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Fatigue Detection from Facial Features Using AI to Prevent Accidents

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ABSTRACT: - One of the main causes of injuries and fatalities worldwide is road accidents brought on by fatigued drivers, particularly when driving long distances and at night. A mouth aspect ratio (MAR)-based deep CNN model is suggested to enhance detection. The probability of such collisions is greatly decreased by the system's constant monitoring and alerting of the driver. The system analyses fatigue levels using ml and dl models. For precise facial landmark detection, the DLIB library is utilised. This technology can be installed in vehicles as an inexpensive driver support system and promises to improve road safety and lower accident rates.

Keywords: ***Face Recognition, Python flask, OpenCV, DLIB, Facial Landmark Analysis, Real-time Alert System.***

INTRODUCTION

Driver fatigue is one of the leading causes of road accidents worldwide, particularly during long-distance and night-time driving. Fatigue reduces a driver’s alertness, slows reaction times, and impairs decision-making, often resulting in dangerous situations. Traditional methods for detecting drowsiness rely on vehicle behavior analysis or physiological sensors, which can be expensive, intrusive, or impractical for everyday use. Computer vision techniques have emerged as an effective alternative, allowing non-contact monitoring of facial features such as eye movements and blinking patterns. Continuous eye closure is a key indicator of drowsiness and can be detected in real time through video analysis.

Developing a system that identifies fatigue early can help prevent accidents and improve road safety. The proposed work focuses on designing a cost-effective and real-time driver fatigue detection system. The system uses facial landmark detection and Eye Aspect Ratio (EAR) calculations to monitor driver alertness. Alerts are generated automatically when prolonged eye closure is detected, helping drivers regain attention. The work is important because it provides a practical solution for reducing fatigue-related accidents. It is non-intrusive, easy to implement, and suitable for deployment in regular vehicles. The objectives include monitoring eye behavior, detecting drowsiness accurately, generating timely alerts, and improving overall traffic safety. By combining real-time analysis with a simple hardware setup, this system aims to enhance driver safety without causing discomfort. The study contributes to intelligent transportation systems and promotes safer driving practices. Overall, this approach addresses a critical safety challenge with a practical and reliable solution.

LITERATURE SURVEY

Many studies have addressed the problem of driver fatigue detection using various techniques. Early methods relied on physiological signals such as EEG, ECG, and heart rate, which provided accurate results but were intrusive and uncomfortable for drivers. Vehicle-based approaches monitored steering patterns, lane deviation, and acceleration changes to identify drowsiness, but they depended on specific driving conditions and were not fully reliable. Recent research has shifted toward computer vision methods, which are non-intrusive and practical. Facial landmark analysis, eye blink detection, and head pose estimation are widely used to monitor alertness. The Eye Aspect Ratio (EAR) method has been applied successfully to detect prolonged eye closure as a sign of fatigue. Some studies combined Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) models to analyze temporal changes in facial features for improved accuracy. Others integrated infrared cameras to maintain performance in low-light conditions. Audio or vibration alerts are commonly used to notify the driver when drowsiness is detected. While deep learning models improve detection accuracy, they often require higher computational resources. Many works have demonstrated real-time implementation with standard cameras, proving the feasibility of vision-based systems. However, challenges remain in handling varying illumination, occlusion, and different facial orientations. Overall, previous research indicates that a low-cost, non-intrusive, and accurate fatigue detection system is achievable using computer vision techniques.

RELATED WORK

Many researchers have explored techniques to detect driver drowsiness and fatigue. Early approaches focused on physiological signals such as EEG and heart rate, which provided accurate results but required wearable devices. Vehicle-based monitoring, like analyzing steering patterns and lane deviations, offered an indirect method to identify fatigue but was limited by road conditions. Recent studies have emphasized computer vision methods, analyzing facial features such as eye closure, blinking frequency, and head movement. The Eye Aspect Ratio (EAR) has proven effective in detecting prolonged eye closure in real time. Some works combined deep learning models like CNN and LSTM to capture spatial and temporal changes in facial behavior. Infrared cameras were also used in low-light conditions to maintain accuracy. Alert mechanisms, such as audio or vibration signals, were integrated to notify drivers immediately. These studies highlight the effectiveness of vision-based systems while also showing challenges in varying lighting, occlusion, and facial orientations. The current work builds on these findings to develop a cost-effective, non-intrusive, and real-time fatigue detection system suitable for practical deployment.

EXISTING SYSTEM

Existing driver drowsiness detection systems typically rely on physiological sensors, vehicle-based monitoring, or computer vision techniques. Physiological systems use signals like EEG or heart rate to detect fatigue, but they are intrusive and uncomfortable for drivers. Vehicle-based methods analyze steering patterns, lane deviations, and speed fluctuations, providing non-intrusive detection, yet they depend heavily on road conditions and driving style.

Vision-based approaches monitor facial features such as eye closure, blinking rate, and head movements, offering real-time and contactless detection. Alerts are generated through audio or vibration signals when fatigue is identified. While these systems have achieved good accuracy, they face several challenges, including poor performance in low-light conditions, occluded or rotated faces, and the need for high computational resources. Additionally, many methods involve expensive hardware, limiting their

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practical deployment. Overall, existing systems provide valuable insights but are not yet fully reliable, cost-effective, or widely applicable.

PROPOSED SYSTEM

The proposed system is a real-time driver drowsiness detection framework that uses computer vision and deep learning techniques. A camera captures the driver's facial video stream, which is processed to detect the face and extract key landmarks, particularly around the eyes. The Eye Aspect Ratio (EAR) is computed to monitor eye closure, while head movement is also analyzed to assess alertness. To improve detection accuracy, a hybrid CNN-LSTM model is employed. The Convolutional Neural Network (CNN) extracts spatial features from individual frames, capturing facial patterns and eye behavior. The Long Short-Term Memory (LSTM) network analyzes temporal sequences, identifying prolonged eye closure or repeated blinking patterns indicative of fatigue.

The system architecture consists of a video input module, face and landmark detection, feature extraction, CNN-LSTM analysis, and an alert generation module. When drowsiness is detected, an audio or visual alert is triggered to warn the driver. The block diagram represents this pipeline, showing the flow from video acquisition to alert output. The architecture ensures real-time performance and is non-intrusive, requiring only a standard camera. It is designed for easy integration into vehicles and can handle variations in lighting and facial orientation. Overall, the proposed system combines advanced deep learning with practical deployment for improved road safety.

SYSTEM ARCHITECTURE

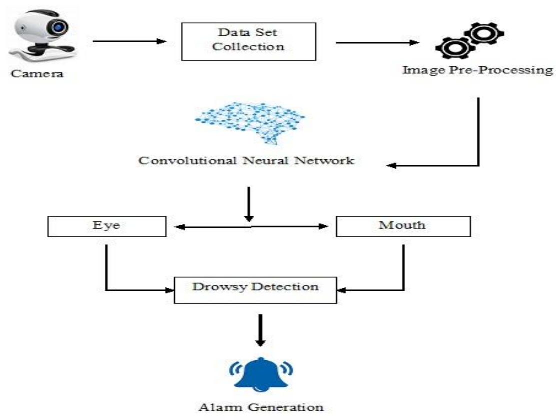

Fig:1 Fatigue Detection System

METHODOLOGY DESCRIPTION

Client Side:

The user interface is handled by the client side, known as the frontend layer. It is created using HTML, CSS, and JavaScript to make the page responsive and interactive. After logging in securely, the

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system activates the camera to continuously capture the driver's facial video and monitor alertness in real time, generating warnings whenever signs of drowsiness are detected.

Api Requests and Responses:

Uses REST-based architecture with defined endpoints and HTTP methods such as GET and POST. Exchanges data in JSON format and applies standard HTTP status codes to ensure clear and reliable communication.

Server Side:

The backend is developed using Python and Flask and follows a layered architecture. Video input from the camera is processed to perform face detection and fatigue analysis using deep learning models. The server handles alert generation and system logic, ensuring secure, scalable, and well-organized processing.

Database/Data Management:

The database layer uses a secure database, like SQLite, to store user credentials, aut hentication information, and driver monit oring records.

Passwords and other sensitive data are enc rypted to improve data security.

Security And User Authentication:

This system uses user authentication to ensure that only authorized users have access to the translation features. Passwords are hashed for security and privacy purposes.

RESULTS AND DISCUSSION

Login Page:

This is the Secure Login Page for The Avoid Accidents by fatigue detection from face recognition system. To access system functions, users must first authenticate using valid credentials. It ensures authorized use and protects user data.

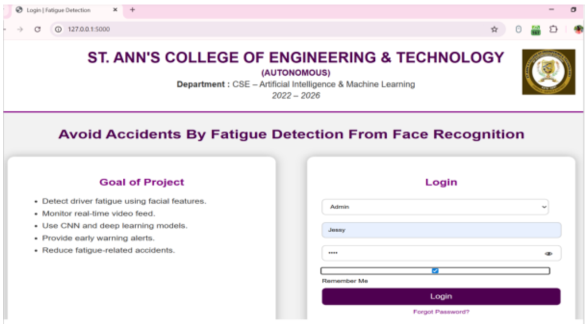

Fig :2 Login Page and Home Page:

After logging in, this interface allows you to select Fatigue Detection Description and Fatigue Detection Using Face.

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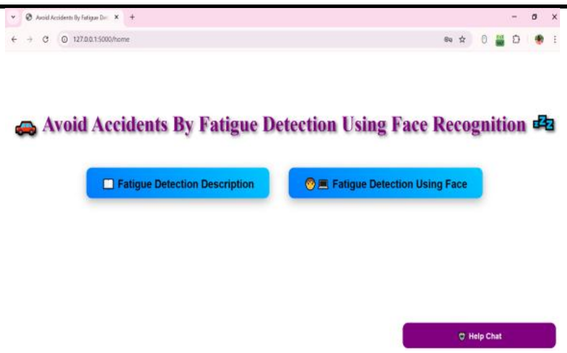

Fig :3 Home Page Chatbot

A simple chatbot is included to help users understand fatigue detection

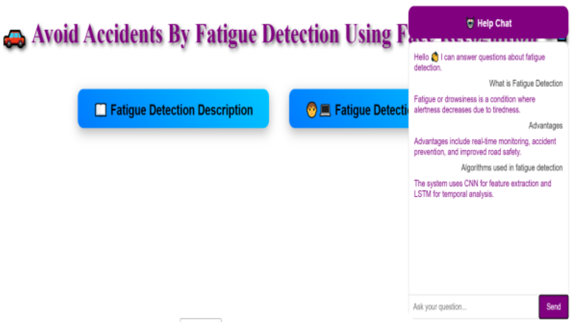

Fig :4 Chatbot Fatigue

Description

The whole explanation, which contains th e Introduction, Motive, Advantages,Concl usion, etc., is displayed when we click on the Fatigue detection description.

Fig 5: Fatigue Description

FATIGUE DETECTION SYSTEM:

Upon selecting the Fatigue Detection Syst em,
Live detection and stored video detection are included on the page.

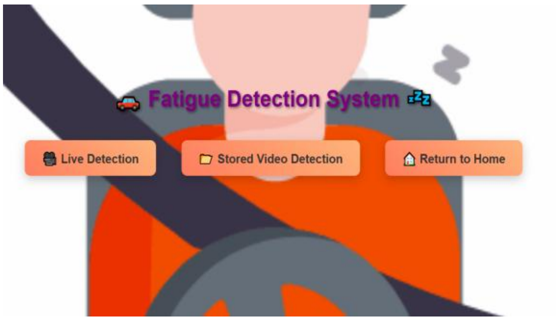

Fig 6: Fatigue Detection System

The system supports both live and archived video detection modes. When the "Live Detection" button is clicked, the system captures a person's face in real time and continuously analyzes it to identify signs of drowsiness. In addition, the "Stored Video Detection" option allows users to upload pre-recorded videos, enabling the system to process and detect drowsiness from previously captured footage.

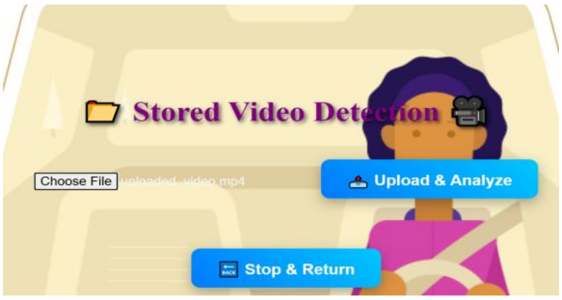

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Fig7: Stored Video Detection Output Page

When the "Stored Video" button is clicked, the user must upload a recorded video for analysis. The system then processes the video to detect signs of drowsiness by analyzing eye movements and facial expressions. If drowsiness is identified, it displays the accuracy of the prediction and alerts the driver through a warning message along with an alarm sound.

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Fig 8: OUTPUT PAGE

CONCLUSION

The deep learning-based Driver Drowsiness Detection System aims to reduce accidents caused by driver fatigue by continuously monitoring signs such as eye closure, yawning, and head movements. It utilizes Convolutional Neural Networks (CNNs), facial landmark detection, and real-time image processing techniques to accurately identify drowsiness. By delivering precise, non-intrusive, and real-time alerts, the system helps promote safer driving conditions. Although challenges such as varying illumination, camera quality limitations, and occasional false positives exist, the study provides a strong foundation for future improvements, including predictive fatigue detection, mobile application integration, and multi-sensor approaches. Overall, this research highlights the significant role of AI in enhancing road safety, preventing accidents, and ultimately saving lives.

FUTURE SCOPE

In the future, the fatigue detection system can be further improved with advanced technologies and additional features. Future developments may focus on enhancing accuracy, integrating multiple detection methods, and adapting to various environments. By leveraging artificial intelligence, multi-sensor detection, and cloud-based analytics, the system can become a more robust solution, helping to reduce fatigue-related accidents and improve overall road safety. and a mobile app. With these tourism, healthcare, and virtual meetings.

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