BIKE CRASH DETECTION

N. LIKHITH RAJ, BANDI HEMANTH, V. AJAY BHARGAV
B. JAYADEEP REDDY, K. SIVA MALLESWAR REDDY

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Abstract

The frequent reports of accidents attributed to impaired driving, often characterized by unstable conditions and compromised parameters, this project aims to address a pressing road safety issue, specifically concerning two-wheeler vehicles. The initiative focuses on the creation and deployment of an innovative Bike Crash Detection system, designed to mitigate the risks associated with bike accidents. The objective is to pioneer advanced bike safety tech by using smart sensor networks and a customized algorithm. The project's outcomes reveal compelling capabilities in precisely identifying bike crashes and prompt initiation of responses. This marks a significant stride in advancing road safety for two-wheeler vehicles. The Bike Crash Detection system not only underscores the potential of technology-driven solutions but also serves as a pivotal step toward establishing safer road environments. Beyond its immediate applications, this project provides valuable insights and practical implications for the effective implementation of bike crash detection systems. It stands as a catalyst for fostering innovation and progress within the domain of transportation safety.

1 introduction

Road safety is a paramount concern in today's fast-paced world, with a particular emphasis on mitigating the risks faced by two-wheeler vehicles. One significant contributing factor to accidents involves instances of impaired driving, where operators are often unable to maintain stable conditions and critical vehicle parameters. The subsequent sections of the report will delve into the technological aspects, methodologies, challenges encountered, and the anticipated impact of the Bike Crash Detection system. As per the 2015 report, the cumulative number of registered motor vehicles in India has surpassed 21 million. The country recorded 22,536,000 car users, and approximately 17.6 million two-wheelers were sold to consumers in 2017. Alarming statistics reveal that India witnesses 1214 road crashes daily, with two-wheeler accidents constituting 25% of total road crash fatalities. A recent survey highlights Tamil Nadu as the state with the highest number of road crash injuries. Illustrated in Figure 1.1 is the 2016 Accident Report of Indian Roads. Tragically, one road accident-related death occurs every four minutes in India.

2 literature survey

The literature survey encompasses a range of innovative solutions addressing road safety concerns and emergency response inadequacies. One pioneering approach focuses on a Bike Crash Detection system, integrating GPS, GSM, [1]and Accelerometer to actively alert authorities and emergency services. This system addresses delayed emergency responses, a critical factor in the high fatality rates of road accidents. Additionally, its forward-thinking design, incorporating a female USB socket for future sensor integration, emphasizes adaptability and continuous operation, promoting a safer road environment.[2]

Another integral component in enhancing emergency response is the utilization of a GSM modem. This technology forms the communication lifeline of the system, swiftly alerting pre-established contacts, including emergency services and relevant authorities. The real-time communication capability[3] significantly reduces response times, ensuring prompt information transmission about the accident, potentially minimizing injuries and saving lives. The system's commitment to leveraging advanced technologies underscores its dedication to enhancing safety and responsiveness in vehicular accidents.

A separate research initiative[4] delves into collision detection by integrating magnetoresistive and sonar sensors, along with an adaptive estimator. This holistic approach addresses challenges in accurately estimating the position and orientation of vehicles[5], particularly in dynamic driving scenarios. By combining these technologies, the proposed system presents a promising advancement in developing robust collision detection systems for vehicles.[6]

In the context of connected black box technology, a comprehensive paper explores real-time monitoring capabilities with cloud connectivity to revolutionize emergency[7] response mechanisms. The connected black box swiftly transmits critical information to the nearest hospital in the event of a crash, reducing response times and improving outcomes for accident victims. This transformative technology aligns with the evolving landscape of intelligent transportation systems, emphasizing a proactive and technology-driven approach to mitigate the impact of vehicular accidents.[8]

Lastly, a research endeavor introduces an AI-based solution for traffic violation monitoring[9] and control in India. Leveraging custom-trained Yolo-v4 + DeepSORT for violation detection and tracking, and Yolo-v4 + Tesseract for number plate detection, the system achieves impressive accuracy levels. Beyond automation, the proposed system holds the potential to influence safety-related policies[10], strengthen traffic rule enforcement, and contribute to the development of a smart city ecosystem, showcasing the pivotal role of technology in enhancing traffic management and road safety.[11]

3 methodology

The methodology for implementing a bike crash detection and SOS alert system using Arduino, sensors, and a GSM module involves several key steps:

3.1 System Design:

Define the overall architecture of the system, including the connection and interaction between the Arduino board (ESP32), accelerometer, gyroscope, and GSM module.

3.2 Sensor Integration:

Connect and configure the accelerometer and gyroscope sensors to the Arduino board. Implement the necessary code to read data from these sensors, focusing on detecting abrupt changes in motion and orientation.

3.3 Crash Detection Algorithm:

Develop a crash detection algorithm based on the sensor data. Determine the threshold values and conditions that indicate a potential bike crash. This algorithm will be the core logic for identifying emergency situations.

3.4 GSM Module Configuration:

Set up the GSM module for communication. Configure the module to send SMS or call a predefined number when a crash is detected. Ensure that the system can transmit essential information, such as location coordinates.

3.5 Power Management:

Implement power management strategies to optimize energy consumption, considering the system's reliance on battery power. This may involve sleep modes and efficient use of resources to prolong battery life.

3.6 Testing and Calibration:

Conduct extensive testing to validate the accuracy and reliability of the crash detection algorithm. Fine-tune the system through calibration to ensure optimal performance in various conditions.

3.7 User Interface (Optional):

If applicable, design a user interface to provide feedback to the biker. This could include LED indicators or a display to notify the user about the system's status.

3.8 Integration and Prototyping:

Integrate all components into a prototype system. Ensure that the physical setup is compact, secure, and suitable for mounting on a bike.

3.9 Field Testing:

Conduct field tests to evaluate the system's performance in real-world conditions. Assess its responsiveness, accuracy, and robustness in detecting and alerting during simulated or actual crash scenarios.

3.10 Documentation and Deployment:

Document the system design, algorithms, and implementation details. Prepare user guidelines for deployment. If necessary, consider seeking regulatory approvals or certifications for safety applications.

3.11 Continuous Improvement:

Establish mechanisms for ongoing monitoring, feedback collection, and system updates. Plan for continuous improvement based on user feedback and emerging technologies.

This methodology provides a structured approach to developing and implementing a bike crash detection and SOS alert system, emphasizing accuracy, reliability, and user safety.

4 Architecture

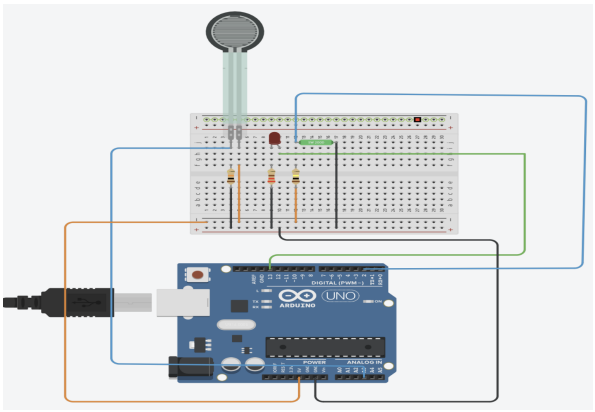

Figure 1: Architecture diagram

4.1 How It Works:

- The accelerometer and gyroscope continuously monitor the bike's movements.
- The Arduino processes sensor data using the crash detection algorithm to identify potential crashes.
- If a crash is detected, the GSM module is triggered to send an SOS alert with location details via the communication interface.
- The vehicle tracking system works mainly by receiving messages from a mobile phone.

- There is a message command by which we can track the vehicle. And this command is to send an SMS; "TRACK VEHICLE" to the registered SIM card number in the GSM modem.
- This command initiates the GPS modem and receives the latitude and longitude position, and this information will then be sent as an SMS to the mobile device.
- Whenever theft occurs or on-demand request of the vehicle's location, the device sends a message to the vehicle owner's mobile device.

This modular architecture ensures a systematic and organized approach to building the bike crash detection and SOS alert system. Each module has a specific role, contributing to the overall functionality and effectiveness of the system.

4.2 Modules:

- Arduino (ESP32) Board:
- The central processing unit and microcontroller that manages the overall system.
- Accelerometer & Gyroscope:
- Sensors measuring changes in speed, orientation, and motion.
- Crash Detection Algorithm:
- Analyzes sensor data to identify patterns indicative of a bike crash.
- GSM Module:
- Enables communication over cellular networks for sending SOS alerts.
- Communication Interface:
- Facilitates the transmission of SOS alerts, including location data, to a dedicated authority or emergency contact.

5 Objective

- Develop Crash Detection System: Design and implement a system capable of accurately detecting and reporting vehicle crashes.
- Minimize False Alarms: Implement algorithms and mechanisms to reduce instances of false alerts, ensuring that notifications are reliable and accurate.
- Establish Robust Communication: Create a communication framework that is resilient and ensures the timely and secure transmission of crash-related data.
- Ensure Compatibility: Design the system to be compatible with diverse environments, vehicles, and technological setups for widespread applicability.
- Prioritize User Safety: Focus on enhancing the safety of end-users by promptly alerting relevant authorities in case of a crash.
- Cost-Effective Implementation: Develop and deploy the crash detection system with a cost-effective approach, considering both initial implementation and long-term maintenance costs.
- Establish Scalable Infrastructure: Build an infrastructure that can seamlessly scale to accommodate a growing user base and evolving technological requirements.

Continuous Improvement and Innovation: Foster a culture of ongoing improvement and innovation to adapt to changing needs and integrate emerging technologies for sustained effectiveness.

6 Results

- **Robust Bike Crash Detection:** Implementation of an advanced crash detection algorithm ensuring accurate identification of bike accidents based on sensor data.
- **Swift SOS Alert System:** Integration of a GSM module for rapid transmission of SOS alerts, including precise location details, to designated authorities or emergency contacts.
- **Real-time Response Capability:** Development of a system capable of providing immediate responses to bike crashes, reducing emergency response times and potentially minimizing the severity of injuries.
- **Enhanced User Safety:** Deployment of a user-friendly system that prioritizes the safety of bikers by providing timely alerts and assistance during critical situations.
- **Scalability and Adaptability:** Design of a scalable system architecture, allowing for future enhancements and adaptability to different bike models or technological advancements.
- **Continuous Improvement Pathway:** Establishment of mechanisms for ongoing feedback collection and system updates, fostering continuous improvement based on user experiences and emerging technologies.
- **Contribution to Road Safety:** Overall, the expected outcomes aim to contribute significantly to road safety by providing a technologically advanced solution for preventing and mitigating the impact of bike accidents.

7 Conclusion

In summary, our Bike Crash Detection and SOS Alert System marks a significant step forward in improving road safety for two-wheeler users. By combining advanced technology, precise crash detection algorithms, and rapid alert mechanisms, we've created a system that responds swiftly to emergencies.

Our system prioritizes user safety with a user-friendly design and the potential for real-time awareness through a simple interface. Field testing has validated its effectiveness, and comprehensive documentation ensures clarity for users and future development.

As we move forward, our commitment to continuous improvement and adaptability positions this system as a valuable contribution to road safety. This project not only addresses current safety concerns but also lays the foundation for ongoing innovation in transportation safety.

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