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Designing Multi-Model Alerts for Drowsy Driver using Machine Learning and Image Processing

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Abstract— *Drowsiness and drunken driving causes road accidents. This paper proposes a real time detection of driver's drowsiness as well as alcohol intoxication and subsequently alerting them. The main aim of this proposed system is to reduce the number of accidents due to driver's drowsiness and alcohol intake to increase the transportation safety. This proposed system contains 8-megapixels digital USB camera, PC loaded with Raspbian-OS, Alcohol sensor (MQ-3) is used to detect the intake of alcohol in percentage. If the intoxication matching fails, GSM gets triggered on and transmits warning message. The PC with Open CV is serially interfaced with Arduino Uno. GSM, Bluetooth, relay circuitry and buzzers are interfaced with Arduino Uno. This will perform some life saving tasks like alarm notification and switching off the power source of the car.*

Keywords-(OpenCV, RaspberryPi, Drowsiness)

I. INTRODUCTION

Numbers of vehicles are significantly increasing every year and so are the cases of vehicle thefts and accidents. Thus internet of things (IoT) is a technology which can be use to overcome the issues[2]. Current generation smart phones provide robust sensor suites including accelerometers, GPS, microphones, and cameras[3]. These sensors allow smart phones to be used for various sensing tasks such as activity monitoring, personal health, and environment monitoring. Smart phones also provide a powerful communication platform as they are generally equipped with Wi-Fi, Bluetooth, and a 3/4G data connection. Smart phones are extremely portable and have powerful processing and storage capabilities.

In addition, many physiological sensors come equipped with Bluetooth. They can be connected to a smart phone wirelessly and used to extend its sensing capabilities. This paper describes preliminary efforts towards a system that uses a smartphone-based wireless body area network with specific applications in psychophysiological assessment and more general applications in context-aware computing and emotion-oriented computing. In the modern era, most of the accidents are caused by drunken driving and driving under the influence (DUI)[1]. Drunk driving is the only one reason behind most of the unnatural deaths in the world[4][13].

This IOT module is proposed to protect the people from unnecessary deaths caused by road accidents due to drunken driving[9].

The proposed system makes use of the IOT device as Raspberry Pi 3 Model B as a core. It mainly includes alcohol concentration detection sensor, facial recognition to safeguard the drowsy driver[16]. We use different type of safeguarding things such as GPS module, Triggering an alarm and Automatic ignition off etc. With the growing population the use of vehicles has become superfluous and this has led to the accidents increasing at an alarming rate resulting in a large loss of property and human life. This project aims at finding the occurrence of any accident and reporting the location of accident.

GSM technology is used to intimate the vehicle position in the form of latitude and longitude coordinates through SMS. The location spot is retrieved using Global Positioning System which is a navigational system using a network of satellites orbiting the earth. Sensors such as IR, alcohol and fire, ring detectors detect signal in case of an accident occurrence and send a signal to the connected microcontroller. The controller in turn automatically turns on the left indicator and parks to its left side and also helps in locking of ignition.

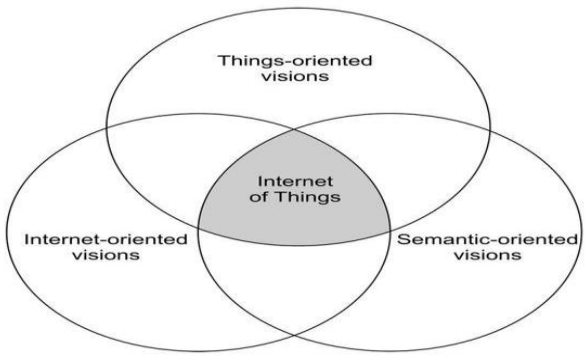
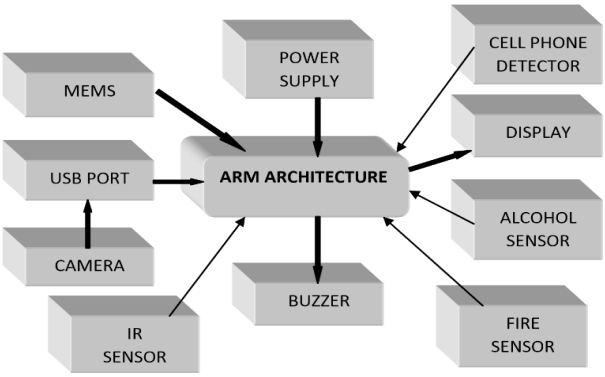


Fig1. The Visions of IoT

In a developing nation like India, with advancement in the transportation technology and rise in the total number of vehicles, road accidents are increasing rapidly. The main cause behind these road accidents are the lack of training institutes, unskilled drivers, poor road conditions, use of cell phones during driving, consuming alcohol while driving, overloading and poor governmental plans in this regard. The proposed work is to alert the driver when he is drowsy or distracted, from non-alert mode to alert mode by means of buzzer[14]. In this paper real time data is collected with the help of video camera and other micro electro mechanical system devices (MEMS). This data gives information about driving condition of the driver which acts as input to controller. The appropriate measures are then taken by the controller to alert the driver[22].

The whole system is built upon Raspberry Pi board, Raspbian OS, OpenCV image processing library and QT as editor. The primary focus is given to the faster drowsiness detection and processing of data. The system is used to detect the eyes - whether they are closed or open in real-time through the Logitech camera, where drivers are not connected to any external devices and also malfunctioning is highly impossible. Intimation services are provided to alert the drivers through IoT where eye ball detection, GPS and GSM modules are interfaced with the Raspberry pi board[20]. Here, one of the eye blink sensor was fixed in vehicle to detect unconsciousness and was indicated through an alarm[15].

II. BLOCK DIAGRAM



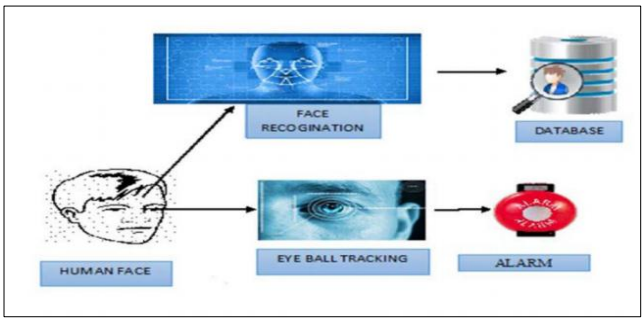


Fig 2. ARM Architecture and Block Diagram

III.WORKING

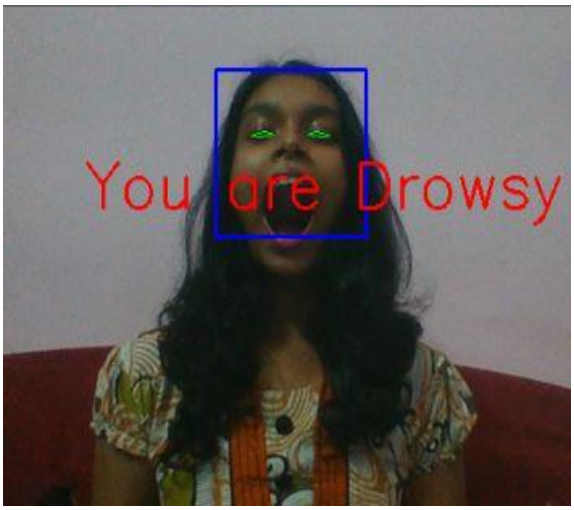


Fig 3. Drowsiness Detection

The technologies used for implementation are OpenCV and dlib[12].

OpenCV

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. In simple language, it contains libraries for Image Processing[10].

dlib

dlib is a modern toolkit containing modern machine learning algorithms. The Harr Cascade classifier is used to detect the facial regions on a detected image[11].The dlib library of OpenCV is used to detect the landmarks of detected faces in image.

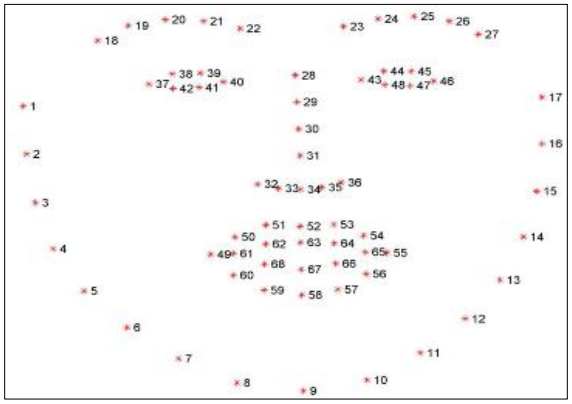


Fig 4. Point plot on input image

- The library outputs a 68 point plot on a given input image. In the facial attributes, we are concerned with eyes, mouth and head movement[5]. The Eye Aspect Ratio (EAR) is the estimate of the eye open state, EAR is a constant value when the eye is open, but rapidly falls to 0 when the eye's are closed[17][21].

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

- **Raspberry pi board:** The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries[19]. The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards, mice and cases).
- **Buzzer:** A buzzer or beeper is an audio signaling device which may be mechanical, electromechanical, or piezoelectric (piezo for short).
- **PC with OpenCV:** OpenCV (Open Source Computer Vision Library) is released under a BSD license and hence it's free for both academic and commercial use.
- **ARM Microcontroller:** ARM, previously Advanced RISC Machine, originally Acorn RISC Machine, is a family of reduced instruction set computing (RISC) architectures for computer processors, configured for various environments.
- **IR sensor:** An object can be detected with an infrared system consisting of an infrared transmitter and a receiver.
- **Alcohol sensor:** The alcohol sensor we will use is the MQ-3 sensor. This is a sensor that is not only sensitive to alcohol.This type of sensor circuit can be used as a breathalyzer to check a person's blood alcohol level[6][7][8].
- **Micro electro mechanical system devices (MEMS):** Micro electro mechanical systems (MEMS) is the technology of microscopic devices, particularly those with moving parts.

IV. SOFTWARE SPECIFICATIONS

➢ Python

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms.

The Python interpreter and the extensive standard library are freely available in source or binary form for all major platforms from the Python Web site, https://www.python.org/, and may be freely distributed. The same site also contains distributions of and pointers to many free third-party Python modules, programs and tools, and additional documentation.

The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications.

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages[18].

Fig 5. Python

- **Python is Interpreted –** Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- **Python is Interactive –** you can actually sit at a Python prompt and interact with the interpreter directly to write your programs.

- **Python is Object-Oriented –** Python supports Object-Oriented style or technique of programming that encapsulates code within objects.

- **Python is a Beginner's Language –** Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

➢ IDLE

IDLE (Integrated Development and Learning Environment) is an integrated development environment (IDE) for Python. The Python installer for Windows contains the IDLE module by default.

V. HARDWARE COMPONENTS

- Arduino Board
- Raspberry Pi
- IR Sensors
- Fire Sensors
- Alcohol Sensors
- Ring Detector
- Buzzer
- ARM Microcontroller
- 12V DC Motors – 60 rpm
- Logitech Camera
- USB Cable
- UART Cable
- Memory Card
- Phone Detector
- Micro electro mechanical system devices (MEMS)
- PC with OpenCV

VI. RESULTS

The figure 6 shows the interfacing of components which are used in this system. Here we have designed such that an eye blink is continuously monitored by the eye blink sensor. If eye is in closing position the buzzer is initiated.

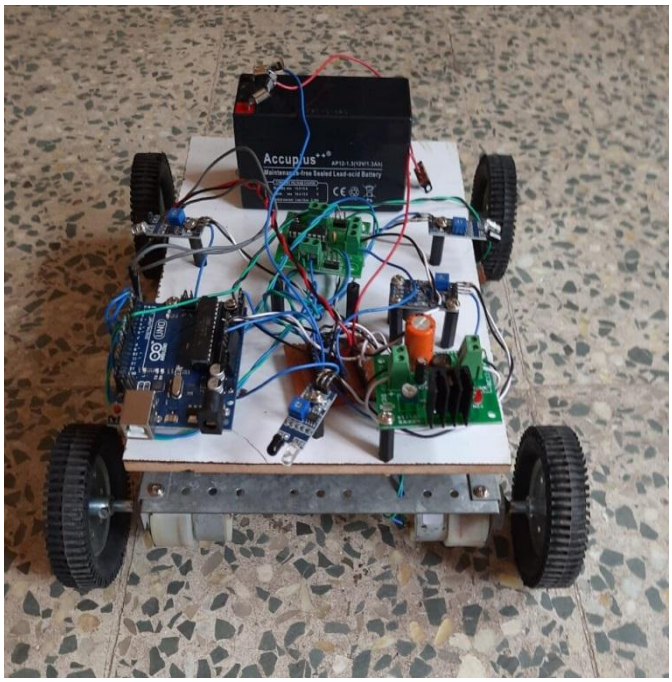


Fig 6. Result

VII. ADVANTAGES

1. Detection of drowsiness
2. Decreasing road accidents
3. No need of monitoring cameras or other devices attached or aimed at the driver.
4. This method is practically feasible.

VIII. CONCLUSIONS

A driver alertness detection system is proposed based on fatigue detection in real-time. The proposed method easily detects the eye blink and the drowsiness. Information about the eyes position was obtained through image processing algorithms. Image processing offers a noninvasive approach to detect drowsiness without any annoyance and interference.

An algorithm for performing face recognition was used. It was found that with this algorithm, a good measurement of the blink rate was obtained. The proposed algorithm was able to detect the eyes at medium and high illumination and independent of gender and age, but for optimal detection the camera had to be positioned as close to the face as possible.

In order to prevent the effects of poor detection due to insufficient light, night vision camera was implemented to obtain better results. Safe driving will be ensured by indicating the driver using a buzzer indicator.

IX. ACKNOWLEDGMENT

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