

REAL TIME SLEEP/DROWSINESS DETECTION USING FACE RECOGNITION

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ABSTRACT

Drowsiness Detection is favorite topic of researchers in recent years because it is cause of many road accidents. It can also help in detecting the need of rest. When drivers drive for long time then they feel fatigue which can effect on their driving and can cause of death and injury in road accidents. The reason of fatigue can be long drive, feeling sick, headache, drink and drugs etc.

This research will play an important role in driver's life and can save their life. In this paper, I introduced an Android application which can detect the drowsiness state, normal state and number of times eye blinking. This application will alert the driver in drowsy state and can save the driver's life. The application will give the information of five things: percentage of normal state, drowsy state, number of times eye blinking, number of times yawning and number of frame captured by application camera. It will take login information and then give the information and alert the driver when he is in drowsy state.

Keyword: Drowsiness, Machine Learning, Android Application.

INTRODUCTION

Drowsiness is a kind of fatigue. When driver is in sleepy state then they lose the control of vehicle which can cause of dangerous accident. The main idea behind this research is to find the drowsy state of person and will alert the person time-to-time. The main reason behind the sleepy state can be fatigue of long drive, feeling sick, headache, drink and drugs etc. There are so many road accidents happened in every year and the main reason of these accidents are fatigue. So, it becomes mandatory to make system or applications like this which can alert the driver.

To avoid the road accidents by drowsiness, I introduced an Android application in this research paper. There are so many researches on drowsiness detection which I discussed in literature review. This application is mainly for drivers and can be used by everyone. This application will provide accurate and fast results. The machine Learning is used to make this research successful.

The paper has four sections. The 2 section is about literature review which discusses the recent research paper on this topic. The 3 section discuss methodology and proposed algorithm. Section 4 describes the conclusion and future work.

LITERATURE REVIEW

In this literature review section, we discuss various methodologies that have been proposed by researchers for real time drowsiness detection and eye blinking detection during the recent years. The techniques which researchers used are also discussed in this section.

Amna Rahman in 2015, proposed a method for “Real time Drowsiness Detection using eye blink monitoring”. In this method, the Haar-cascade classifier is used for face detection which collects the rectangular features. Then the best features choose from all the features by weak learning algorithm. Again, Haar cascade classifier algorithm is used to detect features that are related to eyes from all the features. First, Images are converted into gray-scale then the corner is detected by eye blink detection algorithm which uses two eye corner points and one is at lower eye lid. Harris corner detection is used to detect these points. The calculation of midpoint between corners and then calculate the distance ‘d’ of midpoint from the point at lower eyelid. This distance ‘d’ clarifies that eyes are open or closed. They also detect the intervals to know that the driver/person is drowsy or not.

B. Mohana in 2015 has proposed a method of “Drowsiness Detection based on Eye closure and yawning detection”. In this research, they use haar feature based cascade classifiers and facial landmark detection. The eye’s state detected by EAR and yawning state detected by lip’s distance. These can detect the drowsiness state by number off times eye blinked and mouth’s opening.

Roshan Shantaran Tavhare in 2019 has proposed a method of “Real time/sleep/Drowsiness Detection”. In this research, first they extract frames from images and convert it to gray scale. They apply facial landmark detector for face and eye region. The eye’s open or close state is determined by Eye State Ratio (EAR) calculation and compare with threshold. It will alert when driver or person is in drowsy state.

METHODOLOGY

There are different types of methodologies to detect drowsiness:

- **Physiological based measures:** There are physiological signals to detect drowsiness: heart rate, pulse rate, electrocardiogram (ECG), electromyogram (EMG), electroencephalogram (EEG) and electrooculogram (EOG). Some researchers have used these EOG to identify driver drowsiness through eye movements.
- **Behavioral based measures:** The behavior of the driver including yawning, eye blinking, head pose, tip of nose etc is captured by a camera and the driver is alerted if any of these drowsiness symptoms are detected.
- **Vehicle based measures:** The speed of vehicles, movement of steering wheel, pressure on pedal, closeness of vehicle with other vehicles are constantly monitored and any changes in these metrics that crosses a threshold indicates that driver is in drowsy state.

There are techniques that can be used to detect drowsiness

- **Machine Learning:** machine learning is an application of AI that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it to learn from themselves.
- **OpenCV (Open Source Computer Vision Library):** It is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. The library has more than 2500 optimized algorithms, which include a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human action in videos etc.
- **Dlib:** dlib is an open source C++ library implementing a variety of machine learning algorithms, including classifications, regression, clustering, data transformation and structure prediction.

Algorithms of Dlib:

- SVM
- K-Means clustering
- Bayesian Networks etc.

This section provide the detail of research algorithm

The algorithm has 6 stages:

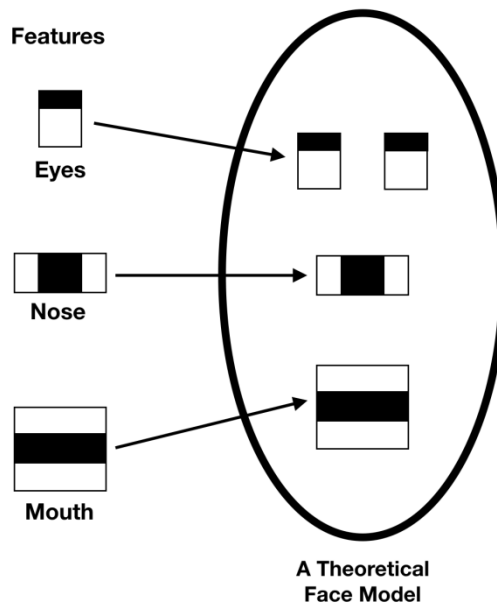
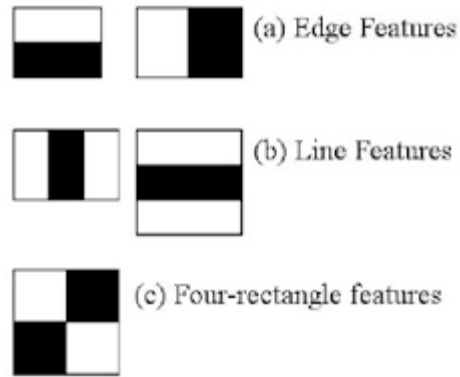
1. Pre-Processing :

The video is captured by camera of Android Phone. The focused will be on driver/person's face.

2. Face detection:

The face is detected by haar cascade classifier algorithm presented by Paul Viola and Michael Jones in their research paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. This algorithm is based on the Haar wavelet technique to analyze pixels in the image into squares by function. It is based on Viola-Jones detection algorithm which is trained in given some input faces and non-faces and training a classifier that identifies a face. This algorithm makes the face detection easy and fast. It will take the rectangular features from the camera. The rectangular box is set of pixels. There can be facial and non-facial features. So, we have to extract these features to detect the face.

We can extract best features by using Adaboost. It is used to boost the performance of any machine learning algorithm. It is used with weak learners. These are models that achieve accuracy just above random chance on a classification problem. It uses the weak learning algorithm. There can be non-facial features. So, it will reject these negative images and positive images or facial features will be extracted from all these features.



3. Eye Detection:

In this research paper, the eyes can be localized by using Dlib python library which contains landmark facial detector. Facial landmark detection is the process of finding points of interest in an image of a human face. It has 68 facial landmark coordinates.

Facial landmark are used to localize:

- Eyes
- Mouth
- Eyebrows

- Nose



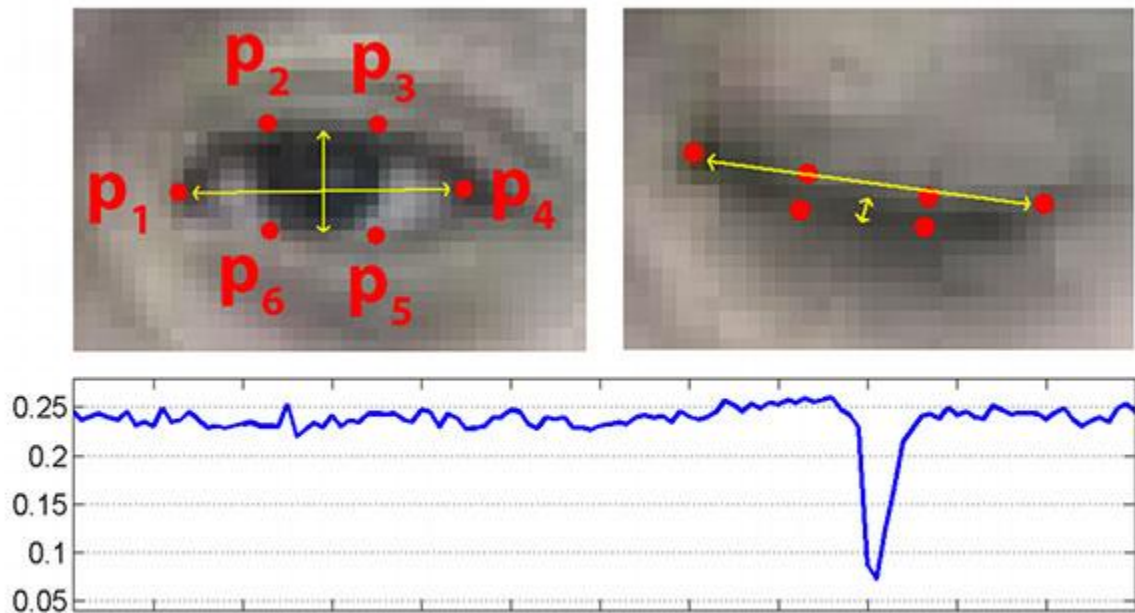
We can detect both right eye and left eye using this technique.

4. Eye closure detection:

Eye Aspected Ratio (EAR) is parameter which is used to check the eye's state whether it is open or closed. It is an estimate of the eye opening state. It is constant value when the eye is open but rapidly falls to 0 when the eye is closed. A program can determine if a person's eyes are closed if the Eye Aspected Ratio falls below a certain threshold

$$EAR = \frac{\|p2-p6\| + \|p3-p5\|}{2\|p1-p4\|}$$

Where, p1.....p6 are the eye 's landmark location. The distance between these points determine the eye's state. If the value of EAR is close to zero, it means eyes are closed. Otherwise, it is open. It can check EAR for only one eye, because our both eyes blinking together.



5. Yawn detection:

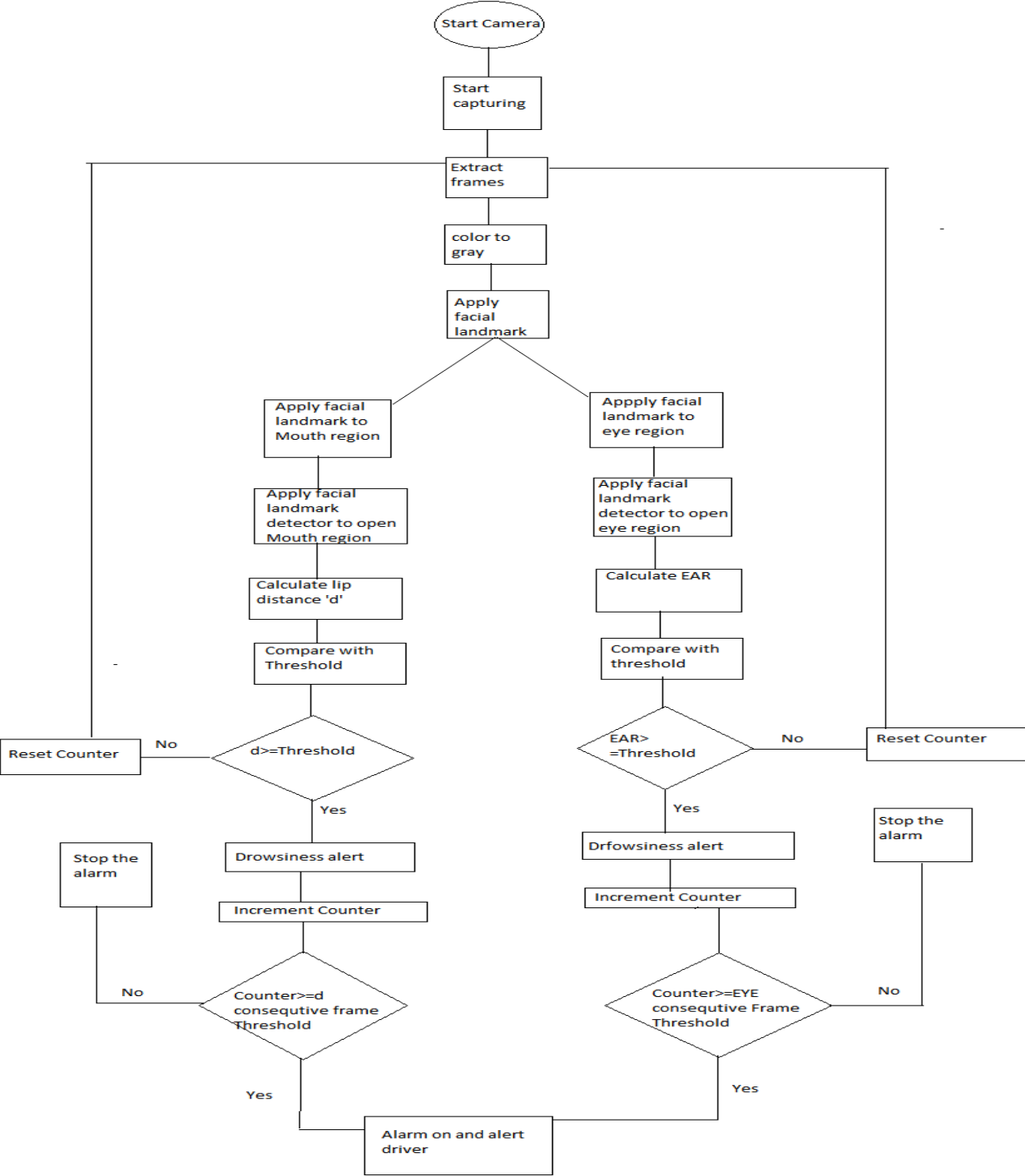
Like eye closure detection, we can detect the state of mouth whether it is open or not. The lip distance can determine the state of mouth. If the lip distance 'd' is greater than threshold then it means it is yawning. The yawning can help in detection of drowsiness state.

6. Drowsiness Detection:

If eyes are closed then it is sign of drowsiness but it will check at particular duration. The average blink duration of a person is 100-400 milliecond. If person's eyes are closed beyond this interval then it will be drowsy state. The all values can be calculated of only one eye because our both eyes blinking at same time.

The person yawned more than the boundary value then it will drowsy state because small opening of mouth can be result of talking and eating. The duration will also consider. Then the driver alerted in drowsy state and will take information from application of number of times eye blinking, number of times yawning, drowsy state value in percentage and normal state value in percentage.

MODELING DIAGRAM (FLOWCHART)



CONCLUSION

A Real time Drowsiness Detection using face recognition is presented. The proposed research detects the drowsiness state using eye's state and mouth opening (yawning). In this research, I used Haar based cascade classifier and delib's facial landmark which determine facial feature, level of eye open and level of mouth opens. This technique will provide accurate and fast results.

Future work:

- This research can also be extended for aero planes and pilots.
- The Application can be update for new features like head knobbing etc.
- This Application is only for Android Phones and can make for IOS.
- Other AI techniques can be applied for better results.

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