An Intelligent Application for Detecting and Alerting on Dangerous Driving Behaviors

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***Abstract*—Worldwide, traffic accidents are a major source of fatalities and injuries, resulting in financial losses and societal expenses. One of the main factors contributing to traffic accidents is human error, which includes driver weariness, distraction, and other risky driving practises. AI and computer vision developments have created new possibilities for tracking driver behaviour and warning of risky driving practises. Numerous academics have investigated the use of computer vision algorithms to identify and categorise driving behaviour, including detecting attention and sleepiness. These issues have also been addressed by machine learning algorithms, enabling the creation of systems that can recognise and categorise various driving behaviours. Some existing systems use sensors, such as cameras and accelerometers, to monitor driver behavior and provide feedback. However, these systems can be limited in their effectiveness and may require significant calibration and maintenance. The proposed application to monitor driver visual analytic using AI aims to overcome some of these limitations by using advanced computer vision algorithms and machine learning techniques to provide real-time feedback to the driver.**

***Index Terms*—Artificial Intelligence, Visual Analytic, Computer Vision**

I. Introduction

Road safety is a pressing concern worldwide, as road accidents are a major cause of fatalities, injuries, and economic losses. One of the primary causes of road accidents is human error, particularly unsafe driving habits such as driver fatigue, distraction, and other forms of impaired driving. According to the WHO, around 1.35 million people die each year globally due to road accidents, with driver fatigue, distraction, and other unsafe driving habits being primary contributing factors. While various technologies exist to monitor driver behavior and provide feedback, such as sensors and cameras, these systems can be limited in their effectiveness and may require significant calibration and maintenance. Advances in computer vision and machine learning techniques have opened up new opportunities to monitor driver behavior and alert them to unsafe driving habits in real time. This study suggests a driver visual analytics program that employs artificial intelligence (AI) to analyze a driver's visual behavior and notify them if they display indicators of fatigue, distraction, or other risky driving practices. A camera that is positioned on the dashboard or steering wheel of the car is used to implement the system. It records the driver's face and eye movements. If the driver is found to be drowsy or distracted, the application could alert them with a sound, vibration, or message to encourage them to take a break or refocus their attention on the road. The proposed system has the potential to improve road safety by lowering the number of collisions brought on by driver inattention, weariness, and other risky driving practices. The proposed application also aims to improve the accuracy of existing systems and focus on detecting bad driving behaviors while introducing an alarming system to prevent accidents while driving. The proposed system holds the potential to make a substantial contribution to road safety and decrease the frequency of accidents due to human error by tackling these crucial concerns

II. Related Work

A. An HMI Concept to Improve Driver's Visual Behavior and Situation Awareness in Automated Vehicle

This paper introduces a concise HMI (Human Machine Interface) concept that utilizes an LED ambient light located at the bottom of the windscreen to convey critical information such as the status and intention of the automation, detected potential hazards, and warning for a take-over request (TOR) by altering the color, frequency, lighting position, and animation of the LED. The primary aim is to enhance situational awareness (SA) during automated driving, improve the take-over quality, and enable the driver to perform non-driving related tasks (NDRTs) without distraction or annoyance. The effectiveness of the new HMI was evaluated in a between-subject-design experiment using a static driving simulator with 50 participants, who performed a visual motoric task on a smartphone during a 45-minute automated drive with or without the new HMI [1].

B. Dynamic Human Behaviour Pattern Detection and Classification

The focus of this study is on analyzing and classifying four types of detailed human behaviors - walking, standing, running, and sitting - through videos. To achieve this, the study proposes the use of a Convolutional Long Short-Term Networks (CLSTM) model that combines the CNN and LSTM models to facilitate the learning, detection, and classification of dynamic human behavior patterns. Initially, the visual representation of human behaviors is learned through AlexNet, a traditional CNN architecture that processes time-based images. These results are then fed into the LSTM model to learn time-based sequence features that can be used for detailed behavior pattern classification. The study also reports a prototype of a Human Behavior Detection System that utilizes the CLSTM model, and some preliminary case study results are presented [2].

C. Drivers' Visual Search Behavior: Eye Tracking Analysis Approach

This study presents an analysis of how drivers visually process information displayed along Ir H Juanda street Depok, and how eye-tracking techniques can be used to evaluate the comprehension of visual displays presented in video format. The study utilized fixation and attention maps to report on the drivers' attention during the experiment. The research findings highlight the potential of eye movement recordings as a valuable tool for gaining insights into drivers' attention while acquiring visual information [3].

D. Effects of Vehicle Simulation Visual Fidelity on Assessing Driver Performance and Behavior

In this study, we developed two immersive virtual environments - a "low" graphic fidelity driving simulation that is representative of most current research simulation testbeds and a "high" graphic fidelity environment created using Unreal Engine, which represents state-of-the-art graphical presentation. A user study was conducted with 24 participants who were required to navigate a route in a virtual urban environment, using AR graphical cues for direction and monitoring the road scene for pedestrian hazards. Driving performance, gaze patterns, and subjective feedback were recorded via situational awareness survey (SART) [4].

E. XGBoost Algorithm-Based Monitoring Model for Urban Driving Stress: Combining Driving Behavior, Driving Environment, and Route Familiarity

The focus of this study is to monitor a driver's driving stress levels by developing a model based on driving behavior, driving environment, and route familiarity. To extract data for the model, a real driving task was designed. The driving behavior is described by measuring the speed and acceleration of the vehicle, while the driving environment is quantified using a dilated residual networks (DRN) model. This model divides the video image from the full region into sub-regions based on the distribution of the driver's attention [5].

III. EXISTING METHODOLOGY

In this study, a real driving task was designed to extract data, and a driver's driving stress monitoring model was proposed based on driving behavior, driving environment, and route familiarity [6]. The speed and acceleration of the vehicle describe the driving behavior, while the driving environment is quantified using a dilated residual networks (DRN) model.

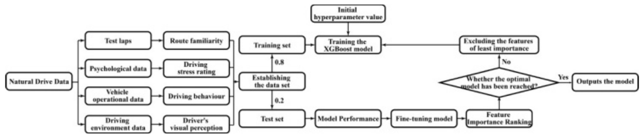

Fig. 1. Different layers of XGBoost Method

This model divides the video image from the full region into sub-regions based on the distribution of the driver's attention. To improve the model's accuracy, a hierarchical method based on weighted extreme gradient boosting was used [7]. This method continuously adds and trains new trees in each iteration to fit the residuals of the predicted values of the previous decision tree and the sum of the predicted values of all previous decision trees. Finally, the predicted values of all decision trees are summed together to obtain the final result.

IV. PROPOSED METHODOLOGY

Fig.2 details the proposed architecture for the application to monitor driver visual analytics using AI based on CV and ML techniques. The implementation of the system involves utilizing a camera that is mounted on either the dashboard or steering wheel of the vehicle. The camera is responsible for capturing the movements of the driver's face and eyes. The camera is connected to a processing unit, such as a microcontroller or a dedicated processing board, which runs the computer vision algorithms and machine learning models. The CV algorithms analyze the driver's eye movements and facial expressions to detect signs of fatigue, distraction, or other unsafe driving habits. The ML models leverage this data to categorize the behavior of the driver and ascertain the necessary course of action to be taken. For example, if the driver is found to be drowsy or distracted, the application could alert them with a sound, vibration, or message to encourage them to take a break or refocus their attention on the road. The system can also be integrated with other sensors, such as accelerometers and GPS, to provide additional data on the vehicle's speed, acceleration, and location. Utilizing this data can enhance the precision of the system and offer additional background information regarding the driver's actions. The proposed architecture also includes a user interface that allows the driver to configure the system settings and view feedback on their driving behavior. The user interface could be implemented using a mobile application or a dashboard display, depending on the vehicle's configuration. Overall, the proposed architecture for the application to monitor driver visual analytics using AI is designed to be accurate, reliable, and easy to use. There is the possibility that it could enhance road safety and lessen the occurrences of accidents caused by human error, to a great extent.

The system can also be integrated with other sensors, such as accelerometers and GPS, to provide additional data on the vehicle's speed, acceleration, and location. This data can be used to further improve the accuracy of the system and provide more context for the driver's behavior.

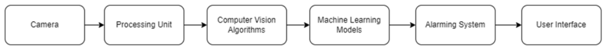

Fig. 2. Different Steps in the Architecture

The proposed architecture also includes a user interface that allows the driver to configure the system settings and view feedback on their driving behavior. The user interface could be implemented using a mobile application or a dashboard display, depending on the vehicle's configuration.

Overall, the proposed architecture for the application to monitor driver visual analytics using AI is designed to be accurate, reliable, and easy to use, with the potential to significantly improve road safety and reduce the number of accidents caused by human error.

V. CONCLUSION

In conclusion, the development of an AI-based application for monitoring driver visual analytics is a promising area of research with the potential to enhance road safety and decline accidents. The proposed architecture, which includes a camera, processing unit, computer vision algorithms, machine learning models, alarming system, and user interface, offers a robust and flexible approach to detecting and responding to unsafe driving behaviors.

While XGBoost is a popular machine learning algorithm that has been successfully applied in many domains, including driving behavior monitoring, it is not without its limitations. The algorithm's reliance on large amounts of data, potential for overfitting, limited interpretability, high computational requirements, and need for careful feature engineering may make it less suitable for some driving behavior monitoring applications.

Overall, selecting the most appropriate machine learning algorithm and approach for monitoring driver behavior requires careful consideration of the specific requirements and constraints of the application. With further research and development, AI-based driving behavior monitoring systems hold great promise for improving road safety and reducing accidents.

VI. FUTURE WORKS

There are several potential areas for future research in the development of an AI-based application for monitoring driver visual analytics. These include incorporating additional data sources, exploring alternative machine learning algorithms, developing more advanced computer vision algorithms, implementing real-time feedback and intervention, and conducting field studies and user testing. By addressing these areas, researchers and developers can further improve the effectiveness and usability of AI-based driving behavior monitoring systems, ultimately contributing to improved road safety and reduced accidents.

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