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Smart Intelli-Helmet for Biker's Safety

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Abstract: *The increasing number of road accidents involving motorcyclists necessitates the development of innovative safety measures. While leveraging the current technology and using sensor and microcontrollers it is possible to design a robust helmet. A smart helmet is a protective type of headgear that protects the rider from any type of head injury along with added features that makes the experience of riding a bike a desired one. This research paper presents a comprehensive review and analysis of smart helmets designed to enhance biker safety. Smart helmets integrate advanced technologies such as sensors, communication systems, and augmented reality to provide real-time monitoring, accident detection, and improved situational awareness. The paper discusses the key components and features of smart helmets, their benefits, and potential challenges in their adoption. Additionally, it examines the existing research and identifies future directions for the development and implementation of smart helmet technologies.*

Keywords: Smart helmet, biker safety, sensors, communication systems, augmented reality, real-time monitoring, accident detection, situational awareness

I. INTRODUCTION

The bike accidents are increasing day by day throughout the world which leads to loss of many lives. People generally don't abide by the law which results in even more accidents that happen on a daily basis.

If one were to estimate, approx. 1.3 million lives are lost due to traffic, rash driving, road blocks, etc. There are numerous reasons behind the accidents, especially the younger generation who love riding, exploring places on their bikes tend to break the rules and are more known for rash driving.

Considering all these facts and trying to solve one problem at a time we came up with an idea that will help solve or reduce the accidents while riding a bike.

We came up with an idea of designing a smart helmet that leverages the latest technology which helps protect the rider from any fatal injury to the head. As we all know, the way helmets are designed today just satisfies one function of keeping the head safe. And since wearing a helmet doesn't guarantee the safety of a person and it is quite a baggage to carry around, we skip on wearing a helmet.

In the research paper, **"Design and Implementation of Smart Helmet Using Low Power MSP430 Platform"**[1]**,** the whole setup is pretty bulky and the size of the systems is also a factor here, adding an active cooling system will result in further reduced runtime of the system. So, instead in our project we prefer to have a good performance to power ratio by using32-bit microcontrollers. As for the cooling, we would be taking the advantage of the way the helmets are designed and implementing passive cooling which all comes while at the same time keeping the footprint as small as possible.

In the research paper, **"Smart Helmet for Safe Driving"**[2], have used the GSM module for communicating in emergency situations which is quite a tedious and complex process which increases the overall size of the system bringing in more limitation for designing the antenna. In our project, we decided to go with the WiFi or even BLE to further reduce the power consumption. The WiFi or BLE will be connected to the smartphone of the rider, which will give the ability of contacting emergency services in a much better way.

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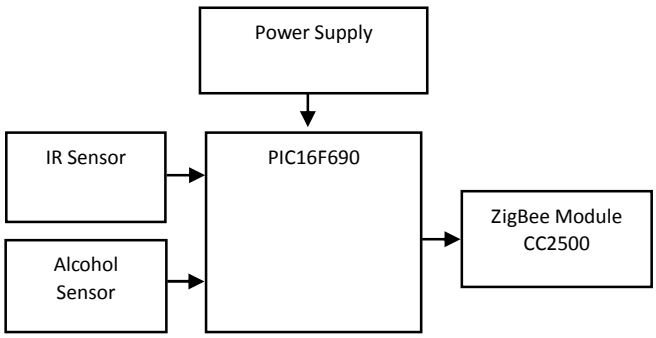
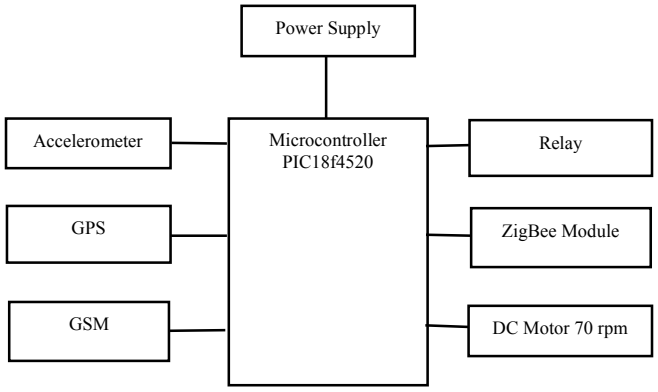
II. WORKING

Block Diagram of Helmet



- The IR Sensor placed in helmet section first detects whether the rider wear a helmet or not.
- Alcohol sensor placed in helmet section also check for whether the rider drunk or not.
- According to these two conditions it enables the input pin of PIC16F690 controller placed in helmet unit.
- Then it enables the transmitter pin of PIC microcontroller and sends the OK signal from helmet unit ZigBee module to bike unit ZigBee module.
- This is the working off transmitter section or helmet unit.

Block Diagram of Bike Unit:



Bike ZigBee module accepts the OK signal which is transmitted from helmet ZigBee module.
The push button placed in bike section is used to indicate whether side stand removed or not.
When side stand is removed i.e. push button is pressed then this OK signal given to the PIC16f690 controller placed in bike unit.
Then PIC controller checks for receiver pin for signal received or not.
According to it gives logic high signal to the really driver circuit.
It energises the really and the connection established between battery and key switch.

Components and Features of Smart Helmets

- The Analog Sensors Interfacing: All the analog sensors connected with PIC microcontroller and will be be responsible for collecting the data from the real world. The data collection and processing is done by the PIC microcontroller itself and the reason behind choosing the PIC is because of its ADC channel capacity. The PIC is very powerful microcontroller and has many added benefit that comes inbuilt into the microcontroller it self.
- MQ-3 Alcohol Sensor: MQ-3 gas sensor shown in Figure 2 is used for identifying the alcohol content from breath. It can be positioned just in front of the mouth. The sensor responds to various molecules in alcohol and

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determines if the rider is drunk. The sensor also has a potentiometer to adjust the concentration of gases. We calibrate the detector for 0.4mg/L of alcohol concentration in air and use a resistance of 200 KΩ. It has a 4 pins namely GND, VCC, A out and D out. The sensor supports both analog and digital outputs, here we use digital output of this sensor.

- MEMS Sensor: We use the MEMS sensors such as pressure, force, gyroscope, accelerometer to monitor the status of the rider and also collecting the data in case of emergency. MEMS technology does have some advantages of its own. MEMS sensors provide convenient features available with every other sensor line without any space constraints. In addition, MEMS makes use of very compact micro machine components so tiny that each MEMS sensor can easily fit into the palm of your hand. Plus, MEMS sensors have an IP67 seal. This is because the sensors need to be able to withstand some intense temperatures ranging from 40º to +85ºC. Most industries in which MEMS sensors are used operate in extreme temperatures. And, this seal enables the sensors to be submerged into shallow water for temporary periods, allowing them to monitor the offshore and subsea pitch and roll applications. Other electrolytic sensors might have higher accuracy but are often more sensitive to temperature.

The Controller Unit: The controller unit is the heart of this system since both the microcontroller arenecessary for operating the whole system and overlooking every single task that takes place at both backend and frontend. Both the controller are very important in maintaining the status of the helmet and keep the power consumption veryless.

Battery Management System :BMS plays a very crucial role since the BMS has very important role of supplying power and keeping the system alive.

III. ALGORITHM

1) Initialisation:
Initialise the helmet's sensors, such as IR sensor, alcohol sensor, temperature sensor, etc.Set initial values for calibration and thresholds.

2) Sensor Data Acquisition:
Continuously read sensor data from the helmet's sensors.Store the sensor data in appropriate variables or data structures.

3) Impact Detection:
Analyse the accelerometer data to detect potential impacts or collisions.Set thresholds to differentiate between normalmovements and impacts.If a significant impact is detected,proceed to the next step.

4) Emergency Response:
Activate emergency response mechanisms, such as triggering an alarm, sending alerts to predefined contacts, or initiating communication with a connected device (e.g., smartphone) or server.
Record relevant sensor data (e.g., impact magnitude, location, time) for further analysis or investigation.
Depending on the specific use case, additional actions like activating airbags, signalling nearby vehicles, or sending distress signals can be included.

IV. RESULTS

As soon as the IR sensor detects the rider is wearing a helmet, it further proceeds with checking the alcohol consumption from the riders breath.
According to these two conditions the input pin of the controller gets enabled.
The OK signal is then send to the Bike unit.
The OK signal received from the Helmet Unit which is transmitted using the ZigBee module helps in validating the riders safety
The controller present in the Bike Unit then energises the connection between the battery and key switch.
Thus the project works perfectly fine when the prototype is tested.

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V. BENEFITS OF SMART HELMETS

1. Real-time Monitoring: Smart helmets continuously monitor vital parameters such as speed, heart rate, and environmental conditions. This data can be used to identify potential risks, detect abnormalities, and provide timely warnings to the rider.
2. Accident Detection and Emergency Response: By leveraging sensors and connectivity, smart helmets can detect accidents and automatically notify emergency services or pre-designated contacts. This feature ensures prompt medical assistance and improves the chances of survival for injured riders.
3. Enhanced Situational Awareness: AR overlays and heads-up displays (HUDs) provide riders with real-time information about their surroundings, including navigation prompts, traffic conditions, and hazard alerts. This augmented situational awareness helps riders make informed decisions and react quickly to potential dangers.
4. Deterrence and Theft Prevention: Smart helmets often include anti-theft features such as motion sensors, geolocation tracking, and alarm systems. These security measures deter theft and increase the chances of recovering stolen helmets.

VI. CHALLENGES AND FUTURE DIRECTIONS

1. Cost and Affordability: The high cost of smart helmets remains a significant barrier to their widespread adoption. Future research should focus on cost reduction strategies while maintaining the necessary functionalities and safety features.
2. Standardisation and Compatibility: The lack of standardised communication protocols and compatibility between smart helmet systems and existing infrastructure pose challenges for seamless integration. Establishing industry standards and collaboration among stakeholders can address these issues.
3. User Acceptance and Education: Promoting user acceptance and educating riders about the benefits and functionalities of smart helmets are essential. Public awareness campaigns and educational initiatives can help overcome initial skepticism and resistance.
4. Integration with Intelligent Transportation Systems (ITS): Integrating smart helmet technologies with emerging intelligent transportation systems can further enhance safety by enabling vehicle-to-vehicle and vehicle-to-infrastructure communication.

VII. CONCLUSION

Smart helmets hold significant promise in enhancing biker safety through real-time monitoring, accident detection, and improved situational awareness. This paper has provided a comprehensive review and analysis of smart helmet technologies, highlighting their key components, benefits, and potential challenges. Future research and development efforts should address affordability, standardisation, user acceptance, and integration with intelligent transportation systems to fully realise the potential of smart helmets in ensuring the safety of motorcyclists.

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