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Driver Drowsiness System Using Computer Vision

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Abstract – In today's modern world once each different family has vehicle the driver's standing is crucial as a result of one in all the most reasons for motor transport accidents is expounded to driver's basic cognitive process or somnolence. somnolence detector on a automobile will scale back various accidents. Accidents occur due to one moment of negligence, so driver observance system that works in period of time is important. This detector ought to be deployable to associate degree embedded device and perform at high accuracy. during this paper, a unique approach towards period of time somnolence detection supported deep learning which might be enforced on an occasional value embedded board and performs with a high accuracy is planned. Main contribution of our paper is compression of a baseline model deployable to associate degree embedded board.

Key Words **- Drowsiness System, Road Safety, Real-time Deep Neural Network, Model Compression, CNN (Convolutional Neural Network),**

1. INTRODUCTION

Driver sleepiness is one in all the leading causes of motor conveyance accidents. In 2019, 846 fatalities associated with drowsy drivers were recorded in NHTC's reports [1]. These fatalities have remained for the most part consistent across the past decade. There was associate calculable average of eighty-three thousand rashes every year associated with drowsy driving between 2005 and 2009.In lightweight of this incidents, drivers employing a detector which may verify sleepiness is required to scale back such accidents. The alert system will awaken the drowsy driver therefore reducing probability of associate accident. numerous techniques are enforced to live driver sleepiness. The techniques are often generally classified into three classes one. Driving pattern of the vehicle two. Psychophysiological characteristics of drivers three. laptop Vision techniques for driver watching

In the technique, numerous state of the art techniques are enforced supported watching hand-wheel movement [2][3]. a number of the techniques during this cluster target the acceleration or breaking of the automotive in a very statistic, lane departure to work out the extent of sleepiness. The second technique within the class target electrical bio-signals like graph (Electroencephalography), ECG (Electrocardiography) and EOG (Electro-oculogram) [4]. However, the techniques within the 2 antecedently mentioned categories have severe limitations like estimating associate inaccurate output that ends up in spooking a driver regarding the vehicle. the previous category of techniques will solely be employed in sure driving condition and don't seem to be strong in nature, whereas the latter is tough for sensible functions, since it's uncomfortable for the driving force to wear numerous signal measurement tools on the body. Thus, driver watching supported laptop Vision is turning into well-liked. laptop Vision techniques in the main target police investigation eye closure, yawning patterns and also the overall expression of the face. This paper highlights a laptop vision based mostly deep learning approach for driver sleepiness. This detector takes driver's face as input through a camera and classifies the sleepiness behavior into three categories (normal, yawning and drowsy). the largest advantage of the planned model is that the model is compressed sufficiently small that are often deployed on associate embedded board like a Raspberry Pi 3B whereas conserving cheap accuracy (and some video lag). To deploy this driver sleepiness detection system in a very vehicle, a compressed model is desirable. Since someone will doze off at any time, it's extremely necessary to own a time period detection system for sleepiness detection, that consumes low power and might be deployed simply on a vehicle equally with electronic management unit.

2. Related Work

In this chapter, we tend to take a glance at previous approaches on drowsiness detection. so as to boost accuracy and speed of sleepiness detection, varied ways are planned. typical approaches on sleepiness detection are listed below, followed by the most recent approaches victimization deep learning.

2.1 Conventional Approaches for Driver Drowsiness

Driving pattern may be calculated by computing wheel movement or deviation from lane or creative position. tiny changes to the wheel square measure necessary once driving to keep the automobile straight during a given lane. Krajweski et al. [3] achieved associate accuracy of eighty-six percentile in somnolence detection supported correlations between tiny changes and somnolence. within the different case of driving pattern recognition, deviation in lane position is employed. This monitors the car's position with various to the lane and analyze the abnormality [6]. even so, the driving pattern primarily based techniques square measure extremely dependent on on the driving skills, road conditions and vehicle characteristics. The second category of techniques uses information taken from physical sensors, like EEG, EKG and EOG information. graphical record signals contain statistics concerning brain's activity. 3 main signals in graphical record for mensuration driver's somnolence square measure alpha, delta and letter signals. once a driver is drowsy, delta and letter signals spears up, alpha signal growing slightly. this method provides the most effective accuracy among all the 3 ways with over ninetieth accuracy). However, the key disadvantage of this methodology is that the discernment that distracts drivers by bestowing several sensors on the body. Non-intrusive approaches for bio-signals exist, however square measure less correct. The last one is predicated on facial feature extraction using pc Vision, wherever actions like eye closure, head movement, yawning period, stare or countenance are used.

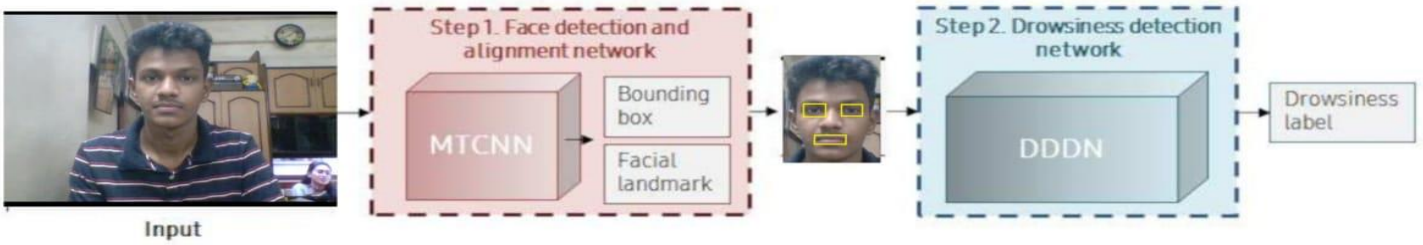
2.2 Drowsiness Detection using Deep Learning

In Recent times, as Machine learning and deep learning are growing earlier throughout the technology community, deep learning is wide wont to resolve tough issues that can't be handled properly exploitation standard strategies. Deep learning supported Convolutional Neural Networks (CNNs) makes a innovation particularly for pc Vision tasks like image classification, object detection, feeling recognition, etc.

2.3 Compression Algorithms of Deep Learning Model

While deep learning is influential on numerous classification tasks, it's AN encumbrance to deploy these algorithms for sensible applications on embedded systems since model size of deep learning is usually large and nice machine complexness is needed. Therefore, within the fashionable years, algorithms to decrease model size and increase speed are planned by mistreatment varied ways in which. Normally, trained networks embrace terminated info, thus a number of weights are often thrown out by applying pruning while not accuracy drop. to scale back model size a lot of, division techniques are oriented like bit-quantization.

In bit-quantization, the smallest amount variety-of-bits area unit utilized for representing info of model whereas decreasing accuracy loss. In a number of researches, they adopted binary networks. even supposing these works have benefits in terms of model size and speed, accuracy cannot be sustained owing to the ease of binary operations.



***Overall framework of drowsiness detection: Step 1 consists of face and landmark detector and step 2 consists of drowsiness detection network from the detected* face**

3. Methodology

This section presents the proposed architecture. The baseline architecture is described.

3.1 Architecture

The complete design of the projected temporary state detection involves 2 phases as exemplified in Figure one. it's a ballroom dancing method within which the primary step is that the joint face detection and alignment and therefore the second is that the temporary state detection model. For the face detection and placement task, Multi-Task Cascaded Convolutional Networks (MTCNN) is employed since it's called one in all the quickest and correct face detector. Exploiting cascaded structure, it is able to do high speed in joint face detection and alignment. As a results of face detection and alignment, face boundary coordinates and 5 landmark points containing locations of left-eye, right-eye, nose, left-lip-end and right-lip-end are obtained.

Driver temporary state Detection (DDD) in second step indicates the projected models for detection driver's temporary state. DDD takes within the output of the primary step (face detection and alignment) as its input.

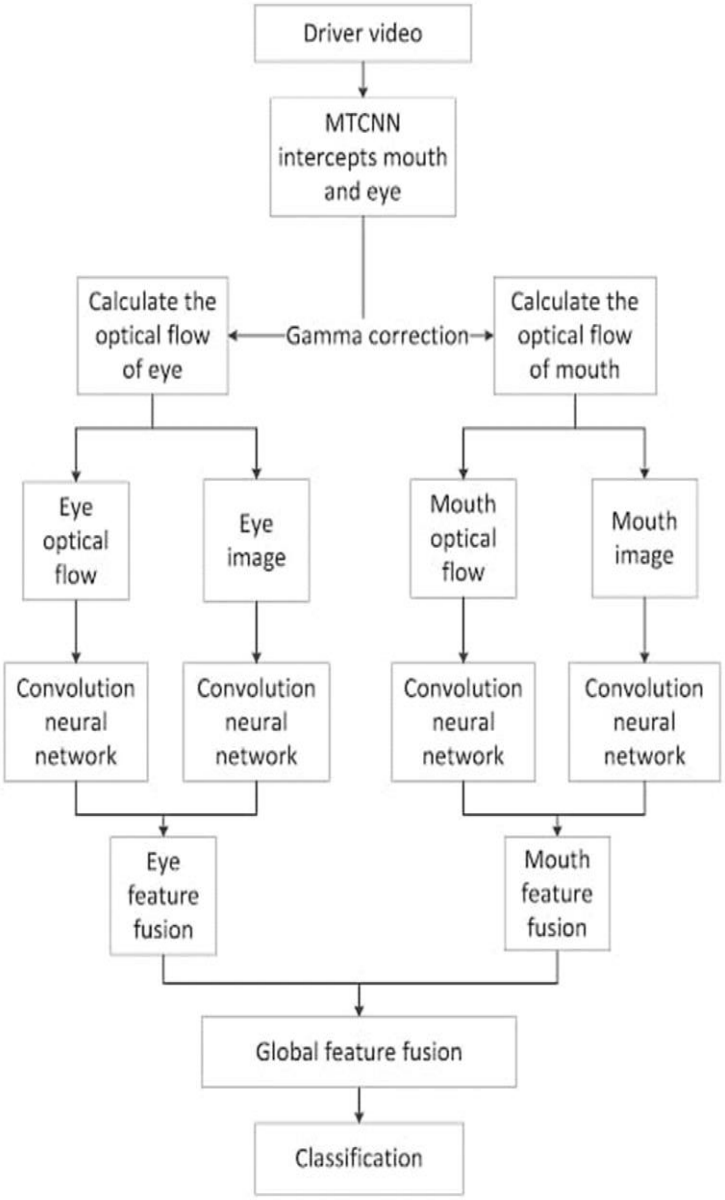
3.2 Model Architecture

The model we used is built with Keras using Convolutional Neural Networks (CNN). A convolutional neural network is a special type of deep neural network which performs extremely well for image classification purposes. A CNN basically consists of an input layer, an output layer and a hidden layer which can have multiple numbers of layers. A convolution operation is performed on these layers using a filter that performs 2D matrix multiplication on the layer and filter. The CNN model architecture consists of the following layers:

- Convolutional layer; 32 nodes, kernel size 3
- Convolutional layer; 32 nodes, kernel size 3
- Convolutional layer; 64 nodes, kernel size 3
- Fully connected layer; 128 nodes

The final layer is also a fully connected layer with 2 nodes. In all the layers, a Relu activation function is used except the output layer in which we used Softmax.

Flow of system



4. Experimental Results

In this section, experimental conditions and results are presented. First, experimental conditions including the dataset and specifications for hardware and software are described. Second, driver drowsiness detection accuracy and execution speed are discussed in detail. We have added some GUI elements using the python-tkinter library for operations on normal desktops.

4.1 Hardware and Software Environments

Owing to the compressed model used for our drowsiness detection system we have set the hardware requirements to a minimal. This system was developed and trained on a machine with a GTX 1650 which has 896 CUDA cores with a base clock speed of 1485 Mhz., It was also tested on Raspberry Pi 3B as an embedded board, it performed satisfactorily.

For software perquisites, one must have python (3.6 or higher) installed on their system with following packages for the program to run effectively:

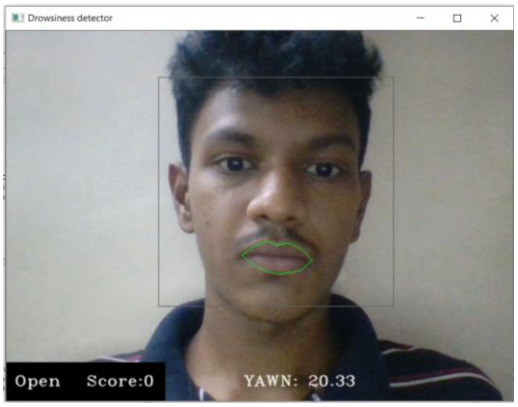
- Keras
- Tensorflow
- Pygame
- OpenCV

4.2 Dataset

The dataset we used for this model is made by us. to make the dataset, we have a tendency to wrote a script that captures eyes from a camera and stores in our native disk. we have a tendency to separated them into their various labels 'Open' or 'Closed'. the info was manually cleansed by removing the unwanted pictures that weren't necessary for building the model. the info contains around 7000 pictures of people's eyes below totally different lighting conditions. when coaching the model on our dataset, we've got hooked up the ultimate weights and model design file "models/cnnCat2.h5".

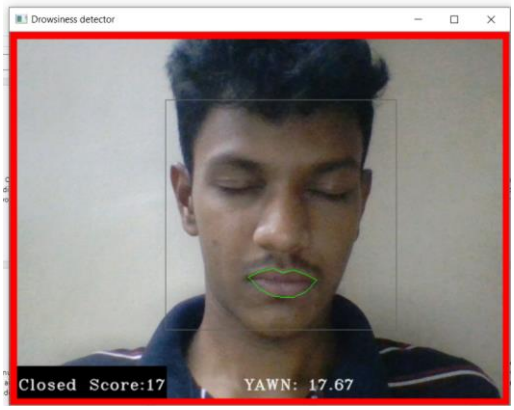
4.3 Results on proposed model

1. **Normal Face Detection**



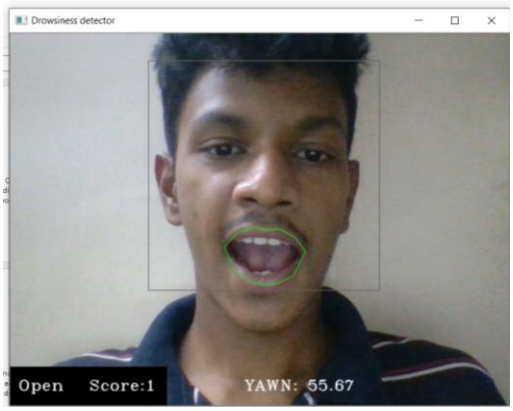
Here, the model predicts that the person neither yawning nor is he feeling drowsy.

2. **Drowsy Eyes Detection**



Here, the model predicts that the person has closed he's for more than 15 frames (threshold) determining that he is sleepy.

3. **Yawning Detection**



Here, the model predicts that even though the person's eyes are open, he is still yawning hence giving an warning.

5. CONCLUSIONS

In this paper, extremely increased deep neural network model for driver's somnolence detection is aimed and compressed for embedded system. The minimum facial landmarks area unit used as inputs to find driver's somnolence and a compression technique is applied to be enforced on time period embedded system. The experimental results below numerous environments supported chance of application for time period driver's somnolence detector. Results indicated that eyes and mouth play the foremost components in somnolence classification. Use of an eye fixed and mouth offers superfluous accuracy of 5% scrutiny thereto of eyes, mouth and face. this could happen once the model tries to be told gratuitous information from face. The results so accomplish that our optimized deep neural networks model will be used for driver's somnolence detection on embedded devices with a high accuracy for safety with Advanced Driver help System (ADAS) and Driver watching System (DMS).

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