
SOFTWARE REQUIREMENTS SPECIFICATION

for

GET
2d Game Engine Toolbox

Version 1.0 approved

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CMPT-376W

April 9, 2020

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Revision History

Name	Date	Reason For Changes	Version
Kier Lindsay	April 9, 2020	Initial Copy	1

1 Introduction

1.1 Purpose

This document refers to the GET software, version 1.0. GET stands for Game Engine Toolbox and it is a two-dimensional (2D) game engine designed to bridge a gap between existing graphics library and large complete three-dimensional (3D) game engines. It will extend the capabilities of graphics Library and provide common systems and feature needed to develop a game without forcing the user into a large complex engine. In its first iteration (version 1.0), GET is based on the C++ Simple and Fast Multimedia Library (SFML) engine. This SRS will cover the entirety of GET

1.2 Document Conventions

This document follows the IEEE SRS template. It also makes use of the KISS mentality in order to make things easy to parse.

1.3 Intended Audience and Reading Suggestions

This document is intended for the developers who will be implementing the game engine. We would also like to consider users of the engine as this document may offer a high level overview of what the product offers and its design philosophy. We recommend that developers start by reading chapter 2 (Overall Description), especially section 2.2 (Product Functions) as they will be in charge of implementing the components mentioned there. Then, they can move on to chapter 4 which elaborates the system features of each module of the software.

1.4 Project Scope

This project is meant to complement an existing graphics library providing the core functionalities all games require and tools for developers to use. It is meant to provide a more advanced and highly customization starting point for game developers who want to have full control over their game. It is also meant to be modular so that developers are not forced into using our designs and have the freedom to incorporate as many or as few of the features we provide. The current iteration of GET focuses on SFML which is a C++ multimedia library. It is used as the backbone of the software and the aim is to cover more libraries in the next versions.

1.5 References

SFML ImGui SDL2 RayLib

Minimal programing guides.

others as we write them or references to documentation for implementation

<List any other documents or Web addresses to which this SRS refers. These may include user interface style guides, contracts, standards, system requirements specifications, use case documents, or a vision and scope document. Provide enough information so that the reader could access a copy of each reference, including title, author, version number, date, and source or location.>

2 Overall Description

2.1 Product Perspective

The product being specified in this SRS is completely new. It is self-contained in the sense that it does not have any dependencies that require additional steps to be taken by its user, even though it relies on the SFML library.

2.2 Product Functions

Engine

Timing - Setups at maintain a core game loop Allows users to use real dt or fix it so each tick is a consistent time. Allows users to set tickrate and framerate independently Allows users to hook into update and render calls

States - Manage switching between game states Allow users to Bind a number of game states to an engine each with its own update and render functions Allow users to toggle states.

Assets - Manages the loading and management of game assets such as fonts and textures. Supports Fonts Supports Sprites Supports Textures Supports Animations

Physics Module - This will provide Management and Physics functions that apply to bodys. Camera - This will provide cameras that can be applied to A game state. or accessed as a transformation. UI - Adds the ability to make and control UI's Util - extra utility functions that extend GL or offer useful functions Extend Math for GL's vectors. Add Extra bodys and objects such as partical systems

2.3 User Classes and Characteristics

Full users - these users will use this software as their starting point and build there game around our components and tools.

Partial users - These users will user the core graphics library as their starting point and may incorporate some components of our software into there project.

2.4 Operating Environment

Our Target environment for this project would be to extend SFML and we should expect the same environment that sfml does.

OS: Linux, OSX, Windows

Depandancys: SFML, OpenGL, Imgui

Language Target: C++

2.5 Design and Implementation Constraints

SFML does not support 3d inherently so it should be expected that the protect also does not support 3d.

2.6 User Documentation

API Reference

Setup Guide

Basic examples todo: expand on each of these maybe add more

2.7 Assumptions and Dependencies

3 External Interface Requirements

3.1 User Interfaces

<Describe the logical characteristics of each interface between the software product and the users. This may include sample screen images, any GUI standards or product family style guides that are to be followed, screen layout constraints, standard buttons and functions (e.g., help) that will appear on every screen, keyboard shortcuts, error message display standards, and so on. Define the software components for which a user interface is needed. Details of the user interface design should be documented in a separate user interface specification.>

3.2 Hardware Interfaces

joysticks? <Describe the logical and physical characteristics of each interface between the software product and the hardware components of the system. This may include the supported device types, the nature of the data and control interactions between the software and the hardware, and communication protocols to be used.>

3.3 Software Interfaces

Graphics Library <Describe the connections between this product and other specific software components (name and version), including databases, operating systems, tools, libraries, and integrated commercial components. Identify the data items or messages coming into the system and going out and describe the purpose of each. Describe the services needed and the nature of communications. Refer to documents that describe detailed application programming interface protocols. Identify data that will be shared across software components. If the data sharing mechanism must be implemented in a specific way (for example, use of a global data area in a multitasking operating system), specify this as an implementation constraint.>

3.4 Communications Interfaces

Networking multiplayer <Describe the requirements associated with any communications functions required by this product, including e-mail, web browser, network server communications protocols, electronic forms, and so on. Define any pertinent message formatting. Identify any communication standards that will be used, such as FTP or

HTTP. Specify any communication security or encryption issues, data transfer rates, and synchronization mechanisms.>

4 System Features

<This template illustrates organizing the functional requirements for the product by system features, the major services provided by the product. You may prefer to organize this section by use case, mode of operation, user class, object class, functional hierarchy, or combinations of these, whatever makes the most logical sense for your product.>

4.1 Engine Module

4.1.1 Description and Priority

This feature provides the core game loop and state functionality it is an essential feature and is high priority. The timing component we allow users to manage the main loop speed. and when it calls the current states update and render functions. These can be different so games can run at a constant physics rate and scale that as necessary but only render when needed or at a fixed frame rate. It will have game states that can be switched between from events within the update function. This is meant to be extended by the users game and the update and render functions overridden with games specific code.

4.1.2 Stimulus/Response Sequences

- Stimulus: Time adjusted
Response: Internal time variables set so the new timing take effect the next tick
- Stimulus: State changed
Response: the corresponding states update and draw function will be used on the next tick.
- Stimulus: New Tick
Response: Current states update function is called and if it is time to draw a frame the render function is also called
- Stimulus: Camera Set
Response: Current states Camera is set and the cameras transformation from world coordinates to Camera coordinates is applied while rendering

4.1.3 Functional Requirements

- REQ-ET1:** Tick rate and Frame rate must be controlled independently
- REQ-ET2:** When calling Update in a tick the Tick time must be sent as a parameter
- REQ-ET3:** If ticks cannot be computed in time render frames may be dropped.
- REQ-ES1:** The update and render function should be called for all active states.
- REQ-ES2:** States should be able toggle states from within the update function.
- REQ-ES3:** States Should have an Identifier, Update function, and Draw function
- REQ-ES4:** States should accept a camera transformation which applies to the render function.
- REQ-ES5:** States should be able to be given indexes for rendering order. This should default to the order they were added

4.2 Physics Module

4.2.1 Description and Priority

The Physics Module will be a high priority. This will have three components the *Physics Manager* which can be used to hold *Physics Bodies* and manage the relationships between them as well as the *Physics Functions* which will provided many useful physics calculations and can be used on bodies independently or be used by the physics manager to update the bodies it manages..

4.2.2 Stimulus/Response Sequences

- Stimulus: New Body Created
Response: Body Initialized with provided parameters and is returned to user for use
- Stimulus: New Manager Created
Response: Physics Manager Initialized with universal constants provided and environment for bodies is setup
- Stimulus: Body Added to manager
Response: Body is added to the manager and will be updated and rendered all world relationships will be applied to it

- Stimulus: Relationship Added to manager
Response: Bodies referenced by the relationship will have it applied to them
- Stimulus: Collision Detected between Bodies
Response: Bodies are separated and appropriate forces are applied.
- Stimulus: Body Updated delta time
Response: All applied relationships are computed and bodies parameters are updated
- Stimulus: Body Rendered
Response: Body is drawn to screen at corresponding position
- Stimulus: Body Deleted
Response: All relationships are removed and corresponding managers and bodies are notified then body is deleted.

4.2.3 Functional Requirements

- REQ-PB1:** The Physics Body class should store all physical properties required by the Functions this includes: Shape, Position, Velocity, Acceleration, Rotation, Rotational Velocity, Friction, Elasticity, Shape
- REQ-PB2:** The Physics Body class should have an *Update* function which updates the bodies property according to classical mechanics when called, this function will take in a delta time parameter
- REQ-PB3:** The Physics Body class should have an *Render* function which Draws the bodies shape. This should be designed to be overridden by users.
- REQ-PB4:** The Physics Body class should keep an list of relationships it is a part of so that is can apply them all when updated.
- REQ-PF1:** The Physics Function should accept universals constants as parameters or allow global defaults be set.
- REQ-PF2:** The Physics Function should include *Collision detection* between two bodies with *Minimum Translation Vectors* (MTV). It should include fast approximate bounding box collision detection as well.
- REQ-PF3:** The Physics Function should include *collision solving* functions which will apply the necessary forces to handle a collision between two bodies.

- REQ-PF4:** The Physics Function should include *gravity* functions to apply gravity between two bodies.
- REQ-PF5:** The Physics Function should include *constant force* functions to apply constant forces to a body these could be used to create world gravity or wind forces.
- REQ-PM1:** The Physics Manager should create an environment to hold Body's as well as set world constants for the bodies it manages.
- REQ-PM2:** The Physics Manager should allow relationships to be made between bodies which define additional iterations. This includes forces and whether or not bodies should interact with each other.
- REQ-PM3:** The Physics Manager should have an *Update* function which applies all relations and updates all bodies
- REQ-PM4:** The Physics Manager should have an *Render* function which renders all bodies. This should allow for bodies to be drawn in a defined order
- REQ-PM5:** The Physics Manager should allow bodies to be grouped and relations or physics functions can be defined for the whole group or for each pair of bodies in the group.
- REQ-PM6:** The Physics Manager should allow world Relationships to be set which apply to all bodies. These include global forces and n-body gravity as well as other optional relationships as appropriate.
- REQ-PM7:** The Physics Manager should allow preform collision detection between select objects this should be efficiently implemented so that full collision detection is only used when necessary not at all times.

4.3 User Interface Module

4.3.1 Description and Priority

The User Interface module provides the developer with functionalities that augment the graphics module of their game engine. It is meant to be built on top of the Physics Module as it is a visual interpretation of the constraints implemented there. Its priority level is low since it is not required for the game to run and its purpose is to enable the players to interact with the game.

4.3.2 Stimulus/Response Sequences

- Stimulus: New Humanoid Shape Created
Response: Humanoid shape is initialized with its parameters and is returned to user for use.

- Stimulus: Humanoid Shape linked to Body
Response: Humanoid shape is added to an already instantiated body from the Physics Module. Its behavior handling is passed to the Body's manager.
- Stimulus: New Miscellaneous Shape Created
Response: Miscellaneous shape is created using the provided image files and is returned to user for use.
- Stimulus: Miscellaneous Shape linked to Body
Response: Miscellaneous shape is added to an already instantiated body from the Physics Module. Its behavior handling is passed to the Body's manager.
- Stimulus: New Background Created
Response: Background is initialized with its parameters and is returned to user for use.
- Stimulus: Background linked to Physics Manager
Response: Background is link to an instance of Physics Manager and all its property will be valid within the background.

4.3.3 Functional Requirements

5 Other Nonfunctional Requirements

5.1 Performance Requirements

The size of the library should not exceed that of SFML. This is on the order of 10 MB this limit aim to keep the loading and download times of developers games low. Reasons to exead this may be analized on a case by case basis but if component exceed this limit they should be optional so that developers can exclude them if not needed.

REQ-NFP1: Physics management must fast and able to support thousands of objects. Ideally man collision algorithm will faster then $O(n!)$ This would be the speed of an naive implementation and there should be speedups that we can use to improve upon this. The target performance should be $O(n\log(n))$ as this would allow many more object to exist in the words but this may not be possible.

REQ-NFP2: We hope that the library reaches reasonable time and memory complexity. But in general component should be using the time and space complexities of the latest research on whichever component is being used. This will be found during implementation when the component is being designed.

REQ-NFP3: Should not have any memory leaks or other performance degradation over time.

5.2 Safety Requirements

This library although aimed towards game developers should attempt to be as stable and reliable as possible if it is uses to develop mission critical applications and therefor should meat these requirements

REQ-NFD1: Be well tested for reliability and crash tolerance. This involves maintain reliable operation for extended periods of time without degrading performance. see REC-NFP3

REQ-NFD2: The documentation should include detailed operational parameter ranges. with a guarantee of correctness for operation within them. These allow developers to use this library in mission critical application and easily audit our code for correctness.

5.3 Security Requirements

Although this library does not have networked components game hacking is a large problem these days the problem is very hard to mitigate and ultimately any solution we implement may not make a difference since the software can always be read. These solutions would land on the shoulders of game developers to implement across their entire game. For other corporate applications application we would like consider a few things though.

REQ-NFS1: The library should operate entirely in user space if possible this would prevent it from allowing privilege escalation attack entirely. If not possible more scrutiny should be applied to those components security on a case by case basis.

5.4 Software Quality Attributes

This project should strive to offer great value The aim should be to produce high quality code that performs well and developer love to use. It is the hope that the usefulness and power of this project are high so that it is recognised as a useful tool and can find its place in the large game development ecosystem.

5.5 Business Rules

Honesty is important and this project should both be honest to each other while developing it about what is happening. This will make the development process easier and more fluid. We should also be honest to the users by not making our code or documentation ambiguous. This just makes everything easier for everyone.

6 Other Requirements

6.1 Appendix A: Glossary

- Graphics Library or GL - is a library the provides a window and functions to draw to the window. Examples of graphics libraries are SFML and SDL2
- SFML - Simple fast media layer, this is a graphics library
- Body - Our usage of the term body references physics body's or objects.

6.2 Appendix B: Analysis Model

