

SMART A New Approach (Smart Management and Architecture for Road Traffic)

AMAR VERMA¹, PREET GUPTA², AKHILESH AGRAWAL³, ABHINAV SINGH⁴, Dr. NANDITA PRADHAN⁵Dept. Of Electronics and Communication Engineering
United College of Engineering & Research, Naini, Prayagraj

ABSTRACT

This paper presents unique solutions for problems related to traffic management, traffic diversion as well as for electricity wastage in India's old cities where these problems are a major issue and are difficult to handle. This proposed paper uses IoT, Microcontrollers and various sensors to solve these social problems, and with the help of these a practically implemented solution can be formed which is user friendly and totally automatic.

In view of above an automatic density-based traffic management system will be a very unique approach to solve problems of traffic congestion and management where the proposed traffic management system is fit to be used on our traffic of four lanes. This project can sense the exact traffic of respective lane and can provide alternative paths for traffic diversion. This alternate path will act as a power path for emergency vehicle like Ambulance, police vehicle and VIP vehicles for their hassle-free movement.

This paper also proposes a smart parking system and smart street light for hassle free parking of vehicle with the knowledge of exact available slots for parking, and LDR based smart street light system which helps to reduce electricity wastage by only turning on the street lights of those portion where vehicle is present.

KEYWORDS

IOT, Arduino, Node MCU, Servo motor, IR Sensor, LCD Display, LED, I2C Convertor.

INTRODUCTION

With the development of technology, cities now have a variety of electronic gadgets, and the modern lifestyle has changed significantly. The need for cities to become smarter is growing, so making the best use of the available resources is essential.

A 'Smart City' is a developed urban area that creates sustainable economic, mobility, environmental

development and provides high quality of life by excelling in multiple key areas. Therefore, the idea is to deploy Internet of Things (IoT) that enables everyday objects to be equipped with communicational functionalities allowing them to be connected at any place at any time there by implementing a 'Smart City'.

With the help of this proposed model, we can solve the above specified problems faced by our old cities especially in cities like Prayagraj, Banaras etc in a integrated way where every year events like Kumbh mela, Magh mela, Chhath pooja occur and the cities have to tackle a lot of traffic related issues.

The first traffic signals were simple fixed time devices where each route was given right of way for a fixed time in a preset sequence without reference to the traffic using the junction. This type of open loop control soon gave way to vehicle actuated forms of control with vehicles being detected by pneumatic pads built into the road surface.

The traffic in urban area is dominated by events such as factory and shop opening times, that occurs at similar times each day. It is therefore possible to predict with reasonable accuracy, the future traffic in a network at a given time of the day and to predict that over a period of week.

Paper[1] described about Density based traffic control system it uses IR sensors & Arduino to reduce traffic congestion problem and design an intelligent traffic control system. The IR sensor is used to detect obstacles. It comprises an emitter (IR LED), detector IR photodiode and auxiliary circuitry. When the reception of IR radiation source is higher, output voltage will also high.

Paper [2] described about Density based traffic management system which is designed to develop a density based traffic signal system where its signal timing changes automatically after sensing the traffic density at the intersection.

Paper [3] described about Smart Parking System In

smart parking, systems are there are features data routing systems, smart payment systems, and electronic car parks. These types require disclosure of whether parking spaces are vacant or not. With the user registration in the system, a unique identifier is created for him, and with the booking, it has the booking details, and via their smartphones, the entire time, exit time, and money are calculated.

Paper [4] described about Smart Parking System it consists of Tracking of parking slots is also an essential factor, which can be done using an IoT system integrated with sensors.

Paper [5] described about Smart Street light system which have the main aim of smart street light systems is that lights turn on when needed and light turn off when not needed. Moreover, the smart street light system in this paper behaves like usual street lights that turn on all night.

In this Proposed model Integrated approach is adopted where a main objectives are implemented together with the help of four main objective which are classified as following:-

- 1- SMART PARKING
- 2- SMART STREET LIGHT
- 3-DENSITY BASED TRAFFIC MANAGEMENT SYSTEM
- 4-ALTERNATIVE PATH & POWER PATH

1- SMART PARKING

Smart parking systems using Arduino are becoming increasingly popular due to their ease of use, affordability, and reliability. A smart parking system can help reduce traffic congestion, decrease fuel consumption, and improve the overall efficiency of parking.

To create a smart parking system using Arduino with a 20*4 LCD display, you will need to use sensors to detect whether a parking space is occupied or not. You can use different types of sensors, such as ultrasonic sensors or infrared sensors, depending on your application and budget.

Once you have the sensor data, you can use an Arduino board to process the data and display it on a 20*4 LCD display. The LCD display can show the availability of the parking spaces, indicating whether they are vacant or occupied.

To get started, you will need to connect the sensors to the Arduino board and program it to read the sensor data. Then, you can use the LCD library to display the availability of

the parking spaces on the LCD display.

2-SMART STREET LIGHT

Smart street lights are an innovative solution for energy-efficient lighting on streets and roads. These lights use advanced technologies like sensors, microcontrollers, and wireless communication to provide intelligent lighting control, energy management.

Arduino is a popular microcontroller platform that can be used to build smart street light systems. With Arduino, developers can program sensors to detect the presence of vehicles, pedestrians, or cyclists and turn on the street light accordingly. They can also use Arduino to control the power consumption of the streetlights and turn them on or off automatically based on the time of day or the level of ambient light.

To build a smart street light system using Arduino, few components like sensors (e.g., IR sensors), LED lights are required. A code has to be written that reads data from the sensors and sends commands to the LED lights.

3-DENSITY BASED TRAFFIC MANAGEMENT SYSTEM

Traffic congestion is a major problem in older cities of urban areas, leading to increased travel times, fuel consumption, and air pollution. So, in view of this a density-based traffic management system will be a very unique approach to solve problems of traffic congestion and management where the proposed density-based traffic management system is totally fit to be used on our traffic four lanes and is totally automatic and don't require any manual operation.

The density-based traffic management system works by placing sensors at strategic points along the road to measure the density of vehicles. The sensors can be either ultrasonic or infrared, and they are connected to an Arduino board.

The Arduino board processes the sensor data and calculates the traffic density. Based on the density level, the Arduino board sends signals to the traffic signals controller to adjust the traffic lights. For instance, if the traffic density is high, the traffic lights will remain green for a longer time to allow more vehicles to pass through. Conversely, if the traffic density is low, the traffic lights will change faster to allow more traffic from other directions.

The density-based traffic management system has several advantages over traditional traffic management systems, including:

- Improved Traffic Flow: The system ensures a smooth flow of traffic by adjusting the traffic lights based on the traffic density level.
- Reduced Congestion: By optimizing traffic flow, the system reduces congestion on the roads, leading to reduced travel times and fuel

consumption.

- Cost-Effective: The system is cost-effective and easy to install compared to other traffic management systems.
- Scalable: The system can be easily scaled up to cover a larger area or more roads.
- Environmentally Friendly: The system reduces air pollution by reducing travel times and fuel consumption.

4- ALTERNATE PATH AND POWER PATH

With the help of alternate path the diversion of traffic can be done for solving traffic congestion problem and this path will also work as a power path if any emergency vehicle, Ambulance or high priority VIP vehicle will arrive then without disturbing the normal traffic alternate path can be provided to such vehicles.

METHODOLOGY

This model performs various functionalities which are classified as follows:-

- 1.The density-based traffic management system has ultrasonic sensors attached to each lane of the four lane traffic light controlled by Arduino uno which sense the density of traffic at each lane and if the density at any respective lane is more than usual then the time for green light for that respective lane will be increased by 10 seconds, also an alternate path which is normally closed will be opened for traffic diversion.
2. If any emergency vehicle (for e.g. Ambulance, Fire brigade, police vehicles, VIP vehicle) arrived then the alternate path will work as a power path and at that time the path will be opened only for that respective vehicle for hassle free movement of that vehicle.
- 3.The smart street lighting system consist of LDR and IR sensor attached to the street which sense the position of vehicle and according to which the further street lights will glow where the vehicle is present.
- 4.The smart parking system has IR sensors attached with an LCD controlled by Node-MCU which check the availability of slots of the parking lane and according to which vehicles are parked at respective empty place and the lcd display the status of slots as empty or filled.

FLOW CHART

Flow chart of the proposed model as described above is show in the figure-1.

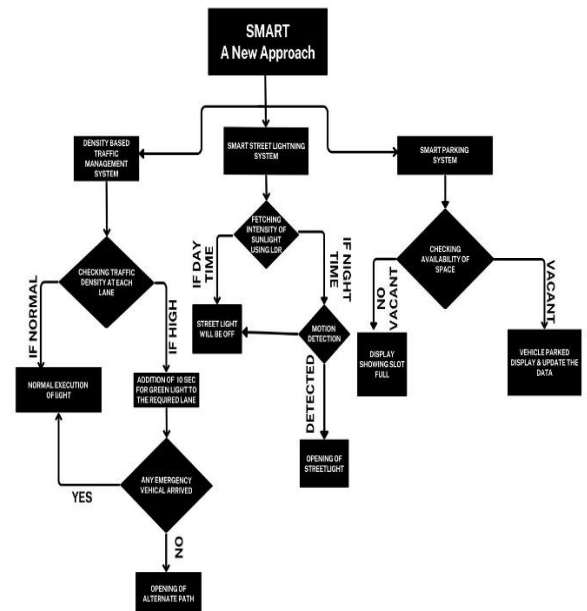


Figure-1

BLOCK DIAGRAM

Block diagram of the proposed model is show in the figure-2.

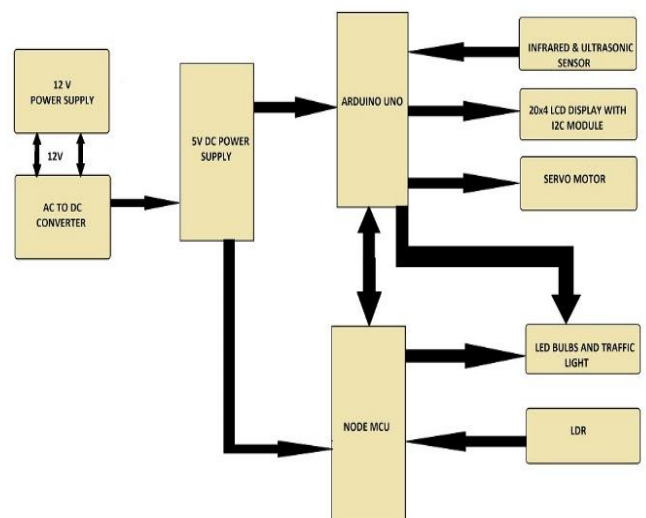


Figure-2

IMPLEMENTATION

In order to implement the project in integrated manner, following are the components used,

1. Arduino Uno:

Figure-3 shows Arduino Uno which is a popular microcontroller board based on the ATmega328P microcontroller. It is a simple and cost-effective solution for electronic prototyping and DIY projects. The Arduino Uno board has 14 digital input/output pins, 6 analog inputs, and a 16 MHz quartz crystal oscillator. It can be programmed using the Arduino Integrated Development Environment (IDE).



Figure-3

2. NodeMCU:

Figure-4 shows NodeMCU which is a development board that integrates a Wi-Fi module, allowing for easy connectivity to the internet. It is based on the ESP8266 microcontroller and provides an easy-to-use interface for developing and testing IoT projects. The NodeMCU board can be programmed using the Arduino IDE or Lua programming language, making it accessible to developers with different skill levels.

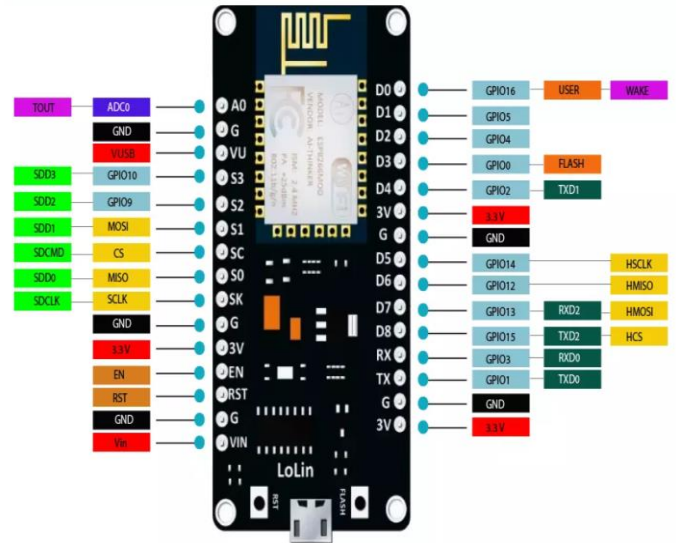


Figure-4

3. IR Sensor:

Figure-5 shows IR sensor or Infrared sensor which is a device that detects infrared radiation from objects in its field of view. It is commonly used in proximity sensing, object detection, and motion detection applications. IR sensors are used in a wide range of electronic devices, including remote controls, security systems, and automation systems.

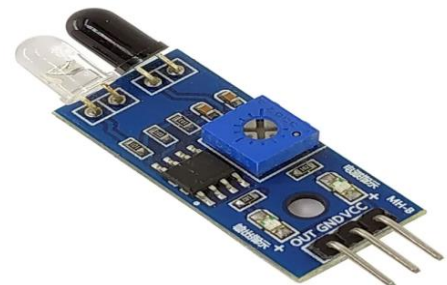


Figure-5

4. LCD Display 20*4:

Figure-6 shows LCD display or Liquid Crystal Display which is a type of flat-panel display used in electronic devices to display text, images, and other content. A 20*4 LCD display means that it has 20 characters per line and 4 lines. LCD displays are commonly used in electronic devices such as calculators, digital clocks, and consumer electronics.



Figure-6

5. LED:

Figure-7 shows LED or Light Emitting Diode which is a semiconductor device that emits light when a current flows through it. LEDs are commonly used in electronic devices as indicators, lighting, and displays. LEDs are energy-efficient, long-lasting, and available in a wide range of colors.



Figure-7

6. Servo Motor:

Figure-8 shows A servo motor which is a type of motor commonly used in robotics and automation that allows for precise control of angular position. It consists of a small DC motor, gears, and a control circuit that adjusts the motor's position based on an input signal. The position of the servo motor can be controlled by sending a PWM (pulse width modulation) signal to it, with the duty cycle of the signal determining the angle of the motor's shaft.



Figure-8

7. I2C Converter:

Figure-9 shows I2C(Inter-IntegratedCircuit) converter which is a communication protocol used to connect multiple devices in a network. It allows for communication between devices using only two wires, a clock line (SCL) and a data line (SDA). The I2C converter acts as a bridge between devices that use different protocols or different voltage levels, allowing them to communicate with each other.

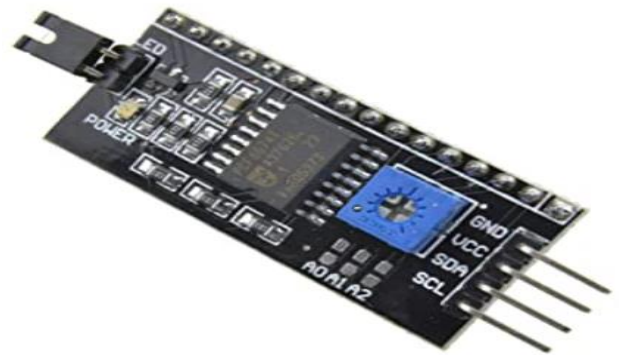


Figure-9

Final working in which all the objectives are integrated and implemented in as shown in Figure-10 and Figure-11.



Figure-10

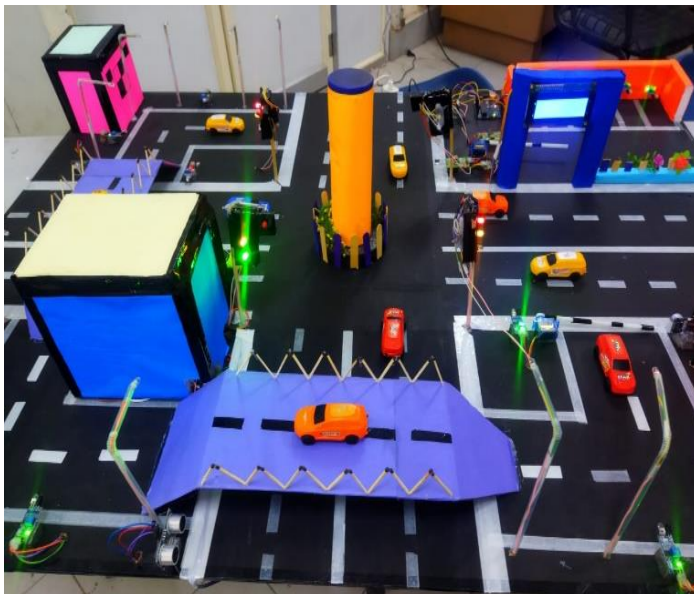


Figure-11

RESULT & CONCLUSION

In conclusion, this IoT and microcontroller-based system is the best approach for solving traffic congestion and traffic management problems in old cities. The system uses sensors to measure the density of vehicles and adjusts the traffic lights accordingly, leading to improved traffic flow, reduced congestion, and cost savings. Additionally, the system can be easily scaled up and is environmentally friendly, making it a viable option for traffic management

in old cities in urban areas.

The system has several advantages, for instance, the system is effective in areas with irregular traffic patterns or in areas with high pedestrian traffic. Furthermore, the system requires regular maintenance to ensure proper functioning of the sensors and traffic signal controllers.

The density-based traffic management system using Arduino is a promising solution to the problem of traffic congestion in urban areas. With its ability to optimize traffic flow and reduce congestion, the system can lead to significant cost savings, reduce electricity wastage and environmental benefits with the help of smart street light system and smart parking system. This system also contains an alternate path for traffic diversion at the time of heavy traffic and this alternate path will behave as a power path for emergency vehicle like Ambulance, police vehicle and VIP vehicles for their hassle-free movement.

While there are challenges to consider, the benefits of the system outweigh the drawbacks, making it a worthwhile investment for cities and municipalities.

REFERENCES

- [1] International Journal of Engineering Research & Technology (IJERT).
- [2] Researchgate.net, Journal of Physics Conference Series 1529(2):022061
DOI:10.1088/1742-6596/1529/2/022061
- [3] International Journal of Computer Science & Information Technology (IJCSIT) Vol 12, No 4, August 2020
DOI: 10.5121/ijcsit.2020.12405 55 Amira. AElsonbaty1 and Mahmoud Shams21 Department of communication and electronics, Higher institute of engineering and Technology
- [4] International Journal of Engineering and Technical Research 10(10):100
DOI:10.17577/IJERTV10IS100061
- [5] Researchgate.net, Journal of Urban Technology 29(2):1-16
DOI:10.1080/10630732.2022.2082825, License CC BY-NC-ND 4.