Software Development Plan

Atlantis 3D

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Introduction

This project is carried out at the department of Experimental High Energy Physics (EHEF) of the Faculty of Science of the Radboud University Nijmegen. It is part of my master thesis at the department Information Science of the Radboud University Nijmegen. During this project Theo Schouten (Inf.Sc) and Peter Klok(EHEF) will be the supervisors. The project will run from September 2005 until March 2006 thus a period of six months.

This plan includes an introduction to and description of the product and identifies the activities to be performed in order to create it. Based on these activities a schedule is given for project control.

In this chapter a general introduction of this project will be given. First I will start with some background information about the package Atlantis and 3D graphics.

Background information

Late 1949 the French scientist Louis de Broglie proposed that the countries of Europe would collaborate and set up an European research facility for particle physics to achieve together what none off the countries could have achieved alone. As a result the “Centre Européenne de Recherche Nucléaire” (CERN) came into existence on July 1, 1953 [1].

In the Large Hadron Collider (LHC) at the CERN laboratory in Geneva experiments will take place by colliding particles at extremely high speeds. During these collisions many other particles are formed and ultimately one hopes to find the Higgs particle proposed by theoreticians, but so far never “seen”. Special detectors in the LHC register these collisions and save the enormous amount of data collected by the detector into a database. One of the main detectors in LHC is built by the ATLAS collaboration.

For the analysis of this collision data so called “event displays” are used. These are applications which can visualize the collected data in different ways. For the ATLAS detector the event display package Atlantis is used (written in Java). EHEF is member of the Atlas collaboration and is concerned with e.g. the development of Atlantis.

3D Projection

Atlantis currently provides seven types of two dimensional (2D) and three types of three dimensional (3D) projections of the data collected by the detectors. These 3D projections non-typical and do not provide clear images of the detector system and the event particles.

An independent software review advised the Atlantis development group to integrate 'real' 3D support in the application, meaning an insightful three dimensional representation of the detector and particles in such a way that physicists can actually use it during the analysis phase. One of the reasons is to have one application that includes everything.

Three dimensional representations can be given in many ways. But for simplicities sake I will only

consider stereo- and monoscopic viewing. Stereo viewing takes into account that both human eyes have a slightly different view on an object while monoscopic viewing only considers one viewing point (generally the center between the eye's) [2].

Besides the viewing method, speed is very important too. There are numerous ways to optimize the graphics pipeline. One of these is occlusion culling [3]. This is a technique used to abandon as much objects from a scene as possible, because the object either can not be seen as it behind the viewer or it is completely behind another object and thus is not visible. The use of culling can speed up rendering of a scene considerably.

Research

In the previous chapter a very general introduction is given about Atlantis and 3D. Next a formal definition of the problem will be given and explained followed by a description of the approach that will be used to solve this problem and a risk analysis.

Problem definition

The project assignment is formulated as follows:

“Integrate a three dimensional projection module in the Atlantis application that is both fast and easy to use.”

Approach

Goal of this project is the implementation of a three dimensional projection module in Atlantis. To do this the following steps should be performed:

1 Answer the following research questions:
  1.1 What is the best method to represent the three dimensional data (stereo- versus monoscopic viewing)?
  1.2 How do other applications integrate three dimensional projections?
  1.3 How does object culling work and how can it be applied to Atlantis?
  1.4 What other methods can be used to increase speed?

2 After the research phase this knowledge will be applied during the implementation of the module. To implement the module I will use the Java3D API as it provides 3D graphics with hardware acceleration in a platform independent way.

3 After the prototype has been developed the impact on Atlantis will be determined. Several people will be invited to use the prototype and based on their responses the prototype will be improved or another viewing method will be chosen.

4 At the end of a project the Atlantis group will decide if the module will be expanded and added to Atlantis as an official feature based on my findings.

Risks

Risk analysis is a very important aspect of every project. To minimize the risks during this project the following points are being addressed for special care:

- The chosen viewing method is not appropriate. This has to be detected as early as possible to prevent loss of time. Detection can be done by letting users try the new module as soon as possible.
- Integration of Java3D in Atlantis is not possible or causes unexpected behaviours. In this case an option is to look into the Java3D sources and see if can be coupled more tightly to the Atlantis sources.
- Java3D has too much of an impact on the Atlantis system. In this case it is necessary to find methods to speed up Java3D by applying manual changes to the Java3D source code.

Project management

This project is divided into several phases. In this chapter I will identify and describe these phases. Every phase has a milestone product and will become part of the final thesis.

Introduction

During this phase I will acquaint myself with the Atlantis environment and the necessary tools, development language, etc. I also will search for papers about the subject and read those to get into the material. Result of this phase is the actual research plan in this document.

Research

This project will start with a research phase. During this phase answers should be given to the questions asked above by using papers, books and other materials when necessary. Results of this phase will be listed in the final thesis.

Development prototype

The outcome of the research phase will be used to determine how the prototype will be built and who it behaves within Atlantis. Development will be done in Java using the Java3D extensions. At the end of this phase a prototype of the 3D projection should be running.

Performance & user feedback

After the prototype has been developed the performance of the module and Atlantis will be measured to find out if a 3D projection has a negative influence on the performance of the complete Atlantis software package.

Next a selection of Atlantis users will be invited to use the new module and give feedback on

performance and usability. Based on my measurements and the feedback of the users I will advise EHEF to continue development of this module or not.

During this phase it is also possible to add additional features on request of EHEF or additional research in case the performance is too low.

Thesis

At the end of the project I will finalize my thesis. During the complete project part of this document has already been written, especially during the research phase.

Time table

In this last part of the plan document a time table is included with the time allocated per task during this project. The time is given in weeks.

Time	Phase	Result
3	Introduction	Software Development Plan
6	Research	Theoretical part thesis
7	Development	Working prototype
5	Performance & user feedback	Advise
3	Thesis	Final thesis

Literature

[1] LHC Large Hadron Collider, Cern Publication, June 1990

[2] Autostereoscopic 3D Displays, Neil A. Dodgson, August 2005, IEEE Computer Society

[3] Occlusion Culling Algorithms, Tomas Möller & Eric Haines, November 9, 1999, Gamasutra, http://www.gamasutra.com/features/19991109/moller_haines_01.htm