A Project Report on

Driver Drowsiness And Alert System

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Engineering

in

Information Technology

by

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Approval Sheet

This Project Report entitled ***"DRIVER DROWSINESS AND ALERT SYSTEM"*** Submitted by ***"Saylee Patne"(16104021), "Riya Sangal"(16104014), "Yashashree Gore"(17204009),*** is approved for the partial fulfillment of the requirenment for the award of the degree of ***Bachelor of Engineering*** in ***Information Technology*** from ***University of Mumbai***.

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CERTIFICATE

This is to certify that the project entitled ***"Driver Drowsiness and alert System"*** submitted by ***"Saylee Patne" (16104021),"Riya Sangal" (16104014),"Yashashree Gore" (17204009),*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Information Technology.***,to the University of Mumbai,is a bonafide work carried out during academic year 2017-2018.

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

Drowsy driving is one of the major cause for road accidents. Hence, detection of drivers fatigue and its indication is an active research area. Therefore, in this study, a low cost, real time drivers drowsiness detection system is developed with acceptable accuracy. In the developed system, a front camera of drivers cell phone records the video and drivers face is detected. For this purpose, eyes, nose and mouth are detected to improve the area of interest using Viola-Jones Algorithm. Then, Histogram Equalization is performed for detection at night driving. Using OpenCv Library with Android is the best choice when it comes to face detection for better performance of Real Time Image processing.The images will be stored on cloud. Using SVM (Support Vector Machine), similarities and dissimilarities between the facial images of same person are verified with the stored images. When the drowsiness is detected, then the driver is alerted by audio.

Contents

Chapter 1

Introduction

Drowsy driving is one of the major causes of deaths occurring in road accidents. The truck drivers who drive for continuous long hours (especially at night), bus drivers of long-distance route or overnight buses are more susceptible to this problem. Driver drowsiness is an overcast nightmare to passengers in every country. Every year, a large number of injuries and deaths occur due to fatigue related road accidents. Hence, detection of drivers fatigue and its indication is an active area of research due to its immense practical applicability. The basic drowsiness detection system has three blocks/modules; acquisition system, processing system and warning system. Here, the video of the drivers frontal face is captured in acquisition system and transferred to the processing block where it is processed online to detect drowsiness. If drowsiness is detected, a warning or alarm is sent to the driver from the warning system. Generally, the methods to detect drowsy drivers are classified in three types; vehicle based, behavioural based and physiological based. In vehicle-based method, a number of metrics like steering wheel movement, accelerator or brake pattern, vehicle speed, lateral acceleration, deviations from lane position etc. are monitored continuously. Detection of any abnormal change in these values is considered as driver drowsiness. This is a non-intrusive measurement as the sensors are not attached on the driver. In behavioural based method, the visual behaviour of the driver i.e., eye blinking, eye closing, yawn, head bending etc. are analysed to detect drowsiness. This is also non-intrusive measurement as simple camera is used to detect these features. In physiological based method, the physiological signals like Electrocardiogram (ECG), Electrooculogram (EOG), Electroencephalogram (EEG), heartbeat, pulse rate etc. are monitored and from these metrics, drowsiness or fatigue level is detected. This is intrusive measurement as the sensors are attached on the driver which will distract the driver. Depending on the sensors used in the system, system cost as well as size will increase. However, inclusion of more parameters/features will increase the accuracy of the system to a certain extent. These factors motivate us to develop a low-cost, real time drivers drowsiness detection system with acceptable accuracy. Hence, we have proposed a front-camera based system to detect drivers fatigue from the face image only using Viola Jones algorithm and HOG algorithm for night vision.

Objective

- It can be used for the safety of driver while driving which reduces accidents and detects drowsiness of the driver.

- To generate alerts to the driver by playing loud music.

- To capture video and detect drowsiness.

- To enhance the safety of the driver.

- To monitor driver fatigue and alert him when drowsiness situation is detected.

- To monitor driver attentiveness by ensuring hes keeping his eyes on the road.

Chapter 2

Literature Review

The papers referred to while developing the system are mentioned below.

1. Paper Title: Driver Drowsiness Monitoring System using Visual Behaviour and Machine Learning.

Authors: Ashish Kumar and Rusha Patra

Publication: 2018 IEEE

Description: In the developed system, a webcam records the video and drivers face is detected in each frame employing image processing techniques. The video is recorded using webcam (Sony CMU-BR300) and the frames are extracted and processed in a laptop. After extracting the frames, image processing techniques are applied on these 2D images. Presently, synthetic driver data has been generated. The volunteers are asked to look at the webcam with intermittent eye blinking, eye closing, yawning and head bending. The video is captured for 30 minutes duration. After extracting the frames, first the human faces are detected. Numerous online face detection algorithms are there. In this study, histogram of oriented gradients (HOG) and linear SVM method [10] is used. In this method, positive samples of fixed window size are taken from the images and HOG descriptors are computed on them. Subsequently, negative samples (samples that do not contain the required object to be detected i.e., human face here) of same size are taken and HOG descriptors are calculated. Usually the number of negative samples is very greater than number of positive samples. After obtaining the features for both the classes, a linear SVM is trained for the classification task. To improve the accuracy of SVM, hard negative mining is used. In this method, after training, the classifier is tested on the labeled data and the false positive sample feature values are used again for training purpose. For the test image, the fixed size window is translated over the image and the classifier computes the output for each window location. Finally, the maximum value output is considered as the detected face and a bounding box is drawn around the face. After detecting the face, the next task is to find the locations of different facial features like the corners of the eyes and mouth, the tip of the nose and so on. Prior to that, the face images should be normalized in order to reduce the effect of distance from the camera, non-uniform illumination and varying image resolution. Therefore, the face image is resized to a width of 500 pixels and converted to grayscale image. After image normalization, ensemble of regression trees is used to estimate the landmark positions on face from a sparse subset of pixel intensities. In this method, the sum of square error loss is optimized using gradient boosting learning. Different priors are used to find different structures. Using this method, the boundary points of eyes, mouth and the central line of the nose are marked. After detecting the facial landmarks, the features are computed. After computing all the three features, the next task is to detect drowsiness in the extracted frames. In the beginning, adaptive thresholding is considered for classification. Later, machine learning algorithms are used to classify the data. For computing the threshold values for each feature, it is assumed that initially the driver is in complete awake state. This is called setup phase. In the setup phase, the EAR values for first three hundred (for 10s at 30 fps) frames are recorded. Out of these three hundred initial frames containing face, average of 150 maximum values is considered as the hard threshold for EAR. The higher values are considered so that no eye closing instances will be present. If the test value is less than this threshold, then eye closing (i.e., drowsiness) is detected. As the size of eye can vary from person to person, this initial setup for each person will reduce this effect. Similarly, for calculating threshold of MOR, since the mouth may not be open to its maximum in initial frames (setup phase) so the threshold is taken experimentally from the observations. If the test value is greater than this threshold then yawn (i.e., drowsiness) is detected. Head bending feature is used to find the angle made by head with respect to vertical axis in terms of ratio of projected nose lengths. Normally, NLR has values from 0.9 to 1.1 for normal upright position of head and it increases or decreases when head bends down or up in the state of drowsiness. The average nose length is computed as the average of the nose lengths in the setup phase assuming that no head bending is there. After computing the threshold values, the system is used for testing. The system detects the drowsiness if in a test frame drowsiness is detected for at least one feature. To make this thresholding more realistic, the decision for each frame depends on the last 75 frames. If at least 70 frames (out of those 75) satisfy drowsiness conditions for at least one feature, then the system gives drowsiness detection indication and the alarm is given. Drawbacks: Uses webcam which is external hardware and can be costlier and as well as requires high level image processing to focus the visuals.

2. Paper Title: Eye Gaze Tracking Based Driver Monitoring System

Authors: Annu George Mavely, J.E Judith, Sahal P A, Steffy Ann Kuruvilla

Publication: 2017 IEEE

Description: In this paper a driver monitoring system using eye gaze technique is introduced. In this method, the first step is the tracking of human face from a real time video sequence to locate the eye region and to determine the number of times the user blinks his/her eye. The main focus is to use this eye tracking system to detect the drowsiness of the driver while driving thereby reducing the number of accidents happening day by day. In the proposed method Raspberry Pi 2 is soul of the framework, which control the total framework operation. Fig.1 describes the proposed methodology of driver monitoring system using eye gaze tracking. It is used as the image and general processing unit. In raspberry Pi Broadcom 700MHz Chip is used as main signal processing chip unit in which CPU is a 32 bit ARM11-RISC processor. This project uses a Logitech c270 HD webcam and LED IR illuminator for image capturing. A version of LINUX called Raspbian wheezy operating system is installed. It is a free operating system optimized specially for the hardware of Raspberry Pi. A 32GB MicroSD card is used to install OpenCV 3.2 on Pi board. Vibration motor is used to generate steering vibrations based on the algorithm. With the help of speaker or headphone or with any sound producing devices alarms are produced. For image capturing process uses a low cost web camera. Camera is connected to the Pi board using USB port. In automobile vehicles camera is placed above the steering wheel pointing straight to the user. By placing camera in this manner helps to capture drivers face easily. An IR illumination source is used to capture the image during night without causing any discomfort to the driver. For automatic on off purpose the LEDs are fitted with LDR. For monitoring the driver not only the eyes were detected but also eye gaze also calculated. The eye gaze are tracked from a real time video sequence. CAMSHIFT (Continuously Adaptive Mean Shift) algorithm is used for extracting the ROI (Region of Interest). The users drowsiness is detected by determining whether the eyes were opened or not. The eye detection algorithm detects whether the eyes are opened this helps as in determining the users drowsiness. In the frame when the users face is detected and eyes are not detected, assume that the user is falling asleep. When the eyes of the user is not detected more than a particular time period the user is alerted to wake up.

Drawbacks: This project uses Raspberry Pie which needs more power supply and uses sensors which increases the cost of the product.

3. Paper Title: An Accurate ECG Based Transportation Safety Drowsiness Detection Scheme

Authors: Kwok Tai Chui, Kim Fung Tsang, Hao Ran Chi, Bingo Wing Kuen Ling, and Chung Kit Wu

Published in 2016 IEEE

Description: In this paper, a driver drowsiness classifier (DDC) based on the ECG signals is developed. Also, a self-defined kernel is designed and implemented based on the optimal correlation analysis. The convolution kernel is fused with the cross-correlation kernel by a genetic algorithm. In the performance evaluation, the DDC obtains an overall accuracy of 97.01 percent, the sensitivity of 97.16 percent and the specificity of 96.86 percent. If either the convolution or the cross correlation kernel is employed, then the performance of the classifier will be degraded by more than 10percent on average. The comparison results reveal that the performance is downgraded by 17 percent to 63 percent if the feature selection is performed by the typical kernels. It can be seen that the driver drowsiness detection via the ECG signals outperforms those based on the existing methods. Due to the high measurement stability and the high immunity to noise of the ECG signals compared to the image-based EEG and EOG signals, the ECG signals find more important applications in the market. Also, our proposed kernel improves the performance by 48.4 percent to 87.2 percent compared to related image-based methods and the biometric signal-based methods. The cross correlation based kernel matrix (Kxcorr,ij) captures the symmetric information among the ECG signals from different classes whereas convolution based kernel (Kconv,ij) captures the anti-symmetric information among the ECG signals from the same class. Hence, the

KDDC can achieve a better performance than the prevailing kernels. This is because both the symmetric and anti-symmetric information of the ECG signals are highly related to the three driver states, namely the awake stage, the sleep stage 1 and the sleep stage 2. Also, the KDDC is adaptively designed and customized to the driver drowsiness detection application.

Drawbacks: It uses ECG module for heart rate which can be costlier.

Chapter 3

Problem Definition

Today drowsy driving is a serious problem that leads to thousands of accidents each year. Motor vehicle collisions lead to significant death and disability as well as significant financial cost to both security and individual due to the driver impairments. Drowsiness is one of the factors for collisions.
In India, no monitoring device is used to measure the drowsiness of driver. Some kind of systems like driver fatigue monitor, real time vision based on driver state monitoring system, seeing driver assisting system, user center drowsiness driver detection and working system are implemented in foreign countries. All the systems focus either changes in eye movement, physiological measures or driver performance measure.
The main purpose of this project is to develop an application for Drowsiness detection of the driver.Thats why this system is proposed for reducing accidents.Instead of using hardware components like webcam, we will be implementing on mobile app.We are implementing a system where the app will capture the video of drivers face in frames and Viola Jones algorithm will be applied on these frames.We will be using OpenCv Libraries for face detection.The frames will be compared to trained frames stored in database. When the new frames are captured calculation is done on the region of interest to determine the ratio of height and width of the region and on that basis detection is done and aletrts are send.We will be implementing this on Android studio and will be using Java programming language..

Chapter 4

Proposed System Working

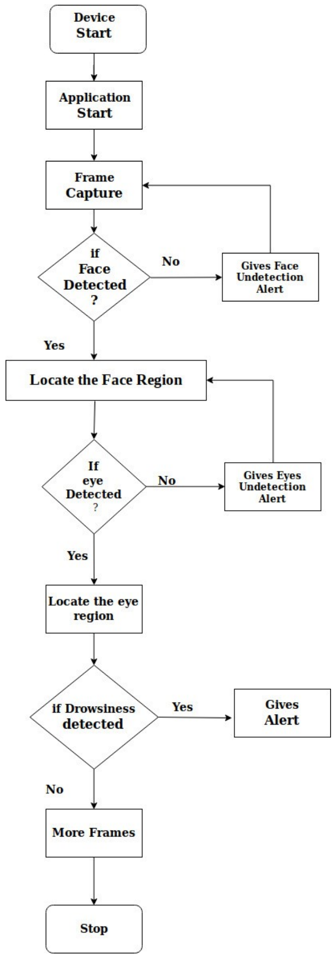


Figure 4.1: Driver Monitoring System Working

Initially, the driver device needs must be switched ON. The driver then starts the application. The proposed app on starting checks for the Face Dimension of Driver and if the driver face is not visible or detected will alert the driver about non-recognised face. The driver than adjust the phone as per the need and then on successful recognition locates face region for eyes. Similar procedure takes for eye recognition and on successful recognition the algorithm starts processing the eye pattern and face pattern for DROWSINESS symptoms.

If the system suspects DROWSINESS symptoms will immediately alert the Driver by ringing the phone at full volume. If the symptoms are not detected will continue to monitor the frame unless the app is stopped by the Driver.

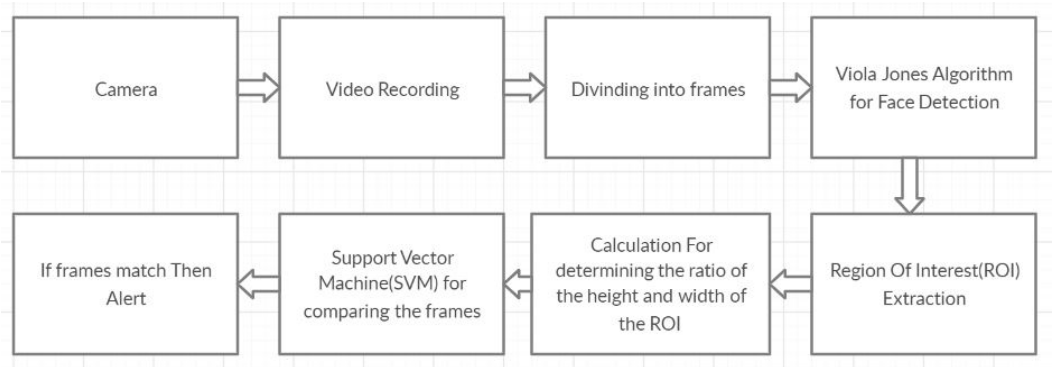


Figure 4.2: Flow of modules

In this we have proposed the Viola-Jones algorithm and SVM of the face, which improves the recognition rate of eye-opening state needed to determine drivers drowsiness status. When the application starts, it asks for camera permissions. Video recording starts, and is done in frames. These frames are extracted and Viola-Jones algorithm is applied for face to be detected. The region of Interest(like-eye, mouth, nose) is extracted and calculation is done for determining the ratio of height and width of the region. Using SVM the frames are compared to the trained data .The trained is stored in the database.For night driving, histogram equalization is used to detect the face.

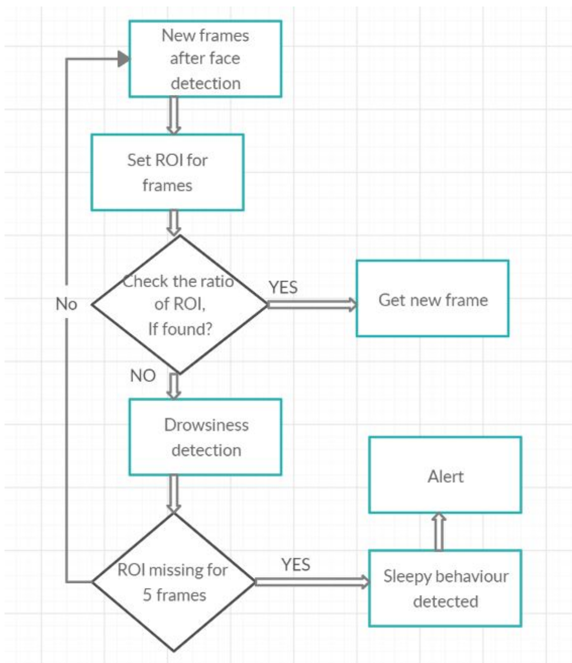


Figure 4.3: Flow diagram

Whenever a frame is extracted it is compared to the the existing one.If there is no such frame found the calculations are done and then processed.

Viola-Jones Algorithm Method
Viola-Jones algorithm for drivers driving video consists of four methods, namely, integral image, Haar-like feature, Adaboost algorithm and Cascade structure. Only three elements of the four, integral image, Haar-like feature, and cascade structure, are used to simplify the calculation and enable real-time detection. The other element, Adaboost algorithm is employed by creating a strong classifier combining a few single classifiers of simple features, which makes it possible to accurately detect objects and people.

Spatial Correlation of Face
To increase the accuracy of the facial region analysis and reduce the execution time of detection, we use the spatial correlation method which is information between facial components. In the human face, the position of both eyes, nose and mouth is nearly constant regardless of the person. Taking advantage of this fact, among the candidate images obtained by low-threshold-value detector, the drivers face, eyes, nose, and mouth are detected with more precise high-threshold-value detector. Eyes, mouth and face are extracted from the detected face through spatial correlation, and it has seven following features. First, the average length of the head is five times the length of the eye. Second, the position of both eyes is between the tip of the head and the jaw on the average, and the distance between eyes sis generally equal to the length of one eye. Third, the beginning of the nose is at the midpoint of whole face and the tip of the nose is centered between the midpoint of the face and the bottom of the jaw. Fourth, the length of the nose is like the length of one eye. Fifth, the starting position of the mouth is just below the nose of the face long axis and the end position of the mouth is two-thirds point of the tip of nose and the chin. Sixth feature is that the distance from the center of the mouth to the center of the face is 1/4 length of the head. Finally, the mouth length is similar to the combined length of the two eyes. Through these seven spatial correlation features, size and coordinate values of eyes, nose, and mouth are determined.

Histogram Equalization
Histogram equalization is a method of transforming a histogram having one-sided brightness distribution in the input image into a histogram with uniform brightness distribution. In this, we equalization image histogram to the right, increasing the sharpness in night driving images and enabling detection of the drivers face.

Support Vector Machine
SVM (Support Vector Machine) is a supervised learning algorithm which is mainly used to classify data into different classes. Unlike most algorithms, SVM makes use of a hyperplane which acts like a decision boundary between the various classes.
Hyperplane : In two dimentional space this hyperplane is a line dividing a plane in two parts where in each class lay in either side. SVM can be used to generate multiple separating hyperplanes such that the data is divided into segments and each segment contains only one kind of data.SVM is a supervised learning algorithm. This means that SVM trains on a set of labelled data. SVM studies the labelled training data and then classifies any new input data depending on what it learnt in the training phase.

Chapter 5

Design and Implementation

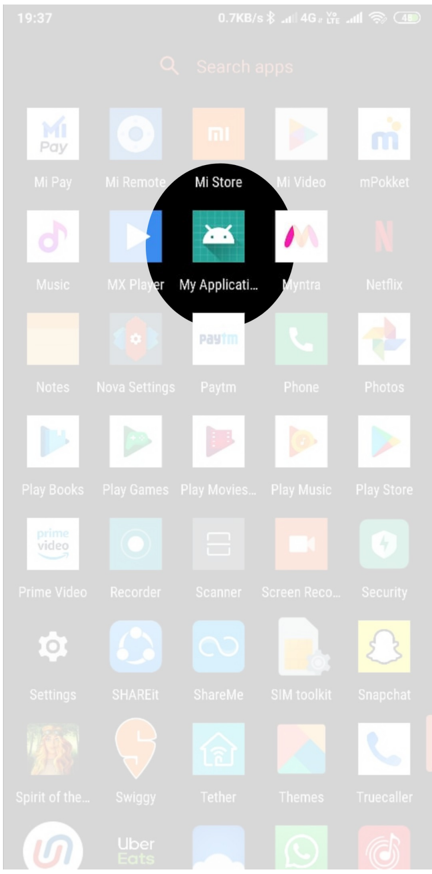


Figure 5.1: Application Icon

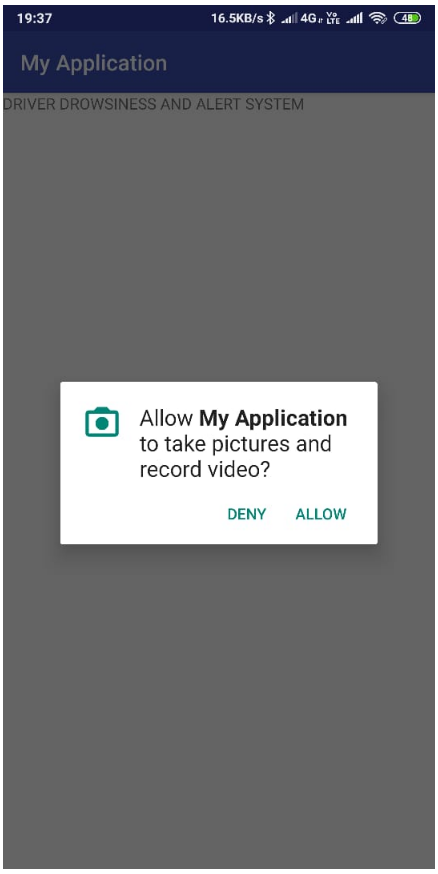
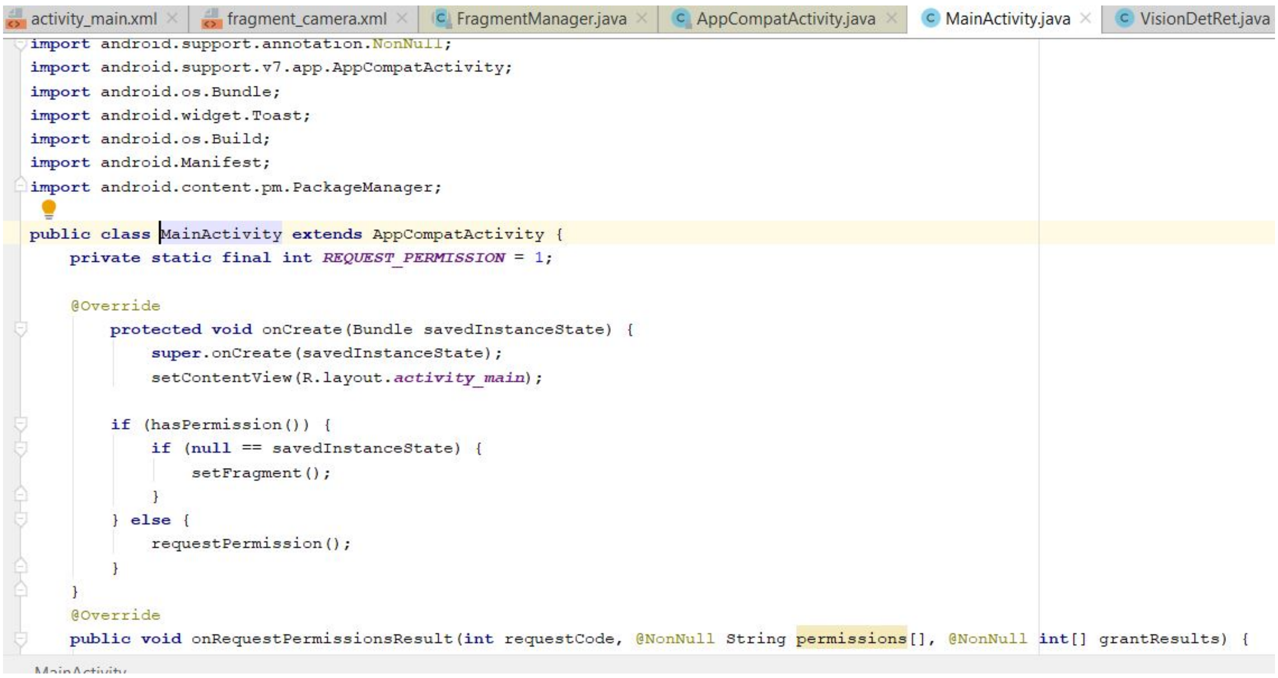


Figure 5.2: Grant Permission




```java
import android.support.annotation.NonNull;
import android.support.v7.app.AppCompatActivity;
import android.os.Bundle;
import android.widget.Toast;
import android.os.Build;
import android.Manifest;
import android.content.pm.PackageManager;

public class MainActivity extends AppCompatActivity {
    private static final int REQUEST_PERMISSION = 1;

    @Override
        protected void onCreate(Bundle savedInstanceState) {
            super.onCreate(savedInstanceState);
            setContentView(R.layout.activity_main);

        if (hasPermission()) {
            if (null == savedInstanceState) {
                setFragment();
            }
        } else {
            requestPermission();
        }
    }
    @Override
    public void onRequestPermissionsResult(int requestCode, @NonNull String permissions[], @NonNull int[] grantResults) {
```

Figure 5.3: Code for permission grant

When user clicks on the app it will ask for camera permission and then directly the camera will ON for face detection.

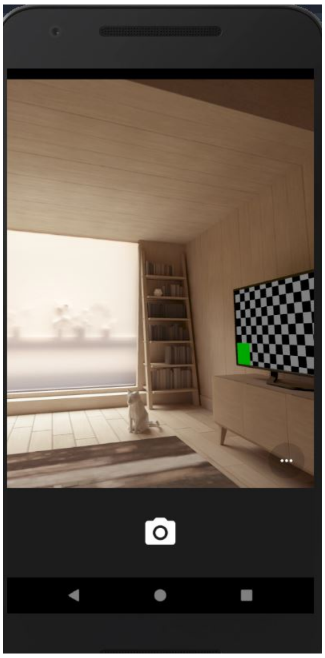


Figure 5.4: Camera
Here the face detection will be done.
(This is camera of Android studio.In normal mobile app using front camera you will be able to detect face)

Chapter 6

Future Scope

Using Pressure sensor on the steering alarm, Automatic braking System can be set in case of drowsiness.

By using wireless Technology if the driver gets drowsy an alert message can be sent to a selected persons mobile by using GSM module along with the alarm in vehicle.

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