Available online www.ejaet.com

European Journal of Advances in Engineering and Technology, 2019, 6(12):76-79

Research Article ISSN: 2394 - 658X

Expert System Based Smart Helmet for Smart Vehicle Applications

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ABSTRACT

An expert system based smart helmet is a novel technique which makes smart vehicle driving for future smart city, 5G and IOT applications. The main aim of smart helmet is to prevent the rider from starting his bike unless and until he actually wears the helmet and also to sense the status of the vehicle. It also incorporates the concept of GSM and GPS to track a location of the vehicle and to provide the victim prompt medical attention. The location of the vehicle/accident is given by a GSM module to the cell phones of family and friends through an SMS. Thus SMS containing the information about the status as well as the location (latitude and longitude) of the area is send to family and friends using a microcontroller. The work also incorporates a tilt sensor which senses the tilt of the bike above a permissible limit (>60 degree) and informs the need of recovery.

Key words: IOT, GPS, GSM, Smart sensor, Smart vehicle, Accident detection

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INTRODUCTION

According to World Health Organisation nearly 1.3 million humans die every year throughout the globe due to road accidents and around 30-40 million people suffer non-fatal injuries leading to disabilities of their body parts. In developing countries, were motorcycle is the most convenient way of road transportation because of low-cost, low fuel consumption, easily affordable and travel faster in less possible time. But on the other side people in metropolitans cities and urban areas people need to spend less time in travel, so they need to travel faster which may lead to accidents and are more prone to motorcycle crashes. In road accidents, head and face are most commonly found causes of death. Age group of 16-28 years is more prone to accidents and the leading cause of death. In some cases the person injured the accident may not be directly responsible for the accident, it may be fault of some other rider, but end of the day it's both the drivers involved in the accidents who is going to suffer.

If accidents are one issue, lack of treatment in proper time is another reason for deaths. According to the same survey if 698 accidents occur per year, nearly half the injured people die due to lack of treatment in proper time. The reasons for this may again be many such as late arrival of ambulance, no person at place of accident to give information to the ambulance. The government of India has made use of helmet mandatory for every citizen of India. Wearing ISI certified helmet can reduce the injuries to head and face. Many rules and regulations have been proposed by the government of India to prevent road accidents and proper implementation of rules. So to prevent these types of alarming incidents /accidents we have designed a helmet which will provide solutions for all the above mention problems. Idea of giving the information about accident as soon as possible and in time is of prior importance. Also the helmet is used to check the alcoholic condition. The helmet is used to check the alcohol condition, if it is less than the threshold, then only the engine will on. Because after all time matters a lot, if everything is done in time, at least we can save half the lives that are lost due to bike accidents.

There are several smart helmet systems but with a different proposed solution and approaches. Sayan Tapadar *et al* [1] proposed a bluetooth enabled smart helmet and detection of accidents and alcohol consumption of the user wearing the helmet using impact sensor, flex sensor, accelerometer and breathe analyzer. The accelerometer sensor senses the changes within the X, Y and Z axis and sends the sensed data to online software programming interface via the server. The breath analyzer senses the amount of alcohol present in the breath of the user wearing the helmet. The records sensed from the sensors are used to train the aid vector machine (SVM). The helmet additionally has a characteristic in

order that it may connect to the smart phones through Bluetooth and communicate with online software programming interface with the net connection [2].

Sudhir Rap Rupanagudi *et al* [3] presented a novel methodology, which helps in monitoring the real-time traffic scenario behind the motorcycle driver and also the intimation system to inform him about the same. Spartan 3E FPGA is used to assist in the simulation of the real-time environment. The helmet is mounted with a camera which will capture the behind the motorcycle driver and helps the algorithm to detect traffic behind the driver. G. Sasikala *et al* [4] proposed a system to create awareness in society to use the helmet and help people to lead to safety. It is RF communication-based helmet detection system. The system consists of two modules transmitter and receiver module, in which the transmitter module is attached to the helmet and the receiver module, is attached to the motorcycle. The transmitter module consists of a switch, HT12E encoder IC, 23RD transmitter module. The receiver module consists of RF receiver, HT12D decoder IC, 8051 microcontroller,

We have implemented smart helmet using various bioelectric sensors on the helmet to measure various activities to make it as an expert system. A small camera is used for recording the driver's activity and the records can be used for passing message from the one vehicle to another vehicle by using wireless transmitter. We have used solar panel for helmet power supply by using same power supply is used to charge our mobile. GPRS can be used for the storing data online.GPS can be programmed to calculate the speed of the bike in case of over speeding the vehicle can be stopped. Also, it can be used for location tracking.

EXPERIMENTAL METHODS

Microchip has recently introduced flash chips with different types, such as 16F628, 16F877 and 18F452. The 16F877 costs twice the price of the old 16F84, but it is eight times more than the code size, with more RAM and much more I/O pins, a UART, A/D converter and a lot more features. Software such as, Genie Design Studio can be downloaded for free. It can be used to program microcontroller circuits. It allows the programmer to simulate the program, before downloading it to a PIC microcontroller IC. Simulating the program on screen, allows the programmer to correct faults and to change the program. The LCD display panel is used to display status messages and error messages. DMC series display modules developed by OPTREX CORPORATION is used as for display. The modules consist of high contrast and large viewing angle TN and STN type LC (liquid crystal) panels. Each module contains a CMOS controller and all necessary drivers which have low power consumption. The controller is equipped with an internal character generator ROM, RAM and RAM for display data. All display functions are controllable by instructions making interfacing practical. Both display data RAM and character generator RAM can be read making it possible to use any part not used for display as general data RAM. The products of this series therefore have wide application possibilities in the field of terminal display or display for measuring devices.

GSM -uses Frequency Division Multiplexing AND Time Division Multiplexing- FDMA divides the frequency ranges for GSM, which are 890-915, 935-960. Each is divided into 200 KHz wide channels. As far as TDMA goes, each time slot is 577 micro seconds long, 8 time slices is a frame, lasting for a grand total of 4.615ms. A multi-frame consists of 51 frames, 51 multi-frames make up a super frame, and 2048 super frames make a hyper frame which is 2715648 frames.

GPS module A1080-A is a highly integrated GPS receiver module that can be used as an SMT component. It is capable to receive signals from up to 20 GPS satellites and transferring them into position and timing information that can be read over a serial port. This new generation of GPS module combines small size. The A1080-A GPS receivers are available as off-the-shelf component, 100% tested and shipped in standard tape-and-reel package.

Driver is used to boost the current. The current from microcontroller is not sufficient enough to switch the relay so a current amplifier is used. ULN 2003 is used to drive the relay. Ideally suited for interfacing between low-level logic circuitry and multiple peripheral power loads, the Series ULN20xxA/L high-voltage, high-current Darlington arrays feature continuous load current ratings to 500 mA for each of the seven drivers. At an appropriate duty cycle depending on ambient temperature and number of drivers turned ON simultaneously, typical power loads totaling over 230 W (350 mA x 7, 95 V) can be controlled. Typical loads include relays, solenoids, stepping motors, magnetic print hammers, multiplexed LED and incandescent displays, and heaters. All devices feature open-collector outputs with integral clamp diodes. The block diagram of the setup is shown in figure 1.

Hi-tech C is an IDE is used to write, compile, and debug embedded programs. Hi-tech C adds many new features to the Editor like Text Templates, Quick Function Navigation, Syntax Coloring with brace highlighting, Configuration Wizard for dialog based startup and debugger setup. A unique feature of the Hi-tech C is the Device Database which contains information about more than 400 supported microcontrollers. When you create a new Hi-tech C project and select the target chip from the database, Hi-tech C sets all assembler, compiler, linker, and debugger options for you. The only option you must configure is the memory map.

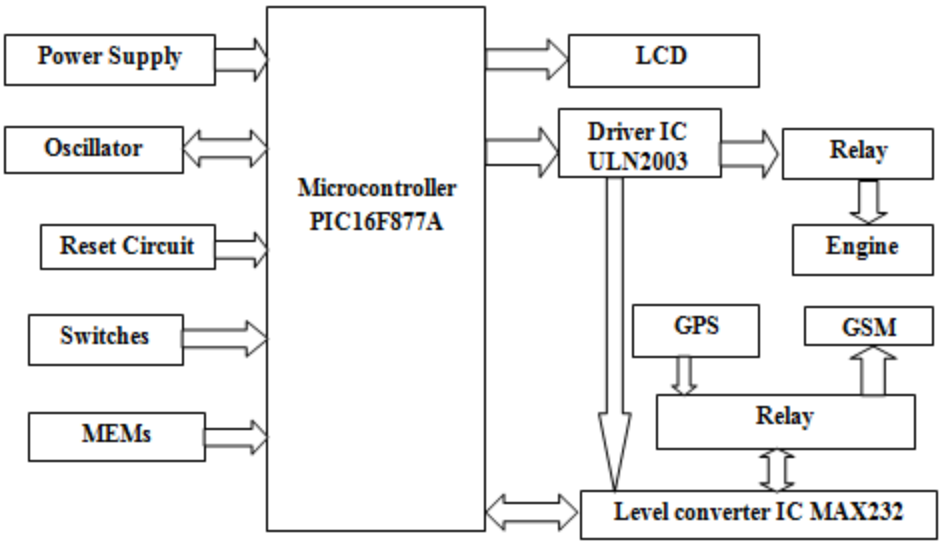

Fig. 1 Block diagram of expert system based smart helmet

RESULTS AND DISCUSSION

The main part of the system is the microcontroller PIC16f877A as shown in figure 2. All the processes and control actions are done on the microcontroller. The microcontroller checks whether the switch positions are in a contact condition to start the vehicle. Otherwise the engine is not start i.e. when we put the helmet on the head, then only the switches are in contact position. Again the microcontroller reads the MEMs acceleration values, i.e. for measuring tilt condition. When an accident will take place, the helmet will shake and that tilt condition will measure using MEMs. The output from the MEMs is in analog format. Then it is connected to the analog application. Here we take the x and y direction values. When an accident wills takes place, the alert information will transferred to the authorities using GSM Modem. The information includes also the position values. The position values will take using GPS Modem. The GSM Modem and GPS Modem are interfaced with the microcontroller is through a level converter IC named MAX232.

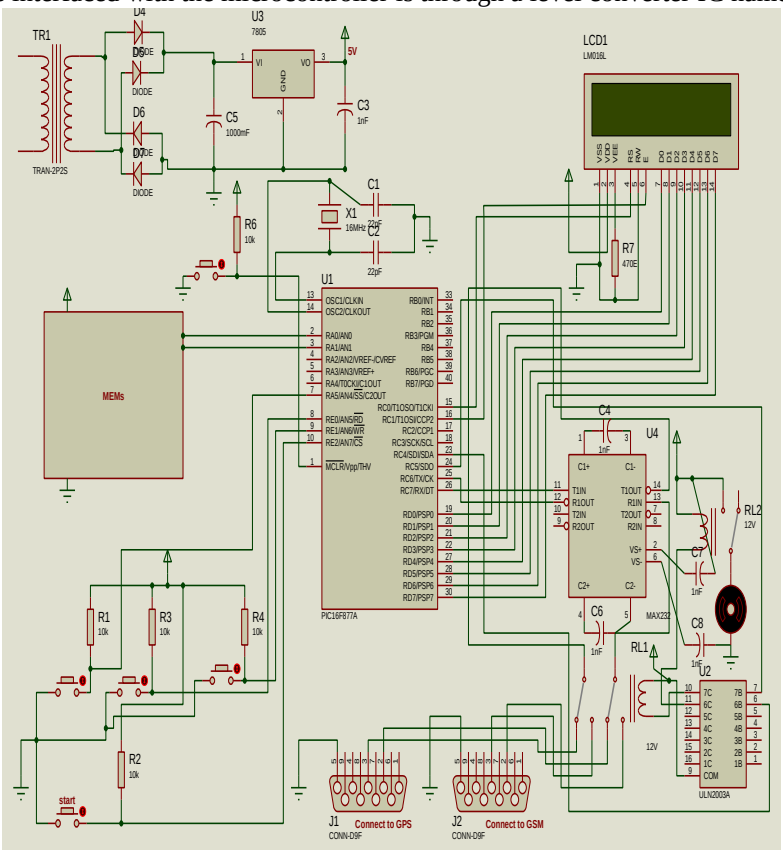

Fig. 2 Circuit diagram of expert system based smart helmet

The engine control will take place automatically. So the engine will interface with the microcontroller through a relay. The relay is interfaced with the microcontroller through a driver IC named ULN2003. All the operations are displayed on the LCD. The switches are used to detect whether the helmet is placed on the head. When the helmet is on the head, the switch position is in contact and then only the engine will be get started. The switches used are push ON switches. LCD serves as a useful interface for the user. The most common type of LCD controller is the Hitachi 44780 which provides a relatively simple interface between microcontroller and LCD. The LCD has 16 character x 2 line display facility. The message to be displayed is send to the LCD through data-bus. The experimental setup of the smart helmet is given in figure 3.

Fig. 3 Experimental setup of expert system based smart helmet

CONCLUSION

A smart system based Smart Helmet is to significantly increase safety and awareness for motorcycle drivers. With an accessible and convenient way for drivers to stay aware of their blind spots, the Smart Helmet will be a vital asset for any motorcyclist interested in adding a blanket of safety while on the road. While not intended to be a replacement for any existing road safety practices, the Smart Helmet gives drivers an added assurance of safety. In this paper we have successfully designed a smart helmet band working as an expert system using GSM and GPS technology. The paper realized by wearing the helmet compulsorily in order to start the ignition of vehicle .From this paper, the Expert system based Smart Helmet team has learned how to incorporate smaller subsystems into one greater project. Concepts such as power management, wireless communication, visual displays, and proximity sensor readings were all researched and implemented from the scratch. On top of the engineering aspects learned, the Smart Helmet team gained valuable communication and teamwork skills that will be valuable in the future.

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