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Design and implementation of Virtual reality in creating Car Driving Simulation

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ABSTRACT

This paper presents a Virtual-Reality (VR) system that simulates car driving experience that can be used to train, test and evaluate driving license applicants. It's a part of multi-semester college project and is aimed to help in driving license testing and training. We introduce the VR simulator system which is developed open source software and integrated without our custom built hardware to provide a 360° immersive environment to the user. We aim to provide a very cheap alternative to the existing simulator systems so that it can used for training and educational purposes using harnessing the processing power of modern Android smartphone.

INTRODUCTION

Virtual Reality (VR) can be defined as a technology that creates a three dimensional virtual immersive environment for the user using the VR headset. With the release of numerous VR headsets, which are essentially head-mounted displays with lenses for each eye to provide immersive experience, it is easier and cheaper to implement and use VR in applications.

Driving Simulator is collection of the hardware components that resemble the interior of a car and consists of seat, steering wheel, accelerator and brake pedals. These physical components are embedded with sensors that provide input to the system based on the interaction of the user with the simulator hardware.

We present a relatively new approach to simulated driving by harnessing the advancements in mobile processing power and VR technology in recent time, making VR simulation experience as close to reality.

THE COMPONENTS

1. Unity 3D Environment: The virtual environment is simulated and developed using Unity 3D. It consists of the roads, vehicles, buildings, trees, signals and other physical components with which the user can interact. It also the displayed the user's evaluation score based on his driving skills [1].

2. VR Headset: It is the head-mount display that the users wears. It displays the virtual environment. The headset has mount where an Android phone having a high resolution display can be inserted. It has two lenses, one in front of each eye that simulates the images displayed on the Android phone screen into a 3D environment. The headset is also equipped with motion sensors that allows user to get a 360° view of the virtual environment generated using unity 3D.

3. Steering wheel: The steering wheel is embedded with a gyroscope to sense it movement by the user. The data from the steering wheel's gyroscope is used to reflect the steering motion of the car in the virtual environment so the car turns as the user turns the steering wheel.

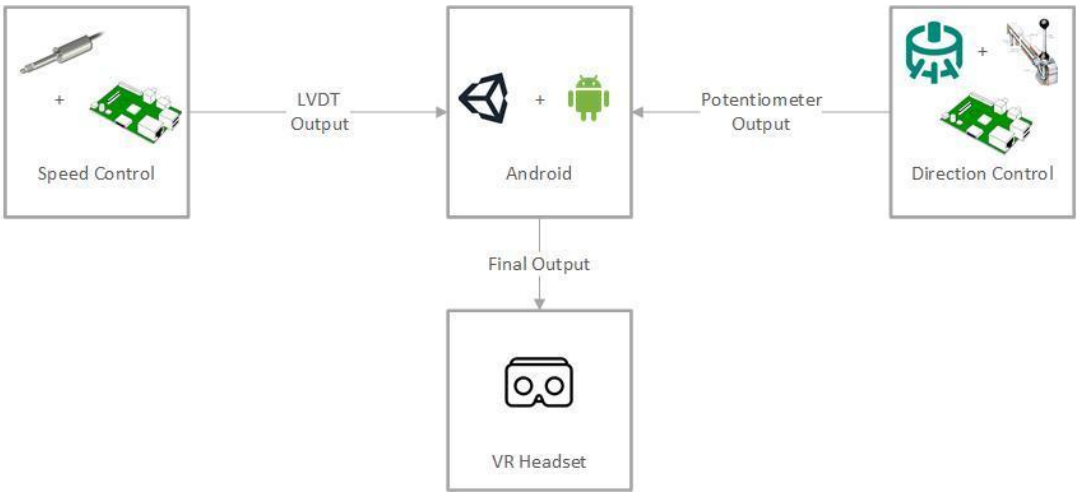

Figure 1. Block Diagram

4. Clutch, Brake Accelerator pedals: We constructed the accelerator and brake pedals with spring mechanism that mimic the pedals of a car. These pedals are also fitted with gyroscope sensors so get input from their downward moment and reflecting it in the virtual environment that the user views in the 3D VR headset.[3]
5. Gear Box: we have made the gearbox with a shaft that has 5 positions for reverse and shifting gears of the cars. [4]

Figure 2. Sign Board with Evalution

LIMITATIONS

The traffic situation: the traffic generated doesn't represent real-life scenarios. Vehicles are spawned on the road at random intervals and made to disappear after it gets a certain distance away from. We can use methods for realistic.

The hardware we used doesn't aesthetically represent the car's interiors, as the project is still in the early demo stage but we are working on building robust hardware components like the clutch, brake, accelerator pedals using hydraulic pistons and exploring alternatives to create a better car interior fabrication unit.

It is difficult to measure and plot the torque produced by actual car engine corresponding pressure exerted by user on the pedal. For the time being we have assumed the torque to increase linearly on the release of the clutch pedal, which doesn't represent real world driving scenario. So the torque force vs pedal movement could be improved.

APPLICATIONS

1. Driving training in safe environment. Introducing a beginner with the car components, steering and brakes doesn't make him fit to try driving on a road. We provide a way for the learner to test his driving skills and reflex in this virtual medium without the risk on causing and damage in real world
2. Entertainment purpose. Minor modifications can be made to convert the project to a game that can be a source of entertainment like games at movie theatres.
3. Better evaluation system for driving license testing for Indian states. Current system requires the applicant to clear an MCQ test of a few question. Our project would be able to make a better evaluation whether the applicant should be allowed to give practical test, saving time of both applicant and driving license committee.

RELATED AND FUTURE WORK

1. Realistic traffic generation on the road that represents realistic traffic scenarios based on [the traffic pattern research papers]
2. Maps of actual cities can be implemented. Maps are available by [Google earth project].
3. Reference current simulators systems being used. Example Toyota and Arizona.

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