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An Iot Based Smart Helmet With Real Time Communication For Accident Detection And Prevention

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ABSTRACT: It aims to provide a smart helmet that will give a systems and devices capable of accident detection and notification. It uses a sensor; and cloud computing infrastructures for building the system. The accident detection system outputs the accelerometer values to the processor which is constantly on the lookout for erratic changes. When the emergency occurs, the vehicle location is obtained by making use of the global positioning system. The system promises a reliable and quick delivery of information relating to the accident in real time and updated to cloud which are accessed by IOT. Thus, by making use of the ubiquitous connectivity which is a salient feature for the smart cities, a smart helmet for accident detection is built.

I. INTRODUCTION

There are around a large number of street mishaps every year in India. The Accidents may be cause due to many reasons like by drink and drive, be more reckless, drive faster, etc. Other times the person who gets hurt may not be responsible for the accident. It might be the fault of some other vehicle rider. However, generally many of the riders will undergo accidents, rescuing is more complicated than it sounds & sometimes the riders may also die. Some deaths are due to the ambulance not arriving at an expected location quickly. In case of accident, to save time, to inform the relevant person, a system is suggested which is able to ensure that the rider receives the necessary attention in a brief time. A helmet plays a very important role in saving the life of the ridden So to encourage people to wear helmets and to avoid accidents, a design is proposed that synchronizes the module present in bike.

III. LITERATURE REVIEW

The paper by Hussain A. Attia and Shereen Ismail presents an enhanced electronic safety system design, complete with simulation results tailored for teenagers and older drivers.[1] These groups often exhibit physiological traits that can lead to various driving errors, necessitating careful monitoring to prevent their recurrence. In contrast to the initial design, the safety system discussed here incorporates two additional parameters: the frequency of driving errors and the duration of those errors. The total number of recorded driving errors—whether they fall below or exceed the established front distance limits—will be evaluated. If the count surpasses a predetermined threshold, an appropriate safety response will be initiated. The simulation results showcase the system's ability to recognize three distinct driving conditions: safe front distance, short front distance alarm, and long front distance alarm. Furthermore, the findings highlight the system's effectiveness in terms of response, indicating a promising potential for achieving high performance in driving safety.

Risto Öörni discusses the demand for four intelligent vehicle safety systems (IVSSs)—emergency braking, speed alert, blind spot monitoring, and lane keeping support—by analyzing their demand curves, which illustrate demand as a function of product price. This analysis is based on data collected from user interviews and a review of existing literature.[2] The study also outlines a method for creating both linear and exponential demand curves for these systems using the gathered data. The estimated demand curves were evaluated through least-squares fitting against the user interview data. Results indicated that the mean absolute error was consistently higher for all systems when applying the linear model compared to the exponential model. This finding suggests that the exponential model provides a more accurate representation of the demand for IVSSs than the linear model does.

The estimated linear and exponential demand curves were evaluated using least-squares fitting based on data gathered from user interviews.[3] The mean absolute error was consistently higher for all systems examined when applying the linear model compared to the exponential one. This indicates that the exponential model more accurately represents the demand for IVSSs than the linear model. Shouvik Chakraborty and Sachidananda Sen discussed how the rising number of vehicle accidents has prompted the study and design of active safety systems in modern cars. To achieve this, various sensors are utilized to measure vehicle yaw, wheel velocities, and acceleration. However, determining key parameters such as slip angle and frictional forces can be challenging with sensors and often comes with high costs. Estimating the friction coefficient and frictional forces is crucial for designing effective active safety systems, as this information is essential for creating efficient control systems. Additionally, due to the highly nonlinear nature of the system, using linearized estimation techniques can result in significant approximation errors. This paper introduces an estimation algorithm based on the unscented Kalman Filter tailored for a specific nonlinear tire model to estimate the friction coefficient and both lateral and longitudinal frictional forces.

Chuchu Fan and Bolun Qi published a paper discussing the safety analysis of Autonomous Vehicles and Advanced Driver Assist Systems (ADAS), which is a significant challenge for the automotive industry. In this paper, we introduce a newly developed data-driven formal verification technique and illustrate its application through a case study focused on the integrated safety analysis of an Automatic Emergency Braking (AEB) system.[4] Our approach merges model-based hybrid system reachability analysis with sensitivity analysis of components that may have unknown or inaccessible models. The scenarios we examine for safety analysis reflect the most common types of rear-end collisions, which are critical for evaluating AEB and forward collision avoidance systems. We demonstrate that our verification tool, Dry VR, can effectively confirm the safety of these scenarios—defined by parameters such as braking profiles, initial velocities, and uncertainties in position and reaction times—and assess the severity of accidents in unsafe scenarios. This analysis can quantify the safety envelope of the system within the parameter space, which is beneficial for both design and certification processes. Additionally, we illustrate how reachability analysis can be integrated with statistical data about the parameters to evaluate the risk level of the system, which is crucial for determining Automotive Safety Integrity Levels (ASIL) as required by the ISO26262 standard.

Mallikarjuna Gowda C P and Raju Hajare discuss a proposed system aimed at developing and designing a suitable solution for automotive applications using Zigbee protocols[5]. The existing systems face several issues, including inaccuracies in speed calculations, distance measurements, and slow response times. The proposed system addresses many of these challenges by incorporating a GPS module in place of the traditional speedometer and utilizing sensors that are reliable in situations where human intervention is either unintended or poses a risk to life. The system also tackles the problems associated with traffic congestion.

IV. PROPOSED METHODOLOGY

A. BLOCK DIAGRAM

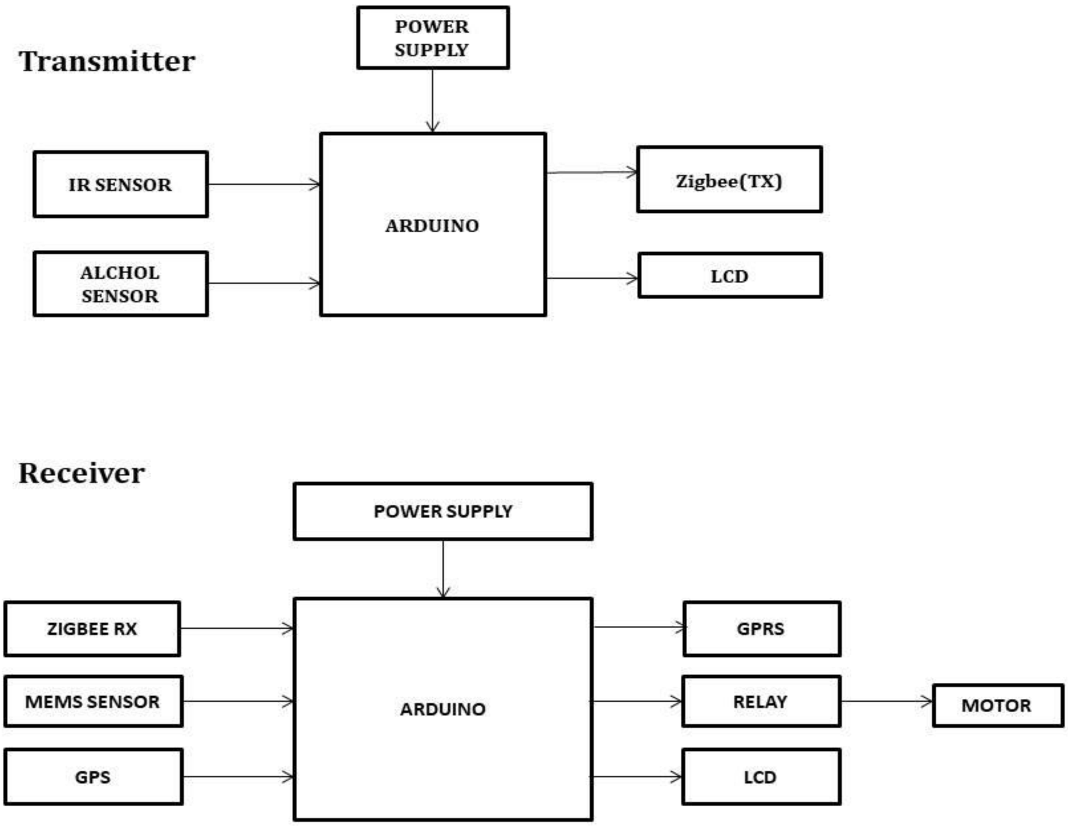

Fig 1: Block diagram

The project is organized into two main units: the helmet and the bike. In the helmet unit, also referred to as the transmitter unit, An IR sensor is positioned on the inside upper part of the helmet, where the head will make contact with the sensor surface. An alcohol sensor is located in front of the rider's mouth for easy detection. Additionally, the battery and standard circuits are housed within the helmet. The secondary controller and RF transmitter circuit are also installed inside the helmet, while the antenna is mounted on the outside. The receiver unit, illustrated in Fig. 13(b), is situated on the bike. The RF receiver collects all data from the helmet (the transmitter unit). If certain conditions are met, the ignition will start, allowing the bike to move. The GPS module can continuously transmit the bike's location information. In the event of an accident, the GSM activates and sends the location details to the registered mobile number.

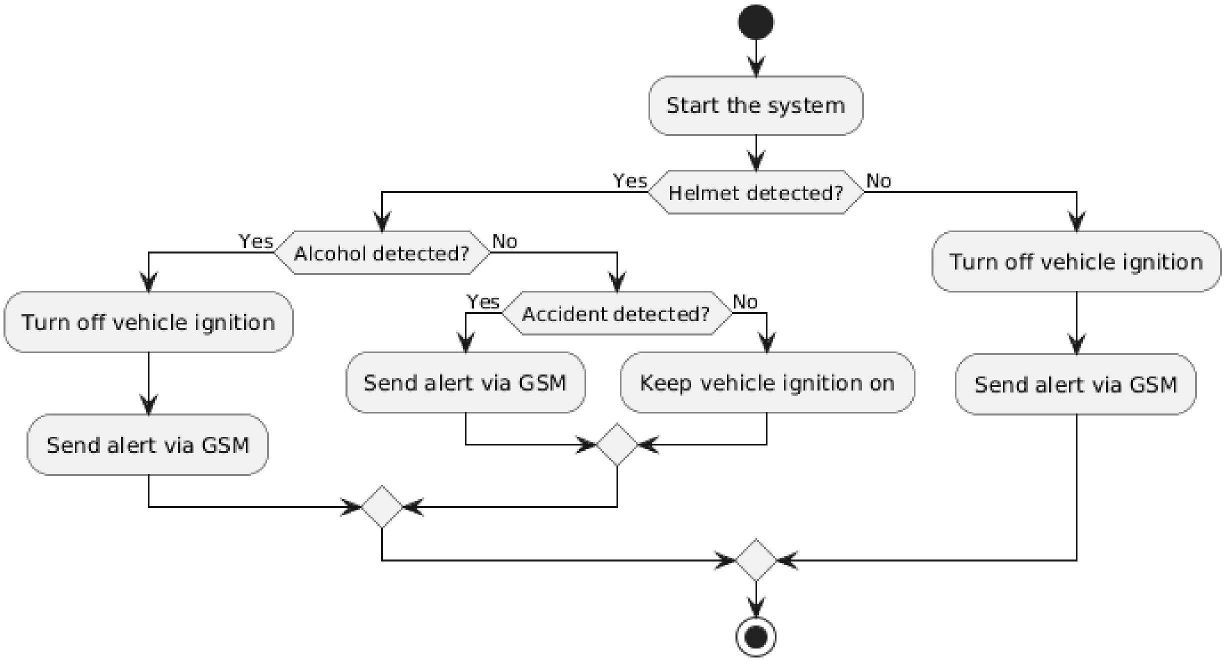

Fig -2: Algorithm of Smart Helmet

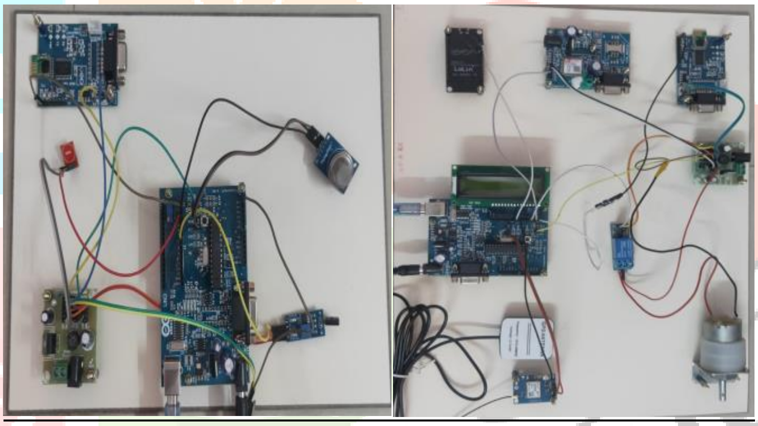

Fig -3: (a): Helmet section (Transmitter) **(b):** Vehicle section (Receiver)

C. VARIOUS SENSORS

1. Arduino UNO: The UNO is an excellent board for anyone looking to dive into electronics and coding. If you're new to this platform, the UNO is the most reliable option to begin your journey. It's the most popular and well-documented board in the entire Arduino lineup. The Arduino Uno features a microcontroller based on the ATmega328P. It includes 14 digital input/output pins (6 of which can serve as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. Everything you need to support the microcontroller is included; just connect it to your computer with a USB cable or power it using an AC-to-DC adapter or battery to get started. You can experiment with your UNO without too much concern about making mistakes; in the worst-case scenario, you can replace the chip for just a few dollars and start fresh.

Fig -4: Arduino UNO

2. Gyroscope Sensor : The ADXL335 is a compact, lightweight, low-power 3-axis accelerometer that provides signal-conditioned voltage outputs. It measures acceleration with a full-scale range of ±3 g. This device can detect static acceleration due to gravity in tilt sensing applications, as well as dynamic acceleration from motion, shock, or vibration. Users can adjust the bandwidth of the accelerometer by selecting the appropriate CX, CY, and CZ capacitors connected to the XOUT, YOUT, and ZOUT pins. Bandwidth options are available to match specific applications, ranging from 0.5 Hz to 1600 Hz for the X and Y axes, and from 0.5 Hz to 550 Hz for the Z axis. The ADXL335 comes in a compact, low-profile package measuring 4 mm × 4 mm × 1.45 mm, featuring a 16-lead plastic lead frame chip scale package (LFCSP_LQ).

Fig -5: Gyroscope Sensor

The ADXL335 is a comprehensive 3-axis acceleration measurement system with a minimum measurement range of ±3 g. It features a polysilicon surface micro machined sensor along with signal conditioning circuitry, which together create an open-loop acceleration measurement architecture. The output signals are analog voltages that correspond to the acceleration detected.

3. IR Sensor: The IR sensor works by emitting infrared light to detect the presence of the helmet and measuring the light that reflects back. When the helmet is within the sensor's range, it reflects the IR light, confirming that it is there. If the helmet is not present, the sensor notices the absence of reflection, which can trigger an alert or activate other actions, such as shutting off the motor.

Fig-6: IR Sensor

This straightforward approach ensures that the system functions only when the helmet is in place, enhancing the rider's safety. IR sensors are affordable and easy to implement, making them suitable for basic proximity detection. However, their effectiveness can be influenced by factors like surrounding light conditions and dirt on the sensor.

4. Gas sensor: The MQ-2 gas sensor uses SnO2 as its sensitive material, which has lower conductivity in clean air. When combustible gases are present, the sensor's conductivity increases with the rising concentration of the gas. A simple electronic circuit can be used to convert this change in conductivity into an output signal that corresponds to the gas concentration. The MQ-2 gas sensor is highly sensitive to LPG, propane, and hydrogen, and it can also detect methane and other combustible vapours. It is cost-effective and suitable for various applications. This sensor is particularly sensitive to flammable gases and smoke.

Fig -7: Gas Sensor

The smoke sensor operates on a 5-volt power supply and indicates the presence of smoke through the voltage it outputs; more smoke results in a higher output. A potentiometer is included to adjust the sensitivity. When smoke is detected, the sensor provides an analog resistive output that corresponds to the concentration of smoke. The circuit includes a heater powered by VCC and GND from the power supply. Additionally, there is a variable resistor in the circuit, and the resistance across the pin varies with the amount of smoke in the air. As the smoke concentration increases, the resistance decreases, leading to a higher voltage between the sensor and the load resistor.

5. Relay's: Relays serve as the main protection and switching devices in various control processes and equipment. They respond to one or more electrical quantities, such as voltage or current, which allows them to open or close contacts or circuits. Essentially, a relay is a switching device that isolates or alters the state of an electric circuit from one condition to another.

Fig -8: Relay

6. Direct Current (DC) Motor: Almost every mechanical advancement we observe around us is driven by an electric motor. Electric machines serve as a means to convert energy. Motors take electrical energy and transform it into mechanical energy.

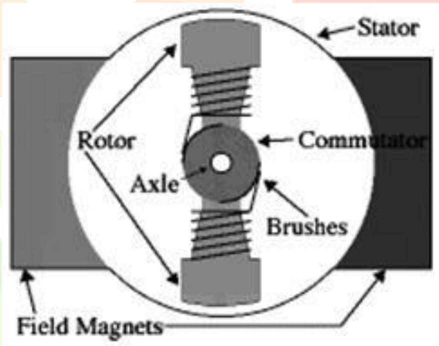

Fig -9: DC Motor

We rely on electric motors to power countless devices in our daily lives. These motors are generally divided into two main categories: Direct Current (DC) motors and Alternating Current (AC) motors.

7. Liquid Crystal Display : An LCD screen is an electronic display module that has a wide range of applications. The 16x2 LCD display is a basic module that is commonly used in various devices and circuits. A 16x2 LCD can display 16 characters per line, with a total of 2 lines. Each character on this LCD is represented in a 5x7 pixel matrix.

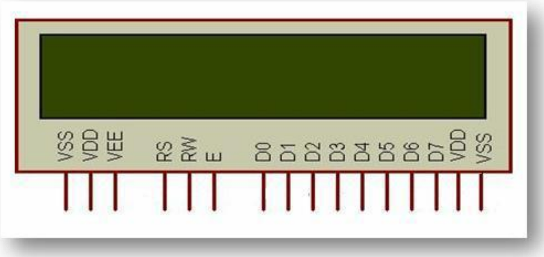

Fig -10: Pin Diagram of LCD

This type of LCD has two registers: the Command register and the Data register. The Command register holds the command instructions for the LCD, which are tasks like initializing the display, clearing the screen, setting the cursor position, and controlling the display. The Data register contains the data to be shown on the LCD, specifically the ASCII values of the characters that will be displayed.

8. Global Positioning System (GPS): The Global Positioning System, commonly known as GPS, is a satellite navigation system that provides users with location and time information under any weather conditions. It is widely used for navigation in various modes of transport, including planes, ships, cars, and trucks. This system offers essential capabilities to both military and civilian users worldwide. GPS delivers continuous real-time, three-dimensional positioning, navigation, and timing across the globe. Comprising at least 24 satellites, the Global Positioning System operates 24/7, regardless of weather, without any subscription fees or setup costs. Initially launched by the U.S. Department of Defense for military purposes, GPS became accessible for civilian use in the 1980s.

Fig -11: Global Positioning System

9. Global System for Mobile Communication (GSM): The Global System for Mobile Communication (GSM) is a widely recognized standard for digital cellular communication. Established in 1982, GSM was created by a standardization group aiming to develop a common mobile telephone standard for Europe, which would set specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is anticipated that numerous countries outside of Europe will also join the GSM partnership.

Fig -12: GSM

The GSM/GPRS Modem-RS232 features a Dual Band GSM/GPRS engine, the SIM900, which operates on frequencies of 900 and 1800 MHz. This modem includes an RS232 interface, allowing you to connect both a PC and a microcontroller using an RS232 chip (MAX232). The baud rate can be configured between 9600 and 115200 through AT commands. Additionally, the GSM/GPRS Modem has an internal TCP/IP stack, enabling internet connectivity via GPRS. It is suitable for applications involving SMS, voice, and data transfer in M2M interfaces.

10. Zigbee Protocol : The NRF24L01+ is a compact 2.4GHz transceiver that features an integrated baseband protocol engine (Enhanced ShockBurst™), making it ideal for ultra-low power wireless applications. It operates within the global ISM frequency band, specifically from 2.400 to 2.4835GHz. To create a radio system using the nRF24L01+, you only need a microcontroller (MCU) and a few basic passive components. Configuration and operation of the nRF24L01+ can be done via a Serial Peripheral Interface (SPI). The register map, accessible through the SPI, includes all the configuration registers for the nRF24L01+ and can be accessed in any operational mode of the chip.

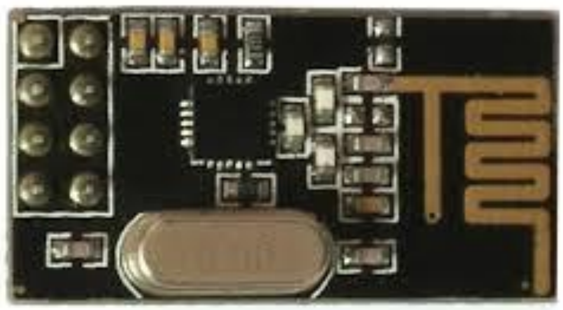

Fig -13: Zigbee Protocol

V. RESULT

The smart helmet is developed and tested for various conditions to find out how effectively it operates. There are mainly 4 different conditions the smart helmet is tested for. When the user is drunk and he is not wearing any helmet, the bike will not start. The proximity IR sensor will detect no helmet and the MQ-3 Alcohol sensor will detect alcohol and disable the ignition of the bike. When the user is wearing helmet the proximity sensor will give positive signal but since the user is drunk the MQ-3 sensor will give negative reading and as a result the bike will not be able to start.

Fig 14: IOT based smart helmet (transmitter & receiver)

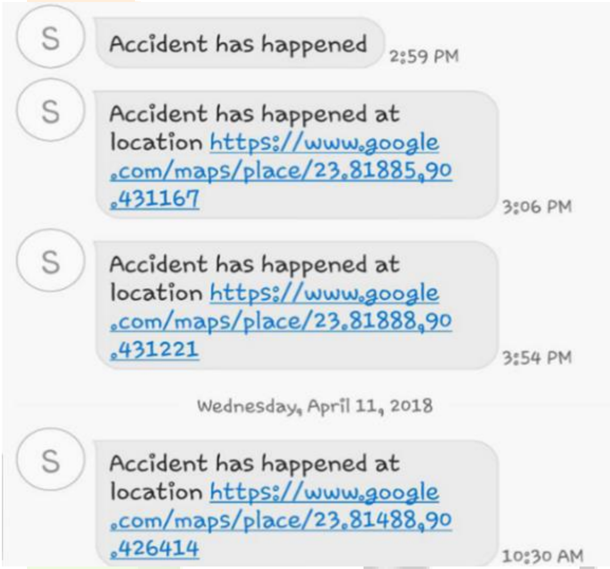

Fig 7.2 : Screenshots of messages sent by smart helmet

VI. CONCLUSION AND FUTURE SCOPE

Road accidents are on the rise every day, largely because riders are neglecting to wear helmets and consuming alcohol. In today's world, a significant number of people are losing their lives in these incidents. By implementing a smart helmet, we can help detect accidents before they happen. The primary goal of this project is to design a smart helmet that focuses on accident prevention and alcohol detection. An IR sensor will determine whether the rider is wearing the helmet. Meanwhile, a gas sensor will identify any alcohol present in the rider's breath. If the rider is not wearing a helmet or has consumed alcohol, the motorcycle will not start. Conversely, if the rider is wearing a helmet and shows no signs of alcohol, the bike will start as normal. In the event of an accident, the sensors will detect the motorcycle's condition and report the incident. The bike's GPS will then send the accident location to the main server of nearby hospitals.

The solutions mentioned rely on certain hardware, like sensors that must be installed in the car, or they require a smartphone to be inside the vehicle. While using such hardware can be a more cost-effective method, it poses a risk of being damaged in an accident, leading to inaccurate or no readings at all. Therefore, there is a need for a reliable solution that doesn't depend on any hardware or sensors to help prevent traffic accidents. Additionally, improvements could involve implementing a vision system to record the driver's activities. This recorded data could then be utilized by authorities to monitor traffic and enforce safety regulations. It could also be enhanced by adding a wireless transmitter to vehicles, facilitating better communication between them.

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