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Smart Helmet Using IoT

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ABSTRACT—Travel is becoming a need in both the richest and poorest neighborhoods, given the premise that people are growing and metropolitan areas are becoming larger. Two - wheelers are much more prominent in India than cars and vans due to their low cost and convenience. In many cases, the rider is injured primarily on the skull. A helmet is very necessary for the rider's safety. For many ages, it has been recognized that various technological advancements are influencing how things operate in practice. More innovations have been made from the origin of recorded history to answer the present problems that humans face on a daily basis. Transport system is one of the businesses that has embraced technological advancements to reduce fatalities and injuries in incidents. As a result of the study of earlier empirical concepts, an advantageous approach for a smart helmet utilizing the Internet of Things architecture has been developed. The smart helmet system was created using a combination of sensors and microcontrollers. The system includes an Arduino UNO controller under the headgear with an ultrasonic sensor and an alcohol sensor, as well as an Arduino UNO microcontroller module with a relay and an RF receiver. This facilitates a smart helmet technique to be implemented effectively and without errors, as evidenced by detailed evaluation.

Keywords: Alcohol Sensor, ultrasonic Sensor, Dual channel relay, Internet of Things, Safety Headgear

I. INTRODUCTION

Motorcycles are by far the most efficient mode of road transportation in densely populated areas as well as rising countries such as India. Two-wheelers, on the other hand, are among the most hazardous types of transportation on the road. A motorcycle accident involving a rider who is not wearing a helmet might be fatal. Intoxication while riding, driving recklessly, doing different antics such as stunting on the streets, being unaware of an incoming automobile, removing hands while navigating, endeavoring to achieve feats while balancing on the motorbike, and many other variables all play a role. The negligence of the motorists jeopardizes not only their own existence, but also the livelihoods of everybody else.

Motorcycle travelling comes with its own set of risks, especially when the operator fails to follow the rules and take the necessary precautions to minimize adverse circumstances that might result in a fatal collision. Despite the fact that there are standards controlling motorcycle safety, the requirements are virtually always disregarded. The traffic wardens are responsible for enforcing motorcycle restrictions are having difficulty due to the rapid increase in the number of motorcycle riders and a shortage of people to manage the problem.

An accident is described as a unique, unexpected, unusual, and unanticipated behavior that may occur at any time and in any environment. The cause of an event might be due to the rider's negligence, a mechanical problem in the vehicle, or it could be unidentified. However, the repercussions of a collision might be fatal or severely injure the motorcyclist or other individuals on the road. The major cause of such events is the irresponsibility of the motorist. Motorcycle riders may suffer considerably as a result of the lack of quick first aid and medical assistance. Some deaths happen as a consequence of the paramedic neglecting to actually show up on time at the designated place. In order to conserve time and warn the right person in the event of a catastrophe, a strategy is proposed that can guarantee that the rider obtains the adequate treatment as soon as possible.

Even though an incidence is one cause of death, the other is a lack of quick First Aid and Critical Care. As per the evaluation, more than half of all injured people die as a result of a lack of prompt care, a paramedic's delayed reaction, or no one else at the site of the accident to offer details to the paramedic. This is the situation in our daily lives; the concept of finding a solution to problems led to the aim of sharing accident details at the earliest and on time because, after all, timing is important; if only about anything and everything is finished on schedule, we that would save a large portion of the dead civilians due to bike accidents.

Traffic accidents are often averted by raising awareness and employing appropriate technical developments. There are numerous instances of such incidents that occur and enlightened us on a daily basis. That each incidence, whether it be in one's everyday life or on the road, has its beginnings within you or someplace nearby. Any form of street crash, like every other catastrophic event in life, is a devastation that may help you to comprehend how valuable life is and how important it is to carry preventive measures with you until riding a motorbike. According to this concept, current technologies has significantly reduced road deaths by applying safety protocols. Whenever it relates to motorcycle vehicle crashes, it might be due to speeding, drinking too much alcohol, or any other reason. This distorts the truth inside; alternatively it might be the result of unintentional catalysts. These factors are not attributable to human irresponsibility, but to miscalculations brought on by some other factor. Another car colliding with you, bad weather, and so on might all be factors. As a result, an effective approach to reducing such occurrences is required, which has already been properly surveyed in their survey paper.

In section 2 of this research paper, relevant studies are discussed. The suggested approach is described in detail in section 3. In part 4, the experimental assessment is carried out, and section 5 concluded this study piece with the potential for future improvement.

II. LITERATURE SURVEY

P. Li, R. Meziane et al. [1] developed an intelligent system for detecting worker risk in an industrial plant. At the heart of this system is the Smart Safety Helmet (SSH), which combines IMU and EEG sensors. In the final experiment, the authors demonstrate how an accelerometer can detect head motion caused by worker tiredness and sleepiness. The normalized acceleration variance of the X- and Z-axes could be utilized as indexes in this research to distinguish harmful motion from others. These data could be merged with the EEG signal to improve the risk prediction's accuracy. Three actions are suggested identified in the risk assessment risk level: 1) take no action (low risk), 2) notify the user via haptic biofeedback such as vibration motor (medium risk), and 3) shut down the machine tool if the risk level exceeds the high danger level.

C. J. Behr et al. developed a smart mining helmet that can detect three different types of unsafe events: dangerous levels of hazardous gases, miner helmet expulsion, and collision or impact. A miner yanking his mining helmet off his head was deemed a dangerous occurrence. Following that, an off-the-shelf infrared sensor was successfully used to identify when the miner's helmet was on his head. A miner being struck in the head by an object with a stronger force than 1000 on the HIC is another potentially deadly scenario [2]. An accelerometer was used to monitor the head's acceleration, and the HIC was estimated using the software. The visualization software's layout was finished. The accelerometer was successfully calibrated during tests. A breakout board and a prototype board were among the PCBs designed and manufactured. To govern the measuring of sensors and the calculations made with the measured data, a comprehensive software implementation dependent on Contiki OS was created by the authors. The system was thoroughly tested to evaluate whether or not it meets the standards.

V. L. Padmini et al. are investigating the use of a machine learning-based technique to assess helmet wear among motorcyclists. Using video frames obtained from security cameras, the object detection-based system is trained to recognize motorcycles and their helmets [3]. The desktop interface program visualizes live streaming traffic surveillance footage with tools and algorithms similar to OpenCV and support vector classification. When trained, the Linear SVC algorithm generates data relevant to motorcycle helmet use based on existing road traffic surveillance. When the item is further away from the field, the developed algorithm produces high accuracy results that slightly diverge.

D. Bibbo et al. show that a solar cell array mounted on a cyclist's helmet might generate enough energy to power a variety of smart sensors, with applications ranging from human performance monitoring to improving road safety. The same device might be used in a variety of situations where a helmet is required and wearing sensors on the head are required, such as airbag activation in motorcycles. Furthermore, because placing big batteries near the head, particularly when long battery life is required, can be dangerous, such systems could be a valuable tool in ensuring user safety [4].

M. Jeong et al. [5] developed a software framework that enables the integration and management of a wide range of IoT-based devices and services. A smart helmet with sensors, HMD, and command center system was developed. In addition, the authors used a simulator to evaluate the smart helmet and executed the actual field trials depending on the scenario. They were able to subscribe and notify the information of the rescuers in real-time, and they were able to identify the location-based search and notification functions for the search region between the rescuers.

S. J. Swathi et al. developed a safety framework that integrates a smart helmet with a bike to lower the risk of two-wheeler accidents, bike theft, and intoxicated driving. The RFID technology, password authentication, and sensors, such as a gas sensor and a proximity sensor, are utilized to accomplish the suggested methodology. In this proposed technology, a proximity sensor is installed in the helmet, preventing the user from riding the two-wheeler if the helmet is not worn [6]. The Gas Sensor is installed to detect whether or not the rider has ingested alcohol. If this is the case, the ignition system will not turn on. The ignition system turns on, and the gas sensor determines whether or not the rider has drunk alcohol; if so, the gas sensor detects it, and the ignition system turns off automatically.

The IoT-based Smart Helmet is low-cost assistive equipment that ensures the biker's security and safety in the event of a traffic accident. D. N. et al. suggested an IoT-based helmet that will be able to track the biker and relay GPS coordinates to a pre-defined number, preventing road accidents and detecting alcohol intake. It may also identify a crash and send a notification to a predetermined number as well as the nearest police station. The microcontroller, piezoelectric sensor, position sensor, alcohol sensor, IOT modem, RF transmitter, GPS receiver, power supply, and solar panel are all part of this system [7].

M. A. Rahman et al. suggest a smart helmet model for accident detection and prevention. For accident prevention, IR sensors, gas sensors, and load sensors are used. Any accident is detected using a 3-axis accelerometer [8]. The Arduino platform is used to interpret sensor data and provide a communication system between sensors and mobile apps. The mobile application is linked to a central monitoring system, allowing authorities to keep track of each user's accident history. When an accident occurs, the location of the accident is sent to the monitoring database, which then sends the location to the nearest hospital and police station. The accident detection system is highly accurate, and it records, detects, and reports incidents in real-time. The rider might use the driving data to better his or her driving. This approach encourages motorcycle riders to wear helmets. A motorbike excursion would be more protected and safer with the smart helmet.

The framework of the Konnect smart helmet is described by S. Chandran et al. An integrated network of sensors, a Wi-Fi-enabled CPU, and cloud computing technologies are used to create the smart helmet for accident detection and warning. The helmet is intended to identify an accident and immediately notify emergency contacts. The danger of an accident is quantified using a 3-axis accelerometer that continuously monitors the driver's head orientation and helmet position [9]. When the threshold limit is exceeded, an automatic text message is sent to the emergency numbers with the driver's location. The text messages are sent out at regular intervals to make it easy for the driver's contacts to find him. Therefore, a smart helmet for accident detection is built using ubiquitous connectivity.

Dr. Y MohanaRoopa et al. [10] designed a smart helmet in conjunction with three major components are Alcohol Sensor, Accident Switch with GSM, and GPS. In a single helmet, all of these components are fixed together. So far, only the Alcohol Sensor and the Accident Switch have been integrated into a single system. However, the authors propose that, in addition to the Alcohol Sensor, the Accident Switch and GSM, and GPS be integrated into a single helmet. The Alcohol Sensor is a device that detects whether or not the motorist has consumed alcohol while driving. If the driver has ingested alcohol, the system will deliver an alarm message when the person has consumed alcohol. Accident switches, also known as Bump switches, are used to send emergency SMS alerts to contacts on the victim's phone as well as hospitals.

The two-wheeler safety system, which includes a smart helmet and an intelligent bike, is dependable and intends to assist in the prevention, detection, and reporting of accidents, therefore lowering the likelihood of drunk driving cases. It also has several advantages over prior systems. R, Tejashwini et al. proposed approach emphasize the importance of preventing accidents and ensures a higher level of safety in two-wheelers. The majority of accidents nowadays are caused by motorcycles. The severity of these accidents is exacerbated by the lack of a helmet or the consumption of alcoholic beverages [11]. By applying this system, a safe two-wheeler ride may be achieved, reducing the number of head injuries caused by accidents caused by the lack of a helmet, as well as the number of accidents caused by intoxicated driving. In the event of an accident, a GSM modem will send a message to the specified

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numbers that have been programmed using a microcontroller.

R. Vashisth et al. introduced the smart helmet. The helmet unit includes an alcohol sensor, a helmet on detection circuit, a fog sensor, a GSM module, an LCD, a microcontroller ATMega328-PU, an accelerometer for accident detection, and an RF module. The sensors in the helmet produce the analog output. This signal is routed to a comparator, which serves as an ADC. The output signals of the comparator and sensor lock are encoded as binary signals and sent via the RF transmitter. The RF Module [12] includes a transmitter with a range of 5 meters. It is used to send control signals to the bike module for implementation. It is used to send control signals to the bike module so that they can be implemented. ALCHO-LOCK is a function that is used to avoid drunk driving incidents. Accidents are recognized by an accelerometer, which is increased by the inclusion of a GSM module in the circuit, which is meant to automatically send one message to one personal contact and one responsible authority indicating that the individual has been in an accident, as well as a fog sensor to improve visibility in the event of fog or smog.

III PROPOSED METHODOLOGY

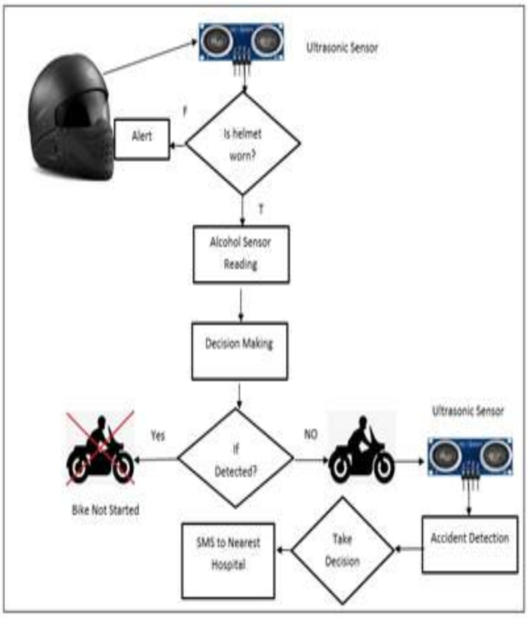

Figure 1: System Overview Diagram

The presented approach for the Smart helmet system has been elaborated graphically in the system overview displayed in the figure 1 above. The approach has been detailed in a step by step manner in the section given below.

Step 1: Data Collection – For the purpose of initiating the approach the Arduino UNO microcontroller is interfaced with the development laptop. The Arduino UNO controller is being used for the purpose of connecting the sensors and collecting their readings. This setup includes the use of a number of different sensors, such as, ultrasonic, Alcohol sensorand a RF module that are connected to the helmet. These sensors are connected to the microcontroller board and a sketch for collection and streaming of the sensor readings to the laptop is uploaded on the microcontroller. The circuit diagram for the same is given in the figure 2 below.

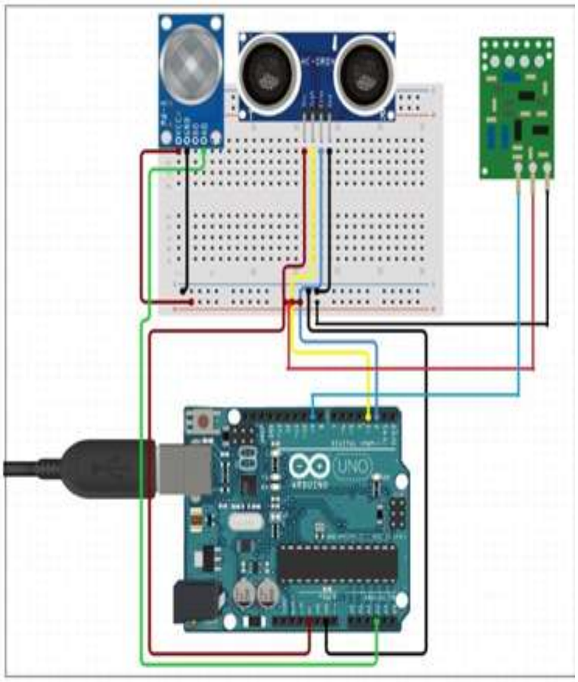

Figure 2: Circuit Diagram for helmet connections

Step 2: Helmet and Alcohol Sensor Status Estimation–ere in this step, the ultrasonic sensor is weaved inside the helmet to get its value when it is worn. If it is worn the threshold value of less than 10 is triggered in the system. This event eventually starts the bike using a two channel relay. For the purpose of demonstration, the designed project is used a toy bike enabled with batteries which is implicitly controlled by the relay channel. On the other hand, once the bike starts, if the alcohol sensor senses alcohol, then its value hits 650 and above and then this triggers to event of shutting down the bike. The circuit diagram for the relay with Arduino is shown in the figure 3.

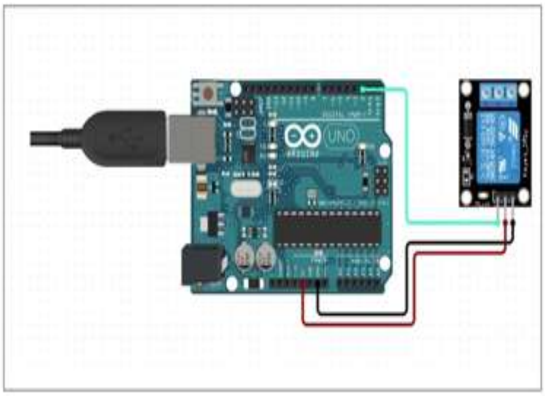

Figure 3: Arduino with Relay

Step 3: Accident Identification and Intimation – After the successful realization of the biker wearing the helmet and the biker is not under the influence of alcohol, the bike will be started and the rider can operate the vehicle. The bike has an ultrasonic sensor attached through an Arduino UNO microcontroller as shown in the figure 4 given below. The ultrasonic sensor is being utilized to detect the event of a collision, which is done by scanning for the ultrasonic sensor values if they drop below 10. Once a scenario of an accident has been detected through a change in the sensor values, the system is triggered to send an emergency response to the selected numbers through the pywhatkit. This allows for a timely response the accident scenario.

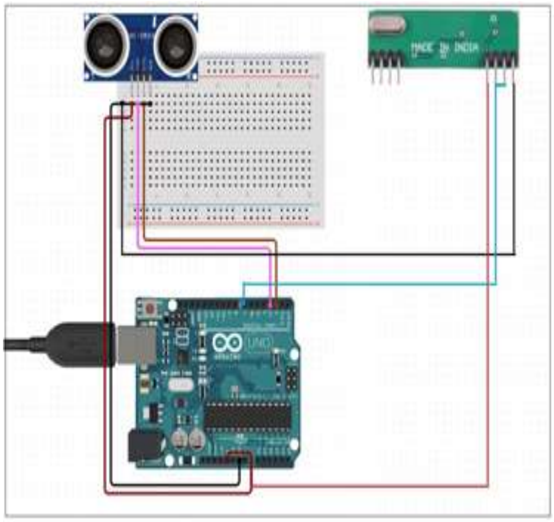

Figure 4: Circuit Diagram for Arduino and ultrasonic for accident detection.

IV RESULTS AND DISCUSSIONS

The formulated strategy for the creation of a smart helmet has been developed through the use of the Java platform on the NetBeans IDE. On a development laptop featuring an Intel Core i5 CPU, 1TB of hard disc drive configuration, and 8GB of RAM, the proposed technique was implemented. The integrated sensor array is controlled by an Arduino UNO microcontroller.

The provided technique's assessment criteria were thoroughly evaluated. The RMSE and MSE assessment methods, which may also reliably reflect the productivity of the given approach, were used to examine the practicality of the proposed approach. The evaluation criteria were thoroughly examined to indicate that the smart helmet approach provided in this study was successfully implemented.

Performance Evaluation based on Root Mean Square Error

The efficiency of the Smart helmet system was assessed using the Root Mean Square Error (RMSE). The error value among the two or more relevant and dependent variable is computed using the RMSE approach. The total number of events and the true events for smart helmet system initialization that consists of helmet being worn, alcohol being consumed and accident being detected which are intimately comparative and consistent attributes in the development of the proposedframework. Equation 1 given below will be used to compute this.

– $$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(x_{1,i} - x_{2,i})^2}{n}} \quad (1)$$

Where,

$\sum$ - Summation

$(x_1 - x_2)^2$ - Differences Squared for the summation in between the total number of eventsand the true events for helmet worn, alcohol consumed and accident detected

n - Number of samples or Trails

Table 1 shows the results of using the RMSE metric to gain a more thorough representation of the performance metrics.

Scenario	No. of Events	True Events	MSE
Helmet Worn	5	5	0
Alcohol Consumed	5	5	0
Accident Detected	5	5	0

Table 1: Mean Square Error measurement

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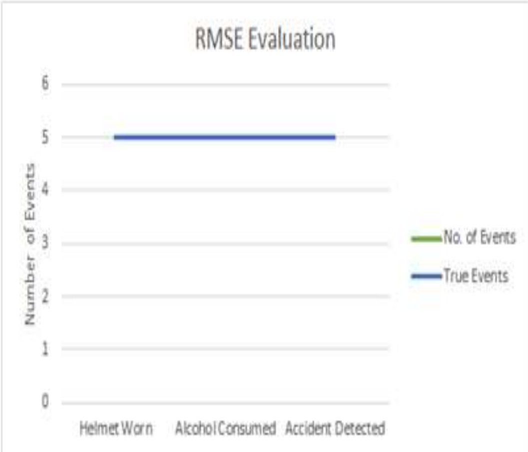

Figure 5: Comparison of MSE in between properly identified sensor values V/s improperly identified sensor values

Table 1 and the plot in Figure 5 represent the mean square error rate among the total number of events and the true events for helmet worn, alcohol consumed and accident detectedfor a total of five sequences. The average RMSE of the extended trials was 0. The RMSE characteristics are calculated with the goal of identifying sensor values for smart helmet initialization. The system is regarded exceptionally accurate if the RMSE value is zero. The RMSE number suggests that the first execution of such a strategy was exceedingly successful and remarkable.

V. CONCLUSION AND FUTURE SCOPE

The presented approach for the realization of the Smart Helmet system has been elaborated in this research article. Motorcycling is more cost-effective to run, more adaptable in congested areas, and easier to park. Furthermore, statistics indicates that the number of people who go on two wheels is rapidly growing. In India, there seem to be a large number of road deaths each year. Fatal accidents can happen for a multitude of reasons, involving riding whilst inebriated, irresponsible behavior, driving dangerously, and so on. Frequently, the person who has been hurt is not to blame for the accident. It might be the fault of the person of another car. Both commuters, though, will be affected. As a result of this investigation, an appropriate methodology for a smart helmet using the Internet of Things architecture has been developed. This approach has utilized an array of sensors and microcontrollers for the purpose of achieving the smart helmet system. The system utilizes an Arduino UNO controller with the ultrasonic sensor and alcohol sensor in the helmet along with an Arduino UNO microcontroller board with the relay and an RF reciever. This enables an effective and error free implementation of a smart helmet approach which has been confirmed with extensive experimentation.

For the purpose of future research, this approach can implemented into other vehicles in a real time scenario such s cars, busses and trucks.

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