CTIS411 SENIOR PROJECT- 1 INITIAL PLAN (IP)

VR-based Firefighting Aircraft Simulation

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CTIS
COMPUTER TECHNOLOGY AND
INFORMATION SYSTEMS

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1 Executive Summary

The project will simulate a realistic aerial firefighting situation in order to help inexperienced people improve their skills. The simulation will make use of VR technology and a controller to provide a realistic and immersive simulation experience where the users will get to apply flight and fire extinguishment procedures of a real aerial firefighting situation. Since the proposed solution of VR simulation is cheaper and safer compared to practicing in a real aircraft, the project eliminates the risks of any fatal outcomes that could be a result of pilot errors done by the inexperienced pilots.

2 Project Purpose

2.1 Problem to be solved

Pilots should be trained well before using a real aircraft. Our project lets the firefighting pilots practice and become proficient enough in handling a plane and aerial firefighting before they use real aircrafts in real life scenarios in a low-stress environment.

2.2 Basis of Solution

Besides practicing Aerial Firefighting on real aircraft, creating an adequate simulation will provide a better experience because since this is a simulation it will reduce the stress of pilots by eliminating fatal consequences due to pilot errors.

2.3 Intention

This project aims to provide a detailed Fire Fighting Aircraft simulator for the users to provide Aerial Firefighting experience. In order to supply experience to the users, this simulation contains critical procedures such as take-off, landing on water, filling the water tank of the Aircraft from a lake or sea, extinguishing fire and landing on the base back.

VR technology is becoming more and more popular in the area of teaching rather than games. As of today, the firefighting department uses VR technology to simulate situations to train and prepare the firefighter. And one of the most popular uses of VR is the flight simulator. However, an aircraft firefighting simulator has never been done before. With this project we aim to train, prepare the firefighter pilots to unique situations and hazards of such a situation.

3 Project Scope

Major activities in the development of the project will include environment design, asset modelling, material creation, model texturing, fire & smoke animation and the coding which will take place in the game engine where we will bring together all the elements we prepared.

The environment design will be done in Gaea and/or World Creator. At this stage of development, we will be planning and generating the height map of the environment's terrain.

Asset modelling work will be done in a 3D CG (Computer Graphics) creation software. Our team will be using Blender, Cinema 4D and Houdini as a 3d modelling tool. At this stage of the project development, we will create the 3d models of the plane, trees, rocks, bushes etc.

We will be creating our materials in Substance Painter software. We will start this task after the asset modelling is completely finished since we need to know exactly what materials we need for our 3d models. For example, we will create the materials for the plane (multiple iron surfaces), the grassy ground of the forest, the asphalt ground of the small airbase where the plane will be taking off and landing and so on.

After the material creation is finished, we will start the texturing of the models using the software Substance Painter, where we will be applying the materials which we created as well as various textures onto our 3d models.

Fire and smoke animation will be handled using Houdini, Cinema 4D or with Unity Particle System inside Unity.

After the asset creation and animation aspects of the project development is complete, we will import all of the assets we prepared into Unity and finally start the coding side of the project. Since the type of coding will be object oriented we will give thorough definitions and use cases in our documentation.

4 Product Requirements

4.1 Users of Software

- Firefighting Pilot Candidates

  Our main users will be the students. We intend to train them and have a brief understanding of what they will face on the field.

- Firefighting Pilots

  Pilots can also use this simulation in order to learn new Aircrafts and practice in order to improve their skills.

- Flight Simulator Users

  Most popular uses of VR technology are flight simulators. People who are interested can use the simulation to have an idea about the job and can be acquainted with the fire incident.

- VR game/simulation Developers

  While developing a flight simulation, developer can use this software to form an opinion on flight simulations in general.

- VR Gamers

  Since this simulation is very suitable for gamification, it will attract some of the gamers' attention.

4.2 Exclusions

Our software main focus will be plane related such as landing, taking water and dumping on the fire. If time permits, ground type of actors and procedures will be applied.

4.3 Limitations

Simulating a plane's behavior is another type of software. Flying processes such as taking off sequences, fire extinguishing and landing maneuvers will be as realistic and as possible.
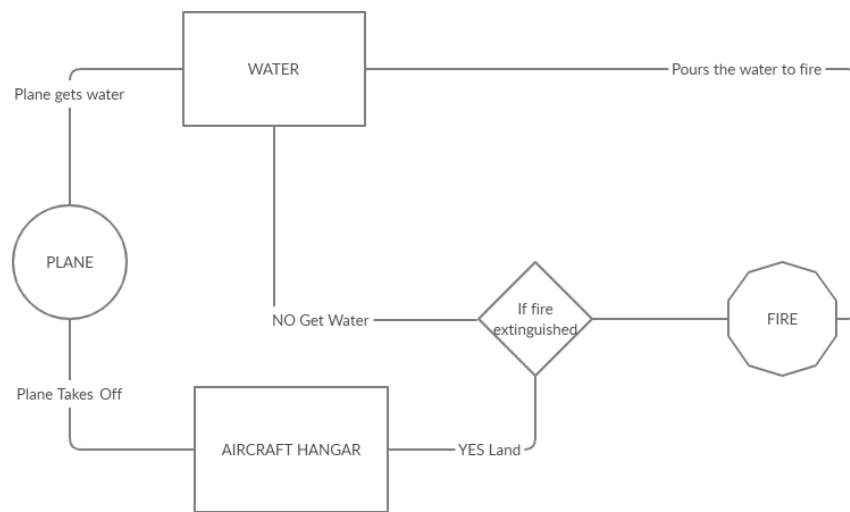
Figure 1: Context Diagram

5 Software Development Process Model

This project will apply Iterative Software Development Process Model. Since our deliverable times are set by our consultant, as a team we think that an iterative type of development model would be the best suit for our needs and software needs. A second reason we chose Iterative Development is that our Simulation's needs and requirements may change depending on the difficulties we face in the development phase therefore it is more logical to maintain software phases together.
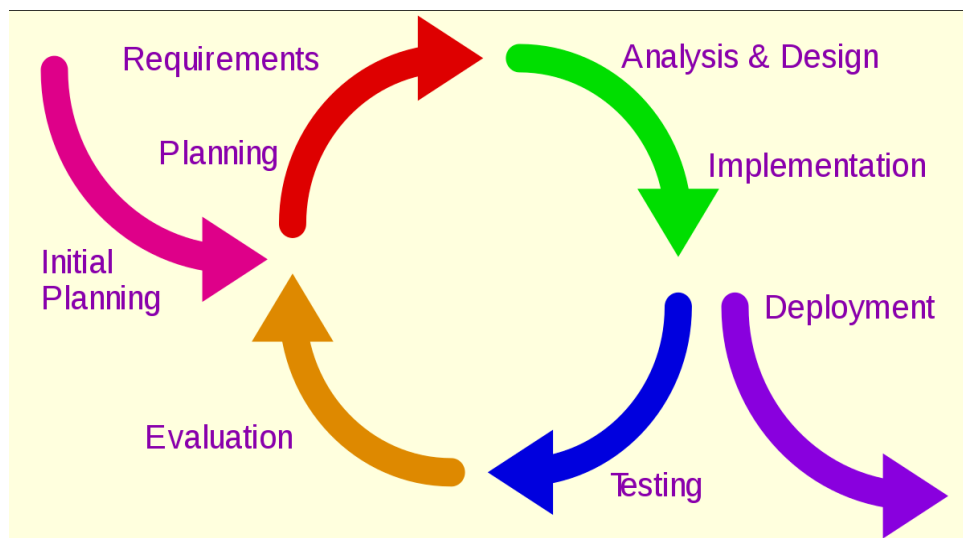

Figure 2: Software Development Cycle

6 Project Stakeholders and Organization

The roles of the team members will be interchangeable due to progress of the project. However, major roles will be specific to every person according to their most-dominant expertise. These roles have been specified in the table below:

Name	Role	Task Content
Beyhan Akporay	Consultant	Development feedbacks and assessment
Okyay Say	Advisor/Supervisor	Project Sponsor
Emre Bener	Coder, Animator	Implementation of Code
Ömer Faruk Eş	Tester	Testing, software validation and verification
Engin Kaan Görgün	UI Developer, Modelling & Material Creator	UI Implementation and Development
Mustafa Oğulcan Tekiner	Environment Creator, Modelling & Texturing	3D Modelling

7 Project Communication

- Due to pandemic, team meetings will be held online at discord. For general communication Whatsapp and discord will be used. Issue related topics will be talked on GitHub at related issue topics.
- For our presentation rehearsal and advisory actions we will use Zoom.
- We plan to have 2 meetings a week consisting of at least 3 hours. In these meetings we will work together on the project and discuss the obstacles we encounter.
- We will be using either GitHub or GitLab to manage the project files and manage versioning.

8 Project Change Control

Since we are doing a Simulation software, descriptions and requirements will be formed and finalized during implementation. If any changes in the simulation proposed, we will discuss in our meetings and if necessary change the project requirements. Our backup files, demos and version controls will be on GitLab.

9 Milestones & Deliverables

Environment design, asset modelling, material creation, model texturing, fire & smoke animation and the coding which will take place in the game engine where we will bring together all the elements we prepared.

Deliverables	Dates
Initial Plan	Week 4
Software Requirement Specification (SRS) and Requirements Prototype (Requirements elicitation and Validation)	Week 7
Software Project Management Plan (SPMP)	Week 10
Software Design Description (SDD)	Week 13
System 1st Increment Demo	Week 14
Project Presentation	Week 14
System 2st Increment Demo	2021
Project Release	2021

10 Assumptions

- We assume that Unity and Steam will not cut the service and always be available.
- If Unity has an update it will be compatible with our old files.
- Our school will provide necessary VR equipment.

11 Constraints

- The project has to be VR compatible.
- The simulation has to have a realistic feel since it's supposed to be an educational simulation.
- The Plane Cockpit will be realistic and provide an immersive feeling.
- The project has to be a simulation of an aerial firefighting scenario.
- System requirements VR Gear
- Minimum System Requirements:

Video Card	NVIDIA GTX 1060 / AMD Radeon RX 480 or greater
CPU	Intel i5-4590 / AMD Ryzen 5 1500X or greater
Memory	8GB RAM or greater
Video Output	Compatible HDMI 1.3 video output
OS	Windows 10 (Windows 7/8.1 no longer recommended)

12 Risks

Risk	Probability	Effect	Strategy
Absence of immersing feelings.	Medium	Since the project is an educational-purpose simulation, it has to have a realistic feel and it has to represent the real life experience as closely as possible	We will work on the realism aspect of the game in order to achieve a better realistic feel.
Failure of proper optimization	High	It will result in a lack of FPS (frames per second) during the gameplay. Especially in VR games, optimization is very important. Therefore we have to be very careful with optimization of the project in every aspect.	We will reduce overall poly count in our models and reduce graphics quality settings in Unity.
Violation of Covid-19 pandemic regulations.	High	Usage of the VR gear might be impossible.	Instead of using VR gear the simulation can be used on a curved screen.