Smart Helmet Using Natural Language Processing, Head Mounted Display And Solar Panel

Arpita Jadhav, Saurabh Rajput, Khedekar Vilas Baburao, Dr. Dharmendra Singh Rajput

Abstract: Bike accidents have been occurring daily and increasing day by day, people don't tend to wear a helmet while riding a bike to overcome this issue instead of using a helmet just as a safety equipment it is possible to make much more out of it which will help the rider in many ways such as to utilize the time while riding, effectively reaching to the desired destination, safely riding by knowing the most possible road conditions. The design of Smart Helmet in this paper is the way to achieve above mentioned traits which will be using direct helmet to mobile connection through Arduino UNO and HC-05 Bluetooth Module, Speech Inputs and Speech Outputs for better convenient communication with the helmet using Natural Language Processing (NLP), more detailed display output to the rider without getting the rider's visual off the traffic scene using a Heads-Up Display (HUD).

Index Terms: NLP, Helmet, Arduino, Solar Panel, HUD, Ultrasonic Sensor, Bluetooth

1. INTRODUCTION

Wearing a helmet is a safety rule which people don't consider following. According to 'Time of India' report 98 two-wheeler riders died without helmets daily in 2017 [1]. But still awareness of wearing a helmet is not as per the need. Other than this while riding a bike from one place to another place far from each other can make rider tired. Consider a scenario, where a rider is going to his workplace which is far from his home and it takes 1-2 hrs daily to reach. In this time he cannot do anything else other than riding a bike. While riding, a rider can hear music or listen to something else using headphones, but there is no proper utilization of time in this. In another case, if a rider needs to reach to an unfamiliar place, it is very inconvenient to stop and check the map repeatedly. One more factor arises when on a highway and due to other rash drivers it is possible that accidents may occur. Wearing a simple helmet for safety can be the specific use of it, but wearing a helmet that assists riders, entertains riders and helps to utilize the time with safety can be generic use of it.We've come up with a helmet design which is not just a safety equipment but also a riding assistant which will help the rider. Utilization of time while riding is the key factor of our proposed system, other than this instead of using mobile for navigation, the helmet will help you to navigate routes effectively, it can also be used to get assisted for the road traffic conditions. One of its features is making and answering a call using voice command. Rather it will also give alerts about the rash drivers close to the rider wearing the helmet. The communication is to be carried out among the rider and the rider's helmet is through the speech for this Speech to Text and Text to Speech will be used along with the Natural Language Processing (NLP). The communication between the smartphone and helmet will be carried out via Bluetooth. The smartphone application will be using the phone's processor for processing and executing the task.

2. PROPOSED SYSTEM

The Smart helmet itself comprises of most of the components except the processor which will be executing the operations of the helmet. Firstly the array of microphones will be installed on the chin protector the, 'array of microphones' makes the noise cancellation process very efficient as practically there will be inevitable noise coming towards the rider while riding the bike [2]. The chief component is the 'Arduino Uno' which will be incorporated at the rear side internally between the polystyrene foam liner and the comfort liner [3]. The HC-05 Bluetooth Module will be affixed with the Arduino for the communication with the smartphone [4]. The Scaled-down class of Heads-up Display inspired by is to be used for displaying information such as navigation directions, driver alerts, power meter, etc. [5]. Ultrasonic Sensor/Infrared Sensor which will be distributed on four places on the helmet first will be on the front side above the visor (face shield), other two will be on the side opposites of each other and the last one will be placed on the rear side of the Helmet [6]. Lastly, the Solar Panel will be used to power the entire circuitry present inside the helmet which is to be situated on the upper side of the hard outer shell of the helmet. Headphone Speakers will be placed near the ear area to hear the output of the Moving to the Smart Phone, a simple smartphone having Bluetooth will be enough to establish a connection with the helmet. An application which will be processing and executing the voice commands and the sensor data received from the helmet through Bluetooth [4].

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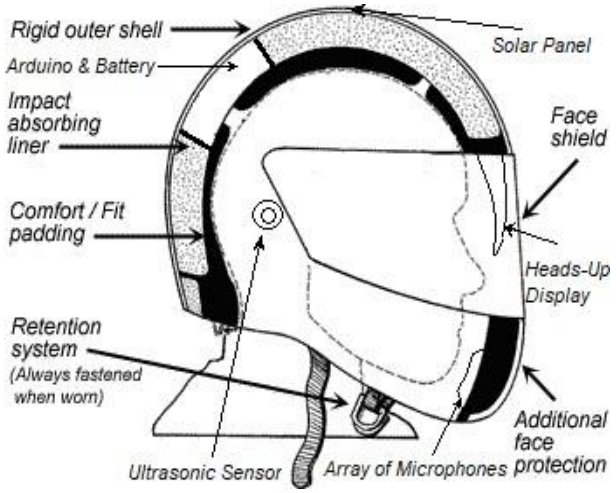

Figure 1: *Helmet Structure*

3. TECHNICAL STUDIES

3.1 An array of Microphones

MEMS microphones are cheap, small, and have an adequate signal-to-noise ratio (SNR) and frequency response. These features enable the production of miniature arrays that are just several centimeters in diameter [7]. These scaled-down arrays are likely to be mass-produced, as a PCB can be manufactured in the desired array shape and the microphones can be coupled with standard PCB manufacturing techniques. The fundamental theory used to process the signals produced by these sensor arrays is based on wave propagation. They consist of multiple microphones positioned in such a way that the dimensional acoustic information can be properly captured. An arrayed microphone can read a sound signal from various different points concomitantly, with the proper processing, for spatial audio filtering. This means that with a microphone array, one can choose a point in space and filter out only the sound waves originating from that direction. A microphone array is having the ability to locate a certain voice source [7].

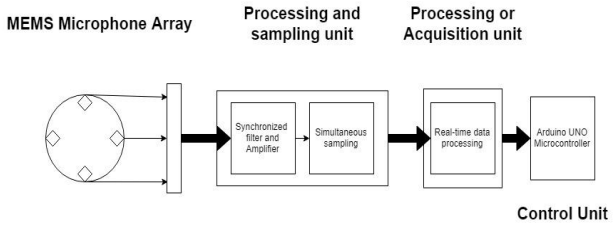

Figure 3: *Control Unit*

3.2 Arduino Uno

Arduino Uno microcontroller can get cognizant of the environment by receiving input from a variety of sensors and other signal or data-generating devices which can affect its surroundings by controlling lights, motors, and other actuators [3]. Arduino programming language is used to program the microcontroller based on its wiring and the Arduino development environment based on its processing.

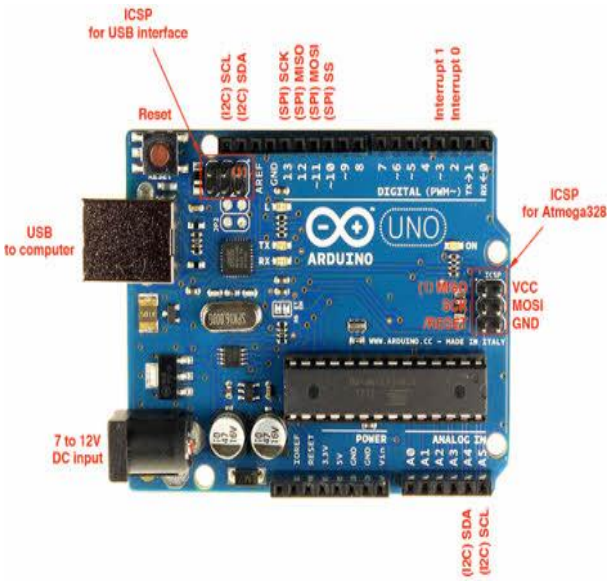

Figure 2 :*Arduino [8]*

3.3 HC-50 Bluetooth Model

HC-05 module is known as an apparent Bluetooth Serial Port Protocol (SPP) module, designed for wireless serial connection setup. The serial port of this Bluetooth module is fully privileged Bluetooth V2.0+Enhanced Data Rate (EDR) 3Mbps modulation with total 2.4GHz radio transceiver and baseband. It uses CSR Bluecore External single-chip Bluetooth system with CMOS technology and with Adaptive Frequency Hopping Feature (AFH). It has the footprint as small as 12.7mmx27mm [4].

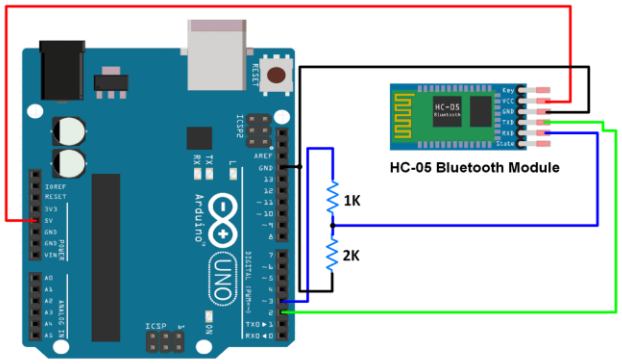

Figure 4: *Arduino Bluetooth module [9]*

3.4 Heads-up Display

The mode of display on the windshield or Head-Up Display (HUD) is a part of the solution for exhibit information from systems to the driver since it is identified to diminish the time and frequency drivers look away from the traffic scene, the HUD being defined as any transparent display that presents data without requiring users to look away from their usual point of view [10].

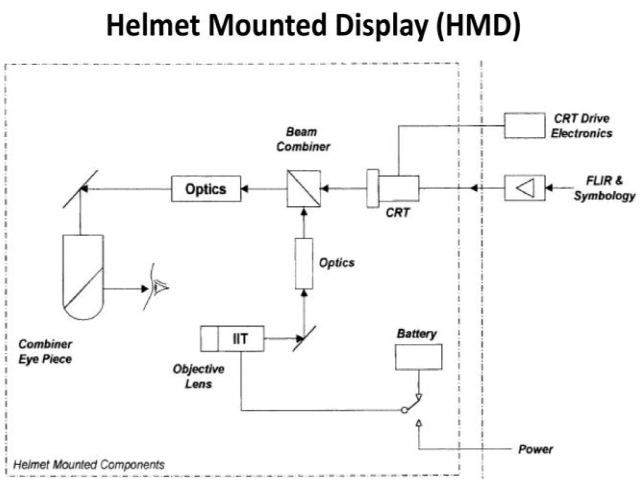

Figure 5: *Circuit Diagram*

3.5 HC-SR04 Ultrasonic sensor

Ultrasonic sensor HC-SR04 is used to calculate the distance in the range of 2cm-400cm with the perfectness of 3mm. The sensor module comprises an ultrasonic transmitter, receiver, and control circuit. The working of the ultrasonic sensor is [6]:

1. Sending of the high-level signals for 10us using Trigger.
2. The module sends eight 40 kHz signals automatically and then detects whether a pulse is received or not.
3. Once the signal is received, then it is through the high level. The time of high length is the time delay between sending and receiving the signal.

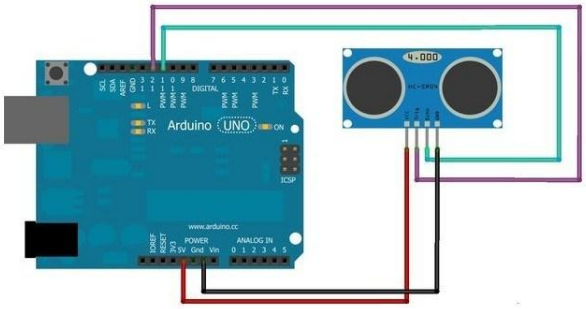

Figure 6:*Arduino Sound Connection[11]*

3.6 Solar Panel

Solar chargers can charge a Ni-Cd battery which banks up to 48 V and thousands of ampere-hours (up to 4000 Ah) capacity. This type of solar charger setups generally use an intelligent charge controller, these can be connected to a battery to store energy for off-peak usage. A solar panel is able to generate a scale of charging voltages depending upon sunlight intensity, so a voltage regulator is to be included in the charging circuit so as to not over-charge (overvoltage) a device [12].

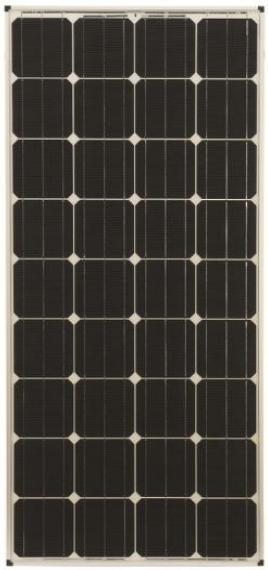

Figure 7:*Solar Panel[13]*

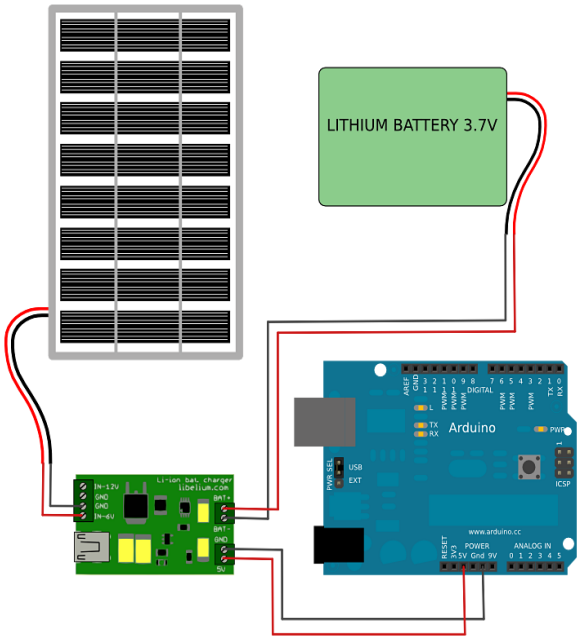

Figure 8: *Solar Panel Arduino[13]*

3.7 Natural Language Processing

Natural Language Processing is a technology that makes it possible for computers to understand human languages as the automatic manipulation of natural language, like speech and text, by a software program. (NLP) is a subdivision of computer science and artificial intelligence concerned with the interconnection between computers and human languages, specifically how to program computers to process and analyze large amounts of natural language data [14].

4. SYSTEM WORKFLOW

System workflow of this system is entirely based on the features that the helmet is bagged up with.

4.1 Basic Circuitry Connections

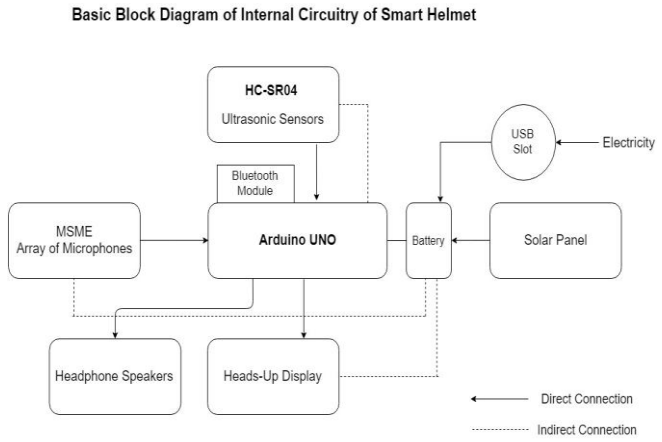

Figure 9: *System Workflow*

As shown in the above diagram the Arduino Uno is the main component of the Helmet Unit, all the connections follow towards it. Firstly the MSME Array of Microphones which is going to be used for the speech input will collect the voice input from the rider and convert as well as filter it and then these voice signals will be passed to the Arduino Uno Microcontroller. Now in consideration of the HC-SR04 Ultrasonic Sensors which will be measuring the distance of the rider from the other drivers for the rider to stay away from the rash drivers or the close vehicles, this sensed data from the sensor will be transferred to the microcontroller for further conversion. The Microcontroller will be giving the output data to the Heads-Up Display which will be displaying the required data to the rider. The Battery unit of the entire circuitry is to be connected to the microcontroller which will be indirectly providing the power to all the components of the Helmet unit. Certainly, the charging of this battery power source will be carried out with the help of Sunlight or the USB slot provided to it which will make it easy to charge it by using a USB charger, making it a two way powered circuit. The Headphone speakers which are to be mounted on the opposite sides of the Helmet (i.e. On the Ears of the rider) will be delivering the speech output, the playing the music and listening to a call for the rider. Bluetooth Module coupled with the microcontroller will be used to transfer all the signals from the Helmet unit to the smartphone through an established wireless connection.

4.2 Voice Command Module

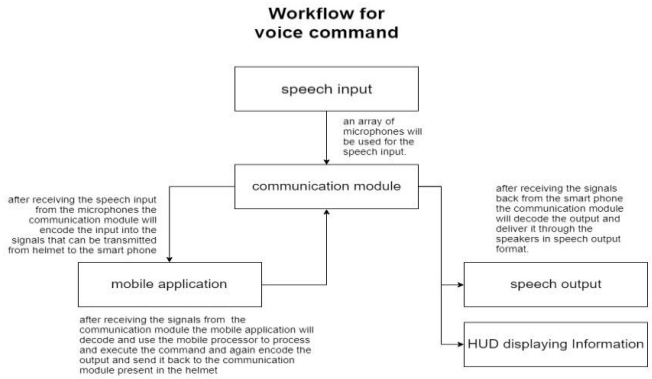

Figure 10: *Workflow for Voice Command*

In case of Speech Input the Array of the Microphones will be play a vital role for capturing the rider's voice and then converting it to signals and passing it to the communication module (i.e. The Arduino Uno microcontroller and the HC-05 Bluetooth Module) the encoding or conversion of the raw signals will be carried out at this stage and further passed on to the smartphone wirelessly. The Smart Phone application will decode or reconvert the signal received and then process the speech input using Natural Language Processing (NLP) and then understand the statement and execute the statement leading to carry out the operation from the statement and then the generated output data will be sent back to the communication module where according to the format the output data will be represented to the rider on the Heads-Up display or the Headphone speakers or both simultaneously.

4.3 Vehicle and Distance Measurement Module

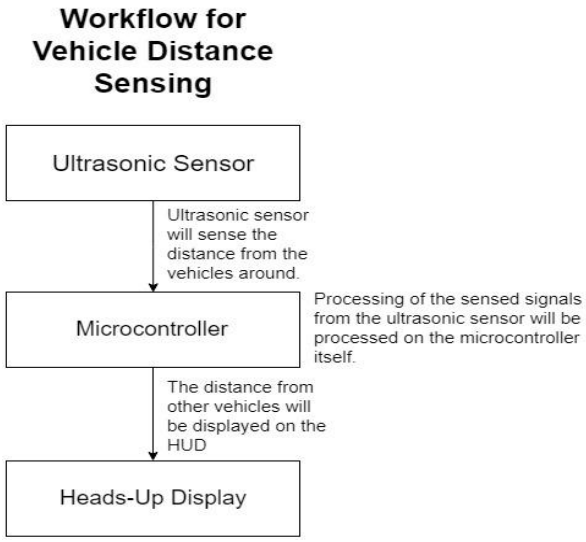

Figure 11: *Workflow for Vehicle Distance*

The Ultrasonic Sensors will be sensing the vehicles of all four sides and all the sensed signals will be transferred to the microcontroller the sensed signals will be processed on the Arduino Uno itself as it will generate output then and there and pass the exhibiting data to the Heads-Up Display and the

HUD will be displaying the distance data to the rider. For reduction of time to show the real-time distance data this procedure will be carried out on the microcontroller itself.

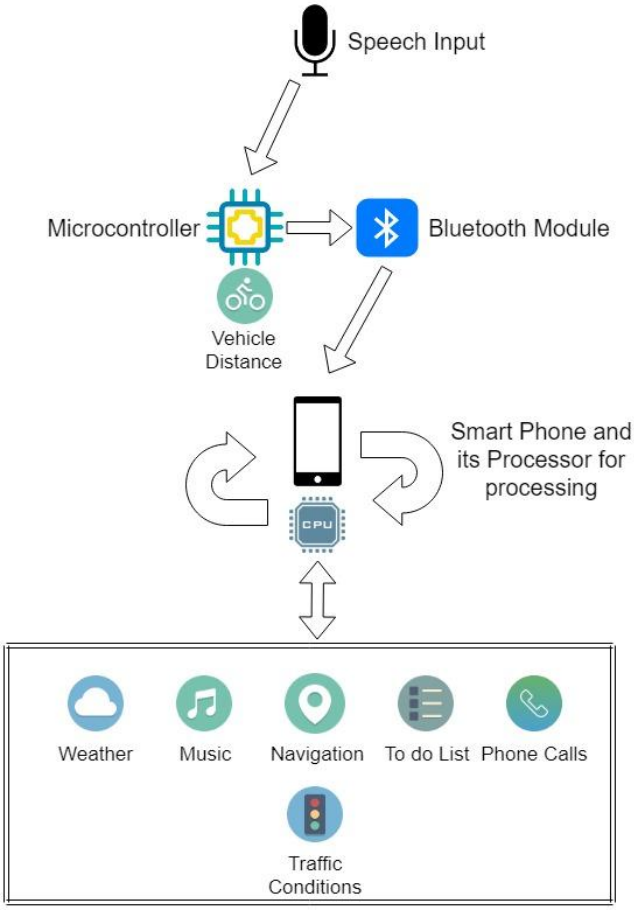

Figure 12: *Overall Working of Proposed System*

5. CONCLUSION

Wearing this Smart Helmet will reduce the accidents as well as the damage after an accident eventually. Smart helmet provide tremendous efficient riding experience, by knowing the traffic behavior around the rider will feel safe to ride the bike, and travelling for long distances will no more be a boring task. Navigating to the unknown locations will be convenient for the bike rider.

6. REFERENCES

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