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AI-Powered Smart Biker Safety and Monitoring Platform

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Abstract: Accidents causing severe injuries are mostly caused by two-wheelers, with inadequate response to emergencies being another issue here. Several factors cause this problem, including failure to wear helmets, accident monitoring, and reporting. Conventional approaches to solving this problem rely heavily on human intervention such as human-based monitoring and rider vigilance. It may be insufficient in case of emergencies.

In this context, AI-Based Smart Bike Safety and Accident Detection System Using IoT and Deep Learning will be proposed. This approach uses Artificial Intelligence to monitor helmet use, detect any accidents, track location and provide alert when necessary. Helmet detection is used to ensure that the rider is using the helmet before operating the motorcycle. Sensor detection detects the occurrence of accidents through the detection of collision, tilt, and stationary. In case of an accident, the system notifies people and gives the location of the accident.

This paper discusses the implementation of AI-based smart bike safety and accident detection system.

Keywords: Smart bike safety, helmet detection, accident detection, IoT, deep learning, GPS tracking, emergency alert system, rider safety.

I. INTRODUCTION

Today, there has been an increase in the use of two-wheelers due to their affordability and convenience of everyday usage. But there has also been an increase in the rate of accidents that happen due to the lack of helmet use, rash driving, absence of any monitoring mechanism, and slow emergency responses. That shows there is a need for innovation to address this issue in the marketplace.

The research project "AI-Powered Smart Biker Safety and Monitoring Platform" has been proposed with the objective of solving the rider safety issue using various technologies such as Artificial Intelligence, Computer Vision, and IoT. This technology system ensures the safety of the rider on the road.

This system works on capturing images through a camera and detecting the presence or absence of a helmet through image processing technology using AI. Motion detection is done using motion sensors and analysis algorithms to detect any abnormality or accidents in the rider behaviour. In case of emergencies, an SMS alert will automatically get sent with the help of GPS technology to pre-set emergency contacts. The objective of this project is to minimize the risk of accidents through increased safety knowledge, awareness, and fast response in case of an emergency. With the inclusion of helmet detection, accident identification, GPS tracking, and alerts on one single platform, the suggested system is an intelligent approach to biker safety today.

1.1 Problem Statement

In the case of analyzing the current urban environment, it can be noted that there are various civic and road-related issues that have impacts on bikers, such as reckless driving, tired riders, poor road conditions, absence of helmets, overspeeding, and others. Even though there are current biker safety systems that utilize GPS monitoring, these systems are devoid of intelligent analysis and prevention features. Some other systems lack accident detection and prevention, live monitoring, intelligent risk assessment, and emergency response capabilities.

One of the other problems with current safety systems is the lack of integrated solutions that will monitor riders, track vehicles, detect accidents, and provide emergency response. In the event of an accident, the failure to detect the accident and contact relevant parties in time can result in serious injury or even death of victims. Furthermore, some riders might ignore safety precautions without having the monitoring and intelligent warning system in place.

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Thus, what is required is an AI-based solution that will monitor the behavior of the rider, detect accidents, track the location of the rider, evaluate road and driving conditions, and contact relevant people in the event of danger.

1.2 Research Objectives

The Smart biker safety system is designed to

- Real-time monitoring of rider behavior in order to determine any unsafe activities like riding without a helmet.
- Detection of an accident through the use of intelligent sensors and technologies involving AI.
- Instant alerting of emergencies accompanied by the rider's live GPS coordinates to either family members or emergency services.
- Development of a real-time tracking system whereby users can keep track of the rider's location, speed, and activity status.
- Improvement of rider awareness with safety alerts during unsafe riding.
- Integration of accident detection, live tracking, rider monitoring, and emergency communication within one smart system.

II. LITERATURE SURVEY

This section reviews five key research works that collectively inform the design of the Biker Safety. Each study contributes important insights into complaint management paradigms, while also revealing gaps that our system seeks to close.

A. Real-Time Vehicle Detection Using Deep Neural Networks

In addition, a study by Megha Mishra et al. introduced a real-time vehicle detection system using Deep Neural Networks for enhancing intelligent traffic monitoring and surveillance. The purpose of this research is to detect vehicles in live videos more accurately and at faster speeds than the traditional means of monitoring. The system analyzes the video frame, detects the relevant features from it and then classifies them to identify the vehicles. From the results obtained in this research, it shows that artificial intelligence systems can play an essential role in reducing manual intervention and providing effective traffic management. Nevertheless, the model needs significant computational capacity and is prone to performing poorly in cases where there is low light or foggy weather.

B. VEGA: Electric Vehicle Navigation Agent via Physics-Informed Neural Operator and Proximal Policy Optimization.

H. Lim et al. presented an intelligent system of navigation for electric vehicles that employs sophisticated optimization and reinforcement learning approaches. In the suggested VEGA approach, Physics-Informed Neural Operators are used together with Proximal Policy Optimization to ensure higher efficiency and optimize the navigation process and vehicle behavior. The system is capable of making decisions based on environmental conditions and selecting optimized routes automatically. In this way, the work shows the application of AI in intelligent transportation systems. Despite the efficiency of the suggested algorithm, it requires complicated training and computational support. This article is relevant to the proposed project since it includes ideas concerning intelligent decision-making and optimization.

C. Automated Seat Belt Detection Using Surveillance Cameras for Indian Traffic

A system of seat belt detection was created using surveillance cameras in the traffic environment of India by researchers Renuka T. R. et al. This study utilizes the application of computer vision and artificial intelligence image processing methods to determine the safety measures adopted by motorists. This involves analyzing video footage and categorizing them based on the presence or absence of seat belts worn by the driver. This study seeks to minimize manual labor required by traffic authorities while ensuring compliance with safety rules and regulations. Moreover, this study highlights the role of environmental conditions and obstructions on detection rates. This study has direct implications on the proposed project in that the principles of computer vision applied in this study for detecting seat belts among drivers can also be applied in the detection of helmet use among bike riders. It also discusses organizational concerns including data protection, customer complaints and logistics during busy hours. In general, these studies provide insights into operational, financial, and strategic aspects of the contemporary food delivery market.

D. Intelligent Security System for e-Bikes Using Smart Lock with Tamper Detection.

Dr. L. Chitra presented an intelligent security solution for e-bikes that involves integrating intelligent locking devices with tampering detection systems. The solution integrates sensors to detect any attempts at accessing the bike and automatically sending messages via Internet of Things communication systems. The study explores ways of securing bikes against theft and other forms of insecurity through the application of advanced communication and detection tools. The study illustrates the importance of applying sensor technology to improve vehicle security within smart

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transportation systems. However, the solution requires uninterrupted power supply and occasional erroneous detection by the sensors. The paper will be helpful in supporting the proposed project because it offers relevant ideas about IoT communication, sensors, and alert messaging.

E. Real-Time Helmet Violation Detection Using YOLOv5 and Ensemble Learning. Franklin and Savitha [5] proposed FixMyCity, a Progressive Web Application (PWA)-based civic complaint system featuring geo-based routing, duplicate complaint detection, before-and-after image evidence, and a public transparency map showing resolved complaints. The system supports role-based workflows across citizens, employees, sub-administrators, and main administrators. GPS location capture and automatic zone-based routing ensure accurate assignment of complaints, while a public map displaying resolved issues with photographic proof enhances citizen trust. The study demonstrated a noticeable reduction in complaint response time and improved user trust through transparency. Key gaps include the absence of voice/IVR accessibility, no AI-based image classification at submission, and no real-time worker navigation. The Smart Civic AI system extends FixMyCity's geo-based routing with AI image recognition and IVR complaint submission.

Table I. Comparative Analysis of Related Works

Paper	Approach	Focus Domain	Pros	Cons	Application
Paper 1	Deep Neural Network	Vehicle Detection	Systematic and accurate monitoring process	Calculating intensive and lighting dependent	Helmet and Rider Detection
Paper 2	PINO, PPO	Smart Navigation	Route planning and intelligent decision making	Training and data-intensive	Rescue mission and tracking
Paper 3	Pattern recognition, GPS	Theft Detection	Systematic alerts and location tracking	False alerts and constant monitoring	Bike theft detection and GPS tracking
Paper 4	Computer vision, AI	Safety Detection	Systematic detection and monitoring	Weather and camera-dependent	Helmet safety detection
Paper 5	IOT, Smart sensors	Bike Security	Systematic alerts and monitoring process	Power dependency and false alerts	Bike accident alerts and IOT applications

III. PROPOSED SYSTEM

The suggested AI-based smart bike safety and accident detection system is expected to be implemented as an integrated framework that involves AI, IoT, and other sensory devices. First, the proposed framework involves a camera module that collects live video footage of bike riders. Afterward, a deep learning model like YOLO is employed to detect whether a rider wears a helmet. If the person does not have one, the system may notify the rider and register a violation for further safety analysis.

The proposed integrated framework is supposed to involve multiple sensors, including MPU6050 and vibration sensors, for accident detection. The latter device is responsible for detecting bike collisions based on vibration intensity, while MPU6050 detects the bike's tilt and motion patterns. Thus, the system uses multiple methods to verify that a bike accident occurs by checking for stillness.

After the occurrence of an accident has been confirmed, the communication module in the IoT system activates. The GPS system gathers the location data from the rider, whereas the GSM or Wi-Fi system sends the emergency alerts that include data about the accident along with location data to the emergency contact numbers.

As a complete solution, all four processes, including sensing, processing, decision-making, and communication have been integrated in the proposed framework. With features like helmet recognition, accident detection, GPS detection, and emergency alert notifications, the proposed solution offers an effective approach towards ensuring road safety.

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IV. RESULT ANALYSIS AND DISCUSSION

Analysis of the existing systems for biker safety reveals that most of the currently available systems offer basic functionality in terms of tracking and emergency alert capabilities. But they usually lack intelligent monitoring, real-time accident detection, and an overall safety management solution for bikers. This shortcoming means that bikers can be at risk even during emergencies and dangerous driving conditions.

The AI-Powered Smart Biker Safety and Monitoring Platform offers a smart solution through the integration of AI technology, IoT sensors, GPS tracking, and real-time alerts. This platform constantly monitors the rider's activities in terms of overspeeding, abrupt breaking, and helmet wearing. In case any dangerous activity is noticed, immediate alerts are sent out in order to enhance driving skills of bikers.

One of the main advantages of the system under discussion is the automatic accident detection. In case the accident happens, the system will detect the impact with the help of smart sensors, and provide real-time information about the rider's current location to the emergency contacts and medical services. This may help reduce the emergency response time significantly and save lives.

Also, the system has a real-time monitoring dashboard, which allows tracking the current position, speed, and activity of the rider. As compared to the existing systems, the proposed system will provide a more reliable, intelligent, and user-friendly solution for bikers' safety.

In conclusion, the proposed system can be used for increasing road safety and helping to respond faster to emergencies. Further improvements of the system, including cloud integration, support of several languages, and artificial intelligence analysis, can be considered as well.

V. CONCLUSION AND FUTURE SCOPE

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