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ONLINE VIRTUAL TEAM COLLABORATION PLATFORM WITH 3D GRAPHICS

CENG 491

Requirement Analysis Report

METU

2007

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1. INTRODUCTION

The requirement analysis part has always been critical to design, so it is vital for the next steps of the design process. In this report, the below objectives will be taken into consideration:

- to describe what the customer (corporation in our case) requires
- to establish a basis for the creation of a software design
- to define a set of requirements that can be validated once the software is built

1.1 Background and Overview

3D simulations are widely used for educational purposes. As Distance Education programs develop, need for interactive learning tools rises more and more. Simulation use in education has potential in two areas:

The first being a replacement model for real world experiences. It brings the advantage of not putting real world elements at risk. The other being a simulation model in which a learner can learn underlying theories based on exploration.

In our project “Online Virtual Team Collaboration Platform with 3D Graphics”, the users will have the opportunity of working in a collaborative environment to achieve the goal determined by our scenario. Each user will be responsible from his/her role in the whole teamwork. They will interact with the system through their character in the simulation.

1.2 Project Definition

The project’s title is “Online Virtual Team Collaboration Platform with 3D Graphics”. The title itself can be seen a basic definition for the project. Most of the constraints of the project are determined in the first meeting with ETC. The details grew out on the following weeks.

The project is defined as an educative simulation platform to be used by three people at the same time. The users will not be very much experienced about computer programs, so that they should not be forced to make complex operations on the user side. Instead they will use communication options effectively and when some events occur on the screen they will perform simple actions such as making clicks on the object graphics.

In the context of events the users will form an opinion about how to behave on similar situations. But the flow of events should not be constant so that the users will not automatically commit an action, they will judge the available alternatives and try to pick the best of them.

Another constraint is about the nature of the common goal. The goal should be something beneficial for the mankind.

SCENARIO:

We chose a ship as environment. A fire will start in the ship and the three users, each having different jobs on the ship, will try to overcome the emergency (i.e. extinguish fire, save people, first-aid service)

Users:

- Coordinator (Captain)
- Chief of rescue team (responsible of fire and evacuation)
- Chief of first-aid team

Resources:

- ❖ Resource of Coordinator:
  - Human Resource: captain assistants
  - Other Resource: no other resource
- ❖ Resource of "chief of rescue team":
  - Human Resource: crew
  - Other Resource: extinguisher, cutting and piercing equipment, special protective outfits, lifeboats
- ❖ Resource of "chief of first-aid":
  - Human Resource : health officers
  - Other Resource : medical equipment, wheeled bed

Views:

- ❖ View of Coordinator:
  - Will have a larger perspective than the other two users

- Fire alarm will be given only to the captain central station not to make the passengers panic.
- His/her resource (captain assistants)

❖ View of “chief of sea-rescue”:

- Will directly see the flames and get aware of fire
- Passengers
- His/her human resource (crew)
- His/her other resource (listed above)

❖ View of “chief of first-aid”:

- Injured people
- His/her human resource (health officers)
- His/her other resource (listed above)

Modes:

There will be two available modes for the users. Mode1 will be appropriate for the users who are not familiar with the computers. In mode1 user will use mouse most of the time and communicate the other users with voice communication devices. Mode2 will require computer experience a bit. Keyboard inputs and text messaging will be used in addition to other alternatives.

1.3 Project Goals

The project’s main goal is teaching to work in a collaborative sense to its users. To achieve the collaboration, a well-constructed communication link is needed between the users. The communication will be both by text and voice. Each of the three users will have special resource complying with their job. In addition to the equipment included in the resource, the users will have a group of people that will obey the commands given by them. They will try to manage up the conditions occurred in the scenario. When they spent 2-3 hours on the simulation, they should be educated on the issue in some way. The graphical part does not have the highest priority when compared to the defined goals above.

The main goals characterized by our project can be summarized as:

- Cooperation for a common goal
- Communication via voice and written messages
- Control of resource
- Visualize simulation environment in a 3D perspective
- Constructing user's view to create situation awareness for their tasks

1.4 Scope of the Project

Scope of the project is limited with:

- Providing a useful education for collaborative teamwork satisfying the specifications
- Setting up multiple communication methods between users
- Resource controlling
- Analysis of the market in terms of existing products
- Analysis of user requirements

2. PROCESS

The most important elements that define a process are process model and team organization choices. They are explained below in detail.

2.1 Process Model

Depending on the characteristics of the project, we reached an agreement on using waterfall model as the most suitable process model for our project. Since there is a strict schedule with deadlines that is given at the beginning of the project, using waterfall matches best with the case. No overlap or iteration is allowed during any period of the process. After a phase is completed we will not turn back for large scale modifications. The most criticized property of waterfall model is the absence of evolutionary approach and supplying the product only after all the phases are over. But in the implementation phase we will provide several prototypes in order to get rid of the mentioned disadvantage.

2.2 Team Organization

The most proper team organization category for our group is *Democratic Decentralized* (DD). Our reasons to choose DD are:

- Consensus plays an important role in our decision making process
- We have no permanent team leader
- Every member of the team should understand how things are handled
- Communication is horizontal
- We have coordinators for tasks, namely rotating task coordinators, but these coordinators may change as tasks change

2.3 Major Constraints

There are several constraints we need to face during the development process of our project.

- *Project Schedule:* The deadlines of phases in the project are strictly determined by the project schedule. These deadlines together constitute a time constraint.
- *Language Constraint:* The project will be implemented in C++.
- *User Interface Constraint:* User interface will be clear and simple. It should be easy to use considering the user profile.
- *Experience Constraint:* This is the first time we are taking place in such project, so we are living experience constraints.

3. RESEARCH

In order to be aware of the current methods used in developing an online virtual team collaboration platform simulation, we had made research about the target users, technologies used in developing these kinds of simulations and specific rules about these emergency situations.

3.1 Market Research

With the advent of the internet and low cost computers, virtual learning environments have a significant growth after 1990s. Virtual learning environments are the primary tool for distance education. Undoubtedly, one of the most interesting examples is the online course that has been run entirely in a 3D virtual world though the popular online community Second Life [1]. Also there are many examples of virtual learning environments about emergency training.

CROSSES (CROwd Simulation System for Emergency Situations) is a European Union financed international project that is training people to efficiently react to emergency situations like fire, poisonous gas emissions etc. Detailed realistic description of the situation is provided with acoustic simulation from sound samples and three dimensional graphic representations of people and crowd. Dynamic simulation and training system is supported by crowd behavior modeling and control connected to acoustic corresponding effects [2].

Evacuation Simulator is a virtual environment development that stimulates fire emergency in the building. This application aims to train employees who work in a large office with complex floor-plan against fire emergency. With this application, people learn how to find the shortest way out of the office while there is a realistic fire and smoke spreading. During the simulation, employees gain practical skills like getting minimum health damages and if possible rescue other people while leaving the building.

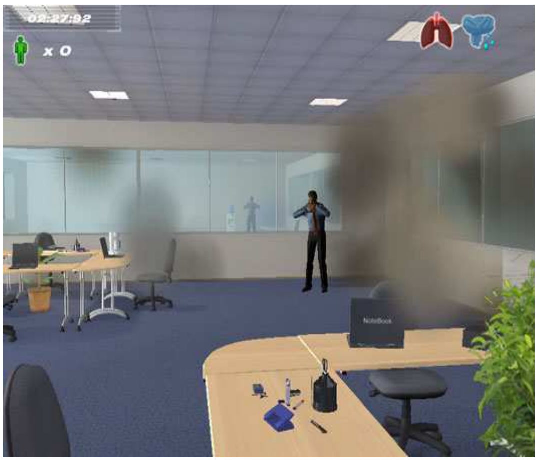


Figure-1: A screenshot from Evacuation Simulator

SimTech is the research project that implements a virtual 3D world for emergency medical team training application that is supported by SUMMIT (Stanford University Medical Media & Information Technologies). It aims to reduce medical errors in ER by providing the necessary simulated environment for interdisciplinary trauma teams to work together effectively [3].

Figure-2: A screenshot from SimTech

ADMS (Advanced Disaster Management Simulator) is an interactive virtual reality-based team training system. Its main purpose is providing emergency responders to gain skills in command, control, coordination and communication. People, vehicles, infrastructure, resources and evolving threads are simulated as dynamic elements of the entire disaster. Threats are natural and man-made; including fires, terrorist acts, aircraft accidents, hazardous material spills and multi-vehicle road accidents.

3.2 Meeting with Ali Bayrak

A main concern between team members is being inexperienced about developing a large scaled project. In order to overcome this situation we decided to arrange a formal meeting with Ali Bayrak who is a teaching assistant at METU Computer Engineering Department and experienced about concepts related to our project.

The meeting was held on Thursday, November 01, 2007 with the participation of the team members and Ali Bayrak. The opinions, advices and general feedbacks of Mr.Bayrak can be summarized as the following:

- As a past game developer, Ali Bayrak advised us to make a highly usable simulation that overlaps with the specifications of our project. He stated that an easily controllable design will make the uses concentrate on the main purpose and benefit from the simulation.
- He advised us to follow an object oriented approach for the project development since it is a successful way of developing this kind of projects.
- He strongly advised us to develop or examine prototypes of the technologies that we intend to use.
- He agreed with us about the use of OGRE as graphics renderer. He pointed out the good documentation of OGRE. He also added the remarkable speed of OGRE as an important advantage.
- He advised us to find the animated models via internet instead of modeling them ourselves. However, if we fail to find all of the animated models, we plan to use 3ds max for modeling works.
- We asked him about his decision between DirectX and OpenGL but he underlined that this will not encounter a problem with OGRE.
- We stated our concerns about the physics engine since OGRE does not provide default physics engine. He told us we must have use a physics engine and talked about ODE.
- As the team members were stuck about the decision between DirectPlay and Open Torque, Ali Bayrak enlightened us to use DirectPlay since it will provide compatibility with the Windows Operating System.
- We asked his opinions about OpenAL however we got a negative feedback. He stated that we can have problems about synchronization. Although it has good sides like providing successful Doppler affect, he advised us to use another sound engine more appropriate then OpenAL. We decided to use DirectSound in order to create a compatible development environment. He agreed with us about this decision and found it clever.
- Furthermore, he gave us some advice about large-scaled projects. He highlighted the importance of comment writing in team work for code readability.

The interview mainly affected our decisions about the open source libraries. Ali Bayrak let us examine the project from the view of experienced developers' eyes. He encouraged us about the future of the project. Special thanks to Ali Bayrak.

3.3 Literature Survey

We have examined papers, reports and some other documentation related to our topic. In this section there is a brief summary of how these documents were helpful while shaping our ideas about the project. Our research can be divided into three topics:

3.3.1 Evacuation of Passenger Ships

Luckily, none of us have been in danger at sea; so we need to research the evacuation procedures in passenger ships in order to ensure our virtual reality environment.

Evacuability of Passenger Ships at Sea [4] is about development of a passenger evacuation simulation model developed by SSRC (Ship Stability Research Center in UK). This paper emphasizes the importance of the geometry of the ship and human behavior in evacuation situations. It suggests path-planning algorithm and also re-planning for blocked paths (in our case fire and smoke will block some of the paths). Human behavior factor brings uncertainty to the evacuation time, so the most likely evacuation time is calculated with Monte-Carlo method by considering the average time for evacuation and the worst case scenario. The differences between night and day scenarios are also examined.

This paper gave us very useful ideas about virtual ship modeling and the human behavior modeling, especially about variable *awareness time* among the crowd, walking speed's influence from local density, some passenger's disabilities or medical conditions and blocked paths from fire and smoke.

3.3.2 Learning with Virtual Reality

Our project aims to be educative for the users about emergency management and collaboration in such situations. To achieve our educative purpose with our virtual reality environment, we have researched about this topic.

A Conceptual Basis for Educational Applications of Virtual Reality [5] is about the potential value of virtual environments to education. This paper states that a virtual world – like real world, allows the natural interaction with objects. Both physical and perceptual interactions are permitted in virtual reality, which is very important for knowledge. It concludes that the best basis for theory of learning in virtual environment is constructivism - theory of learning where humans construct meaning from current knowledge structures [6].

This paper reminded us the opportunity of zooming – out in our virtual reality environment, which real world could not provide and could be very useful for educative purposes. But we did not decided yet whether to use it or not, because this could ruin our environment's reality. The requirement of virtual environments that some objects respond to user interaction is satisfied by our characters' interaction with their sources. Also we considered about using 3D audio – that sound appears to be emitted from a source within the environment, that is the position and orientation of the user will determine the volume of sound. This feature also can bring reality to our environment.

3.3.3 Modeling Fire Disaster

When we started our project with this scenario, the first thing that we worried about was modeling the fire and smoke in the fire disaster, so the last topic is left for this subject.

Application of Virtual Reality Technology to Evacuation Simulation in Fire Disaster [7] is about a virtual reality system for the simulation evacuation in underground station. The paper presents the simulation of fire scene in detail. Unlike other fire disaster simulator's simplifying approach to spreading of flames and smoke, this simulator uses a realistic approach, it uses fire numerical simulation model, FDS [8](Fire Dynamics Simulator) to predict the development of the fire. FDS solves Navier – Stokes equations numerically to predict smoke and hot air flow movement, caused by fire, wind, ventilation systems and other factors. Compared to experimental results, FDS can predict flow velocities and temperatures to an accuracy of 20 percent.

After examining this paper we research about Fire Dynamics Simulator. Related information can be found in "Technical Search" part.

3.4 Technical Research

- To design "online virtual team collaboration platform with 3D graphics", we made technical research related to our project scope.

- We have examined the features of the following graphic renderers:

    - TORQUE

- OGRE

  Depending on the research results we decided to use OGRE in our project since OGRE has a good documentation and speed.

- Our decision for network communication library between DirectPlay and Open Torque was in the favor of DirectPlay.
- For voice communication we went over the details of the following:
  - DirectPlay
  - Torque
  - JVOIPLIB

  We again chose DirectPlay to keep consistency.

- We compared DirectSound and OpenAL. Examining our comparison results we thought that we should use DirectSound instead of OpenAL. Ali Bayrak had also a guiding role over this choice.
- Since the use of physics engine is still being considered, we did not make a comprehensive research. However, we have thought about ODE which can easily be integrated to our project.
- We reached an agreement on using FDS (Fire Dynamics Simulator) which is a computational fluid dynamics model of fire-driven fluid flow. It solves numerically a form of the Navier-Stokes equations appropriate for low-speed, thermally-driven flow, with an emphasis on smoke and heat transport from fires.

4. PROJECT REQUIREMENTS

The requirements describe the concept of an objective, goal or necessary characteristics. Furthermore, requirements are the instructions describing what functions the software is supposed to provide, what characteristics the software is supposed to have, and what goals the software is supposed to meet or to enable users to meet. This set of information answers the “what” questions about the project.

Requirements are defined by the following elements:

- Scenario
- Expectations of the department and the company
- User characteristics
- Educative purposes
- Technical limitations

The following part of the report contains clear, correct, unambiguous, specific and verifiable software requirements of our project.

4.1 Functional Requirements

Functional requirements describe what the software is supposed to do by defining functions and high-level logic. To be clearer, these requirements define the internal workings of the application, technical details, data manipulation, processing and specific functionality that show how the use cases are satisfied.

In order to determine the functional requirements, we have analyzed the project as parts and gathered the points defining the requirements. The different character roles and scenario were the main parts for this identification. We have considered all the situations which a character can confront, how he behaves on the given situation.

We prefer to define our requirements in 3 groups informally: basic requirements, possible requirements and exciting requirements.

(*) *Basic Requirements:* The general objectives and goals stated by the instructor, the assistant of the course and the sponsoring company that are mainly expected from an online virtual team collaboration simulation.

(**) *Possible Requirements:* The requirements that is inevitable for achieving a successful project. These features are considered by team members and not explicitly stated by the instructor.

(***) *Exciting Requirements:* These features probably go far beyond the expectations and prove to be satisfying when present; however they are not guaranteed to be implemented due to lack of time and resource constraints.

4.1.1 Menu Requirements

We will have several menus in the program. Each of them examined separately.

4.1.1.1 Start Menu

General Requirements:

In start menu, there will be no submenus. A user friendly design will be used (color, font and menu organization will be chosen properly). Menu will include the following items.

Menu Items:

- (*)Select Role: User will select one of the three roles (if not selected by one of the other users yet). These roles are captain, first-aid chief and rescue chief.
- (*)Start: User will be allowed to start the simulation only after choosing the role and mode.
- (***)Replay: The last simulation will be played again.
- (*)Read Help: User will get help if needed.
- (*)Options: Sound, graphics and control options will be adjusted here.
- (*)Select Mode: Mode1 or Mode2 will be selected.
- (*)Exit: Exit the application.

If the user presses ESC during the simulation flow, system will pause for the user and a subset of the start menu will appear on the screen. "Start" (like resume this time), "Read Help", "Options" and "Exit" items will be shown in the menu.

4.1.1.2 In-Application Menu

General Requirements:

All of the three characters will need to perform some actions during the simulations. The kind of these actions is determined by their tasks. In addition, there are some common operations for the users.

Menu Items:

During the simulation, the users will communicate through voice and text messages. The use of voice communication will be achieved by using a "walkie-talkie submenu". Users will choose communication type and the character to build communication with.

More items are to be added upon need.

4.1.2 Main Flow Requirements

General Requirements:

- (**)The simulation is divided into two phases: beginning phase (pre-disaster), disaster phase.
- (**)In the beginning phase the environment can be examined by the users.
- (*)In the disaster phase, users will try to complete their tasks in success.
- (**)When the simulation ends, a simulation summary will appear on the screen. So the users will have a chance to test themselves and try to upgrade their level. This requirement supports the educative feature of the simulation.

Environment:

- (*)It is the place that the simulation takes place in.
- (*)The environment is a ship.
- (**)The events will be on the board.
- (**)Captain central station will be seen by the captain only.
- (*)The rescue boats will be seen if captain requested for external support

User Characters:

- (*)Captain will walk, talk on walkie-talkie to the other users, make help calls (since facilitator is aware of everything in the simulation he may help or Coast Guard may help)
- (*)First-aid team chief will walk, run, talk on walkie-talkie, request support by calling the captain, carry the injured with wheeled bed using his resource, make treatment using his resource.

- (*)Rescue team chief will walk, run, talk on walkie-talkie, request support by calling the captain, try to put out the fire using his resource, evacuate passengers using his resource.

Facilitator:

Facilitator will hear all the communications. He will have both the first person view of users and the third person view (switch camera). He will be able to change the camera view.

Other Characters:

- Crew under the command of first-aid team chief will walk, run, carry the injured with wheeled bed, make first-aid treatment, (***) speak.
- Crew under the command of rescue team chief will walk, run, try to extinguish the fire, (***) speak.
- Passengers will walk, run, panic, cry out, get injured, get healed, faint and die.

User Requirements:

- (*)Mouse, keyboard and voice communication devices will be used.
- (**)Settings will be done using menus.
- (*)During the simulation, a pause menu will be provided to the user when ESC pressed.
- Simulation uses monitor and sound devices to supply output to the user.
- (*)User has the first person's view.
- (*)Facilitator has two views: first person's view and third person's view.

4.1.3 Operational and Structural Requirements

Core Engine: It combines the subcomponents of the simulation by making necessary calculations.

Graphics: During simulation the graphics engine takes its input from the received data from the server and renders it accordingly.

Sound: User can control sound options like volume level. In emergency cases instant sounds effects will be delivered.

Artificial Intelligence: For the situations that characters meet, AI will used at basic level to make the event flow more realistic.

Physics: Used to make the graphics more realistic. A fire dynamics simulator, *FDS* will be used.

Networking: The users will be connected through a network and the voice communication will be achieved over the network.

Simulation Data:

- Phase information
- Characters
- Objects in the ship
- Resource of characters
- Sound effects
- Speeches
- Images

4.2 Non-Functional Requirements

Non-functional requirements are requirements which specify constraints that help judging the operation of a system, rather than its specific behaviors. Typical non-functional requirements are usability, reliability, portability and cost. Since cost is not an effective requirement for us, we will consider about usability, reliability and portability.

4.2.1 Usability and Virtual Reality

The main concern for the simulation developing is the target user's computer capability. A simulation must be easily usable by a related person; however he did not know anything about the computers. As our purpose is to educate these people for the real life, we must equip them with the equipments they use in real life. Unfortunately, this is not a keyboard or mouse. The voice communication technique and a facilitator bring up an easily adaptable simulation environment.

In order to make users concentrate to the situation, it is inevitable to build up a realistic environment. The virtual reality should be supplied by not only graphical realism but also the appropriate physics rules or human behaviors. Therefore, we make use of a physics engine and a fire dynamics simulator. The virtual reality will surely increase the benefits of the simulation since it will be a close test of real life.

4.2.2 Reliability and Security

The reliability and security requirements are always considered as key requirements in our team. Developing a bug free simulation is an important aim for us. Testing and debugging should be done very carefully in order to achieve this aim. The realistic environment of the simulation should not be sabotaged by the buggy codes.

Furthermore, the online usage of simulation points out the importance of security. The carefully developed code should block outer threats to the users during and after the simulation.

4.2.3 Portability

We still have some concerns about open source libraries we will use, DirectPlay or Torque Network Library, but we are more likely to use DirectPlay for many parts of the simulation. Therefore, the simulation would not be working on a Linux operating system. However, the simulation will work on Windows operating system.

4.3 Software Requirements

A *Windows XP Operating System* is enough for a user to run the simulation. On the other hand, if we are directed to change our libraries the simulation will also be working on a Linux machine.

4.4 Hardware Requirements

- A PC with P4 class processor or equivalent
- Graphics card and Direct3D support
- 256 MB of memory
- Some free disk space for installation
- Sound card
- Internet or network connection
- Devices for voice communication

5. SYSTEM ANALYSIS AND MODELING

5.1 Data Flow Diagrams

5.1.1 Level: 0 DFD

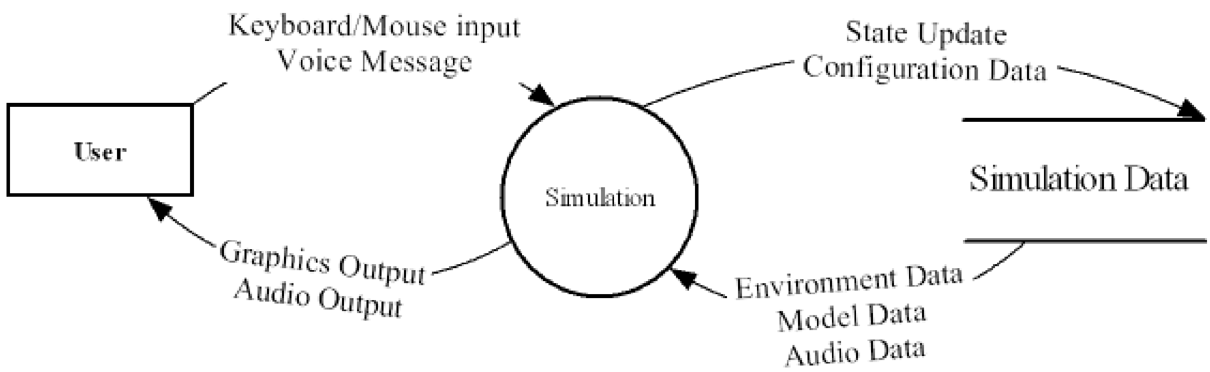


Figure-3: Level: 0 DFD

5.1.2 Level: 1 DFD

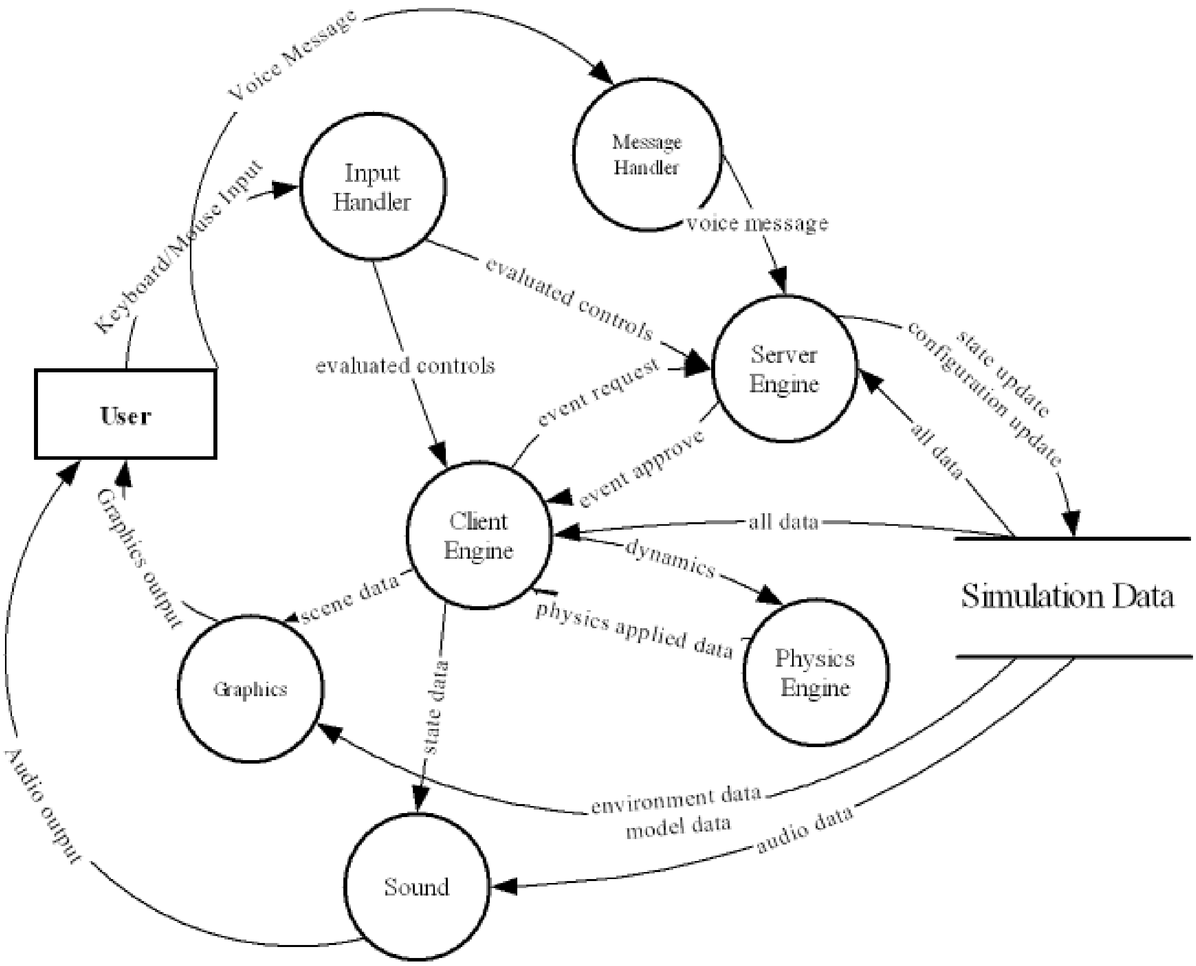


Figure-4: Level 1 DFD: Simulation

5.2 Use Case Analysis

The following part of the report contains the use cases grouped into similarities with each other.

5.2.1 Menu Use Cases

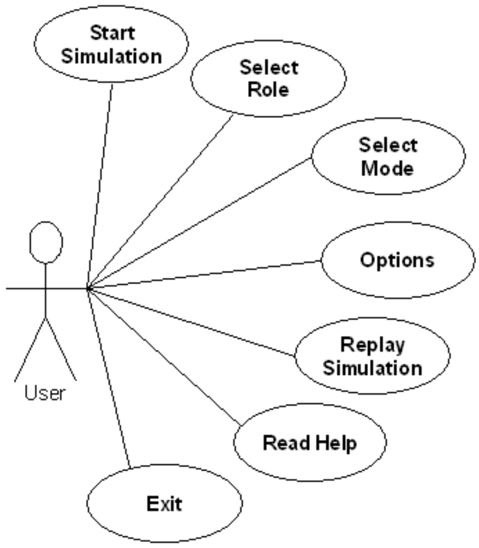


Figure-5: Menu Use Cases

5.2.2 Character Use Cases

<u>Captain Use Case:</u>

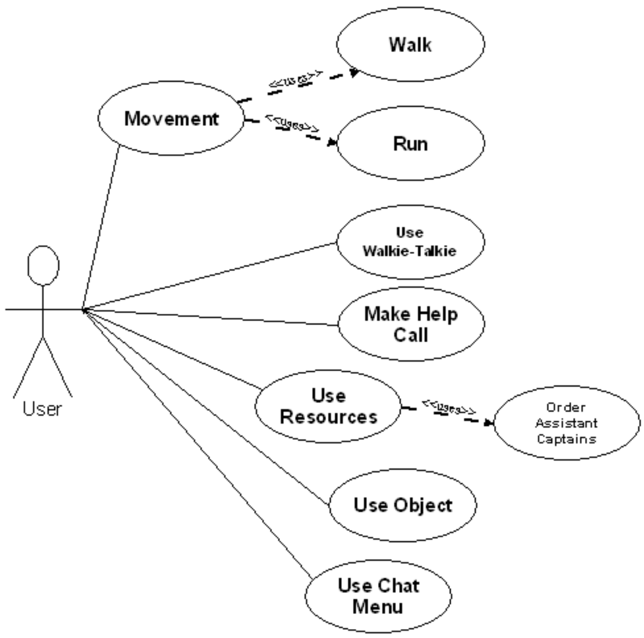


Figure-6: Captain Use Case

First-Aid Team Chief Use Case:

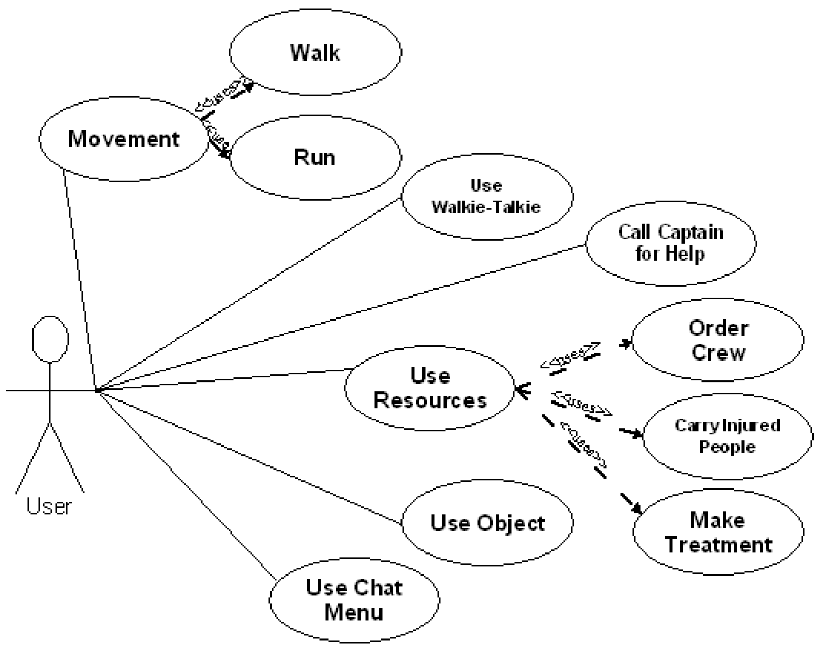


Figure-7: First Aid Team Chief Use Case

Rescue Team Chief Use Case:

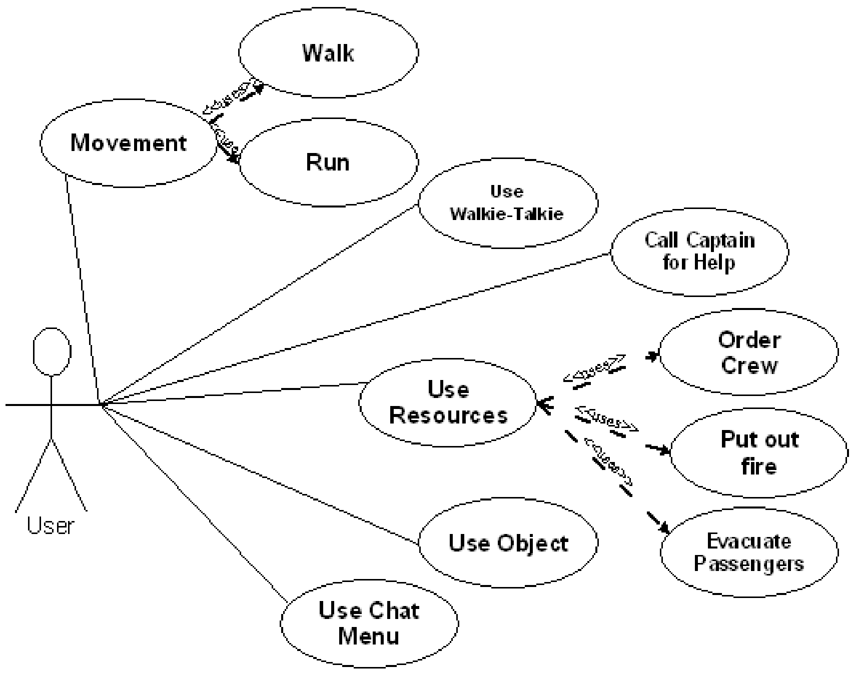


Figure-8: Rescue Team Chief Use Case

Facilitator Use Case:

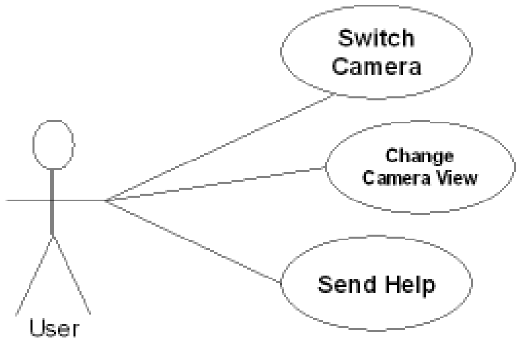


Figure-9: Facilitator Use Case

Passenger Use Case:

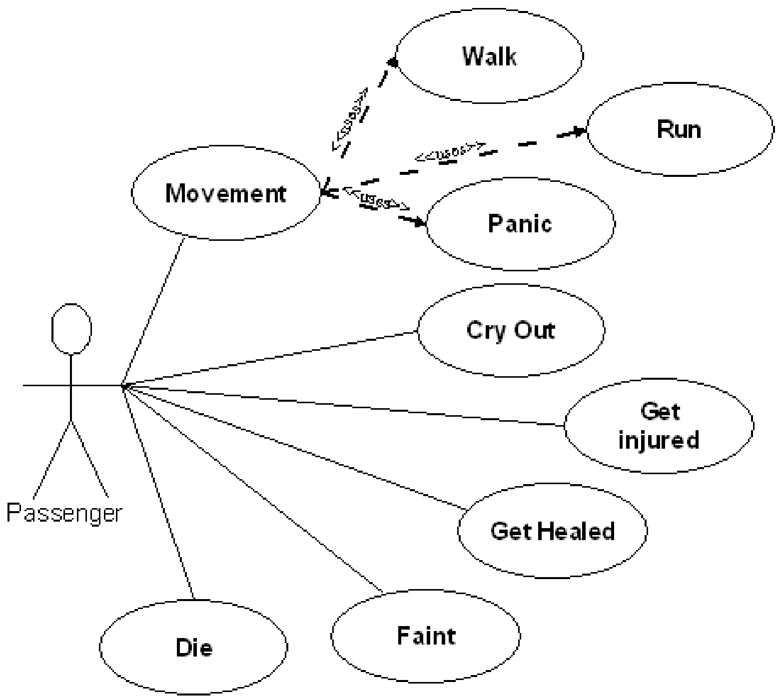


Figure-10: Passenger Use Case

6. PROJECT SCHEDULE

We have explained the sharing of tasks in Gantt chart with expected completion dates.

Again as stated in Gantt chart, we plan making alpha testing between 05.06.2008 and 05.09.2008, beta testing and debugging between 05.12.2008 and 05.15.2008. Corrections can be done depending on the test results.

We tried to estimate the duration of sub processes. The estimation results are shown in the next sections.

6.1 Estimation

Measurement is a key activity for project management since it is necessary to have some indicators of how the process is advancing. We found it beneficial to make estimations about the project in order to calculate how much work is needed to complete the project successfully.

6.1.1 Function Point Estimations

Independent from the coding style and programming languages, the function point method utilizes the "domain" parameters related to a project and arrives at an estimate. The following table represents the function point estimations for our project.

Parameter	count	simple	Average	complex	
# user inputs	4	3	4	6	4*4 (average)
# user outputs	4	4	5	7	4*5(average)
# user inquiries	5	3	4	6	5*3(simple)
# files	7	7	10	15	5*10(average) + 2*15(complex)
# external interfaces	5	5	7	10	3*7(average) + 2*10(complex)
				Count total	172

The above table estimates the count total according to the parameters and the weights of those parameters.

Factor	Grade
1. Reliable backup and recovery	1
2. Data communications	5
3. Distributed processing	1
4. Critical performance	4
5. Heavily utilized operational environment	1
6. Online data entry	0
7. Input transactions over multiple screens (online)	0
8. Master file updates online	0
9. Complex input/output/file/inquiries	3
10. Complex internal processing	5
11. Reusable code design	3
12. Conversion and installation included in design	2
13. Multiple installations for different organizations	1
14. Design for facilitating change and ease of use	5
Total Adjustment Factor	31

The complexity adjustment factors are graded from 0 (negligible) to 5 (essential). According to these estimated values the function point is:

$$FP = countTotal\ x\ [\ 0.65 + 0.01\ x \sum F_i\ ]$$

$$= 172\ x\ [\ 0.65 + 0.01\ x\ 31\ ]$$

$$FP \cong 165$$

<u>Effort Estimation (Kemerer Model)</u>

$$E = 60.62\ x\ 7.728\ x\ 10^{-8}\ x\ FP^3$$

$$= 60.62\ x\ 7.728\ x\ 10^{-8}\ x\ 165^3$$

$$\cong 21\ person - month$$

<u>Duration Estimation</u>

$$D = E/P$$

$$= 21/4$$

$$\cong 5\ months$$

6.1.2 Lines of Code Estimations

The conversion from function point estimation to lines of code estimation directly depends on the programming language selected for developing the project which is C++ for us. The standard value of LOC/FP for C++ is 53 [9].

$LOC = FP\ x\ 53$

$= 165\ x\ 53$

$= 8745\ LOC$

$\cong 8.7\ KLOC$

Effort Estimation (Bailey-Basili Model)

$E = 5.5 + 0.73\ x\ KLOC^{1.16}$

$= 5.5 + 0.73\ x\ 8.7^{1.16}$

$\cong 14\ person - months$

Duration Estimation

$D = E/P$

$= 14/4$

$\cong 4\ months$

6.1.3 COCOMO Estimations

Project Type	a_b	b_b	c_b	d_b	a_i	b_i
organic	2.4	1.05	2.5	0.38	3.2	1.05
semi-detached	3.0	1.12	2.5	0.35	3.0	1.12
embedded	3.6	1.20	2.5	0.32	2.8	1.20

We use semi-detached COCOMO model for the estimations.

Effort Estimation

$E = a_b \, x \, KLOC^{b_b}$

$= 3.0 \, x \, 8.7^{1.12}$

$= 34 \, person - months$

Duration Estimation

$D = c_b \, x \, E^{d_b}$

$= 2.5 \, x \, 34^{0.35}$

$= 9 \, months$

6.2 Gantt chart

The Gantt chart can be found on Appendix Part.

7. RISK MANAGEMENT PLAN

Each project should have a risk management plan in order to be cautious about the future of the project. To achieve this, the risks should be defined in detail and possible actions should be offered for the occurrence of the risk. In addition, proper mitigations for the risks should be considered.

7.1 Description of Risks

Team Risks: Working as a team brings some extra requirements that the members should consider. Every member should have the feel of responsibility and contribute to the process. We do not expect such problems to occur for our team, but in addition to these problems there are problems that are beyond our limits. Lack of time can be one of these but we will try to minimize the effect of it.

Experience Risks: These risks are probably the most serious ones. We use some applications that we have never used before and we do not have much time to get experienced with them. Lack of experience in software business is another serious risk.

Customer Risks: We have already confronted this kind of problems. So we, as a team, feel ready for such cases to some extent. If customer needs are misunderstood, disastrous results are possible. Customer risks include lack of some user skills.

Technology Risks: Available technological support is a major restriction for our project. To exemplify, we will have to create necessary animated models if we cannot find them during our search. Pace of technological improvement can be another risk. Our project may be less useful in near future as a result of technological development.

Schedule Risks: These are risks dependent on the deadline.

7.2 Risk and Solution Table

Risk	Probability	Impact	Actions
Lack of authority	10%	2	The leading member at that time will interfere the situation
Lack of responsibility	5%	2	1. The member will be reminded of his/her responsibilities. 2. If problem cannot be solved, project assistant will be informed.
Lack of time	70%	1	1. Effective plans will be made for time management. 2. The other ones will take over the busy member's task.
Lack of application experience	50%	2	1. The users will try to compensate inexperience 2. Project assistant will be asked for technical support
Lack of experience in software business risk	60%	1	Project advisor and assistant will be asked for advice
Modification in user requirements	30%	3	1. Users' requirements will be analyzed in detail. 2. Modifications will be applied as soon as possible
Unwillingness of customer to help	20%	1	More attention will be paid on communication
Customer dissatisfaction	20%	3	The reasons will be analyzed for further works
Customer insufficiency for using the product	40%	1	Features will be tried to be simplified
Lack of libraries, tools and platforms	60%	2	Use the available resource
Invalidation of the product due to technological changes	30%	3	Use latest technology available today
Missing the deadlines	5%	4	Rearrange plans for amendment

1- Negligible
2- Marginal
3- Critical
4- Catastrophic

8. SOFTWARE QUALITY PLAN

Quality is the totality of features and characteristics of a product, process or service that bear on its ability to satisfy stated or implied needs.

In a well-planned project all the necessary quality attributes are defined and checked carefully. These attributes are determined by the project itself. General quality attributes can be mainly defined as in the table:

Lifecycle	Product Transition	Product Operations	Product Revision
Quality Attributes	Portability Reusability	Correctness Reliability Efficiency Usability Safety Reboostness	Maintainability Flexibility Testability

More Specific Quality Attributes:

For graphics;

- Are basic needs for a 3D environment satisfied?
- Does it look clear and understandable enough?

For communication;

- Does the voice communication work properly?
- Does the text messaging part work properly?

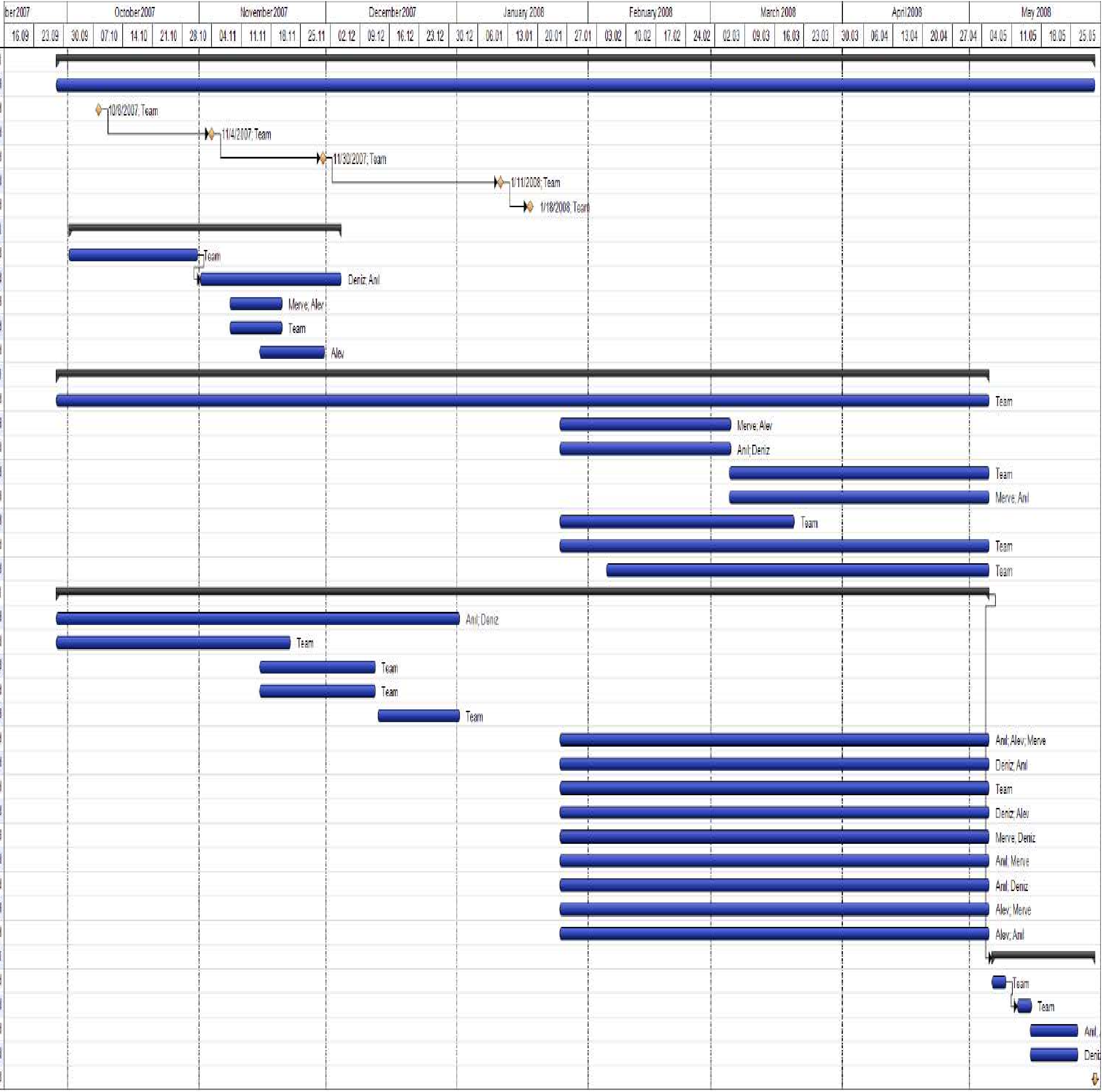
- Is there any synchronization problem?

For source code;

- Is the source code easy to read?

9. APPENDIX

#	Name	Start	Finish	Duration
1	**Managing Project**	**9/28/2007**	**5/30/2008**	**176.0 d**
2	Project Management	9/28/2007	5/30/2008	176.0 d
3	DEL:Proposal Report	10/8/2007	10/8/2007	0.0 d
4	DEL:Analysis Report	11/4/2007	11/4/2007	0.0 d
5	DEL:Initial Design Report	11/30/2007	11/30/2007	0.0 d
6	DEL:Detailed Design Report	1/11/2008	1/11/2008	0.0 d
7	DEL:Prototype Demo	1/18/2008	1/18/2008	0.0 d
8	**Developing Concept**	**10/1/2007**	**12/4/2007**	**47.0 d**
9	Scenario Decision	10/1/2007	10/31/2007	23.0 d
10	Developing Scenario and Characters	11/1/2007	12/4/2007	24.0 d
11	Character and Object Design	11/8/2007	11/20/2007	9.0 d
12	Simulation Flow Design	11/8/2007	11/20/2007	9.0 d
13	Interface Design	11/15/2007	11/30/2007	12.0 d
14	**Producing Simulation Resources**	**9/28/2007**	**5/5/2008**	**157.0 d**
15	Resource Gathering	9/28/2007	5/5/2008	157.0 d
16	Character Modeling	1/25/2008	3/5/2008	29.0 d
17	3D Objects Modeling	1/25/2008	3/5/2008	29.0 d
18	Texturing Models	3/5/2008	5/5/2008	44.0 d
19	Character Animations	3/5/2008	5/5/2008	44.0 d
20	3D Scene Modeling	1/25/2008	3/20/2008	40.0 d
21	Sound Selection	1/25/2008	5/5/2008	72.0 d
22	Scene Lightning	2/5/2008	5/5/2008	65.0 d
23	**Developing Simulation Engine**	**9/28/2007**	**5/5/2008**	**157.0 d**
24	Open Source Engine Analysis	9/28/2007	1/1/2008	68.0 d
25	Identifying Engine Requirements	9/28/2007	11/22/2007	40.0 d
26	Designing Engine	11/15/2007	12/12/2007	20.0 d
27	Designing Engine Architecture	11/15/2007	12/12/2007	20.0 d
28	Prototype Engine Implementation	12/13/2007	1/1/2008	14.0 d
29	3D Graphics Module	1/25/2008	5/5/2008	72.0 d
30	Basic Physics Module	1/25/2008	5/5/2008	72.0 d
31	I/O Module	1/25/2008	5/5/2008	72.0 d
32	Sound Module	1/25/2008	5/5/2008	72.0 d
33	Lightning Module	1/25/2008	5/5/2008	72.0 d
34	Basic AI Module	1/25/2008	5/5/2008	72.0 d
35	Network Module	1/25/2008	5/5/2008	72.0 d
36	Voice Communication Module	1/25/2008	5/5/2008	72.0 d
37	GUI Module	1/25/2008	5/5/2008	72.0 d
38	**Final Release**	**5/6/2008**	**5/30/2008**	**19.0 d**
39	Alpha Testing	5/6/2008	5/9/2008	4.0 d
40	Beta Testing & Debugging	5/12/2008	5/15/2008	4.0 d
41	Installation Manual	5/15/2008	5/26/2008	8.0 d
42	User Manual	5/15/2008	5/26/2008	8.0 d
43	DEL:Final Demo	5/30/2008	5/30/2008	1.0 d



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