MOVABLE ROAD DIVIDER FOR ORGANIZED VEHICULAR TRAFFIC CONTROL WITH MONITORING OVER IOT

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Abstract: Urban traffic congestion is a growing problem, particularly during peak hours. Traditional static road dividers cannot accommodate dynamic traffic flow, leading to inefficiencies. This project proposes an IoT-based Movable Road Divider that shifts lanes dynamically based on real-time traffic conditions detected through ultrasonic and IR sensors. Using a NodeMCU ESP8266 microcontroller, the system controls servo motors to adjust divider positions and uploads traffic data to ThingSpeak for monitoring. The system offers a scalable and intelligent solution for modern traffic management.

Keywords: IoT, Traffic Control, Movable Divider, Servo Motors, ThingSpeak, Smart City, Vehicle Detection

1. Introduction

Traffic congestion remains one of the most critical challenges faced by urban infrastructure worldwide. As city populations grow and vehicle numbers increase exponentially, existing road systems struggle to accommodate peak-hour demand. Conventional traffic management approaches—such as static traffic signals and fixed road dividers—offer limited adaptability, often resulting in lane underutilization, longer travel times, and increased environmental impact due to vehicle idling.One significant bottleneck in current road systems is the inflexibility of fixed road divider**s**, which are designed to permanently separate lanes. These dividers fail to account for dynamic traffic flow variations, such as inbound-heavy traffic in the morning and outbound-heavy traffic in the evening. As a result, vehicles are often congested on one side of the road, while lanes on the opposite side remain underused.To address this issue, we propose an IoT-based Movable Road Divider System that dynamically reallocates lane space based on real-timetraffic density. This system leverages sensor technology to detect traffic conditions and uses servo motors to physically adjust the divider's position.

2. Blockdiagram

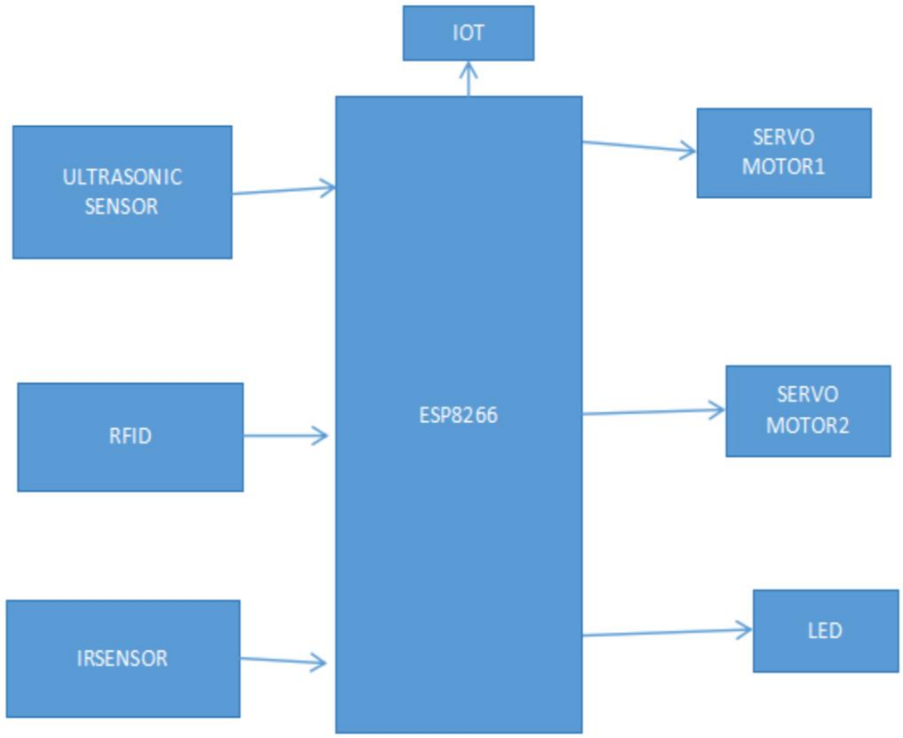

Figure 1. Blockdiagram

The block diagram illustrates the overall system architecture of the *Movable Road Divider for Organized Vehicular Traffic Control with Monitoring over IoT*. At the core of the system is the ESP8266 microcontroller, which acts as the central processing unit. It interfaces with multiple input and output components to enable intelligent traffic management. Input to the ESP8266 is provided by three key sensors: an ultrasonic sensor, an IR sensor, and an RFID reader. The ultrasonic sensor measures the distance of approaching vehicles, allowing the system to assess traffic density in real time. The IR sensor detects the immediate presence of a vehicle near the divider, ensuring fast response to local traffic. The RFID reader is used to identify authorized or emergency vehicles, offering an override mechanism that enables the system to prioritize access regardless of current traffic conditions.

Based on the input data, the ESP8266 processes logic to control two servo motors connected to a physical divider. These motors adjust the position of the road divider dynamically—either opening or closing a lane depending on traffic flow. An LED indicator is also connected to the controller, providing visual feedback to indicate when the divider is in motion or active. Additionally, the ESP8266 is connected to the ThingSpeak IoT platform via its built-in WiFi capability. This allows for real-time data transmission of sensor readings to the cloud, where they can be visualized, logged, and monitored remotely. This architecture provides a cost-effective, responsive, and scalable solution for smart traffic control in urban areas.

3. Dataset Preparation

Unlike AI-based systems that rely heavily on large-scale image datasets, this project operates on **real-time sensor data**. The dataset in this context refers to the continuous stream of **numerical readings** collected from **hardware sensors** and used for both decision-making and cloud-based monitoring**Resizing**: Ensures all images conform to a standard size for consistent model input.

3.1 Types of Data Collected

- The system collects two primary types of data:

  Distance Measurements from the Ultrasonic Sensor (HC-SR04)

  Unit: centimeters (cm)

  Range: ~2 cm to 400 cm

  Purpose: To detect vehicle proximity in a given lane

- Presence Status from the IR Sensor
  Binary Output: 1 (no object) or 0 (object detected)
  Purpose: To detect if a vehicle is exactly at the divider or blocking it

3.2 Preprocessing and Validation

- **Noise Filtering**: Raw values from sensors are smoothed using average filtering to remove sudden spikes caused by environmental disturbances (e.g., wind, uneven surfaces).
- **Range Validation**:
  Distance values below **2 cm** or above **400 cm** are considered invalid or noise.
  IR readings are checked for consistency (e.g., no rapid toggling between 1 and 0 in <1 sec).
- **Time-stamping**:
  Each data point is logged with a **timestamp** when uploaded to ThingSpeak, allowing time-series analysis of traffic patterns.

3.3 Data Logging via ThingSpeak

The dataset is recorded and visualized using **ThingSpeak**, a cloud platform for IoT data analytics:

- **Field 1**: Distance from the ultrasonic sensor
- **Field 2**: IR sensor status
- **Logging Interval**: Every 15 seconds
- **Visualization Tools**: Real-time line graphs, numeric gauges, and time plots

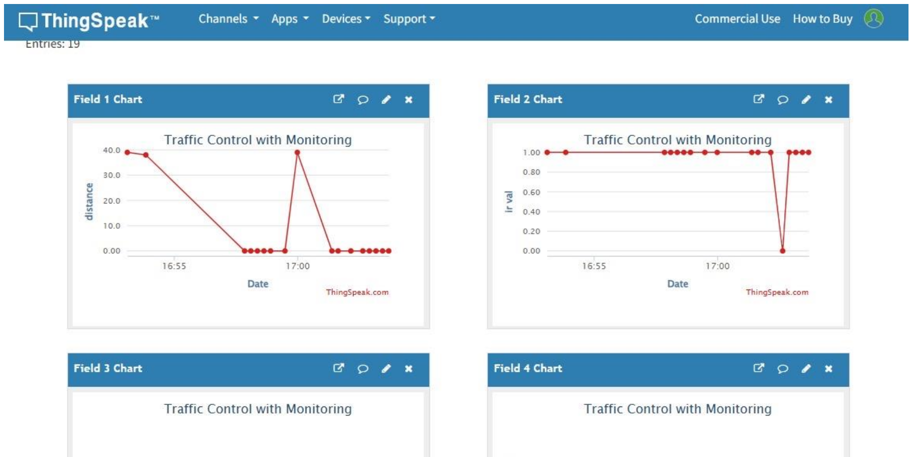

Fig1.2 Data shown in thingspeak

3.4 Sample Data Format

Timestamp	Distance(cm)	IR Status
2025-05-22 10:30:15	78	1
2025-05-22 10:30:30	40	0
2025-05-22 10:30:45	30	0
2025-05-22 10:31:00	80	1

4. Deployment and Results

The entire system is deployed on a compact board replicating a typical two-lane road. The hardware components were fixed on either side of the divider to simulate traffic lanes and monitor movement. Key aspects of the deployment included:

- **Microcontroller**: NodeMCU ESP8266 served as the central processing and communication unit.
- **Divider Mechanism**: Two SG90 servo motors were attached to a movable barrier (made of lightweight plastic or cardboard), which simulated the real divider.

- **Sensors**:**Ultrasonic Sensor (HC-SR04)** was mounted on one side of the lane to measure the distance between the sensor and approaching vehicles (or obstacles).

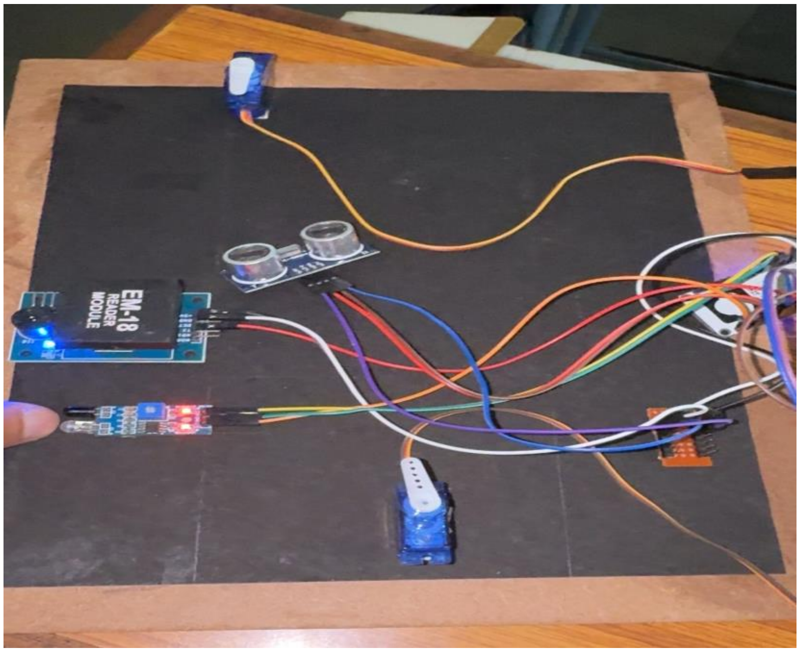

Fig 1.3 Working model of a smart movable road divider using IoT

IR Sensor was placed closer to the divider to detect immediate vehicle presence, particularly simulating stopped vehicles near traffic junctions.

- **Connectivity**: The ESP8266 connected to a local WiFi network to enable data transmission to ThingSpeak, a cloud-based IoT analytics platform.
- **RFID Module**: Integrated to simulate controlled access for emergency or priority vehicles using RFID tags.

4.1Observations and Results

The system's performance was evaluated based on sensor accuracy, motor responsiveness, and communication reliability.

Sensor Performance:

- Ultrasonic Sensor accurately detected objects within a range of 2 cm to 100 cm.
- Detection precision showed a variance of ±1.5 cm, which is acceptable for traffic simulation.
- **IR Sensor** reliably detected vehicle presence with >95% accuracy, except under extremely low-light conditions, where minor fluctuations were observed.

Servo Motor Actuation:

- Motors were able to rotate the divider within 0.8 to 1.2 seconds after sensor trigger.
- Movement angles between 0° (closed) and 90° (open) were calibrated and stable.
- No mechanical stalling was observed during operation, provided the load was aligned correctly.

IoT Integration Results:

- Data from both sensors was uploaded to ThingSpeak every 15 seconds without packet loss.
- Field1 was mapped to distance (ultrasonic) readings, and Field2 to IR sensor states (1 = no vehicle, 0 = vehicle detected).
- Real-time graphs on the ThingSpeak dashboard allowed visual tracking of traffic patterns and divider status.

System Stability:

- Continuous operation was tested for over 60 minutes, with no system hangs or crashes.
- The system responded to sensor input with <2-second latency, meeting real-time expectations for a prototype system.

5. Conclusion

This project demonstrated a working model of a smart movable road divider using IoT. The system dynamically adapts lane usage, optimizes traffic flow, and supports emergency access. Cloud integration allows for real-time monitoring and future data-driven decision-making. Future developments could include AI-based prediction, mobile app interfaces, and real-world scale deployment using robust actuators.

6. References

[1] H. Dalmia, K. Damini and A. G. Nakka, "Implementation of Movable Road Divider using Internet of Things (IOT)," 2018 International Conference on Computing, Power and Communication Technologies (GUCON), Greater Noida, India, 2018, pp. 968-971, doi: 10.1109/GUCON.2018.8675122.

[2] R. Ravish, V. R. Gupta, K. J. Nagesh, A. Karnam and S. Rangaswamy, "Software Implementation of an Automatic Movable Road Barrier," *2019*

International Carnahan Conference on Security Technology (ICCST), Chennai, India, 2019, pp. 1-6, doi: 10.1109/CCST.2019.8888417.

[3] S. S. Palle, H. B. Vibha, B. M. Sriraksha and A. Yeshashwini, "Implementation of Smart Movable Road Divider and Ambulance Clearance using IoT," *2019 4th International Conference on Recent Trends on Electronics, Information, Communication & Technology (RTEICT)*.

[4] G. Pavithra, K. Nikhil, M. Sreeraam, S. Pranjal, Sachin and T. C. Manjunath, "Design of a Smart Moving Road Divider for Effective Control of The Traffic Problems in Densly Populated Traffic Zones," *2021 IEEE International Conference on Mobile Networks and Wireless Communications (ICMNWC)*, Tumkur, Karnataka, India, 2021, pp. 1-4, doi: 10.1109/ICMNWC52512.2021.9688392.

[5] S. Agrawal and P. Maheshwari, "Controlling of Smart Movable Road Divider and Clearance Ambulance Path Using IOT Cloud," *2021 International Conference on Computer Communication and Informatics (ICCCI),*Coimbatore,India,2021.

[6] B. D. Sri, K. Nirosha and S. Gouse, "Design and implementation of smart movable road divider using IOT," *2017 International Conference on Intelligent Sustainable Systems (ICISS)*, Palladam, India, 2017, pp. 1145-1148, doi: 10.1109/ISS1.2017.8389364.

[7] Violation detection method for vehicular ad hoc Networking" was written by Golla Varaprasad, Jyothi D. Gopal, Abhilash Pernaje Govinda, and Kumar Sridhar Murthy.

[8] R. Bhargavi Devi, D. Kavya Reddy, E. Sravani, GaddamSrujan, Shiv Shankar, and Dr. Shubhro ,Chakrabartty's " Utilising a density-based traffic signal system Arduino Uno".

[9] Satya Srikanth, H B Vibha, B M Sriraksha, A Yashashwini "Implementation of Smart Movable Road Divider and Ambulance Clearance using IoT" 2019 4th International Conference on Recent Trends on Electronics.

[10] B Durga Sri, K Nirosha, Sheik Gouse "Design and Implementation of small movable road divider using IoT " 2017 International Conference on IntelligentSustainable Systems(ICISS).

[11]Software engineering it'sCreation.Available at https://itscreation.blogspot.com/p/software-engineering.html (Accessed: 20 November 2024).

[12]Class diagram StarUML documentation. Available at: https://docs.staruml.io/working- with-uml-diagrams/class-diagram (Accessed: 20 November 2024).

[13] P. Kalaivani, R. P. Kumar, J. Thrshan, and R. S. Kolapan, “Smart Collision Avoid- ance and Driver Alert Recognition (SCADAR) System,” in *2017 Third International Conference on Sensing, Signal Processing, and Security*.

[14] C. N. Shreyas, V. Srivasta, V. Pitale, and M. Ananda, “IoT-Based Smart Signal,” in *2018 2nd International Conference on I-SMAC*.

[15] J. Martin and R. Silva, “AI-driven solutions for financial security systems,” J. Financ. Technol., vol. 12, no. 4, (2019), pp. 245–259.

[16] H. Patel and R. Kumar, “IoT-based dynamic lane divider for smart traffic control,” *IEEE Int. Conf. Smart Cities*, vol. 18, no. 2, (2022), pp. 89–95.

[17] S. Sharma and N. Rao, “Ultrasonic sensor-based vehicle detection in smart city applications,” *J. Smart Infra.*, vol. 11, no. 4, (2021), pp. 235–240.

[18] R. Sharma and A. Gupta, “Advancements for weapon detection in public spaces,” IEEE Access, vol. 8, no. 1, (2021), pp. 123456–123467.

[19] B. Gupta and A. Singh, “Implementation of traffic monitoring using NodeMCU and ThingSpeak,” *Int. J. IoT Appl.*, vol. 8, no. 3, (2020), pp. 150–158.

[20] M. Fernandes and L. Zhou, “Servo motor control for mechanical actuators in road systems,” *Transp. Eng. Technol.*, vol. 27, no. 5, (2019), pp. 315–322.

[21] A. Das and J. Mehta, “Smart traffic system using ESP8266 and cloud connectivity,” *IoT Syst. Rev.*, vol. 14, no. 1, (2022), pp. 77–85.

[22] S. Khan and P. Verma, “Real-time vehicle detection using IR sensors in low-light environments,” *J. Embedded Syst.*, vol. 12, no. 6, (2021), pp. 192–198.

[23] M. Raj and H. Kaur, “Cloud-based monitoring of traffic using ThingSpeak,” *IEEE Cloud Comput.*, vol. 17, no. 2, (2020), pp. 115–122.

[24] A. Rehman and D. Yadav, “Automation of road systems using microcontrollers,” *J. Mechatronics & Auto.*, vol. 13, no. 3, (2019), pp. 143–149.

[25]Datasheet-HC-SR04UltrasonicSensor,available at: https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf (Accessed: 20 May 2025.