ISSN: 2321-2152

IJMECE

International Journal of modern electronics and communication engineering

E-Mail
editor.ijmece@gmail.com
editor@ijmece.com

www.ijmece.com

ISSN 2321-2152
www.ijmece.com
Vol 12, Issue 4, 2024

IOT based Fully Automated Speed Bumps and Road Blockers for Smart Cities

[1]DR.E.Krishnahari, [2]Jalagam Krishna
[1]Associate Professor, Department of ECE, [2]Embedded systems (M.Tech)
[1, 2] Holy Mary Institute of Technology & Science, Keesara – Bogaram – Ghatkesar Rd, Kondapur, Telangana 501301
[1]rrkrishna12@gmail.com, [2]krishnajalagam222@gmail.com

Abstract: The growing population and the increasing number of vehicles have led to severe traffic congestion and longer travel times, often causing drivers to choose incorrect routes. To address these challenges, this work proposes an intelligent traffic management system that utilizes IoT technology to enhance road safety and efficiency. The system integrates automatic speed control mechanisms, such as road blockers, speed bumps, and tire killers, with IoT-enabled vehicles. This synchronization allows for dynamic traffic regulation, where vehicles are guided based on real-time traffic conditions. Additionally, the system focuses on prioritizing emergency vehicles, such as ambulances and fire trucks, by utilizing IoT to provide them with the fastest route, ensuring timely arrival at their destinations. This solution combines Radio Frequency Identification (RFID) technology with internet platforms, enabling seamless communication and automation. The aim is to create a smart road network that prevents accidents, reduces traffic jams, and enhances overall traffic flow, ultimately making cities safer and more efficient. This intelligent approach integrates automation and connectivity to optimize urban transportation.

Index Terms: *IoT, RFID, Road Blocker, Speed Bumps, Tyre Killer, Emergency Vehicles.*

1. INTRODUCTION

Technology has revolutionized every aspect of our lives, making various systems more reliable, efficient, and smarter. One such area that benefits from technological advancements is road safety. Road accidents have remained a global concern, and with the rapid growth of urbanization, traffic congestion and accidents have become more frequent. This creates [1] a need for intelligent systems to help avoid accidents and manage traffic efficiently, opening a wide window for the development of smart road systems. A key component of these systems is the integration of Internet of Things (IoT) technology, which connects various road elements for real-time monitoring and control. By leveraging IoT, roads can become smarter, improving traffic flow, reducing accidents, and enhancing safety [2].

The design of a smart road system includes the incorporation of roadside units, which form part of an intelligent transport system. These units are equipped with IoT technology [3], allowing for automated communication and decision-making in real-time. One of the most vital features of these systems is the deployment of road blockers, which serve as controlled traffic settings. Road blockers are designed to protect both lives and properties by regulating the flow of vehicles in specific areas. For example, they are particularly useful in controlling traffic in commercial areas, parking lots, and residential zones, where access is limited to authorized vehicles only. Additionally, road blockers provide high-level traffic control at commercial entrances and exits, preventing unauthorized vehicles from entering or leaving designated areas [4].

Another important element of this system is the use of speed bumps. Speed bumps are commonly placed in residential areas, busy locations, and school zones to regulate the speed of vehicles and ensure pedestrian safety. These bumps are usually installed on the road to restrict vehicle speed during the day. However, the system is designed to be adaptive; during the night, the speed bumps rotate downwards and flatten out, eliminating any obstruction for nighttime traffic. This feature ensures that vehicles can travel without impediments when traffic is lighter [5].

Tyre killers, or spike barriers, are another significant aspect of the smart road system. These barriers are fixed to the ground and consist of heavy-duty spikes that rise from the surface when activated. They function as access control barriers, preventing the passage of unauthorized vehicles. In cases where the system needs to allow vehicles to exit a supervised area, the tyre killers retract into the ground. This mechanism ensures that only authorized vehicles are permitted to enter or exit certain areas, further enhancing security [6].

By combining these technologies, we can create a more efficient and safer traffic system that adapts to varying needs throughout the day, helping to mitigate accidents and congestion while providing optimal traffic management solutions.

2. LITERATURE SURVEY

The integration of technology in road safety systems has garnered significant attention in recent years due to the increasing need to address traffic congestion and accident prevention. Various studies have explored the potential of combining Internet of Things (IoT) technology with intelligent transportation systems to create smarter and safer roadways. One such innovation is the integration of IoT with adaptive cruise control and autosteering systems to improve vehicle handling and cornering behavior, as discussed by Idriz et al. [1]. This integration enables vehicles to respond dynamically to road conditions, reducing the likelihood of accidents, particularly in corners or sharp turns.

IoT-driven road safety systems have also been the focus of studies aiming to improve traffic management and safety. Vishal et al. [2] proposed an IoT-based road safety system that uses sensors and real-time data to monitor and control traffic flow. This system aims to enhance the safety of drivers by detecting hazardous conditions and providing automated responses, such as adjusting traffic signals and activating safety measures like speed bumps or road blockers. The system can also help optimize emergency vehicle routes, allowing ambulances and fire trucks to bypass congested areas and reach their destinations faster.

Another study by Malekar and Bhute [3] reviewed advanced adaptive traffic light control systems that use digital image processing and embedded systems. These systems are capable of adjusting traffic signal timings based on real-time traffic conditions, reducing congestion and enhancing traffic flow in urban areas. Such adaptive systems are a critical component of smart road systems, as they provide dynamic responses to traffic volume, promoting efficient traffic management.

Vijinetha and Nataraj [4] explored the application of IoT in intelligent traffic control systems. They highlighted how IoT can facilitate real-time monitoring and control of traffic lights, road conditions, and vehicle movement, improving traffic efficiency and reducing accidents. Their research focused on creating systems that could adapt to varying traffic conditions, providing smoother traffic flow and safer roadways. These intelligent

ISSN 2321-2152
www.ijmece.com
Vol 12, Issue 4, 2024

systems can also contribute to reducing energy consumption by optimizing traffic signal timings and minimizing vehicle idling time.

The use of IoT for smart traffic systems has also been explored in the context of emergency vehicle prioritization. Goel et al. [10] presented an intelligent traffic light system that prioritizes emergency vehicles based on wireless sensor networks (WSN). This system allows emergency vehicles such as ambulances and fire trucks to pass through intersections with minimal delays by altering traffic light cycles, thus enhancing the response time during critical situations.

In addition to adaptive traffic lights and emergency vehicle prioritization, RFID technology has been utilized to enhance traffic control systems. Chandrasekaran et al. [8] demonstrated the use of RFID for object localization in cluttered environments, which can be particularly useful for vehicle tracking and monitoring in urban traffic systems. RFID-based solutions can provide real-time information about vehicle locations, aiding in traffic surveillance and management.

Another aspect of road safety addressed by IoT systems is vehicle detection, tracking, and counting for traffic surveillance. Kumar et al. [7] proposed a system that utilizes Raspberry Pi for detecting and counting vehicles in real-time, helping authorities monitor traffic volume and identify congestion points. This type of surveillance system can be integrated into smart road networks to provide data for adaptive traffic control and accident prevention.

The development of smart traffic control systems also extends to the design of road infrastructure, such as speed bumps and road blockers. These systems are designed to regulate vehicle speed in areas where pedestrians or cyclists are present, such as school zones or residential areas. Speed bumps are commonly used in areas where it is crucial to slow down vehicles to prevent accidents. However, recent innovations have led to the development of retractable speed bumps, which lower when not needed to allow for smoother traffic flow at night. This adaptive feature enhances traffic flow without compromising safety during off-peak hours.

Tyre killers, or spike barriers, are another critical safety feature discussed in several studies. These barriers are designed to prevent unauthorized vehicles from entering restricted areas by deploying heavy-duty spikes from the ground. Such systems are especially useful in commercial areas and parking lots, where controlling access is necessary for security purposes. By preventing unauthorized vehicles from entering sensitive zones, tyre killers help to maintain safety and order within controlled areas.

3. MATERIALS AND METHODS

The proposed Intelligent Traffic Management System leverages IoT technology to enhance road safety and traffic efficiency. The system integrates automatic speed control mechanisms (road blockers, speed bumps, tire killers) with IoT-enabled vehicles. This synchronization enables dynamic traffic regulation, guiding vehicles based on real-time traffic conditions. RFID technology and internet platforms facilitate seamless communication and automation. The system prioritizes emergency vehicles, providing them with the fastest routes for timely arrival. The microcontroller ATMEGA 08 serves as the core controller, managing various components including power supply, keypad, RF receiver, ESP8266 (IoT), LCD display, driver circuit, relays, and actuators for speed control and barrier operation. This intelligent solution aims to prevent accidents, reduce congestion, and optimize

ISSN 2321-2152
www.ijmece.com
Vol 12, Issue 4, 2024

urban transportation, making cities safer and more efficient.

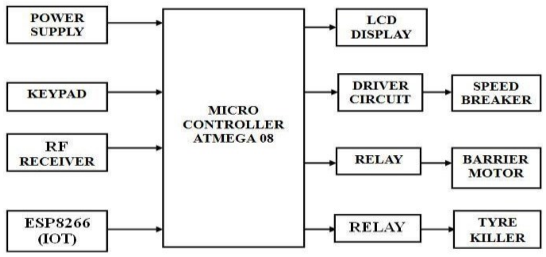

Fig.1 Proposed Block Diagram

The diagram illustrates an IoT-based intelligent traffic management system. It comprises a microcontroller (ATMEGA 08) as the central unit, interfaced with various components: power supply, keypad, RF receiver, ESP8266 (IoT module), LCD display, driver circuit, relays, and actuators for speed control (speed breaker, barrier motor, tire killer). This system aims to regulate traffic flow, prioritize emergency vehicles, and enhance overall road safety through real-time monitoring and control.

a) Modules:

Power Supply: The Power Supply provides the necessary energy to the system, ensuring all components function effectively. It converts electrical energy from an external source into the required voltage levels for the microcontroller, sensors, and actuators. This ensures that the entire traffic management system operates reliably and continuously without interruptions due to power failure.

Keypad: The Keypad is used for manual control and configuration of the system. Operators can input commands or adjust settings, such as the activation of barriers or speed control mechanisms. It serves as an interface for administrative interaction with the system.

RF Receiver: The RF Receiver receives signals from RFID tags or other wireless communication sources. It enables the system to detect authorized vehicles and activate specific actions, such as granting access to restricted areas or adjusting traffic control measures based on vehicle identification.

ESP8266 (IoT): The ESP8266 (IoT) is a wireless communication module that connects the system to the internet. It enables remote monitoring and control of the system, allowing for real-time updates and interaction with cloud platforms. It facilitates data transmission between the system and external networks.

Microcontroller ATMEGA 08: The Microcontroller ATMEGA 08 is the central processing unit of the system. It coordinates all functions, including sensor data processing, signal transmission to actuators, and communication with IoT modules. It ensures smooth operation by managing the interactions between various system components.

LCD Display: The LCD Display provides visual feedback to users and operators. It displays system status, alerts, and diagnostic information, allowing for easy monitoring and troubleshooting. The display ensures that operators are informed of the system's current state in real time.

Driver Circuit: The Driver Circuit acts as an interface between the microcontroller and power-hungry components, such as motors and relays. It amplifies control signals from the microcontroller to drive actuators and other components, ensuring they operate correctly.

Relay: The Relay is an electrically operated switch that controls high-power devices in the system. It activates or deactivates barriers, speed bumps, and other actuators based on the microcontroller's signals. Relays help automate the operation of the system without manual intervention.

Speed Breaker: The Speed Breaker is a road safety feature used to control vehicle speed. When activated, it rises to slow down vehicles in designated areas such as residential zones or school zones. Its automated control helps regulate traffic speed without requiring human intervention.

Barrier Motor: The Barrier Motor operates the physical barriers in the system, such as road blockers or gates. It raises or lowers barriers based on signals from the microcontroller, allowing access to authorized vehicles while preventing unauthorized entry into restricted zones.

Tyre Killer: The Tyre Killer is a security feature that consists of retractable spikes placed on the road. When activated, it prevents unauthorized vehicles from passing by raising spikes that damage tires. It serves as an effective tool for controlling access to restricted areas or controlling traffic flow in sensitive zones.

b) Working Process:

The working process of the Intelligent Traffic Management System begins when an authorized vehicle approaches the area. The RFID receiver detects the vehicle's RFID tag, sending a signal to the microcontroller. The microcontroller processes the signal and checks if the vehicle is authorized. If authorized, the microcontroller activates the barrier motor to raise the barrier and allow the vehicle through. Simultaneously, the microcontroller monitors traffic conditions and may control speed breakers or tire killers to regulate the vehicle's speed or prevent unauthorized vehicles from passing. The ESP8266 module enables remote monitoring and updates the system via the internet. The LCD display shows system status, providing real-time information. The system operates autonomously, adjusting to real-time traffic and emergency vehicle needs, ensuring safety and efficiency.

4. CONCLUSION

As the world faces growing complexities, the integration of the Internet of Things (IoT) has provided a viable solution to many challenges, including road safety and traffic management. By synchronizing road platforms with IoT, this approach aims to reduce traffic-related issues and improve overall road efficiency. The use of RFID technology, combined with cloud-based internet platforms, enables real-time vehicle identification and communication, thereby allowing for automated control of traffic systems. RFID sensors help guide vehicles, especially emergency ones, to avoid congestion and reduce the risk of accidents. This innovative system effectively addresses the problems of increasing congestion, prioritizing emergency vehicles, and enhancing road safety. By implementing automatic road blockers, speed bumps, and tire killers, this system ensures smoother traffic flow and contributes to safer roads. Additionally, the system's ability to control vehicle speeds in critical zones helps mitigate traffic-related issues. In conclusion, IoT-based technologies can significantly reduce the severity of road accidents, offering a smarter and more reliable solution for modern urban traffic management, ultimately contributing to safer and more efficient cities.

The ***future scope*** of this IoT-based intelligent traffic management system includes expanding its integration with other smart city infrastructure, such as automated traffic lights and pedestrian monitoring systems. Further advancements could involve incorporating machine learning algorithms for predictive traffic analysis, enhancing real-time decision-making. Additionally, the system could be

ISSN 2321-2152
www.ijmece.com
Vol 12, Issue 4, 2024

adapted to support electric vehicles, autonomous vehicles, and other emerging transportation technologies, fostering even smarter and safer urban mobility solutions.

REFERENCES

[1] Adem F.Idriz, Arya S.Abdul Rachman, Simone Badri, "Integration of Autosteering with Adaptive Cruise Control for Improved Cornering behavior", in IET, Intelligent Transport system,2017,volume 11, Issue 10, pp 667-675.

[2] Dasari Vishal, H. Saliq Afaque, Harsh Bhardawaj, T. K. Ramesh, "IoT- Driven Road Safety System", in ICEECCOT- 2017.

[3] Shweta S. Malekar, Yokesh Bhute, "A review: Implementation of Advance Adaptive Traffic Light Control system using DIP and Embedded", in IJRITCC, volume 5, Issue 2, ISSN: 23218169, February 2017.

[4] Harshini Vijinetha H, Dr. K R Nataraj, "IoT Based Intelligent Traffic Control system", in IJRASET, V Dasari vishal, H. Volume 5, issue 5, May 2017, ISSN: 2321-9653.

[5] Adem F. Idriz, Arya S. Abdul Rachman, Simone Badri, "Integration of Auto steering with Adaptive Cruise Control for Improved Cornering behaviour", in IET, Intelligent Transport system, 2017, volume11, Issue10, pp 667-675 .

[6] Kavya P Walad, Jyothi Shetty, "Traffic Light Control SystemUsing Image Processing", in IJIRCCE, volume 2, special Issue 5, and October 2014.

[7] Majeti V N Hemanth kumar, vasanth B, "Vehicle Detection, Tracking and counting objects for traffic Surveillance System using Raspberry- Pi", in IJMTER2015, ISSN:2396-8161.

[8] Vishal Chandrasekaran, Keshav Narayan, Romil kumarnvasani, Vidhya Balasubramanion, "IN PLACE RFID: Indoor path Loss Translation for object localization in cluttered Environmental", in 2015 IEEE, 10th International conference on ISSNIP, Singapore, 7-9 April 2015.

[9] Veera venkatesh, Nazneeh syed, "Smart Traffic Control System for emergency vehicle Clearance", in IJIRCCE, Volume 3, Issue 8, August 2015.

[10] Amnesh GoelSukanya Ray, Nidhichandra, "Intelligent Traffic LightSystem to Prioritized Emergency Purpose Vehicles based on WSN", in IJCA, volume 40-NO.12, February 2012.