Preliminary report

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SUMMARY:

The title of this project, Einheri, is the name of a game that will be developed alongside a new framework. The framework will be made for making general purpose graphical and networked applications. Existing frameworks and engines such as SDL [17], SFML [11], Unreal Engine [8] and Unity [30] are already available, but this framework will be developed with a different approach. It's worth noting the objective is not to replace or reach the same feature set as the aforementioned tools. The goals for the framework are flexibility, low overall coupling of systems, and a small memory footprint.

To test the framework, an online 3D game consisting of a client, server, and toolkit, will be developed with it. To ensure playability and quality of the game, a group of testers will help by providing fortnightly feedback. Players will explore a world with stories and characters based on Norse mythology and the viking age. As a player, one can help certain in-game characters with tasks that range from easy to hard difficulty levels.

This assignment is an exam submission done by a student at NTNU in Ålesund.

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Chapter 1

Introduction

Einheri is the name of an online multiplayer 3D game that will be developed for this project. The game will be based on Norse mythology, and the viking age. Players will be able to interact with an open world, and explore the stories it has to tell. Developing content is a key part of game development. Shaping the world, editing the character dialogues, and defining objects and items. These jobs will be done using a toolkit developed specifically for this game. The toolkit will provide a node based scripting system for defining character dialogues and item behavior. All the components for the game will be built using a framework that will be developed for this project. The framework must implement systems for networking, skeletal animations, rendering, audio, input, and so forth. Typically, graphical software use existing frameworks or engines, but the goal for this project is to build something new.

A website will also be created, which will let new users sign up, download the client, and view leaderboards. Other features include a news section, and a world map.

Chapter 2

Terminology

C++ is a multi-paradigm programming language developed by Bjarne Stroustrup

Unreal Engine is an industry standard open-source game engine by Epic Games

Unity is a game engine popular among independent developers by Unity Technologies

ImGui *Dear ImGui* is a flexible and customizable platform independent C++ library for quickly implementing user interfaces

SDL Simple DirectMedia Layer is a framework for graphical applications in C and C++

SFML Simple and Fast Multimedia Library is a framework for graphical applications in C++

TCP Transmission Control Protocol is a networking protocol with a no packet loss guarantee

API Application Programming Interface

WASAPI Windows Audio Sessions API for streaming audio in Windows

A* A-star is a popular algorithm used for pathfinding

TTF TrueType Fonts

UML Unified Modeling Language

MSDN Microsoft Developer Network

Chapter 3

Project organization

3.1 Group

Student number	Name of student
997517	Sebastian Søviknes Gundersen

Table 1: Students in the group

3.2 Organizational tasks

Tasks must be completed according to plan. Progress reports need to be handed in every two weeks, and feedback must be compiled from testers. In the case of deviancy from the project plan, it must be measured. Actions must then be taken based on the planned deviation management.

3.3 Management

The management consists of Saleh Abdel-Afou Alaliyat at NTNU in Ålesund.

Chapter 4

Mindset

As a software developer, it is important to develop ethical software, and respect the user. Contemporary software is heavily focused on violating privacy [26] and monetizing personal information [18]. Every new project involving personal information, should also be based on the guidelines defined by Datatilsynet [3].

There is also the eery trend of *Software as a Service* (SaaS) that is being pushed by many companies, such as Microsoft [19]. It is unfortunate that people are no longer allowed to own the software they pay for [25]. In the future, even operating systems may have similar restrictions if things continue in this direction. There are alternatives such as GNU/Linux, but most consumers do not install a distribution of Linux when purchasing a computer. SaaS can be compared to arguably evil hardware manufacturers against the right to repair, such as Apple [15]. The free software community is one that more companies and software developers should look towards.

Chapter 5

Project description

5.1 Objective

There are two distinct goals for this project. One is to develop a framework with the required features specified in the next section. The other is to create an interesting and playable game based on that framework, along with a toolkit to produce content for the game.

5.2 Requirements specification

Both the framework and the game core will be compiled uniquely for the client, server, and toolkit. The client does not need model conversion and ImGui, while the server does not need any of the graphics or audio systems at all. With this in mind, all game logic must be completely separated from the rendering. The scope of the project is limited by the requirements specified below.

Requirements for the framework:

- Skeletal animation system with attachments support
- Multithreaded networking system with a packet protocol based on TCP
- Audio system based on WASAPI [21] – 3D sounds will not be implemented
- Logging system with detailed and readable output with easy usage
- Loading common asset files like PNG [27] and Ogg Vorbis [33][34]

- Import models using Assimp [16], then convert to a custom model format
- Flexible rendering system, easily allowing custom defined vertex layouts and shaders
- TTF [1][20] unicode text rendering with FreeType [7]
- ImGui [2] platform implementation to allow the toolkit to use ImGui
- Capable of being used without including third party libraries (besides GLM [10] and ImGui)
- Proper synchronization between frames, with a take on fixed time steps [5][32]
- Ortho and perspective cameras, with controllers
- I/O stream to easily write and read memory

Requirements for the game core:

- Streamable game world without chunking
- Dialogue system with conditions, events, and variables
- Item system with similar behavior to dialogues
- Quest system, on top of the dialogue system
- Combat system with support for both melee and ranged attacks
- Inventory and equipment slots for the player
- Chat system to let players communicate
- Fishing to gather food for use in combat to heal lifepoints
- Stamina that affects combat and agility
- Pathfinding with A* [24]
- Minimap
- Area music, and sound effects for actions
- Warehouses
- Player trading

Requirements for content produced in toolkit:

- Minimum a dozen quests for the player to complete
- At least double as many important game characters as there are quests
- The world must be explorable, meaning it should take several minutes to cross it
- Various types of swords, spears, axes and bows must be available
- Unfriendly characters, animals or monsters to be killed in combat for rewards or progress in a quest

Requirements for the toolkit:

- Import models in exchange formats [31] and convert them to a custom format
- Tool to easily view and configure attachments for models
- Edit the height map for the world, and place tile textures
- Place objects in the world, and edit their properties
- Configure items and objects that are used in the game
- Node based editor for the dialogue trees, providing intuitive visualization

Requirements for the client:

- Update the game world according to packets received from the server
- Send player input to the server
- User interface showing inventory, equipment, skills and quests
- Must be able to automatically auto-update itself when there is a new update released

Requirements for the server:

- Receive input from the client
- Validate the actions of players
- Update the game world based on validated actions, and broadcast to necessary players
- Synchronize player data with the database

Requirements for the website:

- Visitors should be able to register a new account to be used in the game
- A highscore table indicating who ranks best in certain aspects of the game
- Ability to change the password of an account, or perform a password reset
- Link to download the game client
- Link to view a map of the game world
- List of feedback polls voted on by the testers
- A news section that summarizes the latest updates to the game

5.3 Methodology

Although this is an individual project, an agile approach will be attempted, with focus on iterative development. Start out with the minimum viable product, and decide further development from that. There is a plan to follow, but continuous feedback from the testers will be considered.

5.4 Information gathering

There are many websites with useful information, including articles, scattered throughout the web. MSDN will be important to develop for Windows. Reading the documentation for other libraries and APIs used will also be necessary. Sites such as Stack Overflow and GameDev.net have a lot of questions and answers in almost any topic.

5.5 Risk analyzis

The requirements are somewhat designed to minimize risks, but there is always a possibility of something going wrong. The most important thing early on, is to focus on the framework and game core. The content is very important for a playable game, but it also needs to have the necessary features implemented. Other things that can go wrong include the server not performing enough validation checks, and thus crashing. Some computers, such as low-end laptops, might not be able to run the game at a decent frame rate of 60.

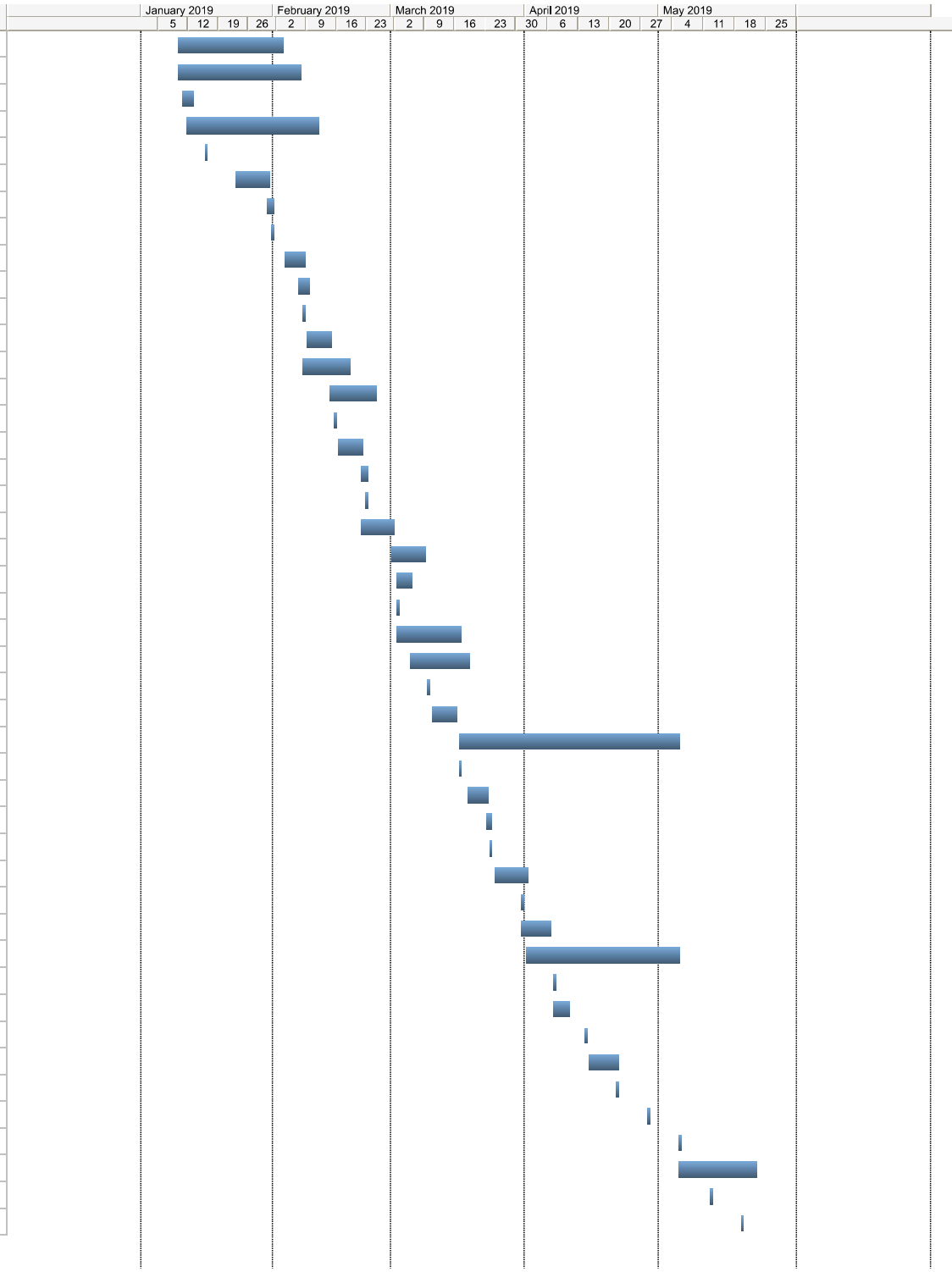
5.6 Primary activities in further work

The framework is in a functioning state, thus most of the work will be to continue on the game and toolkit. Additionally, it is important to add relevant content such as an interactive world with stories to tell.

5.7 Progress plan

See next page.

	Name	Duration	Start	Finish
1	Preliminary report	18days?	01/08/2019	01/31/2019
2	Framework: Implement all features according to requirements	20days?	01/08/2019	02/04/2019
3	Game: Players connecting to server and moving around	3days?	01/09/2019	01/11/2019
4	Toolkit: Create the world editor	22days?	01/10/2019	02/08/2019
5	Meeting #1	1day?	01/14/2019	01/14/2019
6	Toolkit: Create model manager for conversion and attachments	6days?	01/21/2019	01/28/2019
7	Toolkit: Create item and object configuration tools	2days?	01/28/2019	01/29/2019
8	Meeting #2	1day?	01/29/2019	01/29/2019
9	Website: Be able to register and download the game	3days?	02/01/2019	02/05/2019
10	Game: Inventory and equipment	3days?	02/04/2019	02/06/2019
11	Feedback poll #1	1day?	02/05/2019	02/05/2019
12	Client: Auto-update feature	4days?	02/06/2019	02/11/2019
13	Toolkit: Create the node based dialogue editor	9days?	02/05/2019	02/15/2019
14	Game: Dialogue interface	9days?	02/11/2019	02/21/2019
15	Meeting #3	1day?	02/12/2019	02/12/2019
16	Game: Chat system	4days?	02/13/2019	02/18/2019
17	Website: News section	2days?	02/18/2019	02/19/2019
18	Feedback poll #2	1day?	02/19/2019	02/19/2019
19	Server: Persistency	6days?	02/18/2019	02/25/2019
20	Game: Quest system	6days?	02/25/2019	03/04/2019
21	Game: Pathfinding	4days?	02/26/2019	03/01/2019
22	Meeting #4	1day?	02/26/2019	02/26/2019
23	Content: Draft of the world map	11days?	02/26/2019	03/12/2019
24	Game: Combat system	10days?	03/01/2019	03/14/2019
25	Feedback poll #3	1day?	03/05/2019	03/05/2019
26	Game: Minimap	4days?	03/06/2019	03/11/2019
27	Content: Quests	36days?	03/12/2019	04/30/2019
28	Meeting #5	1day?	03/12/2019	03/12/2019
29	Game: Players can trade eachother	3days?	03/14/2019	03/18/2019
30	Game and toolkit: Implement area background music, and sound effects	2days?	03/18/2019	03/19/2019
31	Feedback poll #4	1day?	03/19/2019	03/19/2019
32	Game: Fishing	6days?	03/20/2019	03/27/2019
33	Meeting #6	1day?	03/26/2019	03/26/2019
34	Game: Warehouses	5days?	03/26/2019	04/01/2019
35	Content: Make music and sound effects	25days?	03/27/2019	04/30/2019
36	Feedback poll #5	1day?	04/02/2019	04/02/2019
37	Website: View highscores and a map of the game world	4days?	04/02/2019	04/05/2019
38	Meeting #7	1day?	04/09/2019	04/09/2019
39	Content: Decorate world with more details	5days?	04/10/2019	04/16/2019
40	Feedback poll #6	1day?	04/16/2019	04/16/2019
41	Meeting #8	1day?	04/23/2019	04/23/2019
42	Feedback poll #7	1day?	04/30/2019	04/30/2019
43	Bugfixing and polishing	14days?	04/30/2019	05/17/2019
44	Meeting #9	1day?	05/07/2019	05/07/2019
45	Feedback poll #8	1day?	05/14/2019	05/14/2019



5.8 Development tools

- Visual Studio 2017 for writing and debugging C++ code [22]
- Visual Studio Code for writing shaders and the project report [23]
- CMake to generate project files [14]
- Blender for creating 3D models [6]
- GIMP for image editing [29]
- REAPER to record and edit audio [12]
- PhpStorm to develop the website [13]
- PuTTY for connecting to the server [28]
- Git for version control of the code and assets [9]
- GitHub for hosting the git repository

5.9 Internal control and evaluation

The goals are concretely defined, and it is therefore easy to decide whether or not they are complete. The group of testers will be responsible for providing constructive feedback and criticism to improve the game. If a system is implemented, but has minor bugs, it will be considered complete until the bugfixing period starts.

Chapter 6

Documentation

6.1 Reports and technical documents

Progress reports will be written for every two weeks. In addition, the feedback from testers, gathered every two weeks, will be compiled and turned into a form of documentation. Metrics for frame rates and other statistics, such as platform details, might be useful to gather. Writing documentation for the framework is also important. The contents will be a reference on the classes and functions, as well as general guidelines, and how to use it. This information might be partially generated by the usage of tools that parse source code, such as Doxygen [4]. The documentation will be made publically available online. Other documentation may include UML diagrams to show the relationship between all systems, and how they interact with eachother.

Chapter 7

Planned meetings and reports

7.1 Meetings

Meetings will be held with the advisor every second Tuesday to report on progress. The meetings are useful to get constructive feedback from the advisor. They also provide a way to prove responsibility, by showing progress according to plan.

Date	Time
14.01.2019	10:00
31.01.2019	12:30
12.02.2019	11:00
26.02.2019	11:00
12.03.2019	11:00
26.03.2019	11:00
09.04.2019	11:00
23.04.2019	11:00
07.05.2019	11:00

Table 2: Planned meeting schedule

7.2 Progress reports

The progress reports will describe the planned activities, and the actual work that was done. The planned activities are decided by following the project plan, defined in the gantt diagram. If any deviations occurred, they must be explained in the progress reports. These reports will be sent to the advisor on the day before each meeting. This gives the advisor time to look it over for the meeting. The report will then be discussed during the meeting.

Chapter 8

Planned deviation management

There are many systems at play here. Each system must be treated differently. Since the framework mostly works as expected as of writing this report, major problems are not expected. If a game system is harder to implement than anticipated, it should consume time from content development rather than excluding the functionality. In scenarios where the system has a minor issue, that issue should instead be fixed in the final bugfixing and polishing stage of the project.

Risk Assessment		SEVERITY		
		LOW	MEDIUM	HIGH
PROBABILITY	HIGH	Leftover bugs that do not interrupt gameplay		
	MEDIUM	Lack of game content, tech must be prioritized	Problems in the game core, resulting in players having a bad experience playing	Server not performing enough validation checks, resulting in crashes or cheating
	LOW		Sickness, halting plan progress	Bugs with the framework that cause major problems

Table 3: Risk assessment matrix

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