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**Punjab University College of Information Technology**

**Final Year Project Proposal**

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1. **Project Title:**

Virtual Reality Powered Car Driving Serious Game

1. **Background:**

This project is the third extension of previous two project named as **“Virtual Reality Powered Driving Tutor”** and **“Virtual Reality Powered Realistic Driving Tutor”**.

* 1. **Virtual Reality Powered Driving Tutor (First Version):**

This projectwas based on the simulation of a 3D modeled car which was powered with virtual reality technology. This project was completed by the students of PUCIT from **Fall 2011**.

**2.2 Virtual Reality Powered Realistic Driving Tutor (Second version):**

In this extended version realistic road network was introduced which would enable to create virtual environment of any city. This project was based on the modeling of a 3D road network which is powered with virtual reality technology. Simulation of 3D driving environment is created using Oculus. AI was used to simulate the surrounding traffic and pedestrian and the car for human interaction used Logitech apparatus to take input. This project was completed by the students of PUCIT from **Fall 2012**.

**2.3 Research on the project:**

Standard formats to represent cartographic road network data have been explored and identified from research literature. It has been found that an open XML format exists to represent cartographic road network data namely OpenDRIVE which is being used by many vehicular traffic flow simulators such as MovSim. MovSim is a highly cited open source vehicular traffic flow simulator, but its visualizer is 2D. To develop a 3D human-in-the-loop simulator or a serious game it requires to model the virtual environment – the virtual road network using of-the-shelf game engine e.g. Unity3D. In this project a Serious Game will be develop which construct a 3D virtual environment using cartographic road network data.This Game will develop the road network in such a way that traffic simulation will follow the traffic models that are used in MovSim. MovSim has the traffic models that are useful to create a realistic traffic and 3D environment using open drive format. In this Game we can control one or more vehicles and keep a record of person that how a person is driving the vehicles. We can judge about his personality.

1. **Project Overview Statement:**

|  |
| --- |
| **Project Title:**  Virtual Reality Powered Car Driving Serious Game |
| **Group Leader:**  DANISH HASHMI |
| **Project Members:**   |  |  |  |  | | --- | --- | --- | --- | | **Name** | **Registration #** | **Email Address** | **Signature** | | MUHAMMAD MOIN-UL-HASSAN | 2013-UCS-492 | bsef13a014@pucit.edu.pk |  | | AHSAN MASOOD SABIR | 2013-UCS-498 | bsef13a022@pucit.edu.pk |  | | MUHAMMAD MOEEN SANAULLAH | 2013-UCS-506 | bsef13a030@pucit.edu.pk |  | | DANISH HASHMI | 2013-UCS-508 | bsef13a032@pucit.edu.pk |  | | MUHAMMAD UMAIR RAUF |  | bsef13a055@pucit.edu.pk |  | |
| **Project Goal:**  This Serious Game will develop the road network in such a way that traffic simulation will follow the traffic models that are used in MovSim. MovSim has the traffic models that are useful to create a realistic traffic and 3D environment using open drive format. In this Serious Game we can control one or more vehicles and keep a record of person that how a person is driving the vehicle. We can judge about his personality. The person will be tested on different environment changes of real life such as rain, high traffic, darkness etc. that will be created virtually in this Game. |
| **Objectives:**   |  |  | | --- | --- | | **Sr.#** |  | | **1** | This product will help people to learn driving in virtual surroundings  which will be helpful to learn how to drive in different and difficult situations of real life. | | **2** | As it is difficult to reproduce such scenarios in real life for practice purposes, it will simulate in virtual environment with realistic behavior of traffic. | | **3** | The number of driving practices on real cars will be reduced such as the probability of different problems that a beginner driver has to face in real life such as near to accidents, panic situations. | | **4** | We can judge the behavior of a person about the driving and keep a record of his information. | | **5** | We can also deploy this game to the different driving center to test the driving of the person and make a decision to give him a license or not. | |
| **Project Success criteria:**  Project success criteria is that we will work continuously then surely we will be succeed. Communication with supervisor is most important in this project. We must have to pay attention on our goals. For this project we need to strong our grip on unity 3D and other programming languages like C#, JAVA. We will use the parser that convert openDrive file to virtual 3D environment. We will use MovSim main functionality to create virtually 3D world with realistic traffic behavior and environment. |
| **Assumptions, Risks and Obstacles:**  **Assumptions:**  After the research, we are taking the assumption that MovSim is the source of our inspiration. The traffic models used in MovSim all are correct and we can create a 3D virtual world with realistic traffic behavior.  **Risks:**  As this project is too much complex and hold multiple platform and research knowledge so the only risk is the time. We cannot exactly determine the time of the different tasks. This is totally a unique research and development project.  **Obstacles:**  We are very dependent on the web research So, sometimes it is very hard to find exactly what you want. This project demands the highly efficient and modern hardware and other equipment that is costly. |
| **Organization Address (if any):** |
| **Type of project:** 🗹 Research 🗹 Development |
| **Target End users:**   1. Driving Centers 2. Drivers 3. Driving Learner 4. Any Person having interest in games |
| **Development Technology:** 🗹 Object Oriented 📺Structured |
| **Platform:** 🗹 Web based 📺Distributed  🗹 Desktop based 📺Setup Configurations  📺Other\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Suggested Project Supervisor:** Syed Waqar ul Quonain Jaffry |
| **Approved By:** |
| **Date:** Monday, 17 October, 2016 |

1. **Current working on the project:**

In the summer vacations under the AIMRL (Artificial Intelligence Multi-Disciplinary Research Laboratory) we already have started this project we understand the previous code fix the issues in the previous code We followed unity tutorials and made games. We also read research papers for traffic simulation and creating a virtual world. We worked on MovSim and understand its execution flow. Currently we are working on web services to manipulate data from MovSimCore to MovSimViewr. After much understanding we decide to do this project.

1. **High Level System Components:**

**5.1 OpenDRIVE Parser:**

OpenDRIVE is an open format specification to describe a road network's logic. OpenDRIVE is a XML format and it has a hierarchical structure. OpenDRIVE files describe the road structure, geometry and also entities like signals etc. In order to construct a 3D road molder, we need to parse these OpenDRIVE files, store the data and interpret how to use it.

Parsing an XML file means we need to read the XML document and then store the data of each tag appropriately in proper objects.

OpenDRIVE is being used by many vehicular traffic flow simulators such as MovSim. MovSim is a highly cited open source vehicular traffic flow simulator, but its visualizer is 2D as shown in Figure 1.



Figure 1

To develop a 3D human-in-the-loop simulator it requires to model the virtual environment – the virtual road network using of-the-shelf game engine e.g. Unity3D. In this project we will write the parser which construct a 3D virtual environment using cartographic road network data obtained by OpenDRIVE file.

**5.2. Environment builder scenarios:**

Once we have the objects after reading the XML file we will build an environment that represents the 3d road network using existing unity renderer. In this Environment we will map the models of traffic used in MovSim and develop the virtual world. Here we will also add environment changes.

**5.3. Unity Test Drive:**

Simulation of test driving car is being done taking control inputs via Logitech Gear.

**5.4. Driving behavior of a person:**

we will also maintain a record of a person and judge the driving behavior of a person in different conditions.

**5.5. MovSim:**

MovSim is a microscopic traffic simulator with xml-based configuration and csv text output.

Features:

* multi-lane simulator including onramps, off-ramps, "flow-conserving bottlenecks" and traffic-lights
* multiple models of different model classes (car-following models, coupled-map models and cellular automata)
  + Intelligent Driver Model (IDM) [Wikipedia](http://en.wikipedia.org/wiki/Intelligent_driver_model)
  + Enhanced IDM/Adaptive Cruise Control Model [Preprint](http://arxiv.org/abs/0912.3613)
  + Optimal Velocity or Bando Model
  + Velocity Difference Model
  + Gipps Model [Wikipedia](http://en.wikipedia.org/wiki/Gipps%27_Model)
  + Krauss Model
  + Nagel-Schreckenberg Cellular Automaton [Wikipedia](http://en.wikipedia.org/wiki/Nagel-Schreckenberg_model)
  + Kerner-Klenov-Wolf Cellular Automaton
* general lane-changing model MOBIL [Paper](http://www.akesting.de/download/MOBIL_TRR_2007.pdf)
* detailed physics-based model for fuel consumption and emissions
* text-file output of detectors, spatiotemporal fields, floating-car data etc.

MovSim has several submodules/components:

* The *core* contains the main MovSim library and a console application that can run a traffic simulation and produce*.csv* output for further processing or graphical display.
* The *viewer* displays an animated traffic simulation.
* The *consumption* comprises a physics-based fuel consumption model which can also be fed by csv data.
* The *xsd* module comprises the xsd schema resources for the xml binding (JAXB)
* The *common* provides general functionality for all submodules.

**6. List of optional functional units:**

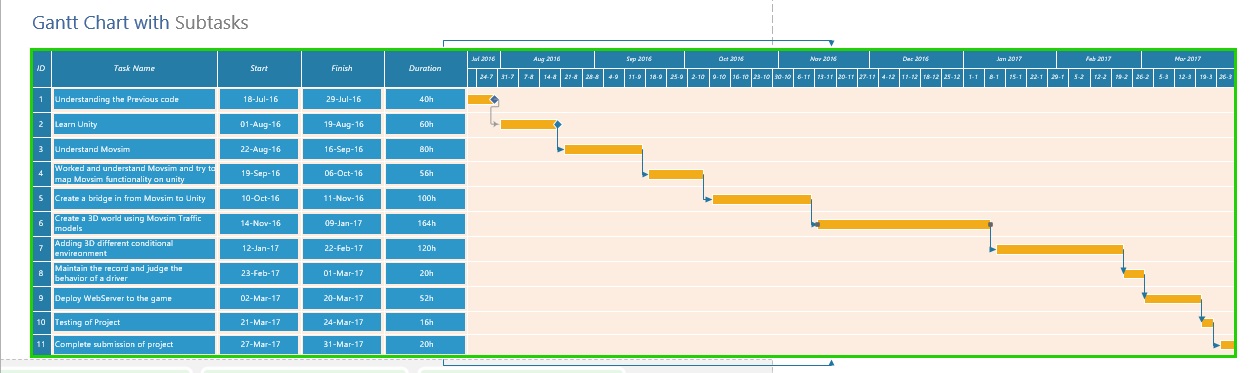
**6.1. Web Servers:**

As we are using web services so we will also deploy a web server as an extra feature so that many drivers and gamers can drive their vehicles in this game.

**7. Application Architecture:**

1. Unity3d will be used for simulation.
2. Mono runtime development tool will be used for scripting purposes.
3. Graphic models will be imported in Unity3d.
4. The physics of the models will be handled in Unity3d.
5. Traffic Models of MovSim will be used.
6. AI will be used to judge the human personality.

**8. Gantt Chart**



**9. Hardware and Software Specification:**

1. High graphic cards in the computer to support game graphics.
2. Logitech G27 Racing wheel attached with computer to play the game and control the vehicles.
3. Oculus rift DK2 will use to provide the feel of virtual environment to th user.
4. Minimum Ram requirement in computer is 6GB.

**10. Tools and technologies used with reasoning:**

**10.1. Unity 3D Engine:**

We will use Unity 3D engine to build the virtual world.

**10.2. Web Services:**

We will use Web Services to maintain a bridge between the MovSimCore and MovSimViewer so that we can build the game on the basis of proper traffic models.

**10.3. Artificial Intelligence:**

We will use Artificial Intelligence to judge the behavior of a person, other vehicles and pedestrian.

**10.4. MovSim:**

We will use MovSim to build the realistic road network and simulation of traffic.

**10.5. Programming languages:**

**1)** C# used for the scripting of unity 3D engine and modeling of virtual world.

**2)** Java is used for reading the data from MovSim and build a connection between MovSim and Unity 3D engine.

**11.** **System Architecture Diagram:**

Custom Objects

MovSim OpenDrive Parser

input output

XML

input

Virtual 3D environment

Unity Render

output

**12. References:**

[1] <http://www.opendrive.org/>

[2] <http://www.movsim.org/>

[3] http://www.opendrive.org/docs/OpenDRIVEFormatSpecRev1.4H.pdf