REAL-TIME IMPLEMENTATION OF KNN-BASED DROWSINESS DETECTION USING JETSON NANO

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Abstract

Abstract— Nowadays, the rate of road accidents due to microsleep has been alarming. During microsleep, people might doze off without realizing it. For many decades, drowsiness detection system for vehicles was not among the major concerns though it turns out as one of imperative features that could have avoid microsleep and thus should be implemented in all vehicles in order to ensure safety of drivers and other vehicles on the road. To the best of our knowledge, enforcements on driving restriction during drowsiness state is yet to be implemented. The absence of such system in the current transportation systems expose drivers to great danger especially at night because accidents are highly likely to happen at night due to drowsy and fatigue drivers. Therefore, this project proposes a real-time drowsiness detection system for vehicles, featuring ignition lock to reduce accidents. An eye blink sensor is embedded in a wearable glasses and heart beat sensor is used to detect drowsiness level of drivers.

Index Terms— Drowsiness detection; eye tracking; blinking; AIML; computer vision; classification;

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Introduction

Accidents involving vehicles on road are becoming unpreventable nowadays. World Health Organization (WHO) once had revealed that over 3400 people die on the world's road every day and billions of people are suffering non-fatal injuries and disabilities as a result of their injuries. Traffic Safety Foundation study found that 37to drowsiness or mircosleep. Accidents could cause fatal injuries and increase mortality rates. According to statistic of Indonesia National Police, from 2007 to 2010, 65human carelessness and human error. For instance, in 2011 during EID festival, a statistic reveals that most of the accidents in that country happened due to drowsiness of drivers (1018 cases) . Studies also shows that most of the accidents around the world are due to drowsiness. Drowsiness is commonly known as tiredness or sleepiness which leads to falling asleep at inappropriate times or situation. Drowsiness causes the driver to loss control on speed or become unaware of obstacles on road and this could end up in fatal accidents. Statistics show that fatal accidents happen every 52 seconds around the world. Driver drowsiness detection is a significant concern for road safety. Drowsy driving is defined as driving when there are symptoms of fatigue, sleepiness, or an inability to maintain alertness. There are several factors underlying the feeling of drowsiness such as a lack of sleep, long driving hours, and monotonous conditions. The eye-blinkingbased method is a promising approach to detect driver drowsiness. This process involves monitoring the pattern and frequency of eye-blinks while driving. Eye-blinks are a good indicator of a driver's level of alertness and are based on the frequency and pattern changes of eye-blinks with respect to the driver's condition. A decrease in the frequency of eye-blinks or an increase in the duration of eye closure can be indicators of driver drowsiness. By monitoring these variable changes, it is possible to determine whether a driver is at risk of falling asleep at the wheel. This information can be captured using various systems and sensor technologies such as in-vehicle cameras or wearable devices to provide real-time monitoring of driver alertness and identify a person's condition. The eye-blinkingbased method is non-intrusive and can be used to detect driver drowsiness.

LITERATURE SURVEY

1) Role of Jetson Nano in Drowsiness Detection : Jetson Nano, developed by NVIDIA, is an edge computing device suitable for deep learning-based applications. Its advantages in drowsiness detection include: Real-Time Processing: Jetson Nano processes video inpu from a camera in real-time, enabling quick response to drowsiness events. Low Power Consumption: Compared to conventional computing systems, Jetson Nano operates efficiently with minimal power usage. Deep Learning Integration: The device supports deep learning frameworks such as TensorFlow, PyTorch, and OpenCV, facilitating the development of robust drowsiness detection models.

2) Infrared (IR) Eye Tracking: IR eye-tracking techniques involve the use of infrared light to illuminate the eyes and a camera to capture the reflection of light in the eyes. IR works by using an infrared light source in the eyes and capturing the reflection using a camera. IR eye tracking is widely used in fields such as psychology, HCI, market research, and gaming. This is because IR eye-tracking techniques are non-intrusive and can be used with a wide range of subjects such as those wearing glasses and contact lenses.

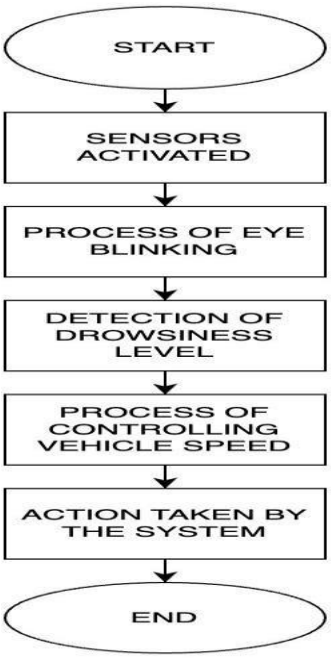
3) Video-Based Eye Tracking: In computer-vision-based eye tracking and eye detection from an input image, localization is considered to be the main area. These two areas are challenging because there are several issues associated with eye detection and tracking such as the degree of eye openness or the variability of eye sizes in target objects. Computervision-based methods use video cameras to capture images of the eyes and analyze them to determine eye movements. Cameras can be set up to track eye

movements in real-time or in laboratory settings. The basic idea of this method is to use image processing techniques to detect and track the position of the pupils in a video stream and then use the acquired information to infer the direction of gaze. Generally, there are two types of video-based eye-tracking systems, remote and wearable. Regarding the remote-tracking type, eye tracking uses a camera placed at a certain distance from the participant and then records their eye movements at the same time.

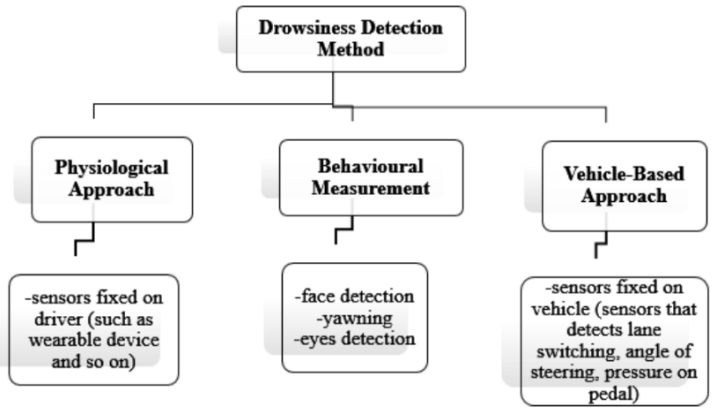
Feature extraction

The term "feature," which is frequently used in applications for image processing, machine learning, deep learning, data mining, and pattern recognition, is best defined as the qualitative aspect of an object. Dimensionality reduction can be achieved through two approaches: feature selection and feature extraction. While feature selection involves choosing relevant features from the original data, feature extraction involves transforming the original data into new features that possess robust pattern recognition capabilities . The process of feature extraction is facilitated by the utilization of the “Dlib” library, a versatile C++ library that encompasses various machine learning techniques, including classification, clustering, and regression . The appropriate features for the grouping models are created based on 68 face iterations, as seen in Figure 2. In this study, the mouth-to- aspect ratio, eyeto-aspect ratio, and mouth-eye-aspect ratio are the featuresthat are taken into account.

ARCHITECTURE

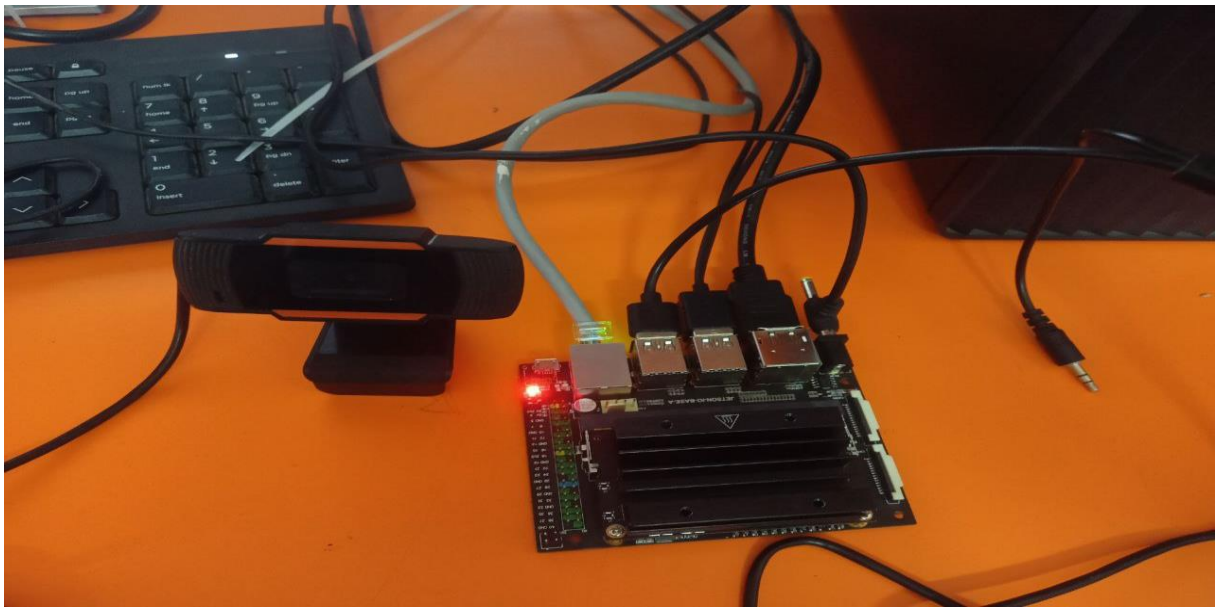


Various techniques to detect drowsiness

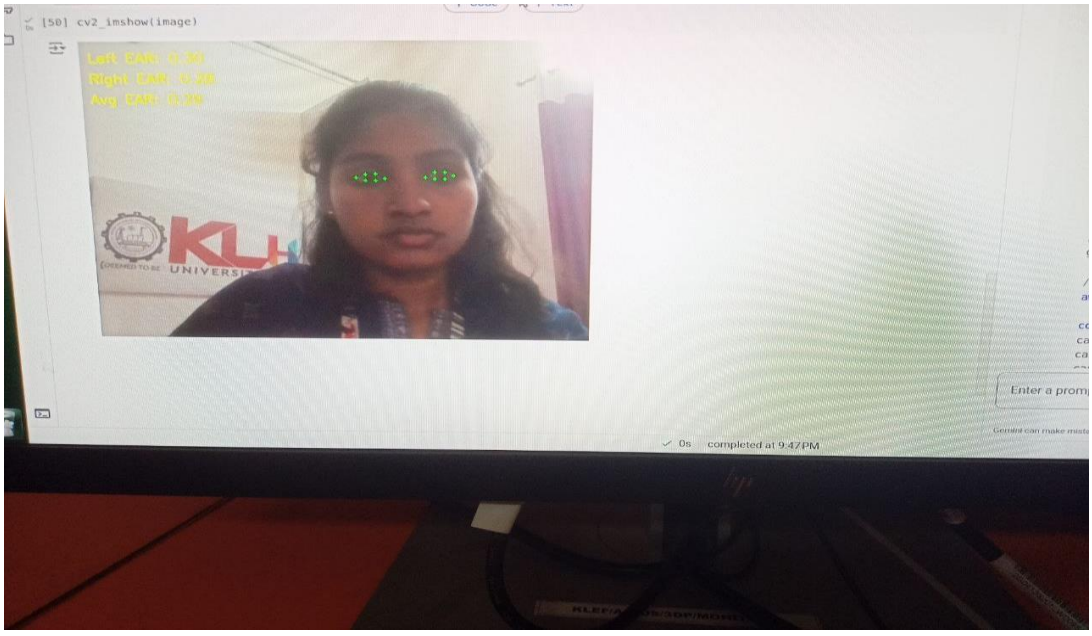


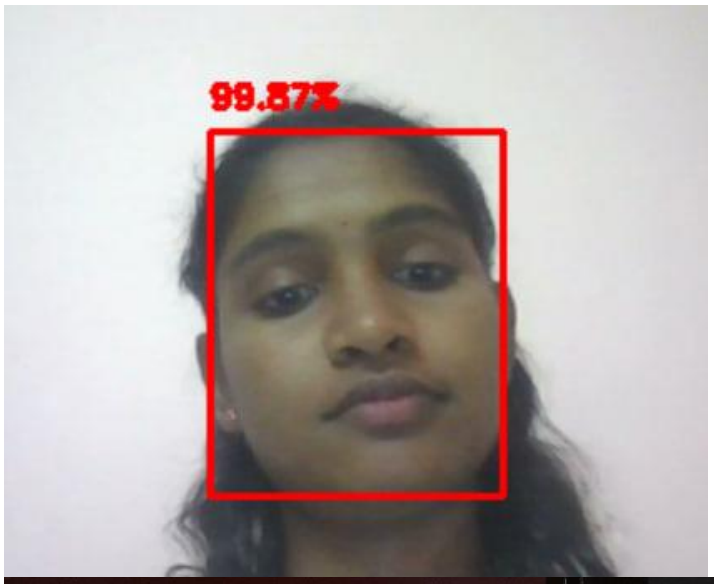
Features of used hardware

	Jetson TX2	*Jetson Nano*	*Hp pavilion*
GPU	NVIDIA Pascal, 256 CUDA cores	NVIDIA Maxwell, 128 CUDA cores	NVIDIA GeForce GTX 1050 Ti
CPU	Dual-core Denver 2 64-bit + Quad-core ARM Cortex-A57 MPCore	Quad-core ARM Cortex-A57 MPCore	Intel(R) Core(TM) i5-8300H CPU
Memory	8 GB 128-bit LPDDR4	4 GB 64-bit LPDDR4	16,0 GB Ram 64-bit
Data storage	32 GB eMMC, SDIO, SATA	MicroSD card	16 GB RAM



Workflow of the proposed method with algorithm application, eye tracking, and distance measurement of eye states between the camera and driver's head location

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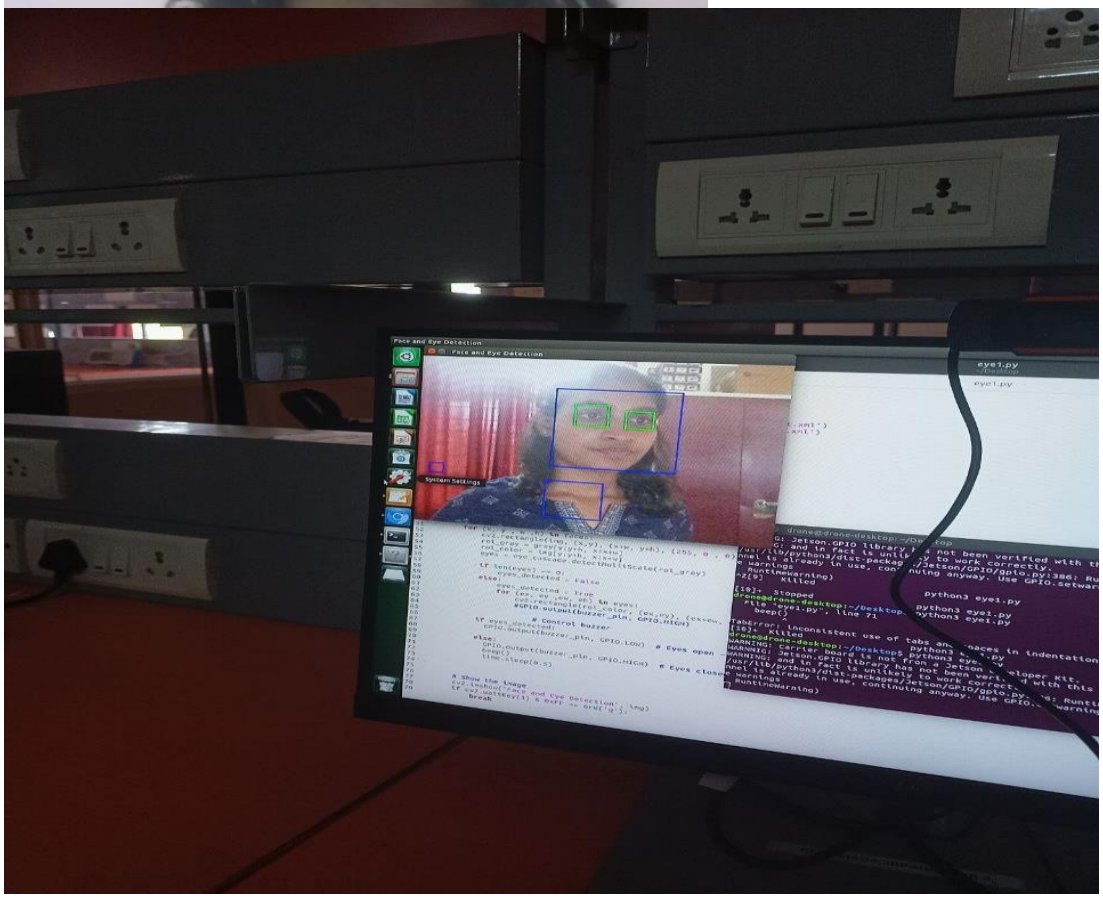
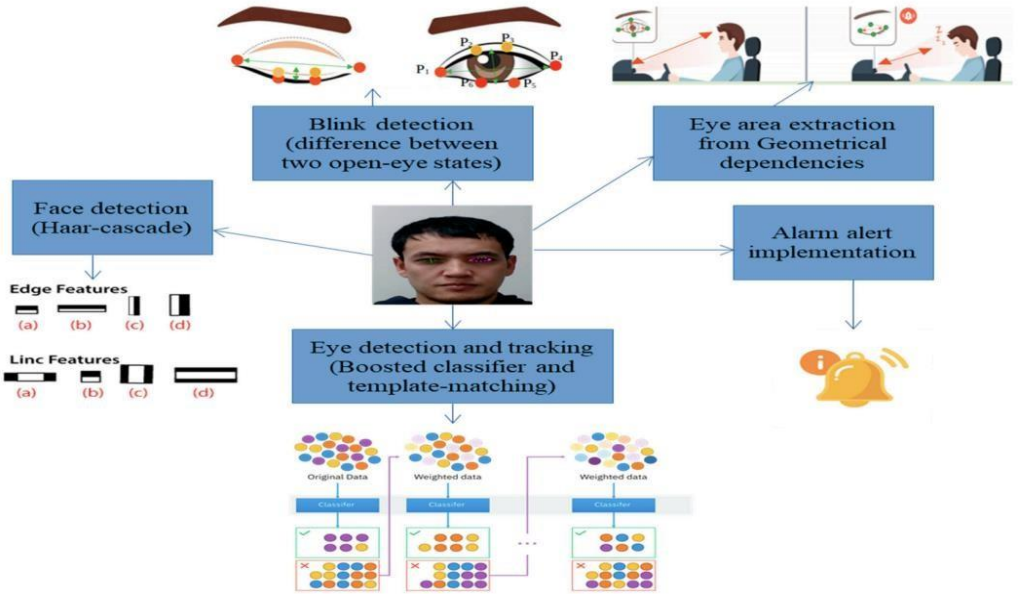

Face and Eye Detection
Face and Eye Detection
System Settings
eye1.py



RESULT

Using a Nvidia Jetson Nano and OpenCV, the suggested system detects weariness in real time. The system's accuracymay be enhanced by fine-tuning the machine learning model with a larger dataset. Also, the model can be trained on other datasets in order to learn more signs of tiredness, thus increasing the accuracy and cutting some of the false positive predictions. To make sure that all false positive predictions are eliminated, the next iteration will be able to connect to a smartwatch that checks the heart rate and blood pressure for a more exact determination. Eye blink sensor is fixed in the wearable device (glasses) of driver and heart beat sensor is attached on driver's finger. The driver must wear the glasses and the heart beat sensor for safety reason. The enforcement to wear these two devices is as important as wearing seat belt in the car. Practically, in real implementation, the eye blink sensor will be embedded in the glasses so that it will not disturb the driver's view. However, for testing purposes, the eye blink sensor is visible in this project. Then, all the sensors are connected to Arduino Mega which receives and verifies all the data from the sensors and sends them to cloud data environment. The microcontroller also sends warning to driver every time when abnormalities or danger is encountered. Upon the last warning, where the driver is considered as sleepy, the GPS module generates the location of driver and a message is sent to their relatives or friends with location details to let them know the status of driver.

CONCLUSION

This paper showed how to develop a weariness detection system with Nvidia Jetson Nano, Raspberry Pi Camera, and Python scripting. The device may find exhaustion and inform the user in cases of excessive degrees of fatigue by assessing a live stream feed of a person's face and the system may be fine-tuned to increase its accuracy, and a graphical user interface can be designed to make it more user-friendly. Using CNN there will be some changes in accuracy and performance. Because the Nvidia Jetson has a reasonable amount of memory and processing power the performance will be unnoticeable, but the accuracy will be much better. Since the algorithm will feed the ROI into the classifier it will enable the system to decide how tired a person is.

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