

Driving behavior monitoring and reporting system



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Chapter 1

Introduction

1.1 Overview of Project

Road traffic accidents in Pakistan is a serious issue causing an average of 15 deaths everyday and 7500-8000 deaths annually. Studies shows that 67% of the accidents could be attributed to human errors which are caused different quantitative and qualitative factors such as smoking, drowsiness, inattention, speeding, hard braking etc. Driving behavior monitoring systems are not very common in Pakistan which give rise to problems like traffic rules violation, uncertain economic conditions for insurance industry etc. Dash- cams and CAN-BUS are the existing solutions but are not popular among the general public. All in all drowsiness and distraction are the two subjects of the study for designing driver inattention monitoring systems. Computer vision techniques are used to detect visual features. Exploiting visual features focuses on extracting facial features like face, eyes and mouth. Analyzing the state of eyes and mouth can provide observable cues for the detection process. Mainly, techniques using visual features can be divided into four categories: eye state analysis, eye blinking analysis, mouth and yawning analysis and facial expression analysis. Image processing and machine learning techniques are the two main steps for detecting and processing visual features. Driver facial image will be captured via smartphone and other factors will be recorded using sensors. The application will use machine learning and image processing algorithms for monitoring driver behavior.

1.2 Background

Road traffic accidents in Pakistan is a serious issue causing an average of 15 deaths everyday and 7500-8000 deaths annually. The statistics shared by PBS(Pakistan Bureau of Statistics) shows a rapid increase in accidents and annual loss during the past years. The National Highway & Motorway Police officials have lamented that on average 15000-16000 people die in Pakistan annually due to traffic accidents and this figure was much higher as compared to the loss of lives due to terrorism in the country. Studies shows that 67% of the accidents could be attributed to human errors, 28% to poor infrastructure and deteriorating condition of roads and 5% to unfit vehicles. So traffic accidents can significantly reduced by reducing human errors. These human errors are caused by different quantitative and qualitative factors such as smoking, drowsiness, inattention, speeding, hard braking etc. To regulate driving

behavior, a monitoring system must be introduced for driving style assessment and driver intent prediction. This monitoring helps to identify if there are any law violations, helps insurance industry and DLIMS(Driving license issuing and monitoring system).

1.3 Motivation

Road traffic accidents are increasing day by day which is a serious issue in Pakistan. Since the main cause was found to be the human error therefore driver behavior monitoring systems were introduced that include Dash-cams and CAN-BUS. These solutions are not feasible and common in Pakistan so the first motivating factor is to facilitate common people with an affordable and feasible solution. The second motivating factor is to facilitate Rikshaw drivers as well since Rikshaw is among the commonly used vehicles in Pakistan. The third motivating factor is the popularity of technological use of smartphones in vehicles by transportation networks like Uber and Careem so people can adopt this solution without any hesitation.

Chapter 2

Objectives of the project

2.1 Industry Objectives

- The main objective of the development of purposed solution is to reduce the accident rate in our society. E.g., According to WHO(World Health Organization) main causes of traffic fatalities are Drunk driving 32%, Speeding 31%, Distraction 16% and Bad weather 11%. From these stats it is very clear that 79% of fatal accidents are due to drivers. The Driver Behavior monitoring system monitors the behavior and helpful in preventing these type of accidents.
- The proposed solution is very beneficial for the local Distribution companies(Goods suppliers) & fleet management, they hire drivers to deliver the goods of a manufacturer to the local shops. Due to this system expenses on the vehicle are significantly reduced and its durability increases. Most of the drivers are driving harshly because they are not the owner & no one seeing them at that time. Due to harsh braking, Rapid Acceleration and unsmooth driving: fuel consumption increases, a bad impact on engine performance, life of tires and brakes decreases.
- It is very beneficial for the insurance companies. This system can easily detect the reason of car accident. People are involving in the deliberative car accidents for the sake of money, which effect our insurance industry economically.
- This system can implemented in the school, colleges and university buses, to secure the lives of our new generation.
- The proposed solution can be used as an extension of E-Challan system, whenever the system report about distraction of driver then he will be fined.

2.2 Research Objectives

- Role of Facial expressions in predicting unsafe driving.
- Yawing analysis for the prediction of fatigue and sleepiness.
- Eye state and eye blinking analysis for drowsiness detection.

- Driver behavior study, things that causes the distraction during driving
- Effect of driver behavior on the fuel consumption and durability of vehicle.
- Multiple Deep learning & computer vision techniques which produces accurate results for captured videos or images of drivers.
- Relation between driver Behavior and probability of the accident due to a specific behavior.
- Identifying the drivers mistakes that causes accidents.

2.3 Academic Objectives

- Training and testing of a model in supervised machine learning.
- Implementation of Neural networks for the classification of images.
- Object detection in computer vision using libraries like pytorch & torchvision.
- Implementation of computer vision and deep learning techniques on a model in real time application to get accurate results.
- Building an android application for real time reporting.
- This project give awareness to drivers about the traffic rules and compel them follow the traffic rule. Specially to younger driver who are immature. With this monitoring system they are monitored by there parents so they dont try to break the rules. Our application contain the tips for driving that are used by the drivers to optimize their driving skills.

Chapter 3

Scope of the Project

Our project scope has one main deliverable i.e., a mobile application that will use data collected by our smartphone camera and sensors and generate results. Results are generated based on the comparisons with our trained dataset. This real time monitoring will allow us to generate alerts in case of false driving behavior. Data will be continuously stored in database. Data training is done by collecting data with a smartphone. Then data preprocessing is done and data is trained using machine learning algorithms. Initially the project does not need a high budget since all the data is recorded through a smartphone and no extra hardware implementation is needed.

Chapter 4

Target Audience

Our application is concerned with the drivers. All those people who have licensed vehicles either its a car , rickshaw, bus etc can use our application monitor his/her driving skills. moreover companies like careem and uber can also use our application to keep an eye on their drivers.

Chapter 5

Possible Applications of Work

The driving behavior monitoring system has different driver, vehicle and management oriented applications that helps

- Fleet Management

Fleet management is an administrative approach to manage commercial vehicles for work purposes. The use of driver behavior monitoring system in fleet management will help to improve resource utilization, increase vehicles life, monitor driver behavior and improve security.

- Insurance Industry

Insurance industry in Pakistan is relatively small as compared to its peer regions. However, the insurance industry has been tremendously growing over the last 5 years. Life insurance affects a country's social and economic structure to a great extent. Due to its nature, life insurance differs from all other kinds of insurance. In the last few years, this sector in Pakistan has experienced tremendous growth of 30-35% annually. A high claim ratio is often considered desirable from marketing perspective since it helps retain the interest of the policy holders in their insurance policies. Moreover, the insurance companies that have high claim ratio tend to attract more prospective clients. However, consistent high claims ratio may create unanticipated financial obligations that often result in huge underwriting losses and thus wipe-out equity of the firm. Hence, a monitoring and regulatory environment is needed to save the industry from economic crisis.

- DLIMS(Driving Licence Issuing & Monitoring System)

License issuing authority can use driver behavior monitoring system for their driving test. They can monitor and record driver behavior and then issue the license according to the results..

- Traffic Police

Traffic police can use a driver behavior monitoring system to monitor and record driver behavior. They may check if the driver is using a mobile phone, if he is wearing a seatbelt, if he is over-speeding, or if there is any other law violation etc. In this way they may use this system for E-Challan and impose traffic laws strictly.

Chapter 6

Existing System

6.1 Comparisons of existing Systems

Classical monitoring systems are used to monitor and record driving performance by using the in-vehicle sensory or external devices with data acquisition systems. The available systems are usually based on obtaining data from the CAN-BUS (installed in the vehicle for collecting data, They used Hidden Markov Model (HMM) and Gaussian Mixture Model (GMM) for detecting). Nowadays cameras are also installed in vehicles to detect if the driver distracted or fatigue. Normally two cameras are installed in front and at the end of the car to help the driver in lane changing decisions. This system also detects drowsiness of driver and swinging heads based on visual features to detect the behavior of the driver. A dashboard camera, car DVR driving recorder, dash cam, or EDR(event data recorder) is an on board camera that continuously records the interior of the car 360 degrees and can send videos automatically and pictures using 4G. ERDs and some dash cams also record acceleration/ deceleration, speed, steering angle, etc. Dash cam units usually operate via the electrical system, converting 13.8V to a connector. Dash cams are widespread in Russia as a guard against police corruption and insurance fraud. In the United Kingdom, sales of dash cams rocketed in 2015 which has the fastest-growing consumer electronics, with sales increasing 395In Pakistan dash cam have been available for quite some time now, but have not gained popularity in the general public. That may be due to the ignorant nature of the local motorists. So installment of dash cams is an issue in countries like Pakistan.

6.2 Drawbacks of Existing Systems

A dash cam costs 60\$ to 150\$ in general. In Pakistan most of the people are rickshaw or taxi drivers so they don't care about installing dash cams in their vehicle just because they cant afford dash cams. In other countries most of the people avoid installing dash cams because of privacy. Dash cams monitors your behavior but it does not have an alert system. Most of the accidents occur because of drivers laziness.. So the best way to avoid accidents in that case is to generate an alert system. In the era of technology as everyone has android phone so having a system that monitors your driving behavior using your mobile sensors is better than installing another hardware device.

Chapter 7

Problem Statement

Driver behavior analysis using mobile phones sensors data. Driver drowsiness is the most common cause of accident. In Pakistan dash cam have been available for quite some time now, but have not gained popularity in the general public. That may be due to the ignorant nature of the local motorists. So installment of dash cams is an issue in countries like Pakistan. So we are proposing a low budget system for drivers behavior analysis. Our system will monitor drivers activities will generate an alarm in case of drowsiness. A report will also be generated that will show the complete statistics of his driving skills.we will use image processing and machine learning algorithms for drivers behavior analysis.

Chapter 8

Proposed System

In the span of this project, we propose a comparatively low-cost solution for analysis of the behavior of the driver. The development of smartphones during the last ten years has enabled those who own smartphones to carry significant computational and processing power on their person at all times. Furthermore, all newly smartphones are now equipped with a wide range of sensing devices such as accelerometer, a gyroscope, magnetometer, and many other sensors. In addition to built-in sensors, smartphones provide a link to the Global Positioning System satellite network thus allowing for navigational and tracking system. Various driving behavior systems have been proposed based on smartphone to avoid several problems related to the use of different hardware devices, also the development in smartphone technology such as availability of different sensors (Accelerometer, gyroscope, magnetometer,), cheap cost and different other advantages help the smartphone to be a good and efficient platform for driver behavior detecting and monitoring systems. All in all, drowsiness and distraction are the two subjects of the study for designing driver inattention monitoring systems. Computer vision techniques are used to detect visual features. Exploiting visual features focuses on extracting facial features like face, eyes and mouth. Analyzing the state of eyes and mouth can provide observable cues for the detection process. Mainly, techniques using visual features can be divided into four categories: eye state analysis, eye blinking analysis, mouth and yawning analysis and facial expression analysis. Image processing and machine learning techniques are the two main steps for detecting and processing visual features. Human fatigue expressions are highly important to understand the drowsy behavior of the drivers. Fatigue is a term used to describe the general overall feeling of tiredness. It also refers as exhaustion, drowsiness, lethargy, listlessness and it describes a physical /mental state of being tired and weak. based on classical computer vision technique methods for detecting driver drowsiness as following: Eye state analysis Eye blinking analysis Mouth and yawning analysis Facial expression analysis Commercial solutions, such as iOnRoad and augmented driving focus on monitoring such activities. A mobile application can be that detects driver drowsiness and sleeping by applying image processing techniques on video frames obtained via the front camera and alerts the driver.

Eye features, bio signal variation, in-vehicle temperature, and vehicle speed are used to monitor driver safety level. We propose an Android application solution, our system

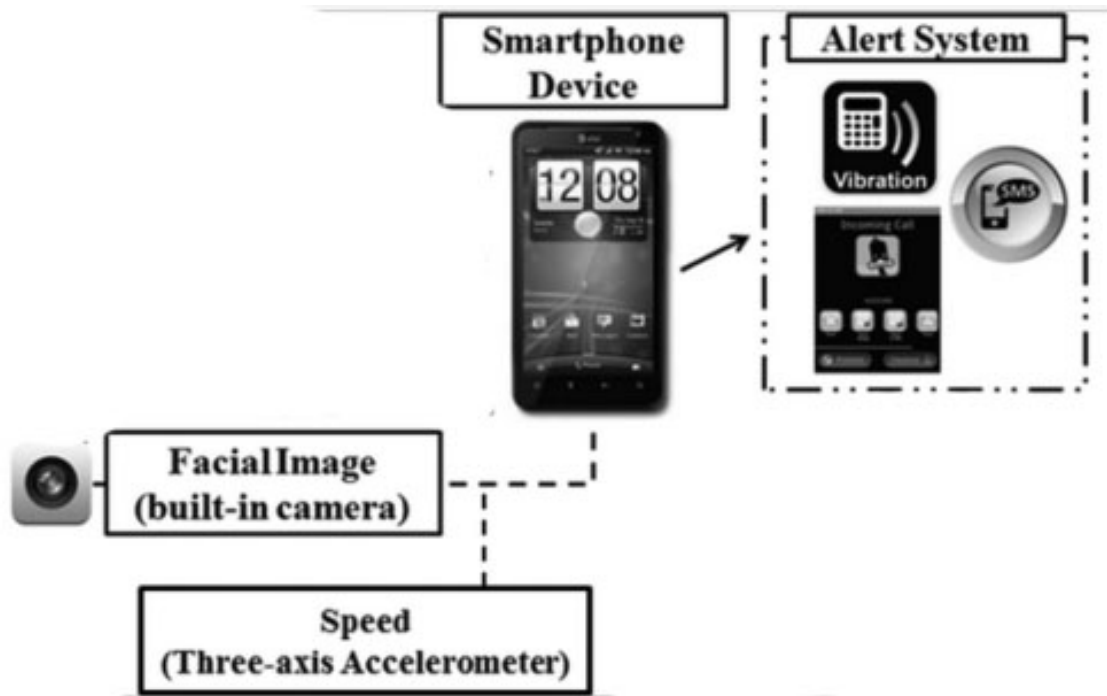


Figure 8.1: *Working of model*

will collect data from various sensors such as video, electrocardiography, temperature and a three-axis accelerometer. If the driver's safety level is compromised then a fake call alerts the driver. drivers facial image is captured via smartphones front camera. Our application will simply use computer vision and machine learning algorithms in order to monitor and detect whether the driver is tired or distracted using the front camera.

Chapter 9

Feasibility Study

For the feasibility of this project we conducted an online survey in which we get very positive response from our target clients. Survey shows that our project having a good market value.

9.1 Technical Feasibility

This system requires a cell phone with high quality camera, navigation system and sensors like accelerometer etc. The next step is feature extraction from the video which is done by using Convolutional neural network. For this purpose we have to train a model which requires anaconda platform, python package and some extra libraries which are used for image classification. All the required packages and libraries are online available. Model training can be done on CPU system as well as GPU system with much more faster speed. GPU systems are available in university lab and easily access able for us. After this we have to apply image processing techniques on this extracted data and for this purpose py-torch and torch-vision libraries are used which are also easily access able online. For the development of android application, we need to install android studio which is online available and easily download able. The system requirement for android studio at least 8 GB ram with 256 SSD or 500 hard. For the application testing purpose a virtual device can be created or alternatively a USB cable is required to connect the phone with machine to test the application. All the required software and machine requirement are easily available which reflects that the project is technically feasible.

9.2 Operational Feasibility

For the operation of our system it requires a phone with high resolution camera placed on a fixed place in the car, this camera records the video. A high speed internet is required to transfer the recorded data from this mobile to the server. When the data is received the trained machine learning model can categorize the activities of the driver. The application on the other hand generate the reports on the base of the categorized data by the trained model. Which is received by the owner of that vehicle.

9.3 Economical Feasibility

Computer machines and smart phones are easily available at low prices these days. For the development of this project a computer machine and a smart phone is required as a hardware device. All the other required items are software which are freely available online and easily installed on the system like anaconda using SPYDER IDE with libraries and android studio for the application development is also installed on that machine. So, our idea is economically feasible for implementation in the current scenario.

Chapter 10

System Requirements

10.1 Hardware Requirements

As we are proposing a low budget system for driver behavior analysis so for this we will use the sensors that are easily available in our android devices. So we will use the following sensors:

- Accelerometer and gyroscope (for speed checking)
- GPS (for location identification)
- Camera 12 megapixels (for facial expression Detection)
- Android Phone
- Hard disk minimum 5GB

10.2 Software Requirements

As we are going to develop a mobile application for our system so the software that will be required for developing our system will be following:

- python 3.6
- Android Studio
- Open CV
- pyTorch
- tensorflow
- Database

Chapter 11

Limitations and challenges in the implementation of the project

Beside a lot of advantages and positive impact on our society, there are some limitation of this project.

- **Privacy Issues**
The first challenge in the implementation of that project is the privacy issue, everybody is not feeling comfortable for driving in front of camera. Privacy is disturbed due to the video recording of driver as each and every movement is captured during driving.
- **High Quality Camera**
A good camera phone is required for this system, if the camera result is blurred then there is a possibility that our model cant detect the correct activity and due to false activity detection false reports will be generated.
- **High Speed Internet**
A high speed internet is required for tracking of location, acceleration measurement and sending of video data to server for further processing and detection of activity.
- **Camera Location**
The recording can be disturbed when the camera phone is used for calling or any other purpose. Even if the phone is dislocated from the assigned place the activity cant be monitored accurately.

Chapter 12

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