Smart Helmet for Accident Prevention and Detection

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Abstract - *The objective of the smart helmet is to provide a means and apparatus for detecting and reporting accidents. Sensors, and cloud computing infrastructures are utilised for building the system. The accident detection system communicates the accelerometer values to the processor which continuously monitors for erratic variations. When an accident occurs, the related details are sent to the emergency contacts by utilizing a cloud based service. 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 up dated 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.*

Key Words: smart helmet, accident detection, Arduino, IoT, Sensor

1. INTRODUCTION

India has a huge number of road accidents every year. The accidents may be due to many reasons like by drink and drive, driving rashly, exceeding the speed limit, etc. Sometimes, the person who gets injured might not be responsible for the accident. It might be the fault of some other vehicle rider. But overall both riders will get affected. Due to a lack of first aid and emergency medical services on time, the riders may die. Some deaths are due to the ambulance not reaching the desired location on time. In case of an accident, to save time and inform the concerned person, a system is proposed which can make sure that the rider gets the required attention in a short time. In India, many people use two-wheeler vehicles as compared to four-wheeler vehicles because of its low cost and simplicity. In many accidents, the rider gets injured mainly on the head. 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.

2. LITRETURE REVIEW

[1]. Hussain A.Attia1, Shereen Ismail enhanced electronic safety system design with simulation results for teenagers and older drivers is presented in this paper. Because of their physiological characteristics that lead to multiple driving errors, which need monitoring to avoid their recurrence. Comparing to the initial design, the presented safety system in this study considers additional two parameters; the number of driving errors and the errors duration. Based on these two parameters, the total number of recorded driving errors (lower/higher than the low/high front distance limits respectively) will be considered. If this number exceeds a certain limit of error then a suitable response will be taken as a safety reaction. Simulation results are demonstrating the recognition capability among the three cases of driving conditions, which are safe front distance, short front distance alarm, and long front distance alarm. In addition, the results are reflecting the highly effectiveness of the system in term of response and promising the possibility of obtaining high performance system in the fields of driving safety.

[2]. RistoÖörni talk about the demand for four intelligent vehicle safety systems (IVSSs) – emergency braking, speed alert, blind spot monitoring and lane keeping support – is analysed by constructing their demand curves (demand as a function of product price) based on data available from user interviews and a literature study. The study also provides a method for constructing linear and exponential demand curves of the systems from data gathered from user interviews. The estimated linear and exponential demand curves were tested by least-squares fitting to the data collected from user interviews. The mean absolute error was consistently larger for all of the systems studied here when using the linear instead of exponential model. This suggests that the exponential model reflects more accurately the demand for IVSSs than does the linear model.

[3]. Shouvik Chakraborty, Sachidananda Sen explained about an increasing number of accidents of Vehicles has led to the study and design of Active safety systems in modern automobiles. For the purpose, a number of sensors for the measurement of Vehicle yaw, wheel velocities and acceleration are deployed. However, some key parameters like slip angle and frictional forces are hard to be determined using sensors and also cost prohibitive. Estimation of friction coefficient and frictional forces has been of wide importance for the design of Active safety systems as the information is required for the design of efficient control system. Besides, the system being highly nonlinear in nature, linearized

estimation technique may lead to high approximation errors. This paper presents an unscented Kalman Filter based estimation algorithm for a specific nonlinear tire model for the estimation of friction coefficient and lateral and longitudinal frictional forces.

[4]. Chuchu Fan, Bolun Qi published the paper about the Safety analysis of Autonomous Vehicles and Advanced Driver Assist Systems (ADAS) is a central challenge facing the automotive industry. In this paper, we present a recently developed data-driven formal verification technique and demonstrate its applicability in a case study involving integrated safety analysis of an Automatic Emergency Braking (AEB) system. Our technique combines model-based, hybrid system reachability analysis with sensitivity analysis of components with possibly unknown or inaccessible models. The scenarios we consider for safety analysis are representative of the most common type of rear-end crashes, which are used for evaluating AEB and forward collision avoidance systems. We show that our verification tool Dry VR can effectively establish safety of these scenarios (specified by parameters like braking profiles, initial velocities, uncertainties in position and reaction times), and compute the severity of accidents for unsafe scenarios. The analysis can quantify the safety envelope of the system in the parameter space which is valuable for both design and certification. We also show how the reachability analysis can be combined with statistical information about the parameters, to assess the risk-level of the system, which in turn is essential, for determining Automotive Safety Integrity Levels (ASIL) mandated by the ISO26262 standard.

[5]. Mallikarjuna Gowda C P, Raju Hajare talk about the proposed system aims at developing and designing a suitable system for automobile purposes using Zigbee protocols. The main problems faced in the existing system are inaccuracies in the calculation of speed, distance measurement, and slow response time, etc. The proposed system solves many of the problems faced by the existing systems by using a GPS module instead of the conventional speedometer and also uses sensors which are reliable in areas where human intervention is either unintended or where it puts life to risk. The problems of traffic congestion in urban arterials are increasing day by day and it is very difficult to handle it during emergencies. So we are developing a communication unit within the system to interact with other vehicles in order to clear the lanes. This system aims at communicating with the vehicle in its surrounding with the help of its location (i.e., using the latitude and longitude) to indicate their proximity. When these vehicles are very close in proximity the drivers are cautioned with the help of a message. In this way the drivers can communicate with each other and act according to the situation.

3.METHODOLOGY

3.1 Arduino UNO

The UNO is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the UNO is the most robust board you can start playing with. The UNO is the most used and documented board of the whole Arduino family. Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

Fig -1: Arduino UNO

Fig.1. reprsents the Arduino UNO Chip where Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available.

3.2 Gyroscope Sensor

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 *g*. It can measure the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package(LFCSP_LQ).

Fig -2: Gyroscope Sensor

The ADXL335 is a complete 3-axis acceleration measurement system. The ADXL335 has a measurement range of ±3 *g* minimum. It contains a polysilicon surface micro machined sensor and signal conditioning circuitry to implement an openloop acceleration measurement architecture. The output signals are analog voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration. The sensor is a poly silicon surface micro machined structure built on top of a silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against acceleration forces. Deflection of the structure is measured using a differential capacitor that consists of independent fixed plates and plates attached to the moving mass. The fixed plates are driven by 180° out-of-phase square waves. Acceleration deflects the moving mass and unbalances the differential capacitor resulting in a sensor output whose amplitude is proportional to acceleration. Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration. The demodulator output is amplified and brought off-chip through a 32 kΩ resistor. The user then sets the signal bandwidth of the device by adding a capacitor. This filtering improves measurement resolution and helps prevent aliasing.

3.3 Touch Sensor

Our senses inform to us when our hands touch something. Computer input devices are indifferent to human contact as there is no reaction from software in the event of The sense of touch is an important sensory channel in many animals and some plants. making, maintaining or breaking physical contact like touches or releases. Thus, touch sensing input devices offers numerous possibilities for novel interaction techniques. Touch sensor technology is slowly replacing the mechanical objects like mouse and keyboard. A touch sensor detects touch or near proximity without relying on physical contact. Touch sensors are making their way into many applications like mobile phones, remote controls, and control panels, etc. Present day touch sensors can replace mechanical buttons and switches.

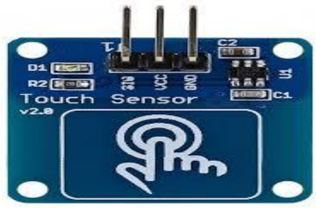

Fig -3: Touch Sensor

Touch sensors with simple rotational sliders, touch pads and rotary wheels offer significant advantages for more intuitive user interfaces. Touch sensors are more convenient and more reliable to use without moving parts. The use of touch sensors provides great freedom to the system designer and help in reducing the overall cost of the system. The overall look of the system can be more appealing and contemporary.

3.4 Vibration Sensor

Vibration Sensor is a high sensitivity non-directional vibration sensor. When the module is stable, the circuit is turned on and the output is high. When the movement or vibration occurs, the circuit will be briefly disconnected and output low. At the same time, you can also adjust the sensitivity according to your own needs. The vibration switch that opens when vibration is detected and closes when there is no vibration.

Fig -4: Touch Sensor

3.5 Gas Sensor

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application. Sensor is sensitive to flammable gas and smoke. Smoke sensor is given 5 volt to power it. Smoke sensor indicate smoke by the voltage that it outputs .More smoke more output. A potentiometer is provided to adjust the sensitivity. But when smoke exist sensor provides an analog resistive output based on concentration of smoke. The circuit has a heater. Power is given to heater by VCC and GND from power supply. The circuit has a variable resistor. The resistance across the pin depends on the smoke in air in the sensor. The resistance will be lowered if the content is more. And voltage is increased between the sensor and load resistor.

Fig -5: Gas Sensor

3.6 Relay

Relays are the primary protection as well as switching devices in most of the control processes or equipment. All the relays respond to one or more electrical quantities like voltage or current such that they open or close the contacts or circuits. A relay is a switching device as it works to isolate or change the state of an electric circuit from one state to another.

Fig -6: Relay

Classification or the types of relays depend on the function for which they are used. Some of the categories include protective, reclosing, regulating, auxiliary and monitoring relays. Protective relays continuously monitor these parameters: voltage, current, and power; and if these parameters violate from set limits they generate alarm or isolate that particular circuit. These types of relays are used to protect equipment like motors, generators, and transformers, and so on. Reclosing relays are used to connect various components and devices within the system network, such as synchronizing process, and to restore the various devices soon after any electrical fault vanishes, and then to connect transformers and feeders to line network. Regulating relays are the switches that contacts such that voltage boosts up as in the case of tap changing transformers.

3.7 Direct Current (DC) motor

Almost every mechanical development that we see around us is accomplished by an electric motor. Electric machines are a method of converting energy. Motors take electrical energy and produce mechanical energy. Electric motors are utilized to power hundreds of devices we use in everyday life. Electric motors are broadly classified into two different categories: Direct Current (DC) motor and Alternating Current (AC) motor. In this article we are going to discuss about the DC motor and its working. And also how a gear DC motors works. A DC motor is an electric motor that runs on direct current power. In any electric motor, operation is dependent upon simple electromagnetism. A current carrying conductor generates a magnetic field, when this is then placed in an external magnetic field, it will encounter a force proportional to the current in the conductor and to the strength of the external magnetic field. It is a device which converts electrical energy to mechanical energy. It works on the fact that a current carrying conductor placed in a magnetic field experiences a force which causes it to rotate with respect to its original position.

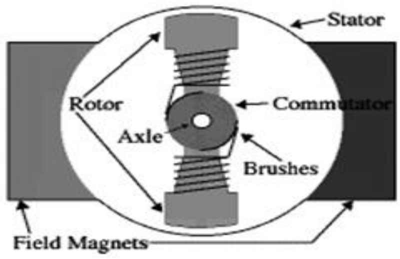

Fig -7: DC Motor

The rotor consists of windings, the windings being electrically associated with the commutator. The geometry of the brushes, commutator contacts and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnets are misaligned and the rotor will turn until it is very nearly straightened with the stator's field magnets.

3.8 Liquid Crystal Display

LCD screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits.

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

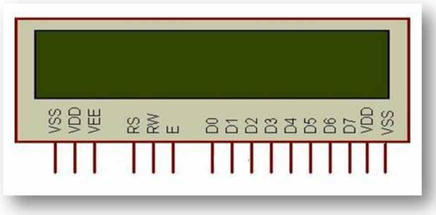

Fig -8: Pin Diagram of LCD

3.9 Global Positioning System

GPS or Global Positioning System is a satellite navigation system that furnishes location and time information in all climate conditions to the user. GPS is used for navigation in planes, ships, cars and trucks also. The system gives critical abilities to military and civilian users around the globe. GPS provides continuous real time, 3-dimensional positioning, navigation and timing worldwide. The Global Positioning System (GPS) is a satellite-based navigation system made up of at least 24 satellites. GPS works in any weather conditions, anywhere in the world, 24 hours a day, with no subscription fees or setup charges. The U.S. Department of Defense (USDOD) originally put the satellites into orbit for military use, but they were made available for civilian use in the 1980s.

Fig -9: Global Positioning System

3.10 Global System for Mobile Communication

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership.

Fig -10: GSM

GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine- SIM900, works on frequencies 900/ 1800 MHz. The Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip(MAX232). The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply . Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet through simple AT commands.

3.11 Zigbee Protocol

The NRF24L01+ is a single chip 2.4GHz transceiver with an embedded baseband protocol engine (Enhanced ShockBurst™), suitable for ultra-low power wireless applications. The nRF24L01+ is designed for operation in the world wide ISM frequency band at 2.400 - 2.4835GHz. To design a radio system with the nRF24L01+, you simply need an MCU (microcontroller) and a few external passive components. You can operate and configure the nRF24L01+ through a Serial Peripheral Interface (SPI). The register map, which is accessible through the SPI, contains all configuration registers in the nRF24L01+ and is accessible in all operation modes of the chip. The embedded baseband protocol engine (Enhanced ShockBurst) is based on packet communication and supports various modes from manual operation to advanced autonomous protocol operation. Internal FIFOs ensure a smooth data flow between the radio front end and the system's MCU. Enhanced Shock- Burst reduces system cost by handling all the high speed link layer operations.

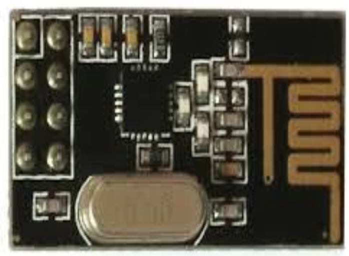

Fig -11: Zigbee Protocol

The radio front end uses GFSK modulation. It has user configurable parameters like frequency channel, output power and air data rate. NRF24L01+ supports an air data rate of 250 kbps, 1 Mbps and 2Mbps. The high air data rate combined with two powers saving modes make the nRF24L01+ very suitable for ultra-low power designs. NRF24L01+ is drop-in compatible with nRF24L01 and on-air compatible with nRF2401A, nRF2402, nRF24E1 and nRF24E2. Intermodulation and wideband blocking values in nRF24L01+ are much improved in comparison to the nRF24L01 and the addition of internal filtering to nRF24L01+ has improved the margins for meeting RF regulatory standards.

4. FUNCTIONALITY

In this system, we use ARDUINO UNO (ATmega328P) microcontroller which acts as brain of the system, because the entire system program instruction stored in it. Here we have two section in which one is at the helmet and the other is at the vehicle. The helmet section has touch sensor which gives the information about the status of whether the helmet is occupied or not, also we have sensors like gyroscope and vibration sensor to know the status of accident. The location of accident area along SMS or either call have done by the GSM module we have. All the data fetched from the helmet section is transferred through RF technology and reception take place at the vehicle section. The data is also update to cloud so that we are able to either control or monitor the respective system using IOT.

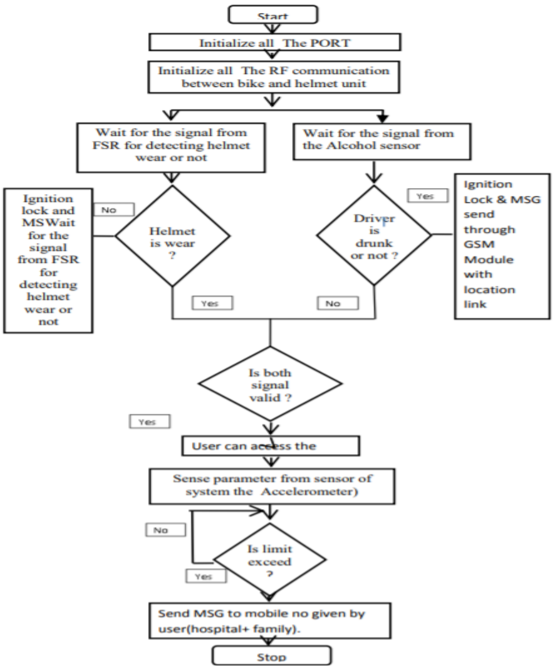

Fig -12: Algorithm of Smart Helmet

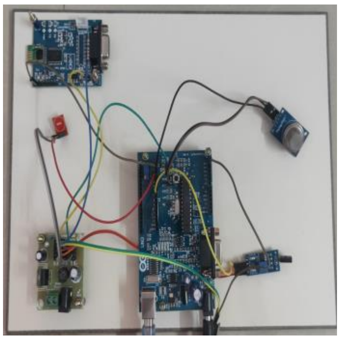

Fig -13(a): Helmet section (Transmitter)

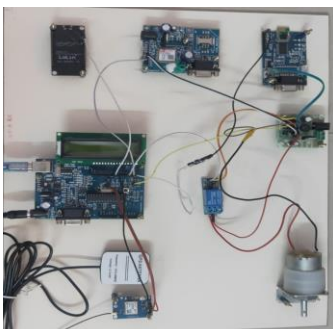

Fig -13(b): Vehicle section (Receiver)

It is already mentioned that the project is divided into two units namely helmet and bike. In helmet unit, also called the transmitter unit shown in Fig.13(a),the force sensing resistor is placed on inside upper part of the helmet where actually head will touch with sensor surface. And alcohol sensor is placed on in front of rider's mouth so that it can sense easily. And the battery and regular circuits were fixed inside the helmet. Secondary controller and RF transmitter circuit were also placed inside the helmet. Antenna is located outside the helmet. The receiver unit shown in Fig.13(b) is placed in the bike. The RF receiver accepts all the data from the helmet (i.e transmitter) unit. Depending on the conditions, if true, the ignition starts and bike moves. The GSM can continuously send the location information of the bike. If any accident occurs, the vibration sensor gets activated and sends the location information to the registered mobile number.

5. FUTURE IMPROVEMENTS

The above mentioned solutions are either dependent on some hardware such as sensors that have to be present in the car or require a smartphone to be present within the vehicle. Although the use of such hardware turns out to be a more cost-efficient approach, it has the drawback of being destroyed in the accident and hence giving false or no readings at all. Therefore, a competent solution that does not depend on any hardware device or sensor is required for the prevention of traffic accidents. Further improvisations include installing a vision system for recording the activities of the driver. The recorded information then can be used by the controlling authority for monitoring the traffic and safety rules. It can be upgraded by mounting the wireless transmitter on cars which is helpful for enhanced communication vehicle to vehicle.

6. CONCLUSION

Road accidents are increasing day by day because the riders are not using the helmet and due to consumption of alcohol. In today's world, huge numbers of people are dying on road accidents. By using smart helmet, the accidents can be detected. The main target of the project is designing a smart helmet for accident avoidance and alcohol detection. The IR sensor checks if the person is wearing the helmet or not. The Gas sensor recognizes the alcoholic substance in the rider's breath. If the person is not wearing the helmet and if he consumes alcohol , the bike will not start. If there is no sign of alcoholic substance present and helmet is used, then only the bike will start. At the point when the rider met with an accident, the sensor recognizes the condition of the motorbike and reports the accident. Then the GPS in the bike will send the location of the accident place to main server of the nearby hospitals.

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