Smart Traffic Management Via Divider Shifting Mechanisms

KEDAR BHAMBURE[1], NILESH PATIL[2], GANGADHAR CHALGERI[3], SANTOSH SOLAPURE[4], PROF.SUMIT WANI[5]

[1, 2, 3, 4] *UG Student, Keystone School of Engineering, Pune*

[5] *Research guide, Keystone School of Engineering, Pune*

Abstract*— Smart traffic management through divider shifting mechanisms is a cutting-edge approach to address urban congestion and enhance road safety. Thisinnovative system utilizes a movable divider or barrier that can be adjusted to dynamically alter road configurations and lane allocations. Real-time monitoring, facilitated by a network of sensors and cameras, provides a constant stream of traffic data, which is analysed by advanced algorithms. The system optimizes traffic flow by reallocating lanes based on changing conditions, such as rush-hour congestion or accidents. It can swiftly create barriers in emergency situations to isolate affected areas and facilitate rapid response by emergency services. Variable speed limits are employed to ensure safe driving, while dedicated lanes for pedestrians and cyclists can be created or removed as needed. Integration with a centralized traffic management center allows for efficient coordination and communication with vehicles on the road. Connected vehicles receive real-time information about lane changes and speed limit adjustments, contributing to smoother traffic patterns and increased safety. the system can contribute to environmental sustainability by favouring less congested routes or promoting the use of public transportation during peak hours, thereby reducing emissions.

Indexed Terms- Divider Shifting Mechanisms, Traffic Management, Lane Allocations.

I. INTRODUCTION

In recent years, proportionally increase in numbers of automobiles on the roads. Although the count of vehicles using the roads has increased, the static road infrastructure is almost the same and is unable tocope with changes like congestion, unpredictable travel-time are taking a serious shape. Traffic congestion has been one of the major concerns faced by the metropolitan cities today in spite of measures being taken to reduce it. It has emerged as one of the main challenges for developers in urban areas for planning of sustainable cities with traffic free lanes. In India, traffic is inherently chaotic and noisy. Identification of magnitude of traffic congestion is an essential requirement for defining the congestion and finding appropriate measures.

In the face of increasing urbanization and the corresponding rise in vehicular traffic, our city's road infrastructure is struggling to effectively manage congestion and ensure safe, efficient travel. This challenge has far-reaching implications, affecting not only our daily commute but also our environment and overall quality of life.

II. PROBLEM STATEMENT

In today's bustling urban landscapes, traffic congestion remains a persistent and vexing challenge. Commuters often find themselves ensnared in long queues, experiencing frustrating delays that impact both productivity and well-being. The problem statement is clear: how can we leverage real-time solutions to effectively address traffic congestion and create a more efficient, stress-free commuting experience? Enter the realm of Smart Traffic Management through Divider Shifting Mechanisms, a cutting-edge approach that seeks to transform our roadways into adaptable, dynamic environments capable of responding to traffic conditions in real-time, ultimately revolutionizing the way we navigate our cities.

Motivation:

The motivation behind this project is rooted in the pressing need for practical, forward-thinking solutions to combat the ever-increasing issue of traffic congestion in urban areas. Traffic jams not only waste precious time but also contribute to environmental pollution and heightened stress levels among commuters..

Solution:
Our proposed solution is to implement a Smart Traffic Management System with Divider Shifting Mechanisms, leveraging advanced technology, real-time data analysis, and dynamic road configurations. This innovative approach will enable us toproactively respond to traffic congestion, mitigating delays and improving traffic flow. By intelligently adjusting road dividers in real-time, we can allocate lanes to meet current traffic demands, effectively reducing congestion and creating more efficient routes for commuters. Additionally, our system will encourage the use of eco-friendly modes of transportation during peak hours, further reducing pollution and making our cities more environmentally sustainable. This holistic approach aims to enhance the quality of life for urban residents and establish a foundation for smarter, more adaptive cities of the future.

III. LITERATURE REVIEW

Anireddy Sushrutha and C.R.K. Reddy [2] The paper titled "Movable Road Divider Using Internet of Things" discusses a novel approach to tackle traffic congestion by employing IoT technology for dynamically adjusting road dividers. The motivation behind this work stems from the pressing issue of traffic congestion in urban areas. The authors aim to provide a solution that can reduce traffic congestion, enhance traffic flow, and improve the efficiency of road usage. The authors discuss the existing systems, such as zipper machines or concrete lane dividers, which can be effective but have limitations, including human intervention and reduced lane widths. In contrast, the proposed system leverages IoT and automated road dividers to address traffic problems on heavily congested roads.

Rashmi C et al [4]paper titled "Movable Road Dividers" introduces an inventive solution for addressing the chronic problem of urban traffic congestion through the implementation of movable road dividers. The authors keenly recognize a fundamental issue with static road dividers, which lies in their incapacity to adapt to the ever-changing dynamics of traffic conditions. This becomes increasingly pressing as urban populations burgeon and the number of vehicles per household escalates, necessitating a more efficient use of existing road infrastructure.

IV. PROPOSED METHODOLOGY

1. Design the Divider System: Plan the physical divider system using a rack and pinion mechanism. This system will allow you to raise and lower the divider to shift lanes.
2. Motor and Driver Setup: Connect the DC motor to the L293D motor driver, which interfaces with the Arduino. Ensure proper wiring and connections to control the motor's direction and speed.
3. Arduino Programming: Write Arduino code to control the motor's movements based on real-time traffic data. Use sensors and cameras to collect data and determine when and how to shift the divider.
4. Traffic Data Collection: Install sensors alongthe road to collect real-time traffic data, including traffic volume, vehicle speed, and congestion levels. This data will inform your traffic management decisions.
5. Data Processing: Implement algorithms on the Arduino to process the collected data. Decide on criteria for lane shifts, such as when traffic congestion reaches a certain threshold or during specific time intervals.
6. Dynamic Lane Allocation: Program theArduino to adjust the position of the divider based on the processed data. For example, if there's heavy traffic in one direction, shift the divider to allocate more lanes in thatdirection.
7. LED Indicators: Install LED indicators on the divider to signal lane changes to drivers. Use different colours or patterns to convey lane status (open or closed) and speed limits.
8. Safety Mechanisms: Implement safety features, such as obstacle detection sensors, to prevent accidents during divider shifts.
9. Ensure emergency stops and safeguards are in place.

10. Testing and Calibration: Thoroughly test the system in a controlled environment to ensure it responds accurately to changing traffic conditions. Calibrate sensors and the divider mechanism as needed.
11. Integration with Traffic Management Center: Establish communication between the Arduino-based system and a centralized traffic management center, which can override or adjust lane configurations manually if necessary.
12. Power Supply: Ensure a stable power supplyto run the system continuously. Implement backup power sources or UPS (Uninterruptible Power Supply) to prevent disruptions during power outages.
13. Maintenance and Monitoring: Regularly maintain and monitor the system for wear and tear, sensor malfunctions, and software updates. Implement remote monitoringcapabilities for real-time system health check.

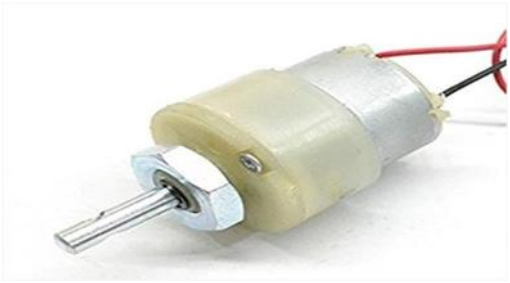
V. COMPONENTS USED

Hardware Components:

1. Arduino uno:

The Arduino Uno is a popular open-source microcontroller board designed for makers, hobbyists, and professionals. It is an open-source electronic platform that consists of software and hardware components. The Arduino UNO iscategorized as a microcontroller that use the ATmega328 as controller in it. The board features a range of digital and analog input/output pins that can be easily programmed using the Arduino IDE (Integrated Development Environment). Its user- friendly ecosystem, extensive online community, and a vast collection of libraries and shields make it an ideal choice for both beginners and experienced developers in the world of embedded electronics and programming. The Arduino board is the most used board of all Arduino boards. The board contains 14 digital input/ output pins in which 6 are analog input pin, one power jack, USB connecter, one reset button and other components. All components are attachedin the Arduino UNO board to make it functioning andcan be used in the project. The board is charged by USB port or can be directly charged by the DC supply to the board.

2. DC Motor



A DC (Direct Current) motor is an electrical device that converts electrical energy into mechanical rotation. It operates on the principle of electromagnetic fields and consists of a rotor and a stator. When current flows through the motor's coils, it creates a magnetic field, causing the rotor to turn. DC motors are commonly used in various applications, including robotics, appliances, and machinery, due to their simplicity and precise speed control. Every DC motor has six basic partsaxle, rotor (armature), stator, field magnet(s), and brushes. In most common DC motors the external magnetic field is produced by high-strength permanent magnets.The stator is the stationary part of the motor this includes the motor casing, as well as two or morepermanent magnet pole pieces. The rotor rotates with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to

the commutatorwith the rotor inside the stator (field) magnets.

3. L293D Motor Driver

The L293D is a popular dual H-bridge motor driver IC (integrated circuit) that serves as a vital component in robotics and electronics projects. It allows bidirectional control of two DC motors or a single stepper motor, making it ideal for applications that require precise motor control. The L293D can handle a wide range of input voltage andprovides protection features to prevent damage to the connected motors and the driver itself. Its simplicity and effectiveness in controlling motors have made it a staplein the world of hobbyist and educational electronics.

The L293D motor driver is a component thatmanages the DC motor's operation in thesystem. It's responsible for controlling both the direction and speed of the motor, ensuring it moves in the desired direction and at the appropriate speed to adjust the traffic divider or barrier for lane shifts. This motor driver plays a crucial role in the precise and controlled movement of the DC motor, enhancing the system's ability to respond to changing traffic conditions effectively.

4. Rack and Pinion Mechanism

A rack and pinion mechanism is amechanical system used for linear motion and converting rotational motion into linear motion. It consists of two main components:a gearwheel called a pinion and a flat, toothed bar known as a rack. When thepinion gear rotates, it engages with the rack,causing it to move in a straight line. Rack and pinion systems are commonly used invariousapplications, such as steering systems in vehicles, CNC machines, and automation equipment, to provide preciseand efficient linear movement and control. The Rack and Pinion Mechanism is a hardware component tasked with raising andlowering the divider, which in turn shifts lanes in the traffic management system. This mechanism consists of a toothed rack (alinear gear) and a corresponding pinion gear.As the pinion gear rotates, it engages withthe rack's teeth, creating linear motion thatallows for the controlled vertical movementof the divider. This mechanism's role is pivotal in adjusting traffic configurations and optimizing traffic flow within thesystem..

5. IR Sensor

An IR (Infrared) sensor is a device that detects infrared radiation in its vicinity. These sensors work by emitting an infrared signal and then detecting the reflection or presence of objects based on how they interact with that signal. Infrared sensors are commonly used for various applications, including motion detection, distance measurement, and object tracking, and they are found in devices like remote controlsand proximity sensors. They are particularly useful in low-light or dark environments as they operate based on infrared light, which is not visible to the human eye.

6. LED

A Light Emitting Diode, or LED, is a semiconductor device that emits light when an electric current passes through it. LEDs are energy-efficient, durable, and come in various colours. They are widely used for indicators, displays, lighting, and in various electronic applications. LEDs have become a popular choice due

to their long lifespan and low power consumption, making them a more environmentally friendly and cost-effective alternative to traditional light sources like incandescent bulbs.

Software components:

1. Arduino IDE

The Arduino Integrated Development Environment (IDE) is a user-friendlysoftware platform designed for programming and developing applications for Arduino microcontroller boards. It provides an intuitive and versatile environment for writing, uploading, and debugging code for a wide range of projects.The Arduino IDE is open-source and supports a simplified version of the C and C++ programming languages, making it accessible to both beginners and experienced developers. It comes with a comprehensive library of pre-written code, or "sketches," that can be easily customized, enabling users to interact with various sensors, actuators, and other electronic components. The IDE also offers a straightforward interface for managing board configurations, including selecting the specific Arduino board and its associated parameters. With its built-in serial monitor for real-time data communication and a simple upload process, the Arduino IDE has become an invaluable tool for countless makers, hobbyists, and professionals in the world of embedded electronics and microcontroller programming.

Specifications:

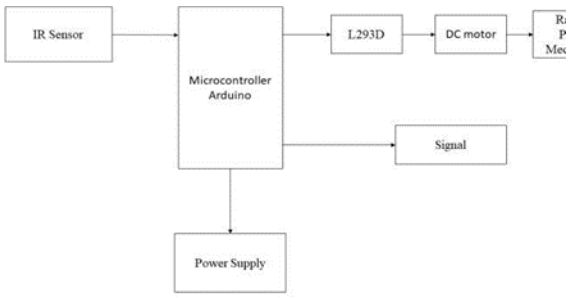
- Function: Integrated Development Environment for Arduino.
- Programming Language:Simplified C/C++.
- Open-Source: Free andcommunity-supported.
- Code Library: Extensive collection of pre-written code for variouscomponents.
- Board Support: Configurable for different Arduino boards.
- Serial Monitor: Built-in for real- time data communication.
- User-Friendly: Suitable for beginners and experienceddevelopers.
- Versatile: Used for a wide range of embedded electronics projects.

2. Proteus Software

Proteus is a popular electronic design automation (EDA) software suite primarily used for designing, simulating, and testing electronic circuits and printed circuit boards (PCBs). It is widely utilized by engineers, students, and professionals in the field of electronics and embedded systems development. Proteus offers a comprehensive set of tools for schematic capture, circuit simulation, and PCB layout design. Users can create and test circuits in avirtual environment, which helps in identifying and rectifying issues before actual hardware implementation. Additionally, Proteus supports microcontroller simulation and provides an extensive library of electronic components and microcontrollers, making it an invaluable resource for designing and validating electronic projects.

Proteus works by providing a virtual environment for designing and simulating electronic circuits. Users create circuit schematics by placing components and wiring them together graphically. The software simulates the circuit's behaviour in real-time, allowing users to test its functionality before building a physical prototype. This helps in identifying and fixing issues, ensuring that the final electronic design works as intended. Proteus is commonly used by engineers and electronics enthusiasts for a wide range of applications, from simple circuits to complex microcontroller-based projects.

Block Diagram:



- The IR sensors provide data on traffic conditions, which is processed by the Arduino controller.
- The Arduino controller makes decisions about lane allocation, LED signalling, and motor control.
- The L293D motor driver controls the DC motor,

which adjusts the lane divider via therack and pinion mechanism.

- The Traffic Management Center communicates with the Arduino to coordinate and monitor traffic management actions.
- LED indicators provide visual signals to drivers based on the system's decisions.
- Obstacle detection and emergency response components ensure safety during lane shifts.

REFERENCES

[1] Rashmi C, Roopa T N, Samrudh R and Sandhya M, "MOVABLE ROAD DIVIDERS", International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 06, June 2020.

[2] Anireddy Sushrutha and C.R.K. Reddy," Movable Road Divider Using Internet of Things", International Journal of Computer Sciences and Engineering, Vol-8, Issue-2, Feb 2020.

[3] Roopa Ravish and Shanta Ranga Swamy, "NTELLIGENT TRAFFIC MANAGEMENT: A REVIEW OF CHALLENGES, SOLUTIONS, ANDFUTURE PERSPECTIVES", Vol. 22, no.2, 2021.

[4] Sonali Naram, Pradnya Mahabale and Ashlesha Nemane," Smart Traffic Flow Management System using ATmega 328 Microcontroller", International Research Journal of Engineering and Technology(IRJET), Volume: 06, Issue: 05, May 2019.

[5] K. Vidhya, A. Bazila Banu, Density Based Traffic Signal System", Volume 3, Special Issue 3, March2014

[6] Priyanka Khanke, Prof. P. S. Kulkarni, "A Technique on Road Tranc Analysis usingImage Processing", Vol. 3 Issue 2, February2014.

[7] Rajeshwari Sundar, Santhoshs Hebbar, and Varaprasad Golla, Implementing intelligent Traffic Control System for Congestion Control, Ambulance Clearance, and Stolen Vehicle Detection" IEEE Sensors Journal,Vol. 15, No. 2, February 2015.

[8] Ms.Pallavi Choudekar, Ms.Sayanti Banerjee, Prof.M.K.Muju, Real Time Traffic Light Control Using Image Processing" Vol. 2, No.March.

[9] Shabbir Bhusari, "Traffic control system using Raspberrypi", Global Journal of Advanced Engineering Technologies ISSN (Online), Volume 4, Issue 4- 2015, pp 413-415.MARCH2015.