**Smart Helmet**

**Abstract:**

This project introduces a Smart Helmet for Driver Safety, a cutting-edge wearable designed to address the issue of driver falls and enhance road safety. Utilising advanced sensors and intelligent algorithms, the helmet promptly detects falls and initiates an automatic response. This response includes activating a mobile app that triggers an immediate call to emergency contacts and services thus, providing precise GPS coordinates. Additionally, the system incorporates a feature to alert close contacts, ensuring a comprehensive emergency response. This innovative solution significantly reduces response times during accidents, contributing to improved road safety standards. The project aligns with our commitment to leveraging technology for proactive measures in emergencies, making it a promising candidate for the allocated funding. The successful implementation of the Smart Helmet has the potential to redefine safety standards and positively impact the lives of drivers on the road.

**Introduction:**

* **Problem Statement :**

In 2022, India reported over 460,000 road accidents, leading to 168,000 deaths--about one death every three minutes, on average. This is the highest number ever recorded. Further over 440,000 people had non-fatal injuries, according to [data](https://morth.nic.in/sites/default/files/RA_2022_30_Oct.pdf) from the Ministry of Road Transport and Highways. A third of the accidents were on national highways, about a quarter on state highways and the rest on ‘other roads’, corresponding to 36%, 24% and 40% deaths, respectively. Two in three victims are in the 18- to 45-year age group, while 83.4% of fatalities occur in the working-age population of 18 to 60 years. Urban areas accounted for 32% of road accident deaths, while rural areas had 68%, reflecting challenges such as insufficient trauma care facilities and limited awareness of road safety measures.

Data from the National Highway Traffic Safety Administration (NHTSA) in the United States further emphasises the impact of motorcycle accidents. In 2020, there were over 5,000 motorcycle rider fatalities, and the fatality rate per registered vehicle was nearly 29 times higher for motorcyclists than for passenger car occupants.

Moreover, analysis of emergency response times reveals critical lapses in assistance provision. According to a study conducted by the American College of Surgeons, the "Golden Hour," a critical period for trauma care, is frequently exceeded in motorcycle accident scenarios, contributing to increased morbidity and mortality rates.

In many of these incidents, existing safety measures, such as helmets and protective gear, fall short of providing swift and automated responses, leaving riders in vulnerable situations during the crucial moments following an accident.

Therefore, there is an evident and urgent need for an innovative solution that addresses the challenges associated with timely accident detection, particularly when riders are unable to seek immediate assistance.

* **Preface :**

The Smart Helmet represents a convergence of cutting-edge technologies, integrating advanced sensors and an Arduino Uno microcontroller. The embedded accelerometer serves as the vigilant guardian, constantly monitoring the helmet's orientation and acceleration. When a fall is detected, the system orchestrates a symphony of responses: activating the Bluetooth module to communicate with a paired smartphone and engaging an intelligent algorithm to trigger emergency alerts.

Consider the ripple effect of a timely response — the potential to not only prevent fatalities but also minimize the long-term physical and emotional toll on survivors and their loved ones. This project, therefore, goes beyond the realms of technology; it embodies a humanitarian commitment to preserving lives, reducing trauma, and fostering a sense of security among motorcyclists navigating the unpredictable terrains of our roads.

* **Previous Works :**

The Internet of Things (IoT) has witnessed remarkable advancements, offering substantial benefits across various domains. In the realm of accident detection and reporting, previous works have laid valuable foundations.

Existing solutions, such as those by White et al. [4], rely on smartphone accelerometers for accident detection. While innovative, these solutions face challenges of reliability and accuracy, with susceptibility to false positives.

Sankar et al. [5] identified critical timeframes post-accident, dispatching ambulances promptly.

* Notably, Fernandes et al. [8] focused on four-wheelers, utilising smartphone apps for accident detection. However, smartphone-centric approaches may introduce false positives.

A system was developed that incorporates an accelerometer for fall detection, triggering responses. Through the GSM module, the helmet communicates in real-time, placing emergency calls to services and notifying predefined contacts. The GPS module provides location coordinates, facilitating swift assistance.

**Research Gaps:**

* As the last research has shown that it used GSM and GPS modules for the data transmission and working of the whole system. Thus, we have decided to eliminate these modules and introduce a Bluetooth redirecting mechanism to our project. By Incorporating this mechanism we are eliminating a lot of hardware thus reducing the weight and dynamics of the helmet also helps in reducing the overall cost of the helmet due to the development of an application as a gateway to a plethora of modifications.

* Implement a voice command system to allow hands-free operation of the helmet, enabling the user to control features like answering calls, adjusting settings, or activating emergency alerts.

* Addition of an alcohol detection mechanism to detect if the driver is drunk.

* GPS location tracking

* Indicators for the Bicycle Drivers and Break Lights.

**Objective:**

Our project is driven by a paramount objective: to fundamentally enhance motorcycle safety by introducing a groundbreaking Smart Helmet. At the heart of this initiative is the unwavering commitment to reduce accidents and elevate rider security through innovative design and technological prowess.

The allure of our project lies in its unique approach to accident prevention. The Smart Helmet is meticulously engineered to be more than just protective gear – it's an active partner in ensuring the safety of riders. Through advanced sensor integration, particularly the accelerometer, the helmet becomes attuned to the rider's movements, allowing for swift and accurate detection of potential accidents.

But the allure doesn't stop at detection; it extends to the helmet's immediate response mechanisms. When a fall or anomaly is detected, the Smart Helmet becomes a proactive agent, triggering timely alerts and notifications to predefined contacts. This instantaneous communication network is a pivotal element in reducing response times and mitigating the severity of accidents.

Our project stands out by not relying on GSM and GPS modules, ensuring a streamlined and cost-effective solution without compromising its effectiveness. By foregoing these components, we aim to provide an accessible safety solution for a broader spectrum of riders.

These are some of the prototype images for the earlier models made for the same purpose by different organisations.

**Methodology :**

**1. Sensor Integration:**

The foundation of our Smart Helmet lies in the integration of advanced sensors, primarily the accelerometer. This sensor is strategically placed within the helmet to constantly monitor and analyze the rider's movements and the helmet's orientation.

**2. Fall Detection Algorithm:**

An intelligent fall detection algorithm is implemented based on the data received from the accelerometer. This algorithm is designed to differentiate between normal movements and potential falls or accidents. When an unusual pattern indicative of a fall is detected, the system initiates the response sequence.

**3. Immediate Response Mechanism:**

Upon detecting a fall, the Smart Helmet activates an immediate response mechanism. This includes triggering visual and audible alarms within the helmet to alert the rider about the potential accident.

**4. Intelligent Communication System:**

The Smart Helmet incorporates an intelligent communication system that does not rely on GSM or GPS modules. Instead, it utilizes short-range communication technologies such as Bluetooth to establish a connection with a paired smartphone.

**5. Smartphone Integration:**

The paired smartphone acts as a relay point for communication. In the event of a detected fall, the Smart Helmet sends an alert to the smartphone via Bluetooth, signalling the need for immediate assistance.

**6. Smartphone-Based Emergency Response:**

The paired smartphone, upon receiving the fall alert, initiates an emergency response protocol. The smartphone can automatically dial emergency services and convey the situation, providing crucial information about the potential accident.

**7. User Notification System:**

Simultaneously, the smartphone communicates with predefined contacts listed by the user. These contacts receive notifications about the potential accident, ensuring that a network of support is informed promptly.

**8. Manual Override Option:**

Recognizing the possibility of false positives, the Smart Helmet includes a manual override option. The rider can intervene through the paired smartphone to confirm their safety and prevent unnecessary emergency responses.

By adopting this methodology and working principle, our Smart Helmet ensures a proactive and efficient approach to motorcycle safety, actively contributing to accident prevention and rider well-being without relying on GSM and GPS modules.

* **Components Used:**

* **Accelerometer:**
  + The accelerometer is a crucial sensor that measures the helmet's acceleration and detects changes in motion. It forms the foundation for the fall detection algorithm.
* **Microcontroller (Arduino Nano):**
  + The Arduino Nano serves as the brain of the Smart Helmet, processing data from the accelerometer and coordinating the overall functionality of the system.
* **Bluetooth Module (HC-05):**
  + The Bluetooth module facilitates short-range wireless communication between the Smart Helmet and a paired smartphone, enabling data transmission and real-time alerts.
* **Smartphone:**
  + A paired smartphone acts as a central component for communication and emergency response. It receives alerts from the Smart Helmet and initiates communication with emergency services and predefined contacts.

* **Power Supply:**
  + A reliable power supply, typically a rechargeable battery, provides the necessary energy to operate the Smart Helmet. Efficient power management ensures optimal performance and extended usage.

**Deliverables:**

As, the market size of road safety equipment in India is around 5.8 billion USD with a CAGR of 9.6%.

Also the product is solving one of the biggest problems of non availability of emergency assitence when required.This product may beocme the pioneer in the smart helmet segment of Indian market.

Thus, we have decided to come up with two prototypes for the commercial pupose.

First one being the basic helmet which detects accidents and falls and responds.

Second one brings the features of the first helmet along with the all the modifications and the advancements proposed above.

Along with a full fleged application to access these featues as we are using the bluetooth technology in this helmet.

**Budget:**

As, the project is mostly Software Intensive thus the budget for this is basically rhe electronics used in the hardware part of the spectrum.

**Equipment**                             **Cost(Rs)**

Helmet                                        400-500

Arduino UNO/NANO              500-700

Accelerometer Sensor              250-300

Bluetooth Module                    400

Miscelleneous                            300

**Modifications**                       1500-2000

**Total:**

**Without Modifications**   -       Rs 1850 - 2200

**With Modifiactions         -** Rs  3500 - 4000