027         [[nodiscard]] GLFWwindow* getGLFWwindow() const { return m_window; };
00028
00029         [[nodiscard]] VkExtent2D getExtent() const { return {m_width, m_height}; };
00030         [[nodiscard]] bool wasWindowResized() const { return m_framebufferResized; }
00031         void resetWindowResizedFlag() { m_framebufferResized = false; }
00032
00033     private:
00034
00035         static void framebufferResizeCallback(GLFWwindow* window, int width, int height);
00036
00037         GLFWwindow* m_window{nullptr};
00038         uint32_t m_width;
00039         uint32_t m_height;
00040
00041         bool m_framebufferResized = false;
00042
00043     }; // class Window
00044
00045 } // namespace ven
```

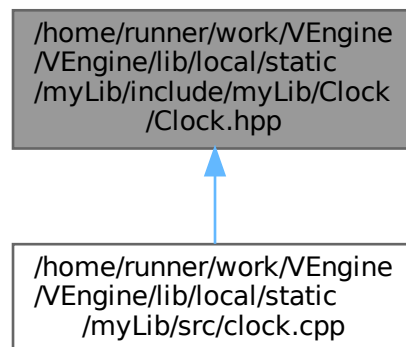

7.37 /home/runner/work/VEngine/VEngine/lib/local/static/myLib/include/myLib/Clock/Clock.hpp File Reference

Clock class for time management.

```
#include <chrono>
#include "myLib/Clock/Time.hpp"
Include dependency graph for Clock.hpp:
```



This graph shows which files directly or indirectly include this file:



Classes

- class `myLib::Clock`
Class for time management.


```

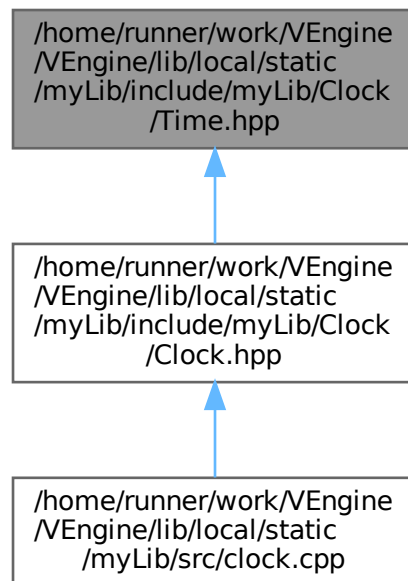
00033         ///
00034         void restart() { m_start = std::chrono::high_resolution_clock::now(); };
00035
00036         ///
00037         /// @brief Pause the clock
00038         ///
00039         void pause();
00040
00041         ///
00042         /// @brief Resume the clock
00043         ///
00044         void resume();
00045
00046         ///
00047         /// @brief Get the elapsed time since the last restart
00048         /// @return Time The elapsed time
00049         ///
00050         [[nodiscard]] Time getElapsedTime() const;
00051
00052     private:
00053
00054         ///
00055         /// @property The start time
00056         ///
00057         TimePoint m_start;
00058
00059         ///
00060         /// @property The pause time
00061         ///
00062         TimePoint m_pause;
00063
00064         ///
00065         /// @property The "is in pause" boolean variable
00066         ///
00067         bool m_paused{false};
00068
00069     }; // Clock
00070
00071 } // namespace myLib

```

7.39 /home/runner/work/VEngine/VEngine/lib/local/static/myLib/include/myLib/Clock/Time.hpp File Reference

Class for time management.

This graph shows which files directly or indirectly include this file:



Classes

- class [myLib::Time](#)
Class used for time management.

Namespaces

- namespace [myLib](#)

7.39.1 Detailed Description

Class for time management.

Definition in file [Time.hpp](#).

7.40 Time.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Time.hpp
00003 /// @brief Class for time management
00004 /// @namespace myLib
00005 ///
00006
00007 #pragma once
  
```

```

00008
00009 namespace myLib {
00010
00011     ///
00012     /// @class Time
00013     /// @brief Class used for time management
00014     ///
00015     class Time {
00016
00017     public:
00018
00019         ///
00020         /// @brief Construct a new Time object
00021         ///
00022         explicit Time(const double seconds) : m_seconds(seconds) {};
00023
00024         ///
00025         /// @brief Transform the time to seconds
00026         /// @return int The time in seconds
00027         ///
00028         [[nodiscard]] int asSeconds() const { return static_cast<int>(m_seconds); };
00029
00030         ///
00031         /// @brief Transform the time to milliseconds
00032         /// @return int The time in milliseconds
00033         ///
00034         [[nodiscard]] int asMilliseconds() const { return static_cast<int>(m_seconds * 1000); }
00035
00036         ///
00037         /// @brief Transform the time to microseconds
00038         /// @return int The time in microseconds
00039         ///
00040         [[nodiscard]] int asMicroseconds() const { return static_cast<int>(m_seconds * 1000000);
00041     };
00042
00043     private:
00044
00045         ///
00046         /// @property The time in seconds
00047         ///
00048         double m_seconds{0.0F};
00049     }; // Time
00050
00051 } // namespace myLib

```

7.41 /home/runner/work/VEngine/VEngine/lib/local/static/myLib/include/myLib/Random.hpp File Reference

Class for random number generation.

```
#include <random>
```

Include dependency graph for Random.hpp:

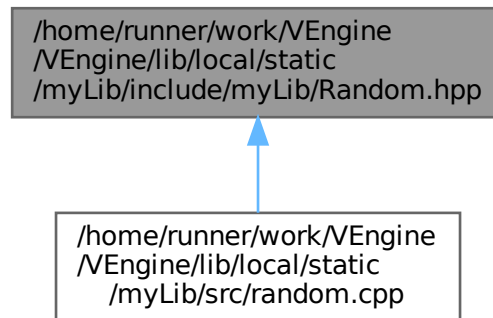
```

/home/runner/work/VEngine
/VEngine/lib/local/static
/myLib/include/myLib/Random.hpp

```

random

This graph shows which files directly or indirectly include this file:



Classes

- class [myLib::Random](#)
Class for random number generation.

Namespaces

- namespace [myLib](#)

7.41.1 Detailed Description

Class for random number generation.

Definition in file [Random.hpp](#).

7.42 Random.hpp

[Go to the documentation of this file.](#)

```

00001 ///
00002 /// @file Random.hpp
00003 /// @brief Class for random number generation
00004 /// @namespace myLib
00005 ///
00006
00007 #pragma once
00008
00009 #include <random>
00010
00011 namespace myLib {
00012
00013     ///
00014     /// @class Random
00015     /// @brief Class for random number generation
00016     ///
00017     class Random {
00018     public:
00019 
```

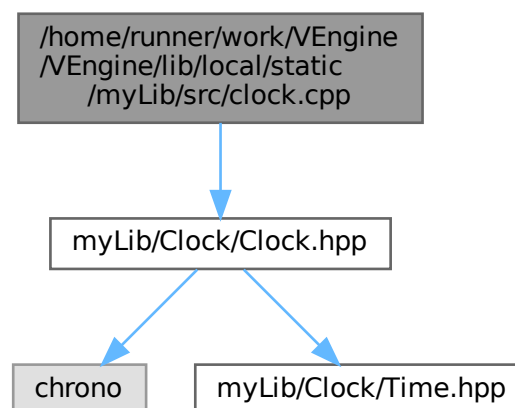
```

00020
00021     ///
00022     /// @brief Generate a random integer between min and max
00023     /// @param min The minimum value
00024     /// @param max The maximum value
00025     /// @return int The random integer
00026     ///
00027     static int randomInt(int min, int max);
00028     static int randomInt() { return randomInt(-1000, 1000); };
00029
00030     ///
00031     /// @param min The minimum value
00032     /// @param max The maximum value
00033     /// @return float The random float
00034     ///
00035     static float randomFloat(float min, float max);
00036     static float randomFloat() { return randomFloat(-1.0f, 1.0f); };
00037
00038 }; // class Random
00039
00040 } // namespace myLib

```

7.43 /home/runner/work/VEngine/VEngine/lib/local/static/myLib/src/clock.cpp File Reference

#include "myLib/Clock/Clock.hpp"
 Include dependency graph for clock.cpp:



7.44 clock.cpp

[Go to the documentation of this file.](#)

```

00001 #include "myLib/Clock/Clock.hpp"
00002
00003 void myLib::Clock::pause()
00004 {
00005     if (m_paused) {
00006         return;
00007     }
00008     m_pause = std::chrono::high_resolution_clock::now();
00009     m_paused = true;
00010 }

```

```

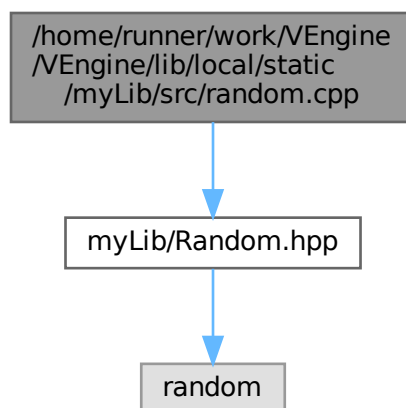
00011
00012 void myLib::Clock::resume()
00013 {
00014     if (!m_paused) {
00015         return;
00016     }
00017     m_start += std::chrono::high_resolution_clock::now() - m_pause;
00018     m_paused = false;
00019 }
00020
00021
00022 myLib::Time myLib::Clock::getElapsedTime() const
00023 {
00024     TimePoint now = std::chrono::high_resolution_clock::now();
00025     std::chrono::duration<float> elapsed_time{};
00026     if (m_paused) {
00027         elapsed_time = m_pause - m_start;
00028     } else {
00029         elapsed_time = now - m_start;
00030     }
00031     return Time(elapsed_time.count());
00032 }

```

7.45 /home/runner/work/VEngine/VEngine/lib/local/static/myLib/src/random.cpp File Reference

```
#include "myLib/Random.hpp"
```

Include dependency graph for random.cpp:



7.46 random.cpp

[Go to the documentation of this file.](#)

```

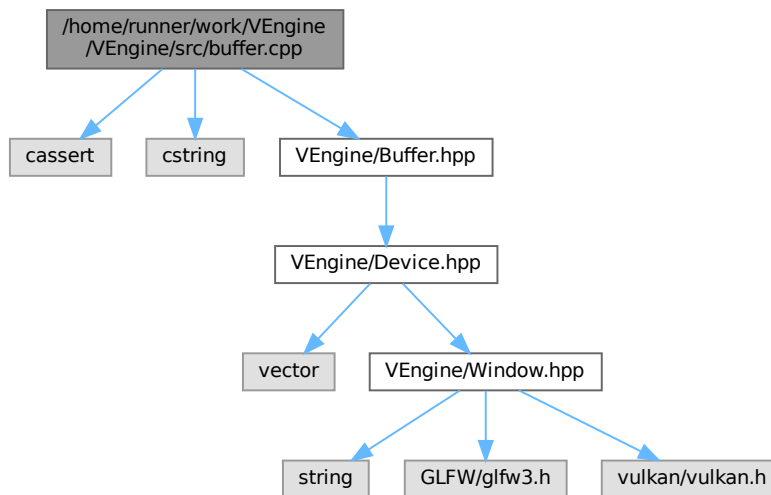
00001 #include "myLib/Random.hpp"
00002
00003 int myLib::Random::randomInt(const int min, const int max)
00004 {
00005     std::mt19937 gen(std::random_device{}());
00006     std::uniform_int_distribution<> dis(min, max);
00007     return dis(gen);
00008 }
00009
00010 float myLib::Random::randomFloat(const float min, const float max)
00011 {
00012     return min + static_cast<float>(randomInt(-1000, 1000)) / 1000.0f * (max - min);
00013 }

```


7.47 /home/runner/work/VEngine/VEngine/README.md File Reference

7.48 /home/runner/work/VEngine/VEngine/src/buffer.cpp File Reference

```
#include <cassert>
#include <cstring>
#include "VEngine/Buffer.hpp"
Include dependency graph for buffer.cpp:
```



7.49 buffer.cpp

[Go to the documentation of this file.](#)

```
00001 #include <cassert>
00002 #include <cstring>
00003
00004 #include "VEngine/Buffer.hpp"
00005
00006 VkDeviceSize ven::Buffer::getAlignment(const VkDeviceSize instanceSize, const VkDeviceSize
minOffsetAlignment) {
00007     if (minOffsetAlignment > 0) {
00008         return (instanceSize + minOffsetAlignment - 1) & ~(minOffsetAlignment - 1);
00009     }
00010     return instanceSize;
00011 }
00012
00013 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}
00014 {
00015     m_bufferSize = m_alignmentSize * m_instanceCount;
00016     device.createBuffer(m_bufferSize, m_usageFlags, m_memoryPropertyFlags, m_buffer, m_memory);
00017 }
00018
00019 ven::Buffer::~~Buffer()
00020 {
00021     unmap();
00022     vkDestroyBuffer(m_device.device(), m_buffer, nullptr);
00023     vkFreeMemory(m_device.device(), m_memory, nullptr);
00024 }
```

```

00025
00026 VkResult ven::Buffer::map(const VkDeviceSize size, const VkDeviceSize offset)
00027 {
00028     assert(m_buffer && m_memory && "Called map on m_buffer before create");
00029     return vkMapMemory(m_device.device(), m_memory, offset, size, 0, &m_mapped);
00030 }
00031
00032 void ven::Buffer::unmap()
00033 {
00034     if (m_mapped != nullptr) {
00035         vkUnmapMemory(m_device.device(), m_memory);
00036         m_mapped = nullptr;
00037     }
00038 }
00039
00040 void ven::Buffer::writeToBuffer(const void *data, const VkDeviceSize size, const VkDeviceSize offset)
00041     const
00042 {
00043     assert(m_mapped && "Cannot copy to unmapped m_buffer");
00044     if (size == VK_WHOLE_SIZE) {
00045         memcpy(m_mapped, data, m_bufferSize);
00046     } else {
00047         char *memOffset = static_cast<char *>(m_mapped);
00048         memOffset += offset;
00049         memcpy(memOffset, data, size);
00050     }
00051 }
00052
00053 VkResult ven::Buffer::flush(const VkDeviceSize size, const VkDeviceSize offset) const
00054 {
00055     VkMappedMemoryRange mappedRange = {};
00056     mappedRange.sType = VK_STRUCTURE_TYPE_MAPPED_MEMORY_RANGE;
00057     mappedRange.memory = m_memory;
00058     mappedRange.offset = offset;
00059     mappedRange.size = size;
00060     return vkFlushMappedMemoryRanges(m_device.device(), 1, &mappedRange);
00061 }
00062
00063 VkResult ven::Buffer::invalidate(const VkDeviceSize size, const VkDeviceSize offset) const
00064 {
00065     VkMappedMemoryRange mappedRange = {};
00066     mappedRange.sType = VK_STRUCTURE_TYPE_MAPPED_MEMORY_RANGE;
00067     mappedRange.memory = m_memory;
00068     mappedRange.offset = offset;
00069     mappedRange.size = size;
00070     return vkInvalidateMappedMemoryRanges(m_device.device(), 1, &mappedRange);
00071 }

```

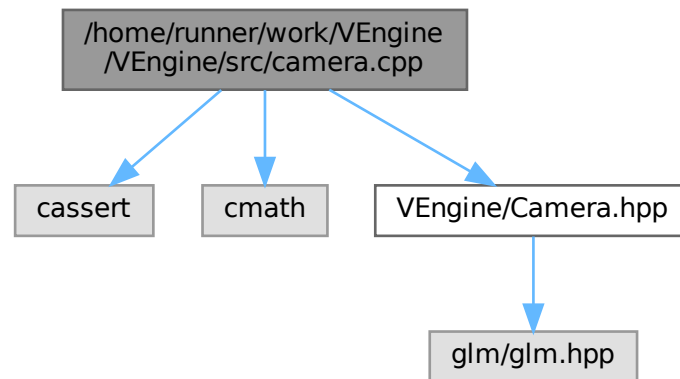
7.50 /home/runner/work/VEngine/VEngine/src/camera.cpp File Reference

```

#include <cassert>
#include <cmath>
#include "VEngine/Camera.hpp"

```

Include dependency graph for camera.cpp:



7.51 camera.cpp

[Go to the documentation of this file.](#)

```

00001 #include <cassert>
00002 #include <cmath>
00003
00004 #include "VEngine/Camera.hpp"
00005
00006 void ven::Camera::setOrthographicProjection(const float left, const float right, const float top,
00007     const float bottom, const float near, const float far)
00008 {
00009     m_projectionMatrix = glm::mat4{1.0F};
00010     m_projectionMatrix[0][0] = 2.F / (right - left);
00011     m_projectionMatrix[1][1] = 2.F / (bottom - top);
00012     m_projectionMatrix[2][2] = 1.F / (far - near);
00013     m_projectionMatrix[3][0] = -(right + left) / (right - left);
00014     m_projectionMatrix[3][1] = -(bottom + top) / (bottom - top);
00015     m_projectionMatrix[3][2] = -near / (far - near);
00016 }
00017
00018 void ven::Camera::setPerspectiveProjection(const float fovy, const float aspect, const float near,
00019     const float far)
00020 {
00021     assert(glm::abs(aspect - std::numeric_limits<float>::epsilon()) > 0.0F);
00022     const float tanHalfFovy = std::tan(fovy / 2.F);
00023     m_projectionMatrix = glm::mat4{0.0F};
00024     m_projectionMatrix[0][0] = 1.F / (aspect * tanHalfFovy);
00025     m_projectionMatrix[1][1] = 1.F / (tanHalfFovy);
00026     m_projectionMatrix[2][2] = far / (far - near);
00027     m_projectionMatrix[2][3] = 1.F;
00028     m_projectionMatrix[3][2] = -(far * near) / (far - near);
00029 }
00030
00031 void ven::Camera::setViewDirection(const glm::vec3 position, const glm::vec3 direction, const
00032     glm::vec3 up)
00033 {
00034     const glm::vec3 w(normalize(direction));
00035     const glm::vec3 u(normalize(cross(w, up)));
00036     const glm::vec3 v(cross(w, u));
00037
00038     m_viewMatrix = glm::mat4{1.F};
00039     m_viewMatrix[0][0] = u.x;
00040     m_viewMatrix[1][0] = u.y;
00041     m_viewMatrix[2][0] = u.z;
00042     m_viewMatrix[0][1] = v.x;
00043     m_viewMatrix[1][1] = v.y;
00044     m_viewMatrix[2][1] = v.z;
00045     m_viewMatrix[0][2] = w.x;
00046     m_viewMatrix[1][2] = w.y;
00047     m_viewMatrix[2][2] = w.z;
00048 }

```

```

00044     m_viewMatrix[2][2] = w.z;
00045     m_viewMatrix[3][0] = -dot(u, position);
00046     m_viewMatrix[3][1] = -dot(v, position);
00047     m_viewMatrix[3][2] = -dot(w, position);
00048
00049     m_inverseViewMatrix = glm::mat4(1.F);
00050     m_inverseViewMatrix[0][0] = u.x;
00051     m_inverseViewMatrix[0][1] = u.y;
00052     m_inverseViewMatrix[0][2] = u.z;
00053     m_inverseViewMatrix[1][0] = v.x;
00054     m_inverseViewMatrix[1][1] = v.y;
00055     m_inverseViewMatrix[1][2] = v.z;
00056     m_inverseViewMatrix[2][0] = w.x;
00057     m_inverseViewMatrix[2][1] = w.y;
00058     m_inverseViewMatrix[2][2] = w.z;
00059     m_inverseViewMatrix[3][0] = position.x;
00060     m_inverseViewMatrix[3][1] = position.y;
00061     m_inverseViewMatrix[3][2] = position.z;
00062 }
00063
00064 void ven::Camera::setViewYXZ(const glm::vec3 position, const glm::vec3 rotation)
00065 {
00066     const float c3 = glm::cos(rotation.z);
00067     const float s3 = glm::sin(rotation.z);
00068     const float c2 = glm::cos(rotation.x);
00069     const float s2 = glm::sin(rotation.x);
00070     const float c1 = glm::cos(rotation.y);
00071     const float s1 = glm::sin(rotation.y);
00072     const glm::vec3 u{(c1 * c3 + s1 * s2 * s3), (c2 * s3), (c1 * s2 * s3 - c3 * s1)};
00073     const glm::vec3 v{(c3 * s1 * s2 - c1 * s3), (c2 * c3), (c1 * c3 * s2 + s1 * s3)};
00074     const glm::vec3 w{(c2 * s1), (-s2), (c1 * c2)};
00075     m_viewMatrix = glm::mat4(1.F);
00076     m_viewMatrix[0][0] = u.x;
00077     m_viewMatrix[1][0] = u.y;
00078     m_viewMatrix[2][0] = u.z;
00079     m_viewMatrix[0][1] = v.x;
00080     m_viewMatrix[1][1] = v.y;
00081     m_viewMatrix[2][1] = v.z;
00082     m_viewMatrix[0][2] = w.x;
00083     m_viewMatrix[1][2] = w.y;
00084     m_viewMatrix[2][2] = w.z;
00085     m_viewMatrix[3][0] = -dot(u, position);
00086     m_viewMatrix[3][1] = -dot(v, position);
00087     m_viewMatrix[3][2] = -dot(w, position);
00088
00089     m_inverseViewMatrix = glm::mat4(1.F);
00090     m_inverseViewMatrix[0][0] = u.x;
00091     m_inverseViewMatrix[0][1] = u.y;
00092     m_inverseViewMatrix[0][2] = u.z;
00093     m_inverseViewMatrix[1][0] = v.x;
00094     m_inverseViewMatrix[1][1] = v.y;
00095     m_inverseViewMatrix[1][2] = v.z;
00096     m_inverseViewMatrix[2][0] = w.x;
00097     m_inverseViewMatrix[2][1] = w.y;
00098     m_inverseViewMatrix[2][2] = w.z;
00099     m_inverseViewMatrix[3][0] = position.x;
00100     m_inverseViewMatrix[3][1] = position.y;
00101     m_inverseViewMatrix[3][2] = position.z;
00102 }

```

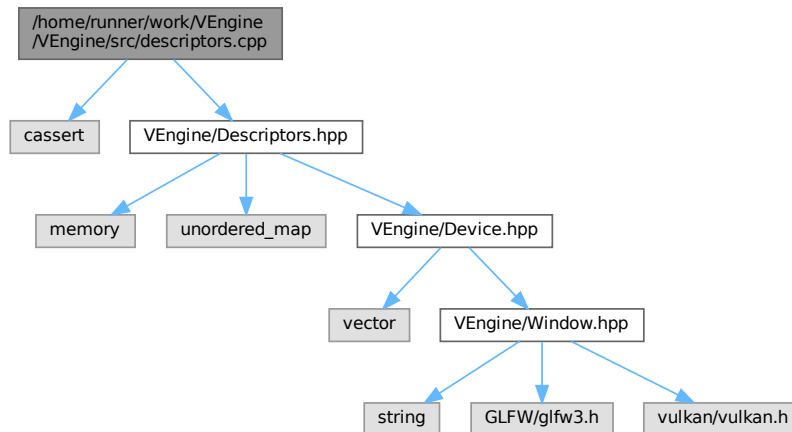
7.52 /home/runner/work/VEngine/VEngine/src/descriptors.cpp File Reference

```

#include <cassert>
#include "VEngine/Descriptors.hpp"

```

Include dependency graph for descriptors.cpp:



7.53 descriptors.cpp

[Go to the documentation of this file.](#)

```

00001 #include <cassert>
00002
00003 #include "VEngine/Descriptors.hpp"
00004
00005 ven::DescriptorSetLayout::Builder &ven::DescriptorSetLayout::Builder::addBinding(const uint32_t
binding, const VkDescriptorType descriptorType, const VkShaderStageFlags stageFlags, const uint32_t
count)
00006 {
00007     assert(m_bindings.count(binding) == 0 && "Binding already in use");
00008     VkDescriptorSetLayoutBinding layoutBinding{};
00009     layoutBinding.binding = binding;
00010     layoutBinding.descriptorType = descriptorType;
00011     layoutBinding.descriptorCount = count;
00012     layoutBinding.stageFlags = stageFlags;
00013     m_bindings[binding] = layoutBinding;
00014     return *this;
00015 }
00016
00017 ven::DescriptorSetLayout::DescriptorSetLayout(Device &device, const std::unordered_map<uint32_t,
VkDescriptorSetLayoutBinding>& bindings) : m_device{device}, m_bindings{bindings}
00018 {
00019     std::vector<VkDescriptorSetLayoutBinding> setLayoutBindings{};
00020     setLayoutBindings.reserve(bindings.size());
00021     for (auto kv : bindings) {
00022         setLayoutBindings.push_back(kv.second);
00023     }
00024
00025     VkDescriptorSetLayoutCreateInfo descriptorSetLayoutInfo{};
00026     descriptorSetLayoutInfo.sType = VK_STRUCTURE_TYPE_DESCRIPTOR_SET_LAYOUT_CREATE_INFO;
00027     descriptorSetLayoutInfo.bindingCount = static_cast<uint32_t>(setLayoutBindings.size());
00028     descriptorSetLayoutInfo.pBindings = setLayoutBindings.data();
00029
00030     if (vkCreateDescriptorSetLayout (
00031         m_device.device(),
00032         &descriptorSetLayoutInfo,
00033         nullptr,
00034         &m_descriptorSetLayout) != VK_SUCCESS) {
00035         throw std::runtime_error("failed to create descriptor set layout!");
00036     }
00037 }
00038
00039 ven::DescriptorPool::Builder &ven::DescriptorPool::Builder::addPoolSize(const VkDescriptorType
descriptorType, const uint32_t count)
00040 {
00041     m_poolSizes.push_back({descriptorType, count});
00042     return *this;
00043 }

```

```

00044
00045 ven::DescriptorPool::Builder &ven::DescriptorPool::Builder::setPoolFlags(const
    VkDescriptorPoolCreateFlags flags)
00046 {
00047     m_poolFlags = flags;
00048     return *this;
00049 }
00050 ven::DescriptorPool::Builder &ven::DescriptorPool::Builder::setMaxSets(const uint32_t count)
00051 {
00052     m_maxSets = count;
00053     return *this;
00054 }
00055
00056 ven::DescriptorPool::DescriptorPool(Device &device, const uint32_t maxSets, const
    VkDescriptorPoolCreateFlags poolFlags, const std::vector<VkDescriptorPoolSize> &poolSizes) :
    m_device{device}
00057 {
00058     VkDescriptorPoolCreateInfo descriptorPoolInfo{};
00059     descriptorPoolInfo.sType = VK_STRUCTURE_TYPE_DESCRIPTOR_POOL_CREATE_INFO;
00060     descriptorPoolInfo.poolSizeCount = static_cast<uint32_t>(poolSizes.size());
00061     descriptorPoolInfo.pPoolSizes = poolSizes.data();
00062     descriptorPoolInfo.maxSets = maxSets;
00063     descriptorPoolInfo.flags = poolFlags;
00064
00065     if (vkCreateDescriptorPool(m_device.device(), &descriptorPoolInfo, nullptr, &m_descriptorPool) !=
00066         VK_SUCCESS) {
00067         throw std::runtime_error("failed to create descriptor pool!");
00068     }
00069 }
00070
00071 bool ven::DescriptorPool::allocateDescriptor(const VkDescriptorSetLayout descriptorSetLayout,
    VkDescriptorSet &descriptor) const
00072 {
00073     VkDescriptorSetAllocateInfo allocInfo{};
00074     allocInfo.sType = VK_STRUCTURE_TYPE_DESCRIPTOR_SET_ALLOCATE_INFO;
00075     allocInfo.descriptorPool = m_descriptorPool;
00076     allocInfo.pSetLayouts = &descriptorSetLayout;
00077     allocInfo.descriptorSetCount = 1;
00078
00079     // Might want to create a "DescriptorPoolManager" class that handles this case, and builds
00080     // a new pool whenever an old pool fills up. But this is beyond our current scope
00081     return vkAllocateDescriptorSets(m_device.device(), &allocInfo, &descriptor) == VK_SUCCESS;
00082 }
00083
00084 ven::DescriptorWriter &ven::DescriptorWriter::writeBuffer(const uint32_t binding, const
    VkDescriptorBufferInfo *bufferInfo)
00085 {
00086     assert(setLayout.bindings.count(binding) == 1 && "Layout does not contain specified binding");
00087
00088     const auto &bindingDescription = m_setLayout.m_bindings[binding];
00089
00090     assert(bindingDescription.descriptorCount == 1 && "Binding single descriptor info, but binding
    expects multiple");
00091
00092     VkWriteDescriptorSet write{};
00093     write.sType = VK_STRUCTURE_TYPE_WRITE_DESCRIPTOR_SET;
00094     write.descriptorType = bindingDescription.descriptorType;
00095     write.dstBinding = binding;
00096     write.pBufferInfo = bufferInfo;
00097     write.descriptorCount = 1;
00098
00099     m_writes.push_back(write);
00100     return *this;
00101 }
00102
00103 ven::DescriptorWriter &ven::DescriptorWriter::writeImage(const uint32_t binding, const
    VkDescriptorImageInfo *imageInfo)
00104 {
00105     assert(setLayout.bindings.count(binding) == 1 && "Layout does not contain specified binding");
00106
00107     const VkDescriptorSetLayoutBinding &bindingDescription = m_setLayout.m_bindings[binding];
00108
00109     assert(bindingDescription.descriptorCount == 1 && "Binding single descriptor info, but binding
    expects multiple");
00110
00111     VkWriteDescriptorSet write{};
00112     write.sType = VK_STRUCTURE_TYPE_WRITE_DESCRIPTOR_SET;
00113     write.descriptorType = bindingDescription.descriptorType;
00114     write.dstBinding = binding;
00115     write.pImageInfo = imageInfo;
00116     write.descriptorCount = 1;
00117
00118     m_writes.push_back(write);
00119     return *this;
00120 }
00121
00122 bool ven::DescriptorWriter::build(VkDescriptorSet &set)

```

```

00123 {
00124     if (!m_pool.allocateDescriptor(m_setLayout.getDescriptorSetLayout(), set)) {
00125         return false;
00126     }
00127     overwrite(set);
00128     return true;
00129 }
00130
00131 void ven::DescriptorWriter::overwrite(const VkDescriptorSet &set)
00132 {
00133     for (auto &write : m_writes) {
00134         write.dstSet = set;
00135     }
00136     vkUpdateDescriptorSets(m_pool.m_device.device(), static_cast<unsigned int>(m_writes.size()),
00137         m_writes.data(), 0, nullptr);
00137 }

```

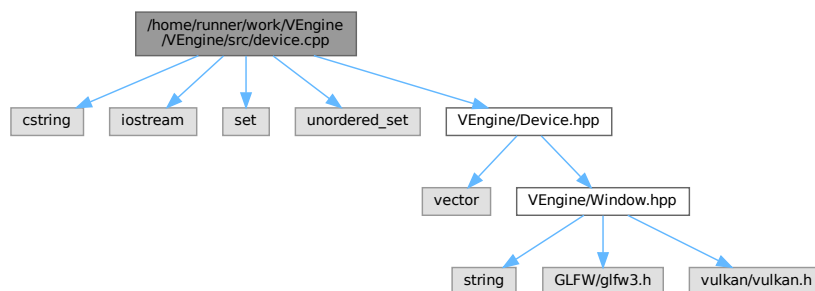
7.54 /home/runner/work/VEngine/VEngine/src/device.cpp File Reference

```

#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)

7.54.1 Function Documentation

7.54.1.1 CreateDebugUtilsMessengerEXT()

```

VkResult CreateDebugUtilsMessengerEXT (
    const VkInstance instance,

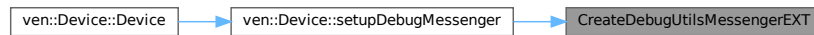
```

```
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:



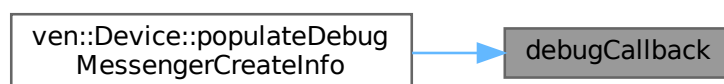
7.54.1.2 debugCallback()

```
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:



7.54.1.3 DestroyDebugUtilsMessengerEXT()

```
void DestroyDebugUtilsMessengerEXT (
    const VkInstance instance,
    const VkDebugUtilsMessengerEXT debugMessenger,
    const VkAllocationCallbacks * pAllocator)
```

Definition at line 26 of file [device.cpp](#).

Referenced by [ven::Device::~~Device\(\)](#).

Here is the caller graph for this function:



7.55 device.cpp

[Go to the documentation of this file.](#)

```

00001 #include <cstring>
00002 #include <iostream>
00003 #include <set>
00004 #include <unordered_set>
00005
00006 #include "VEngine/Device.hpp"
00007
00008 static VKAPI_ATTR VkBool32 VKAPI_CALL debugCallback(const VkDebugUtilsMessageSeverityFlagsEXT
    messageSeverity, const VkDebugUtilsMessageTypeFlagsEXT messageType, const
    VkDebugUtilsMessengerCallbackDataEXT *pCallbackData, void *pUserData)
00009 {
00010     (void) pUserData; (void) messageSeverity; (void) messageType;
00011
00012     std::cerr << "validation layer: " << pCallbackData->pMessage << '\n';
00013     return VK_FALSE;
00014 }
00015
00016 VkResult CreateDebugUtilsMessengerEXT(const VkInstance instance, const
    VkDebugUtilsMessengerCreateInfoEXT *pCreateInfo, const VkAllocationCallbacks *pAllocator,
    VkDebugUtilsMessengerEXT *pDebugMessenger)
00017 {
00018     auto func = reinterpret_cast<PFN_vkCreateDebugUtilsMessengerEXT>(vkGetInstanceProcAddr(instance,
    "vkCreateDebugUtilsMessengerEXT"));
00019     if (func != nullptr) {
00020         return func(instance, pCreateInfo, pAllocator, pDebugMessenger);
00021     }
00022     return VK_ERROR_EXTENSION_NOT_PRESENT;
00023 }
00024
00025 void DestroyDebugUtilsMessengerEXT(const VkInstance instance, const VkDebugUtilsMessengerEXT
    debugMessenger, const VkAllocationCallbacks *pAllocator)
00026 {
00027     auto func = reinterpret_cast<PFN_vkDestroyDebugUtilsMessengerEXT>(vkGetInstanceProcAddr(instance,
    "vkDestroyDebugUtilsMessengerEXT"));
00028     if (func != nullptr) {
00029         func(instance, debugMessenger, pAllocator);
00030     }
00031 }
00032
00033
00034 ven::Device::Device(Window &window) : m_window{window}
00035 {
00036     createInstance();
00037     setupDebugMessenger();
00038     createSurface();
00039     pickPhysicalDevice();
00040     createLogicalDevice();
00041     createCommandPool();
00042 }
00043
00044 ven::Device::~Device()
00045 {
00046     vkDestroyCommandPool(device_, commandPool, nullptr);
00047     vkDestroyDevice(device_, nullptr);
00048
00049     if (enableValidationLayers) {
00050         DestroyDebugUtilsMessengerEXT(instance, debugMessenger, nullptr);
00051     }
00052
00053     vkDestroySurfaceKHR(instance, surface_, nullptr);
00054     vkDestroyInstance(instance, nullptr);
00055 }
00056
  
```

```

00057 void ven::Device::createInstance()
00058 {
00059     if (enableValidationLayers && !checkValidationLayerSupport()) {
00060         throw std::runtime_error("validation layers requested, but not available!");
00061     }
00062
00063     VkApplicationInfo appInfo = {};
00064     appInfo.sType = VK_STRUCTURE_TYPE_APPLICATION_INFO;
00065     appInfo.pApplicationName = "LittleVulkanEngine App";
00066     appInfo.applicationVersion = VK_MAKE_VERSION(1, 0, 0);
00067     appInfo.pEngineName = "No Engine";
00068     appInfo.engineVersion = VK_MAKE_VERSION(1, 0, 0);
00069     appInfo.apiVersion = VK_API_VERSION_1_0;
00070
00071     VkInstanceCreateInfo createInfo = {};
00072     createInfo.sType = VK_STRUCTURE_TYPE_INSTANCE_CREATE_INFO;
00073     createInfo.pApplicationInfo = &appInfo;
00074
00075     std::vector<const char*> extensions = getRequiredExtensions();
00076     createInfo.enabledExtensionCount = static_cast<uint32_t>(extensions.size());
00077     createInfo.ppEnabledExtensionNames = extensions.data();
00078
00079     VkDebugUtilsMessengerCreateInfoEXT debugCreateInfo;
00080     if (enableValidationLayers) {
00081         createInfo.enabledLayerCount = static_cast<uint32_t>(validationLayers.size());
00082         createInfo.ppEnabledLayerNames = validationLayers.data();
00083
00084         populateDebugMessengerCreateInfo(debugCreateInfo);
00085         createInfo.pNext = &debugCreateInfo;
00086     } else {
00087         createInfo.enabledLayerCount = 0;
00088         createInfo.pNext = nullptr;
00089     }
00090
00091     if (vkCreateInstance(&createInfo, nullptr, &instance) != VK_SUCCESS) {
00092         throw std::runtime_error("failed to create instance!");
00093     }
00094
00095     hasGlfwRequiredInstanceExtensions();
00096 }
00097
00098 void ven::Device::pickPhysicalDevice()
00099 {
00100     uint32_t deviceCount = 0;
00101     vkEnumeratePhysicalDevices(instance, &deviceCount, nullptr);
00102     if (deviceCount == 0) {
00103         throw std::runtime_error("failed to find GPUs with Vulkan support!");
00104     }
00105     std::cout << "Device count: " << deviceCount << '\n';
00106     std::vector<VkPhysicalDevice> devices(deviceCount);
00107     vkEnumeratePhysicalDevices(instance, &deviceCount, devices.data());
00108
00109     for (const auto &device : devices) {
00110         if (isDeviceSuitable(device)) {
00111             physicalDevice = device;
00112             break;
00113         }
00114     }
00115
00116     if (physicalDevice == VK_NULL_HANDLE) {
00117         throw std::runtime_error("failed to find a suitable GPU!");
00118     }
00119
00120     vkGetPhysicalDeviceProperties(physicalDevice, &m_properties);
00121     std::cout << "physical device: " << m_properties.deviceName << '\n';
00122 }
00123
00124 void ven::Device::createLogicalDevice()
00125 {
00126     const QueueFamilyIndices indices = findQueueFamilies(physicalDevice);
00127
00128     std::vector<VkDeviceQueueCreateInfo> queueCreateInfos;
00129     const std::set<uint32_t> uniqueQueueFamilies = {indices.graphicsFamily, indices.presentFamily};
00130     float queuePriority = 1.0f;
00131
00132     for (const uint32_t queueFamily : uniqueQueueFamilies) {
00133         VkDeviceQueueCreateInfo queueCreateInfo = {};
00134         queueCreateInfo.sType = VK_STRUCTURE_TYPE_DEVICE_QUEUE_CREATE_INFO;
00135         queueCreateInfo.queueFamilyIndex = queueFamily;
00136         queueCreateInfo.queueCount = 1;
00137         queueCreateInfo.pQueuePriorities = &queuePriority;
00138         queueCreateInfos.push_back(queueCreateInfo);
00139     }
00140
00141     VkPhysicalDeviceFeatures deviceFeatures = {};
00142     deviceFeatures.samplerAnisotropy = VK_TRUE;
00143

```

```

00144     VkDeviceCreateInfo createInfo = {};
00145     createInfo.sType = VK_STRUCTURE_TYPE_DEVICE_CREATE_INFO;
00146
00147     createInfo.queueCreateInfoCount = static_cast<uint32_t>(queueCreateInfos.size());
00148     createInfo.pQueueCreateInfos = queueCreateInfos.data();
00149
00150     createInfo.pEnabledFeatures = &deviceFeatures;
00151     createInfo.enabledExtensionCount = static_cast<uint32_t>(deviceExtensions.size());
00152     createInfo.ppEnabledExtensionNames = deviceExtensions.data();
00153
00154     // might not really be necessary anymore because device specific validation layers
00155     // have been deprecated
00156     if (enableValidationLayers) {
00157         createInfo.enabledLayerCount = static_cast<uint32_t>(validationLayers.size());
00158         createInfo.ppEnabledLayerNames = validationLayers.data();
00159     } else {
00160         createInfo.enabledLayerCount = 0;
00161     }
00162
00163     if (vkCreateDevice(physicalDevice, &createInfo, nullptr, &device_) != VK_SUCCESS) {
00164         throw std::runtime_error("failed to create logical device!");
00165     }
00166
00167     vkGetDeviceQueue(device_, indices.graphicsFamily, 0, &graphicsQueue_);
00168     vkGetDeviceQueue(device_, indices.presentFamily, 0, &presentQueue_);
00169 }
00170
00171 void ven::Device::createCommandPool()
00172 {
00173     const QueueFamilyIndices queueFamilyIndices = findPhysicalQueueFamilies();
00174
00175     VkCommandPoolCreateInfo poolInfo = {};
00176     poolInfo.sType = VK_STRUCTURE_TYPE_COMMAND_POOL_CREATE_INFO;
00177     poolInfo.queueFamilyIndex = queueFamilyIndices.graphicsFamily;
00178     poolInfo.flags = VK_COMMAND_POOL_CREATE_TRANSIENT_BIT |
VK_COMMAND_POOL_CREATE_RESET_COMMAND_BUFFER_BIT;
00179
00180     if (vkCreateCommandPool(device_, &poolInfo, nullptr, &commandPool) != VK_SUCCESS) {
00181         throw std::runtime_error("failed to create command pool!");
00182     }
00183 }
00184
00185 bool ven::Device::isDeviceSuitable(const VkPhysicalDevice device) const
00186 {
00187     const QueueFamilyIndices indices = findQueueFamilies(device);
00188     const bool extensionsSupported = checkDeviceExtensionSupport(device);
00189     bool swapChainAdequate = false;
00190
00191     if (extensionsSupported) {
00192         SwapChainSupportDetails swapChainSupport = querySwapChainSupport(device);
00193         swapChainAdequate = !swapChainSupport.formats.empty() &&
!swapChainSupport.presentModes.empty();
00194     }
00195
00196     VkPhysicalDeviceFeatures supportedFeatures;
00197     vkGetPhysicalDeviceFeatures(device, &supportedFeatures);
00198
00199     return indices.isComplete() && extensionsSupported && swapChainAdequate &&
(supportedFeatures.samplerAnisotropy != 0U);
00200 }
00201
00202 void ven::Device::populateDebugMessengerCreateInfo(VkDebugUtilsMessengerCreateInfoEXT &createInfo)
00203 {
00204     createInfo = {};
00205     createInfo.sType = VK_STRUCTURE_TYPE_DEBUG_UTILS_MESSENGER_CREATE_INFO_EXT;
00206     createInfo.messageSeverity = VK_DEBUG_UTILS_MESSAGE_SEVERITY_WARNING_BIT_EXT |
VK_DEBUG_UTILS_MESSAGE_SEVERITY_ERROR_BIT_EXT;
00207
00208     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;
00209
00210     createInfo.pfnUserCallback = debugCallback;
00211     createInfo.pUserData = nullptr; // Optional
00212 }
00213
00214
00215 void ven::Device::setupDebugMessenger()
00216 {
00217     if (!enableValidationLayers) { return; }
00218     VkDebugUtilsMessengerCreateInfoEXT createInfo;
00219     populateDebugMessengerCreateInfo(createInfo);
00220     if (CreateDebugUtilsMessengerEXT(instance, &createInfo, nullptr, &debugMessenger) != VK_SUCCESS) {
00221         throw std::runtime_error("failed to set up debug messenger!");
00222     }
00223 }
00224
00225 bool ven::Device::checkValidationLayerSupport() const
00226 {
00227     uint32_t layerCount = 0;

```

```

00228     vkEnumerateInstanceLayerProperties(&layerCount, nullptr);
00229
00230     std::vector<VkLayerProperties> availableLayers(layerCount);
00231     vkEnumerateInstanceLayerProperties(&layerCount, availableLayers.data());
00232
00233     for (const char *layerName : validationLayers) {
00234         bool layerFound = false;
00235
00236         for (const auto &layerProperties : availableLayers) {
00237             if (strcmp(layerName, layerProperties.layerName) == 0) {
00238                 layerFound = true;
00239                 break;
00240             }
00241         }
00242         if (!layerFound) {
00243             return false;
00244         }
00245     }
00246
00247     return true;
00248 }
00249
00250 std::vector<const char *> ven::Device::getRequiredExtensions() const
00251 {
00252     uint32_t glfwExtensionCount = 0;
00253     const char **glfwExtensions = nullptr;
00254     glfwGetRequiredInstanceExtensions(&glfwExtensionCount);
00255
00256     std::vector<const char *> extensions(glfwExtensions, glfwExtensions + glfwExtensionCount);
00257
00258     if (enableValidationLayers) {
00259         extensions.push_back(VK_EXT_DEBUG_UTILS_EXTENSION_NAME);
00260     }
00261
00262     return extensions;
00263 }
00264
00265 void ven::Device::hasGlfwRequiredInstanceExtensions() const
00266 {
00267     uint32_t extensionCount = 0;
00268     vkEnumerateInstanceExtensionProperties(nullptr, &extensionCount, nullptr);
00269     std::vector<VkExtensionProperties> extensions(extensionCount);
00270     vkEnumerateInstanceExtensionProperties(nullptr, &extensionCount, extensions.data());
00271
00272     std::cout << "available extensions:\n";
00273     std::unordered_set<std::string> available;
00274     for (const auto &extension : extensions) {
00275         std::cout << '\t' << extension.extensionName << '\n';
00276         available.insert(extension.extensionName);
00277     }
00278
00279     std::cout << "required extensions:\n";
00280     const std::vector<const char *> requiredExtensions = getRequiredExtensions();
00281     for (const auto &required : requiredExtensions) {
00282         std::cout << "\t" << required << '\n';
00283         if (available.find(required) == available.end()) {
00284             throw std::runtime_error("Missing required glfw extension");
00285         }
00286     }
00287 }
00288
00289 bool ven::Device::checkDeviceExtensionSupport(const VkPhysicalDevice device) const
00290 {
00291     uint32_t extensionCount = 0;
00292     vkEnumerateDeviceExtensionProperties(device, nullptr, &extensionCount, nullptr);
00293
00294     std::vector<VkExtensionProperties> availableExtensions(extensionCount);
00295     vkEnumerateDeviceExtensionProperties(device, nullptr, &extensionCount,
00296         availableExtensions.data());
00297
00298     std::set<std::string> requiredExtensions(deviceExtensions.begin(), deviceExtensions.end());
00299     for (const auto &extension : availableExtensions) {
00300         requiredExtensions.erase(extension.extensionName);
00301     }
00302
00303     return requiredExtensions.empty();
00304 }
00305
00306 ven::QueueFamilyIndices ven::Device::findQueueFamilies(const VkPhysicalDevice device) const
00307 {
00308     QueueFamilyIndices indices;
00309
00310     uint32_t queueFamilyCount = 0;
00311     vkGetPhysicalDeviceQueueFamilyProperties(device, &queueFamilyCount, nullptr);
00312     std::vector<VkQueueFamilyProperties> queueFamilies(queueFamilyCount);
00313     vkGetPhysicalDeviceQueueFamilyProperties(device, &queueFamilyCount, queueFamilies.data());
00314     uint32_t index = 0;

```

```

00314
00315     for (const auto &queueFamily : queueFamilies) {
00316         if (queueFamily.queueCount > 0 && ((queueFamily.queueFlags & VK_QUEUE_GRAPHICS_BIT) != 0U)) {
00317             indices.graphicsFamily = index;
00318             indices.graphicsFamilyHasValue = true;
00319         }
00320         VkBool32 presentSupport = 0U;
00321         vkGetPhysicalDeviceSurfaceSupportKHR(device, index, surface_, &presentSupport);
00322         if (queueFamily.queueCount > 0 && (presentSupport != 0U)) {
00323             indices.presentFamily = index;
00324             indices.presentFamilyHasValue = true;
00325         }
00326         if (indices.isComplete()) {
00327             break;
00328         }
00329         index++;
00330     }
00331     return indices;
00332 }
00333
00334 ven::SwapChainSupportDetails ven::Device::querySwapChainSupport(const VkPhysicalDevice device) const
00335 {
00336     SwapChainSupportDetails details;
00337     vkGetPhysicalDeviceSurfaceCapabilitiesKHR(device, surface_, &details.capabilities);
00338     uint32_t formatCount = 0;
00339
00340     vkGetPhysicalDeviceSurfaceFormatsKHR(device, surface_, &formatCount, nullptr);
00341     if (formatCount != 0) {
00342         details.formats.resize(formatCount);
00343         vkGetPhysicalDeviceSurfaceFormatsKHR(device, surface_, &formatCount, details.formats.data());
00344     }
00345     uint32_t presentModeCount = 0;
00346     vkGetPhysicalDeviceSurfacePresentModesKHR(device, surface_, &presentModeCount, nullptr);
00347     if (presentModeCount != 0) {
00348         details.presentModes.resize(presentModeCount);
00349         vkGetPhysicalDeviceSurfacePresentModesKHR(device, surface_, &presentModeCount,
00350         details.presentModes.data());
00351     }
00352     return details;
00353 }
00354
00355 VkFormat ven::Device::findSupportedFormat(const std::vector<VkFormat> &candidates, const VkImageTiling
00356 tiling, const VkFormatFeatureFlags features) const
00357 {
00358     for (const VkFormat format : candidates) {
00359         VkFormatProperties props;
00360         vkGetPhysicalDeviceFormatProperties(physicalDevice, format, &props);
00361         if (tiling == VK_IMAGE_TILING_LINEAR && (props.linearTilingFeatures & features) == features) {
00362             return format;
00363         } if (tiling == VK_IMAGE_TILING_OPTIMAL && (props.optimalTilingFeatures & features) ==
00364         features) {
00365             return format;
00366         }
00367     }
00368     throw std::runtime_error("failed to find supported format!");
00369 }
00370
00371 uint32_t ven::Device::findMemoryType(const uint32_t typeFilter, const VkMemoryPropertyFlags
00372 propertiesp) const
00373 {
00374     VkPhysicalDeviceMemoryProperties memProperties;
00375     vkGetPhysicalDeviceMemoryProperties(physicalDevice, &memProperties);
00376
00377     for (uint32_t i = 0; i < memProperties.memoryTypeCount; i++) {
00378         if (((typeFilter & (1 << i)) != 0U) &&
00379         (memProperties.memoryTypes[i].propertyFlags & propertiesp) == propertiesp) {
00380             return i;
00381         }
00382     }
00383     throw std::runtime_error("failed to find suitable m_memory type!");
00384 }
00385
00386 void ven::Device::createBuffer(const VkDeviceSize size, const VkBufferUsageFlags usage, const
00387 VkMemoryPropertyFlags propertiesp, VkBuffer &buffer, VkDeviceMemory &bufferMemory) const
00388 {
00389     VkBufferCreateInfo bufferInfo{};
00390     bufferInfo.sType = VK_STRUCTURE_TYPE_BUFFER_CREATE_INFO;
00391     bufferInfo.size = size;
00392     bufferInfo.usage = usage;
00393     bufferInfo.sharingMode = VK_SHARING_MODE_EXCLUSIVE;
00394
00395     if (vkCreateBuffer(device_, &bufferInfo, nullptr, &buffer) != VK_SUCCESS) {
00396         throw std::runtime_error("failed to create vertex m_buffer!");
00397     }
00398 }
00399

```

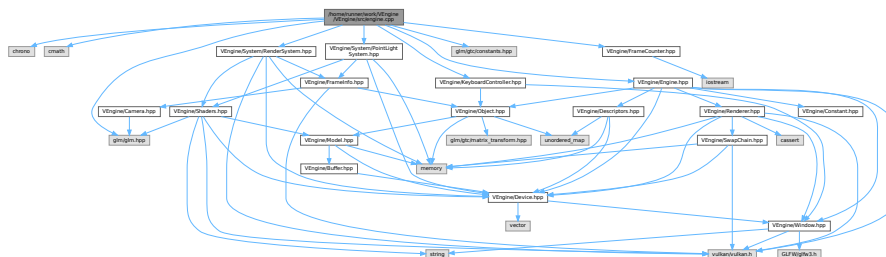
```

00396     VkMemoryRequirements memRequirements;
00397     vkGetBufferMemoryRequirements(device_, buffer, &memRequirements);
00398
00399     VkMemoryAllocateInfo allocInfo{};
00400     allocInfo.sType = VK_STRUCTURE_TYPE_MEMORY_ALLOCATE_INFO;
00401     allocInfo.allocationSize = memRequirements.size;
00402     allocInfo.memoryTypeIndex = findMemoryType(memRequirements.memoryTypeBits, properties);
00403
00404     if (vkAllocateMemory(device_, &allocInfo, nullptr, &bufferMemory) != VK_SUCCESS) {
00405         throw std::runtime_error("failed to allocate vertex m_buffer m_memory!");
00406     }
00407
00408     vkBindBufferMemory(device_, buffer, bufferMemory, 0);
00409 }
00410
00411 VkCommandBuffer ven::Device::beginSingleTimeCommands() const
00412 {
00413     VkCommandBufferAllocateInfo allocInfo{};
00414     allocInfo.sType = VK_STRUCTURE_TYPE_COMMAND_BUFFER_ALLOCATE_INFO;
00415     allocInfo.level = VK_COMMAND_BUFFER_LEVEL_PRIMARY;
00416     allocInfo.commandPool = commandPool;
00417     allocInfo.commandBufferCount = 1;
00418
00419     VkCommandBuffer commandBuffer = nullptr;
00420     vkAllocateCommandBuffers(device_, &allocInfo, &commandBuffer);
00421
00422     VkCommandBufferBeginInfo beginInfo{};
00423     beginInfo.sType = VK_STRUCTURE_TYPE_COMMAND_BUFFER_BEGIN_INFO;
00424     beginInfo.flags = VK_COMMAND_BUFFER_USAGE_ONE_TIME_SUBMIT_BIT;
00425
00426     vkBeginCommandBuffer(commandBuffer, &beginInfo);
00427     return commandBuffer;
00428 }
00429
00430 void ven::Device::endSingleTimeCommands(const VkCommandBuffer commandBuffer) const
00431 {
00432     vkEndCommandBuffer(commandBuffer);
00433
00434     VkSubmitInfo submitInfo{};
00435     submitInfo.sType = VK_STRUCTURE_TYPE_SUBMIT_INFO;
00436     submitInfo.commandBufferCount = 1;
00437     submitInfo.pCommandBuffers = &commandBuffer;
00438
00439     vkQueueSubmit(graphicsQueue_, 1, &submitInfo, VK_NULL_HANDLE);
00440     vkQueueWaitIdle(graphicsQueue_);
00441
00442     vkFreeCommandBuffers(device_, commandPool, 1, &commandBuffer);
00443 }
00444
00445 void ven::Device::copyBuffer(const VkBuffer srcBuffer, const VkBuffer dstBuffer, const VkDeviceSize
size) const
00446 {
00447     const VkCommandBuffer commandBuffer = beginSingleTimeCommands();
00448
00449     VkBufferCopy copyRegion{};
00450     copyRegion.srcOffset = 0; // Optional
00451     copyRegion.dstOffset = 0; // Optional
00452     copyRegion.size = size;
00453     vkCmdCopyBuffer(commandBuffer, srcBuffer, dstBuffer, 1, &copyRegion);
00454
00455     endSingleTimeCommands(commandBuffer);
00456 }
00457
00458 void ven::Device::copyBufferToImage(const VkBuffer buffer, const VkImage image, const uint32_t width,
const uint32_t height, const uint32_t layerCount) const
00459 {
00460     const VkCommandBuffer commandBuffer = beginSingleTimeCommands();
00461
00462     VkBufferImageCopy region{};
00463     region.bufferOffset = 0;
00464     region.bufferRowLength = 0;
00465     region.bufferImageHeight = 0;
00466
00467     region.imageSubresource.aspectMask = VK_IMAGE_ASPECT_COLOR_BIT;
00468     region.imageSubresource.mipLevel = 0;
00469     region.imageSubresource.baseArrayLayer = 0;
00470     region.imageSubresource.layerCount = layerCount;
00471
00472     region.imageOffset = {0, 0, 0};
00473     region.imageExtent = {width, height, 1};
00474
00475     vkCmdCopyBufferToImage(commandBuffer, buffer, image, VK_IMAGE_LAYOUT_TRANSFER_DST_OPTIMAL, 1,
&region);
00476     endSingleTimeCommands(commandBuffer);
00477 }
00478
00479 void ven::Device::createImageWithInfo(const VkImageCreateInfo &imageInfo, const VkMemoryPropertyFlags

```

7.56 /home/runner/work/VEngine/VEngine/src/engine.cpp File Reference

Include dependency graph for engine.cpp:



- `#define GLM_FORCE_RADIANS`
- `#define GLM_FORCE_DEPTH_ZERO_TO_ONE`

7.56.1.1 GLM_FORCE_DEPTH_ZERO_TO_ONE

Definition at line 5 of file `engine.cpp`.

7.56.1.2 GLM_FORCE_RADIANS

```
#define GLM_FORCE_RADIANS
```

Definition at line 4 of file [engine.cpp](#).

7.57 engine.cpp

[Go to the documentation of this file.](#)

```
00001 #include <chrono>
00002 #include <cmath>
00003
00004 #define GLM_FORCE_RADIANS
00005 #define GLM_FORCE_DEPTH_ZERO_TO_ONE
00006 #include <glm/glm.hpp>
00007 #include <glm/gtc/constants.hpp>
00008
00009 #include "VEngine/Engine.hpp"
00010 #include "VEngine/KeyboardController.hpp"
00011 #include "VEngine/System/RenderSystem.hpp"
00012 #include "VEngine/System/PointLightSystem.hpp"
00013 #include "VEngine/FrameCounter.hpp"
00014
00015
00016 void ven::Engine::loadObjects()
00017 {
00018     std::shared_ptr model = Model::createModelFromFile(m_device, "models/flat_vase.obj");
00019
00020     Object flatVase = Object::createObject();
00021     flatVase.model = model;
00022     flatVase.transform3D.translation = {-0.5F, 0.5F, 0.F};
00023     flatVase.transform3D.scale = {3.F, 1.5F, 3.F};
00024     m_objects.emplace(flatVase.getId(), std::move(flatVase));
00025
00026     model = Model::createModelFromFile(m_device, "models/smooth_vase.obj");
00027     Object smoothVase = Object::createObject();
00028     smoothVase.model = model;
00029     smoothVase.transform3D.translation = {0.5F, 0.5F, 0.F};
00030     smoothVase.transform3D.scale = {3.F, 1.5F, 3.F};
00031     m_objects.emplace(smoothVase.getId(), std::move(smoothVase));
00032
00033     model = Model::createModelFromFile(m_device, "models/quad.obj");
00034     Object floor = Object::createObject();
00035     floor.model = model;
00036     floor.transform3D.translation = {0.F, 0.5F, 0.F};
00037     floor.transform3D.scale = {3.F, 1.F, 3.F};
00038     m_objects.emplace(floor.getId(), std::move(floor));
00039
00040     std::vector<glm::vec3> lightColors{
00041         {1.F, 1.F, 1.F},
00042         {1.F, 1.F, 1.F},
00043         {1.F, 1.F, 1.F},
00044         {1.F, 1.F, 1.F},
00045         {1.F, 1.F, 1.F},
00046         {1.F, 1.F, 1.F}
00047     };
00048
00049     for (std::size_t i = 0; i < lightColors.size(); i++)
00050     {
00051         Object pointLight = Object::makePointLight(0.2F);
00052         pointLight.color = lightColors[i];
00053         auto 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});
00054         pointLight.transform3D.translation = glm::vec3(rotateLight * glm::vec4(-1.F, -1.F, -1.F,
1.F));
00055         m_objects.emplace(pointLight.getId(), std::move(pointLight));
00056     }
00057 }
00058
00059 ven::Engine::Engine(const uint32_t width, const uint32_t height, const std::string &title) :
    m_window(width, height, title)
00060 {
00061     createInstance();
00062     createSurface();
00063     m_globalPool =
DescriptorPool::Builder(m_device).setMaxSets(SwapChain::MAX_FRAMES_IN_FLIGHT).addPoolSize(VK_DESCRIPTOR_TYPE_UNIFORM_BUFFER).addPoolSize(VK_DESCRIPTOR_TYPE_SAMPLER).addPoolSize(VK_DESCRIPTOR_TYPE_COMBINED_IMAGE_SAMPLER).addPoolSize(VK_DESCRIPTOR_TYPE_STORAGE_BUFFER).build();
00064     loadObjects();

```



```

00065 }
00066
00067 void ven::Engine::mainLoop()
00068 {
00069     GlobalUbo ubo{};
00070     Camera camera{};
00071     FrameCounter frameCounter{};
00072     KeyboardController cameraController{};
00073     std::chrono::duration<float> deltaTime{};
00074     float frameTime = NAN;
00075     int frameIndex = 0;
00076     Object viewerObject = Object::createObject();
00077     std::chrono::time_point<std::chrono::system_clock> newTime;
00078     std::chrono::time_point<std::chrono::system_clock> currentTime =
std::chrono::high_resolution_clock::now();
00079     std::unique_ptr<DescriptorSetLayout> globalSetLayout =
DescriptorSetLayout::Builder(m_device).addBinding(0, VK_DESCRIPTOR_TYPE_UNIFORM_BUFFER,
VK_SHADER_STAGE_ALL_GRAPHICS).build();
00080     std::vector<std::unique_ptr<Buffer>> uboBuffers(SwapChain::MAX_FRAMES_IN_FLIGHT);
00081     std::vector<VkDescriptorSet> globalDescriptorSets(SwapChain::MAX_FRAMES_IN_FLIGHT);
00082     RenderSystem renderSystem(m_device, m_renderer.getSwapChainRenderPass(),
globalSetLayout->getDescriptorSetLayout());
00083     PointLightSystem pointLightSystem(m_device, m_renderer.getSwapChainRenderPass(),
globalSetLayout->getDescriptorSetLayout());
00084
00085     for (auto & uboBuffer : uboBuffers)
00086     {
00087         uboBuffer = std::make_unique<Buffer>(m_device, sizeof(GlobalUbo), 1,
VK_BUFFER_USAGE_UNIFORM_BUFFER_BIT, VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT);
00088         uboBuffer->map();
00089     }
00090     for (std::size_t i = 0; i < globalDescriptorSets.size(); i++) {
00091         VkDescriptorBufferInfo bufferInfo = uboBuffers[i]->descriptorInfo();
00092         DescriptorWriter(*globalSetLayout, *m_globalPool).writeBuffer(0,
&bufferInfo).build(globalDescriptorSets[i]);
00093     }
00094     camera.setViewTarget(glm::vec3(-1.F, -2.F, -2.F), glm::vec3(0.F, 0.F, 2.5F));
00095     viewerObject.transform3D.translation.z = -2.5F;
00096
00097     while (glfwWindowShouldClose(m_window.getGLFWWindow()) == 0)
00098     {
00099         glfwPollEvents();
00100
00101         newTime = std::chrono::high_resolution_clock::now();
00102         deltaTime = newTime - currentTime;
00103         currentTime = newTime;
00104         frameTime = deltaTime.count();
00105         frameCounter.update(frameTime);
00106
00107         cameraController.moveInPlaneXZ(m_window.getGLFWWindow(), frameTime, viewerObject);
00108         camera.setViewXYZ(viewerObject.transform3D.translation, viewerObject.transform3D.rotation);
00109         camera.setPerspectiveProjection(glm::radians(50.0F), m_renderer.getAspectRatio(), 0.1F,
100.F);
00110
00111         if (VkCommandBuffer_T *commandBuffer = m_renderer.beginFrame())
00112         {
00113             frameIndex = (m_renderer.getFrameIndex());
00114             FrameInfo frameInfo{frameIndex, frameTime, commandBuffer, camera,
globalDescriptorSets[static_cast<unsigned long>(frameIndex)], m_objects};
00115
00116             ubo.projection = camera.getProjection();
00117             ubo.view = camera.getView();
00118             ubo.inverseView = camera.getInverseView();
00119             PointLightSystem::update(frameInfo, ubo);
00120             uboBuffers[static_cast<unsigned long>(frameIndex)]->writeToBuffer(&ubo);
00121             uboBuffers[static_cast<unsigned long>(frameIndex)]->flush();
00122
00123             m_renderer.beginSwapChainRenderPass(commandBuffer);
00124             renderSystem.renderObjects(frameInfo);
00125             pointLightSystem.render(frameInfo);
00126             Renderer::endSwapChainRenderPass(commandBuffer);
00127             m_renderer.endFrame();
00128         }
00129     }
00130     vkDeviceWaitIdle(m_device.device());
00131 }
00132
00133 void ven::Engine::createInstance()
00134 {
00135     VkApplicationInfo appInfo{};
00136     appInfo.sType = VK_STRUCTURE_TYPE_APPLICATION_INFO;
00137     appInfo.pApplicationName = "VEngine App";
00138     appInfo.applicationVersion = VK_MAKE_API_VERSION(0, 1, 0, 0);
00139     appInfo.pEngineName = "VEngine";
00140     appInfo.engineVersion = VK_MAKE_API_VERSION(0, 1, 0, 0);
00141     appInfo.apiVersion = VK_API_VERSION_1_0;
00142     VkInstanceCreateInfo createInfo{};

```

```

00143     createInfo.sType = VK_STRUCTURE_TYPE_INSTANCE_CREATE_INFO;
00144     createInfo.pApplicationInfo = &appInfo;
00145     uint32_t glfwExtensionCount = 0;
00146     const char** glfwExtensions = glfwGetRequiredInstanceExtensions(&glfwExtensionCount);
00147     createInfo.enabledExtensionCount = glfwExtensionCount;
00148     createInfo.ppEnabledExtensionNames = glfwExtensions;
00149
00150     if (vkCreateInstance(&createInfo, nullptr, &m_instance) != VK_SUCCESS)
00151     {
00152         throw std::runtime_error("Failed to create Vulkan instance");
00153     }
00154 }

```

7.58 /home/runner/work/VEngine/VEngine/src/keyboardController.cpp

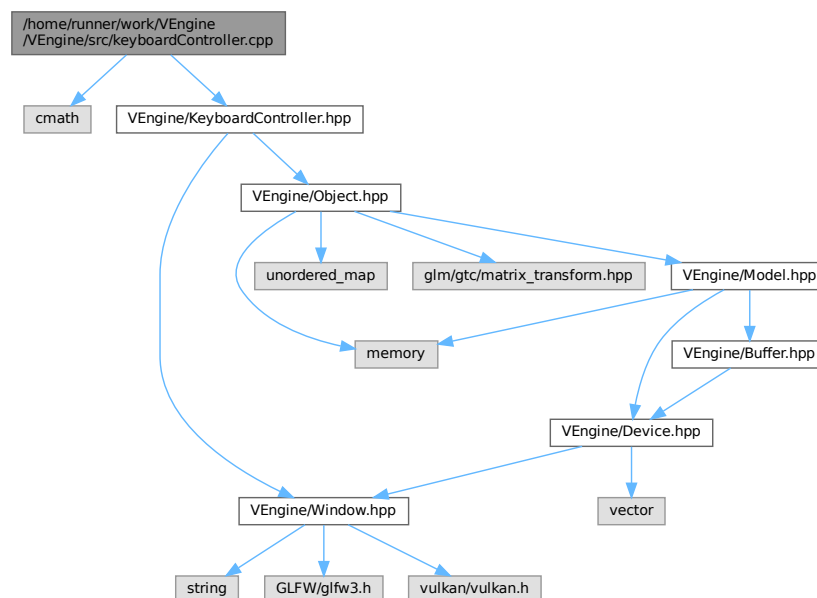
File Reference

```

#include <cmath>
#include "VEngine/KeyboardController.hpp"

```

Include dependency graph for keyboardController.cpp:



7.59 keyboardController.cpp

[Go to the documentation of this file.](#)

```

00001 #include <cmath>
00002
00003 #include "VEngine/KeyboardController.hpp"
00004
00005 void ven::KeyboardController::moveInPlaneXZ(GLFWwindow* window, float dt, Object& object) const
00006 {
00007     glm::vec3 rotate{0};
00008     if (glfwGetKey(window, m_keys.lookLeft) == GLFW_PRESS) { rotate.y -= 1.F; }
00009     if (glfwGetKey(window, m_keys.lookRight) == GLFW_PRESS) { rotate.y += 1.F; }
00010     if (glfwGetKey(window, m_keys.lookUp) == GLFW_PRESS) { rotate.x += 1.F; }
00011     if (glfwGetKey(window, m_keys.lookDown) == GLFW_PRESS) { rotate.x -= 1.F; }
00012
00013     if (dot(rotate, rotate) > std::numeric_limits<float>::epsilon()) {
00014         object.transform3D.rotation += m_lookSpeed * dt * normalize(rotate);
00015     }
00016 }

```

```

00015     }
00016
00017     object.transform3D.rotation.x = glm::clamp(object.transform3D.rotation.x, -1.5F, 1.5F);
00018     object.transform3D.rotation.y = glm::mod(object.transform3D.rotation.y, glm::two_pi<float>());
00019
00020     float yaw = object.transform3D.rotation.y;
00021     const glm::vec3 forwardDir{std::sin(yaw), 0.F, std::cos(yaw)};
00022     const glm::vec3 rightDir{forwardDir.z, 0.F, -forwardDir.x};
00023     constexpr glm::vec3 upDir{0.F, -1.F, 0.F};
00024
00025     glm::vec3 moveDir{0.F};
00026     if (glfwGetKey(window, m_keys.moveForward) == GLFW_PRESS) {moveDir += forwardDir;}
00027     if (glfwGetKey(window, m_keys.moveBackward) == GLFW_PRESS) {moveDir -= forwardDir;}
00028     if (glfwGetKey(window, m_keys.moveRight) == GLFW_PRESS) {moveDir += rightDir;}
00029     if (glfwGetKey(window, m_keys.moveLeft) == GLFW_PRESS) {moveDir -= rightDir;}
00030     if (glfwGetKey(window, m_keys.moveUp) == GLFW_PRESS) {moveDir += upDir;}
00031     if (glfwGetKey(window, m_keys.moveDown) == GLFW_PRESS) {moveDir -= upDir;}
00032
00033     if (dot(moveDir, moveDir) > std::numeric_limits<float>::epsilon()) {
00034         object.transform3D.translation += m_moveSpeed * dt * normalize(moveDir);
00035     }
00036 }

```

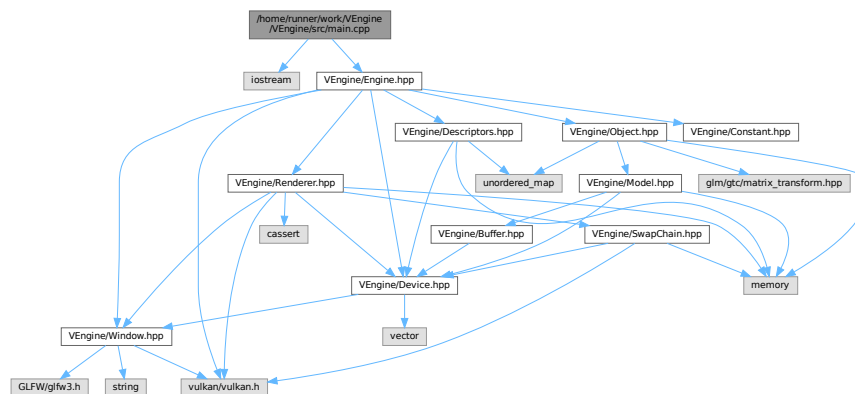
7.60 /home/runner/work/VEngine/VEngine/src/main.cpp File Reference

```

#include <iostream>
#include "VEngine/Engine.hpp"

```

Include dependency graph for main.cpp:



Functions

- int [main](#) ()

7.60.1 Function Documentation

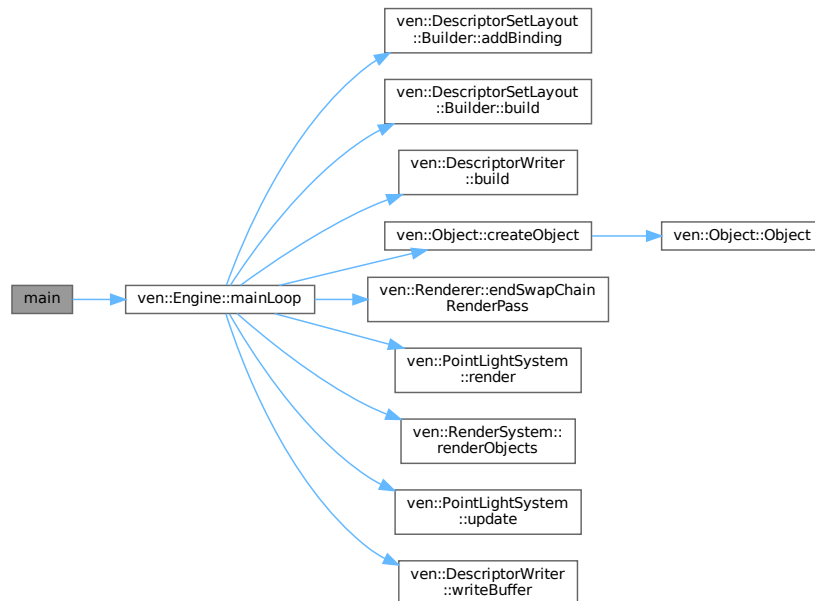
7.60.1.1 main()

```
int main ()
```

Definition at line 7 of file [main.cpp](#).

References [ven::Engine::mainLoop\(\)](#).

Here is the call graph for this function:



7.61 main.cpp

[Go to the documentation of this file.](#)

```

00001 #include <iostream>
00002
00003 #include "VEngine/Engine.hpp"
00004
00005 using namespace ven;
00006
00007 int main()
00008 {
00009     try {
00010         Engine engine{};
00011         engine.mainLoop();
00012     } catch (const std::exception &e) {
00013         std::cerr << "std exception: " << e.what() << '\n';
00014         return VEN_FAILURE;
00015     } catch (...) {
00016         std::cerr << "Unknown error\n";
00017         return VEN_FAILURE;
00018     }
00019     return VEN_SUCCESS;
00020 }

```

7.62 /home/runner/work/VEngine/VEngine/src/model.cpp File Reference

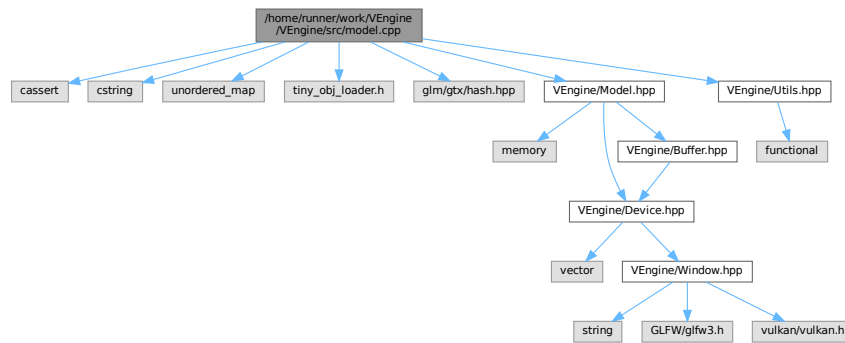
```

#include <cassert>
#include <cstring>
#include <unordered_map>
#include <tiny_obj_loader.h>
#include <glm/gtx/hash.hpp>
#include "VEngine/Model.hpp"

```

```
#include "VEngine/Utils.hpp"
```

Include dependency graph for model.cpp:



Classes

- struct [std::hash< ven::Model::Vertex >](#)

Namespaces

- namespace [std](#)
STL namespace.

Macros

- [#define TINYOBJLOADER_IMPLEMENTATION](#)
- [#define GLM_ENABLE_EXPERIMENTAL](#)

7.62.1 Macro Definition Documentation

7.62.1.1 GLM_ENABLE_EXPERIMENTAL

```
#define GLM_ENABLE_EXPERIMENTAL
```

Definition at line 8 of file [model.cpp](#).

7.62.1.2 TINYOBJLOADER_IMPLEMENTATION

```
#define TINYOBJLOADER_IMPLEMENTATION
```

Definition at line 5 of file [model.cpp](#).

7.63 model.cpp

[Go to the documentation of this file.](#)

```

00001 #include <cassert>
00002 #include <cstring>
00003 #include <unordered_map>
00004
00005 #define TINYOBJLOADER_IMPLEMENTATION
00006 #include <tiny_obj_loader.h>
00007
00008 #define GLM_ENABLE_EXPERIMENTAL
00009 #include <glm/gtx/hash.hpp>
00010
00011 #include "VEngine/Model.hpp"
00012 #include "VEngine/Utils.hpp"
00013
00014 namespace std {
00015     template<>
00016     struct hash<ven::Model::Vertex> {
00017         size_t operator() (ven::Model::Vertex const &vertex) const {
00018             size_t seed = 0;
00019             ven::hashCombine(seed, vertex.position, vertex.color, vertex.normal, vertex.uv);
00020             return seed;
00021         }
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 ven::Model::~Model() = default;
00032
00033 void ven::Model::createVertexBuffer(const std::vector<Vertex> &vertices)
00034 {
00035     m_vertexCount = static_cast<uint32_t>(vertices.size());
00036     assert(m_vertexCount >= 3 && "Vertex count must be at least 3");
00037     const VkDeviceSize bufferSize = sizeof(vertices[0]) * m_vertexCount;
00038     uint32_t vertexSize = sizeof(vertices[0]);
00039
00040     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};
00041
00042     stagingBuffer.map();
00043     stagingBuffer.writeToBuffer(vertices.data());
00044
00045     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);
00046
00047     m_device.copyBuffer(stagingBuffer.getBuffer(), m_vertexBuffer->getBuffer(), bufferSize);
00048 }
00049
00050 void ven::Model::createIndexBuffer(const std::vector<uint32_t> &indices)
00051 {
00052     m_indexCount = static_cast<uint32_t>(indices.size());
00053     m_hasIndexBuffer = m_indexCount > 0;
00054
00055     if (!m_hasIndexBuffer) {
00056         return;
00057     }
00058
00059     const VkDeviceSize bufferSize = sizeof(indices[0]) * m_indexCount;
00060     uint32_t indexSize = sizeof(indices[0]);
00061
00062     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};
00063
00064     stagingBuffer.map();
00065     stagingBuffer.writeToBuffer(indices.data());
00066
00067     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);
00068
00069     m_device.copyBuffer(stagingBuffer.getBuffer(), m_indexBuffer->getBuffer(), bufferSize);
00070 }
00071
00072 void ven::Model::draw(const VkCommandBuffer commandBuffer) const
00073 {
00074     if (m_hasIndexBuffer) {
00075         vkCmdDrawIndexed(commandBuffer, m_indexCount, 1, 0, 0, 0);
    }

```

```

00076     } else {
00077         vkCmdDraw(commandBuffer, m_vertexCount, 1, 0, 0);
00078     }
00079 }
00080
00081 void ven::Model::bind(const VkCommandBuffer commandBuffer) const
00082 {
00083     const VkBuffer buffers[] = {m_vertexBuffer->getBuffer()};
00084     constexpr VkDeviceSize offsets[] = {0};
00085     vkCmdBindVertexBuffers(commandBuffer, 0, 1, buffers, offsets);
00086
00087     if (m_hasIndexBuffer) {
00088         vkCmdBindIndexBuffer(commandBuffer, m_indexBuffer->getBuffer(), 0, VK_INDEX_TYPE_UINT32);
00089     }
00090 }
00091
00092 std::unique_ptr<ven::Model> ven::Model::createModelFromFile(Device &device, const std::string
&filename)
00093 {
00094     Builder builder{};
00095     builder.loadModel(filename);
00096     return std::make_unique<Model>(device, builder);
00097 }
00098
00099 std::vector<VkVertexInputBindingDescription> ven::Model::Vertex::getBindingDescriptions()
00100 {
00101     std::vector<VkVertexInputBindingDescription> bindingDescriptions(1);
00102     bindingDescriptions[0].binding = 0;
00103     bindingDescriptions[0].stride = sizeof(Vertex);
00104     bindingDescriptions[0].inputRate = VK_VERTEX_INPUT_RATE_VERTEX;
00105     return bindingDescriptions;
00106 }
00107
00108 std::vector<VkVertexInputAttributeDescription> ven::Model::Vertex::getAttributeDescriptions()
00109 {
00110     std::vector<VkVertexInputAttributeDescription> attributeDescriptions{};
00111
00112     attributeDescriptions.push_back({0, 0, VK_FORMAT_R32G32B32_SFLOAT, offsetof(Vertex, position)});
00113     attributeDescriptions.push_back({1, 0, VK_FORMAT_R32G32B32_SFLOAT, offsetof(Vertex, color)});
00114     attributeDescriptions.push_back({2, 0, VK_FORMAT_R32G32B32_SFLOAT, offsetof(Vertex, normal)});
00115     attributeDescriptions.push_back({3, 0, VK_FORMAT_R32G32B32_SFLOAT, offsetof(Vertex, uv)});
00116
00117     return attributeDescriptions;
00118 }
00119
00120 void ven::Model::Builder::loadModel(const std::string &filename)
00121 {
00122     tinyobj::attrib_t attrib;
00123     std::vector<tinyobj::shape_t> shapes;
00124     std::vector<tinyobj::material_t> materials;
00125     std::string warn;
00126     std::string err;
00127
00128     if (!LoadObj(&attrib, &shapes, &materials, &warn, &err, filename.c_str()))
00129     {
00130         throw std::runtime_error(warn + err);
00131     }
00132
00133     vertices.clear();
00134     indices.clear();
00135
00136     std::unordered_map<Vertex, uint32_t> uniqueVertices{};
00137     for (const auto &shape : shapes) {
00138         for (const auto &index : shape.mesh.indices) {
00139             Vertex vertex{};
00140             if (index.vertex_index >= 0) {
00141                 vertex.position = {
00142                     attrib.vertices[3 * static_cast<size_t>(index.vertex_index) + 0],
00143                     attrib.vertices[3 * static_cast<size_t>(index.vertex_index) + 1],
00144                     attrib.vertices[3 * static_cast<size_t>(index.vertex_index) + 2]
00145                 };
00146
00147                 vertex.color = {
00148                     attrib.colors[3 * static_cast<size_t>(index.vertex_index) + 0],
00149                     attrib.colors[3 * static_cast<size_t>(index.vertex_index) + 1],
00150                     attrib.colors[3 * static_cast<size_t>(index.vertex_index) + 2]
00151                 };
00152             }
00153
00154             if (index.normal_index >= 0) {
00155                 vertex.normal = {
00156                     attrib.normals[3 * static_cast<size_t>(index.normal_index) + 0],
00157                     attrib.normals[3 * static_cast<size_t>(index.normal_index) + 1],
00158                     attrib.normals[3 * static_cast<size_t>(index.normal_index) + 2]
00159                 };
00160             }
00161         }
00162     }

```

```

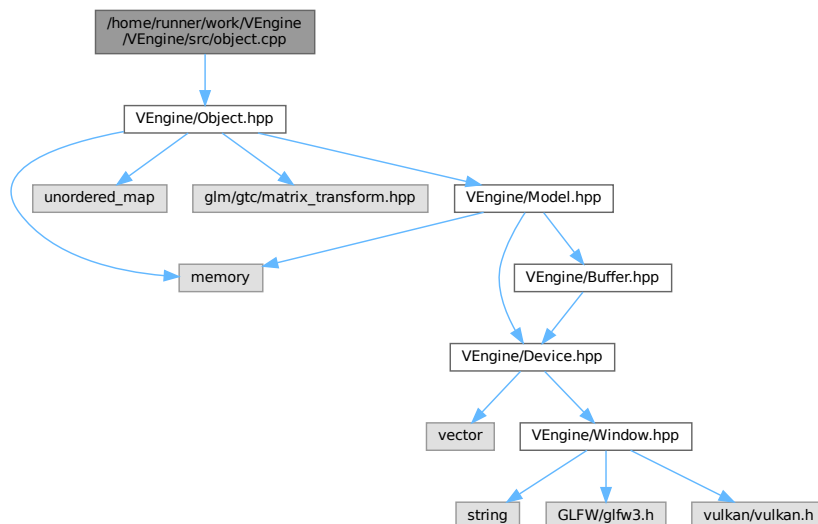
00162         if (index.texcoord_index >= 0) {
00163             vertex.uv = {
00164                 attrib.texcoords[2 * static_cast<size_t>(index.texcoord_index) + 0],
00165                 attrib.texcoords[2 * static_cast<size_t>(index.texcoord_index) + 1]
00166             };
00167         }
00168
00169         if (!uniqueVertices.contains(vertex)) {
00170             uniqueVertices[vertex] = static_cast<uint32_t>(vertices.size());
00171             vertices.push_back(vertex);
00172         }
00173         indices.push_back(uniqueVertices[vertex]);
00174     }
00175 }
00176 }

```

7.64 /home/runner/work/VEngine/VEngine/src/object.cpp File Reference

#include "VEngine/Object.hpp"

Include dependency graph for object.cpp:



7.65 object.cpp

[Go to the documentation of this file.](#)

```

00001 #include "VEngine/Object.hpp"
00002
00003 glm::mat4 ven::Transform3DComponent::mat4() const {
00004     const float c3 = glm::cos(rotation.z);
00005     const float s3 = glm::sin(rotation.z);
00006     const float c2 = glm::cos(rotation.x);
00007     const float s2 = glm::sin(rotation.x);
00008     const float c1 = glm::cos(rotation.y);
00009     const float s1 = glm::sin(rotation.y);
00010     return glm::mat4{
00011         {
00012             scale.x * (c1 * c3 + s1 * s2 * s3),
00013             scale.x * (c2 * s3),
00014             scale.x * (c1 * s2 * s3 - c3 * s1),
00015             0.0F,
00016         },
00017         {
00018             scale.y * (c3 * s1 * s2 - c1 * s3),

```



```

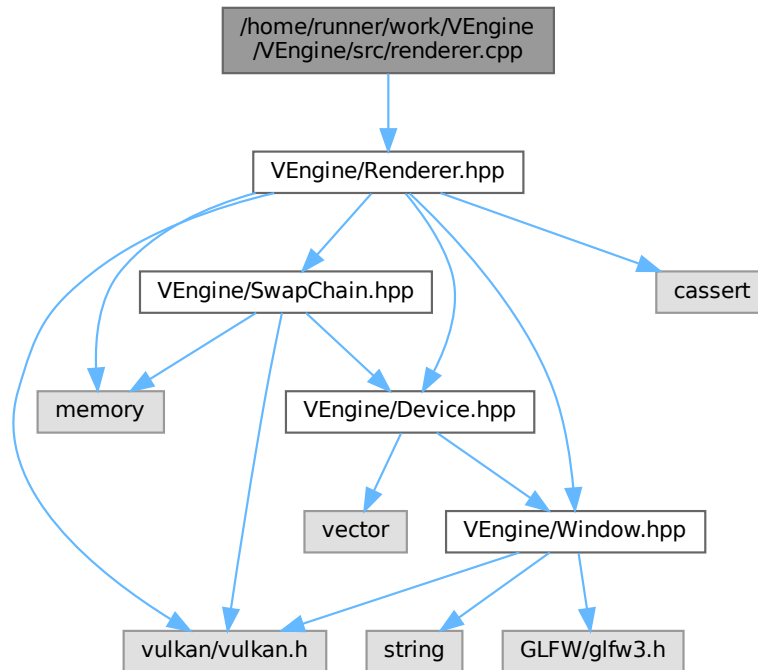
00019         scale.y * (c2 * c3),
00020         scale.y * (c1 * c3 * s2 + s1 * s3),
00021         0.0F,
00022     },
00023     {
00024         scale.z * (c2 * s1),
00025         scale.z * (-s2),
00026         scale.z * (c1 * c2),
00027         0.0F,
00028     },
00029     {
00030         translation.x,
00031         translation.y,
00032         translation.z,
00033         1.0F
00034     }
00035 };
00036 }
00037
00038 glm::mat3 ven::Transform3DComponent::normalMatrix() const
00039 {
00040     const float c3 = glm::cos(rotation.z);
00041     const float s3 = glm::sin(rotation.z);
00042     const float c2 = glm::cos(rotation.x);
00043     const float s2 = glm::sin(rotation.x);
00044     const float c1 = glm::cos(rotation.y);
00045     const float s1 = glm::sin(rotation.y);
00046     const glm::vec3 invScale = 1.0F / scale;
00047
00048     return glm::mat3{
00049         {
00050             invScale.x * (c1 * c3 + s1 * s2 * s3),
00051             invScale.x * (c2 * s3),
00052             invScale.x * (c1 * s2 * s3 - c3 * s1)
00053         },
00054         {
00055             invScale.y * (c3 * s1 * s2 - c1 * s3),
00056             invScale.y * (c2 * c3),
00057             invScale.y * (c1 * c3 * s2 + s1 * s3)
00058         },
00059         {
00060             invScale.z * (c2 * s1),
00061             invScale.z * (-s2),
00062             invScale.z * (c1 * c2)
00063         }
00064     };
00065 }
00066
00067 ven::Object ven::Object::makePointLight(const float intensity, const float radius, const glm::vec3
color)
00068 {
00069     Object obj = Object::createObject();
00070     obj.color = color;
00071     obj.transform3D.scale.x = radius;
00072     obj.pointLight = std::make_unique<PointLightComponent>();
00073     obj.pointLight->lightIntensity = intensity;
00074     return obj;
00075 }

```

7.66 /home/runner/work/VEngine/VEngine/src/renderer.cpp File Reference

```
#include "VEngine/Renderer.hpp"
```

Include dependency graph for renderer.cpp:



7.67 renderer.cpp

[Go to the documentation of this file.](#)

```

00001 #include "VEngine/Renderer.hpp"
00002
00003 void ven::Renderer::createCommandBuffers()
00004 {
00005     m_commandBuffers.resize(SwapChain::MAX_FRAMES_IN_FLIGHT);
00006     VkCommandBufferAllocateInfo allocInfo{};
00007     allocInfo.sType = VK_STRUCTURE_TYPE_COMMAND_BUFFER_ALLOCATE_INFO;
00008     allocInfo.level = VK_COMMAND_BUFFER_LEVEL_PRIMARY;
00009     allocInfo.commandPool = m_device.getCommandPool();
00010     allocInfo.commandBufferCount = static_cast<uint32_t>(m_commandBuffers.size());
00011
00012     if (vkAllocateCommandBuffers(m_device.device(), &allocInfo, m_commandBuffers.data()) !=
00013         VK_SUCCESS) {
00014         throw std::runtime_error("Failed to allocate command buffers");
00015     }
00016 }
00017 void ven::Renderer::freeCommandBuffers()
00018 {
00019     vkFreeCommandBuffers(m_device.device(), m_device.getCommandPool(),
00020         static_cast<uint32_t>(m_commandBuffers.size()), m_commandBuffers.data());
00021     m_commandBuffers.clear();
00022 }
00023 void ven::Renderer::recreateSwapChain()
00024 {

```

```

00025     VkExtent2D extent = m_window.getExtent();
00026     while (extent.width == 0 || extent.height == 0) {
00027         extent = m_window.getExtent();
00028         glfwWaitEvents();
00029     }
00030     vkDeviceWaitIdle(m_device.device());
00031     if (m_swapChain == nullptr) {
00032         m_swapChain = std::make_unique<SwapChain>(m_device, extent);
00033     } else {
00034         std::shared_ptr<SwapChain> oldSwapChain = std::move(m_swapChain);
00035         m_swapChain = std::make_unique<SwapChain>(m_device, extent, oldSwapChain);
00036         if (!oldSwapChain->compareSwapFormats(*m_swapChain)) {
00037             throw std::runtime_error("Swap chain image/depth format changed");
00038         }
00039     }
00040     // well be back
00041 }
00042
00043 VkCommandBuffer ven::Renderer::beginFrame()
00044 {
00045     assert(!isFrameStarted && "Can't start new frame while previous one is still in progress");
00046
00047     const VkResult result = m_swapChain->acquireNextImage(&m_currentImageIndex);
00048     if (result == VK_ERROR_OUT_OF_DATE_KHR) {
00049         recreateSwapChain();
00050         return nullptr;
00051     }
00052
00053     if (result != VK_SUCCESS && result != VK_SUBOPTIMAL_KHR) {
00054         throw std::runtime_error("Failed to acquire swap chain image");
00055     }
00056
00057     m_isFrameStarted = true;
00058
00059     VkCommandBuffer_T *commandBuffer = getCurrentCommandBuffer();
00060     VkCommandBufferBeginInfo beginInfo{};
00061     beginInfo.sType = VK_STRUCTURE_TYPE_COMMAND_BUFFER_BEGIN_INFO;
00062
00063     if (vkBeginCommandBuffer(commandBuffer, &beginInfo) != VK_SUCCESS) {
00064         throw std::runtime_error("Failed to begin recording command m_buffer");
00065     }
00066     return commandBuffer;
00067 }
00068
00069 void ven::Renderer::endFrame()
00070 {
00071     assert(isFrameStarted && "Can't end frame that hasn't been started");
00072
00073     VkCommandBuffer_T *commandBuffer = getCurrentCommandBuffer();
00074     if (vkEndCommandBuffer(commandBuffer) != VK_SUCCESS) {
00075         throw std::runtime_error("Failed to record command m_buffer");
00076     }
00077     VkResult result = m_swapChain->submitCommandBuffers(&commandBuffer, &m_currentImageIndex);
00078     if (result == VK_ERROR_OUT_OF_DATE_KHR || result == VK_SUBOPTIMAL_KHR ||
00079         m_window.wasWindowResized()) {
00079         m_window.resetWindowResizedFlag();
00080         recreateSwapChain();
00081     }
00082     else if (result != VK_SUCCESS) {
00083         throw std::runtime_error("Failed to submit command m_buffer");
00084     }
00085
00086     m_isFrameStarted = false;
00087     m_currentFrameIndex = (m_currentFrameIndex + 1) % SwapChain::MAX_FRAMES_IN_FLIGHT;
00088 }
00089
00090 void ven::Renderer::beginSwapChainRenderPass(const VkCommandBuffer commandBuffer) const
00091 {
00092     assert(isFrameStarted && "Can't begin render pass when frame not in progress");
00093     assert(commandBuffer == getCurrentCommandBuffer() && "Can't begin render pass on command m_buffer
00094         from a different frame");
00095
00096     VkRenderPassBeginInfo renderPassInfo{};
00097     renderPassInfo.sType = VK_STRUCTURE_TYPE_RENDER_PASS_BEGIN_INFO;
00098     renderPassInfo.renderPass = m_swapChain->getRenderPass();
00099     renderPassInfo.framebuffer = m_swapChain->getFrameBuffer(m_currentImageIndex);
00100
00101     renderPassInfo.renderArea.offset = {0, 0};
00102     renderPassInfo.renderArea.extent = m_swapChain->getSwapChainExtent();
00103
00104     std::array<VkClearValue, 2> clearValues{};
00105     clearValues[0].color = {{0.01F, 0.01F, 0.01F, 1.0F}};
00106     clearValues[1].depthStencil = {1.0F, 0};
00107     renderPassInfo.clearValueCount = static_cast<uint32_t>(clearValues.size());
00108     renderPassInfo.pClearValues = clearValues.data();
00109
00110     vkCmdBeginRenderPass(commandBuffer, &renderPassInfo, VK_SUBPASS_CONTENTS_INLINE);

```

```

00110
00111     VkViewport viewport{};
00112     viewport.x = 0.0F;
00113     viewport.y = 0.0F;
00114     viewport.width = static_cast<float>(m_swapChain->getSwapChainExtent().width);
00115     viewport.height = static_cast<float>(m_swapChain->getSwapChainExtent().height);
00116     viewport.minDepth = 0.0F;
00117     viewport.maxDepth = 1.0F;
00118     const VkRect2D scissor{{0, 0}, m_swapChain->getSwapChainExtent()};
00119     vkCmdSetViewport(commandBuffer, 0, 1, &viewport);
00120     vkCmdSetScissor(commandBuffer, 0, 1, &scissor);
00121 }
00122
00123 void ven::Renderer::endSwapChainRenderPass(const VkCommandBuffer commandBuffer)
00124 {
00125     assert(isFrameStarted && "Can't end render pass when frame not in progress");
00126     assert(commandBuffer == getCurrentCommandBuffer() && "Can't end render pass on command m_buffer
    from a different frame");
00127
00128     vkCmdEndRenderPass(commandBuffer);
00129 }

```

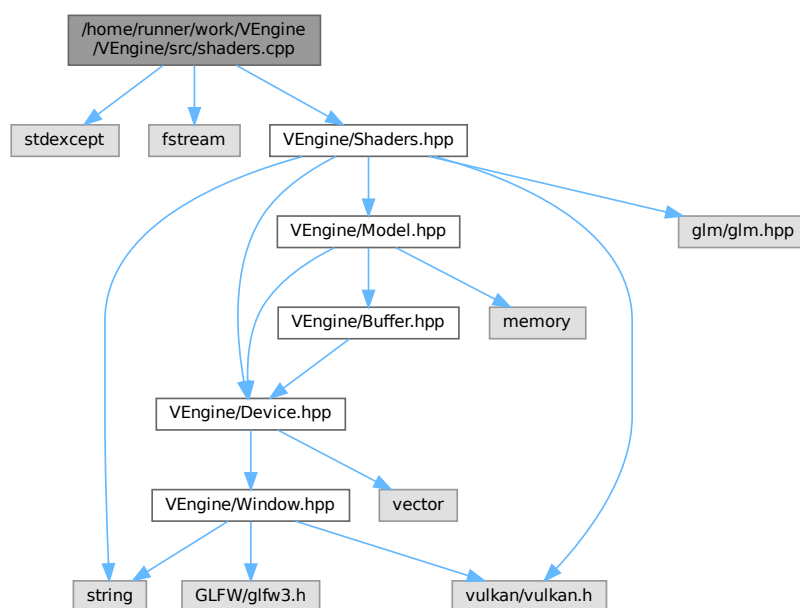
7.68 /home/runner/work/VEngine/VEngine/src/shaders.cpp File Reference

```

#include <stdexcept>
#include <fstream>
#include "VEngine/Shaders.hpp"

```

Include dependency graph for shaders.cpp:



7.69 shaders.cpp

[Go to the documentation of this file.](#)

```

00001 #include <stdexcept>
00002 #include <fstream>

```

```

00003
00004 #include "VEngine/Shaders.hpp"
00005
00006 ven::Shaders::~Shaders()
00007 {
00008     vkDestroyShaderModule(m_device.device(), m_vertShaderModule, nullptr);
00009     vkDestroyShaderModule(m_device.device(), m_fragShaderModule, nullptr);
00010     vkDestroyPipeline(m_device.device(), m_graphicsPipeline, nullptr);
00011 }
00012
00013 std::vector<char> ven::Shaders::readFile(const std::string &filename)
00014 {
00015     std::ifstream file(filename, std::ios::ate | std::ios::binary);
00016
00017     if (!file.is_open()) {
00018         throw std::runtime_error("failed to open file!");
00019     }
00020
00021     const std::streamsize fileSize = file.tellg();
00022     std::vector<char> buffer(static_cast<unsigned long>(fileSize));
00023
00024     file.seekg(0);
00025     file.read(buffer.data(), fileSize);
00026
00027     file.close();
00028     return buffer;
00029 }
00030
00031 void ven::Shaders::createGraphicsPipeline(const std::string& vertFilepath, const std::string&
fragFilepath, const PipelineConfigInfo& configInfo)
00032 {
00033     const std::vector<char> vertCode = readFile(vertFilepath);
00034     const std::vector<char> fragCode = readFile(fragFilepath);
00035
00036     createShaderModule(vertCode, &m_vertShaderModule);
00037     createShaderModule(fragCode, &m_fragShaderModule);
00038
00039     VkPipelineShaderStageCreateInfo shaderStages[2];
00040     shaderStages[0].sType = VK_STRUCTURE_TYPE_PIPELINE_SHADER_STAGE_CREATE_INFO;
00041     shaderStages[0].stage = VK_SHADER_STAGE_VERTEX_BIT;
00042     shaderStages[0].module = m_vertShaderModule;
00043     shaderStages[0].pName = "main";
00044     shaderStages[0].flags = 0;
00045     shaderStages[0].pNext = nullptr;
00046     shaderStages[0].pSpecializationInfo = nullptr;
00047
00048     shaderStages[1].sType = VK_STRUCTURE_TYPE_PIPELINE_SHADER_STAGE_CREATE_INFO;
00049     shaderStages[1].stage = VK_SHADER_STAGE_FRAGMENT_BIT;
00050     shaderStages[1].module = m_fragShaderModule;
00051     shaderStages[1].pName = "main";
00052     shaderStages[1].flags = 0;
00053     shaderStages[1].pNext = nullptr;
00054     shaderStages[1].pSpecializationInfo = nullptr;
00055
00056     const auto& bindingDescriptions = configInfo.bindingDescriptions;
00057     const auto& attributeDescriptions = configInfo.attributeDescriptions;
00058     VkPipelineVertexInputStateCreateInfo vertexInputInfo{};
00059     vertexInputInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_VERTEX_INPUT_STATE_CREATE_INFO;
00060     vertexInputInfo.vertexAttributeDescriptionCount =
static_cast<uint32_t>(attributeDescriptions.size());
00061     vertexInputInfo.vertexBindingDescriptionCount = static_cast<uint32_t>(bindingDescriptions.size());
00062     vertexInputInfo.pVertexAttributeDescriptions = attributeDescriptions.data();
00063     vertexInputInfo.pVertexBindingDescriptions = bindingDescriptions.data();
00064
00065
00066     VkPipelineViewportStateCreateInfo viewportInfo{};
00067     viewportInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_VIEWPORT_STATE_CREATE_INFO;
00068     viewportInfo.viewportCount = 1;
00069     viewportInfo.pViewports = nullptr;
00070     viewportInfo.scissorCount = 1;
00071     viewportInfo.pScissors = nullptr;
00072
00073
00074     VkGraphicsPipelineCreateInfo pipelineInfo{};
00075     pipelineInfo.sType = VK_STRUCTURE_TYPE_GRAPHICS_PIPELINE_CREATE_INFO;
00076     pipelineInfo.stageCount = 2;
00077     pipelineInfo.pStages = shaderStages;
00078     pipelineInfo.pVertexInputState = &vertexInputInfo;
00079     pipelineInfo.pInputAssemblyState = &configInfo.inputAssemblyInfo;
00080     pipelineInfo.pViewportState = &viewportInfo;
00081     pipelineInfo.pRasterizationState = &configInfo.rasterizationInfo;
00082     pipelineInfo.pMultisampleState = &configInfo.multisampleInfo;
00083
00084     pipelineInfo.pColorBlendState = &configInfo.colorBlendInfo;
00085     pipelineInfo.pDepthStencilState = &configInfo.depthStencilInfo;
00086     pipelineInfo.pDynamicState = &configInfo.dynamicStateInfo;
00087

```

```

00088     pipelineInfo.layout = configInfo.pipelineLayout;
00089     pipelineInfo.renderPass = configInfo.renderPass;
00090     pipelineInfo.subpass = configInfo.subpass;
00091
00092     pipelineInfo.basePipelineIndex = -1;
00093     pipelineInfo.basePipelineHandle = VK_NULL_HANDLE;
00094
00095     if (vkCreateGraphicsPipelines(m_device.device(), VK_NULL_HANDLE, 1, &pipelineInfo, nullptr,
&m_graphicsPipeline) != VK_SUCCESS) {
00096         throw std::runtime_error("failed to create graphics pipeline");
00097     }
00098 }
00099
00100 void ven::Shaders::createShaderModule(const std::vector<char> &code, VkShaderModule *shaderModule)
const
00101 {
00102     VkShaderModuleCreateInfo createInfo{};
00103     createInfo.sType = VK_STRUCTURE_TYPE_SHADER_MODULE_CREATE_INFO;
00104     createInfo.codeSize = code.size();
00105     createInfo.pCode = reinterpret_cast<const uint32_t*>(code.data());
00106
00107     if (vkCreateShaderModule(m_device.device(), &createInfo, nullptr, shaderModule) != VK_SUCCESS) {
00108         throw std::runtime_error("failed to create shader module");
00109     }
00110 }
00111
00112 void ven::Shaders::defaultPipelineConfigInfo(PipelineConfigInfo& configInfo)
00113 {
00114     configInfo.inputAssemblyInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_INPUT_ASSEMBLY_STATE_CREATE_INFO;
00115     configInfo.inputAssemblyInfo.topology = VK_PRIMITIVE_TOPOLOGY_TRIANGLE_LIST;
00116     configInfo.inputAssemblyInfo.primitiveRestartEnable = VK_FALSE;
00117
00118     configInfo.rasterizationInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_RASTERIZATION_STATE_CREATE_INFO;
00119     configInfo.rasterizationInfo.depthClampEnable = VK_FALSE;
00120     configInfo.rasterizationInfo.rasterizerDiscardEnable = VK_FALSE;
00121     configInfo.rasterizationInfo.polygonMode = VK_POLYGON_MODE_FILL;
00122     configInfo.rasterizationInfo.lineWidth = 1.0F;
00123     configInfo.rasterizationInfo.cullMode = VK_CULL_MODE_NONE;
00124     configInfo.rasterizationInfo.frontFace = VK_FRONT_FACE_COUNTER_CLOCKWISE;
00125     configInfo.rasterizationInfo.depthBiasEnable = VK_FALSE;
00126     configInfo.rasterizationInfo.depthBiasConstantFactor = 0.0F;
00127     configInfo.rasterizationInfo.depthBiasClamp = 0.0F;
00128     configInfo.rasterizationInfo.depthBiasSlopeFactor = 0.0F;
00129
00130     configInfo.multisampleInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_MULTISAMPLE_STATE_CREATE_INFO;
00131     configInfo.multisampleInfo.sampleShadingEnable = VK_FALSE;
00132     configInfo.multisampleInfo.rasterizationSamples = VK_SAMPLE_COUNT_1_BIT;
00133     configInfo.multisampleInfo.minSampleShading = 1.0F;
00134     configInfo.multisampleInfo.pSampleMask = nullptr;
00135     configInfo.multisampleInfo.alphaToCoverageEnable = VK_FALSE;
00136     configInfo.multisampleInfo.alphaToOneEnable = VK_FALSE;
00137
00138     configInfo.colorBlendAttachment.colorWriteMask = VK_COLOR_COMPONENT_R_BIT |
VK_COLOR_COMPONENT_G_BIT | VK_COLOR_COMPONENT_B_BIT | VK_COLOR_COMPONENT_A_BIT;
00139     configInfo.colorBlendAttachment.blendEnable = VK_FALSE;
00140     configInfo.colorBlendAttachment.srcColorBlendFactor = VK_BLEND_FACTOR_ONE;
00141     configInfo.colorBlendAttachment.dstColorBlendFactor = VK_BLEND_FACTOR_ZERO;
00142     configInfo.colorBlendAttachment.colorBlendOp = VK_BLEND_OP_ADD;
00143     configInfo.colorBlendAttachment.srcAlphaBlendFactor = VK_BLEND_FACTOR_ONE;
00144     configInfo.colorBlendAttachment.dstAlphaBlendFactor = VK_BLEND_FACTOR_ZERO;
00145     configInfo.colorBlendAttachment.alphaBlendOp = VK_BLEND_OP_ADD;
00146
00147     configInfo.colorBlendInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_COLOR_BLEND_STATE_CREATE_INFO;
00148     configInfo.colorBlendInfo.logicOpEnable = VK_FALSE;
00149     configInfo.colorBlendInfo.logicOp = VK_LOGIC_OP_COPY;
00150     configInfo.colorBlendInfo.attachmentCount = 1;
00151     configInfo.colorBlendInfo.pAttachments = &configInfo.colorBlendAttachment;
00152     configInfo.colorBlendInfo.blendConstants[0] = 0.0F;
00153     configInfo.colorBlendInfo.blendConstants[1] = 0.0F;
00154     configInfo.colorBlendInfo.blendConstants[2] = 0.0F;
00155     configInfo.colorBlendInfo.blendConstants[3] = 0.0F;
00156
00157     configInfo.depthStencilInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_DEPTH_STENCIL_STATE_CREATE_INFO;
00158     configInfo.depthStencilInfo.depthTestEnable = VK_TRUE;
00159     configInfo.depthStencilInfo.depthWriteEnable = VK_TRUE;
00160     configInfo.depthStencilInfo.depthCompareOp = VK_COMPARE_OP_LESS;
00161     configInfo.depthStencilInfo.depthBoundsTestEnable = VK_FALSE;
00162     configInfo.depthStencilInfo.minDepthBounds = 0.0F;
00163     configInfo.depthStencilInfo.maxDepthBounds = 1.0F;
00164     configInfo.depthStencilInfo.stencilTestEnable = VK_FALSE;
00165     configInfo.depthStencilInfo.front = {};
00166     configInfo.depthStencilInfo.back = {};
00167
00168     configInfo.dynamicStateEnables = {VK_DYNAMIC_STATE_VIEWPORT, VK_DYNAMIC_STATE_SCISSOR};
00169     configInfo.dynamicStateInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_DYNAMIC_STATE_CREATE_INFO;
00170     configInfo.dynamicStateInfo.pDynamicStates = configInfo.dynamicStateEnables.data();
00171     configInfo.dynamicStateInfo.dynamicStateCount =

```

```

static_cast<uint32_t>(configInfo.dynamicStateEnables.size());
00172     configInfo.dynamicStateInfo.flags = 0;
00173     configInfo.bindingDescriptions = Model::Vertex::getBindingDescriptions();
00174     configInfo.attributeDescriptions = Model::Vertex::getAttributeDescriptions();
00175 }

```

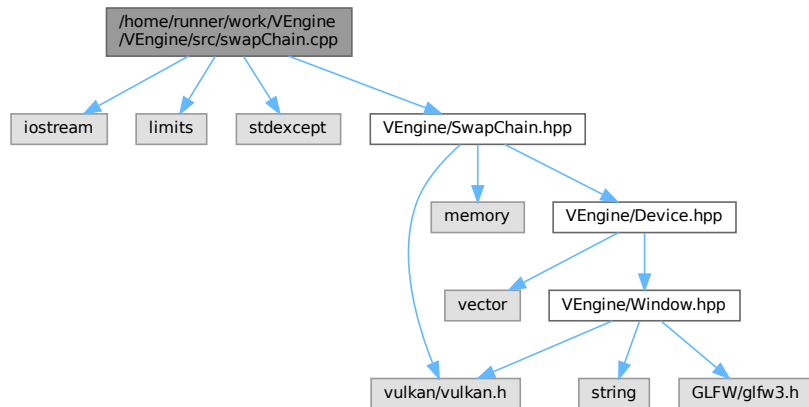
7.70 /home/runner/work/VEngine/VEngine/src/swapChain.cpp File Reference

```

#include <iostream>
#include <limits>
#include <stdexcept>
#include "VEngine/SwapChain.hpp"

```

Include dependency graph for swapChain.cpp:



7.71 swapChain.cpp

[Go to the documentation of this file.](#)

```

00001 #include <iostream>
00002 #include <limits>
00003 #include <stdexcept>
00004
00005 #include "VEngine/SwapChain.hpp"
00006
00007 ven::SwapChain::~SwapChain()
00008 {
00009     for (VkImageView_T *imageView : swapChainImageViews) {
00010         vkDestroyImageView(device.device(), imageView, nullptr);
00011     }
00012     swapChainImageViews.clear();
00013
00014     if (swapChain != nullptr) {
00015         vkDestroySwapchainKHR(device.device(), swapChain, nullptr);
00016         swapChain = nullptr;
00017     }
00018
00019     for (size_t i = 0; i < depthImages.size(); i++) {
00020         vkDestroyImageView(device.device(), depthImageViews[i], nullptr);
00021         vkDestroyImage(device.device(), depthImages[i], nullptr);
00022         vkFreeMemory(device.device(), depthImageMemorys[i], nullptr);
00023     }
00024
00025     for (VkFramebuffer_T *framebuffer : swapChainFramebuffers) {
00026         vkDestroyFramebuffer(device.device(), framebuffer, nullptr);

```

```

00027     }
00028
00029     vkDestroyRenderPass(device.device(), renderPass, nullptr);
00030
00031     // cleanup synchronization objects
00032     for (size_t i = 0; i < MAX_FRAMES_IN_FLIGHT; i++) {
00033         vkDestroySemaphore(device.device(), renderFinishedSemaphores[i], nullptr);
00034         vkDestroySemaphore(device.device(), imageAvailableSemaphores[i], nullptr);
00035         vkDestroyFence(device.device(), inFlightFences[i], nullptr);
00036     }
00037 }
00038
00039 void ven::SwapChain::init()
00040 {
00041     createSwapChain();
00042     createImageViews();
00043     createRenderPass();
00044     createDepthResources();
00045     createFramebuffers();
00046     createSyncObjects();
00047 }
00048
00049 VkResult ven::SwapChain::acquireNextImage(uint32_t *imageIndex) const
00050 {
00051     vkWaitForFences(device.device(), 1, &inFlightFences[currentFrame], VK_TRUE,
00052         std::numeric_limits<uint64_t>::max());
00053     return vkAcquireNextImageKHR(device.device(), swapChain, std::numeric_limits<uint64_t>::max(),
00054         imageAvailableSemaphores[currentFrame], VK_NULL_HANDLE, imageIndex);
00055 }
00056
00057 VkResult ven::SwapChain::submitCommandBuffers(const VkCommandBuffer *buffers, const uint32_t
00058     *imageIndex)
00059 {
00060     if (imagesInFlight[*imageIndex] != VK_NULL_HANDLE) {
00061         vkWaitForFences(device.device(), 1, &imagesInFlight[*imageIndex], VK_TRUE, UINT64_MAX);
00062     }
00063     imagesInFlight[*imageIndex] = inFlightFences[currentFrame];
00064
00065     VkSubmitInfo submitInfo = {};
00066     submitInfo.sType = VK_STRUCTURE_TYPE_SUBMIT_INFO;
00067
00068     const VkSemaphore waitSemaphores[] = {imageAvailableSemaphores[currentFrame]};
00069     constexpr VkPipelineStageFlags waitStages[] = {VK_PIPELINE_STAGE_COLOR_ATTACHMENT_OUTPUT_BIT};
00070     submitInfo.waitSemaphoreCount = 1;
00071     submitInfo.pWaitSemaphores = waitSemaphores;
00072     submitInfo.pWaitDstStageMask = waitStages;
00073
00074     submitInfo.commandBufferCount = 1;
00075     submitInfo.pCommandBuffers = buffers;
00076
00077     const VkSemaphore signalSemaphores[] = {renderFinishedSemaphores[currentFrame]};
00078     submitInfo.signalSemaphoreCount = 1;
00079     submitInfo.pSignalSemaphores = signalSemaphores;
00080
00081     vkResetFences(device.device(), 1, &inFlightFences[currentFrame]);
00082     if (vkQueueSubmit(device.graphicsQueue(), 1, &submitInfo, inFlightFences[currentFrame]) !=
00083         VK_SUCCESS) {
00084         throw std::runtime_error("failed to submit draw command m_buffer!");
00085     }
00086
00087     VkPresentInfoKHR presentInfo = {};
00088     presentInfo.sType = VK_STRUCTURE_TYPE_PRESENT_INFO_KHR;
00089
00090     presentInfo.waitSemaphoreCount = 1;
00091     presentInfo.pWaitSemaphores = signalSemaphores;
00092
00093     const VkSwapchainKHR swapChains[] = {swapChain};
00094     presentInfo.swapchainCount = 1;
00095     presentInfo.pSwapchains = swapChains;
00096
00097     presentInfo.pImageIndices = imageIndex;
00098
00099     const VkResult result = vkQueuePresentKHR(device.presentQueue(), &presentInfo);
00100
00101     currentFrame = (currentFrame + 1) % MAX_FRAMES_IN_FLIGHT;
00102
00103     return result;
00104 }
00105
00106 void ven::SwapChain::createSwapChain()
00107 {
00108     const SwapChainSupportDetails swapChainSupport = device.getSwapChainSupport();
00109
00110     const VkSurfaceFormatKHR surfaceFormat = chooseSwapSurfaceFormat(swapChainSupport.formats);
00111     const VkPresentModeKHR presentMode = chooseSwapPresentMode(swapChainSupport.presentModes);
00112     const VkExtent2D extent = chooseSwapExtent(swapChainSupport.capabilities);

```



```

00110
00111     uint32_t imageCount = swapChainSupport.capabilities.minImageCount + 1;
00112     if (swapChainSupport.capabilities.maxImageCount > 0 && imageCount >
swapChainSupport.capabilities.maxImageCount) {
00113         imageCount = swapChainSupport.capabilities.maxImageCount;
00114     }
00115
00116     VkSwapchainCreateInfoKHR createInfo = {};
00117     createInfo.sType = VK_STRUCTURE_TYPE_SWAPCHAIN_CREATE_INFO_KHR;
00118     createInfo.surface = device.surface();
00119
00120     createInfo.minImageCount = imageCount;
00121     createInfo.imageFormat = surfaceFormat.format;
00122     createInfo.imageColorSpace = surfaceFormat.colorSpace;
00123     createInfo.imageExtent = extent;
00124     createInfo.imageArrayLayers = 1;
00125     createInfo.imageUsage = VK_IMAGE_USAGE_COLOR_ATTACHMENT_BIT;
00126
00127     const QueueFamilyIndices indices = device.findPhysicalQueueFamilies();
00128     const uint32_t queueFamilyIndices[] = {indices.graphicsFamily, indices.presentFamily};
00129
00130     if (indices.graphicsFamily != indices.presentFamily) {
00131         createInfo.imageSharingMode = VK_SHARING_MODE_CONCURRENT;
00132         createInfo.queueFamilyIndexCount = 2;
00133         createInfo.pQueueFamilyIndices = queueFamilyIndices;
00134     } else {
00135         createInfo.imageSharingMode = VK_SHARING_MODE_EXCLUSIVE;
00136         createInfo.queueFamilyIndexCount = 0; // Optional
00137         createInfo.pQueueFamilyIndices = nullptr; // Optional
00138     }
00139
00140     createInfo.preTransform = swapChainSupport.capabilities.currentTransform;
00141     createInfo.compositeAlpha = VK_COMPOSITE_ALPHA_OPAQUE_BIT_KHR;
00142
00143     createInfo.presentMode = presentMode;
00144     createInfo.clipped = VK_TRUE;
00145
00146     createInfo.oldSwapchain = oldSwapChain == nullptr ? VK_NULL_HANDLE : oldSwapChain->swapChain;
00147
00148     if (vkCreateSwapchainKHR(device.device(), &createInfo, nullptr, &swapChain) != VK_SUCCESS) {
00149         throw std::runtime_error("failed to create swap chain!");
00150     }
00151
00152     // we only specified a minimum number of images in the swap chain, so the implementation is
00153     // allowed to create a swap chain with more. That's why we'll first query the final number of
00154     // images with vkGetSwapchainImagesKHR, then resize the container and finally call it again to
00155     // retrieve the handles.
00156     vkGetSwapchainImagesKHR(device.device(), swapChain, &imageCount, nullptr);
00157     swapChainImages.resize(imageCount);
00158     vkGetSwapchainImagesKHR(device.device(), swapChain, &imageCount, swapChainImages.data());
00159
00160     swapChainImageFormat = surfaceFormat.format;
00161     m_swapChainExtent = extent;
00162 }
00163
00164 void ven::SwapChain::createImageViews()
00165 {
00166     swapChainImageViews.resize(swapChainImages.size());
00167     for (size_t i = 0; i < swapChainImages.size(); i++) {
00168         VkImageViewCreateInfo viewInfo{};
00169         viewInfo.sType = VK_STRUCTURE_TYPE_IMAGE_VIEW_CREATE_INFO;
00170         viewInfo.image = swapChainImages[i];
00171         viewInfo.viewType = VK_IMAGE_VIEW_TYPE_2D;
00172         viewInfo.format = swapChainImageFormat;
00173         viewInfo.subresourceRange.aspectMask = VK_IMAGE_ASPECT_COLOR_BIT;
00174         viewInfo.subresourceRange.baseMipLevel = 0;
00175         viewInfo.subresourceRange.levelCount = 1;
00176         viewInfo.subresourceRange.baseArrayLayer = 0;
00177         viewInfo.subresourceRange.layerCount = 1;
00178
00179         if (vkCreateImageView(device.device(), &viewInfo, nullptr, &swapChainImageViews[i]) !=
VK_SUCCESS) {
00180             throw std::runtime_error("failed to create texture image view!");
00181         }
00182     }
00183 }
00184
00185 void ven::SwapChain::createRenderPass()
00186 {
00187     VkAttachmentDescription depthAttachment{};
00188     depthAttachment.format = findDepthFormat();
00189     depthAttachment.samples = VK_SAMPLE_COUNT_1_BIT;
00190     depthAttachment.loadOp = VK_ATTACHMENT_LOAD_OP_CLEAR;
00191     depthAttachment.storeOp = VK_ATTACHMENT_STORE_OP_DONT_CARE;
00192     depthAttachment.stencilLoadOp = VK_ATTACHMENT_LOAD_OP_DONT_CARE;
00193     depthAttachment.stencilStoreOp = VK_ATTACHMENT_STORE_OP_DONT_CARE;
00194     depthAttachment.initialLayout = VK_IMAGE_LAYOUT_UNDEFINED;

```

```

00195     depthAttachment.finalLayout = VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL;
00196
00197     VkAttachmentReference depthAttachmentRef{};
00198     depthAttachmentRef.attachment = 1;
00199     depthAttachmentRef.layout = VK_IMAGE_LAYOUT_DEPTH_STENCIL_ATTACHMENT_OPTIMAL;
00200
00201     VkAttachmentDescription colorAttachment = {};
00202     colorAttachment.format = getSwapChainImageFormat();
00203     colorAttachment.samples = VK_SAMPLE_COUNT_1_BIT;
00204     colorAttachment.loadOp = VK_ATTACHMENT_LOAD_OP_CLEAR;
00205     colorAttachment.storeOp = VK_ATTACHMENT_STORE_OP_STORE;
00206     colorAttachment.stencilStoreOp = VK_ATTACHMENT_STORE_OP_DONT_CARE;
00207     colorAttachment.stencilLoadOp = VK_ATTACHMENT_LOAD_OP_DONT_CARE;
00208     colorAttachment.initialLayout = VK_IMAGE_LAYOUT_UNDEFINED;
00209     colorAttachment.finalLayout = VK_IMAGE_LAYOUT_PRESENT_SRC_KHR;
00210
00211     VkAttachmentReference colorAttachmentRef = {};
00212     colorAttachmentRef.attachment = 0;
00213     colorAttachmentRef.layout = VK_IMAGE_LAYOUT_COLOR_ATTACHMENT_OPTIMAL;
00214
00215     VkSubpassDescription subpass = {};
00216     subpass.pipelineBindPoint = VK_PIPELINE_BIND_POINT_GRAPHICS;
00217     subpass.colorAttachmentCount = 1;
00218     subpass.pColorAttachments = &colorAttachmentRef;
00219     subpass.pDepthStencilAttachment = &depthAttachmentRef;
00220
00221     VkSubpassDependency dependency = {};
00222     dependency.srcSubpass = VK_SUBPASS_EXTERNAL;
00223     dependency.srcAccessMask = 0;
00224     dependency.srcStageMask = VK_PIPELINE_STAGE_COLOR_ATTACHMENT_OUTPUT_BIT |
VK_PIPELINE_STAGE_EARLY_FRAGMENT_TESTS_BIT;
00225     dependency.dstSubpass = 0;
00226     dependency.dstStageMask = VK_PIPELINE_STAGE_COLOR_ATTACHMENT_OUTPUT_BIT |
VK_PIPELINE_STAGE_EARLY_FRAGMENT_TESTS_BIT;
00227     dependency.dstAccessMask = VK_ACCESS_COLOR_ATTACHMENT_WRITE_BIT |
VK_ACCESS_DEPTH_STENCIL_ATTACHMENT_WRITE_BIT;
00228
00229     const std::array<VkAttachmentDescription, 2> attachments = {colorAttachment, depthAttachment};
00230     VkRenderPassCreateInfo renderPassInfo = {};
00231     renderPassInfo.sType = VK_STRUCTURE_TYPE_RENDER_PASS_CREATE_INFO;
00232     renderPassInfo.attachmentCount = static_cast<uint32_t>(attachments.size());
00233     renderPassInfo.pAttachments = attachments.data();
00234     renderPassInfo.subpassCount = 1;
00235     renderPassInfo.pSubpasses = &subpass;
00236     renderPassInfo.dependencyCount = 1;
00237     renderPassInfo.pDependencies = &dependency;
00238
00239     if (vkCreateRenderPass(device.device(), &renderPassInfo, nullptr, &renderPass) != VK_SUCCESS) {
00240         throw std::runtime_error("failed to create render pass!");
00241     }
00242 }
00243
00244 void ven::SwapChain::createFramebuffers()
00245 {
00246     swapChainFramebuffers.resize(imageCount());
00247     for (size_t i = 0; i < imageCount(); i++) {
00248         std::array<VkImageView, 2> attachments = {swapChainImageViews[i], depthImageViews[i]};
00249
00250         const VkExtent2D swapChainExtent = getSwapChainExtent();
00251         VkFramebufferCreateInfo framebufferInfo = {};
00252         framebufferInfo.sType = VK_STRUCTURE_TYPE_FRAMEBUFFER_CREATE_INFO;
00253         framebufferInfo.renderPass = renderPass;
00254         framebufferInfo.attachmentCount = static_cast<uint32_t>(attachments.size());
00255         framebufferInfo.pAttachments = attachments.data();
00256         framebufferInfo.width = swapChainExtent.width;
00257         framebufferInfo.height = swapChainExtent.height;
00258         framebufferInfo.layers = 1;
00259
00260         if (vkCreateFramebuffer(device.device(), &framebufferInfo, nullptr, &swapChainFramebuffers[i])
!= VK_SUCCESS) {
00261             throw std::runtime_error("failed to create framebuffer!");
00262         }
00263     }
00264 }
00265
00266 void ven::SwapChain::createDepthResources()
00267 {
00268     const VkFormat depthFormat = findDepthFormat();
00269     const VkExtent2D swapChainExtent = getSwapChainExtent();
00270
00271     swapChainDepthFormat = depthFormat;
00272     depthImages.resize(imageCount());
00273     depthImageMemorys.resize(imageCount());
00274     depthImageViews.resize(imageCount());
00275
00276     for (size_t i = 0; i < depthImages.size(); i++) {
00277         VkImageCreateInfo imageInfo{};

```

```

00278         imageInfo.sType = VK_STRUCTURE_TYPE_IMAGE_CREATE_INFO;
00279         imageInfo.imageType = VK_IMAGE_TYPE_2D;
00280         imageInfo.extent.width = swapChainExtent.width;
00281         imageInfo.extent.height = swapChainExtent.height;
00282         imageInfo.extent.depth = 1;
00283         imageInfo.mipLevels = 1;
00284         imageInfo.arrayLayers = 1;
00285         imageInfo.format = depthFormat;
00286         imageInfo.tiling = VK_IMAGE_TILING_OPTIMAL;
00287         imageInfo.initialLayout = VK_IMAGE_LAYOUT_UNDEFINED;
00288         imageInfo.usage = VK_IMAGE_USAGE_DEPTH_STENCIL_ATTACHMENT_BIT;
00289         imageInfo.samples = VK_SAMPLE_COUNT_1_BIT;
00290         imageInfo.sharingMode = VK_SHARING_MODE_EXCLUSIVE;
00291         imageInfo.flags = 0;
00292
00293         device.createImageWithInfo(imageInfo, VK_MEMORY_PROPERTY_DEVICE_LOCAL_BIT, depthImages[i],
depthImageMemorys[i]);
00294
00295         VkImageViewCreateInfo viewInfo{};
00296         viewInfo.sType = VK_STRUCTURE_TYPE_IMAGE_VIEW_CREATE_INFO;
00297         viewInfo.image = depthImages[i];
00298         viewInfo.viewType = VK_IMAGE_VIEW_TYPE_2D;
00299         viewInfo.format = depthFormat;
00300         viewInfo.subresourceRange.aspectMask = VK_IMAGE_ASPECT_DEPTH_BIT;
00301         viewInfo.subresourceRange.baseMipLevel = 0;
00302         viewInfo.subresourceRange.levelCount = 1;
00303         viewInfo.subresourceRange.baseArrayLayer = 0;
00304         viewInfo.subresourceRange.layerCount = 1;
00305
00306         if (vkCreateImageView(device.device(), &viewInfo, nullptr, &depthImageViews[i]) != VK_SUCCESS)
00307         {
00308             throw std::runtime_error("failed to create texture image view!");
00309         }
00310     }
00311
00312 void ven::SwapChain::createSyncObjects()
00313 {
00314     imageAvailableSemaphores.resize(MAX_FRAMES_IN_FLIGHT);
00315     renderFinishedSemaphores.resize(MAX_FRAMES_IN_FLIGHT);
00316     inFlightFences.resize(MAX_FRAMES_IN_FLIGHT);
00317     imagesInFlight.resize(imageCount(), VK_NULL_HANDLE);
00318
00319     VkSemaphoreCreateInfo semaphoreInfo = {};
00320     semaphoreInfo.sType = VK_STRUCTURE_TYPE_SEMAPHORE_CREATE_INFO;
00321
00322     VkFenceCreateInfo fenceInfo = {};
00323     fenceInfo.sType = VK_STRUCTURE_TYPE_FENCE_CREATE_INFO;
00324     fenceInfo.flags = VK_FENCE_CREATE_SIGNALED_BIT;
00325
00326     for (size_t i = 0; i < MAX_FRAMES_IN_FLIGHT; i++) {
00327         if (vkCreateSemaphore(device.device(), &semaphoreInfo, nullptr, &imageAvailableSemaphores[i])
!= VK_SUCCESS ||
00328             vkCreateSemaphore(device.device(), &semaphoreInfo, nullptr, &renderFinishedSemaphores[i])
!= VK_SUCCESS ||
00329             vkCreateFence(device.device(), &fenceInfo, nullptr, &inFlightFences[i]) != VK_SUCCESS) {
00330             throw std::runtime_error("failed to create synchronization objects for a frame!");
00331         }
00332     }
00333 }
00334
00335 VkSurfaceFormatKHR ven::SwapChain::chooseSwapSurfaceFormat(const std::vector<VkSurfaceFormatKHR>
&availableFormats)
00336 {
00337     for (const auto &availableFormat : availableFormats) {
00338         if (availableFormat.format == VK_FORMAT_B8G8R8A8_UNORM && availableFormat.colorSpace ==
VK_COLOR_SPACE_SRGB_NONLINEAR_KHR) {
00339             return availableFormat;
00340         }
00341     }
00342
00343     return availableFormats[0];
00344 }
00345
00346 VkPresentModeKHR ven::SwapChain::chooseSwapPresentMode(const std::vector<VkPresentModeKHR>
&availablePresentModes)
00347 {
00348     for (const auto &availablePresentMode : availablePresentModes) {
00349         if (availablePresentMode == VK_PRESENT_MODE_MAILBOX_KHR) {
00350             std::cout << "Present mode: Mailbox\n";
00351             return availablePresentMode;
00352         }
00353     }
00354
00355     for (const auto &availablePresentMode : availablePresentModes) {
00356         if (availablePresentMode == VK_PRESENT_MODE_IMMEDIATE_KHR) {
00357             std::cout << "Present mode: Immediate" << '\n';

```

```

00358         return availablePresentMode;
00359     }
00360 }
00361
00362 std::cout << "Present mode: V-Sync\n";
00363 return VK_PRESENT_MODE_FIFO_KHR;
00364 }
00365
00366 VkExtent2D ven::SwapChain::chooseSwapExtent(const VkSurfaceCapabilitiesKHR &capabilities) const
00367 {
00368     if (capabilities.currentExtent.width != std::numeric_limits<uint32_t>::max()) {
00369         return capabilities.currentExtent;
00370     }
00371     VkExtent2D actualExtent = windowExtent;
00372     actualExtent.width = std::max(capabilities.minImageExtent.width,
std::min(capabilities.maxImageExtent.width, actualExtent.width));
00373     actualExtent.height = std::max(capabilities.minImageExtent.height,
std::min(capabilities.maxImageExtent.height, actualExtent.height));
00374
00375     return actualExtent;
00376 }
00377
00378 VkFormat ven::SwapChain::findDepthFormat() const
00379 {
00380     return device.findSupportedFormat(
00381         {VK_FORMAT_D32_SFLOAT, VK_FORMAT_D32_SFLOAT_S8_UINT, VK_FORMAT_D24_UNORM_S8_UINT},
00382         VK_IMAGE_TILING_OPTIMAL,
00383         VK_FORMAT_FEATURE_DEPTH_STENCIL_ATTACHMENT_BIT);
00384 }

```

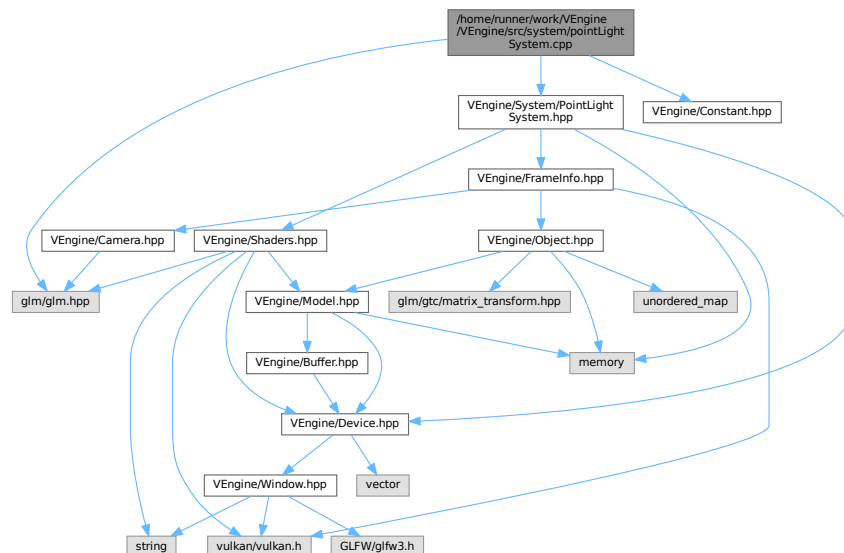
7.72 /home/runner/work/VEngine/VEngine/src/system/pointLight System.cpp File Reference

```

#include <glm/glm.hpp>
#include "VEngine/System/PointLightSystem.hpp"
#include "VEngine/Constant.hpp"

```

Include dependency graph for pointLightSystem.cpp:



Classes

- struct [PointLightPushConstants](#)

Macros

- `#define GLM_FORCE_RADIANS`
- `#define GLM_FORCE_DEPTH_ZERO_TO_ONE`

7.72.1 Macro Definition Documentation**7.72.1.1 GLM_FORCE_DEPTH_ZERO_TO_ONE**

```
#define GLM_FORCE_DEPTH_ZERO_TO_ONE
```

Definition at line 2 of file [pointLightSystem.cpp](#).

7.72.1.2 GLM_FORCE_RADIANS

```
#define GLM_FORCE_RADIANS
```

Definition at line 1 of file [pointLightSystem.cpp](#).

7.73 pointLightSystem.cpp

[Go to the documentation of this file.](#)

```
00001 #define GLM_FORCE_RADIANS
00002 #define GLM_FORCE_DEPTH_ZERO_TO_ONE
00003 #include <glm/glm.hpp>
00004
00005 #include "VEngine/System/PointLightSystem.hpp"
00006 #include "VEngine/Constant.hpp"
00007
00008
00009 struct PointLightPushConstants {
00010     glm::vec4 position{};
00011     glm::vec4 color{};
00012     float radius;
00013 };
00014
00015 ven::PointLightSystem::PointLightSystem(Device& device, const VkRenderPass renderPass, const
    VkDescriptorSetLayout globalSetLayout) : m_device{device}
00016 {
00017     createPipelineLayout(globalSetLayout);
00018     createPipeline(renderPass);
00019 }
00020
00021 void ven::PointLightSystem::createPipelineLayout(const VkDescriptorSetLayout globalSetLayout)
00022 {
00023     VkPushConstantRange pushConstantRange{};
00024     pushConstantRange.stageFlags = VK_SHADER_STAGE_VERTEX_BIT | VK_SHADER_STAGE_FRAGMENT_BIT;
00025     pushConstantRange.offset = 0;
00026     pushConstantRange.size = sizeof(PointLightPushConstants);
00027
00028     const std::vector<VkDescriptorSetLayout> descriptorSetLayouts{globalSetLayout};
00029
00030     VkPipelineLayoutCreateInfo pipelineLayoutInfo{};
00031     pipelineLayoutInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_LAYOUT_CREATE_INFO;
00032     pipelineLayoutInfo.setLayoutCount = static_cast<uint32_t>(descriptorSetLayouts.size());
00033     pipelineLayoutInfo.pSetLayouts = descriptorSetLayouts.data();
00034     pipelineLayoutInfo.pushConstantRangeCount = 1;
00035     pipelineLayoutInfo.pPushConstantRanges = &pushConstantRange;
00036     if (vkCreatePipelineLayout(m_device.device(), &pipelineLayoutInfo, nullptr, &m_pipelineLayout) !=
        VK_SUCCESS)
00037     {
00038         throw std::runtime_error("Failed to create pipeline layout");
00039     }
00040 }
00041
00042 void ven::PointLightSystem::createPipeline(const VkRenderPass renderPass)
```

```

00043 {
00044     PipelineConfigInfo pipelineConfig{};
00045     Shaders::defaultPipelineConfigInfo(pipelineConfig);
00046     pipelineConfig.attributeDescriptions.clear();
00047     pipelineConfig.bindingDescriptions.clear();
00048     pipelineConfig.renderPass = renderPass;
00049     pipelineConfig.pipelineLayout = m_pipelineLayout;
00050     m_shaders = std::make_unique<Shaders>(m_device, std::string(SHADERS_BIN_PATH) +
"point_light_vert.spv", std::string(SHADERS_BIN_PATH) + "point_light_frag.spv", pipelineConfig);
00051 }
00052
00053 void ven::PointLightSystem::render(const FrameInfo &frameInfo) const
00054 {
00055     m_shaders->bind(frameInfo.commandBuffer);
00056
00057     vkCmdBindDescriptorSets(frameInfo.commandBuffer, VK_PIPELINE_BIND_POINT_GRAPHICS,
m_pipelineLayout, 0, 1, &frameInfo.globalDescriptorSet, 0, nullptr);
00058
00059     for (auto &kv : frameInfo.objects)
00060     {
00061         Object &object = kv.second;
00062         if (object.pointLight == nullptr) continue;
00063         PointLightPushConstants push{};
00064         push.position = glm::vec4(object.transform3D.translation, 1.F);
00065         push.color = glm::vec4(object.color, object.pointLight->lightIntensity);
00066         push.radius = object.transform3D.scale.x;
00067         vkCmdPushConstants(frameInfo.commandBuffer, m_pipelineLayout, VK_SHADER_STAGE_VERTEX_BIT |
VK_SHADER_STAGE_FRAGMENT_BIT, 0, sizeof(PointLightPushConstants), &push);
00068         vkCmdDraw(frameInfo.commandBuffer, 6, 1, 0, 0);
00069     }
00070
00071 }
00072
00073 void ven::PointLightSystem::update(const FrameInfo &frameInfo, GlobalUbo &ubo)
00074 {
00075     const auto rotateLight = rotate(glm::mat4(1.F), frameInfo.frameTime, {0.F, -1.F, 0.F});
00076     unsigned long lightIndex = 0;
00077     for (auto &kv : frameInfo.objects)
00078     {
00079         Object &object = kv.second;
00080         if (object.pointLight == nullptr) continue;
00081         assert(lightIndex < MAX_LIGHTS && "Too many lights");
00082         object.transform3D.translation = glm::vec3(rotateLight *
glm::vec4(object.transform3D.translation, 1.F));
00083         ubo.pointLights[lightIndex].position = glm::vec4(object.transform3D.translation, 1.F);
00084         ubo.pointLights[lightIndex].color = glm::vec4(object.color,
object.pointLight->lightIntensity);
00085         lightIndex++;
00086     }
00087     ubo.numLights = static_cast<int>(lightIndex);
00088 }

```

7.74 /home/runner/work/VEngine/VEngine/src/system/renderSystem.cpp

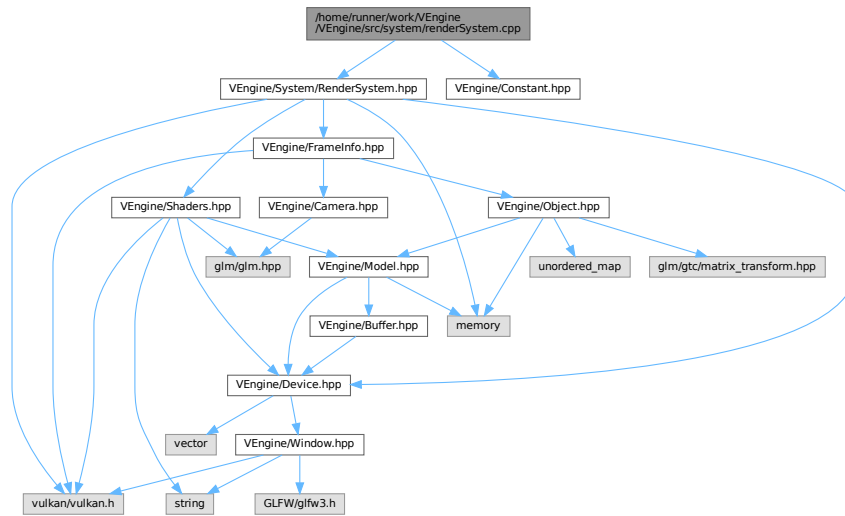
File Reference

```

#include "VEngine/System/RenderSystem.hpp"
#include "VEngine/Constant.hpp"

```

Include dependency graph for renderSystem.cpp:



7.75 renderSystem.cpp

[Go to the documentation of this file.](#)

```
00001 #include "VEngine/System/RenderSystem.hpp"
00002 #include "VEngine/Constant.hpp"
00003
00004
00005 ven::RenderSystem::RenderSystem(Device& device, const VkRenderPass renderPass, const
VkDescriptorSetLayout globalSetLayout) : m_device{device}
00006 {
00007     createPipelineLayout(globalSetLayout);
00008     createPipeline(renderPass);
00009 }
00010
00011 void ven::RenderSystem::createPipelineLayout(const VkDescriptorSetLayout globalSetLayout)
00012 {
00013     VkPushConstantRange pushConstantRange{};
00014     pushConstantRange.stageFlags = VK_SHADER_STAGE_VERTEX_BIT | VK_SHADER_STAGE_FRAGMENT_BIT;
00015     pushConstantRange.offset = 0;
00016     pushConstantRange.size = sizeof(SimplePushConstantData);
00017
00018     const std::vector<VkDescriptorSetLayout> descriptorSetLayouts{globalSetLayout};
00019
00020     VkPipelineLayoutCreateInfo pipelineLayoutInfo{};
00021     pipelineLayoutInfo.sType = VK_STRUCTURE_TYPE_PIPELINE_LAYOUT_CREATE_INFO;
00022     pipelineLayoutInfo.setLayoutCount = static_cast<uint32_t>(descriptorSetLayouts.size());
00023     pipelineLayoutInfo.pSetLayouts = descriptorSetLayouts.data();
00024     pipelineLayoutInfo.pushConstantRangeCount = 1;
00025     pipelineLayoutInfo.pPushConstantRanges = &pushConstantRange;
00026     if (vkCreatePipelineLayout(m_device.device(), &pipelineLayoutInfo, nullptr, &m_pipelineLayout) !=
VK_SUCCESS)
00027     {
00028         throw std::runtime_error("Failed to create pipeline layout");
00029     }
00030 }
00031
00032 void ven::RenderSystem::createPipeline(const VkRenderPass renderPass)
00033 {
00034     PipelineConfigInfo pipelineConfig{};
00035     Shaders::defaultPipelineConfigInfo(pipelineConfig);
00036     pipelineConfig.renderPass = renderPass;
00037     pipelineConfig.pipelineLayout = m_pipelineLayout;
00038     m_shaders = std::make_unique<Shaders>(m_device, std::string(SHADERS_BIN_PATH) + "shader_vert.spv",
std::string(SHADERS_BIN_PATH) + "shader_frag.spv", pipelineConfig);
00039 }
00040
00041 void ven::RenderSystem::renderObjects(const FrameInfo &frameInfo) const
00042 {
```

```

00043     m_shaders->bind(frameInfo.commandBuffer);
00044
00045     vkCmdBindDescriptorSets(frameInfo.commandBuffer, VK_PIPELINE_BIND_POINT_GRAPHICS,
m_pipelineLayout, 0, 1, &frameInfo.globalDescriptorSet, 0, nullptr);
00046
00047     for (auto &kv : frameInfo.objects)
00048     {
00049         Object &object = kv.second;
00050         if (object.model == nullptr) continue;
00051         SimplePushConstantData push{};
00052         push.modelMatrix = object.transform3D.mat4();
00053         push.normalMatrix = object.transform3D.normalMatrix();
00054         vkCmdPushConstants(frameInfo.commandBuffer, m_pipelineLayout, VK_SHADER_STAGE_VERTEX_BIT |
VK_SHADER_STAGE_FRAGMENT_BIT, 0, sizeof(SimplePushConstantData), &push);
00055         object.model->bind(frameInfo.commandBuffer);
00056         object.model->draw(frameInfo.commandBuffer);
00057     }
00058 }

```

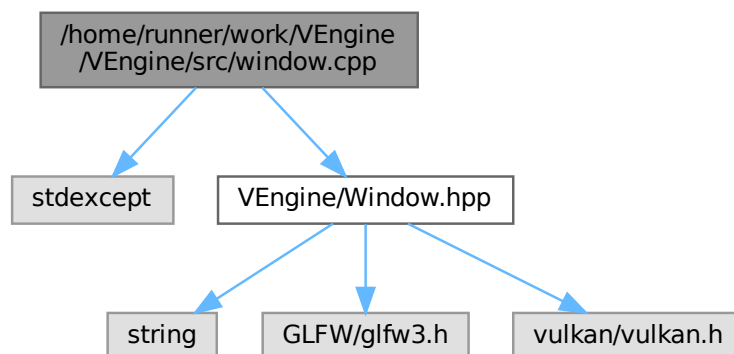
7.76 /home/runner/work/VEngine/VEngine/src/window.cpp File Reference

```

#include <stdexcept>
#include "VEngine/Window.hpp"

```

Include dependency graph for window.cpp:



7.77 window.cpp

[Go to the documentation of this file.](#)

```

00001 #include <stdexcept>
00002
00003 #include "VEngine/Window.hpp"
00004
00005 GLFWwindow* ven::Window::createWindow(const uint32_t width, const uint32_t height, const std::string
&title)
00006 {
00007     if (glfwInit() == GLFW_FALSE) {
00008         throw std::runtime_error("Failed to initialize GLFW");
00009     }
00010
00011     glfwWindowHint(GLFW_CLIENT_API, GLFW_NO_API);
00012     glfwWindowHint(GLFW_RESIZABLE, GLFW_TRUE);
00013 }

```



```
00014     GLFWwindow *window = glfwCreateWindow(static_cast<int>(width), static_cast<int>(height),
00015     title.c_str(), nullptr, nullptr);
00016     if (window == nullptr) {
00017         glfwTerminate();
00018         throw std::runtime_error("Failed to create window");
00019     }
00020     glfwSetWindowUserPointer(window, this);
00021     glfwSetFramebufferSizeCallback(window, framebufferResizeCallback);
00022     return window;
00023 }
00024 void ven::Window::createWindowSurface(const VkInstance instance, VkSurfaceKHR *surface) const
00025 {
00026     if (glfwCreateWindowSurface(instance, m_window, nullptr, surface) != VK_SUCCESS) {
00027         throw std::runtime_error("Failed to create window surface");
00028     }
00029 }
00030
00031 void ven::Window::framebufferResizeCallback(GLFWwindow *window, const int width, const int height)
00032 {
00033     auto *app = static_cast<Window *>(glfwGetWindowUserPointer(window));
00034     app->m_framebufferResized = true;
00035     app->m_width = static_cast<uint32_t>(width);
00036     app->m_height = static_cast<uint32_t>(height);
00037 }
```


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