FACULTY OF COMPUTING
UTM Johor Bahru

SECP 1513: Technology Information System

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PROJECT PROPOSAL

E-DRIVING SIMULATOR

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Client Name:

1. Driving School

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1. Introduction

With a significant percentage of people failing driving tests each year, traditional driving education methods often fall short in fully preparing learners for real-world driving challenges. Many learners struggle to gain confidence in handling real-world driving scenarios. There is a clear need for a more effective and accessible solution. The E-Driving Instructor, Drivionics system offers a solution by leveraging augmented reality (AR), AI, and cloud technology to provide an immersive and cost-effective learning experience to the user. This innovative approach helps learners gain practical driving skills in a safe, controlled environment, enhancing their ability to pass driving tests and become confident drivers.

Traditional driving lessons often suffer from delayed or insufficient feedback from instructors, limiting immediate correction of mistakes. Based on points stated in [1], the slow development of hazard perception in drivers is partly due to the infrequency and poor quality of feedback which does not give the opportunities to the learners to correct their mistakes immediately. As a result, drivers may not gain enough insight into their performance to make necessary adjustments. Furthermore, new drivers often struggle with handling real-world driving challenges, especially because traditional lessons don't expose them to risky situations. In [2], it suggests that using driving simulators will help learners practice dealing with dangerous scenarios in a safe environment. Simulators can create situations like bad weather or sudden hazards that are hard to practice on real roads. By using simulators, learners can improve their skills and reactions to emergencies without the risk of real-life accidents.

The system's approach combines AR smart glasses, smartphones, and AI-driven feedback to create a comprehensive driving education tool. The AR glasses overlay virtual elements onto the real world, such as vehicle component labels and driving scenarios like lane changes and parking, all while maintaining an unobstructed view of the road. AI tracks performance, providing real-time feedback and analysis, while cloud-based data storage enables progress tracking and multi-user support. This approach ensures that students can learn independently or with instructor assistance, creating an engaging and effective learning experience.

The benefits of the E-Driving Instructor system are numerous. It offers a cost-effective, portable, and scalable solution to driving education, reducing dependency on physical vehicles and minimizing risks for beginners. The system enhances safety by allowing learners to practice driving tasks in a virtual environment without real-world consequences, and provides real-time analysis to accelerate skill development [3]. By combining hands-on practice with cutting-edge technology, the system helps improve the overall quality of drivers, benefiting both individuals and driving schools.

While we may not be the first to explore this concept, we recognize that similar ideas have been developed by others in the field. There is already a competitor in the market which is Adiona Driving Simulator. It provides virtual learning environments, but their focus on VR and stationary setups limits their portability and real-world applicability [4]. Unlike Adiona, Drivionics stands apart by integrating augmented reality (AR) directly with the driving experience which allows learners to practice on actual roads while receiving virtual guidance. The system's interactive AR overlays and real-time AI feedback will equip learners with the skills and confidence needed to navigate real-world driving scenarios. This interactive, helps learners build the skills and confidence needed to handle real-world driving situations hence ensuring them to be well-prepared and succeed on the road then pass their driving tests.

2. Existing Systems

Driving instruction mainly relies on in-person lessons and study materials like handbooks and tests. While tech like simulators and apps has made learning more accessible, these tools often lack interactivity and don’t feel like real-world driving.

Manual systems for driving instruction typically involve in-person lessons conducted by professional instructors. These sessions include on-road practice and theoretical classes, making them effective but often time-consuming, expensive, and dependent on the instructor's availability. Physical materials such as textbooks, manuals, and static traffic rule charts are also used to teach driving theory, but they lack interactivity and fail to engage learners fully.

Manual systems face several limitations that hinder their effectiveness. The primary issue is the dependence on human instructors, which restricts scalability and increases costs. With a reliance on one-on-one or group teaching, these systems are not cost-effective for large-scale education. Additionally, the static teaching methods and materials often used in manual systems fail to engage students fully, leading to a lack of interest and involvement in the learning process.

Computerized systems have introduced more accessible options, such as mobile apps and driving simulators. Apps like AR Real Driving (App Store) and Vehicle AR Drive (Google Play) provide driving theory lessons, traffic rule quizzes, and occasionally driving scenarios. While these apps are convenient, they often lack immersive or realistic practice environments. Driving simulators, on the other hand, replicate driving scenarios to a certain extent, offering a controlled practice environment. However, they are usually expensive and lack portability, limiting their accessibility for many learners.

Computerized systems, while offering some improvements, also have their own set of challenges. Many digital learning platforms still lack realism and interactivity, with most apps not integrating real-world scenarios effectively. This gap in practical application can make the learning experience feel disconnected from real-life contexts. Furthermore, advanced simulators, which could offer a more immersive and realistic learning environment, are often prohibitively expensive, making them inaccessible for many learners. These issues highlight the need for more scalable, engaging, and cost-effective learning solutions.

Table 1: Comparison of existing systems

Features	Driving Instructor	Physical Materials	Mobile Application	Driving Simulator	Drivionics
Involved in reality	Yes	No	No	No	Yes
Cost	Average	Low	Low	High	Average
Efficiency	High	Low	Low	High	High
Usage of time	Long	Long	Short	Short	Short
Feedback to learner	Yes	No	No	No	Yes

3. Proposed System

If the project is part of a larger system or if it must interface with some other software, and any other related information, explain in this section. Do provide a brief explanation of the system here by briefly explaining the users' roles and what they can perform via the system.

The proposed system is an E-Driving Instructor using AR glasses as an education application aimed to revolutionize the way of teaching driving students by overlaying virtual elements onto a real world driving environment. By leveraging AR technology, the system provides an immersive and interactive experience to students familiarize themselves with the vehicle components and basic driving lesson in a controlled, augmented environment before hands-on training.

The key feature of this system is to improve understanding of car interior and controls. Using AR visual search in our software which acts like Google Lens and Snap Scan, it displays labeled information about the car interior and its function at the lens glasses. The glasses also can simulate virtual roads, a virtual driving scenario that is projected onto the car windshield virtually. It also has dynamic guidance tasks like parking, lane changes, or navigation presented virtually. The system only overlays visuals without interfering with actual road views and only using the car interior without starting the engine. This can enhance safety training as it simulates challenges like obstacles or traffic without physical risk.

This system also has an AI install as its purpose to be the replacement for driving instructors. It also performs an analysis based on the performance of our driving behavior. The AI can give real-time feedback and record the driving sessions for later review by students or instructors.

The proposed system relies on advanced hardware and software interrogations as it delivers an immersive driving education experience. The hardware includes AR glasses compatible with real cars, a HUD (Head-Up Display) projected onto the windshield to simulate virtual road scenarios. For the software, it has an AR visual search that employs object recognition algorithms to identify the car components in real time.

User Roles and Interactions

Before launching the product, the first thing that needs to be reconsidered is to define user categories and their capabilities. There are 2 categories for the user which are students and instructors. In the perspective of students, the capabilities for them using this tool is that they can access the AR lessons by using smartglass that can immerse themselves into the VR world. The user will be able to experience the virtual driving mode for them practising the lesson of the driving class.

Other than that, the students also can perform any task that is related to RSM that is Pre-Driving Routine inspection. The objective of this inspection is for the purpose to confirm the proper functioning of car components before the start of the journey. Therefore, the student can follow the guided procedure to carry out the RSM that pop out while wearing the AR glass [6]. This also helps the student to memorize the steps effectively. They also will receive feedback from the AI assistant whether there is an instructor or not. An AI assistant will generate driving analysis and process all the mistakes and enhance it to improve for the next lesson. AI plays a vital role to increase the effectiveness of this product.

In the perspective of the instructor, the second user categories also will have their roles in this interactive product.They are capable of monitoring and guiding the student progress physically. The balance of real world and virtual world aid will improve student performance. With the guidance of using an AR smartglass, instructors role as an instructor also to teach the students how to use the tools. Since the smartglass is provided by the company itself, at the same time they can increase their earnings and help the success rate of the driving test.

Technical Specifications

There are 3 parts that are involved in technical specifications which are Hardware, Software and Backend. For the Hardware part, the important components are smartglass which is used to help the implementation of VR and AR world, and motion sensors that are applicable to steering, fuel and brake paddle, clutch(if manual transmission). The motion sensors will detect the movement of cars' paddle in order to be synchronized with the AR application. The smartphones with AR capabilities which means the smartphone must be an updated version compatible with AR apps which is known as Drivionics.

The second part of technical specifications is Software. An app called Drivionics provides AR capabilities to immerse the AR and VR world with the real world. The software part need to be carefully created to ensure the effectiveness of driving lesson. The application will display the home menu for the user to define what they want to do with the application. For instance, there will be 3 different modes of driving which are RSM, Circuit Test and Road Test. With the assistance of AI, the user can be guided to start any of the training and the AI will analyse users progress in order to increase their performance.

Lastly, the Backend part is the final part that plays a crucial role to help the database storage to keep the previous data from multiple users in order to access the data and help the improvement of the tools services. Cloud-based databases can be used for progress tracking and analytics since it is easier to be controlled.

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Appendices

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do you have any resources for this

Certainly, here are some resources that provide insights into existing driving instruction systems and the integration of augmented reality (AR) in this field:

Manual and Computerized Driving Instruction Methods:

- **Classroom Instruction vs. Online Driver's Education:** This article compares traditional in-person driver's education with online methods, discussing the benefits and drawbacks of each approach. DRIVERS ED
- **Driver Training Instructor Manual:** This manual offers comprehensive guidelines on driver training, including the use of computer-based driving simulators to introduce defensive driving techniques. CALIFORNIA STATE POSTAL SERVICE

Figure 1: Resources for manual and computerized systems

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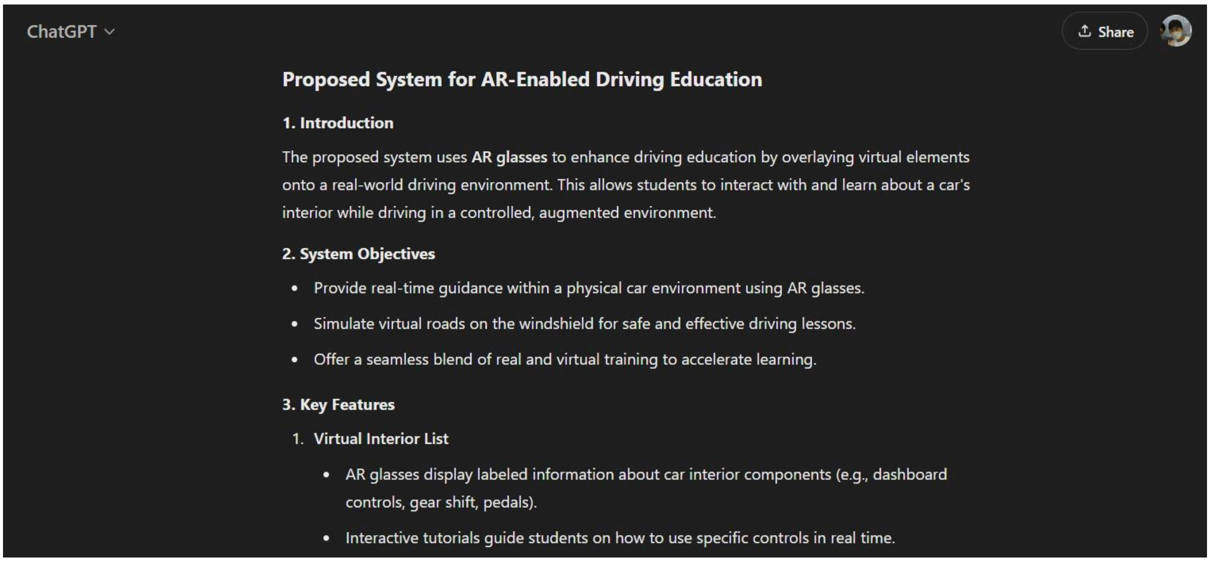
Augmented Reality in Driving Instruction:

- **AR Real Driving:** An app that allows users to drive virtual cars and helicopters in the real world using their smartphone or tablet, providing an interactive AR experience. APPLE APPS
- **Vehicle AR Drive:** This application utilizes augmented reality to display vehicles in front of the user, enhancing the driving experience through interactive simulations. GOOGLE PLAY
- **RoadVisor: SMART AR Navigation:** An open-source augmented reality navigation application aimed at enhancing the driving experience by combining real-time traffic information with advanced AR features. GITHUB
- **Hyundai Virtual Guide App:** An application that allows Hyundai drivers to use their smartphones or tablets to understand their cars better and learn how to perform basic maintenance through AR interactions. HYUNDAI NEWS

Figure 1.1: Resources for manual and computerized systems



Proposed System for AR-Enabled Driving Education

1. Introduction

The proposed system uses **AR glasses** to enhance driving education by overlaying virtual elements onto a real-world driving environment. This allows students to interact with and learn about a car's interior while driving in a controlled, augmented environment.

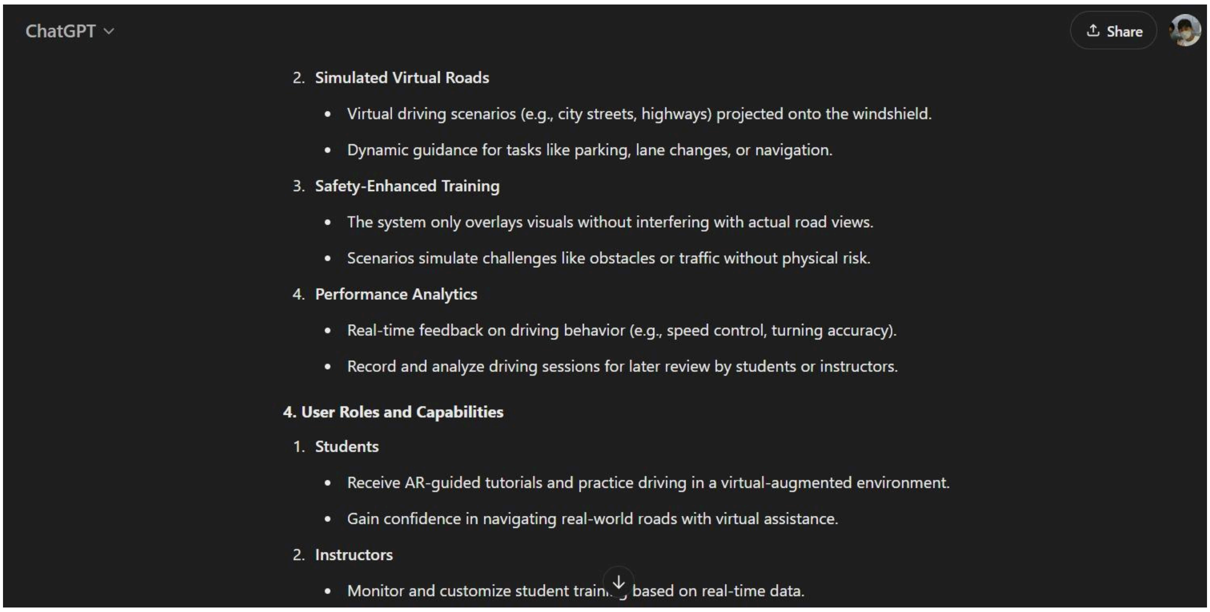
2. System Objectives

- Provide real-time guidance within a physical car environment using AR glasses.
- Simulate virtual roads on the windshield for safe and effective driving lessons.
- Offer a seamless blend of real and virtual training to accelerate learning.

3. Key Features

1. **Virtual Interior List**
   - AR glasses display labeled information about car interior components (e.g., dashboard controls, gear shift, pedals).
   - Interactive tutorials guide students on how to use specific controls in real time.

Figure 2: Proposed System for AR-Enabled Driving Education



2. **Simulated Virtual Roads**
   - Virtual driving scenarios (e.g., city streets, highways) projected onto the windshield.
   - Dynamic guidance for tasks like parking, lane changes, or navigation.
3. **Safety-Enhanced Training**
   - The system only overlays visuals without interfering with actual road views.
   - Scenarios simulate challenges like obstacles or traffic without physical risk.
4. **Performance Analytics**
   - Real-time feedback on driving behavior (e.g., speed control, turning accuracy).
   - Record and analyze driving sessions for later review by students or instructors.

4. User Roles and Capabilities

1. **Students**
   - Receive AR-guided tutorials and practice driving in a virtual-augmented environment.
   - Gain confidence in navigating real-world roads with virtual assistance.
2. **Instructors**
   - Monitor and customize student train... based on real-time data.

Figure 2.1: Proposed System for AR-Enabled Driving Education

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3. **Administrators**
    - Manage AR glasses configurations, scenarios, and user accounts.
    - Ensure compatibility with different car models and training programs.

5. System Architecture

- **Hardware**: AR glasses compatible with real-world cars, HUD (Head-Up Display) for windshield projections.
- **Software**:
    - Object recognition for labeling interior components.
    - Simulated road environments with customizable scenarios.
    - Cloud integration for data storage and analytics.

6. Implementation Plan

1. Develop the AR glasses interface for detecting and labeling car interiors.
2. Integrate HUD-based virtual road simulations into a test car.
3. Conduct pilot testing to refine usability and safety.
4. Deploy to driving schools with instructor ing.

Figure 2.2: Proposed System for AR-Enabled Driving Education