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Design of Virtual Drive (3D Simulator)

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Abstract: With the increase in number of vehicles on the road, the driving ability became an important part in normal life, without learning driving when they try to acquire a driver's license, "on-road test" may be very dangerous and difficult. The goal of the project is to make a virtual reality driving simulator in order to check and enhance the subjects' driving ability. Also it includes a module to analyze the subject's driving ability.
The project is a driving simulator developed for evaluation of full-scale driving simulators and for driver-vehicle interaction study. The simulator consists of a real-time vehicle simulation system, visual and audio system, motion system, control system, and console. The real-time vehicle simulation system supervises the overall operation of the simulator and also simulates the dynamic motion of realistic vehicle models in real-time. The visual system generates high fidelity driving scenes that are displayed on a screen. The system generates realistic motion. The control system acts as an interface between a driver and the simulator. The console monitors the status of the simulator in operation and also collects and manages experimental data.

I. INTRODUCTION

Background:

Driving simulators can be effective training tool. They can be used for individuals to learn how to drive with a disability in a safe and controlled environment before driving on real roads, which can be dangerous for an inexperienced driver. Pre-accident conditions can be experienced in the simulator allowing new drivers to get a feel for what is safe and what will result in an accident. Simulator allowed very accurate training methods that can predict vehicle rollovers, stopping distances on wet, dry or icy roads, severe steering moves requiring skill, and a host of other real-life driving situations. Virtual Reality Driving Simulator can safely and reliably expose examinees to hazardous challenges to assess defensive driving skills.

Motivation:

When one individual tries to learn driving without any virtual reality car simulator the major amount of training is completed on road. This can be dangerous for the driver, trainers, and others who are on the road. Driving Simulator provides learning off-road without being in any kind of danger. Learning with driving simulator is much safer and easy, our aim is every person should drive safely and responsibly. Possibility of encountering dangerous driving conditions without being physically at risk.

Problem Definition:

Today driving has become an important part in the individual's life so it is necessary to learn driving in order to acquire license to do so most of people join driving school and learning driving becomes problem. In order to solve this problem virtual reality driving tool is been used to enhance the subject's driving ability. The system consist of

hardware and software that will be the interface for user that provides real time driving experience. The system will provide dynamic feedback to the user on screen.

Scope:

Virtual Drive will provide the learner a virtual realistic environment to learn driving without being in any danger. To drive on road without any experience is very risky for the learner, trainer and other people around. virtual car simulator will avoid the danger of being on road directly and providing a training virtually which is much safer. The system consist of functions such as dynamic feedback, hardware interface for user. The simulator provides a realistic, highly immersive driving experience. Even special driving scenarios, such as tight corners, braking, emergency cases and accident situations are simulated realistically and sufficiently dynamically.

Two types of driving simulators are:

a. Static Driving Simulators

Static Driving Simulators does not provides the feedback on the screen it is a much simpler Static Driving Simulators does not provides the feedback on the screen it is a much simpler driving simulator it does not have any dynamic effect while driving. Driver experiences similar kind of environment as the car video game does. Static Driving Simulators somehow lacks in realism. Users have the possibility to drive a virtual vehicle model, visualizing vehicle behavior on a wide screen with unprecedented high-quality and low-latency graphics while sitting on a fixed cockpit. For example, in curve driving, drivers drove faster in static-based simulators than when actually driving a car.

b. Dynamic Driving Simulators

Dynamic Driving Simulators are more advanced technique of learning driving. Dynamic Driving Simulators increases the realism which benefits the learner as well as the trainer. The simulators use a platform that moves using actuators. Learning how to drive will gradually increase by using such type of simulation techniques. It provides motion feedback to the driver thanks to an innovative moving platform with reduced overall dimensions and large travels. For example, in curve driving, drivers use lateral acceleration to adjust car velocity.

II. LITERATURE SURVEY AND ANALYSIS

Types of Virtual Reality Environments:-

A. Semi-Immersive Virtual Reality: Semi-Immersive environment allow viewer becomes partly but not fully immersed in this environment and operate at costs much less than the CAVE. It has advantages over fully immersive systems such as a CAVE system which includes cost, ease of use and logistics. But its disadvantages include limited range of interaction devices and problems with multi-user applications.

Example, the air force uses a virtual reality flight simulator as a training tool.

B. Collaborative Virtual Environments: It is a special case in which they may or may not aim for complete immersion but the main goal is to share a virtual experience with real people.

Example, the Education: distance learning, Medicine: surgery simulation.

C. CAVE Fully Immersive Virtual Reality: The person is fully immersed within it and takes the form of a cube-like space in which images are displayed by a series of projectors. Interaction takes place using a variety of input devices, for example, a joystick, wand or more commonly, a haptic device, i.e. data glove. This enables the person to interact with objects, for example, pulling, twisting or gripping by means of touch. The ability to do this is known as haptic.

Example, Rear projection walls, down projection floor, speakers at different angles.

Motion Simulation:

The relation between visually simulated and physically executed roll movements are systematically varied to investigate their respective importance for spatial representations and the fun aspect.

Fig 1 Motion Simulation

Need for Motion

When people play computer games or watch movies on large or multiple screens they already feel as if they are part of the virtual world they are looking at. They sense the motion that is represented on the screen. Then why is it required to have a large and expensive motion system to excite this virtual world accordingly.

The main reason is to prevent simulator sickness. Symptoms of simulator sickness result from a difference in the latency of the visual and motion system and false cues. Therefore the motion latency should be less or equal to the visual latency and false cues should be avoided. A driver uses his sensory inputs to obtain the required input to base his decisions on. The bandwidth of the required input signal should be in accordance to the driver's task.

For cognitive decision, e.g. when to turn on the screen wipers or direction indicator, relatively low frequency information is sufficient. When cornering on a busy road, high frequency information is required. The presence of motion increases the workload of the driver. Acceleration cues and high frequency motion add a feeling of realism. High frequency motion can be used to simulate special events like road rumble.

Related Work:

1. **Simulating Driving Feel for Virtual Driving Simulator based on Semi-physical Simulation:-**

It combine research proposal about steering feel and suspension system and led to conclusion of AVSoD (Automobile steering equipment Computer simulation) which including steering feel model and vibrant feel of seats model. By programming scripts using C# and JavaScript language, the system was model in Unity and load to the objects in scenes of visual simulation. They design the method to control the hardware and the system provides the real driving experience to make drivers believe that they are driving the real cars.

2. **Design and Implementation of Virtual Driving System Fusing Driver's Cognitive and Operating Characteristics:-**

The modelling of virtual traffic environment with the 3DS max and the VRtools software. The finished virtual traffic environment is applied to the driver fatigue monitoring experiment. The result shows that the virtual traffic environment can fully, realistically simulate the viewing scene system of driving simulator and the final fatigue status classification accuracy is 94.2529% (82/87).

3. **Modelling Virtual Driving Environment for a Driving Simulator:**

It focuses on the development of a virtual driving environment to be integrated with other simulator components. In this, the graphic quality and speed were optimized using different techniques in order to produce efficient realism and fidelity. The driving scenes were developed in a customized framework, which allow interaction of different computers in a distributed environment.

4. **Virtual Environment Construction for Driving Simulator:**

We have presented a total software system which enables us to construct virtual towns and to drive a car through the town. The advantage of the system is that both city planning and environmental evaluation are realized by the same software. We have just begun to develop the function to be applied for actual city planning problems.

Existing system

The existing driving simulation models provide tremendous capabilities to study driving behavior in a safe and controlled environment, there are multiple aspects of the real-world that can be addressed to significantly enhance modelling realism. The proposed architecture integrates multiple types of simulation, including (1) motion-based driving simulation; (2) motorcycling and bicycling simulation; and (2) traffic flow simulation. The integration enables the simultaneous and interactive interaction between actual and simulated drivers, and car drivers. In addition, the system provides capabilities to simulate the entire network at a reasonable price; in this way, the drivers can navigate anywhere in the system.

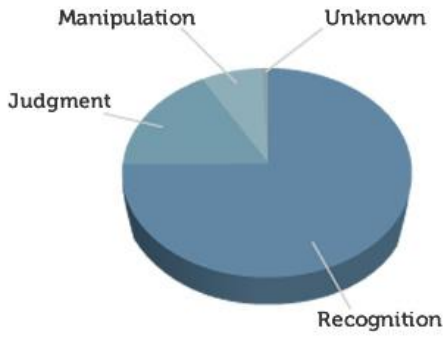

Fig 2 Ratio of fatal and injury accidents by human factors

A. The Toyota driving simulator :

The driving simulator uses driving images and an adjustable speed generator to emulate a situation that is too dangerous to react with an actual car or a driving situation under a specified condition. The simulator is a dedicated engineering tool, featuring the latest technology to accurately reproduce the driving experience in a virtual environment. With more detailed circuit models than anywhere else, the simulator is a next-generation tool for car development where completely consistent and repeatable track conditions promote reliable evaluation that is directly relevant to your development programmer.

Studies indicate 93% of accidents are due to driver recognition misjudgment errors (Fig.3).

To help prevent drivers from these types of accidents, Toyota uses this driving simulator to step into the human (driver) domain and has begun the implementation of future active safety technologies.

Features:

A. Not only provide a realistic image, but also recreate realistic sounds and vibrations: There will be a spherical screen inside the dome that spreads a 360 degree high resolution image. Road vibration would be felt as soon as the driver starts the car. The driver can also hear the road noise and the sound of wind as if they were really driving. The driver would feel the same acceleration as a real car when adjusting speeds and turning at a curve. Leading edge technology has made it possible to create a realistic feeling that lets the driver forget that it is a simulator .These are all innovations to collect realistic driving environmental data from test subjects.

B.

C. Engaging in decreasing everyday accidents

The views from the vehicle are scenes that are seen when commuting to work or while driving on a day off. There isn't any drama in that. This driving simulator can recreate any town that exists in the world with any kind of climate condition.

However, there is a reason why we chose ordinary everyday scenery. The reason lies in the fact that most car accidents occur in an ordinary everyday location. It is essential to analyse drivers that make mistakes in a normal driving situation and to accumulate those results for developing active safety technology.

D. Able to test a driving situation that is impossible in the real world

Even when using a test course with a controlled environment, conducting tests on drivers who are drowsy, distracted or driving under the influence of alcohol can be dangerous. However, these simulations can be conducted safely by using the driving simulator. By using the line of sight measurement device, we research what drivers would be seeing under various conditions. Concurrently, Toyota measures the amount of driving skills, such as steering, accelerating and braking. Furthermore, it is possible to obtain a range of data, such as the driver's brain waves and the heart rate, for analysing the driver's psychological and physiological conditions. By using these, Toyota is researching and creating driving support technologies that will be applied to actual vehicles to keep danger away from the driver.

Fig 3 Toyota driving simulator model.

Limitations of Toyota Driving Simulator system:-

1. In this system as database is not there that is does not store record, previous status of user.
2. The system does not provides dynamic notifications (previous driving mistakes).

Scope:

Today driving has become very important in individual life as in order to drive on road it is important to learn and acquire driving license. In order to learn driving the system “Virtual Drive” can be used. The system will be used to trainee the peoples at one place. The system will consist of a real-time vehicle simulation system, visual, motion system, control system, and console. The system will monitor the simulator and provides the realistic driving experience through different scenes in map. Control system will consist of steering wheel, brakes and accelerator. The control system will act as an interface between a driver and the system. The system will be combination of hardware and desktop application that will provide real time driving experience to user.

III. PROPOSED SYSTEM

Virtual Drive system will trainee the people to learn driving in different situations such as traffic, narrow roads, signals indicating the directions to drive fast on highway, slow driving in cities, sharp turns and driving in proper lanes. The system will consist of steering wheels, brake and accelerator that will be the interface between system and user and the desktop application consists of maps on which the user can drive vehicle.
The following block diagram shows the working of the system "Virtual Drive (3D Simulator)".

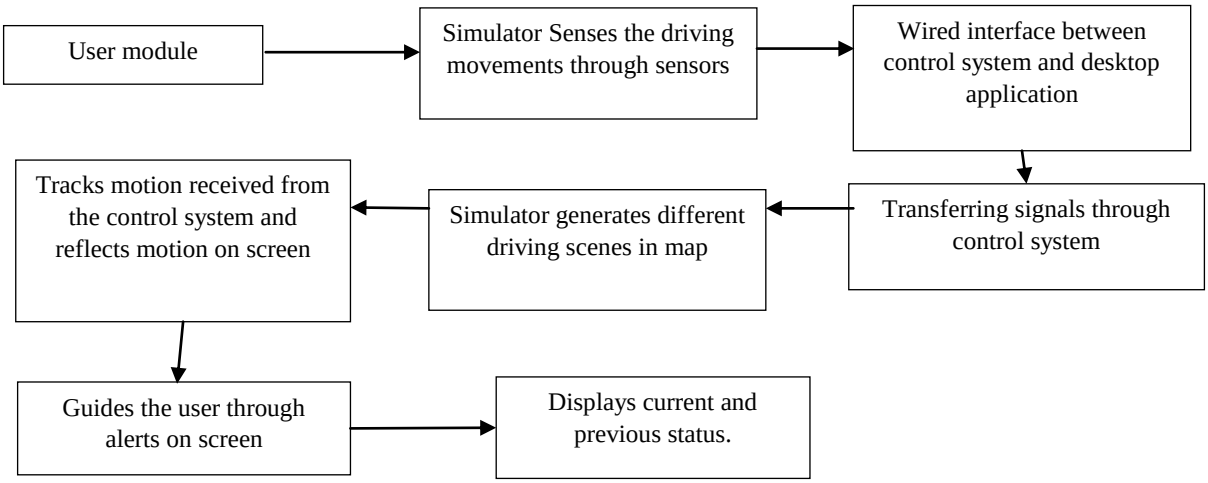

Fig 4 Architectural Block Diagram

Driver gives the input to the system by means of hardware such as brake, accelerator and steering wheel. Simulator senses the driving movements through sensors and gives the output by means of wire to the control system. The control system processes the control signal and display results on the display monitor. Features such as map generation, user history are generated by control unit. The information about the user is stored in database and processed when needed. Notification about any mistakes done by user is displayed dynamically on screen.

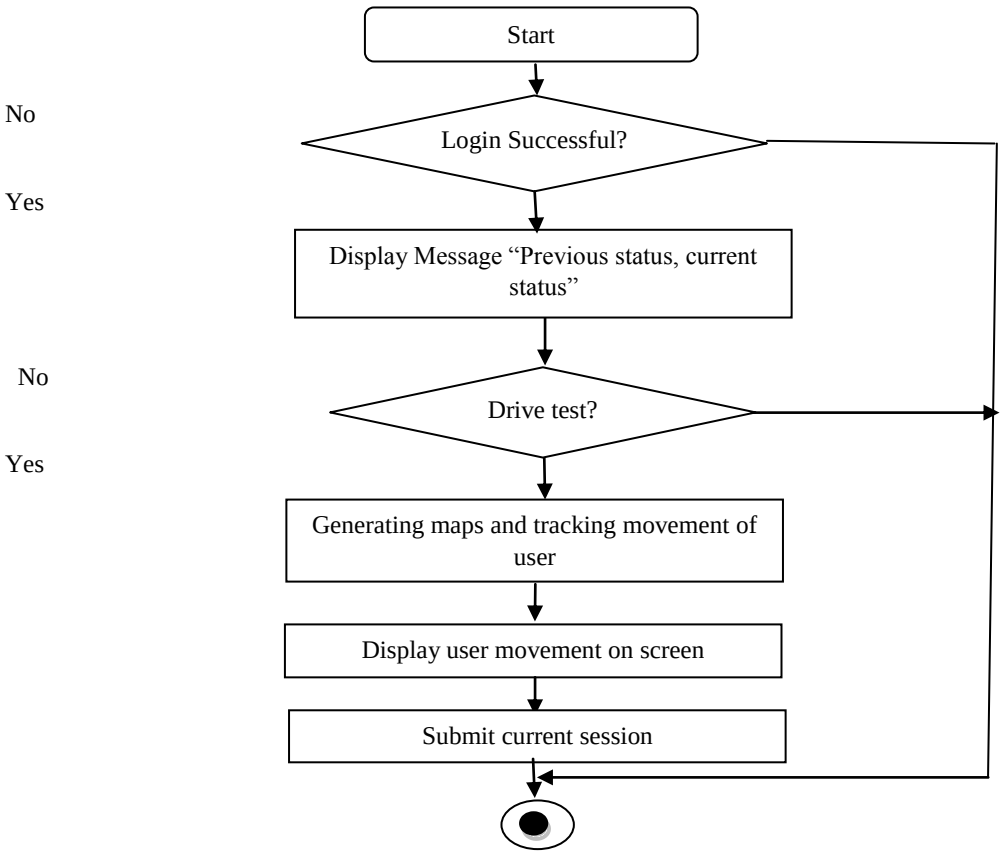

Fig 5Flow Diagram

IV. ANALYSIS

Table:1Comparison of Related Work and Proposed system

Parameters	Virtual Driving Simulator based on Semi-physical Simulation	Virtual Driving System Fusing Driver's Cognitive and Operating Characteristics	Virtual Environment Construction for Driving Simulator	Virtual Drive (3D Simulator)
Driving Simulation (Control over car, Movements of car)	Yes (Full control)	Yes (Full control)	Yes (Full control)	Yes (Full control)
Virtual Environment (Virtual roads, maps, buildings)	Present	Present	Present	Present
Collision Detection	Yes	Complete collision detection by comparing car parts colliding through obstacles	Detects collision through footpaths and colliding from other cars.	Present
.Map looping	No (Drive from point A to Point B)	Yes	Yes	Yes
Main Goal	Training drivers	To improve driver alertness.	Drivers training, City planning	To enhance the driving ability in user to avoid physical accident
.Database (Storing users previous driving status and information)	**No**	**No**	**No**	**Yes**
Dynamic notifications	**No**	**No**	**No**	**Yes**

Virtual Drive (3D Simulator) differs from other system when it comes to Database and Dynamic notification. Our system stores the user's details that is its personal information, driving details, course history and etc. Dynamic notification is another feature where the details and information about courses are displayed during the driving session. Dynamic notification makes user aware about its mistakes while driving this helps the user to improve. Other features like collision detection, map looping and virtual environment will be also included in our system.

V. CONCLUSION AND FUTURE WORK

Virtual Drive (3D Simulator) is designed to have realistic experience that will help the driver to get trainee with various situation. The system will be able to get status of the driving by means of user actions on the system while driving, the review is given to the user after finishing the driving and dynamic notification are indicated during driving. This report explains the entire working of Virtual Drive (3D Simulator) along with minimum requirements needed to implement it.

Virtual Drive simulator can be used in driving schools for learning purpose. Virtual drive simulator will be safe way for a beginner to learn driving as there is no means of danger of real world. Unnecessary use of fuel that is petrol and diesel is completely avoided in learning phase. Virtual Drive simulator is eco-friendly as it does not harm environment after being used.

VI. REFERENCES

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