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Advanced Safety System for Drivers

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Abstract— The study of critical technologies has advanced significantly as the strategic path of advancement for intelligent driving. This mechanism offers safety, real-time monitoring and analysis services for intended issues with perception, decision-making, and control in smart cars modules based on the perception of the intended target's safety system safety, driving scene, and functioning are examined and assessed to increase the safety of autonomous driving which could contribute to the advancement of smart driving. Since safety is the most significant necessity in modern cars, many experts and engineers in the field of automotive design have focused on it. The number of people deceased in car accidents as a result of distracted driving and not wearing a seat belt has risen significantly. In this regard, an initiative has been conducted to build an automotive safety system that will not start only if the driver buckles up and will inform the driver if lethargy is detected. The NeuroSky Mind-wave headset is used in the developed framework to record different electroencephalogram (EEG) ranges. Furthermore, to manage the engine starting, a limiting Switch electronic circuitry is developed and coupled between the safety belt and the spark plug. Eventually, the Arduino microcontroller is employed as a signals processor unit to regulate the car's safety mechanism. The results of the tests demonstrate that the technology can substantially improve protection of the driver.

Keywords— Intended safety system, Safety Features, Intelligent Driving, Arduino, Drowsy Driving Detection System (DDDS).

INTRODUCTION

Modern automobiles contain numerous safety elements that contribute significantly to the reduction of traffic-related injuries and deaths. Not donning a seat belt and driving while drowsiness are two of the leading causes of deadly car accidents. Among the most crucial safety features in modern vehicles is the seat belt, which can protect occupants in the case of a collision or other incident [1]. Although many countries now require travellers to use seatbelts, and some impose penalties for those who don't, several people still fail to prepare for impact whilst travelling. Drowsy driving has become a global issue, and this is one of the primary reasons of automobile accident fatalities. Drowsy driving is said to be the cause of 30% of road accidents [2]. Drowsiness detection systems have been developed using a variety of ways. Some of the approaches utilized to construct such a system include physiological measuring changes in person driving the car, such as Heart-Rate Variations (HRV) [3] and electroencephalogram (EEG) [4]. When compared to other approaches, the EEG approach has demonstrated to have greater advantages because it clearly reflects brain processes as well as the current proper status choice. In a nutshell, the goal of this research is to develop a better car safety system that minimizes the number of people lost in road accidents. The envisioned technology has two parts: a seatbelt-to-ignition system connection and a DDDS (drowsy driving detection system). The goal is to build a locally built mind-wave headset that is quite compact and more convenient for the driver to carry in the future. It is believed that the automobile will not start if the headset is not worn. Additional feature that could be involved is a connection between the seat belt system and the transmission to restrict the vehicle's speed if the user does not buckle up.

RECREATION OF DRIVING SCENE AND PROTOTYPE

Establishing the scene database is a precondition for analysing the driving situation. By gathering the driving information of the actual driver, the driving judgment for several common scenes is codified and examined. Under the assumption of ensuring various functions, the intelligent vehicle may significantly increase the safety of smart driving when paired with scene recovery and identification . Establishing the scene dataset is a precondition for analysing the driving situation. By gathering the driving information of the actual driver, the driving judgment for several common scenes is codified and examined. Under the assumption of assuring various functions, the autonomous system may significantly increase the safety of smart driving when paired with scene recovery and identification. Numerous variables, including the state of the roads, the environment, and the weather, have an impact on autonomous driving. The secret to maintaining safe driving is learning how to deal with external conditions and consistently carry out external detection, driving decisions, and motion control. Mind Computer Interface (MCI) allows interaction between the brain and a computer or indeed any device. As a result, the MCI enables humans to interact with their surroundings and external equipment via their brain processes. Many disabled persons, including those with locked-in syndrome, fitz, paralysis, and spinal-cord injuries, have benefited from this treatment [5,6]. MCI communication can typically be accomplished in three different ways: invasive, semi obtrusive, and non-invasive approaches [7, 8]. Electrodes are inserted right inside the brain or within the skull but externally the brain in the Invasive and Partially Invasive MCIs, accordingly. The benefit of this procedure is that the signal strength is higher than non-invasive methods. However, when physically implanting wire and pins made of metal into the brain, the Invasive system may not be totally reliable [9]. Furthermore, the approach may raise ethical concerns [9,10]. Non-invasive MCI, on the contrary, is thought to be quite safe, despite having the poorest signal clearance [8]. Neural impulse actuator, mentality and EPOC [11] are just a few of the personal gateways that have been explored for human machine interaction. The mindset wearable system is applied in our research. The planned system's schematic architecture is shown in *Fig* 1. The system includes a data computation unit, two inputs:- NeuroSky Headset, Seat- belt Limit Switch,) along with three outputs (, Alarm, Arduino, Illumination Systems and Car Engine). The car only starts if a condition is fulfilled- that the driver is properly wearing the seatbelt, this is recognized by the limiting switch. Furthermore, the use of NeuroSky headset is to identify any irregularity in driver's conciousness and trigger the alarm and car illumination to inform the driver and other drivers in order to deter an accident. The impulses from the Seatbelt Control Switch and the NeuroSky Headset are processed by the Arduino microcontroller, which then activates the car ignition system and the warning system. Ultimately, the BlueSMiRF is an Arduino attachment that allows for Wireless connections with the NeuroSky Headset.

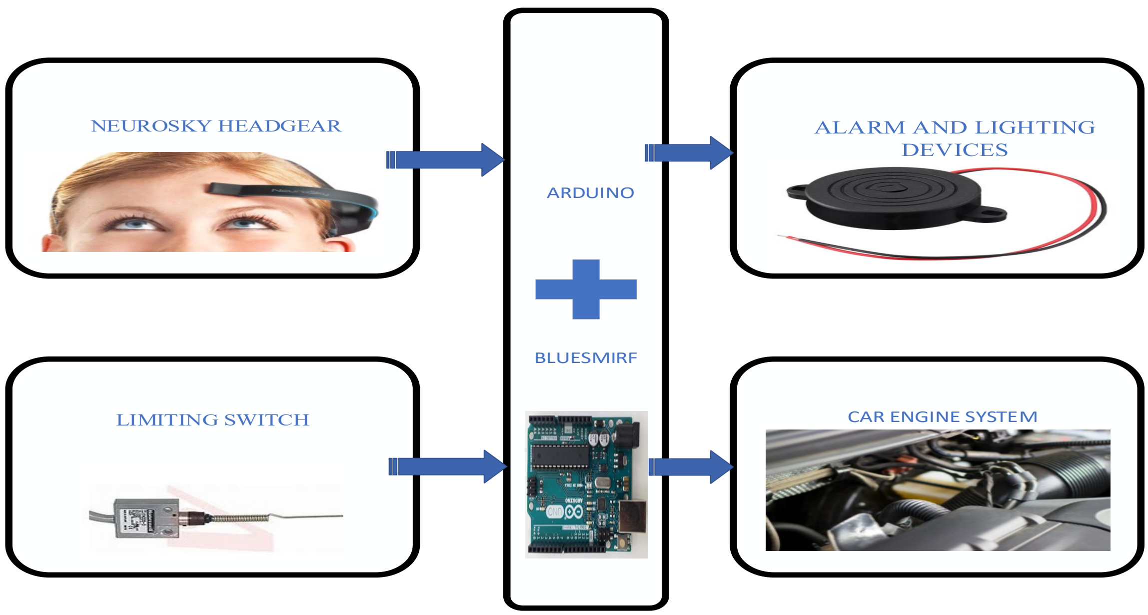

Fig. 1. System Prototype

The Arduino Uno is a microcontroller board developed on the ATmega328 that is open source. It interacted with the surrounding system by receiving input from various switches as well as sensors and manipulating various devices such as lights, motors and other output devices. It contains a reset button, 14 digital I/O pins, a power jack, a USB connector & an ICSP header and as well as a 16 MHz ceramic resonator. It was chosen for this research because it offers UART TTL (5V) serial connection on digital pins 0 (RX) and 1 (TX), as well as Bluetooth communication [12]. Create Arduino language programmes, often known as "sketches," using the Arduino IDE software. Operating systems supported by the Arduino IDE include Windows, Mac OS X, and Linux. All that the Arduino programming interface is simply a collection of C/C++ functions. In this layout, a buzzer is an electromechanical audio signalling device that produces loud sounds to notify the person operating the vehicle. It runs on 3-24V and has a minimum sound output of 95 decibels at 10 cm. Our Bluetooth Modem (BlueSMiRF) has a differing baud rate than the Arduino board. The BlueSMiRF's default baud rate is

115200, while the Arduino board's is 57600. As a result, the BlueSMiRF was set to almost the similar baud rate as the Arduino board in our design. The seat belt contains limiting switch that is normally open type, that was implemented in this design. Alongside a limiting switch is linked in series with the battery and the ignition system [13-15]. Whenever the seat belt is fastened, the plunger gets automatically pressed, closing the electronic circuit and allowing the battery to be linked to the car fuel system. If somehow the plunger does not gets pushed, the circuit will become an open circuit and no electricity will flow, thus isolating the car's ignition system apart from the battery. In this circumstance, the driver will be unable to operate the vehicle. The brain is made up of billions of linked neurons, and the medium of interaction amongst them is electrical. In a mature individual, each state of brain has its own set of interactions that culminate in a distinctive electrical discharge that lasts from around 1 uV to 100 uV [16]. Electroencephalography (EEG) is for capturing of the generated electrical signal by the coordinated action of nerve cells, which is used in mind-wave technology [17]. The NeuroSky Headset is a technology that detects electrical activity in the brain and separates it into several varieties of waves based on frequency, permitting it to predict mental state. The Fig.4 headgear is intended to read various neurological waves that represent concentration levels. The device's features include EEG especially implemented for brain monitoring technology as well as wireless Bluetooth networking. A headset, a dry sensor along with an ear-clip make up the equipment (single electrode). The sensor is situated on the top of the head. The EEG data is obtained from FPl using the ear-clip electrode as a reference. With the ThinkGear ASIC chip, the received signal is strengthened and filtrated.

I. Operation of the system:

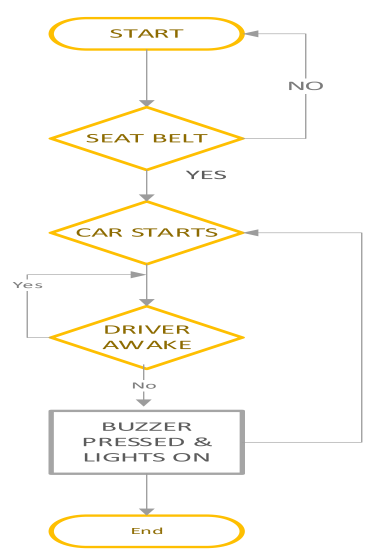

Fig. 2. System Functioning Block Diagram

The car will not operate until the vehicle driver has buckled up his seat belt, as illustrated in the diagram. When the seat belt is fastened, the switch is activated, allowing the driver to start the engine. The groggy driving sensing system is then turned on. It identifies whether the driver is awake or asleep. The Meditation signal is detected by the headset and sent to the Arduino through BlueSMiRF. If the driver is not awake, the Arduino evaluates the signal using the written programme and sets the alarm and led. The system's operation is depicted in a flow chart in Fig.2. Before putting the system together, each device's functionality was evaluated separately. The code was validated on a white board prior even being installed on a current car using Arduino IDE software and Windows 8. First, a prototype car was used to check whether the system, which included a seatbelt with a limiting switch connected in series between both the battery and the motor [18]. The limit switch closed the circuit when the seatbelt was fastened, allowing current to pass from the battery to the ignition system, allowing the automobile to start. Next, the driver puts on the NeuroSky headset and pretends to be asleep and awake. The NeuroSky headgear detects changes in mind-wave impulses and initiates the detecting systems buzzer and signal lighting systems as soon as they occur [20]. The system was tested on three individuals between the ages of 20 and 28. Both drivers were required to wear a seatbelt to ready to initiate the engine during the evaluation of safety system made for seat belt. When the driver didn't strap up, the engine wouldn't start. A preliminary test was done to check the efficacy of the detection system made for groggy driving. Each participant did five trailers. If the system identifies groggy driving and triggers the sound alarming systems, the trial results are considered 100 percent accurate. The overall average accuracy is 90%.

CONCLUSION

It is anticipated that such a system will significantly minimalize traffic-related injuries and fatalities. The device also ensures that drivers adhere to safety standards such as wearing their seat belts and being awake while driving. The Car Safety System was developed effectively with 90% accuracy. Despite the fact that several methods have been developed to detect drowsy driving, the suggested approach has several merits: Because the equipment is small, it can be installed on any automobile. The system is affordable, with the total cost of the system being less than 22k rupees. Greater precision because the system relies on the brain-wave signal instead of head or eye motion. Increased Safety: The system will inform tired drivers as well as other drivers in the area. When the mechanism is uncomplicated and only has a few elements, it is simpler to troubleshoot.

REFERENCES:

[1] J. D. Liu, “Behind the accident, the road left unmanned is still very long,” Robot Industry , vol. 3, pp. 111-118, 2018.

[2] Gordon S. Ensign. 23rd Jun 1987. “Car safety seat”. Patent US4674800.

[3] S. L. Shang, B. Li, “Research on expected functional safety technology of vehicle electronic control system,” China Standardization, vol. 481, pp. 58-62, 2016.

[4] 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," 2019 International Conference on Machine Learning and Cybernetics (ICMLC), 2019, pp. 1-4, doi: 10.1109/ICMLC48188.2019.8949265.

[5] J. Zhang, G. Lu, H. Yu, Y. Wang and C. Yang, "Effect of the Uncertainty Level of Vehicle-Position Information on the Stability and Safety of the Car-Following Process," in

IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 6, pp. 4944-4958, June 2022, doi: 10.1109/TITS.2020.3044623.
[6] E. Abe, K. Fujiwara, T. Hiraoka, T. Yamakawa and M. Kano, "Development of drowsy driving accident prediction by heart rate variability analysis," Signal and Information Processing Association Annual Summit and Conference (APSIPA), 2014 Asia-Pacific, Siem Reap, 2014, pp. 1-4.
[7] Élodie Morin, Mickael Maman, Roberto Guizzetti, Andrzej Duda, "Comparison of the Device Lifetime in Wireless Networks for the Internet of Things", IEEE Access, Vol. 5, pp. 7097-7114, April 7, 2017.
[8] C. T. Lin, C. J. Chang, B. S. Lin, S. H. Hung, C. F. Chao and I. J. Wang, "A Real-Time Wireless Brain–Computer Interface System for Drowsiness Detection," in IEEE Transactions on Biomedical Circuits and Systems, vol. 4, no. 4, pp. 214-222, Aug. 2010.
[9] A. Yikeremu, "Analysis of problems in the development of driverless car technology," Automobile&Parts, no.29, pp. 50-51, 2018.
[10] M. M. Moore, "Real-World Applications for Brain-Computer Interface Technology", IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol. II, No. 2, pp.162-165, June 2003.
[11] X. Zhang, M. Zhou, W. Shao, T. Luo and J. Li, "The Architecture of the Intended Safety System for Intelligent Driving," 2019 IEEE International Symposium on Circuits and Systems (ISCAS), 2019, pp. 1-4, doi: 10.1109/ISCAS.2019.8702580.
[12] K. Al Hammadi, M. Ismaeel and T. Faisal, "Intelligent car safety system," 2016 IEEE Industrial Electronics and Applications Conference (IEACon), 2016, pp. 319-322, doi: 10.1109/IEACON.2016.8067398.
[13] Ramesh C R and L. B. Das, "Brain Computer Interface device for speech impediments," 2015 International Conference on Control Communication & Computing India (ICCC), Trivandrum, 2015, pp. 349-352. doi: 10.1109/ICCC.2015.7432918
[14] I. A. Mirza et al., "Mind-controlled wheelchair using an EEG headset and arduino microcontroller," Technologies for Sustainable Development (ICTSD), 2015 International Conference on, Mumbai, 2015, pp. 1-5. doi: 10.1109/ICTSD.2015.7095887
[15] X. J. Yang, S. Quan Xv and F. J. Liu, "Research on Typical Faults of Active Safety Components of Passenger Cars," 2020 4th Annual International Conference on Data Science and Business Analytics (ICDSBA), 2020, pp. 166-168, doi: 10.1109/ICDSBA51020.2020.00049.
[16] Brain Computer Interfaces, a Review, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3304110/, (accessed on17th October 2014)
[17] E. Moravčík and M. Jaśkiewicz, "Boosting car safety in the EU," 2018 XI International Science-Technical Conference Automotive Safety, 2018, pp. 1-5, doi: 10.1109/AUTOSAFE.2018.8373307.
[18] Agrawal, Navin Kumar, et al. "Design and development of IoT based robotic arm by using Arduino." 2020 Fourth International Conference on Computing Methodologies and Communication (ICCMC). IEEE, 2020.
[19] Karthikeyan, P., et al. "Iot based Simulation of Robot for Pattern Painting on Walls via Android Application." 2022 2nd International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC). IEEE, 2022.
[20] Kumari, Mona, Ajitesh Kumar, and Ritu Singhal. "Design and analysis of IoT-based intelligent robot for real-time monitoring and control." 2020 International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC). IEEE, 2020.