PROJECT ABSTRACT

Smart Helmet with Accident Detection and SOS Alert

An ESP32-based smart helmet that detects crash signatures with an MPU6050 IMU, fixes position with GPS, sends SOS SMS with a map link over GSM, and logs every event to a live cloud dashboard. Delivered built-to-order with helmet prototype, firmware, dashboard, report, PPT and viva kit.

01. Title

Smart Helmet with Accident Detection and SOS Alert

02. Introduction / Background

Two-wheeler riders are the most vulnerable road users, and in many crashes the critical delay is not medical response but nobody knowing the accident happened — the rider is alone, injured or unconscious, and the helmet lies silent. Commercial smart helmets with crash alerting are sealed products priced out of student reach and reveal nothing about how crash detection works. The useful engineering gap is a transparent, student-built system showing the whole loop: inertial crash-signature recognition, GPS localization, and an SOS alert that reaches a real phone. This project implements that on an ESP32 with an MPU6050 IMU, NEO-6M GPS, SIM800L GSM and a cloud alert dashboard.

03. Problem Statement

Students study inertial sensing and IoT alerting separately but rarely combine them into a testable safety system: how a crash signature is distinguished from a dropped helmet, how a location fix is obtained and delivered, and how false positives are handled honestly. The project addresses this with a helmet-mounted ESP32 system that detects impact signatures, confirms them with tilt-and-immobility logic, offers a cancellation window, and only then sends an SOS SMS with a map link — while logging everything to a dashboard.

04. Objectives

- Detect crash signatures with an MPU6050 IMU using impact-threshold, free-fall-then-shock and tilt-confirmation logic.
- Obtain the crash location from a NEO-6M GPS module and embed it as a map link.
- Send SOS SMS alerts to stored emergency contacts via a SIM800L GSM module.

- Provide a buzzer cancellation window so a conscious rider can abort false alerts.
- Log every event with timestamp, peak acceleration and location to a live cloud dashboard.
- Deliver a student-run threshold-tuning procedure so all detection figures come from the buyer's own tests.
- Deliver the complete student kit: prototype, firmware, dashboard, report, PPT and viva Q&A.

05. Proposed Methodology

The system is developed in three stages. (1) Sensing: the MPU6050 streams 3-axis acceleration and angular velocity to the ESP32; firmware computes resultant acceleration and watches for the impact spike, the free-fall-then-shock pattern and the prolonged tilt of a fallen rider. (2) Alerting: on confirmed impact a buzzer countdown runs; if not cancelled, the GPS fix is read and the GSM module texts emergency contacts with a Google Maps link. (3) Telemetry: every event is published over Wi-Fi to the cloud dashboard with the crash log and last known position, with offline buffering when Wi-Fi is absent.

06. System Architecture / Working

The IMU samples motion continuously. A resultant-acceleration spike crossing the impact threshold starts the verification sequence: the firmware checks for the fall-shock pattern and monitors tilt angle, escalating only when the tilted-and-immobile state persists for the confirmation time. The buzzer then sounds the cancellation countdown; a press of the cancel button logs the event as cancelled. If the window expires, the GPS position is captured and the SOS SMS goes out to each stored contact, while the event (type, time, peak g, location) is published to the dashboard.

07. Hardware / Software Requirements

- ESP32 development board (Wi-Fi + Bluetooth)
- MPU6050 6-axis IMU
- NEO-6M GPS module
- SIM800L GSM/GPRS module
- Push-button cancel switch, buzzer, status LEDs
- Rechargeable Li-ion pack with charging module
- Cloud dashboard (Firebase/ThingSpeak class)
- Arduino IDE (C/C++ firmware)
- Standard motorcycle helmet shell (non-structural retrofit)

08. Expected Outcomes

- A working helmet prototype that detects test impacts and sends SOS SMS with a map link.
- A live dashboard with ride status, crash-event log and last known position.
- Student-tuned impact and tilt thresholds documented from the buyer's own drop tests.
- A complete report, PPT and viva Q&A on inertial sensing, crash signatures and GSM/GPS integration.

09. Applications

- Demonstrating wearable safety-IoT concepts for two-wheeler riders.
- Teaching IMU signal processing and event-detection firmware design.
- Prototyping alert pipelines from sensor to phone to cloud.

10. Future Scope

- Rider-behavior scoring (harsh braking, aggressive lean) from the same IMU stream.
- LoRa or NB-IoT alerting for areas without GSM coverage.
- Automatic emergency-service API integration alongside contact SMS.
- Helmet-removal / theft alert as an added sensor channel.