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Accidental Prevention System Using Integrated Sensors and Facial Recognition for Detecting Alcohol Levels and Real Time Counter Measure

[1]Ashok D, [2]Pranav A, [3]Shweta S. K [4]Junaid G. B
[1]Faculty, Department of Computer Engineering and Science, SRM Institute of Science and Technology, Chennai, India. Email: ashokinfo7@gmail.com
[2,3,4]Department of Computer Engineering and Science SRM Institute of Science and Technology Chennai, India. Email: pranavaanand1@gmail.com, shwetaskumar96@gmail.com,junaidgb@gmail.com

Abstract—Abstract Drunk driving is one of the major causes of road accidents today and the measures being taken to counter them still remain ineffective. This paper proposes a system which is foolproof that is used to prevent driving under the influence thereby avoiding further road accidents. The means of accomplishing this involves the use of an alcohol sensor, a heartbeat sensor, and a camera module which is used for facial recognition of the driver. Everything put together with a processor detects driver is the one being tested for sobriety and obtain the drivers alcohol levels if found intoxicated. The system should be trained with the drivers average heart beat and image data for facial recognition. The countermeasure that is taken when the driver is drunk is to prevent the vehicle from starting, sharing the coordinates of the vehicle with the help of a Global Positioning System and calling a cab to the drivers location using an Application Program Interface of any cab company.

Index terms — accident prevention; drunk driving; facial recognition; internet of things

1. INTRODUCTION

1.1. A. Background

According to reports by World Health Organiza-tion(WHO) [1], road traffic accidents claim more than 1.2 million lives per year. This has a huge impact on the global health and development. Road accidents are found to be the leading cause of death among the age gap of 15-29 years. This costs the governments about 3% of the GDP but the action taken to combat this has been insufficient. Drunk drivers can be found in 40% of the total traffic accidents and drunk-related traffic accidents cost 22% of the total expenditures [2]. Studies [3] conducted over 2014 to 2015 by the Transport Research wing, India indicate that accidents have increased by 2.5% and lead to 1,374 deaths every day. Drunk driving has accounted for about 1.5% of the mishaps in India and nearly one-third of the accidents in the United States. Thus, it can be noted that drunk driving is a pressing problem. Driving with an alcohol content between 0.02 g/dl and 0.05 g/dl increases the risk of accidents while more than 0.05 g/dl increases that risk by 6 times [1]. Many countries keep the limit of drinking less than or equal to 0.05 g/dl and anything above this, the person is not considered sober. Drinking and driving influences ones motor skills, mental capacity, perception, reaction time, coordination, judgment, and general ability to pay attention to what is happening on the road. The incapability of having a command over these skills leads to a crash and not only involves the driver but the other passengers in the car, pedestrians, and other motorists. The

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measures currently being taken widely include sobriety checkpoints where law enforcement officers demand the driver to blow into a breathalyzer and test their blood alcohol concentration against a particular limit. This method has proved to be ineffective in many ways as not all intoxicated motorists can be checked by this means. The other measure taken up is installation of breathalyzers in the vehicle that compels the driver to blow into it and if the limit is crossed, the car cannot be started. The problem with this method is the cost of breathalyzers and manual installation. Also, not everyone will take up this safety precaution unless forced to do so because of previous incidents of drunk driving or instructed by the law. The methods proposed before this had few advantages and disadvantages but most of them were not foolproof. This paper illustrates the use of a foolproof embedded system for alcohol detection at the drivers seat more effectively thereby help in prevent intoxicated drivers from driving and causing accidents. The system makes use of a set of sensors to check for symptoms of a drunk person and facial recognition ensures that the drivers breath is being checked. This paper is organised as follows: Section 2 includes the other methodologies researched for this paper. Section 3 consists of the proposed approach along with the system architecture and algorithm. Section 4 is the conclusion inferred from the proposed method and Section 5 includes the references to other resources used for research.

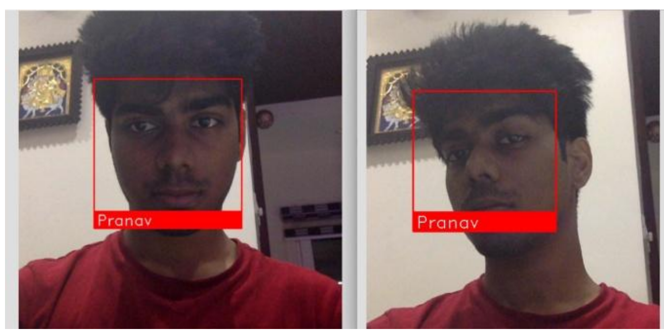

Figure 1. Example Facial Recognition

Figure 2. Example Facial Recognition

1.1.1. B. Facial Recognition. Facial recognition is a visual pattern recognition problem involving the face represented as a three-dimensional object subject to varying illumina-tion, expressions and other factors that need to be identified from acquired images. The advantage of facial identification is that it is non-intrusive in nature and can obtain the necessary data from a distance [4]. The system suggested by this paper has facial recognition as one of its key modules in order to make it a foolproof setup. The paper suggests application of OpenCV which has three major facial recog-nition algorithms used and they are Eigenfaces, Fisherfaces and Local Binary Pattern Histogram (LBPH). Recent studies conducted by

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Manop and Pichaya demonstrated that the LBPH algorithm has the highest accuracy of 81.67% in still-image-based testing [5]. Thus, this system makes use of the LBPH algorithm for facial recognition. OpenCV provides Haar cascade classifier which is used for face detection. The LBP algorithm describes the information of a pixel in contrast with nearby pixels. [6] It calculates the eigenvalues of each pixel and uses a histogram of the spectrum of values to recognize the face with the training data provided. Since one of the problems regarding the existing methods is that the systems could be cheated. Facial recognition is suggested by this paper as a measure to refine the system.

1.2. C. Internet of Things and REST API

The internet of things connects the humans and machines in new and remarkable ways. It offers a telescope and a microscope between people, machines and physical objects and offers more scope to that invisible world. By tagging objects and providing them with internet connection, we can not only track the objects and collect new data, but we can also combine this data to get greater knowledge

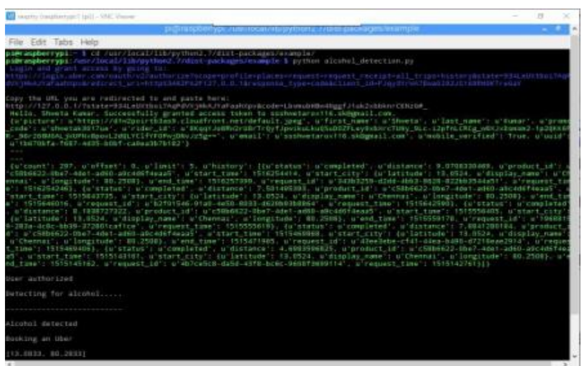

Figure 3. Request ride made to Uber API

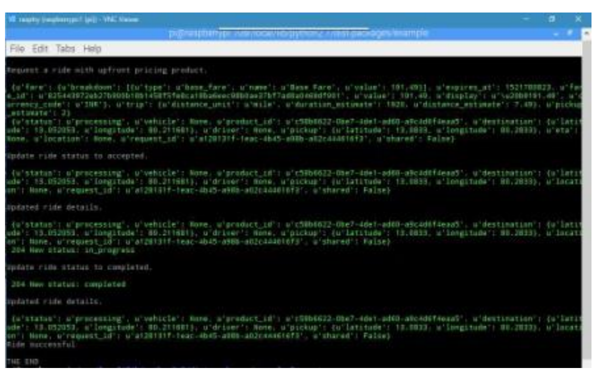

Figure 4. Request ride made to Uber API

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and information [7]. This paper makes use of Internet of things to develop the system and send information about the user's location to the cab company's servers and receive their response. REST APIs are used as the predominant application integration mechanism over the Internet [8]. In this proposed system REST API is used to make a request and receive a response from the online cab company servers as REST APIs take less time and have a better success rate.

2. II. RELATED WORK

There are some existing researches done on monitoring the driver's driving patterns and detection of fatigue, intox-ication and other factors that may cause a driver to lose control of the car and cause an accident. Some of those studies suggested are as follows.

2.1. A. Method I

In [9], Dai et al proposed the method of using a mobile phone combined with an accelerometer and orientation sen-sors. The phone would then be placed behind the wheel. The aim of the system is to study the driving patterns of the user when driving regularly and if any irregularities are found in speed and direction then, it would consider that the driver is drunk and send a message to the police. This method involves obtaining the rotational position of the latitude and longitude axis of the mobile phone when driving. It also checks for the speed of the car when irregular driving patterns occur as it is believed that drunk drivers tend to rash drive. The advantages of this technique are that it is cheap and easy to install and use, less hardware is required and there is no outside interference. The disadvantages with this methodology are that the mobile phone is prone to falling and affect the longitude and latitude axis while driving even regularly. This has found to affect the readings and give inaccurate findings. The other problem found is that it considers a driver braking or accelerating suddenly as cues for drunk driving, however these cannot be considered every time while driving in traffic.

2.2. B. Method II

In [10], Sahabiswas et al suggest the use of Internet of Things to check for drowsiness and alcohol content of driver while driving. It compares various methods and takes up the advantages of these methods thereby trying to incorporate them into one system. The system checks for alcohol content of the driver, eye blink rate, acceleration of car and nature of roads. Major focus is provided to detecting the alcohol content and determining the driver's driving patterns on various roads. The paper proposes using an MQ-3 sensor to detect alcohol in the driver's breath. The method makes use of incremental clustering technique to identify the driver's driving patterns and form clusters to be compared to regularly. If alcohol is detected and the clusters do not match the driving pattern, then the alarm is raised as the driver is found drunk and the police are notified. The disadvantages of this method are that only one alcohol sensor is used to detect alcohol which can become faulty in a short span of time and the clusters formed cannot identify the regular patterns from one another causing false readings.

2.3. C. Method III

In [11], Murata et al proposed the prospect of using a non-invasive method to detect if a person is drunk while driving. Their system depends on the frequency time series analysis as their base. The system involves an air pack sensor present in the driver's seat to read the air pack pulse wave(AP-PW) of the driver. The digital pulse volume was measured with a finger clip while the AP-PW measured the breath alcohol concentration. The studies indicated that gen-der does not have any effect on the readings. The

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experiment involved four subjects and it was concluded that the readings spiked during the first five minutes of drinking alcohol but after 20 minutes the heart rate was found to level with the normal ratings and the AP-PW also started decreasing. Thus, it is not an easy method to detect whether the person is intoxicated or not. They were not able to distinguish between the biological signals under the influence of alcohol and the normal biological signals. Therefore, the proposed method is not accurate and would lead to a faulty system. The other disadvantages of this system are that the studies were conducted by ignoring many external factors such as stress of the subjects undergoing the experiments and the process also requires data to be collected over a long period of time to begin calculations and generate the necessary signals to be analysed.

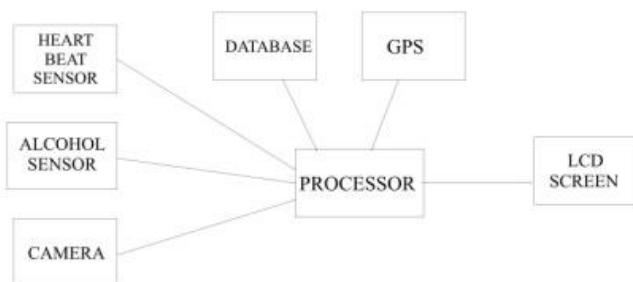

Figure 5. System architecture

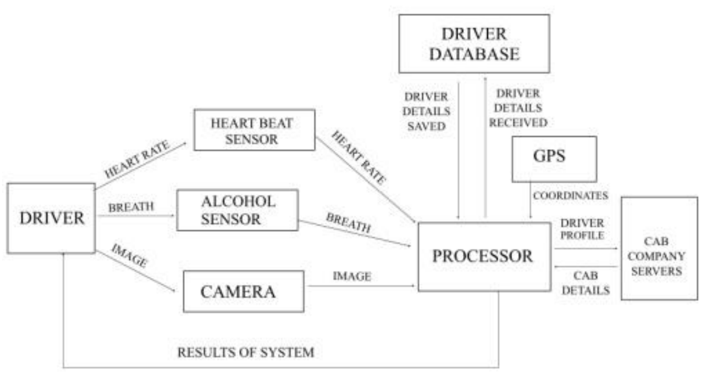

Figure 6. Data flow diagram

3. III. PROPOSED METHODOLOGY

The system suggested by us involves a method that is foolproof and one that takes up measures to prevent driving under the influence of alcohol. Unlike the previous systems seen, this system considers more than one symptom of being intoxicated and ensures that the system cannot be cheated. The system need not be manually installed by users and with further improvement can be included in the architecture of the vehicle. There are many symptoms of a drunk person which include presence of alcohol in breath, increased heart rate, slurred speech, and delayed reflexes. The symptoms considered for this paper are

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presence of alcohol in breath and the heartbeat. The system is made foolproof by using facial recognition to ensure that the driver is the one performing the breath analysis test and is not cheating the system. If it is found that the person is drunk, then the current location coordinates are obtained and sent to the servers of an online cab company and receive a confirmed booking of a cab to pick up the drunk person.

3.1. A. System Architecture

The proposed system architecture includes two sensors to detect the symptoms of a drunk person. Two MQ-3 sensors are used for detecting the blood alcohol content in the person is breath [12]. A 5V heartbeat sensor module is used to detect the heart rate of the driver continuously. A Raspberry Pi 5MP camera module is used to detect and recognize the drivers face. The system uses Raspberry Pi as its core processor. The two alcohol sensors are connected to the processor using an analog-digital convertor. The camera is connected to the camera port of the Raspberry Pi. The Raspberry consists of the local database to store data for training images for facial recognition and regular heart rates of the driver to be compared to. A GPS receiver module and GPS antenna are then connected to the raspberry pi to receive the GPS location of the car. The details of the location are sent by the raspberry pi to the servers of the cab company. The API used for this is a REST API and can be of any online company like Uber, Lyft, or Ola. An LCD is connected to the Raspberry Pi so that the user can give their details easily and can also be notified when drunk and receive the status of their taxi that is booked automatically. The Fig 5 shows how the entire system and connected and organised.The above architecture can also be used with Arduino as the core processor and camera, LCD screens which are compatible with Arduino can be used as well for a simpler system.

Figure 7. Algorithm

3.2. B. Algorithm

The algorithm for the system is depicted in Fig 7. The algorithm begins with creating two data sets in the local database. The first set is a set of training images of the driver is face to be used by the LBPH algorithm. The second set is the regular heart beats of the driver over a short span of time. The average of these heartbeats is calculated. The user is then required to provide the application authorization to their profile in the cab companys database. Once the authorization is complete, the system begins the

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process of alcohol detection. The drivers face is first recognized with the help of the LBPH algorithm that uses Haar cascade frontal provided by OpenCV to detect the face and compares the distribution of calculated eigenvalues against the training data set. More the number of training images, the better is the facial recognition process. Once the face is recognised, the MQ-3 sensor begins detecting for alcohol content in the drivers breath. If the alcohol content is found to be more than the defined threshold, the drivers heartrate is compared with the average heartbeat. If an increase is found, the system raises the alarm that alcohol is detected and stops the car. The GPS then receives the current location of the car and the system sends these coordinates to the servers of the cab company. The request is then accepted by a cab driver and the results are sent back to the drunk user. The cab then picks up the drunk driver thereby preventing drunk driving. The system does have its limitations which can be further improved by including more alcohol sensors around the seat and having heart rate sensors all around the steering wheel like in gym equipment.

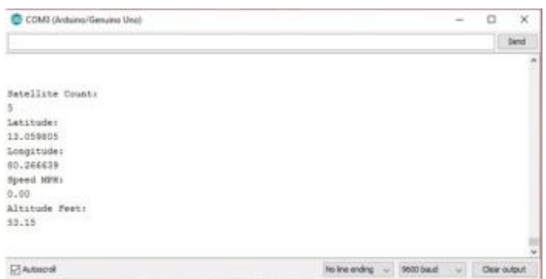

Figure 8. GPS readings

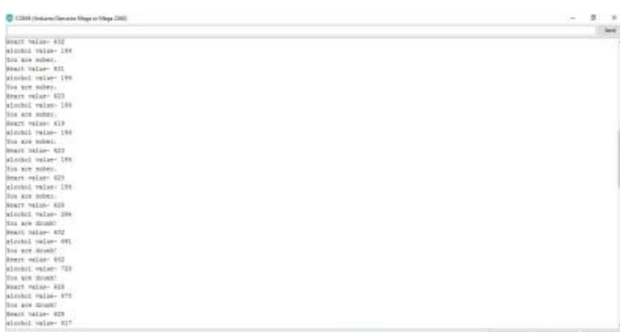

Figure 9. Alcohol and heartbeat sensor readings

4. IV. CONCLUSION

The proposed method is a foolproof method that detects one of the major symptoms of alcohol consumption which are alcohol content in breath and the heartbeat. The system prevents drunk driving by stopping the car and calling for a taxi from any online taxi company. The system need not be manually installed and is automatic. No man power is needed at various locations to detect if the person is drunk as the system will do this automatically and continuously. With further enhancements in the system and the law system, this system can be included in all vehicles and thus create a safe society for people to drive.

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