DETECTION OF DROWSINESS USING IMAGING PROCESSING

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ABSTRACT:

Drowsiness is one of the main contributing factor in many traffic accidents due to the clear decline in the attention and recognition of danger drivers, diminishing vehicle-handling abilities. A new approach towards automobile safety and security in an autonomous area is primarily expected on the automotive system. To overcome this problem, here is a solution namely the driver drowsiness alert system, which gives an alert by watching each driver's eye movements in real – time environment. In a process of detecting a person falling asleep, a real time eye detection of the person is acquired. The image processing of an eye through mood detection and adjacent to count of heart rate is analyzed over time to identify drowsiness and fatigue situations, and characteristics indicative of the person falling dormant are determined. To determine openings and closings of the eyes, eye aspect ratio is analyzed to determine the width and height of the eyes, mood discernment analysis through Keras algorithm and heart rate diagnosis manoeuvring heart beat sensor.

Keywords– *Automotive system, Drowsiness, Image Processing, Keras, Mood detection*

1. INTRODUCTION

1.1 Digital Image Processing - An image may be defined as a two-dimensional function, $f(x, y)$, where x and y are *spatial* (plane) coordinates, and the amplitude of 'f' at any pair of coordinates (x, y) is called the *intensity* or *gray level* of the image at that point. When x, y, and the intensity values of f are all finite, discrete quantities, we call the image a *digital image*. The field of *digital image processing* refers to processing digital images by means of a digital computer.A digital image is composed of a finite number of elements,each of which has a particular location and value certainly called as picture elements, image elements, pels, and pixels.Vision, the most advanced of our senses, is not surprising that images play the single most important role in human perception. However, unlike humans, limited to the visual band of the electromagnetic (EM) spectrum, imaging machines cover almost the entire EM spectrum, ranging from gamma to radio waves. They can operate on images generated by sources that humans are not accustomed to associating with images. These include ultrasound, electron microscopy, and computer-generated images. Thus, digital image processing encompasses a wide and varied field of applications.

1.2 Detection of Drowsiness - Drowsiness detection is a car safety technology which helps prevent accidents caused by the driver getting drowsy. Various studies have suggested that around 20% of all road accidents are fatigue-related, up to 50% on certain roads. It is well known that a significant number of highway accidents result from drivers becoming drowsy or falling asleep, which results in many deaths and injuries. A number of different physical criteria may be used to establish when a person is drowsy, including a change in the duration and interval of eye blinking.Normally, the duration

of bilking is about 100 to 200 ms when awake and about 500 to 800 ms when drowsy. The time interval between successive blinks is generally constant while awake, but varies within a relatively broad range when drowsy.Numerous devices have been proposed to detect drowsiness of drivers.

1. devices that detect movement of the head of the driver, e.g., tilting
2. devices that detect a physiological change in the driver, e.g., altered heartbeat or breathing
3. device that detect a physical result of the driver falling asleep, e.g., a reduced grip of the steering wheel.

1.3 Objective - The focus is on designing a system that will accurately monitor the eye movements of a driver, surveil the face detection to keep a mood track and manoeuver the heart rate in real-time. By monitoring the movements, the symptoms of driver fatigue can be detected early enough to avoid a car accident. To develop a drowsiness & physical fitness detection system while driving**.**

1.4 Motivation - A new approach towards automobile safety and security in an autonomous area is primarily expected on the automotive system. Nowadays, an automobile drowsy driving accident along with emotional traumatic situations has been increased. Driver fatigue is a significant factor in a large number of vehicle accidents. To overcome this problem, here is a project solution namely the driver alert system, which gives an alert by watching each driver's eye movements with mood detection and heart rate maneuvering in real – time environment**.**

1.5 Scope - A real time system for monitoring and detecting the loss of attention in automotive drivers will be adapted, where the eye retina and face of the driver will be image processed and warning alert will be given within minimum recurring time to the driver to avoid real time crashes. Also a System can be designed for dense regions and for low temperature regions and a Mobile Application can also be developed.

2. PROJECT TERMINOLOGY

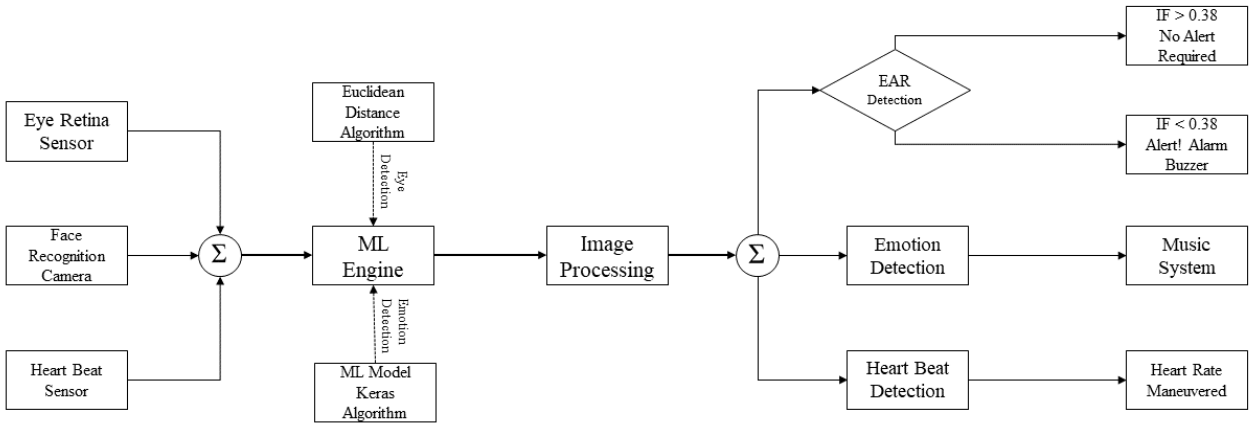


Fig – System Block Diagram

We have designed a system which is used to scan eye movements to monitor driver's fatigue condition that will help to capture the real time eye coordinate values to avoid accidents, along with it a face recognition camera to detect mood of driver that will balance the driver's mind and avoid the traumatic situations and a heartbeat sensor to maneuver continuous heart rate of driver so as to keep record of driver's fitness using image processing.

3. METHODS FOR ANALYSIS

3.1 Initial considerations for mobile deployment

This section provides considerations for implementation of a drowsiness detection model on mobile or in- vehicle devices. For safety-critical applications, it is important that the real-time assessment is timely. The task requirements for such a system, which will be discussed below, include

(1) the collection of frames, (2) pre-processing recorded information, (3) model inference and (4) results processing. The duration of the modelled action is therefore an important consideration. However, capturing more frames than strictly necessary will hinder real-time detection, as both video recording time and model inference time increase. Hence, it is important to understand the duration of symptoms related to driver drowsiness to maximize detection accuracy [1]. In this research, we capture ten frames at a frame rate of 30 frames per second (fps), leading to 333 ms of video recording.

3.2 Data

An Academic Driver Drowsiness Detection (DDD) dataset was used, first introduced during the 2016 Asian Conference on Computer Vision. Videos were recorded at a 480 *640 resolutions with a frame rate of 30 and 15 fps for day and night videos, respectively. For each subject, videos were recorded in a controlled setting in five conditions: (1) without glasses, (2) with glasses, (3) with sunglasses, (4) without glasses at night and (5) with glasses at night. Simulated behaviors include yawning, nodding,

looking aside, talking, laughing, closing eyes and regular driving; video segments have been labelled as drowsy or non-drowsy. For this study, the training dataset is used for model calibration (a total of 8.5 h of video), the evaluation dataset for validation purposes (1.5 h of video), while the testing dataset is not used. First, night videos were converted from 15 to 30 fps to match the frame rate of the other videos in the dataset. Videos are then resized from 480 * 640 to 240 * 320 to reduce pre-processing time during training and disc space. Using Python v3.6.1 and Tensor Flow r1.4 [2], which provides optimizations for mobile inference, the video files are split into 100-frame sequences for training and 10-frame sequences for validation.

3.3 Pre-processing

Since the DDD dataset contains a limited amount of training data, several on-the-fly pre-processing steps were implemented to increase the variety of samples supplied to the neural network during training. These pre-processing steps are tailored to the issue of drowsiness detection and increase robustness of the model when applied in a real world setting [3].

3.4 Model Calibration

All models are pre-trained on the ImageNet dataset, improving the capacity to process spatial information. Video-based models may need additional pre-training for processing temporal information, as activity prediction can be more challenging than image recognition, since videos also include variations in motion and viewpoints [4].

3.5 Phone Application

Faster inference speed and a smaller memory footprint were achieved by integrating the temporal dimension in the first few layers of the neural network. Further, operations not required for inference were stripped from the network and model weights were frozen [5]. The resulting model was deployed as an Android phone application using Android Studio, Tensor Flow and Bazel (i.e. Google's open-source build tool). The application uses several parallel threads to (1) store an up-to-date stack of the latest ten frames of the front-facing camera, (2) perform inference using the trained model and (3) process inference results towarn a drowsy driver.

4. PROJECT EXECUTION

4.1 Hardware – The Hardware's used for the designed system are as follows

4.1.1 Face Recognition Camera -A facial recognition system is a technology capable of matching a human face from a digital image or a video frame against a database of faces, typically employed to authenticate users which works by pinpointing and measuring facial features from a given image. Initially a form of computer application, facial recognition systems have been largely used in recent times on smartphones and in other forms of technology, such as robotics, since computerized facial recognition involves the measurement of a human's physiological characteristics facial recognition systems called as biometrics.

4.1.2 Retina Sensor - A retinal scan is a biometric technique that uses unique patterns on a person's retina blood vessels. It is not to be confused with other ocular-based technologies: iris recognition, commonly called an "iris scan", and eye vein verification that uses scleral veins.

4.1.3 Heart Beat Sensor -A heart rate sensor measures pulse waves, which are changes in the volume of a blood vessel that occur when the heart pumps blood. Pulse waves are detected by measuring the change in volume using an optical sensor and LED

4.2 Software – Python 2.7, OpenCV libraries, Pycharm –

- Python is an interpreted, high-level and general-purpose programming language. Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.
- OpenCV-Python is a library of Python bindings designed to solve computer vision problems. OpenCV-Python makes use of Numpy, which is a highly optimized library for numerical operations with a MATLAB-style syntax. All the OpenCV array structures are converted to and from Numpy arrays.
- Pycharm, an integrated development environment used in computer programming, specifically for the Python language.

4.3 Algorithm for Analysis -

4.3.1 Euclidean Distance in Image Processing –The Euclidean distance is the straight-line distance between two pixels. The city block distance metric measures the path between the pixels based on a 4-connected neighborhood. Pixels whose edges touch are 1 unit apart; pixels diagonally touching are 2 units apart.

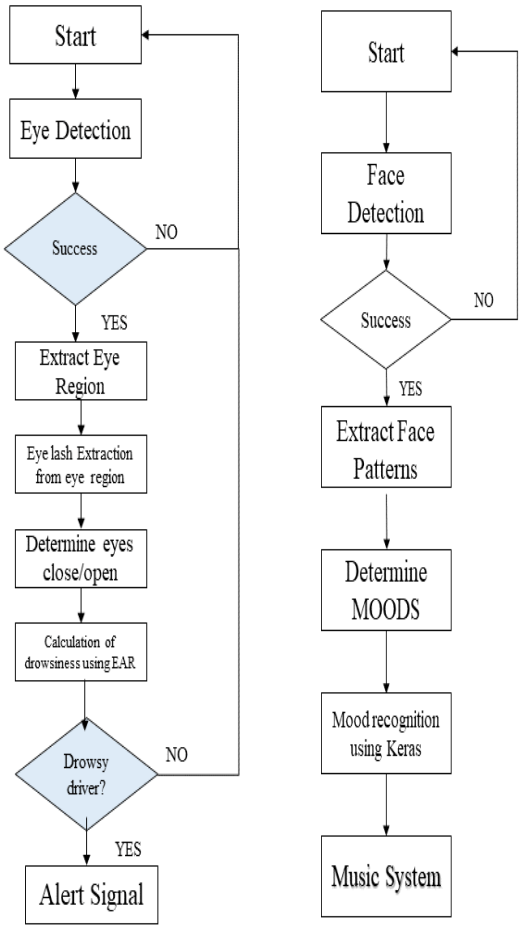
Eye Aspect Ratio -The Eye Aspect Ratio is an estimate of the eye opening state.

$$\mathrm{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

4.3.2Keras Algorithm - Keras is a powerful and easy-to-use free open source Python library for developing and evaluating deep learning models.It wraps the efficient numerical computation libraries Theano and TensorFlow and allows you to define and train neural network models.

4.4 System Flowcharts –

4.4.1 EAR and Mood Detection –



5. PROPOSED METHOD

The focus is on designing a system that will accurately monitor the eye movements of a driver in real-time. By monitoring the movements, the symptoms of driver fatigue can be detected early enough to avoid a car accident. The pivot is to balance the mood state of driver during journey so as to avoid the traumatic situations. By detecting the mood patterns a music system will be played so as to keep the drivers mind stable. A heart beat sensor to maneuver the heart rate of driver. To develop a drowsiness & physical fitness detection system while driving.

6. CONCLUSION

A real time system for monitoring and detecting the loss of attention in automotive drivers has been presented, where the eye retina of the driver has been image processed using EAR and warning alert is given within minimum recurring time to the driver to avoid real time crashes. Also a mood detection module has been developed where the drivers mind will be balanced to avoid the traumatic situations

by playing a suitable music in the background using Keras algorithm. A heart beat sensor is used to maneuver the heart rate of driver to determine the physical fitness throughout the journey.

Advantages -

1. Detects drowsiness and decrease in road accidents
2. Less recurring time
3. Efficient and an offline system

Disadvantages -

1. One having EAR < 0.38 (i.e. nepali people) less efficient for them
2. Not much efficient for one wearing bold/thick eye frames

Future Scope –

1. System can be designed for dense regions and for low temperature regions
2. Mobile Application

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