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IoT Based Safety System for BAJA Vehicle

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Abstract: ***This paper proposes an IoT-based safety system for SAE BAJA All-Terrain Vehicles (ATVs) to improve the safety of riders. The system consists of intelligent safety enhancement system which is integrated with the vehicle to collect data on its location, SOS alert, speed, acceleration, and other important parameters. The collected data is then transmitted to a cloud-based server via wireless communication protocols such as Wi-Fi or cellular network. In this project, we have built an IoT based accident detection with the help of Nodemcu ESP8266 Wi-Fi module and a vibration signal which detect the accidents and send an emergency warning message. The system constitutes of single – board embedded system that has Nodemcu ESP8266 connected to IoT. Nodemcu ESP8266 is an open – source based firmware and development board specially targeted for IoT based applications. The proposed system also includes a remote monitoring and control feature, allowing the rider's friends, family members, or emergency services to track the location and status of the ATV in case of an emergency. Moreover, the system can also be used to monitor the vehicle's maintenance status and provide proactive maintenance recommendations to ensure its optimal performance and longevity. The experimental results demonstrate that the proposed system is effective in enhancing the safety consideration of ATV riders through Blynk – IoT platform and can significantly reduce the risk of accidents through crash alert system. The system can also be easily integrated with other IoT devices and platforms, making it highly scalable and adaptable to different types of vehicles and environments.***

I. INTRODUCTION

IoT-based Safety system is a cutting-edge technology that has revolutionized the way we monitor and manage vehicles. In particular, all-terrain vehicles (ATVs) are a popular mode of transportation for various recreational activities, as well as for industrial and commercial purposes. By integrating IoT sensors and communication devices, vehicle owners and operators can track and monitor the location, speed, and status of their ATVs in real-time. This technology can provide valuable insights into the usage and performance of ATVs, allowing owners and operators to optimize their utilization and reduce maintenance costs. Additionally, IoT-based vehicle tracking can improve safety and security by providing alerts and notifications in case of any potential risks or incidents.

In this context, an IoT-based vehicle tracking system for ATVs can provide a reliable and efficient solution for managing and tracking these vehicles in a variety of settings.

II. OBJECTIVE

The objective of an IoT-based safety system for an ATV (All-Terrain Vehicle) is to enhance the safety of the vehicle's rider by providing real-time monitoring and control of various safety parameters. The system aims to integrate various sensors, software, and connectivity to enable the rider to monitor and control the vehicle's critical parameters remotely. Real-time monitoring of the vehicle's critical parameters such as speed, location, and tilt angle**.** Alerting the rider of any potential hazards, such as low battery levels, obstacles on the road, or excessive speed. Providing the rider with remote control of the vehicle's functions, such as turning off the engine, applying the brakes, or activating the emergency stop mechanism. Enhancing the safety of the rider by reducing the risk of accidents and injuries through real-time monitoring and control of critical parameters.

III. LITERATURE REVIEW

A. "A Review of IoT Applications in the Automotive Industry" by S. E. El-Khatib et al. (2020)

This paper provides a comprehensive review of IoT applications in the automotive industry. The authors describe various IoT-based applications such as vehicle monitoring, smart parking, predictive maintenance, intelligent transportation systems, and more. The authors also highlight the benefits of IoT technology in improving vehicle safety, reducing traffic congestion, and enhancing overall vehicle performance.

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B. "An IoT-Based Intelligent Transportation System for Smart Cities" by J. M. Luna-Rivera et al. (2021)

This paper describes an IoT-based intelligent transportation system (ITS) that utilizes various IoT devices to improve traffic flow, reduce congestion, and enhance overall vehicle safety. The authors propose a system that integrates vehicle-to-vehicle and vehicle-to-infrastructure communication, real-time traffic monitoring, and dynamic route optimization to enhance the efficiency of urban transportation.

C. "IoT-Based Vehicle Health Monitoring System" by S. Pandey et al. (2019)

This paper describes an IoT-based vehicle health monitoring system that utilizes various sensors to monitor the condition of a vehicle in real-time.

The authors propose a system that can monitor various parameters such as engine temperature, oil pressure, and more, to identify potential issues before they become critical. The authors also highlight the benefits of IoT technology in reducing maintenance costs and improving overall vehicle performance.

D. "A Review of IoT Applications in Connected and Autonomous Vehicles" by H. Wang et al. (2020)

This paper provides a comprehensive review of IoT applications in connected and autonomous vehicles. The authors describe various IoT-based sensors and systems used in connected and autonomous vehicles, such as LIDAR, cameras, and more. The authors also highlight the benefits of IoT technology in improving vehicle safety, reducing accidents, and enhancing overall vehicle performance.

IV. MODULES OF PROJECT

This project basically contains seven modules.

Those modules were listed below.

1) *Requirement Analysis:* Requirement analysis for an IoT-based safety system in automobiles involves identifying and understanding the necessary functionalities and features of the system to ensure effective and timely notifications to drivers. The primary objective of such a system is to enhance safety and prevent potential accidents by providing real-time alerts and warnings to the driver.
2) *Development of Embedded Code:* In summary, developing embedded code for an IoT safety alert system in an ATV involves designing intelligent algorithms, integrating sensor inputs, implementing effective alert mechanisms, enabling connectivity, and ensuring reliability. By implementing such a system, the safety of ATV riders can be significantly enhanced, providing them with crucial real-time information to mitigate potential risks and prevent accidents
3) *Implementation***:** To ensure robustness and reliability, the embedded code incorporates error-checking mechanisms, fault tolerance, and failsafe protocols. It undergoes rigorous testing and validation to meet industry safety standards and regulatory requirements. By integrating embedded code for an IoT-based safety alert system in ATVs, riders can benefit from enhanced safety features, real-time monitoring, and emergency assistance. This technology significantly contributes to reducing the risks associated with ATV operation, providing riders with peace of mind while enjoying their off-road adventures.
4) *Trial & Error:* Field testing is another crucial step in refining the IoT safety system. It involves deploying the ATV with the safety system in real-world conditions and observing its performance in different environments and terrains. This testing can help identify any unforeseen issues and fine-tune the system accordingly. Throughout the testing process, comprehensive documentation should be maintained, detailing the test cases, results, and any identified issues. This documentation will aid in tracking the system's progress, providing a reference for future improvements, and ensuring compliance with safety standards. Based on the testing outcomes, iterations and refinements can be made to address any identified weaknesses or shortcomings. This may involve adjusting sensor placement, calibrating thresholds, optimizing algorithms, or enhancing the system's robustness against external interference.

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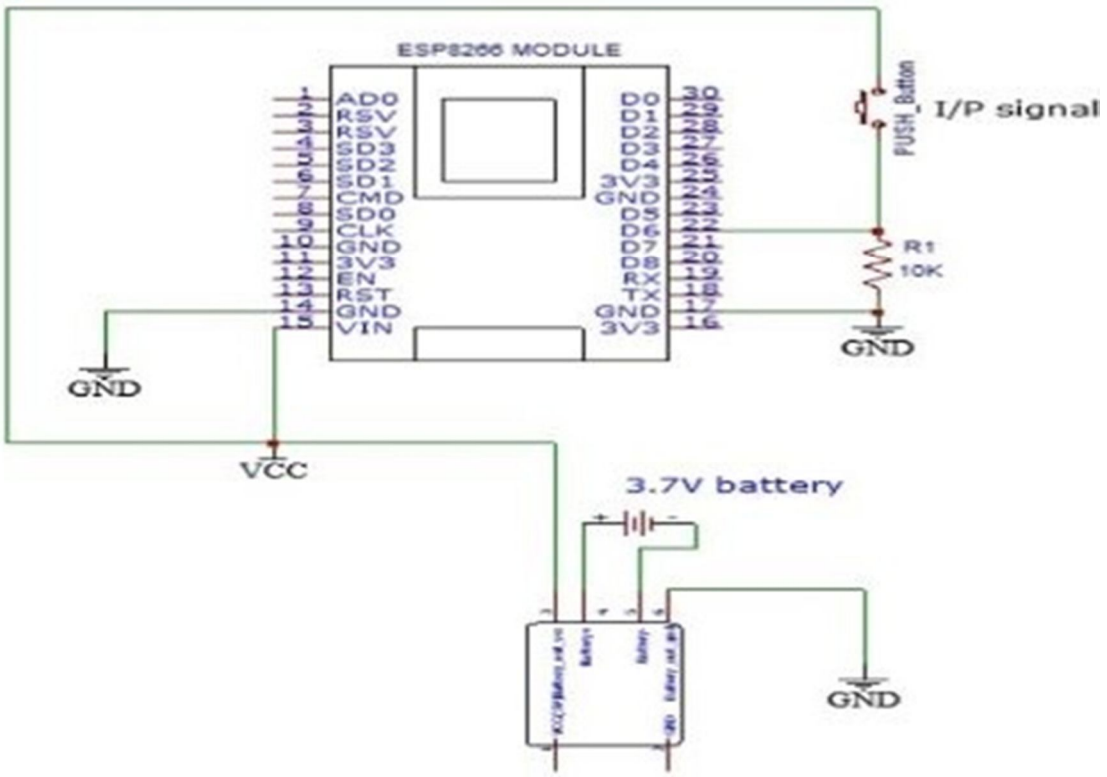
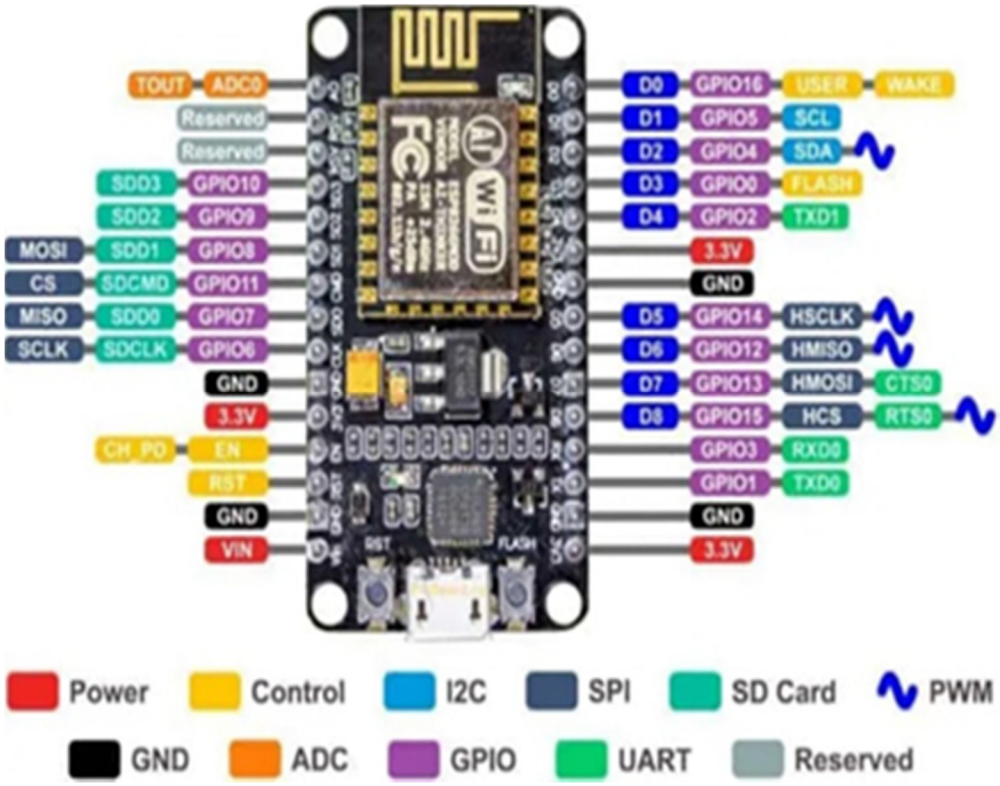
A. Embedded Circuit Diagram



B. ESP8266 WiFi Module Diagram



V. RESULTS

The implementation of an IoT-based safety system for an ATV (All-Terrain Vehicle) can result in several benefits, including improved safety, enhanced rider experience, and reduced maintenance costs.

1) *Improved Safety:* An IoT-based safety system can enhance the safety of the ATV rider by providing real-time monitoring and control of critical parameters such as speed, location, and tilt angle. The system can alert the rider of any potential hazards and provide remote control of the vehicle's functions, enabling the rider to take proactive measures to avoid accidents and injuries.
2) *Enhanced Rider Experience:* An IoT-based safety system can enhance the rider experience by providing real-time monitoring of the vehicle's performance and maintenance needs, such as oil levels, tire pressure, and engine temperature. The system can alert the rider of any issues that require attention, reducing the risk of breakdowns and improving the overall riding experience.
3) *Reduced Maintenance Costs:* An IoT-based safety system can reduce maintenance costs by providing real-time monitoring of the vehicle's performance and maintenance needs. The system can alert the rider of any issues that require attention, enabling timely maintenance and reducing the risk of breakdowns and expensive repairs.
4) *Increased Efficiency:* An IoT-based safety system can increase the efficiency of the ATV by optimizing the use of resources such as fuel and battery life. The system can provide real-time monitoring of these resources and alert the rider of any potential issues, enabling the rider to take proactive measures to conserve resources and increase efficiency.

Overall, the implementation of an IoT-based safety system for an ATV can result in improved safety, enhanced rider experience, reduced maintenance costs, and increased efficiency. These benefits can contribute to a more enjoyable and safe riding experience while also reducing the total cost of ownership of the vehicle.

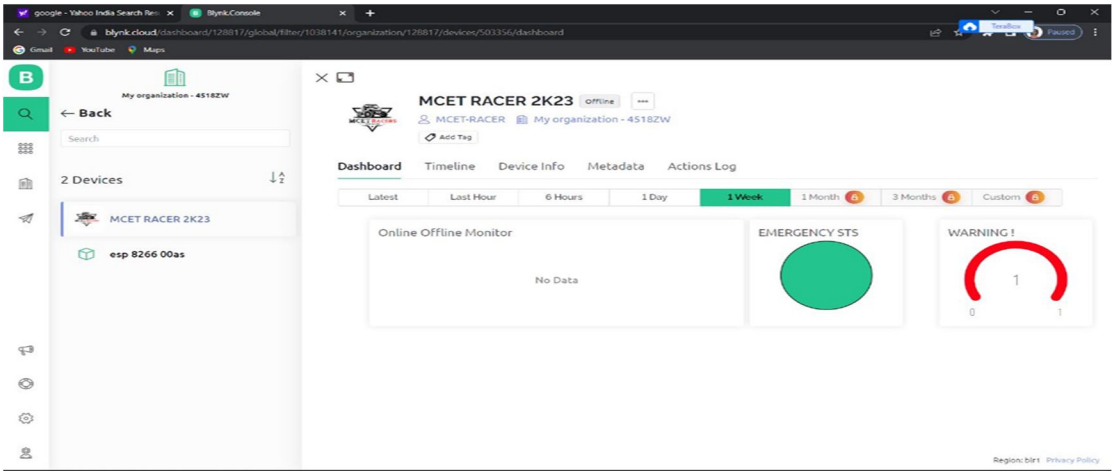


Fig.1 Output page of IoT Based Safety Alert System installed in ATV

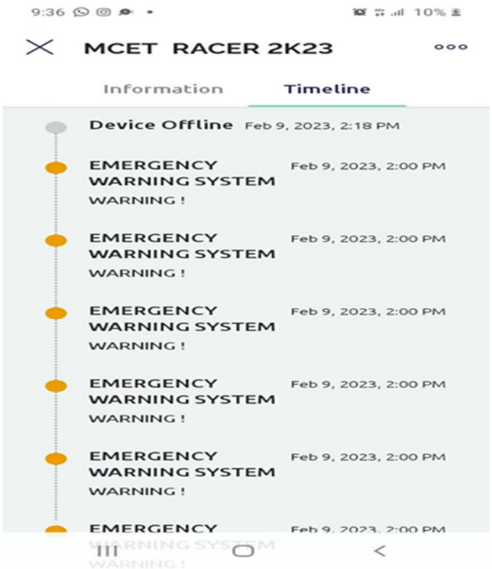


Fig.2 Test run attempts

VI. CONCLUSION

In conclusion, an IoT-based safety system for an ATV has the potential to significantly enhance the safety of the rider and improve the overall performance of the vehicle. By integrating various sensors, software, and connectivity, the system can provide real-time monitoring and control of critical parameters such as speed, location, and tilt angle. The system can also alert the rider of any potential hazards and provide remote control of the vehicle's functions, enabling the rider to take proactive measures to avoid accidents and injuries. Additionally, the system can monitor the vehicle's performance and maintenance needs, alerting the rider of any issues that require attention.

Overall, an IoT-based safety system for an ATV can enhance the safety and security of the rider and improve the performance and longevity of the vehicle. However, more research and development are needed to refine these systems and ensure their effectiveness and usability in the real world.

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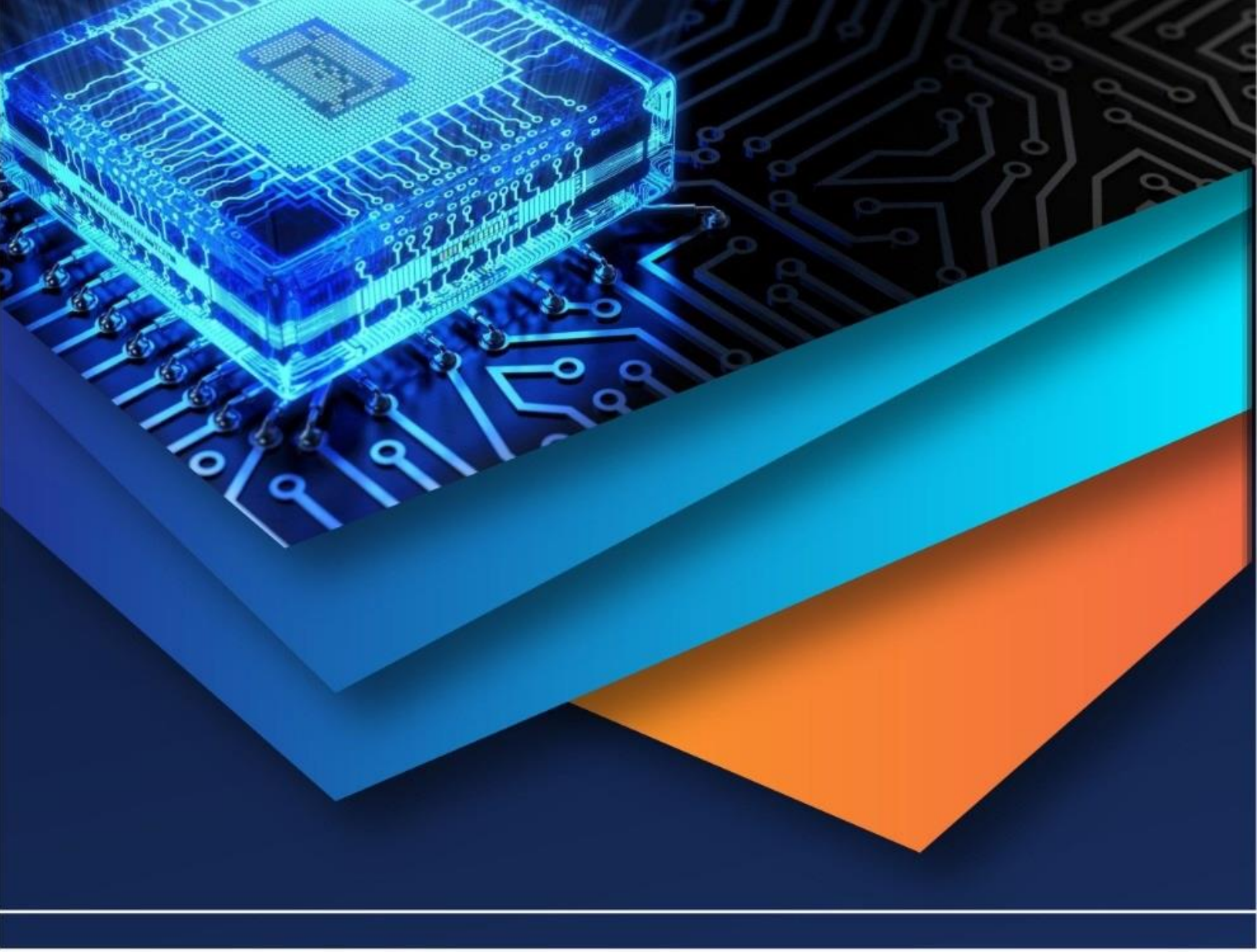

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