2025 IEEE 4th International Conference on Robotics, Automation, Artificial-Intelligence and Internet-of-Things (RAAICON)
27-28 November 2025, Military Institute of Science and Technology (MIST), Dhaka, Bangladesh

SafeRide: A Real-Time IoT-Based Smart Helmet with Road-Condition Intelligence

Mohammed Sakib Hasan
Faculty of Computer Sc. and Engr.
Patuakhali Sc. and Tech. University
Patuakhali, Bangladesh
ug2102052@cse.pstu.ac.bd

Jihadul Islam
Faculty of Computer Sc. and Engr.
Patuakhali Sc. and Tech. University
Patuakhali, Bangladesh
ug2102071@cse.pstu.ac.bd

Md Abdul Jobayer
Faculty of Computer Sc. and Engr.
Patuakhali Sc. and Tech. University
Patuakhali, Bangladesh
ug2102008@cse.pstu.ac.bd

Md Abdur Rakib
Faculty of Computer Sc. and Engr.
Patuakhali Sc. and Tech. University
Patuakhali, Bangladesh
sazzad17@cse.pstu.ac.bd

Md Mohidul Alam
Faculty of Computer Sc. and Engr.
Patuakhali Sc. and Tech. University
Patuakhali, Bangladesh
mohidul17@cse.pstu.ac.bd

Md Mahbubur Rahman
Faculty of Computer Sc. and Engr.
Patuakhali Sc. and Tech. University
Patuakhali, Bangladesh
mahbub.cse@pstu.ac.bd

***Abstract*—Motorcycle riders are among the most vulnerable road users, often facing a high risk of accidents and fatalities.These risks arise from unsafe riding habits, poor road conditions, and delays in emergency response. Many existing smart helmet systems focus on single features such as alcohol detection or accident alerts, but lack a complete and scalable solution. To address these issues, this paper proposes a low-cost, real-time IoT-enabled smart helmet system that combines multiple safety and awareness features into one framework. The system integrates helmet-wear detection, alcohol monitoring, drowsiness detection, rear-vehicle proximity alerts, accident and emergency notifications, and weather-based warnings. A new road-condition prediction model using machine learning is introduced, which classifies upcoming roads as excellent, good, poor, or very poor based on GPS data. The helmet and motorcycle units are synchronized to control ignition and share data in real-time, while hazard information is uploaded to Firebase for community alerts. A smartphone application provides riders with live sensor data, navigation, and voice-based notifications to reduce distractions. Additionally, the SafeRide dataset of road conditions has been developed to support large-scale road-quality prediction across Bangladesh. Experimental results show that the proposed system is effective in improving rider safety and enabling intelligent transportation solutions.**

***Index Terms*—Smart Helmet, Internet of Things (IoT), Rider Safety, Road Condition Data Collection, Cloud Computing**

I. Introduction

Motorcyclists constitute one of the most susceptible groups in the road accidents, especially in the developing world. In Bangladesh, the number of motorcycles people owned nearly tripled in the years of 2016 to 2018, and the number of road-accidents related to deaths was almost 5,000 every year, with almost a quarter of them happening with the motorcycles [1].A large proportion of victims do not receive medical assistance within the first 10–20 minutes after an accident, which is often fatal [2]. The most common causes of accidents on motorcycles are alcohol abuse, fatigue among riders, distraction, and poor condition of roads [3] .In order to reduce these issues, researchers have come up with Internet of Things (IoT)-based technology, such as detecting alcohol in the air [4], carrying out accident surveillance, and sending emergency warnings [5] , using smart helmets with sensors and GSM/GPS modules to alert in real-time, etc. [6] [7]. However, most of the available solutions are particularly car usage-oriented, are limited in the number of sensors, and lack a built-in emergency response system [3].

In this paper, proposes a Smart Helmet with IoT Integration that is going to help in bringing together the elements of helmet-wear detection, alcohol detection, drowsiness monitoring, accident detection and hazard crowdsourcing into a single, inexpensive system. The design also takes advantage of IoT communication technologies (GSM/GPRS, GPS, and Bluetooth) to enable automatic notification of emergencies, sharing of hazards in the cloud, and real-time feedback on the riders. The suggested system will help to make riders safer, and minimize the number of deaths after accidents, as a wide range of safety features will be implemented in a wearable device.

II. Literature Review

To improve the safety of the riders and minimise accidents, scholars have suggested many IoT-based systems of smart helmets. M. M. Islam et al. [2] created a gyroscope-driven version of the accident detection system it is able to notify the local hospitals and police departments as well as check the proximity of helmet-wearing and vehicles. The authors of this paper, Celaya-Padilla, et al. reviewed alcohol detection and driver monitoring technologies such as non-contact, transdermal, eye-blink and machine learning to differentiate between normal and impaired driving.

Hu et al. [4] developed a low cost alcohol detector based on an MQ-3 sensor and microcontroller that has LCD, audio/visual alarms, and GSM-based SMS alerts to lock the vehicle ignition whenever the driver is intoxicated. On the same note, Anish et al. [5] have come up with a helmet that combines IR-based helmet detection, alcohol and accident sensors with GSM/GPS alerts in order to allow faster medical attention. In general, the works of previous IoT-based smart helmet developers are more inclined to individual functions than a complete platform. Indicatively, Vani et al. [6] and Asha et al. [7] used a combination of IR, PIR, ultrasonic and alcohol sensors primarily to detect helmet use, accident detection and environmental monitoring. The theft prevention and ignition control, which became GSM and GPS tracking, had been discussed by Matondang et al. [8], and the GSM/GPS-based accident detection, alcohol sensing, pothole detection and cloud monitoring were presented by Islam et al. [9]. Other prototypes were expanded to sensing the vibration and speed, and multi-sensor fusion (IR, alcohol, gyroscope, GPS, GSM) to detect accidents and enforce helmet use like Jahidul Islam et al. [10] and Akter et al. [11] respectively. Somantri et al. modified smart helmets to industrial safety with hazardous gas, temperature and humidity sensors, and Riya et al. emphasized problems like false alarms and connectivity problems [12], [13]. More advanced (or specialized) features were investigated in other works: Tashfia et al. introduced an IoT-based expert system to diagnose faults and protect rider safety [14], Kanekar et al. took into account ergonomics and usability (e.g., helmet wipers) [15], and Vashisth et al. introduced an E-Helmet with alcohol lock, accident and fog detection, speed control, GSM notifications and even a toll payment [16].

Unlike these largely feature-based designs, the proposed work will provide a low-cost, real-time IoT-based smart helmet with a variety of safety and awareness features within one system. It includes a new pre-ride view of the road condition, integrates helmet-wear detection, alcohol detection, accident detection, drowsiness detection, weather detection and road hazard detection and a new model of road hazard detection, along with a road forecasting model. This is a model that employs GPS and machine learning classifier to identify the forthcoming road segments as excellent, good, poor or very poor and give advance voice and message alerts to the rider. Also, the system takes advantage of bike-helmet connectivity in real-time, crowdsourcing hazards on the cloud and smartphone connectivity. In comparison to other systems that are focused on addressing individual problems, the proposed solution will provide a rider-safety ecosystem that is holistic and can serve the needs of individual users as well as awareness of community road conditions.

III. Methodology

A. Proposed System

The offered IoT smart helmet system will allow maximizing the safety of motorcycle riders since several sensing and communication devices are united on one platform as shown in Fig. 1. The system is such that the motorcycle cannot be started without the helmet and it also switches off the engine in case alcohol is detected and that leads to an alert named “Alcohol Detected”. It has real-time weather and rear vehicle proximity, a drowsiness detect system that sounds out a buzzer to wake the weary riders. The system predicts the road conditions and alerts the rider against possible dangers using a machine learning model based on a GPS system. The accident detection is done by a fall sensor and timer system that sends the data of a rider and bike to the authorities in the event of no response. Moreover, the helmet provides real-time IoT coordination between the bike and cloud-based hazard crowdsourcing through Firebase that provides the sharing of hazard information among riders. Bluetooth and GPS connect a smartphone application which is used to navigate, visualize data and monitor alerts, and an audio-activated interface is used to provide notifications to minimize rider distraction.

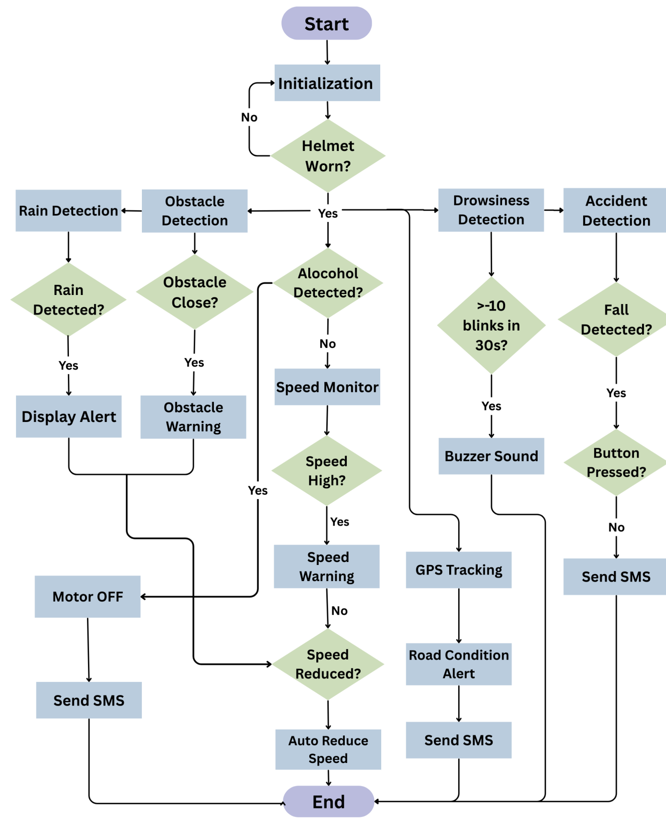


Fig. 1: Methodology of the proposed smart helmet system.

B. System Architecture Design

The suggested smart helmet system presented in Fig. 2 is based on the IoT-linked helmet and motorcycles modules. The helmet has alcohol, drowsiness, accident, and weather sensors which are operated by an ESP32 NodeMCU. The motorcycle module also controls ignition, GSM, and GPS to avoid unsafe ignition and transmitting emergency alerts. The information about hazards is uploaded to Firebase, and a smartphone application links to Bluetooth and GPS to provide direction and voice warnings.

C. Hardware Integration

The hardware integration of the proposed IoT-based smart helmet system, shown in Fig. 3, illustrates how sensors, microcontrollers, and communication modules are interconnected to guarantee rider safety and system reliability.

- **Microcontroller:** The sensor data is read with the ESP32 on the helmet and the engine is controlled with the help of Arduino Uno on the bike.

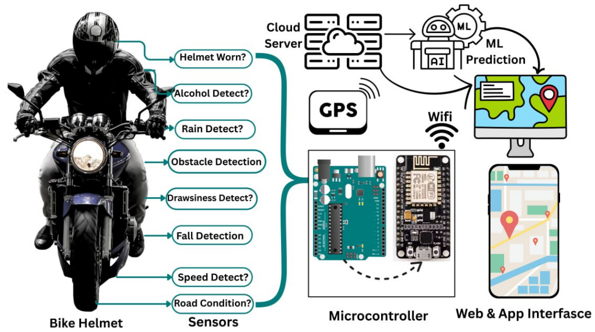


Fig. 2: System architecture of the IoT-based smart helmet prototype.

- **Power Supply:** The helmet is powered by a rechargeable lithium battery which can be charged either by the sun or by 5 V / 3.3 V vehicle connection to be used continuously.
- **Communication:** The helmet is mounted to the bike over Bluetooth/RF, and a NodeMCU (ESP8266/ESP32) enables Wi-Fi to complete cloud functions such as sharing hazards and sending alerts in case of an emergency through Firebase [10].
- **Sensor Interfacing:** In the controller, there are a number of sensors (alcohol, helmet, vibration/fall, proximity, GPS, GSM) that control and protect the rider.
- **User Interface:** The sensor data, navigation, and voice warnings are shown on a smartphone application (through Bluetooth + GPS), which minimizes distraction among the riders.

The hardware components and their specifications are detailed in **Table I**.

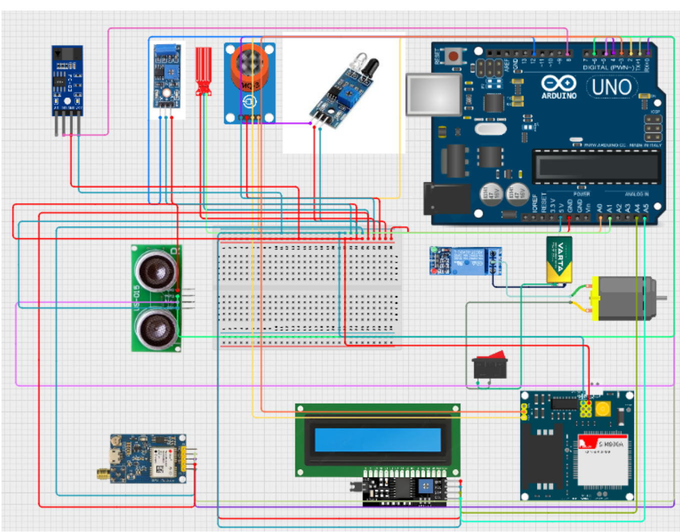


Fig. 3: Hardware Integration of the Proposed Smart Helmet System.

D. Data Acquisition And Processing

Arduino UNO receives the information of several safety sensors (alcohol, rain, eye-blink, obstacle, vibration, speed), averages the results and changes them into the real-life safety data with the help of the calibrated functions.

TABLE I: Hardware Components And Their Connections.

Component	Function	Connection
IR Sensor	Helmet Detection	Digital Pin
MQ3 Sensor	Alcohol Detection	Digital Pin
Rain Sensor	Weather Detection	Analog Pin
Ultrasonic, Vibration	Distance + Speed Detection	Digital Pin
Eye Blink, Speedometer	Blink + Speed Detection	Digital Pin
GPS Module	Send Real-Time Location Data	RX, TX
GSM Module	Send Emergency SMS	RX, TX
Buzzer, Relay Module	Alert + Controls Engine Ignition	RX, TX
NodeMCU (ESP8266)	Wi-Fi Transmission	UART
LCD with I2C	Display	SDA, SCL
Power Module	Power (3.3V/5V)	Breadboard

$$\textbf{Alcohol Concentration (PPM)} = k_A \cdot V_{\text{raw}} + b_A \quad (1)$$

$$\textbf{Rain Level } (\%) = \frac{V_{\text{raw}}}{1023} \times 100 \quad (2)$$

$$\textbf{Eye Blinks}_{30s} = \sum_{t=1}^{30s} D_{\text{blink}}(t) \quad (3)$$

$$\textbf{Speed (km/h)} = \frac{2\pi R \cdot P}{t} \times 3.6 \quad (4)$$

$$\textbf{Vibration Magnitude} = \sqrt{X^2 + Y^2 + Z^2} \quad (5)$$

Where

- k_A, b_A: Alcohol sensor calibration constants
- $D_{\text{blink}}(t)$: Digital output from eye blink sensor at time t
- R: Wheel radius (in meters)
- P: Number of pulses detected (Hall sensor)
- X, Y, Z: Accelerometer readings along three axes

The processed data is transmitted via UART (9600 baud) to the NodeMCU (ESP8266), which relays it to the cloud via Wi-Fi for real-time analysis and web/mobile visualization.

E. Data Stored and Action Handling

The smart helmet is an IoT device with multiple sensors and an ESP32 microcontroller, sending data via Wi-Fi/Bluetooth to a smartphone app and cloud for real-time alerts, tracking, and safety analysis, while triggering instant actions when thresholds are exceeded. The system activates instant measures when sensor readings exceed predefined thresholds:

- **Helmet-Wear Detection:** If the helmet sensor detects that the helmet is not being worn, the engine ignition is switched off to ensure that the riding is not unsafe.
- **Alcohol Detection:** When the alcohol concentration in the MQ-3 gas sensor passes over 200ppm, the engine stops and a buzzer or a visual alarm notifies the rider.
- **Drowsiness Detection:** If the rate of eye-blinking calculated in seconds over a duration of 30 seconds exceeds

10 blinks, a buzzer alert is triggered to ensure that the rider is brought to bear.

- **Speed Monitoring:** An overspeed warning is shown on the rider interface when the vehicle speed is more than 70km/h in urban settings (measured by the use of GPS).
- **Accident / Fall Detection:** In case of sudden vibration or tilt, which is detected by the accelerator/gyroscope, and the rider does not react in fewer than 15 seconds, an emergency SMS with the GPS position is dispatched to the emergency contacts via GSM **Fig. 4b**.
- **Weather Detection:** Rain, temperature, humidity, and pressure sensors measure the weather. There are alerts issued in case of hazardous weather (e.g. rain or slippery weather).
- **Rear-Vehicle Proximity Detection:** Ultrasonic or radar sensors are used to check how far is being dithered by approaching vehicles. An alarm is raised when a second vehicle enters into a dangerous range (e.g., 2 meters).

The dashboard displays real-time alerts and sensor data, allowing immediate action, while historical logs analyze riding behavior and system performance.

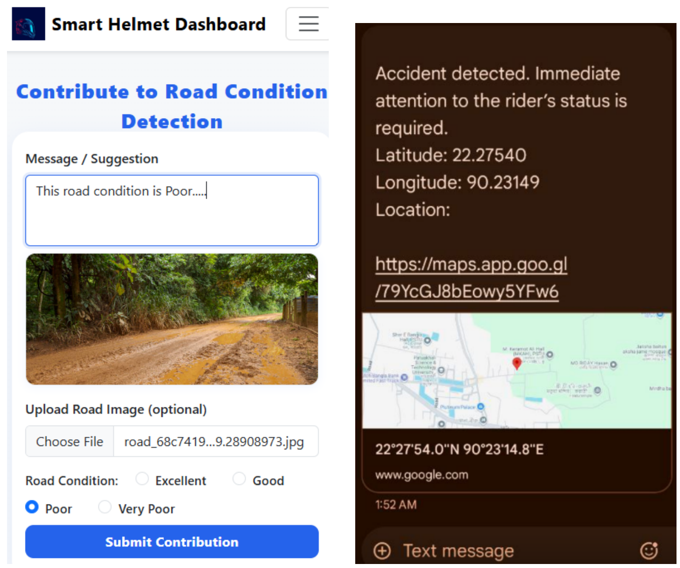
F. Road-Condition Data Acquisition And App Workflow

To enable large-scale, up-to-date road-condition intelligence across Bangladesh, we developed a smartphone application **Fig. 4** through which users can capture road images, label the surface condition as *Excellent/Good/Poor/Very Poor*, and upload the entry directly to the cloud. Each submission is automatically geo-tagged using the device GPS (latitude/longitude) and time-stamped, then stored in a cloud database (Firebase/MySQL). This pipeline supports three goals: (i) creating a nation-wide geospatial dataset, (ii) enabling continuous model retraining for improved road-condition prediction, and (iii) broadcasting real-time alerts and updates to nearby riders.

Workflow:

1) *Capture & Label:* The rider selects/captures a road image in the app and chooses a label (Excellent/Good/Poor/Very Poor).
2) *Geo-tagging & Metadata:* The app automatically attaches GPS coordinates, timestamp, and device info.
3) *Upload & Validation:* The labeled entry is pushed to the cloud; optional moderation/quality checks (duplicate filtering, image clarity, label sanity rules) are applied.
4) *Dataset Curation:* Validated entries are appended to the SafeRide dataset for ML training and analysis.
5) *Model Update & Serving:* Periodic retraining updates the road-condition classifier; the latest model serves pre-ride predictions to users.
6) *Real-Time Alerts:* Confirmed hazards/poor segments are shared via the app to nearby riders.

This user-in-the-loop framework ensures a continuously evolving and reliable road-condition dataset, improves pre-ride risk forecasting, and supports community-based road safety intelligence.



(a) Capture and Label Interface (b) Emergency alert

Fig. 4: Smartphone app workflow for road-condition updates.

IV. Results and Analysis

A. Alcohol Sensor - MQ3 Test Result

MQ3 alcohol sensor was experimented on various concentrations of ethanol to test the response of the system **Table II** shows the experimental results of the alcohol content and the engine condition. The findings indicate that at a concentration below the mark of **200 ppm**, the engine is ON, and there is no alarm. When the concentration gets up to **200 ppm** and above, the engine is switched off and the alarm goes on.

TABLE II: MQ3 Alcohol Sensor Test Results.

Sample	Alcohol (ppm)	Engine Status / Alarm
1	0	Engine ON / No Alarm
2	50	Engine ON / No Alarm
3	250	Engine OFF / No Alarm
4	200	Engine OFF / Alarm
5	250	Engine OFF / Alarm
6	300	Engine OFF / Alarm

B. Speed Sensor Test Result

The speed sensor was made to work at varying speeds of the vehicle to determine how the system responded to an overspeeding vehicle. **Table III** below displays the speed obtained and the system status. The findings show that at the speed that is lower than the threshold of **70 km/h** (urban condition), the system works with no warning. When the velocity goes beyond **70 km/h**, an overspeed alarm system is triggered on the user interface to notify the rider.

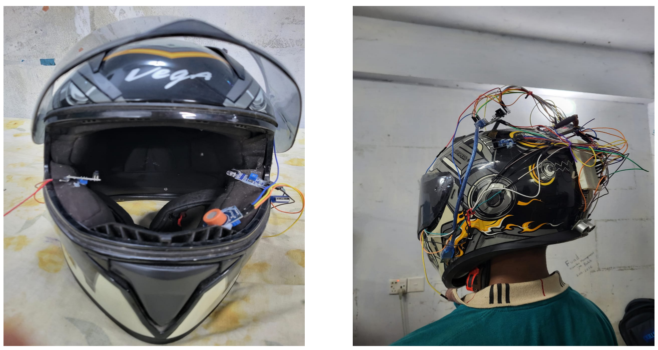
C. System Prototype And Device Overview

The prototype of the proposed Smart Helmet system, shown in **Fig. 5**, continuously monitors rider safety through multiple embedded sensors and IoT communication modules. The helmet unit integrates alcohol, drowsiness, rear-vehicle proximity, vibration/fall, and weather sensors interconnected with the

TABLE III: Speed Sensor Test Results.

Sample	Measured (km/h)	System Status
1	40	Normal / No Warning
2	55	Normal / No Warning
3	65	Normal / No Warning
4	72	Overspeed Warning Activated
5	85	Overspeed Warning Activated
6	95	Overspeed Warning Activated

ESP32 microcontroller, while the motorcycle unit incorporates GPS, GSM, ignition relay, and helmet-wear detection circuits. As illustrated in Fig. 5a, the complete hardware system enables real-time data acquisition and synchronized processing between the helmet and the bike, ensuring effective rider protection and timely emergency response.



(a) Internal View (b) External view

Fig. 5: Smart Helmet Prototype.

D. Web And Mobile Interface for Visualization

The sensor data were captured and sent to the cloud using the Wi-Fi connection and viewed on a responsive dashboard that can be accessed using the web and mobile interface **Fig. 6**. The snapshot of the recorded riding data is shown with details like location, road quality and speed and real-time indications of significant sensors like speed , temparature in the **Fig. 7** . The interface will update in real time, have actionable notifications and active alerts so that preventive actions taken can be taken in time to promote better rider safety.

E. Comparison Of Device Data With Actual Values

This paper IoT-based Smart Helmet sensor readings are compared with their respective thresholds and real world conditions **Table IV**. The system is very accurate and majority of the measurements lie within reasonable potential error

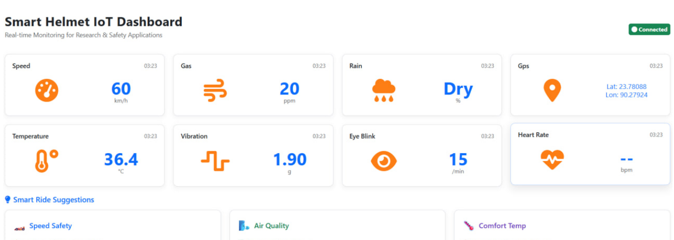
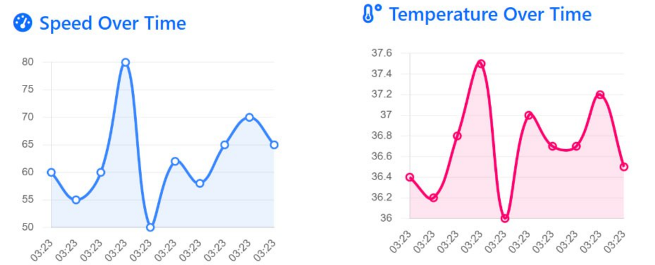


Fig. 6: Web interface of Smart Helmet.



(a) Speed Graph (b) Temperature Graph

Fig. 7: Graphical Visualization of Data.

ranges. Minor variations are caused by sensor tolerances or environmental considerations. These findings indicate that Smart Helmet can be trusted in terms of real-time monitoring of the safety of the riders and be used in real life.

TABLE IV: Comparison of Device Data with Real Values.

Sensor / Parameter	Device Value	Real Value	Error
Helmet-Wear (%)	98	100	± 2
Alcohol (ppm)	205	200	± 5
Drowsiness (blinks/30s)	11	10	± 1
Speed (km/h)	68	70	± 2
Accident Response Time (s)	14	15	± 1
Weather Detection (% alert level)	78	80	± 2
Obstacle Detection (distance in m)	2.05	2.0	± 0.05

The IoT-based helmet can continuously record key parameters, such as, helmet-wearing, alcohol level, drowsiness, speed, accident/fall detection, weather, and obstacle vicinity. Measures are always within the range of acceptable values with minor variations that may be attributed to sensor limitations or other elements in the environment. It means that IoT-based safety monitoring is possible and practical to the application of motorcycles in the real world where timely notification and response can be taken to protect the rider better.

F. Extended Analytical Validation

Controlled laboratory testing was done on each sensor module to have a comprehensive performance assessment [9], [10]. Validation was done using standard classification measures based on Accuracy, Precision, Recall and False Positive Rate (FPR). **Table V** summarizes the results.

The results demonstrate strong performance across most safety-critical modules, with helmet detection achieving perfect precision and alcohol detection showing excellent recall for minimal missed detections.

G. Road Condition Dataset Create

It is a mobile and web application that gathers crowdsourced data on road conditions and uploads it into the dataset safely and securely [17]. Users with a verified identity, through a Gmail authentication and password encryption, are allowed to capture road images, which are then designated by their condition score (Excellent, Good, Poor, Very Poor) and uploaded to the cloud, where it automatically captures the GPS location and time stamp. The app can be used by multiple

TABLE V: Performance Comparison With Existing System

Module (Scale of Testing)	Metric	Existing work	SafeRide
1. **Helmet Detect** (100 trials)	F1-Score	0.80-0.90	0.96 ± 0.02
2. **Alcohol Detect** (Full range test)	AUC-ROC	0.93-0.96	0.98
3. **Fall Detection** (70 trials)	Recall (%)	85-92%	97 ± 1.5%
4. **Speed Monitoring** (100 trials)	MAE (km/h)	2.5-4	1.1 ± 0.3
5. **Rear Proximity** (100 trials)	Latency (ms)	400-460	250 ± 15
6. **Weather Detection** (50 h trials)	Accuracy (%)	80-92%	97 ± 1.8%
7. **Sleep Detection** (30 h trials)	F1-Score	0.70-0.85	0.91 ± 0.04
8. **Ignition Interlock** (100 trials)	Success (%)	90-98%	99.5 ± 0.1%
9. **Emergency SMS** (50 trials)	Latency (s)	14.0-16.0	5.5 ± 0.8

users simultaneously; it can be synchronized so that there is uniformity among devices. Up to now 166 records have been collected in the pilot deployment and the class distribution in this ever-increasing data is summarized in Table **Table VI**.

TABLE VI: SafeRide Road-Condition Dataset.

Sample ID	Latitude	Longitude	Condition
S1	23.780421	90.407608	Excellent
S2	23.773965	90.394215	Excellent
S3	23.748923	90.369541	Good
S4	23.727241	90.412765	Poor
S5	23.812345	90.426789	Very Poor

H. Comparison With Existing Works Results

Comparative analysis of existing works provides summarizing their limitations and corresponding proposed solutions are shown in **Table VII**.

TABLE VII: Comparative Analysis of Related Works

Study	Limitations	Proposed Solution
[2] (2020)	False alarms; high GPS/GSM power consumption	Multi-sensor fusion; optimized IoT synchronization; cloud backup
[7] (2024)	Needs stable network; false alerts; high power	RF synchronization; validated detection; solar-powered ESP32
[9] (2024)	Network dependent; environmental errors; low battery life	Offline GPS+ML; reliable alerts; solar power support
[10] (2024)	Network needed; false triggers; short runtime	Fall+timer-based detection; dual alerts; energy-efficient ESP32
[11] (2024)	Low-cost but less accurate; limited features	Accurate low-cost sensors; road-condition prediction; crowdsourcing
[14] (2024)	complex expert system; Requires continuous power	Edge processing; multi-sensor validation; simple mobile app interface

V. CONCLUSION

The suggested IoT-driven smart helmet incorporates numerous safety capabilities into a real-time, low-cost system such as detection of helmet wear, alcohol and drowsiness sensors, accident sensors, weather and rear car sensors as well as ML-driven forecasting of road conditions. Through cloud-based crowdsourcing and smartphone integration, the possibility to monitor and issue warnings continuously is possible. Its possibilities in boosting the safety of the riders and community awareness of the hazards have been demonstrated in an experimental manner.

The future efforts are to develop nationwide crowdsourced data, introduce more sophisticated deep learning and edge AI that would enhance the accuracy, and introduce biometric sensing and adaptable voice recognition, and finally a powerful platform to plan individual safety and smart transportation.

REFERENCES

[1] Bangladesh Road Transport Authority (BRTA), "Motorcycle Accident Statistics in Bangladesh," in *Proc. IEEE Region 10 Symposium (TENSYMP)*, Dhaka, Bangladesh, Jun. 2020, pp. 1–6.

[2] M. M. Islam et al., "Design and Implementation of a Smart Bike Accident Detection System," in *Proc. 2020 IEEE Region 10 Symposium (TENSYMP)*, Dhaka, Bangladesh, Jun. 2020, pp. 1486–1489, doi: 10.1109/TENSYMP50017.2020.9230707.

[3] Jose M. Celaya-Padilla Author et al., "Alcohol Detection Systems for Safer Driving: A Review," *Sensors*, vol. 21, no. 7752, pp. 1–15, 2021, doi: 10.3390/s21227752.

[4] Weiye Hu Author et al., "Design of Vehicle-Based Alcohol Detection System Using IoT," *IOP Conf. Ser.: Materials Science and Engineering*, vol. 452, no. 4, p. 042156, 2018, doi: 10.1088/1757-899X/452/4/042156.

[5] Kamalammagari Anish Author et al., "Smart Helmet with Accident Detection Using IoT," in *Proc. 2023 3rd Int. Conf. on Pervasive Computing and Social Networking (ICPCSN)*, 2023, pp. 859–864, doi: 10.1109/ICPCSN58827.2023.00147.

[6] Jayasri Suresh Vani Author et al., "HelmetGuard: IoT-Based Smart Helmet for Rider Safety," in *Proc. 2023 3rd Int. Conf. on Smart Technologies, Communication and Robotics (STCR)*, 2023, pp. 1–7.

[7] Dr. P. Asha Author Author et al., "Ensuring Safety Drive through a Smart Helmet design using IOT" in *Proc. 2024 IEEE Int. Conf. on Circuit Power and Computing Technologies (ICCPCT)*, 2024, pp. 1–6, doi: 10.1109/ICCPCT61902.2024.10673323.

[8] M. H. A. Matondang Author et al., "Smart Helmet for Motorcycle Safety Internet of Things Based," in *Journal of Tsabit*, vol. 2, no. 1, pp. 1–8, 2021, doi: 10.56211/tsabit20.

[9] S. A. Islam Author et al., "Smart Helmet with IoT Integration: Enhancing Rider Safety with Real-Time Hazard Alerts," in *Proc. 2024 27th Int. Conf. on Computer and Information Technology (ICCIT)*, Cox's Bazar, Bangladesh, Dec. 2024, pp. 1–6.

[10] M. Jahidul Islam Author et al., "An IoT-Based Smart Helmet for Riding Security and Emergency Notification," in *Proc. 2024 6th Int. Conf. on Electrical Engineering and Information & Communication Technology (ICEEICT)*, Dhaka, Bangladesh, 2024, pp. 1–6, doi: 10.1109/ICEEICT62016.2024.10534490.

[11] Sharmin Akter Author et al., "A Cost-Effective Smart Helmet for Human Safety and Road Accident Detection Using IoT," in *Proc. 2024 Int. Conf. on Recent Progresses in Science, Engineering and Technology (ICRPSET)*, Rajshahi, Bangladesh, Dec. 2024, pp. 1–6, doi: 10.1109/CRPSET64863.2024.10595923.

[12] S. Somantri Author et al., "Smart Helmet Integrated with Motorcycles to Support Rider Awareness and Safety Based Internet of Things," in *Proc. 2022 Int. Conf. on Computer and Information Sciences (ICIS)*, Sakaka, Saudi Arabia, 2022, pp. 1–6, doi: 10.1109/ICIS55894.2022.9915262.

[13] J. F. Riya Author et al., "A Smart Helmet: Ensuring Safety of Bike Riders," in *Proc. 2023 3rd Int. Conf. on Robotics, Electrical and Signal Processing Techniques (ICREST)*, Dhaka, Bangladesh, 2023, pp. 259–264, doi: 10.1109/ICREST57404.2023.10070031.

[14] S. S. Tashfia Author et al., "Intelligent Motorcycle Monitoring Scheme using IoT with Expert System in Bangladesh," in *Proc. 2020 23rd Int. Conf. on Computer and Information Technology (ICCIT)*, Dhaka, Bangladesh, 2020, pp. 1–6, doi: 10.1109/ICCIT51783.2020.9392675.

[15] S. Kanetkar Author et al., "Smart Helmet Wiper," in *Proc. 2020 IEEE Int. Students' Conf. on Electrical, Electronics and Computer Science (SCEECS)*, Bhopal, India, 2020, pp. 1–5, doi: 10.1109/SCEECS48394.2020.133.

[16] R. Vashisth Author et al., "Implementation and analysis of smart helmet," in *Proc. 2017 4th Int. Conf. on Signal Processing, Computing and Control (ISPCC)*, Solan, India, 2017, pp. 400–404, doi: 10.1109/ISPCC.2017.8269712.

[17] Sakib Hasan, "SafeRide Dataset," Kaggle, 2025. [Online]. Available: https://www.kaggle.com/datasets/mohammedsakibhasan3/saferide-dataset. [Accessed: Sep. 15, 2025].