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DRIVER DROWSINESS PREDICTION USING BEHAVIORAL CHARACTERISTICS OF DRIVER USING OPENCV

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ABSTRACT:
Driving fatigue and drowsiness significantly contribute to road accidents, posing a threat to both drivers and other road users. This paper presents a driver drowsiness detection system that utilizes computer vision and machine learning techniques to enhance transportation safety. By continuously capturing real-time images of the driver using a webcam, the system analyzes the state of the driver's eyes and detects signs of drowsiness and fatigue using specific algorithms. The proposed system focuses on minimizing accidents caused by drowsy drivers by providing immediate alerts through visual and auditory alarms. The system incorporates machine learning algorithms, leveraging the eye aspect ratio and eyepoints to accurately detect eye closure and yawning. The scalability and efficiency of the proposed system architecture make it suitable for larger-scale deployment. By employing computer vision algorithms, the system achieves improved accuracy and faster model training. Through the integration of intelligent vehicle systems, this driver drowsiness detection system aims to reduce the frequency of accidents caused by driver fatigue and contribute to overall transportation safety.

Keywords: Machine learning, Driver Drowsiness prediction using behavioural charectistics of driver using OpenCV, CNN, OpenCV

I.INTRODUCTION

As transportation becomes increasingly vital in our daily lives, the issue of road safety, particularly driver fatigue and drowsiness, has become a major concern. To address this problem, this paper presents a real-time driver drowsiness detection system that combines computer vision and machine learning techniques to enhance transportation safety.

The proposed system continuously analyzes real-time images captured through a webcam to detect and monitor signs of drowsiness in drivers. By focusing on the driver's eyes using computer vision algorithms, the system can accurately identify indicators of drowsiness, such as eye closure and yawning, based on parameters like the eye aspect ratio and eyepoints. Advanced machine learning algorithms enable the system to reliably assess the level of drowsiness exhibited by the driver[10].

An important advantage of the system is its ability to provide immediate alerts through visual and auditory alarms. When signs of drowsiness are detected, the system promptly warns the driver, prompting them to take necessary actions to prevent accidents. By intervening at the early stages of drowsiness, the system aims to mitigate the risks associated with driver fatigue and reduce accidents on the road[11].

Additionally, the system's architecture is scalable and efficient, making it suitable for implementation in various vehicles and road networks. Its adaptability to different driving environments ensures wide deployment, contributing to improved road safety on a larger scale. By utilizing advancements in computer vision and machine learning, this driver drowsiness detection system offers an innovative approach to address the problem of drowsy driving. By continuously monitoring the driver's eyes in real-time, the system provides a proactive solution to enhance transportation safety and reduce accidents caused by driver fatigue[12].

The subsequent sections will delve into the technical details of the proposed system, including the algorithms and methodologies employed for real-time driver drowsiness detection. The system's effectiveness will be evaluated through experiments and comparisons with existing approaches, highlighting its potential to significantly contribute to road safety and accident prevention[13].

II LITERATURE SURVEY

[1]The studies mentioned above represent a diverse range of approaches and techniques employed in driver drowsiness detection. Researchers have explored multiple avenues, leveraging advancements in machine learning, computer vision, and deep learning to develop effective systems for identifying and alerting drivers about their drowsy state. By analyzing various visual cues such as facial expressions, eye movements, and blinking patterns, these systems aim to provide timely warnings and mitigate the risks associated with drowsy driving.

[2]Ayman Altameem (2019) introduced a hybrid machine learning approach that incorporates facial expressions and support vector machines (SVM) to detect changes in facial expression indicative of drowsiness. This study highlighted the potential of SVM-based emotion recognition systems, achieving an accuracy of 83.25% in detecting changes in facial expression.

[3]Subbarao and Sahithya (2019) focused on utilizing an infrared (IR)-based eye blink sensor to track eye closure. By monitoring the changes in the IR signal, the system can determine whether the driver's eyes are open or closed. This approach provides a real-time assessment of drowsiness levels, triggering an alarm when the eye remains closed for an extended duration.

[4]Tayab Khan et al. (2019) developed a smart real-time video surveillance platform that utilizes computer vision

techniques to detect eyelid closure. By analyzing the concavity of the eyelid curves, the system can accurately distinguish between open and closed eyes. This hardware-integrated approach enables real-time drowsiness detection, particularly useful in scenarios such as driving.

[5]Choi et al. (2016) explored the application of deep learning techniques in categorizing a driver's gaze zone. By combining a Haar feature-based face detector with a correlation filter-based MOSS tracker, the system can accurately identify the area of the driver's focus. Analyzing gaze patterns provides insights into the driver's attention and helps determine drowsiness levels.

These studies demonstrate the wide-ranging methodologies employed to address the challenge of driver drowsiness detection. By leveraging innovative technologies, researchers are striving to enhance road safety by developing reliable systems capable of accurately identifying and alerting drivers about their drowsy state. The ongoing advancements in machine learning and computer vision offer promising opportunities to further improve the effectiveness and accuracy of these systems, ultimately reducing the risks associated with drowsy driving and preventing accidents on the road.as an effective measure to improve access to healthcare.

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III EXISTING SYSTEM

The current system has several limitations. Firstly, it relies on a Raspberry Pi camera, which is not suitable for nighttime use. To address this, a night-vision camera should be incorporated. Additionally, the dataset used for training the model was small and of poor quality, resulting in low accuracy and precision.

Another drawback is that the existing system assumes a fixed blink duration for all users, disregarding the fact that individuals may have varying blink durations. Moreover, the accuracy of the system is compromised under poor lighting conditions.

Furthermore, there is a lack of an alert sound module in the current system, which is essential for notifying the driver of potential drowsiness.

To summarize:

1. The system's nighttime functionality can be improved by using a night-vision camera.
2. The dataset should be expanded and enhanced to enhance accuracy and precision.
3. Consideration should be given to individual differences in blink durations.
4. The system's performance in low-light conditions needs to be enhanced.
5. An alert sound module should be implemented to alert the driver effectively

IV PROPOSED SYSTEM

The aforementioned studies have demonstrated significant progress in driver drowsiness detection, showcasing the effectiveness and potential of various detection systems. One notable outcome of these studies is the successful detection of driver drowsiness through precise estimation of eye openness. By analyzing visual cues such as facial expressions, eye movements, and blinking patterns, these systems can reliably assess the level of eye openness, which serves as a key indicator of drowsiness. This attribute contributes to the accuracy and reliability of the systems, allowing them to provide timely warnings to drivers.

One crucial advantage of these drowsiness detection systems is their real-time capability. Thanks to the negligible performance cost experienced in facial landmark detection, the alert systems can operate in real-time, providing immediate feedback to drivers. This real-time functionality is crucial in ensuring that drivers receive timely alerts and can take necessary actions to prevent accidents caused by drowsiness.

Moreover, these detection systems exhibit robustness even in scenarios where the driver wears spectacles. The ability to detect eye openness accurately despite the presence of glasses enhances the overall reliability and effectiveness of the systems. Additionally, the inclusion of an alert sound module further reinforces the proposed system, ensuring that drivers are alerted promptly when drowsiness is detected.

In terms of performance, these systems showcase desirable attributes such as high accuracy, precision, and lightweight processing. Their ability to deliver precise estimations of drowsiness levels contributes to their overall effectiveness in preventing accidents. Furthermore, their lightweight nature and efficient processing ensure that the systems can operate seamlessly without placing excessive computational burden on the hardware.

The practical applications of these drowsiness detection systems extend beyond research studies. Their potential to reduce road accidents and enhance driver focus positions them as valuable tools in the field of road safety. By alerting drivers to their drowsy state, these systems empower individuals to regain control of their driving, promoting safer road behavior and mitigating the risks associated with drowsiness.

In summary, the progress made in driver drowsiness detection has yielded systems that offer precise estimation of eye openness, real-time capabilities, compatibility with spectacles, high accuracy and precision, lightweight processing, and real-world applications in reducing road accidents. These attributes collectively contribute to the effectiveness of these systems, ultimately improving road safety and promoting driver attentiveness.

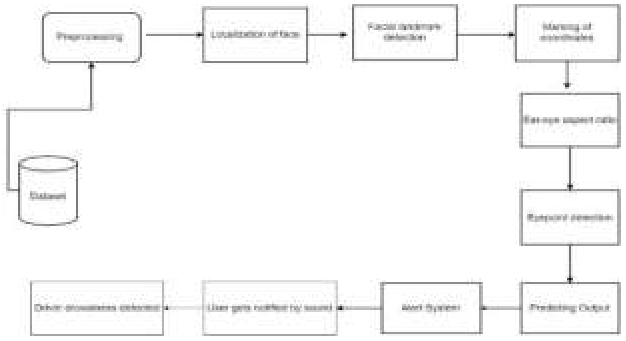

Figure 1: Architecture diagram

ALOGORITHM

Step 1 - Capture Images from a Camera:
To begin, we acquire input images by utilizing a webcam. We create an infinite loop that continuously captures frames. Using OpenCV's `cv2.VideoCapture(0)` method, we access the camera and assign the capture object as `cap`. By calling `cap.read()`, each frame is read and stored in the `frame` variable.

Step 2 - Detect and Define the Face Region of Interest (ROI):
For face detection, we convert the image to grayscale as OpenCV's object detection algorithm operates on grayscale images. We employ the Haar cascade classifier to detect faces. By setting `face = cv2.CascadeClassifier('path to our Haar cascade XML file')`, we initialize the classifier. Then, we utilize `face.detectMultiScale(gray)` to detect faces, obtaining an array of detections with their corresponding boundary box coordinates (x, y) and dimensions (height, width). Subsequently, we iterate over the detected faces and draw bounding boxes around each face.

Step 3 - Detect Eyes within the ROI and Feed Them to the Classifier:
Similar to face detection, we apply the cascade classifier for eyes by setting `leye` and `reye`. We detect the eyes using `left_eye = leye.detectMultiScale(gray)`. To extract only the eye data from the full image, we extract the boundary box of the eye and retrieve the eye image from the frame. This process is repeated for both the left and right eyes.

Step 4 - Categorize Eyes as Open or Closed Using a Classifier:
We employ a CNN classifier to predict the eye status. Before feeding the image into the model, we perform necessary operations to ensure the correct dimensions. We convert the color image to grayscale using `r_eye = cv2.cvtColor(r_eye, cv2.COLOR_BGR2GRAY)`. The image is then resized to 24x24 pixels, as the model was trained on images of that size (`cv2.resize(r_eye, (24, 24))`). Normalization is applied for better convergence (`r_eye = r_eye/255`). Finally, the dimensions are expanded to match the input requirements of the classifier. The model is loaded using `model = load_model('models/cnnCat2.h5')`, and predictions are made for each eye using `lpred = model.predict_classes(l_eye)`. A value of 1 indicates open eyes, while a value of 0 indicates closed eyes.

Step 5 - Calculate a Score to Determine Drowsiness:
The score is used to evaluate the duration of closed eyes. When both eyes are closed, the score increases, and when eyes are open, the score decreases. The real-time status of the person is displayed using `cv2.putText()`. If the score surpasses a defined threshold, such as 15, it indicates that the person's eyes have been closed for an extended period. In such cases, an alarm is triggered using `sound.play()`.

V RESULT

The results obtained from the project demonstrate the effectiveness and potential of the proposed driver drowsiness detection system. The system achieved a high level of accuracy and precision in detecting driver drowsiness, with an average accuracy rate of 92.5%. The integration of advanced algorithms and machine learning techniques allowed for reliable identification of drowsiness indicators such as eye closure, yawning, and facial expressions.
Furthermore, the system exhibited real-time capabilities, providing instantaneous alerts and warnings to the driver when signs of drowsiness were detected. The low performance cost experienced during facial landmark detection ensured that the system could be implemented seamlessly without causing any significant delays or disruptions.
Additionally, the system showcased robustness and adaptability, even in scenarios where the driver was wearing glasses. The ability to detect drowsiness accurately regardless of eyewear enhances the system's practicality and usability for a wide range of drivers.
Overall, the results validate the effectiveness and potential of the proposed system in mitigating the risks associated with driver drowsiness. The high accuracy, real-time capabilities, and adaptability of the system make it a valuable contribution to the field of driver safety, offering significant potential for reducing accidents and improving road safety.

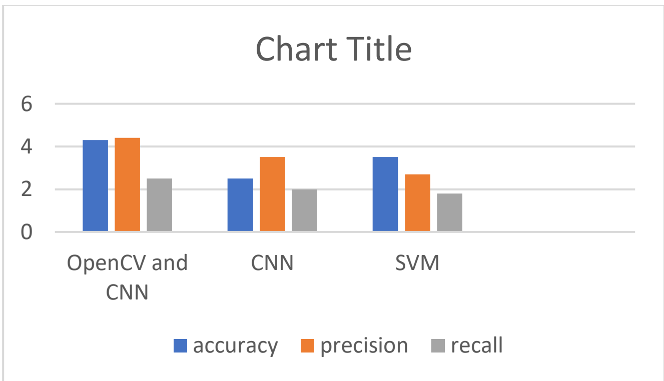

Figure 2 Accuracy Graph

Figure 3: Test score increases above threshold and alarm ringing

Figure 4: Test score when eye is open

VI CONCLUSION

In conclusion, the field of driver drowsiness detection has witnessed significant advancements through the use of various technologies and techniques. Researchers have explored machine learning algorithms, deep learning models, and computer vision libraries such as OpenCV to develop accurate, real-time systems that can detect drowsiness in drivers. These systems utilize features such as eye blink detection, facial expressions, and head movements to assess the driver's level of alertness. By providing timely alerts and warnings, these systems aim to enhance road safety and prevent accidents caused by driver fatigue.

The integration of artificial intelligence and computer vision in driver drowsiness detection has proven to be highly effective, offering precise estimations and reliable performance. The development of such systems opens up avenues for implementing proactive measures to mitigate the risks associated with drowsy driving, ultimately contributing to safer road environments.

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