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TRAFFIC CONGESTION

[1]Mrs. A. Rajini Devi, [2]M. Shravani, [3]M. Vaishnavi, [4]J. Mamatha, [5]Y. Sravanthi

[1]Assistant Professor, [(2,3,4,5)]B. Tech 3rd Year Students,

Department of IT (Information Technology),

Vignan's Institute of Management and Technology for Women,

Hyderabad, Telangana - 501301, India

[1]avularajinidevi@gmail.com, , [2]shravanimarati22@gmail.com, [3]mattavaishnavi2003@gmail.com,

[4] mamathajigiri@gmail.com, [5] sravanthiyadala7@gmail.com

ABSTRACT

This project presents an IoT-based intelligent traffic control system using an ESP32 microcontroller, Bluetooth communication, and sensor integration. The system operates in both automatic and manual modes, with automatic mode dynamically adjusting traffic light durations based on real-time vehicle density measured by an ultrasonic sensor. Manual mode allows remote control of traffic signals via Bluetooth commands, providing flexibility for traffic authorities. An infrared sensor is employed to detect emergency vehicles, granting them immediate priority passage by switching the corresponding road signal to green. A buzzer module enhances safety by providing audible alerts during signal transitions. The system ensures efficient traffic flow, reduces congestion, and prioritizes emergency response. Its modular design allows scalability to multiple roads and integration of additional sensors, making it a practical solution for smart city traffic management.

1.INTRODUCTION:

Due to rapid urbanization and an increase in vehicle ownership, traffic congestion and safety problems have been exacerbated, and timed traffic signals have been proven inefficient. To overcome this, a smart traffic control system using iot technology, esp32, ultrasonic sensors, infrared sensors, and bluetooth has been proposed. The system will be implemented in automatic mode, making traffic signal changes depending upon real-time density, and will be in manual mode in case of override by the authority. The proposed system will be cost-effective and will help in developing smart cities."

2.LITERATURE SURVEY:

Recent studies have explored diverse approaches to intelligent traffic management.

Thomas and Mehta (2023) proposed cloud-integrated, density-based control across intersections, while Reddy and Rao (2023) developed an ESP32-based automated system emphasizing scalability

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and cost-effectiveness. For emergency vehicle prioritization.

Ahmed and Khan (2023) introduced an IR sensor-based solution, and Banerjee and Das (2023) suggested Bluetooth-enabled manual override via mobile apps.

Real-time monitoring has been addressed using ultrasonic sensors by Lee and Wang (2024) and Das and Verma (2024). Verma and Singh (2023) demonstrated Arduino-based control for smaller intersections.

Zhang and Mehta (2024) proposed an IoT-enabled intelligent system for multi-lane traffic.

3.PROBLEM STATEMENT

Urban traffic congestion is a growing problem due to the increasing number of vehicles and the limitations of traditional traffic signal systems. Fixed-time traffic signals operate on preset schedules, ignoring real-time traffic conditions, which leads to unnecessary waiting at intersections, increased fuel consumption, higher vehicle emissions, and overall inefficiency in traffic flow.

Additionally, emergency vehicles such as ambulances, fire trucks, and police vehicles often face delays at intersections because conventional systems cannot prioritize them effectively.

There is a need for an intelligent, adaptive, and real-time traffic management system that can dynamically adjust signal timings based on traffic density, ensure smooth traffic flow, and provide priority passage for emergency vehicles.

The system should also be capable of remote monitoring and control, scalable to multiple intersections, and cost-effective for practical

4.PROPOSED SYSTEM

Traffic congestion has become one of the most pressing challenges in modern urban environments. With rapid urbanization, increasing vehicle ownership, and limited road infrastructure, traditional traffic management systems often fail to adapt to dynamic traffic conditions.

Fixed-time traffic signals, which operate on pre-programmed cycles, cannot respond to real-time variations in vehicle density. This leads to inefficient traffic flow, longer waiting times, increased fuel consumption, and higher pollution levels.

In parallel, emergency response vehicles such as ambulances, fire trucks, and police cars frequently face delays due to congested intersections. These delays can have life-threatening consequences, highlighting the urgent need for intelligent systems that prioritizing emergency movement while maintaining overall traffic efficiently.

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5.METHODOLOGY

a. Data Collection

Traffic data is collected through ultrasonic sensors for density estimation and IR sensors for emergency vehicle detection.

b. System Architecture

ESP32 microcontroller, a combination of input, processing, output, and Bluetooth communication.

c. Traffic Control Operation

- **Automatic Mode**: Regulates green light time based on traffic density.
- **Manual Mode:** Regulates signal lights through Bluetooth communication.
- **Emergency Mode:** Takes priority over other modes, providing immediate green light.

d. Algorithm / Workflow

Initialization → Mode detection → Sensor data processing → Dynamic timing/manual control → Emergency detection → Continual operation.

e. Implementation

Hardware: ESP32, ultrasonic sensor, IR sensor, LEDs

6. ALGORITHM:

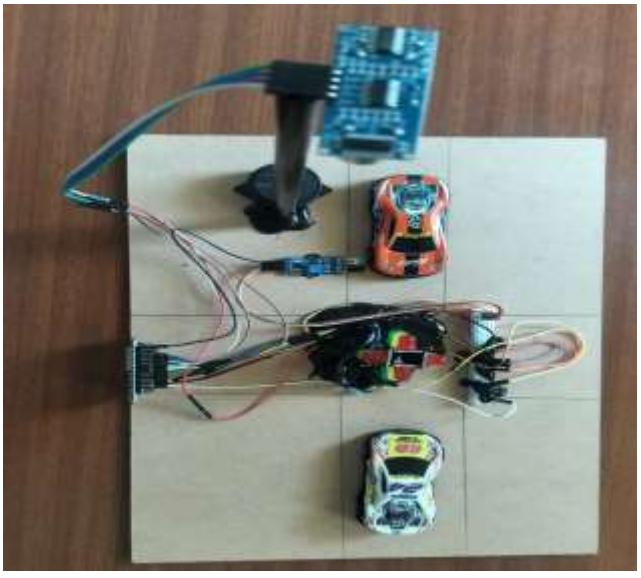
1.**Function set**

2.Display OFF

3.Display clear

4.EntryMode set

7. RESULTS:



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From the above results, it can be clearly seen that the proposed system can effectively overcome the limitations of existing traffic control systems. The efficient adaptation of the system to different traffic conditions can be achieved through the integration of IoT technology and real-time sensing. The inclusion of emergency prioritization and manual control can further enhance its practicality.

8. CONCLUSION:

The IoT-based smart traffic control system with the help of ESP32, ultrasonic and IR sensors, and Bluetooth can be a good approach towards the efficient management of traffic in the city. This system can efficiently manage traffic by controlling the duration of the traffic signals, providing the facility of manual override, and giving priority to emergency vehicles. This system can prove to be a good approach towards the efficient management of traffic in the city and can contribute towards the development of a smart city.

9. FUTURE SCOPE

The IoT-based smart traffic control system can be extended with:

1. Multi-road sensor integration.
2. AI/ML integration for predictive modelling.
3. Cloud-based monitoring and analytics.
4. Vehicle-to-Infrastructure (V2I)communication.
5. Mobile/web interface for authorities.
6. Solar-powered sustainable solution.
7. Pedestrian and cycle detection.
8. Public transport integration.
9. Advanced emergency routing.
10. Smart surveillance and violation detection.

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