Driver Safety System for Drowsiness, Heart Attack, Object Detection, and Internal Temperature Control of Car With Real-Time Wireless Communication

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Abstract

The accidents on the roads increases day by day and people lose their valuable and precious life. Transport is very necessary for a country because the economy of a country depends on transport. With the increase in transport, the accidents also increase because due rush the people lose their time, and they go in tension and lose the natural abilities. For this purpose, a system is designed which is implementable in every type of car, bus, truck, and other type of vehicle. This system avoids collisions when a driver goes in the condition of drowsiness or heart attack and communicates with a user mobile to inform in case of an emergency like a heart attack. Also, the system can control the internal temperature and humidity of the car because with the increase or decrease of temperature the humans can face many problems. When the driver goes in the condition of a heart attack many other people also lose their life and a very big accident occurs.

Keywords: *Accident, Communication, Collision Avoidance, Emergency, Object Detection, Temperature Control, Transport, Vehicle*

Introduction

The improvement of efficiency in transportation is very necessary because the number of vehicles increases from time to time. The automation level is increased in all types of vehicles [1]. A safety system for drivers is necessary. In the morning and evening time, the drivers do not feel well like normal conditions because in the morning time most of the drivers feel condition of drowsiness and in the evening time also, they are bored, and their bodies do not act like a normal human being because of fatigue.

The Road Traffic Crashes (RTC) is not the problem of one country, but it is a major global concern. According to the world report on traffic injury prevention, the third global injury cause is road traffic crashes by the year 2020. Road traffic crashes are the problem of developed and underdeveloped countries. Pakistan is a developing country where people do not give priority to road safety. According to the Government of Pakistan, 2004, that there is a very occurrence of road traffic crashes both fatal and non-fatal. The increase in the number of vehicles is 273 times 2004-2005 in comparison to 1991-1992 [2]. In all provinces of

Pakistan, transportation increases with the increase of the number of people and industry. Pakistan has also industry and for industrial raw materials are needed and these materials are transported through heavy and large vehicles and rush on the roads increases. Also, the people's increases and everyone wants a personal car to use for their personal needs and transportation.

As a consequence of injuries, productivity and financial burden losses to the nation and the injured person faces a personal burden and his family also effects from him [3]. Due to some injuries the person, sometimes loses their valuable parts of the body like leg, hand, eye, etc. Sometimes due to dangerous road accidents, most people die but some lose their sense of feelings and this occurs because of spinal cord injury. As a result of spinal cord injury, the person cannot move their legs and half of his body go to the condition of disability for the whole life and as a result, he becomes a burden on his family. According to WHO 1998 that 2% of the world's population is disabled [2]. In hundred people two are disabled. According to the calculation, twenty peoples are disabled in thousand people. If we calculate it for millions of people, the number will be very high, and this large number is a very big burden for the family and nation.

Crashes due to road traffic affects the families and friends of injured peoples. According to the world health organization (WHO) estimate of 2002, that 180500 children loosed their life because of road crashes. The injuries are unequal more boys are injured than girls and most children from poor families. 73% of males accounted for the road crashes in 2002 which is three times of females 27.6% per 100000 population. Pakistan is a country where families depend mostly on males for earning and the ratio of young males in road accidents is very large. The third cause of death is road accidents. Road accidents occur due to a lack of traffic rules and unawareness of road signs. Some research says that 80 t0 85% of humans' elements are responsible for crashes and accidents [4]. The infrastructure of Pakistan is developed. A large network of roads consisting of 259758km in which National Highway is 8885km and the motorway is 2027km [5]. The analysis states that due to careless driving 55% of accidents occur, 11% due to dozing off the wheel, and 35% of accidents occur at night and 65% in daytime [6]. In the nighttime the main reason for the accident is drowsiness.

Reasons Of Road Accidents

Road accidents occur due to many reasons which are discussed one by one below.

A. Use of Cell Phone

The use of cell phones changes the attention of drivers during driving because sometimes the driver hears good or bad news. In the case of good news, the driver becomes emotional and in case of bad news his/her attention completely disturbs, and sometimes heart attack occurs, as a result, a very fatal accident occurs.

B. Use of Drugs

The use of drug disturbs the natural abilities of the human body and at the time of driving the driver do not feel well and as a consequence, an accident occurs.

C. Unskilled Drivers

The accident occurs most of the time due to unskilled drivers. Sometimes they use the accelerator in place of the brake and many vehicles collide.

D. Use of Drugs

The use of drug disturbs the natural abilities of the human body and at the time of driving the driver do not feel well and as a result, an accident occurs.
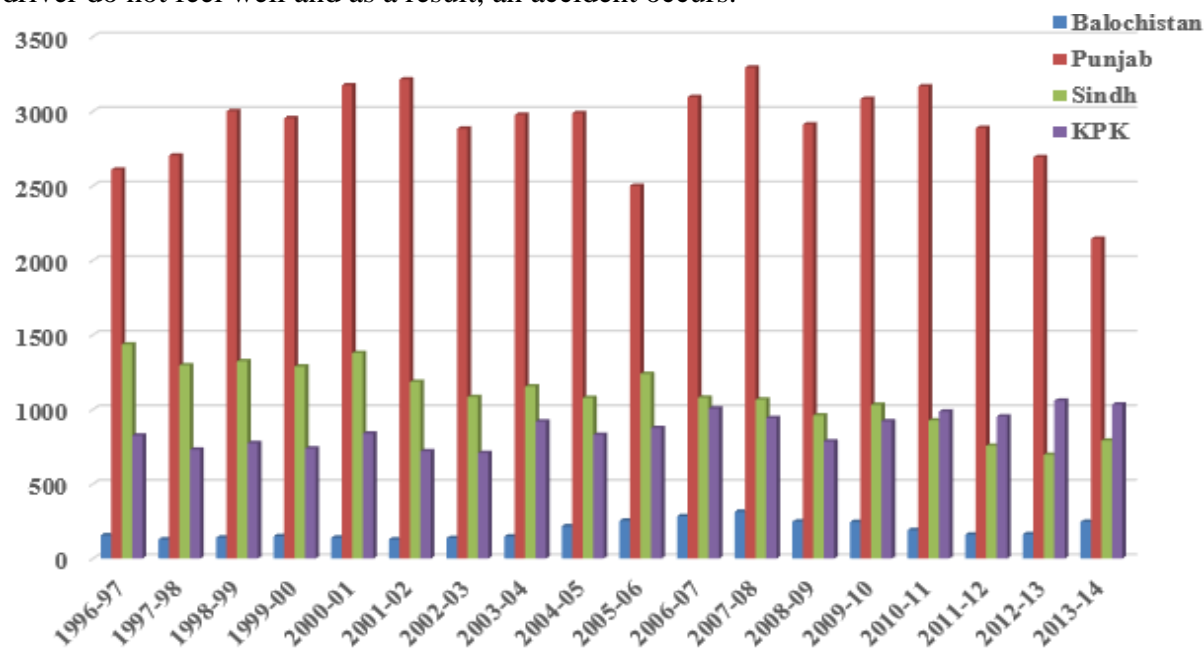
Fig. 1. Killed People in Car Accidents in Pakistan Province Wise

Literature Review

The system designed for drowsiness is computer vision-based to detect the condition of the driver using algorithms and these algorithms are appraised in Python 3.6 and many other libraries are used like OpenCV and imutils. The camera detects the condition of the nose, mouth, and eyebrows. For this system, they used the Asus i7 laptop [7]. The technique used in this system is to detect the drowsiness and send it through the camera and in case of an accident a message is sent to the nearby traffic police near that place, also the location can be detected of the car [8]. The system is computer vision-based which uses a camera to detect the face and uses EAR (Eye Aspect Ratio) and MAR (Mouth Aspect Ratio) to detect the fatigue of the driver [9]. The three-stage technique is used in this system to detect the condition of the driver using a camera, microphone, and smartphone. The Coolpad Note 3 having 3GB RAM and NIR is used in the system [10]. The system uses a night vision camera to detect the blink of the eyes of the driver and in case of drowsiness, it gives the message to decrease the speed [11]. The Google TensorFlow Object detection-based real-time car detection and safety system had presented. The system mainly consists of two parts, one is driver state discrimination and the other is car detection. The system is tested in real a real-world highway [12]. A system is designed raspberry pi and camera-based to detect the collision in the front of the car and when the car is too close to the car it will detect the collision and a sound alert will also be created [13]. The technique used in the system is to use an EOG signal, electrodes are directly attached to the body of the driver, to detect the sleepy condition of the driver. The Arduino and EOG are used in the system [14]. The Raspberry Pi, camera, buzzer, gas sensor, vibration sensor, Wi-Fi module is used in the designed system to detect the condition of the driver and a message will be sent to the server

of the system [15]. Mean Shift Algorithm is used to detect the drowsiness of the driver using image capturing. The camera detects the pupil and face [1].

The system consists of IR Diode-pair, Pulse Oximeter and it is a wearable helmet that the driver wears on the head [17]. The hardware of this system consists of Raspberry Pi, camera, speaker, to detect the movement of the driver's eyes and activate the speaker [18]. The system is based on a pulse sensor to calculate the pulse of the driver [19]. EEG-NIRS ear module is used in this system to detect the drowsiness of the driver [20]. The technique used in the system is wearable glasses that detect the drowsiness of the driver and in case of drowsiness detection, it sends the message to cloud base platform through Wi-Fi [21]. In this designed system, electroencephalography is used to detect the drowsiness of the driver. NeuroSky EEG headset is used to detect the waves of the human brain [22]. Bio harness 3 sensors are used to measure the physiological data of the driver and detect drowsiness [23]. The system that is implemented consists of object detection, drowsiness, control of the internal temperature of the car, and detection of a heart attack. In the other implemented systems camera, bluetooth wearable glasses, EEG NIRS Module, NeuroSky, Bio harness sensor, are used to detect the drowsiness of the driver. Our system has also the ability to detect the object when it comes in front of the vehicle, drowsiness detection, control of the internal temperature of the vehicle, detection of heart attack, and sends a message to emergency number in case of drowsiness or heart attack. Automatically the system reduces the acceleration of the vehicle and a brake is pushed to stop the vehicle.

Methodology

The system consists of many parts. Every part is controlled by one central control unit. All the sensors read the data and send it to the control unit for processing. All parts are shown in fig. 2.
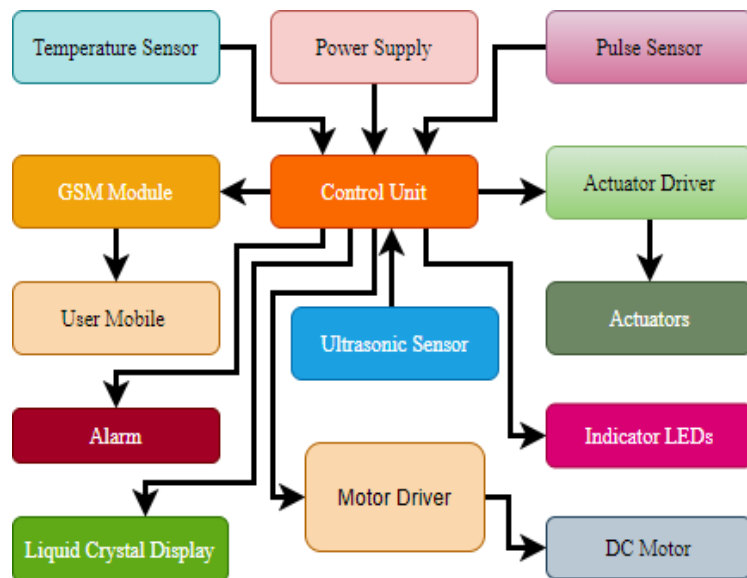

Fig. 2. Block Diagram of the Implemented System

A. *Object Detection and Speed Controlling*

When any hurdle comes in front of the vehicle the sensor detects the hurdle and sends the data to the control unit continuously. If the distance is less than or equal to 1.5m and greater than or equal to 0.7m the led in the front of the driver

will be activated. In the second case if the distance is less than 0.7m the buzzer and actuators will be activated. One actuator is pushing the clutch and brake downward while the second actuator pushes the accelerator upward as shown in fig. 3.
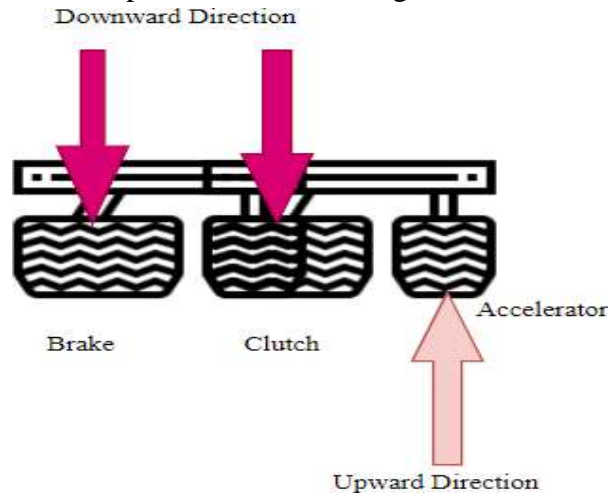

Fig. 3. Clutch, Brake, and Accelerator View

After the function of the controlling three main components of the car, the car will stop.

B. Drowsiness and Heart Attack Detection

Pulse rate is the number of beats of the heart. When the human goes in the condition of sleep this rate decreases and in same when the heart attack occurs this level also decreases. During both conditions, the system detects and gives the data to the control unit to stop the car and a message is sent to the emergency number.
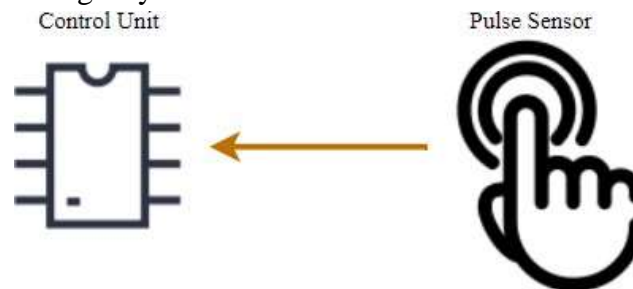
Fig. 4. Pulse Sensor Attached With Driver Finger

The sensor is attached to the finger of the driver and continuously sending the data to the control unit. Based on that, the control unit will decide on the stoping of the car.

C. Internal Temperature of the Car

For the controlling of internal temperature of the car a the temperature sensor measures the current temperature and in case the temperature is increased from the level the side door glass opens automatically as shown in fig. 5. With the increase in temperature the control unit gives the command to the motor driver to start the motor and open the door glass.

Fig. 5. Driver Side Door Glass Opening

The overall system has three units. One unit detects the object in the selected area, the second unit detects the drowsiness and heart attack, and the third unit controls the internal temperature of the car. All the units work parallel and give the data to the control unit to properly give commands and send the data to the emergency number in case of drowsiness or heart attack. The overall system is applicable in any type of car. The communication with the emergency number is done through the GSM Module connected to the controller of the system. The GSM wirelessly transfers the data, and a SIM card is used in the GSM for communication. Furthermore, SMS packages are very inexpensive nowadays and it is very easy to subscribe to SMS offer. The designed hardware of the overall system is shown in fig. 6.
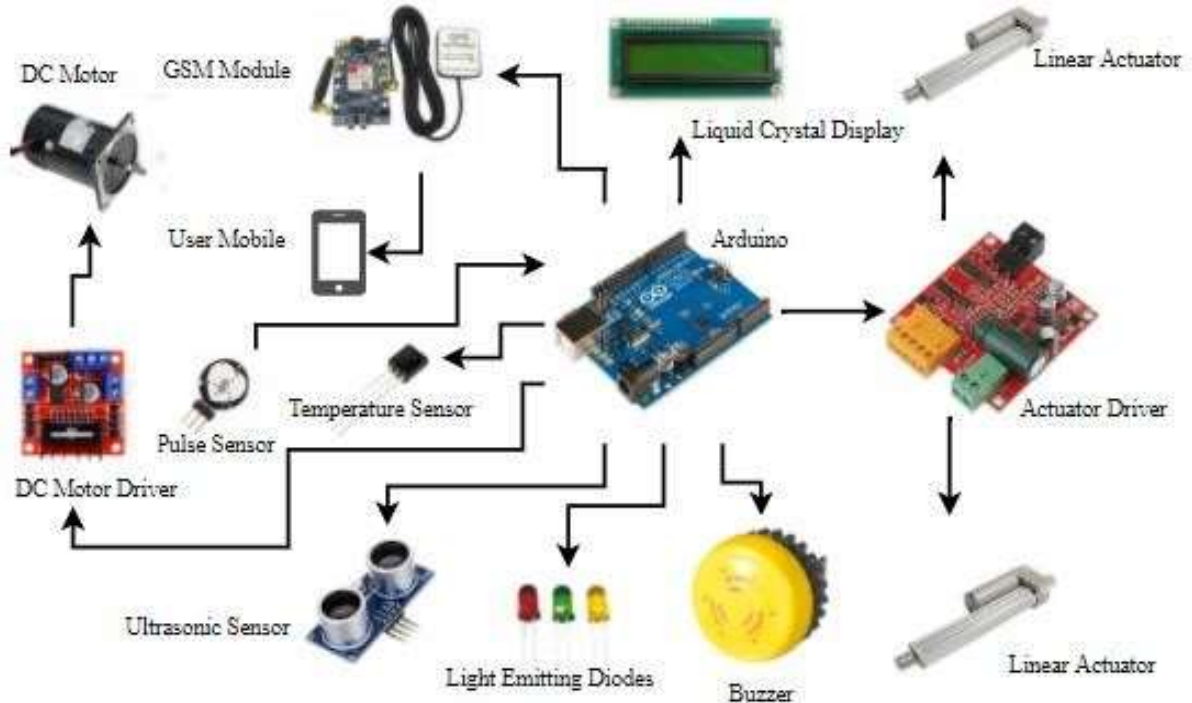
Fig. 6. Implemented Hardware System

Conclusion And Future Work

The results of the system are very good because first, it is very affordable and implementable in every type of car. This system has also the ability to detect the objects in case if the front

glass breaks or sometimes a liquid or other thing falls on the glass and the driver does not see the front road. Also, the internal temperature of the car is controlled because sometimes the drivers continuously using AC of the car and due to heat the oxygen level the driver feels hard to take the breath. In case of drowsiness or heart attack, the car can also control, especially in case of a heart attack driver losing his life but when an accident occurs some other peoples also lose their precious life. In the next phase of the project, hardware can be reduced if the actuator is used for the system.

References

[1] F. Diederichs et al., "Adaptive transitions for automation in cars, trucks, buses and motorcycles," IET Intell. Transp. Syst., vol. 14, no. 8, pp. 889–899, 2020.

[2] U. Ha and H. J. Yoo, "A multimodal drowsiness monitoring ear-module system with closed-loop real-time alarm," Proc. - 2016 IEEE Biomed. Circuits Syst. Conf. BioCAS 2016, pp. 536–539, 2016.

[3] S. G. S. Shah, K. Khoumbati, and B. Soomro, "The pattern of deaths in road traffic crashes in Sindh, Pakistan.," Int. J. Inj. Contr. Saf. Promot., vol. 14, no. 4, pp. 231–239, 2007.

[4] A. Ghaffar, A. A. Hyder, M. I. Mastoor, and I. Shaikh, "Injuries in Pakistan: Directions for future health policy," Health Policy Plan., vol. 14, no. 1, pp. 11–17, 1999.

[5] M. K. Abdul and A. Tehreem, "Causes of Road Accidents in Pakistan," J. Asian Dev. Stud, vol. 1, no. 1, pp. 22–29, 2012.

[6] K. Azam, A. Shakoor, R. A. Shah, A. Khan, S. A. Shah, and M. S. Khalil, "Comparison of Fatigue Related Road Traffic Crashes on the," vol. 33, no. 2, pp. 47–54, 2014.

[7] A. A. Klair and N. Highways, "Trends , Patterns and Causes of Road Accidents on N-5 , North-3 , Trends , Patterns and Causes of Road Accidents on N-5 , North-3 : a Decade Study (2006-2015) By :," no. March, pp. 1–58, 2017.

[8] J. Cordero, "Sistema avanzado de asistencia al conductor para la detección de somnolencia utilizando puntos de referencia faciales Advanced Driver Assistance System for the drowsiness detection using facial landmarks," no. June, pp. 24–27, 2020.

[9] E. Engineering and A. V. Vidyapeetham, "Alert System," no. Icces, pp. 594–598, 2020.

[10] H. Garg, "Drowsiness Detection of a Driver using Conventional Computer Vision Application," 2020 Int. Conf. Power Electron. IoT Appl. Renew. Energy its Control. PARC 2020, pp. 50–53, 2020.

[11] A. Dasgupta, D. Rahman, and A. Routray, "A Smartphone-Based Drowsiness Detection and Warning System for Automotive Drivers," IEEE Trans. Intell. Transp. Syst., vol. 20, no. 11, pp. 4045–4054, 2019.

[12] S. Kailasam, M. Karthiga, R. M. Priyadarshini, K. Kartheeban, and K. Anithadevi, "Accident Alert System for Driver Using Face Recognition," IEEE Int. Conf. Intell. Tech. Control. Optim. Signal Process. INCOS 2019, pp. 2019–2022, 2019.

[13] C. H. Hsieh, D. C. Lin, C. J. Wang, Z. T. Chen, and J. J. Liaw, "Real-Time Car Detection and Driving Safety Alarm System with Google Tensorflow Object Detection API," Proc. - Int. Conf. Mach. Learn. Cybern., vol. 2019-July, 2019.

[14] W. C. Phoon and P. Y. Lau, "Real-Time Forward Collision Alert System using Raspberry Pi," Proc. - 2019 Int. Symp. Intell. Signal Process. Commun. Syst. ISPACS 2019, vol. 2, no. c, pp. 30–31, 2019.

[15] A. A. Hayawi, "Driver ' s Drowsiness Monitoring and Alarming Auto- System Based on EOG Signals," pp. 214–218, 2019.

[16] M. Ratna Kaavya, V. Ramya, and R. G. Franklin, "Alert System for Driver's Drowsiness Using Image Processing," Proc. - Int. Conf. Vis. Towar. Emerg. Trends Commun. Networking, ViTECoN 2019, pp. 1–5, 2019.

[17] S. H. Alam, S. S. Tahsin, I. Tarannum, T. Chowdhury and K. Sarony, "A Cost-Effective Driver Drowsiness Recognition System," 2019 IEEE International Conference on Biomedical Engineering, Computer and Information Technology for Health (BECITHCON), Dhaka, Bangladesh, pp. 20-23, 2019.

[18] I. Bennis, H. Fouchal, O. Zytoune, and D. Aboutajdine, "Drip irrigation system using wireless sensor networks," Proc. 2015 Fed. Conf. Comput. Sci. Inf. Syst. FedCSIS 2015, vol. 5, pp. 1297–1302, 2015.

[19] M. Miranda, A. Villanueva, M. J. Buo, and R. Merabite, "PORTABLE PREVENTION AND MONITORING OF DRIVER ' S DROWSINESS FOCUSES TO EYELID MOVEMENT USING INTERNET OF THINGS Computer Engineering Department Technological Institute of the Philippines Quezon City , Philippines," 2018 IEEE 10th Int. Conf. Humanoid, Nanotechnology, Inf. Technol. Control. Environ. Manag., pp. 1–5, 2018.

[20] U. Ha and H. Yoo, "A multimodal drowsiness monitoring ear-module system with closed-loop real-time alarm," 2016 IEEE Biomedical Circuits and Systems Conference (BioCAS), Shanghai, pp. 536-539, 2016.

[21] L.Chen et al.,"Awearable-glasses-based drowsiness-fatigue-detection system for improving road safety,"2016 IEEE 5th Global Conference on Consumer Electronics, Kyoto2016, pp.1-2.

[22] C. Lin, C. Ding, C. Liu and Y. Liu, "Development of a real-time drowsiness warning system based on an embedded system," 2015 International Conference on Advanced Robotics and Intelligent Systems (ARIS), Taipei, pp. 1-4, 2015.

[23] B. Warwick, N. Symons, X. Chen and K. Xiong, "Detecting Driver Drowsiness Using Wireless Wearables," 2015 IEEE 12th International Conference on Mobile Ad Hoc and Sensor Systems, Dallas, TX, pp. 585-588, 2015.