VISVESVARAYA TECHNOLOGICAL UNIVERSITY BELAGAVI

590018, KARNATAKA.

A PROJECT REPORT

On

"IOT BASED TRAFFIC MANAGEMENT SYSTEM FOR EMERGENCY VEHICLES"

Submitted in Partial Fulfillment for the Award of the Degree

of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE & ENGINEERING

Submitted By:

1SG19CS080 PRIYESH RAJ

Under the Guidance of

Ms. HEMALATHA K

Assistant Professor

Department of Computer Science and Engineering

(Accredited by NBA)

SAPTHAGIRI COLLEGE OF ENGINEERING

(Affiliated to Visvesvaraya Technological University, Belagavi& Approved by AICTE, New Delhi.)

ISO 9001-2015 & 14001-2015 Certified, Accredited by NAAC with 'A' Grade

14/5, Chikkasandra, Hesarghatta Main Road

Bengaluru – 560057.

2022-2023

SAPTHAGIRI COLLEGE OF ENGINEERING

(Affiliated to Visvesvaraya Technological University, Belagavi& Approved by AICTE, New Delhi.)

I SO 9001-2015 & 14001-2015 Certified, Accredited by NAAC with 'A' Grade

Bengaluru-560057

Department of Computer Science and Engineering

(Accredited by NBA)

Certificate

Certified that the Project Work entitled **"IOT BASED TRAFFIC MANAGEMENT SYSTEM FOR EMERGENCY VEHICLES"** carried out by **PRIYESH RAJ (1SG19CS080)** bonafide students of **Sapthagiri College of Engineering**, in partial fulfillment for the award of **Bachelor of Engineering** in **Computer Science and Engineering** of **Visvesvaraya Technological University**, **Belagavi** during the academic year 2022-2023. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the Department Library. The project report has been approved as it satisfies the academic requirements in respect of **Project Work Phase II (18CSP83)** prescribed for the said degree.

Signature of the Guide	Signature of the HOD	Signature of the Principal
Ms. Hemalatha K **Assistant Professor**	**Dr. Kamalakshi Naganna** **Professor & Head**	**Dr. H Ramkrishna** **Principal**

EXTERNAL EXAMINATION:

1.____________________________ ____________________________

2.____________________________ ____________________________

ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the completion of any task would be incomplete without the mention of the people who made it possible, whose constant guidance and encouragement ground my efforts with success.

I consider it is a privilege to express my gratitude and respect to all those who guided me in completion of project.

I am, grateful to thank our Principal **Dr. H Ramkrishna**, Sapthagiri College of Engineering, who patronized throughout our career & for the facilities provided to carry out this work successfully.

It's a great privilege to place on record my deep sense of gratitude to our beloved HOD **Dr. Kamalakshi Naganna** of Computer Science & Engineering, who patronized throughout our career & for the facilities provided to carry out this work successfully.

I am also grateful to thank my project Guide Prof. **Ms. Hemalatha K, Assistant Professor** of CSE department for her invaluable support and guidance.

I would also like to thank the teaching and non-teaching staff members who have helped me directly or indirectly during the project.

Lastly but most importantly I would like thank my family and friends for their co-operation and motivation to complete this project successfully.

PRIYESH RAJ 1SG19CS080

ABSTRACT

Traffic congestion is a major problem in many cities of India along with other countries. Failure of signals, poor law enforcement and bad traffic management has led to traffic congestion. Traffic congestion has a negative impact on the economy, the environment and the overall quality of life. Hence it is high time to effectively manage the traffic congestion problem. The purpose of the system is to propose a smart traffic management system using the Internet of Things and a decentralized approach to optimize traffic on the roads and intelligent algorithms to manage all traffic situations more accurately. The proposed system will overcome the flaws of previous traffic management systems. An algorithm will be used to predict the traffic density for future to minimize the traffic congestion. The proposed system helps to alleviate traffic congestion by turning all red lights on the emergency vehicle’s route to green, allowing it to proceed to its destination without delay. The system controls traffic light and saves time in an emergency period. Thus, it acts as a life saver project.

SAPTHAGIRI COLLEGE OF ENGINEERING

(Affiliated to Visvesvaraya Technological University, Belagavi& Approved by AICTE, New Delhi.)

ISO 9001-2015 & 14001-2015 Certified, Accredited by NAAC with 'A' Grade

#14/5, Chikkasandra, Hesaraghatta Main Road,

Bengaluru-560057

Department of Computer Science and Engineering

(Accredited by NBA)

DECLARATION

I, **PRIYESH RAJ (1SG19CS080)** bonafide students of **Sapthagiri College of Engineering**, hereby declare that the project entitled "**IOT BASED TRAFFIC MANAGEMENT SYSTEM FOR EMERGENCY VEHICLES**" submitted in partial fulfilment for the award of Bachelor of Engineering in **Computer Science & Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2022-2023 is our original work and the project has not formed the basis for the award of any other degree, fellowship or any other similar titles.

Name & Signature of the Student with date

PRIYESH RAJ **1SG19CS080**

ABBREVIATION

1) **RFID** – **R**adio **F**requency **I**dentification
2) **IR** - **I**nfrared Sensors
3) **IOT** - **I**nternet **O**f **T**hings
4) **GDP** - **G**ross **D**omestic **P**roduct
5) **MCU - M**icrocontroller **U**nit
6) **GPS** - **G**lobal **P**ositioning **S**ystem
7) **GPIO** - **G**eneral **P**urpose **I**nput **O**utput
8) **APP** - **A**pplication
9) **RF - R**adio **F**requency
10) **SPI - S**erial **P**eripheral **I**nterface
11) **OLED - O**rganic **L**ight **E**mitting **D**iode
12) **CPU - C**entral **P**rocessing **U**nit
13) **IDE** - **I**ntegrated **D**evelopment **E**nvironment
14) **OS - O**perating **S**ystem
15) **DFD - D**ata **F**low **D**iagram
16) **RGB - R**ed **G**reen **B**lue
17) **UML - U**nified **M**odelling **L**anguage
18) **i.e -** That **I**s
19) **PWM - P**ulse **W**idth **M**odulation
20) **USB - U**niversal **S**erial **B**us
21) **EEPROM** - **E**lectrically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory
22) **Rx - R**eceiver
23) **Tx** - **T**ransmitter
24) **EMF - E**lectro**m**otive **F**orce
25) **UTC** - **U**nit **T**est **C**ase

LIST OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLES

Chapter 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 Background:

Traffic management systems have been around for almost 50 years, and their importance cannot be overstated. They were first introduced in 1972 to centrally control the freeway system in Los Angeles. Since then, they have become an essential part of traffic management all over the world. The Traffic Management System aims to provide motorists with a faster, safer trip on metro area freeways by optimizing the use of available freeway capacity, efficiently managing incidents and special events, providing traveller information, and providing incentives for ride sharing.

In recent years, IoT-based traffic management systems have become increasingly popular, with many cities and municipalities implementing them to improve their emergency response times. These systems use sensors and real-time data to monitor traffic and identify when an emergency vehicle is approaching. They then adjust traffic signals and provide clear paths for the emergency vehicle to navigate through the traffic. The aim of this system is to reduce response times and save lives in emergency situations.

Cities and traffic have developed hand-in-hand since the earliest large human settlements. The same forces that draw inhabitants to congregate in large urban areas also lead to sometimes intolerable levels of traffic congestion on urban streets. Cities are the powerhouses of economic growth for any country. According to Bartone et al. (1994), around eighty percent of Gross Domestic Product (GDP) growth in developing countries is expected to come from cities.

To address this issue, Radio Frequency Identification (RFID) systems have been developed for traffic management. An RFID system consists of an RFID controller and an RFID tag. The RFID controller consists of an RFID interrogator, which is used for communication with the RFID tag. The RFID controller then receives the signals/data received by the interrogator. Messaging interference is used to send commands and data messages from the controller components. The controller core is present inside the RFID controller.

The controller core listens to the interrogators and depending upon the configuration, the controller core can perform read/write operations upon the RFID tag or can do both listening and performing operations. The RFID controller can have a serial interface through which external GSM/GPRS devices can be interfaced with it to make a dual radio device.

RFID tags are wireless devices that make use of radio frequency electromagnetic fields to transfer data, which is used for identifying and tracking objects. RFID tags are of two types: active and passive. Active RFID has a battery installed, which passive RFID doesn't have. Passive RFID has to depend on external sources for working. Tag information can be stored in a non-volatile memory. The tag consists of a Radio Frequency transmitter and receiver. Each tag can be assigned a unique serial number.

In an IoT-based traffic management system, RFID tags can be placed on emergency vehicles, and the RFID controller can be placed at traffic signals. The RFID tags send signals to the RFID controller, which then adjusts the traffic signals to provide a clear path for the emergency vehicle. This technology can greatly reduce the response time of emergency vehicles, making it a critical tool in emergency situations.

IoT-based traffic management systems are not just limited to emergency vehicles; they can be used to manage traffic in general. For example, RFID tags can be placed on vehicles, and the RFID controller can be placed at traffic signals. The RFID tags send signals to the RFID controller, which then adjusts the traffic signals based on the number of vehicles and the traffic flow. This can greatly reduce traffic congestion and improve the overall traffic flow in a city.

One of the key benefits of IoT-based traffic management systems is that they can provide real-time data on traffic patterns. This information can be used by city planners and transportation authorities to make informed decisions about where to place new roads, how to design intersections, and where to focus resources for public transportation. This can help to reduce traffic congestion and make transportation more efficient for everyone.

Another significant advantage of IoT-based traffic management systems is that they can provide real-time information to drivers about the current traffic conditions.

This information can be displayed on electronic signs, mobile apps, or even broadcast on the radio. Drivers can use this information to make informed decisions about their route and avoid traffic congestion. By reducing the number of cars on the road and encouraging carpooling, IoT-based traffic management systems can also help reduce air pollution and carbon emissions, making cities more environmentally friendly.

One of the challenges of implementing IoT-based traffic management systems is the need for a reliable and robust communication network. The system must be able to communicate seamlessly between the RFID tags, the RFID controller, and other devices in the system. In addition, the system must be able to handle large amounts of data in real-time. This requires a high-speed and reliable communication network, such as 5G.

Another challenge is the cost of implementing IoT-based traffic management systems. RFID tags and controllers can be expensive, especially if they are used on a large scale. In addition, the system requires regular maintenance and updates to ensure that it continues to function effectively. However, the benefits of these systems in terms of improved traffic flow and emergency response times can outweigh the costs in the long run.

Overall, IoT-based traffic management systems are an excellent example of how the internet of things can be used to improve public safety and efficiency. These systems use real-time data and sensors to optimize traffic flow, reduce congestion, and improve emergency response times. As cities continue to grow and become more congested, the need for effective traffic management systems will only increase. With the ongoing development of IoT technology, we can expect to see more advanced and sophisticated traffic management systems in the future, making our cities safer and more liveable places.

1.2 Overview of Present Work:

The existing traffic management system in many places relies heavily on the presence and decision-making of traffic police officials. However, this system possesses several limitations when it comes to effectively managing traffic congestion. One of the primary drawbacks lies in the fact that the decision-making process hinges solely on the judgment of individual traffic police officials. They have the authority to either extend the duration of road blockages or allow vehicles from another road to pass through. However, the efficiency and optimization

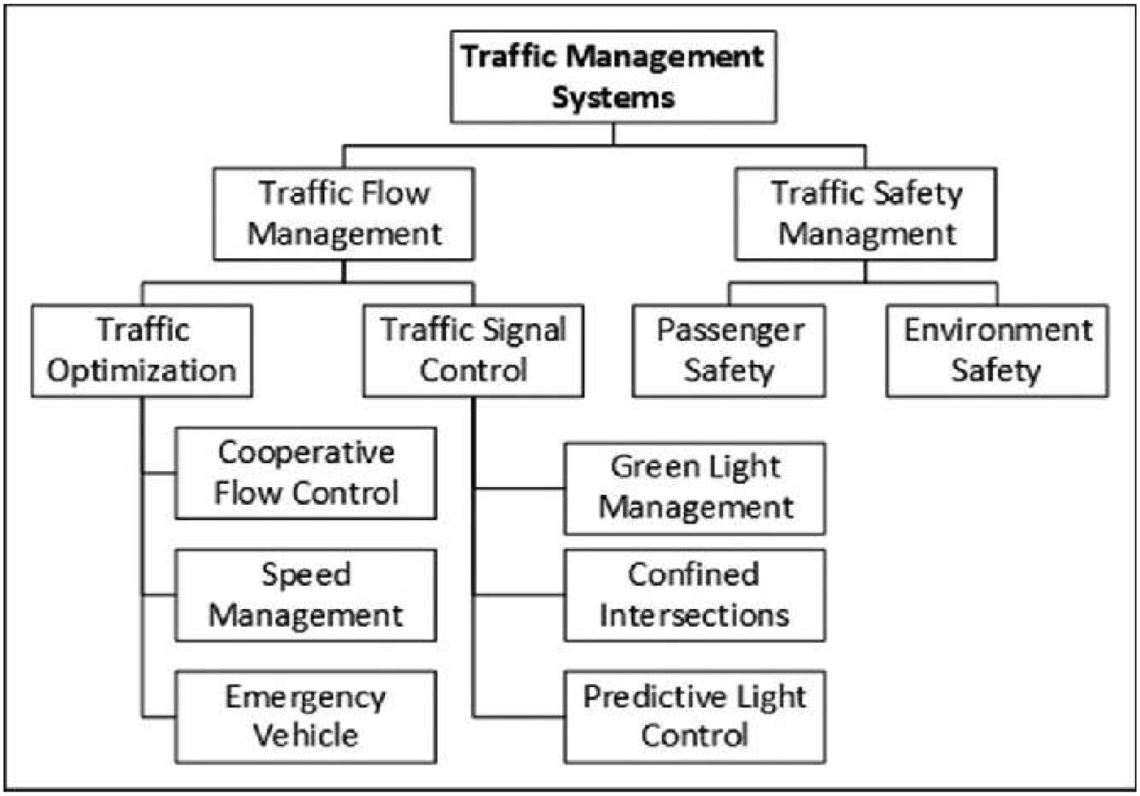


Fig 1.1: Overview of the Present Work

of this decision-making process can vary significantly as it is dependent on the discretion and experience of the individual official. Even when traffic lights are implemented, the fixed time intervals for displaying green or red signals may not be sufficient in addressing the problem of traffic congestion. These predetermined signal timings may not align with the actual traffic conditions on the roads, leading to further congestion and delays.

Furthermore, the existing system lacks a dedicated mechanism for providing a green corridor exclusively for emergency vehicles, such as ambulances, fire trucks, police cars, and organ donor vehicles. During emergency situations, swift movement and unhindered access are critical to reaching their destinations promptly. The absence of a specialized solution within the current traffic control system poses significant challenges for effective traffic management during emergencies.

The management of traffic for emergency vehicles is of paramount concern. The sheer volume of vehicles in urban areas can contribute to traffic jams and delays, which can severely impede an ambulance's ability to reach a hospital within the critical time window. To address these challenges, specialized traffic management systems designed explicitly for emergency services are employed. These systems are tailored to facilitate smoother traffic flow, enabling emergency vehicles to navigate through the road network without encountering unnecessary obstacles or delays. The goal is to create fluid traffic conditions that prioritize the movement of emergency vehicles, ensuring they can maneuver through the city efficiently and reach their destinations as quickly as possible.

In the context of India, it is noticeable that even with the presence of traffic lights, traffic police officials are still required to be present. This indicates that the existing system necessitates additional manpower, resulting in increased costs and inefficiencies in the long run. Consequently, there is a clear need for a smarter and more automated traffic management system that reduces reliance on manual intervention and optimizes traffic flow more effectively. Such a system would be capable of dynamically adjusting traffic control measures based on real-time conditions, responding promptly to changing traffic patterns, and allocating priority to emergency vehicles when required. By implementing such a system, traffic management can be significantly improved, leading to enhanced efficiency and smoother traffic flow on the roads.

1.3 Problem Statement:

The response time for emergency vehicles like ambulances and fire trucks is crucial in saving lives, but traffic congestion can cause significant delays. Traditional traffic management systems are unable to efficiently prioritize emergency vehicles, leading to longer response times and potentially putting lives at risk. Therefore, there is a need for a more effective traffic management system that can prioritize emergency vehicles and provide a clear path for them to reach their destination quickly. An IoT-based traffic management system that utilizes RFID technology and real-time data can address this issue by monitoring traffic flow and adjusting traffic signals to prioritize emergency vehicles.

1.4 Objectives:

The main objectives of this project is:

- **To reduce the response time of emergency vehicles:** The system aims to provide a faster response time for emergency vehicles such as ambulances and fire trucks by using real-time data and RFID technology to monitor traffic flow and adjust traffic signals accordingly. This objective is critical because reducing the response time can potentially save lives and reduce the impact of emergencies on the community.

- **To improve public safety:** The system is designed to improve public safety by providing a clear path for emergency vehicles and reducing the risk of accidents caused by emergency vehicles rushing through traffic. By managing traffic flow more efficiently, the system can also reduce traffic congestion and improve overall road safety.

- **To increase the efficiency of traffic management:** The system aims to increase the efficiency of traffic management by using real-time data to adjust traffic signals based on traffic flow. This can reduce the time it takes for drivers to reach their destinations and improve overall traffic flow, making cities more livable.

- **To reduce the environmental impact of traffic:** By reducing the time vehicles spend on the road and improving traffic flow, the system can also reduce the environmental impact of traffic, including greenhouse gas emissions and air pollution.

- **To enable better emergency response planning:** The system can provide valuable data on traffic patterns during emergency situations, allowing emergency services to better plan and coordinate their response efforts. This objective can help improve the effectiveness of emergency services and reduce the impact of emergencies on the community.

Chapter 2

LITERATURE REVIEW

CHAPTER 2

LITERATURE REVIEW

2.2 Summary of prior works:

[1] Automatic Traffic Diversion System Using Traffic Signals

- **Authors:** K.S.Sandhya, B. Karthikeyan
- **Description**: This paper presents an innovative traffic management system designed to address the issue of traffic congestion in urban areas. The system utilizes inductive loop sensors that are installed at intersections to detect the presence of vehicles. In the event of a traffic jam, the microcontroller in the traffic signal of the affected road communicates with the previous three traffic signals (straight, left, and right) through Zigbee technology. This information exchange allows drivers to be automatically rerouted, thereby preventing further congestion or accumulation of traffic. Moreover, the system includes several features aimed at improving traffic flow. For instance, the system comprises an emergency vehicle detection feature, which detects the approach of an emergency vehicle and automatically gives it priority over other vehicles. Additionally, the system is equipped with jam lights that alert drivers to the presence of traffic congestion ahead, encouraging them to slow down or choose an alternate route. The primary goal of this system is to minimize delays and reduce idling time for drivers, resulting in fuel savings and reduced exhaust emissions. The provision of real-time traffic information and alternative routes to drivers enables more efficient and less stressful driving in urban areas. Furthermore, by reducing traffic congestion, the system can significantly enhance the overall safety and liveability of urban areas.
- **Drawbacks:** The usage of pressure tubes causes roadblocks. Ultrasonic technology raises the cost of installation.

[2] IoT based Intelligent Traffic Signal System for Emergency vehicles

- **Authors:** Shubhankar Vishwas Bhate, Prasad Vilas Kulkarni, Shubham Dhanaji Lagad, Mahesh Dnyaneshwar Shinde, Prof. Shivprasad Patil
- **Description**: They have proposed a system to reduce traffic congestion at a four-way intersection with unidirectional roads by designing an intelligent traffic signal system. Starting with the intersections, the system is primarily designed to handle congestion issues in congested locations..

In order to provide room for an approaching emergency vehicle, the system handles traffic lights. The proposed system analyzes the circumstances when an emergency vehicle arrives, emphasizing proper signal management at the junction. Through communication with a central system, which has the ability to regulate one of the four signals at the junction, the system modifies the signals that are present at the four sites that direct the four unidirectional highways. When a car approaches the junction, the system detects it and sends the data to the central system. The appropriate road's signal status is modified by the central system, which also affects other signals.

- **Drawbacks:** Lua is slower than C. MQTT has a security problem.

[3] Automatic Traffic Signals in Smart Cities for Speedy Clearance of Emergency Vehicles

- **Authors:** A.S.Dhatrak, Dr.S.T.Gandhe
- **Description**: The paper proposes a system consisting of two main sections: the transmitter section and the receiver section. The transmitter section is responsible for sending signals to the receiver section, while the receiver section is responsible for receiving these signals and clearing the traffic signal before an emergency vehicle reaches it. The transmitter section includes a NodeMCU controller system that is connected to a GPS module and a ThingSpeak cloud. The GPS module provides real-time location data for emergency vehicles, and the ThingSpeak cloud uploads this data to provide location information for traffic signals. Using this information, the NodeMCU controller system sends signals to the receiver section when an emergency vehicle is approaching. The receiver section includes a microcontroller unit (MCU) that receives signals from the transmitter section. When a signal is received, the MCU activates a relay switch that clears the traffic signal before an emergency vehicle reaches it. Additionally, the MCU sends an acknowledgement signal back to the transmitter section to confirm that the signal has been received.
- **Drawbacks:** High cost. Acoustic system delay is more. GPS is inaccurate in the range of 75 m to 100 m.

[4] A Survey on Traffic Control Mechanism for Emergency Vehicles

- **Authors:** Diksha A. Chaudhari, Lakxmi S. Gadhari, Gaurav H. Damale, Abhijit R. Dutonde Prof. Himanshu Joshi

- **Description**: The suggested solution attempts to make better use of the GPS technology included into cell phones to increase the capability of traffic control systems to gauge the volume of traffic on the roadways. The system may then determine the path of an emergency vehicle and clear the path by modifying the timers of the associated traffic signals. This modification makes sure that the lights are green for 10 minutes prior to the arrival of the emergency vehicle at the signal, allowing the car to pass without incident. Prior systems' scalability for real-time implementation was constrained by the need to install extra hardware. In order to determine the population density close to the signals, this new method suggests using the embedded GPS module from cell phones. The technology can determine the precise number of persons in the immediate area of each signal by using a defined radius of latitude and longitude for each signal. By doing away with the requirement for new hardware installation, this method increases the system's scalability and efficiency. As a whole, it is anticipated that this planned system will be an effective and efficient way to handle traffic congestion brought on by emergency vehicles. The system will be more precise and simpler to operate in real-time thanks to the usage of GPS technology in cell phones. The suggested system is also expandable, making it a workable alternative for communities of all sizes.
- **Drawbacks:** IT is very expensive. It will cause additional congestion on other paths, it will be time consuming.

[5] IoT based Smart Traffic density Control using Image Processing

- **Authors:** Anilloy Frank, Yasser Salim Khamis Al Aamri, Amer Zayegh
- **Description**: This paper presents the V Model approach, a structured and methodical strategy that advances step by step in a separate phase, is the methodology employed in this study work in order to track the system chronology and dependencies thoroughly. This approach was chosen because it is straightforward and effective in ensuring that the entire flow of work adheres to the procedure in a correct and structured manner. This method offers a distinct and well-organized strategy that starts with the requirement and design phase and continues with the analysis and verification of the system design before going on to the coding phase.Monitoring traffic density, manual signaling mode, and automatic signaling mode are all included in the need phase. Hardware for the traffic controller, a server (M2X IoT platform), and software development for a Java application are all components of the system design phase.

The creation of application code for Raspberry Pi3 image processing, GPIO control, and server connectivity is a component of the implementation step. Java programme for server communication. During the unit testing stage, test cases are created to evaluate each hardware, image processing, and Java application capability. During the system integration testing phase, the interface between the controller and relay module, the Raspberry Pi and server, the application and server, and the image processing and control relay based on traffic density are all tested. The acceptance test phase also includes testing the traffic signal manual control mode, traffic signal auto-signaling mode, automatic updates of traffic density, and traffic signal auto-signaling mode, which manages traffic signals depending on traffic density.

- **Drawbacks:** Obstruction caused by fog or mist Classification and segmentation are challenging tasks.

[6] Smart Traffic Management System Using Internet of Things

- **Authors:** Sabeen Javaid, Ali Sufian, Saima Pervaiz, Mehak Tanveer
- **Description**: This paper presents The technology is built to give real-time traffic monitoring and congestion relief options. The system is made up of a network of sensors and cameras dispersed over different areas to gather traffic data. The gathered data is subsequently sent to a central server for processing and analysis. Traffic reports are generated by the server using an algorithm and then displayed on a web-based interface that is available to traffic management staff. Furthermore, the system has a control component that can modify traffic signals in accordance with traffic reports produced by the server. The control unit may send and receive data to and from the central server thanks to its wireless connection capabilities.The technology also comes with a mobile application that gives users real-time traffic data, including suggested paths to avoid gridlock. Drivers can report accidents and other occurrences through the programme, and these reports can be rapidly transmitted to the central computer for processing.This paper, which uses IoT technology to increase efficiency and lessen traffic congestion, is intended to be a comprehensive solution for managing traffic in real-time.

Drawbacks: The testing range of ultrasonic sensors is limited. Surveillance Fog or mist might obscure the camera

[7] IOT Based Smart Traffic Management System

- **Authors:**Rachana K P ,Aravind R, Ranjitha M , Spoorthi Jwanita , Soumya K

- **Description**: This paper presents the architecture and parts of a cloud-based traffic control system that makes use of IoT gadgets and sensors. The system maintains a database in the cloud that contains data about users, vehicles, traffic infractions, safe speed limits, and road locations. To identify, authorize, and track features like conditions, driving range, top speed, and safety features, the network of vehicles is also stored.In the event that VIP patrols or unforeseen road closures occur, officials have access to the system and can change route blockages. In order to prevent congestion, users can choose alternate routes, and an alarm system alerts potential commuters near the obstructed road. Using devices that recognise the vehicle number plate, the system can record traffic violations including riding without a helmet and exceeding the safe speed limit. The presently logged-in user is then punished in accordance with the governance fines. Based on the level of traffic on the road in question or the commuting route, other traffic equipment like signal lights and digital speedometer boards can be adjusted. The system also has a rerouting algorithm that uses the network of sensors and vehicles used in the IoT module to guide ambulances to low-congestion areas.
- **Drawbacks:** Cloud data is readily manipulable.

[8] IoT Based Dynamic Road Traffic Management for Smart Cities

- **Authors:** Syed Misbahuddin, Junaid Ahmed Zubairi, Abdulrahman Saggaf, Jihad Basuni, Sulaiman A-Wadany and Ahmed Al-Sofi
- **Description**: In order to offer real-time traffic information and regulate traffic flow, the system is designed to receive and analyze data from a variety of sources, including sensors, cameras, and other IoT devices. The Internet of Things (IoT) devices are embedded in the road infrastructure to gather information about traffic volume, vehicle speed, and levels of congestion. The cloud-based platform that saves and analyzes the gathered data to produce real-time traffic data and offer intelligent traffic management options. The mobile application that allows users to plan their travel routes by giving them up-to-date traffic information. The system offers dynamic traffic management solutions like intelligent traffic signal control, congestion avoidance, and rerouting by combining machine learning algorithms and data analytics. Additionally, the system includes a thorough number plate-based penalty system for traffic infractions. The suggested approach intends to improve the efficiency and safety of the road network in smart cities while maximizing traffic flow on roads.
- **Drawbacks:** Due to the participation of authorities, a quick conclusion is not feasible.

[9] Radio Frequency Sensor-Based Traffic Light Control for Emergency Vehicles

- **Authors:** Goshwe, Y. Nentawe, Okewu A. Victor and Kureve D. Teryima
- **Description**:The section covers the implementation of an intelligent traffic control system for emergency vehicles based on radio frequency. The system consists of a control unit and a transmitter. The control unit is positioned at a traffic junction, while the transmitter is installed in the emergency vehicle. The signal is transmitted at 433 MHz by the transmitter using amplitude shift key modulation. The signal is received by the control unit, which decodes it before delivering a digital signal to the microcontroller's external interrupt pin. By doing this, the emergency vehicle is able to pass through the junction's regular flow of traffic.The gearbox from the emergency vehicle is picked up by the control unit when it is 75 meters away from the junction. The control unit then interrupts the regular flow of traffic at the junction by stopping all other vehicles there to make room for the emergency vehicle. Additionally, the microcontroller stops all traffic at the intersection in response to signals from the radio frequency receiver. Overall, this strategy tries to give emergency vehicles priority by delaying regular traffic flow and giving them a direct route to their destination.
- **Drawbacks:** Multiple receiving might lead to interference.

[10] Density Based Smart Traffic System with Real Time Data Analysis Using IoT

- **Authors:** Harsha. J Naga, Nikhil Nair, Sheena Mariam Jacob, J. John Paul
- **Description: The** system that is suggested in this study is a smart traffic system based on density that analyzes real-time data to enhance traffic management. In order to alert drivers about alternate routes to avoid traffic congestion, the system is built to sense and analyze traffic density. Three major parts make up the system: sensors, a microcontroller, and a mobile app. The sensors are placed at intersections and on highways to gather information on traffic, such as vehicle speed, vehicle density, and traffic flow. The microcontroller then processes the data that was obtained, analyzes it, and spots any traffic congestion. The data is then transmitted from the microcontroller to a cloud-based server through the internet, where it is stored and subjected to real-time analysis. Traffic reports are created from the analyzed data and supplied to the mobile application. Drivers may access real-time traffic data using the mobile app, which also offers them alternate routes to escape gridlock. Additionally, the technology is built to adjust to shifting traffic situations like accidents or barricades. To ease congestion and maintain smooth traffic flow, the microcontroller may automatically reroute traffic to alternate routes.

The paper is an all-encompassing traffic management system that makes use of IoT technologies to enhance traffic flow, lessen congestion, and give drivers real-time traffic data.

- **Drawbacks:** The inductive loop must be reinstalled. False detection as a result of multipath propagation.

2.2 Outcome of the review – Problems Identified:

- The outcome of the review i.e. the problem identified in the review of prior works can be summarized as follows:
- High Cost - There is a high cost involved in some papers because they need expensive devices, such as ultrasonic sensors, GIS systems, etc.
- Security Issues - some papers may be vulnerable to attack, as cloud data can be compromised because the cloud data can be manipulated in some cases.
- High maintenance: In order to ensure the accuracy and up-to-datedness of the models, some papers require high levels of maintenance.
- Lower performance - A lack of performance on some papers is due to the fact that human resources have been involved rather than automated methods of processing.
- Obstruction -There are times when obstruction occurs as a result of natural issues, such as fog or mist, which cause obstructions to occur in certain papers.
- Limited Testing distance - There is a limitation in the testing distance for some papers resulting in limited output.
- Accuracy -Some papers do not have a high degree of GPS accuracy, while others do.
- Time expensive - The use of time-consuming technology in some papers will cause more congestion as the result of the use of time-consuming technology.
- Multiple interferences - The radio frequency can cause multiple interferences in some papers because the signal can be received by more than one receiver at the same time.
- Installation - It can be a challenge to install certain devices in some papers as they use unique devices.
- False detection - Due to the low-level sensors in the system and multipath propagation of the signals, some packets receive a false detection. There has been an issue with sensors - some papers have reported that there has been a blockage on the road due to the sensors installed.

2.3 Proposed Work:

When an emergency vehicle arrives at a traffic post, the traffic signals are automatically changed to green, allowing the emergency vehicle to pass through. Each traffic post is equipped with an RF receiver that receives the signal, and the module sends a command to turn the signal green. Therefore, whenever an emergency vehicle approaches a traffic post, it transmits a code indicating an emergency, which the receiver detects. The receiver instantly switches off the other signals, turning all signals red, and signaling green to make way for the emergency vehicle.

The proposed strategy focuses on monitoring traffic density through Infrared (IR) sensors and communicating the data to the comparator, which then digitizes the output. IR sensors are employed here, which operate on the principle that when a vehicle passes between the IR transmitter and IR receiver, the IR sensor detects the density of the road. Based on this data, the microcontroller sends a signal to the traffic signal, indicating that a lane has higher density, and the green signal should be shown in that lane.

The proposed system will have Radio-Frequency Identification (RFID) readers at the traffic junctions, which will read RFID tags attached to the vehicles coming towards the junction. RFID technology uses digital data within the RFID tag, which comprises integrated circuits that contain a small antenna for transferring information to RFID readers. The RFID tags contain an integrated electromagnetic circuit along with an antenna for transmitting and receiving RF signals.

Chapter 3

SYSTEM REQUIREMENTS

CHAPTER 3

SYSTEM REQUIREMENTS

3.1 Functional Requirements

Functional requirements capture the intended behavior of the system. This behavior may be expressed as services, tasks or functions the system is required to perform.

Following are the required features of this project:

- Normal signal control based on historical data, time of the day and the feeds captured by thesensors planted near the way
- Peak time traffic control based on RFID and IR sensors information to get data on flow oftraffic and dynamically change timings
- emergency traffic clearance
- Coordination with neighboring traffic control points
- Provision for traffic diversion

3.2 Non-Functional Requirements

Non-functional requirements play a significant role in the development of the system. If not captured properly, the system may not fulfill some of the basic business needs.

- Availability: System should be available every time and on every window it should support. 24 X 7 availability
- Reliability: System should be reliable enough to satisfactorily improve the performance.
- Supportability: It should provide support to user to easily access all the pages without much effort and it should be capable of updating and maintained in future.
- Maintainability: System should be easily maintainable. It should be flexible enough to stand with change and exceptions. The system should also handle new requirements. It should havethe capability to be maintained in a new environment.
- Usability: System should be user friendly and should provide informative error message toinform user when something goes wrong.

- Security: Security is the main issue. System should be safe and ensure security. It will ensuresecure transfer of data.

3.3 Software / Hardware Used

Hardware Requirements:

- **EM 18 RFID:**

  EM18 RFID is a popular RFID reader module that operates at a frequency of 125 kHz. It consists of a coil, an amplifier, and a voltage regulator, and can read passive RFID tags that are compliant with the EM4001 standard. The module communicates with a host microcontroller using a simple serial interface, and can be powered with a voltage between 5V and 12V.

- **OLED DISPLAY:**

  OLED displays available with different sizes, colors, and communication interfaces. OLED displays come in various sizes, including 128×64 and 128×32, and are available in different colors such as white, blue, and dual-color OLEDs. Some OLED displays use the I2C interface, while others use the SPI interface for communication with other devices.

- **Arduino Nano:**

  Arduino UNO is a popular open-source microcontroller board based on the ATmega328P microcontroller chip. It has a variety of digital and analog input/output pins that can be used for interfacing with other electronic components such as sensors, motors, and displays. The board also has a USB interface for programming and communication with a computer. Arduino UNO is easy to use, making it a great platform for beginners and advanced users

- **Connecting Wire:**

  A connecting wire is represented by a straight line. It is usually made of copper and is provided with insulation to make electrical connection between two points or devices.

- **LED:**

  A jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

- **IR sensor:**

  An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment.

- **Processor - Intel i5 10300H CPU:**

  The Intel Core i5-10300H is a fast processor for laptops with four cores based on the Comet Lake-H series (4th generation of Skylake architecture)

- **RAM - 4 GB:**

  RAM (Random Access Memory) is the hardware in a computing device where the operating system (OS), application programs and data in current use are kept so they can be quickly reached by the device's processor.

- **Disk Space - 256 GB:**

  Disk space is the total amount of data that a hard disk or hard drive can store.

Software Requirements:

- Arduino IDE
- Operating System: Windows 7

Chapter 4

System Design /Methodology

CHAPTER 3

SYSTEM DESIGN / METHODOLOGY

4.1 Architecture

4.1.1 System Design

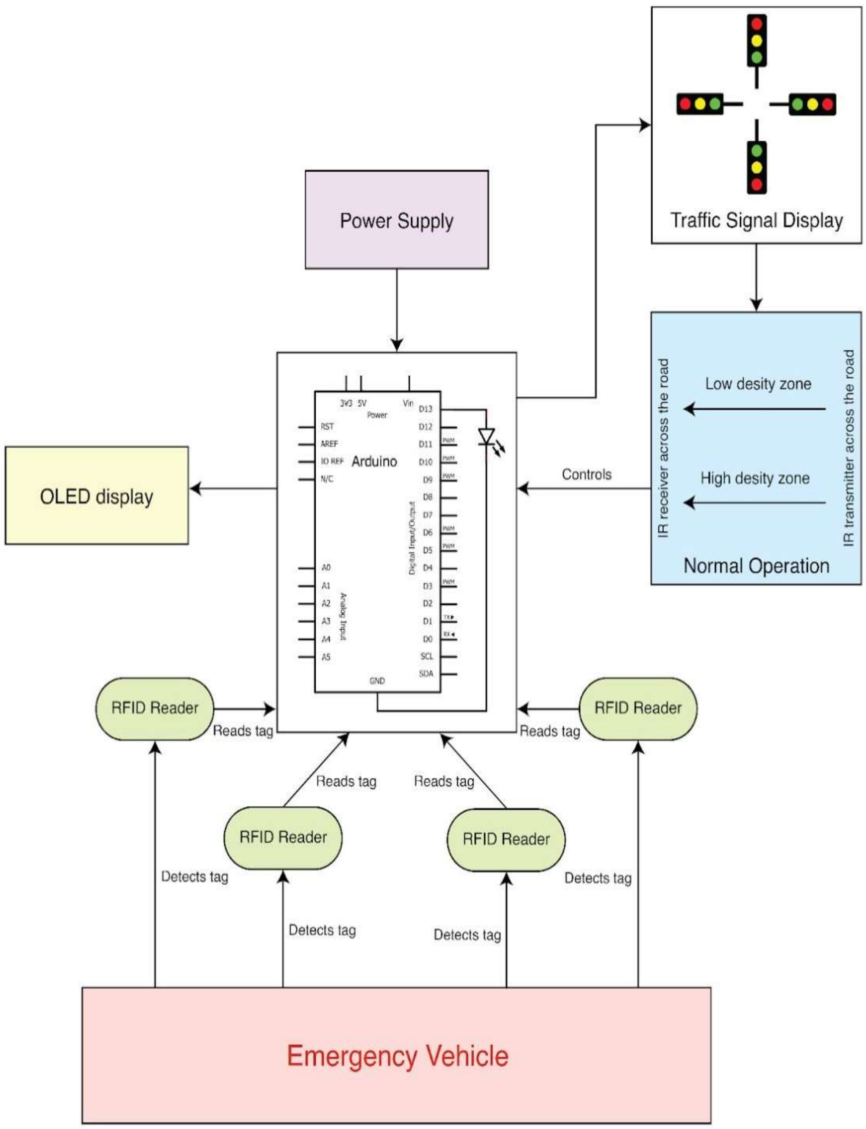


Fig 4.1: System Design

The system design depicts the flow of how a system works while utilizing various devices. The design illustrates how different devices work together to achieve the system's goals and objectives.

The proposed system architecture for efficient traffic control and management consists of several interconnected components that work collaboratively to optimize traffic flow.

At the core of the system architecture are various sensors, cameras, and Internet of Things (IoT) devices strategically placed throughout the road network. These devices collect real-time data on traffic flow, road conditions, and vehicle density.

The central control unit, which serves as the brain of the system, is a microcontroller board known as the Arduino Uno. Built around the ATmega328 microcontroller, this board acts as the interface between different components of the system. It is responsible for receiving and processing data from the sensors, cameras, and other devices. Additionally, it controls the power supply, relays, DC motors, buzzer, and other peripheral components.

To accurately monitor traffic density, the proposed system utilizes ultrasound sensors and image processing techniques. Ultrasound sensors measure the distance between vehicles, enabling the system to calculate the vehicle density on the roads. Live camera feeds provide additional visual information that assists in analyzing traffic patterns and detecting anomalies. To enhance the effectiveness of emergency services, the proposed system incorporates a feature that prioritizes emergency vehicles. When an emergency vehicle is detected, the system can override the regular traffic signal pattern and convert all red lights along its route into green lights. This green corridor ensures that emergency vehicles can reach their destinations quickly and safely, minimizing response times during critical situations.

In addition to the hardware components, the proposed system includes a mobile application for users to access real-time traffic updates and make informed decisions about their routes. The application utilizes the data collected by the system to provide users with accurate and up-to-date information about traffic conditions. Users can receive notifications, alternative route suggestions, and real-time traffic congestion updates, enabling them to plan their journeys more efficiently.

The proposed IoT-based traffic management system leverages advanced technologies, including IoT devices, sensors, cameras, algorithms, and communication networks, to create an efficient and effective traffic management system for smart cities. By optimizing traffic flow, the system aims to reduce congestion, shorten commute times, improve fuel efficiency, and enhance road safety, ultimately contributing to a more sustainable and livable urban environment.

4.2 DATA FLOW DIAGRAM

A data flow diagram (DFD) is a graphical representation of the flow of data through an information system. It is a useful tool for understanding a system and can be effectively used during analysis. A DFD shows how data flows through a system and views the system as a function that transforms inputs into desired outputs. However, any complex system will not perform this transformation in a single step, and data will typically undergo a series of transformations before becoming the output.

With a data flow diagram, users can visualize how the system will operate and what it will accomplish, as well as how it will be implemented. By drawing up old system data flow diagrams and comparing them with new systems' data flow diagrams, users can draw comparisons and implement a more efficient system. Data flow diagrams can also provide the end-user with a physical idea of where the data they input will ultimately have an effect on the structure of the entire system.

4.2.1 Data Flow Diagram - Level 0

At the zero level, the traffic signal project utilizes a microcontroller, such as the ARDUINO processor, which is embedded in the traffic signal itself. The microcontroller serves as the hardware component of the project that processes signals and executes the traffic signal functions. The processor, on the other hand, is the software component of the project that runs on the ARDUINO processor and controls the behavior of the traffic signal.

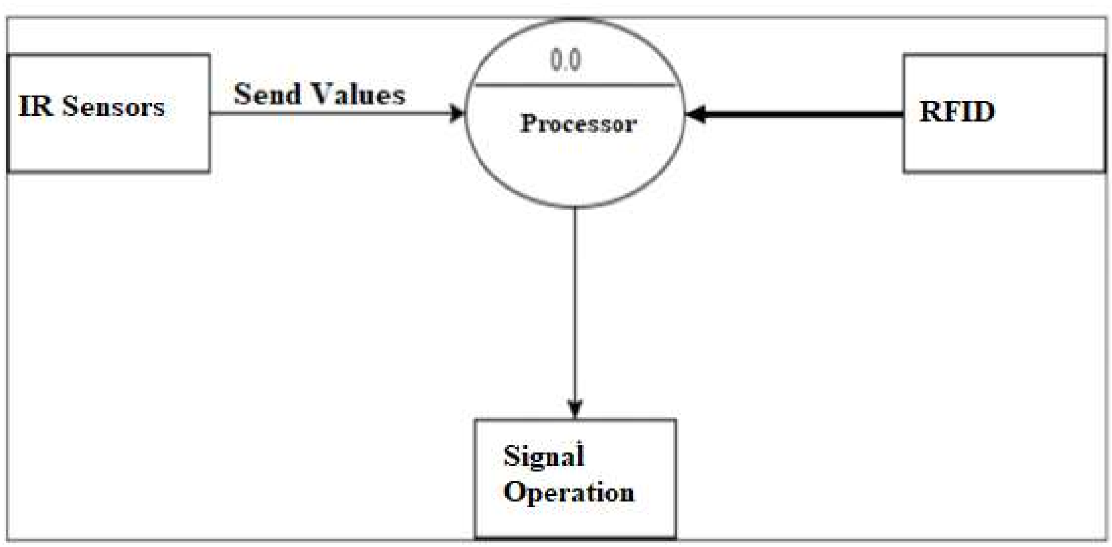


Figure 4.2 DFD level 0

4.2.2 Data Flow Diagram - Level 1

At level 1, the comparison between the reference image and the captured image is performed by a processor. The processor processes the image data and provides input to the system. In the traffic signal project, the ARDUINO processor receives this input from various sources, including RFID and sensors. The ARDUINO processor then uses this input to control the traffic signal and ensure the smooth flow of traffic.

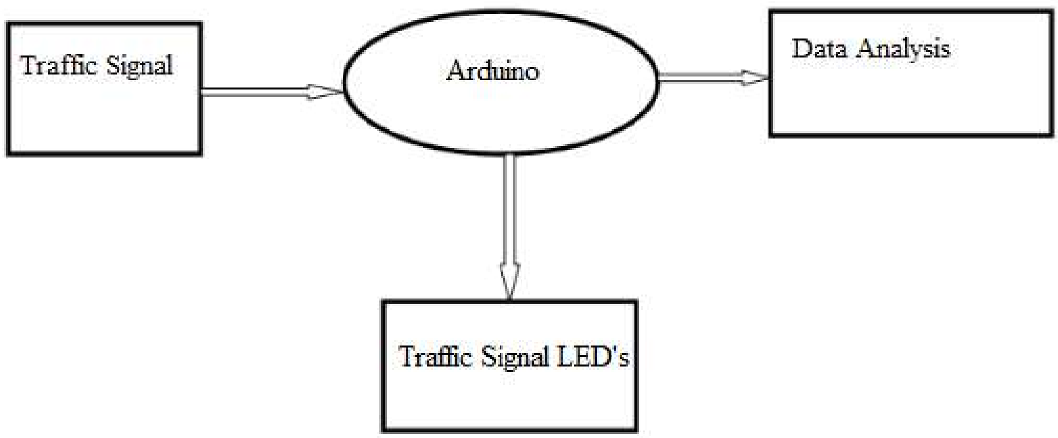


Fig 4.3 DFD level 1

4.4.3 Data Flow Diagram - Level 2

DFD Level 2 takes the traffic monitoring system one step further by providing a more detailed breakdown of the Level 1 components. To fully understand the traffic system's functionalities, it may be necessary to drill down to the Level 2 DFD. The First Level DFD of traffic monitoring provides an overview of how the system is divided into subsystems.

The second-level DFD contains more detailed information about specific aspects of the traffic monitoring system, such as login functionality, vehicle types, diversions, traffic police, length, routes, and traffic conditions. This level also includes specific image processing tasks such as image resizing, RGB to gray conversion, image enhancement, and image matching. By providing more detailed information on the individual components of the traffic monitoring system, the Level 2 DFD enables a deeper understanding of the system's workings.

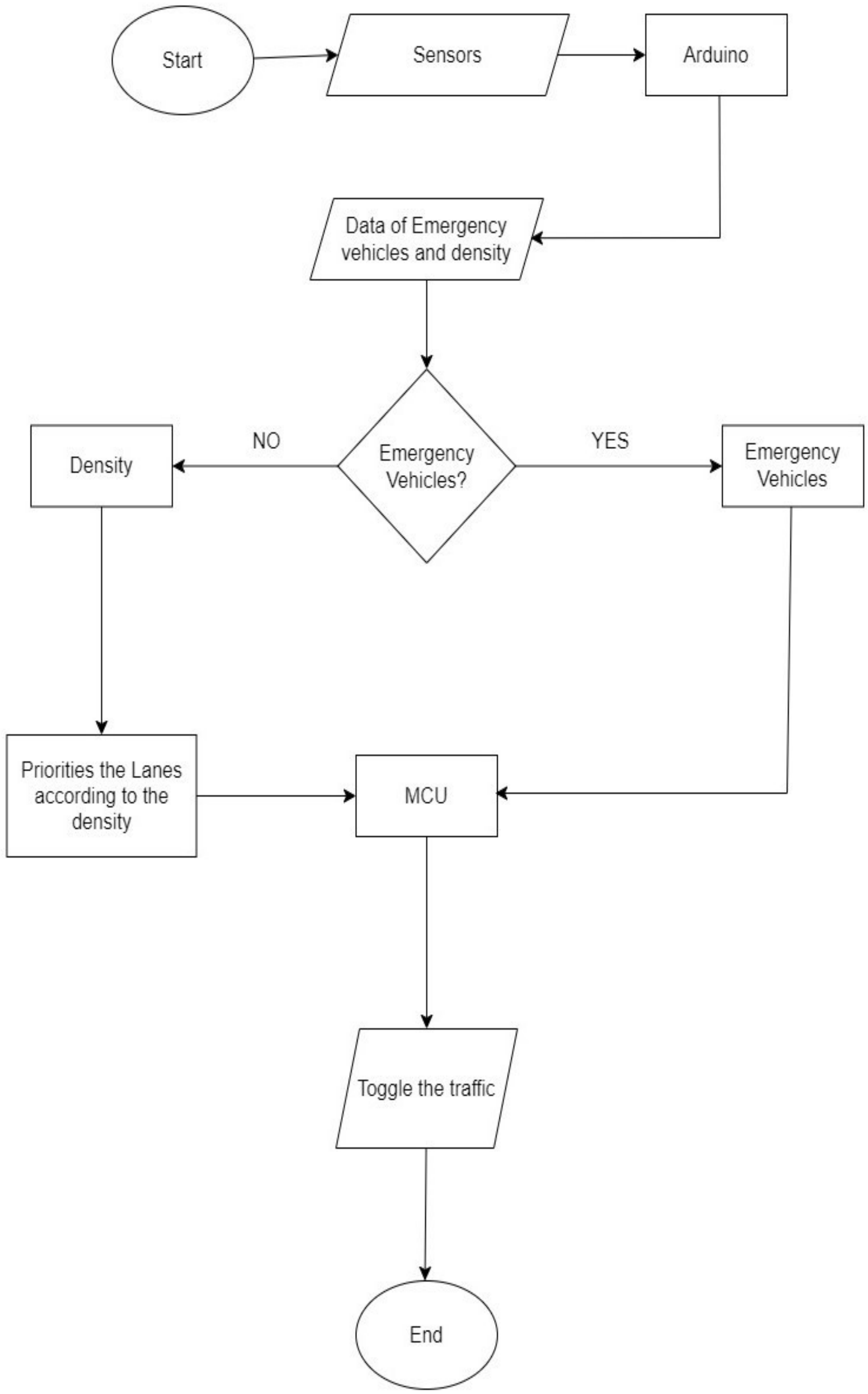


Fig 4.4 DFD level 2

4.3 USE CASE DIAGRAM

An use case diagram represents a user's interaction with the system and illustrates the relationship between the user and the different use cases in which they are involved. Use case diagrams can identify the different types of users of a system and the various use cases, often accompanied by other types of diagrams as well. While a use case itself can drill into a lot of detail about every possibility, a use case diagram provides a higher-level view of the system. It has been said that "Use case diagrams are the blueprints for your system," as they provide a simplified and graphical representation of what the system must actually do.

Having a clear understanding of the user's interaction with the system is essential to design a system that meets the user's requirements. A use case diagram can assist in identifying user needs and desired outcomes, which in turn can inform the development of the system's functionality. By providing a visual representation of the system's use cases, stakeholders can better understand the overall design and functionality of the system, and identify potential areas for improvement or optimization.

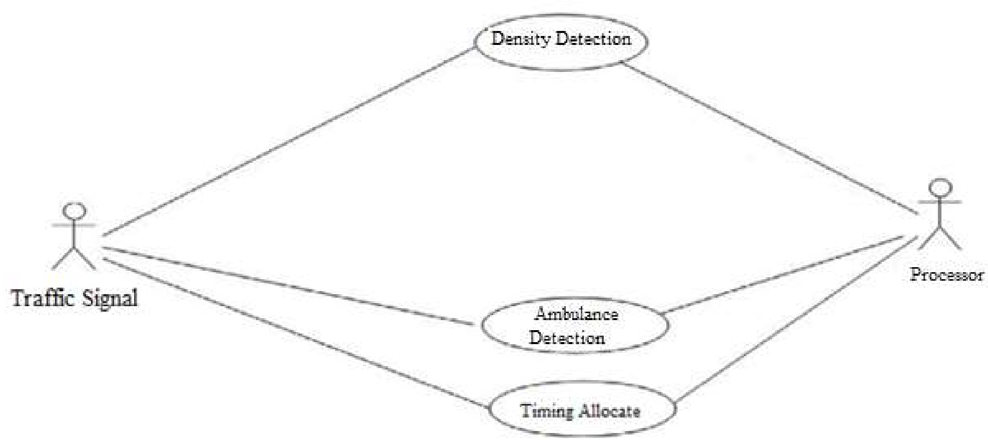


Fig 4.5 USE CASE DIAGRAM

4.4 Class Diagram

A class diagram in unified modified language is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operation, and the relationship among objects. The class diagram is the main building block of object- oriented modelling

It is used for general conceptual modelling of the structure of the application, and for detailed modelling translating the models into programing code. The classes in a class diagram represent both the main elements, interactions in the application and the classes to be programmed.

Traffic control system describes the structure of traffic controller system classes, their attributes, operations and relationship among the objects. Classes of the traffic controller system class diagram are Traffic class, RFID class, IR class, Traffic Police class, OLED class, Traffic light class.

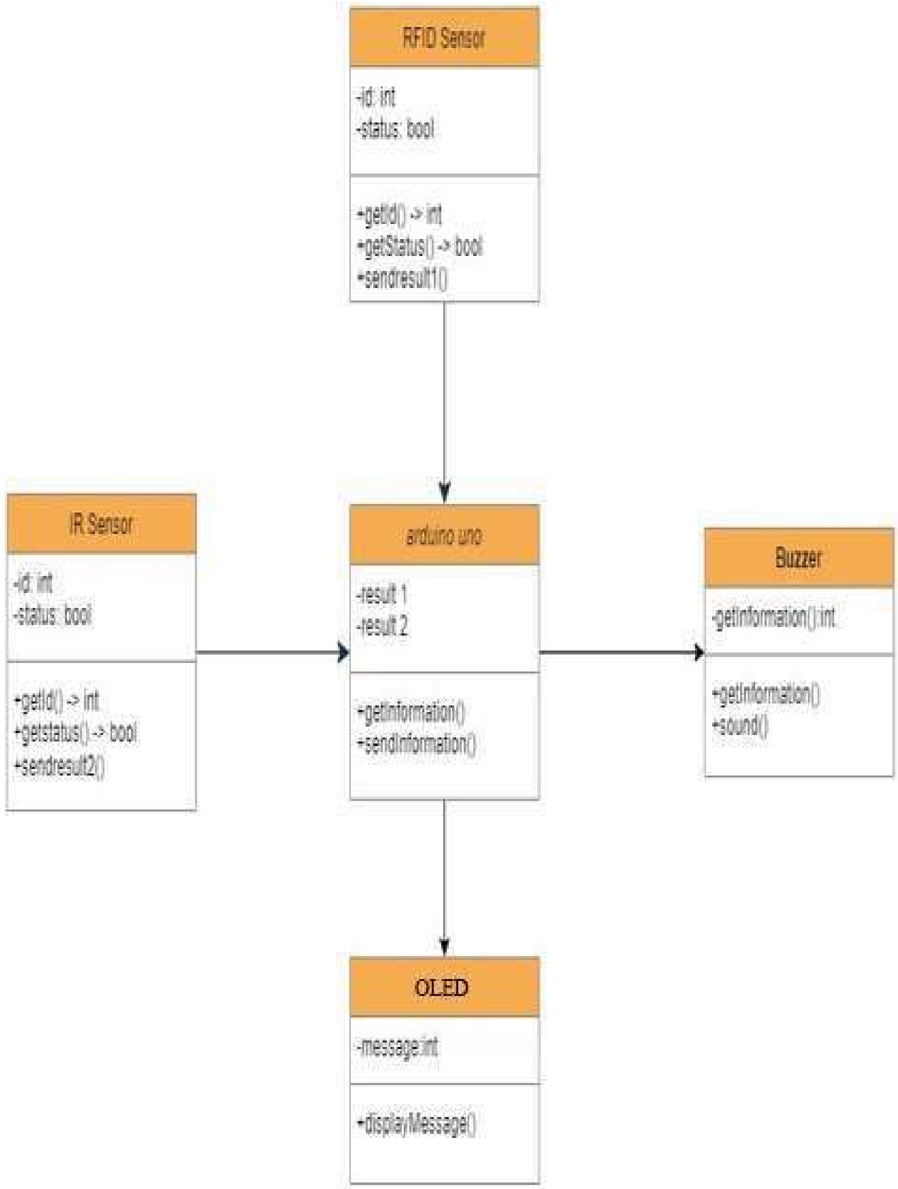


Fig 4.6 Class Diagram

4.5 Sequence Diagram

A sequence diagram in a Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It shows the participants in an interaction and the sequence of messages among them; each participant is assigned a column in a table. Below section shows the sequence diagram in this application.

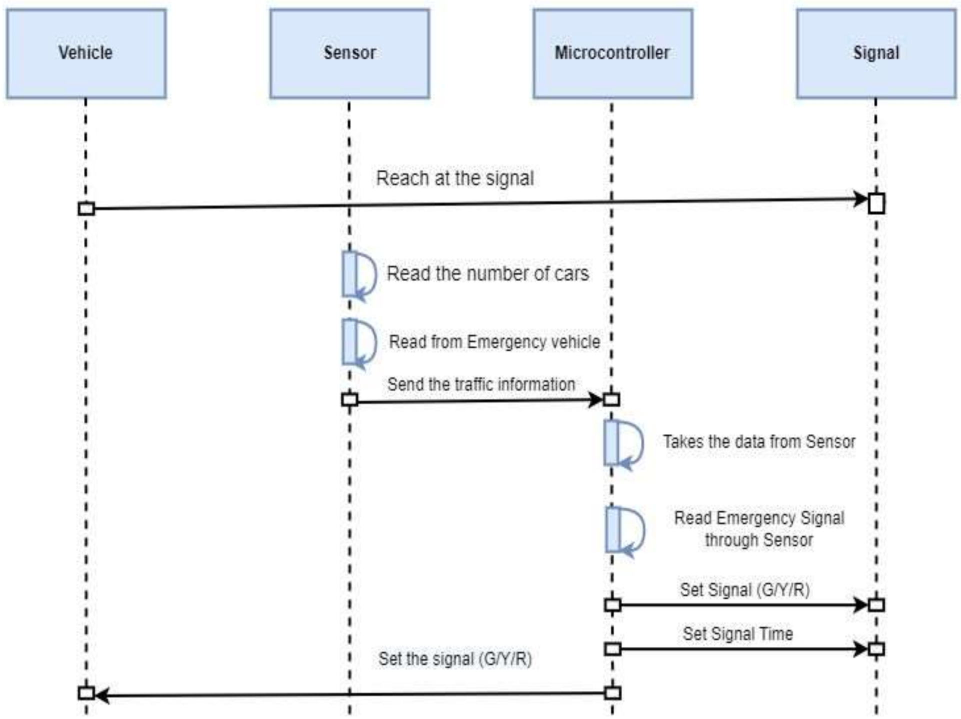


Fig 4.7 Sequence diagram

The sequence diagram illustrates the interactions between various components in an IoT-based traffic management system specifically designed for emergency vehicles. The diagram consists of multiple columns, each representing a different component in the system and showcasing the flow of messages between them. At the top of the diagram, there is a component labeled "Emergency Vehicle" representing the vehicle engaged in an emergency situation. This component initiates the sequence by sending a message to the "RFID Reader" component. The message contains crucial information about the emergency vehicle, such as its current location and intended destination. Upon receiving the message from the Emergency Vehicle, the RFID Reader component processes the information and proceeds to send a message to the "Traffic Signal Controller" component.

This message serves as a notification to adjust the traffic signals in order to facilitate the passage of the emergency vehicle. The Traffic Signal Controller component promptly responds to the message by dynamically altering the signal timings at the relevant intersections to create a green corridor for the emergency vehicle's uninterrupted movement.

Simultaneously, the Traffic Signal Controller component also communicates with the "Traffic Flow Sensor" component. This interaction involves the Traffic Signal Controller providing relevant information about the altered signal timings based on the presence of the emergency vehicle. The Traffic Flow Sensor component, in turn, uses this information to monitor the traffic flow and adjust the signal timing at other intersections accordingly. By dynamically adapting to the traffic conditions, the system ensures efficient traffic management and smooth traffic flow.

In emergency situations, time is of the essence. Every second counts when it comes to saving lives and minimizing the impact of disasters. One of the major challenges faced by emergency responders is navigating through congested traffic to reach their destinations quickly. To address this issue, innovative solutions have been developed using Radio Frequency Identification (RFID) technology to control traffic and provide priority access for emergency vehicles.

RFID technology utilizes radio waves to identify and track objects equipped with RFID tags. These tags contain unique identification information that can be read by RFID readers. By leveraging this technology, it is possible to create an intelligent system that allows emergency vehicles to communicate with traffic infrastructure and gain priority access on the road.

4.6 Major Algorithm

IR Algorithm

```
void ROAD1_IR()

{

 if(digitalRead(IRROAD1) == HIGH)

      {

 }
```

```
delay(2000);

  Serial.println("Object detected on Road 1");

          }
```

RFID

```
Initialize libraries, pins, and variables in setup function

while true:

  if an RFID card is detected:

  if the card matches the first emergency vehicle:

  call the function for the corresponding road

  else if the card matches the second emergency vehicle:

  call the function for the corresponding road

  else if the card matches the third emergency vehicle:

  call the function for the corresponding road

  else:
  set all traffic lights to red
```

Display A Default Message On The OLED Display

```
def function for road 1:

  set traffic lights for road 1  display "ROAD1 MOVEMENT" on OLED display

def function for road 2:

  set traffic lights for road 2  display "ROAD2 MOVEMENT" on OLED display

def function for road 3:

  set traffic lights for road 3  display "ROAD3 MOVEMENT" on OLED display
```

def function for road 4:

set traffic lights for road 4 display "ROAD4 MOVEMENT" on OLED display

Overall Algorithm

1.Include required libraries and define variables for pins and RFID card IDs.

2.Initialize the OLED display and print the startup message.

3.Set the pin modes for LEDs and IR sensors.

4.Set up the serial communication for the RFID reader.

5.Enter the main loop.

6.Check for a valid RFID card ID.

7.If the card is valid, determine which road to enable and turn off the other roads' green LEDs.

8.Display the road's movement on the OLED display.

9.Turn on the green LED for the selected road and turn off the red LED.

10.Wait for a certain time, during which the IR sensors will detect if any vehicles are present.

11.If a vehicle is detected, sound the buzzer.

12.Wait for another period of time before switching the traffic lights back to red for all roads.

13.Clear the OLED display.

14.Repeat from step 6.

Chapter 5

IMPLEMENTATION

CHAPTER 5

SYSTEM IMPLEMENTATION

5.1 Hardware :

The key idea is based on the principle of RFID tracking of vehicles. RFID technology uses digital data within RFID tag. The RFID tags contain an integrated electromagnetic circuit along with antenna for transmitting and receiving RF signals. RFID tag uses electromagnetic signals to identify and track the tags that are attached to vehicle automatically. The tags contain electronically saved information. Passive tags gain energy from a nearby RFID reader's interrogating radio waves. Active tags have their own power source such as a battery and may operate at hundreds of meters from the RFID reader.

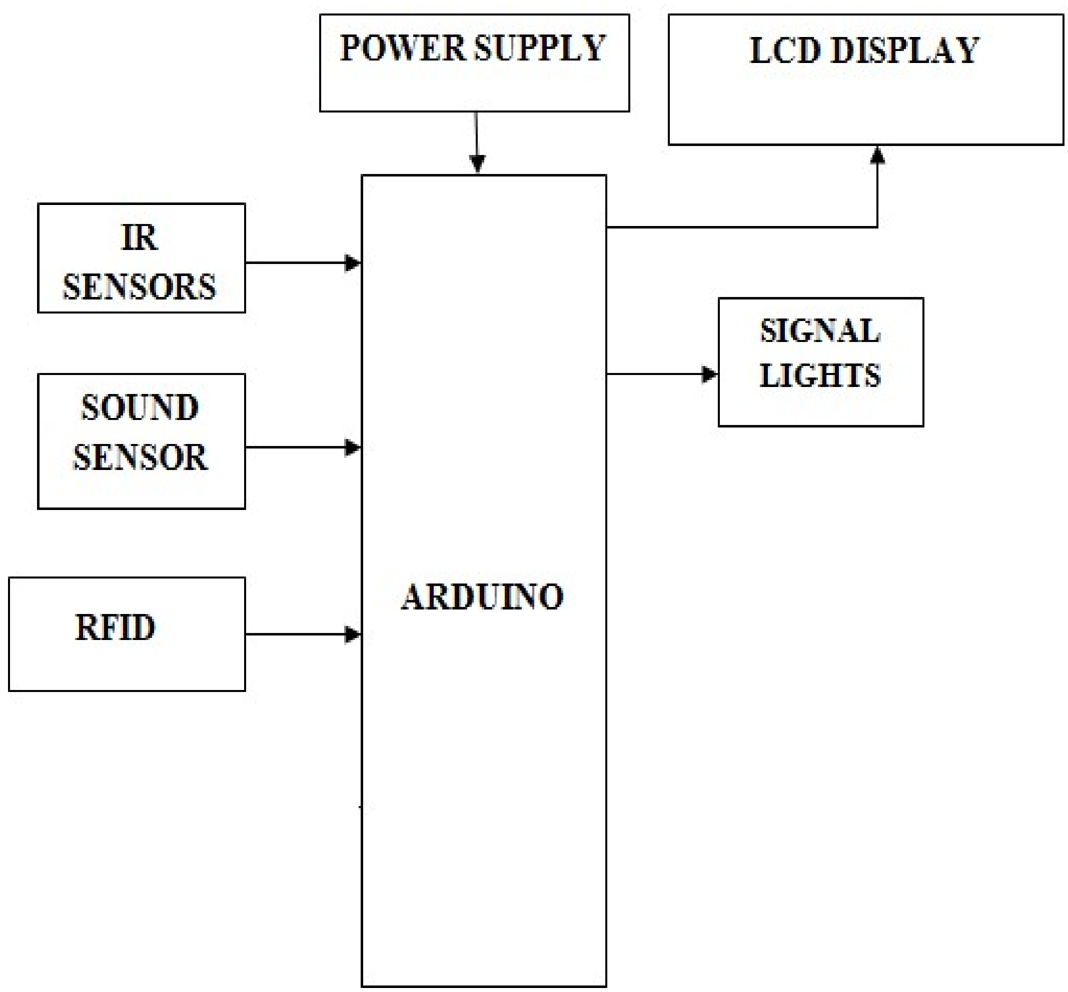


Figure 5.1: Hardware Implementation

For example, When the emergency ambulance arrives at any traffic post, the traffic signals automatically prevent the signals giving transmitter and the IR receiver is at the border a few meters away. The receiver receives the signal and the module sends the command to turn green through the RF IOT Based Traffic Management System For Emergency Vehicles and each traffic post has an RF receiver. So whenever the ambulance approaches the traffic, the ambulance transmits a code saying "emergency" the receiver receives this signal. Then it switches off the other signal instantly, i.e., it turns all the signals red and then makes way for the ambulance by signaling green.

Suggested strategy focuses on monitoring traffic density through IR sensors and communicating data to the comparator, then digitizing output. IR sensors (Infrared Sensor) which works on the principle that when a vehicle passes between IR transmitter and IR receiver.

Arduino:

Arduino Uno is a microcontroller board based on theATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

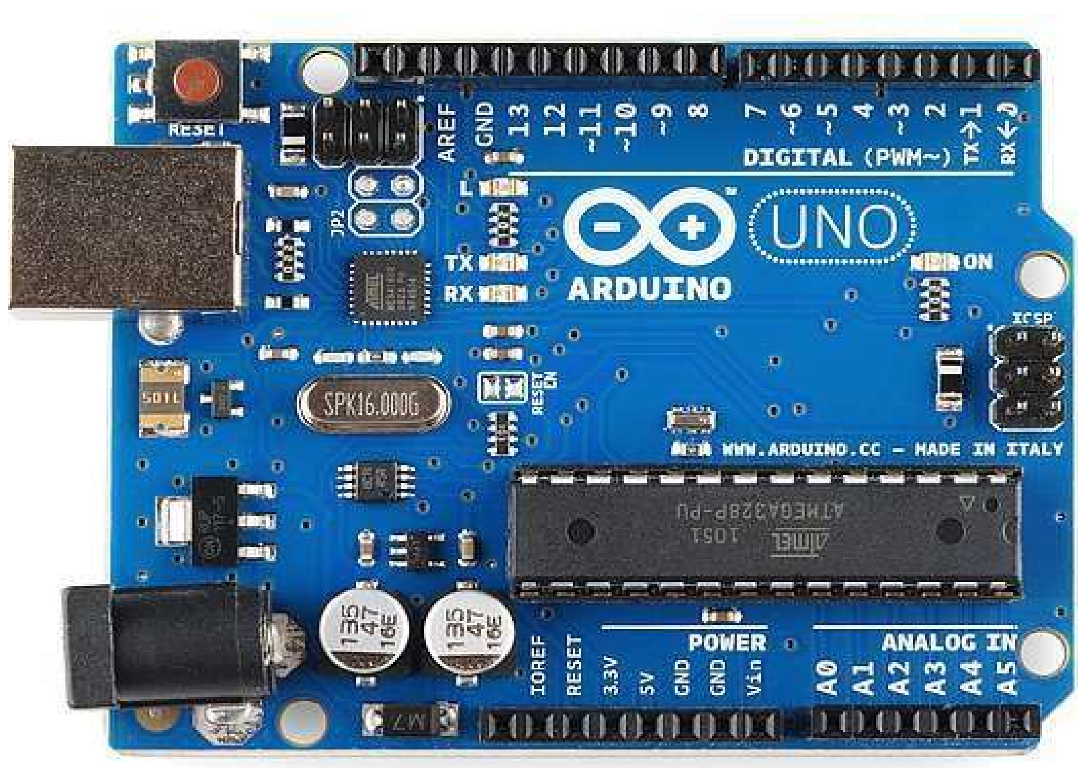


Figure 5.2: Arduino UNO

It contains everything needed to support the microcontroller simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Table 5.1: Arduino Specification

Microcontroller	ATmega328P
Operating Voltage	5v
Input voltage	7-12v
Input voltage limit	6-20v
Digital I/O Pins	6
Analogue input Pins	6
DC current per I/O pins	20 mA
DC current for 3.3v Pin	50 mA
Flash Memory	Of which o.5KB is used
SRAM	2 KB
EEPROM	1KB
Clock Speed	16MHz
Length	68.6mm
Width	53.4nm
Weight	25g

Arduino Programming:

The Arduino Uno can be programmed with the (Arduino Software (IDE)).Select "Arduino Uno from the Tools>Board menu (according to the microcontroller on your board).

The ATmega328 on the Arduino Uno comes preprogrammed with a boot loader that allows us to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. We can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then rese ingthe8U2.
- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

Warnings:

The Arduino Uno has a resettable polyfused that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

Differences with other boards:

The Arduino Uno board has some notable differences from previous Arduino boards, one of which is that it does not use the FTDI USB-to-serial driver chip. This is a significant change as FTDI chips were previously used in all previous Arduino boards for serial communication with a computer. Instead, the Uno features the Atmega16U2 chip (or the Atmega8U2 for earlier revisions up to version R2), which is programmed as a USB-to-serial converter.

This change in USB-to-serial communication allows the Uno board to be more versatile and compatible with a wider range of devices, including newer operating systems. The Atmega16U2 chip can be reprogrammed to act as a variety of different USB devices, such as a keyboard, mouse, or MIDI controller. Additionally, the use of the Atmega16U2 chip frees up additional I/O pins on the board, which can be used for other purposes.

Overall, the use of the Atmega16U2 chip in the Arduino Uno board represents a significant improvement over previous Arduino boards, making it more versatile, compatible, and adaptable to a wider range of applications.

The ATmega328 on the Arduino Uno comes preprogrammed with a boot loader that allows us to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol

Power:

The Arduino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and VIN pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12volts.

The power pins are as follows:

- VIN: The input voltage to the Arduino UNO board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). One can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V: This pin outputs a regulated 5Vfrom the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don’t advise it.
- 3V: A 3.3 volt supply generated by the on-board regulator. Maximum current
- draw is 50 mA.
- GND: Ground pins.
- IOREF: This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.[1]

Memory:

The Arduino Uno board features an ATmega328 microcontroller, which has a memory capacity of 32 KB (with 0.5 KB occupied by the bootloader). This memory capacity allows for the storage and execution of complex programs and applications.

In addition to the program memory, the ATmega328 also has 2 KB of SRAM, or Static Random Access Memory, which is used for storing data that is frequently accessed by the microcontroller. SRAM is much faster than other types of memory, such as EEPROM or flash memory, and can be read or written to very quickly.

The ATmega328 also has 1 KB of EEPROM, or Electrically Erasable Programmable Read-Only Memory. EEPROM is non-volatile memory that can be read from or written to multiple times, making it useful for storing data that needs to be retained even when the power is turned off. The EEPROM library can be used to read and write data to the EEPROM memory.

Overall, the memory capabilities of the ATmega328 microcontroller on the Arduino Uno board allow for the execution of complex programs and applications, as well as the storage and retrieval of data, making it a versatile and powerful tool for a wide range of projects and applications.

Input &Output:

Each of the 14 digital pins on the Uno can be used as an input or output, using pin mode(), digital write (), and digital read () functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull- up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mAis the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach interrupt () function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog write () function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

- LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog reference ()function.

There are a couple of other pins on the board:

- AREF: Reference voltage for the analog inputs. Used with analog Reference().
- Reset: Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

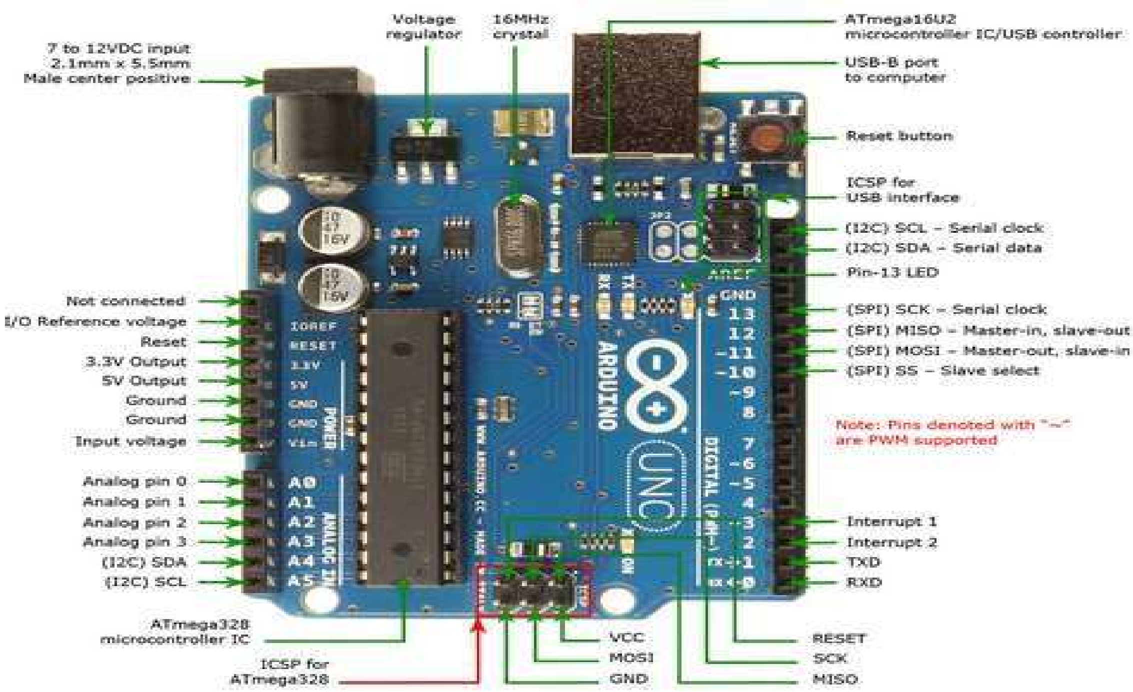


Figure 5.3: Pin Specification

Communication:

Arduino UNO has a number of facilities for communicating with a computer, another Arduino/Genuinoboard,orothermicrocontrollers.TheATmega328provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX).

An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and1).

A Software serial library allows serial communication on any of the Uno's digital pins. The ATmega328alsosupports I2C(TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus; seethe documentation for details. For SPI communication, use the SPI library.

Automatic (Software) Reset:

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nano-farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the boot loader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line.

Regulated power supply:

A regulated power supply is an important component in an IoT-based traffic management system for emergency vehicles as it ensures that the system operates correctly and reliably. It provides a steady voltage output, regardless of input voltage or load current variations, which is necessary for many electronic components to function properly. The power supply must be efficient and reliable while being capable of supplying the required voltage and current levels to each component of the system, including the microcontroller, sensors, wireless communication module, and other peripherals. A switching power supply is a common type of regulated power supply used in IoT applications due to its efficiency and lightweight nature, making it ideal for portable or battery-powered applications.

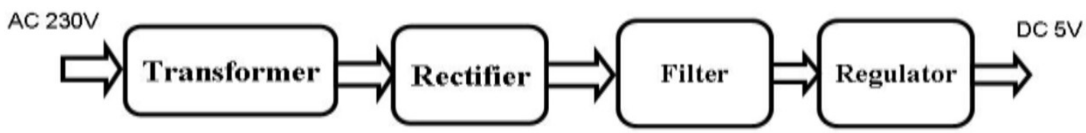


Figure 5.4: Regulated Power Supply

1) Transformer:

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors without changing its frequency. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction. If a load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. This field is made up from lines of force and has the same shape as a bar magnet. If the current is increased, the lines of force move outwards from the coil. If the current is reduced, the lines of force move inwards. If another coil is placed adjacent to the first coil then, as the field moves out or in, the moving lines of force will "cut" the turns of the second coil. As it does this, a voltage is induced in the second coil. With the 50 Hz AC mains supply, this will happen 50 times a second. This is called MUTUAL INDUCTION and forms the basis of the transformer.

2) Rectifier:

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid-state diodes, vacuum tube diodes, mercury arc valves, and other components. A device that it can perform the opposite function (converting DC to AC) is known as an inverter. When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper (I) oxide or selenium rectifier stacks were used.

3) Filter:

The process of converting a pulsating direct current to a pure direct current using filters is called as filtration. Electronic filters are electronic circuits, which perform signal-processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones.

4) Regulator:

A voltage regulator (also called a ‗regulator') with only three terminals appears to be a simple device, but it is in fact a very complex integrated circuit. It converts a varying input voltage into a constant ‗regulated 'output voltage. Voltage Regulators are available in a variety of outputs like 5V, 6V, 9V, 12V and 15V. The LM78XX series of voltage regulators are designed for positive input. For applications requiring negative input, the LM79XX series is used. Using a pair of ‗voltage-divider' resistors can increase the output voltage of a regulator circuit. It is not possible to obtain a voltage lower than the stated rating. You cannot use a 12V regulator to make a 5V power supply. Voltage regulators are very robust. These can withstand over-current draw due to short circuits and also over-heating. In both cases, the regulator will cut off before any damage occurs. The only way to destroy a regulator is to apply reverse voltage to its input. Reverse polarity destroys the regulator almost instantly.

Emergency switch :

An emergency switch, also known as a kill switch or e-stop, is a safety mechanism that immediately shuts down machinery or equipment in emergency situations. It is used in industrial settings to prevent accidents or injuries that may occur due to malfunction or unexpected operation. The switch is easily accessible to workers and can take the form of a push-button, toggle switch, or pull cord. Regular testing and maintenance are necessary to ensure proper function and prevent safety hazards.

Monochrome 1.3 Inch 128X64 OLED Graphic Display:

A monochrome 1.3 inch 128x64 OLED graphic display is a small screen that can display graphics and text in a black and white format. The OLED (organic light-emitting diode) technology used in this display provides high contrast, wide viewing angles, and low power consumption, making it a popular choice for various applications such as wearable devices, IoT devices, and small embedded systems.

1. Supply voltage: 3.3V-5V
2. Pixel: 128*64
3. Display size- 0.96 inch
4. Operating temperature range: -40ºC - +80ºC
5. Use I2C Interface
6. Chip No: SSD1306
7. Colour: white
8. Drive Duty: 1/64 Duty
9. Supported platforms: For Arduino,51 series, MSP430 series, STIM32/2, SCR chips

Figure 5.5 OLED Graphic Display

Advantages:

1. Super high contrast and brightness(adjustable)
2. Only need 2 I/O port to control
3. Low power consumption
4. High contrast, thus supporting clear display with no need of backlight
5. For OLED SSD1306, a more elaborate and beautiful screen than LCD with more functions

IR Sensor:

An IR (Infrared) sensor is an electronic device which can be used to sense certain parameters of its surroundings by either emitting or detecting radiations. It can also measure heat of an object and detect motion. It uses the infrared light to sense objects in front of them and map or guess their distance.

IR Sensor module has great adaptive capability of the ambient light, having a pair of infrared transmitter and the receiver tube, the infrared emitting tube to emit a certain frequency, encounters an obstacle detection direction (reflecting surface), infrared reflected back to the receiver tube receiving, after a comparator circuit processing, the green LED lights up, while the signal output will output digital signal (a low-level signal), through the potentiometer knob to adjust the detection distance.

The effective distance range 2 ~ 10cm working voltage of 3.3V-5V. The detection range of the sensor can be adjusted by the potentiometer, with little interference, easy to assemble, easy to use features, can be widely used robot obstacle avoidance, obstacle avoidance car assembly line count and black-and-white line tracking and many other occasions.

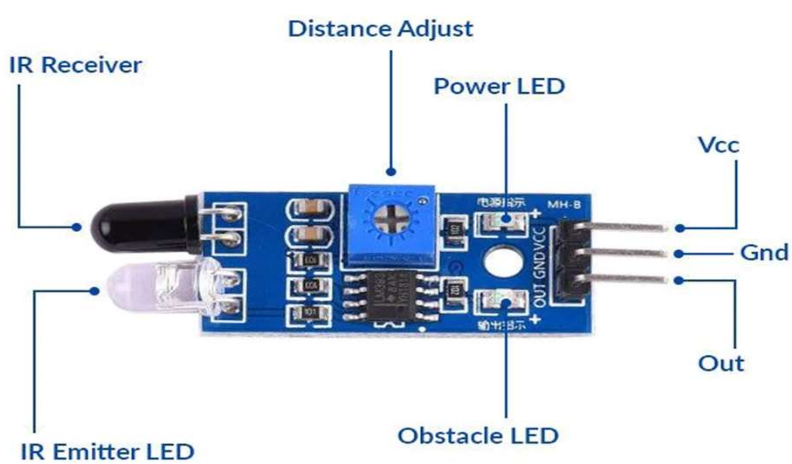


Figure 5.6 : Infrared Sensor

We have to place these IR pair in such a way that when we place an obstacle in front of this IR pair, IR receiver should be able to receive the IR rays. When power is supplied, the transmitted IR rays hit the object and reflect back to the IR receiver.

Instead of traffic lights, we have used LEDs (RED, GREEN, YELLOW). In normal traffic system, you have to glow the LEDs on time basis. If the density of traffic is high on any particular lane, then glows green LED of that particular lane and glows the red LEDs for remaining lanes

Overview of RFID :

Radio frequency Identification i.e. RFID is a wireless identification technology that uses radio waves to identify the presence of RFID tags. Just like Bar code reader, RFID technology is used for identification of people, object etc. presence. FID is used in many applications like attendance system in which every person will have their separate RFID tag which will help identify person and their attendance. FID is used in many companies to provide access to their authorized employees. It is also helpful to keep track of goods and in automated toll collection system on highway by embedding Tag (having unique ID) on them.

RFID based system has two basic elements:

1. RFID Tag:

RFID tag includes microchip with radio antenna mounted on substrate which carries 12 Byte unique Identification number.

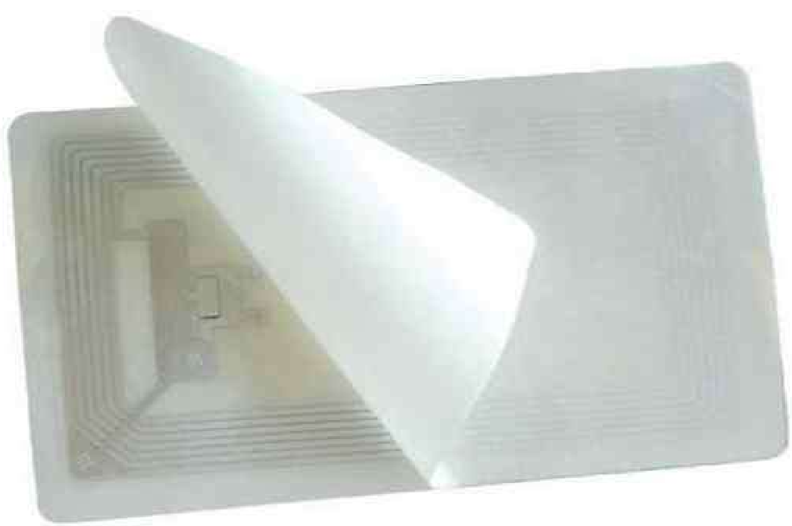


Figure 5.7: RFID Tag

2. RFID Reader:

It is used to read unique ID from RFID tags. Whenever RFID tags comes in range, RFID reader reads its unique ID and transmits it serially to the microcontroller or PC. RFID reader has transceiver and an antenna mounted on it. It is mostly fixed in stationary position.

Figure 5.8: RFID Reader

RFID Reader has transceiver which generates a radio signal and transmits it through antenna. This signal itself is in the form of energy which is used to activate and power the tag. When RFID tag comes in range of signal transmitted by the reader, transponder in the tag is hit by this signal. A tag draws power from the electromagnetic field created by reader. Then, the transponder converts that radio signal into the usable power. After getting power, transponder sends all the information it has stored in it, such as unique ID to the RFID reader in the form of RF signal. Then, RFID reader puts this unique ID data in the form of byte on serial Tx (transmit) pin. This data can be used or accessed by PC or microcontroller serially using UART communication.

EM18 RFID Reader:

EM18 is a RFID reader which is used to read RFID tags of frequency 125 kHz.
After reading tags, it transmits unique ID serially to the PC or microcontroller using UART communication or Wiegand format on respective pins.
EM18 RFID reader reads the data from RFID tags which contains stored ID which is of 12 bytes.
EM18 RFID reader doesn't require line-of-sight. Also, it has identification range which is short i.e. in few centimetres.

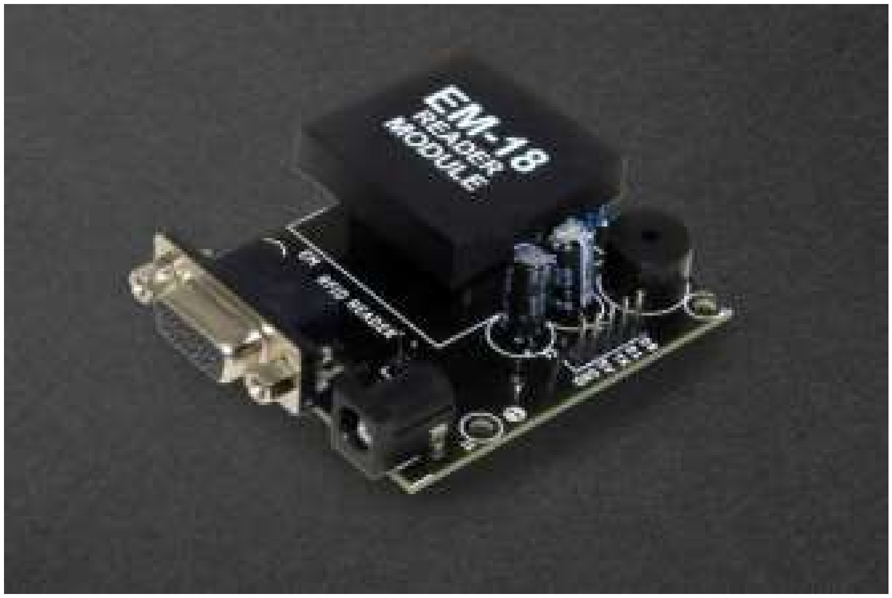


Figure 5.9 : EM18 RFID Reader

RFID reader EM-18 features:

1. Serial RS232/TTL output
2. Operating Frequency is 125KHz.
3. Range is 5-8 cm.

Specification of RFID EM18:

1. Operating frequency: 125kHz
2. Operating voltage: DC 5V
3. Supply current: <50mA
4. Read distance: up to 100mm (depending on the tag used)
5. Interface: UART (TTL level)
6. Dimensions: 40mm x 40mm x 16mm
7. Communication protocol: UART
8. Baud rate: 9600, 8, N, 1

5.2 SOFTWARE

5.2.1 SOFTWARE REQUIRMENTS

Arduino IDE

Arduino is an open-source prototype platform based on easy-to-use hardware and software. It comprises a circuit board, which can be programmed (referred to as a microcontroller), and ready-made software called Arduino IDE (Integrated Development Environment), used to write and upload computer code to the physical board.

Arduino provides a standard form factor that breaks down the functions of the micro-controller into a more accessible package. A program for Arduino can be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio, and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting. Additionally, it provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions, and a hierarchy of operation menus.

A program written with the IDE for Arduino is called a sketch. Sketches are saved on the development computer as text files with the file extension .ino. The Arduino Software (IDE) pre-1.0 saved sketches with the extension .pde.

The Arduino IDE supports the languages C and C++ using special rules of code structuring.

The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions for starting the sketch and the main program loop, which are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.

A minimal Arduino C/C++ sketch, as seen by the Arduino IDE programmer, consists of only two functions:

• setup(): This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch.

• loop(): After setup() has been called, the function loop() is executed repeatedly in the main program. It controls the board until the board is powered off or reset.

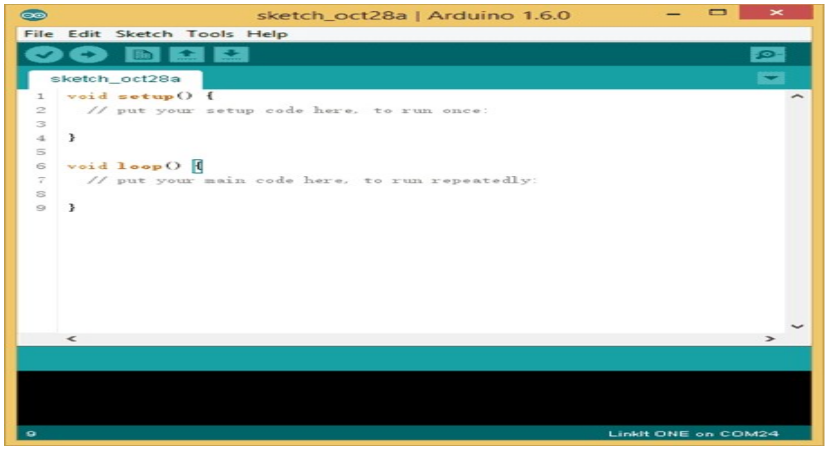


Figure 5.10 : Sketch Area

Arduino - Installation

After learning about the main parts of the Arduino UNO board, we are ready to learn how to set up the Arduino IDE. Once we learn this, we will be ready to upload our program to the Arduino board.

In this section, we will learn how to set up the Arduino IDE on our computer and prepare the board to receive the program via USB cable, in easy steps.

Step 1: First, you must have your Arduino board (you can choose your favorite board) and a USB cable. In case you use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, you will need a standard USB cable (A plug to B plug), the kind you would connect to a USB printer, as shown in the following image. In case you use Arduino uno, you will need an A to Mini-B cable instead, as shown in the following image

Figure 5.11 :Standard USB Cable

Step 2: Download the Arduino IDE Software.

You can get different versions of Arduino IDE from the Download page on the Arduino Official website. You must select the software that is compatible with your operating system (Windows, iOS, or Linux). After your file download is complete, unzip the file.

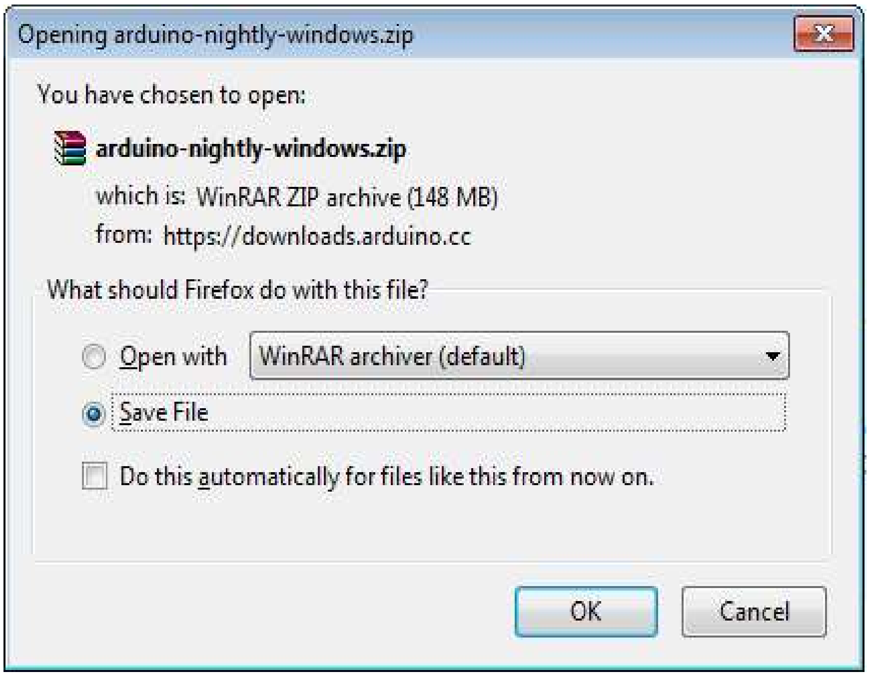


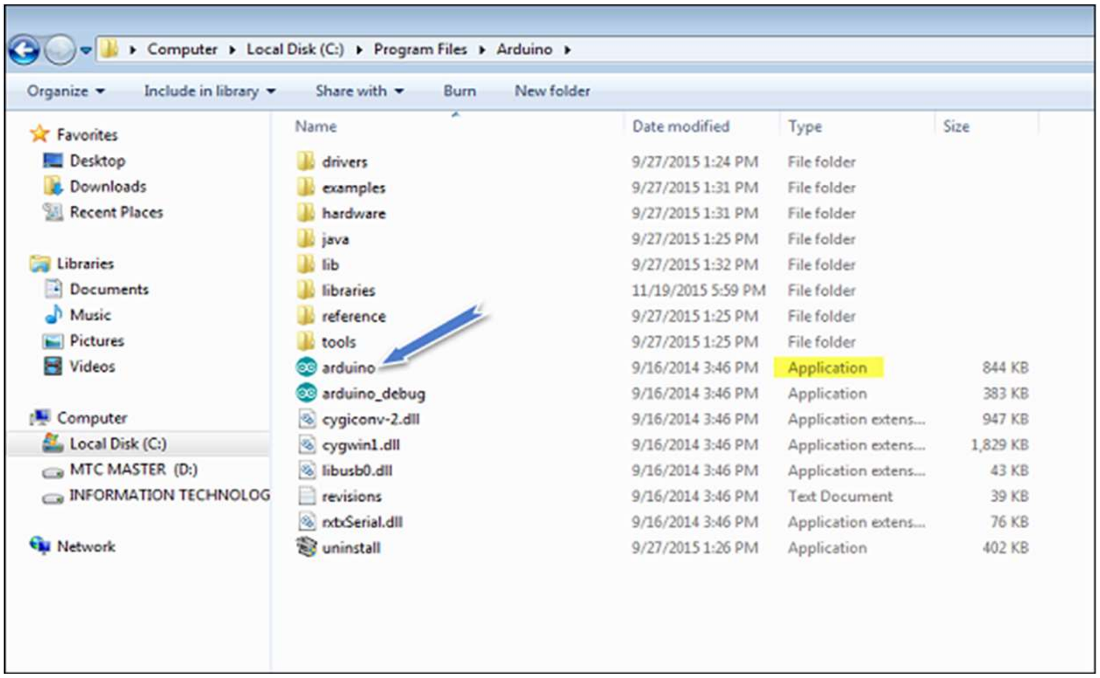
Figure 5.12 : Installation Dialog Box

Step 3: Power up your board.

The Arduino Uno, Mega, Duemilanove, and Arduino Nano automatically draw power from either the USB connection to the computer or an external power supply. If you are using an Arduino Diecimila, you have to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it is on the two pins closest to the USB port. Connect the Arduino board to your computer using the USB cable. The green power LED (labeled PWR) should glow.

Step 4: Launch the Arduino IDE.

After your Arduino IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Double-click the icon to start the IDE.

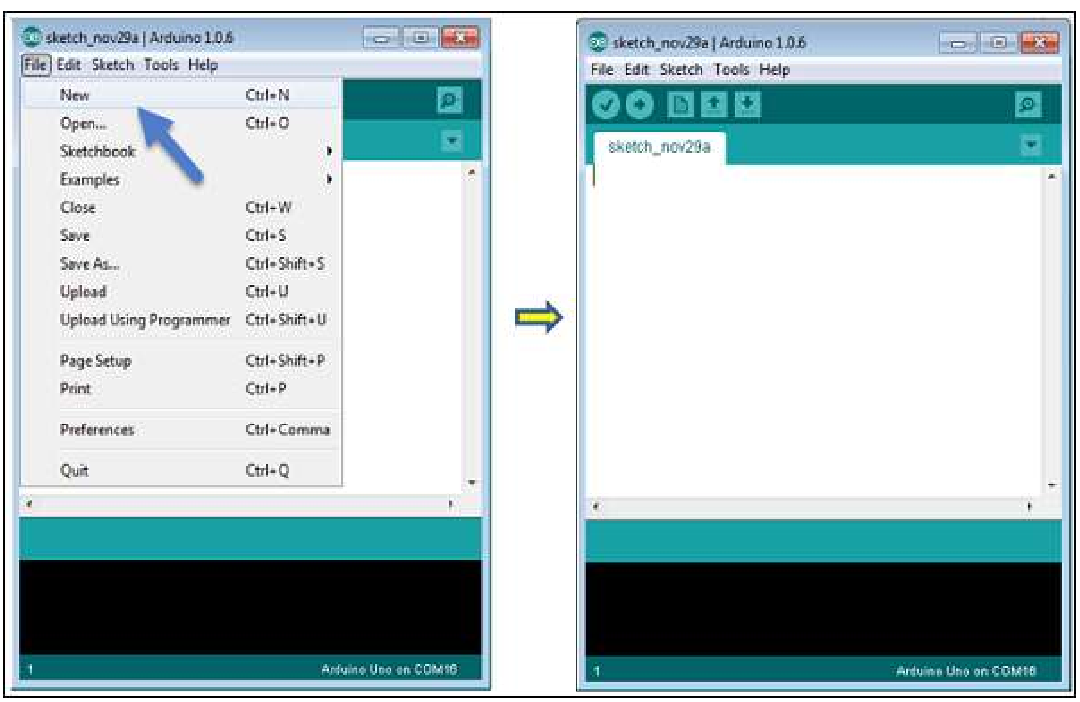


Step 5 − Open your first project.

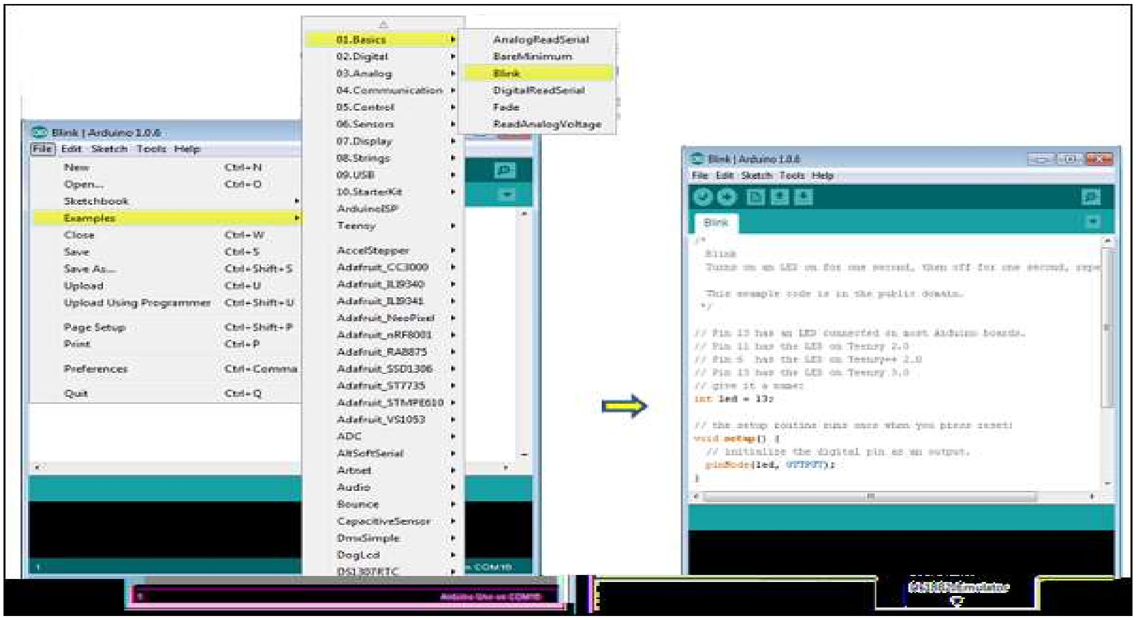
Once the software starts, you have two options −

- Create a new project.
- Open an existing project example.

To create a new project, select File → **New**.



To open an existing project example, select File → Example → Basics → Blink.

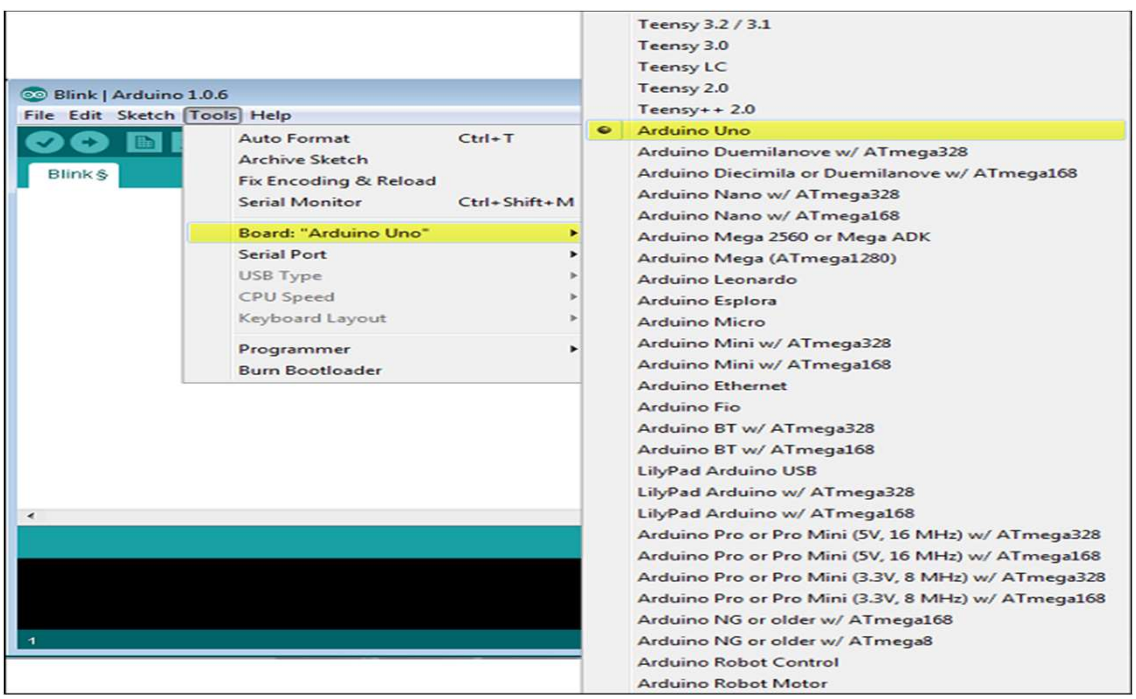


Here, we are selecting just one of the examples with the name **Blink**. It turns the LED on and off with some time delay. You can select any other example from the list.

Step 6 − Select your Arduino board.

To avoid any error while uploading your program to the board, you must select the correct Arduino board name, which matches with the board connected to your computer.

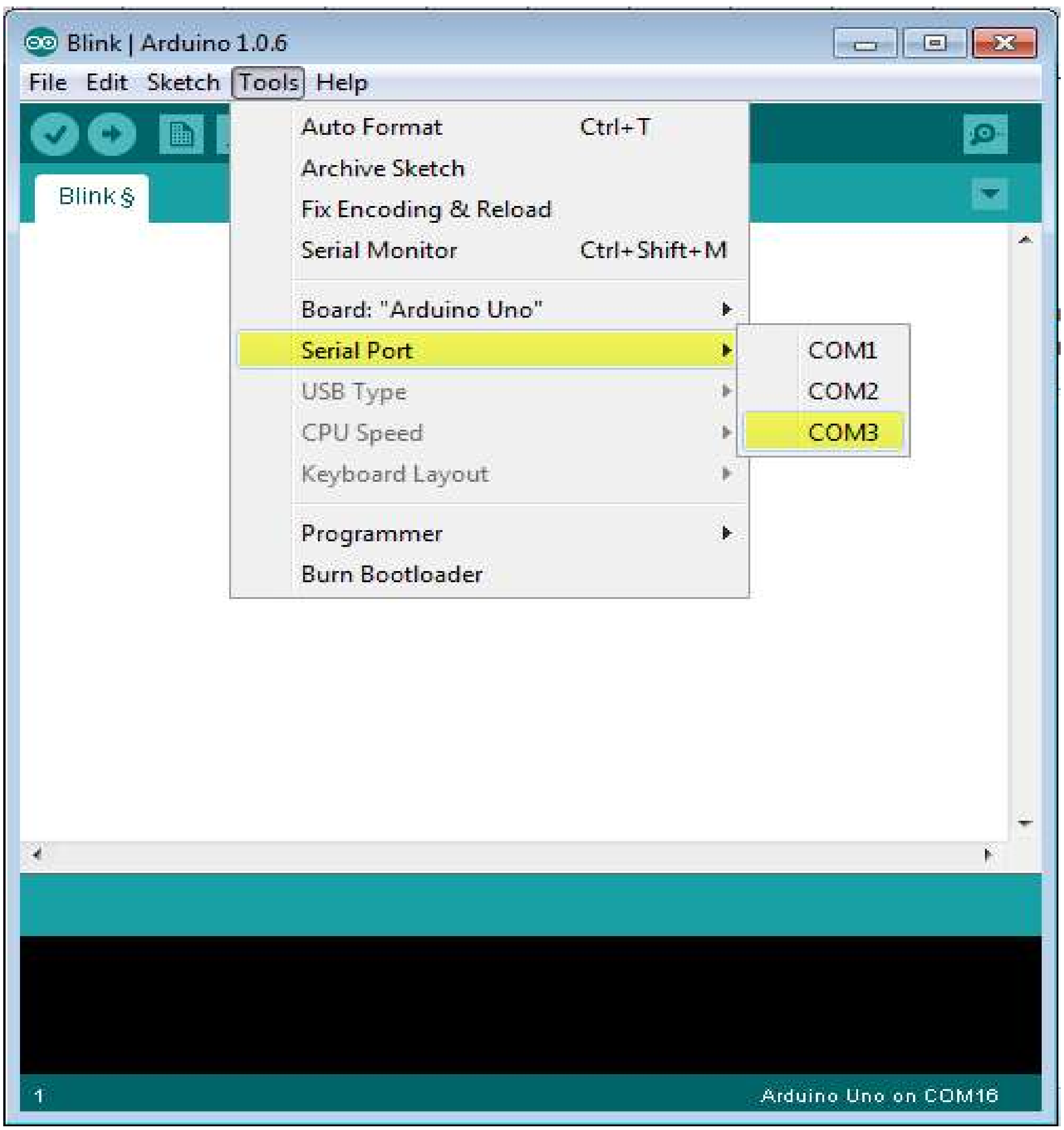
Go to Tools → Board and select your board.



Here, we have selected Arduino Uno board according to our tutorial, but you must select the name matching the board that you are using.

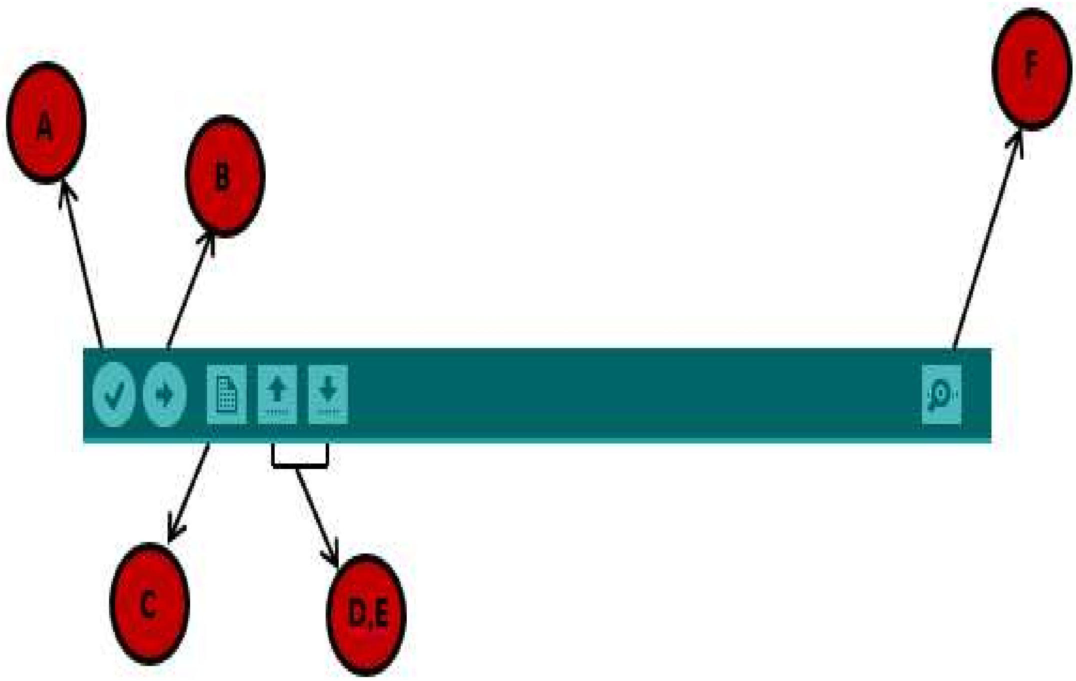
Step 7 − Select your serial port.

Select the serial device of the Arduino board. Go to **Tools** → **Serial Port** menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.



Step 8 − Upload the program to your board.

Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.



A − Used to check if there is any compilation error.

B − Used to upload a program to the Arduino board.

C − Shortcut used to create a new sketch.

D − Used to directly open one of the example sketch.

E − Used to save your sketch.

F − Serial monitor used to receive serial data from the board and send the serial data to the board.

Now, simply click the "Upload" button in the environment. Wait a few seconds; you will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message "Done uploading" will appear in the status bar.

Note − If you have an Arduino Mini, NG, or other board, you need to press the reset button physically on the board, immediately before clicking the upload button on the Arduino Software.

Embedded C:

Embedded C is one of the most popular and most commonly used Programming Languages in the development of Embedded Systems.

Embedded C is perhaps the most popular languages among Embedded Programmers for programming Embedded Systems. There are many popular programming languages like Assembly, BASIC, C++ etc. that are often used for developing Embedded Systems but Embedded C remains popular due to its efficiency, less development time and portability.

What is an Embedded System?

An Embedded System can be best described as a system which has both the hardware and software and is designed to do a specific task. A good example for an Embedded System, which many households have, is a Washing Machine.

Embedded Systems can not only be stand-alone devices like Washing Machines but also be a part of a much larger system. An example for this is a Car. A modern day Car has several individual embedded systems that perform their specific tasks with the aim of making a smooth and safe journey.

Some of the embedded systems in a Car are Anti-lock Braking System (ABS), Temperature Monitoring System, Automatic Climate Control, Tyre Pressure Monitoring System, Engine Oil Level Monitor, etc.

Programming Embedded Systems

As mentioned earlier, Embedded Systems consists of both Hardware and Software. If we consider a simple Embedded System, the main Hardware Module is the Processor. The Processor is the heart of the Embedded System and it can be anything like a Microprocessor, Microcontroller, DSP, CPLD (Complex Programmable Logic Device) and FPGA (Field Programmable Gated Array).

All these devices have one thing in common: they are programmable i.e. we can write a program (which is the software part of the Embedded System) to define how the device actually works.

Embedded Software or Program allow Hardware to monitor external events (Inputs) and control external devices (Outputs) accordingly. During this process, the program for an Embedded System may have to directly manipulate the internal architecture of the Embedded Hardware (usually the processor) such as Timers, Serial Communications Interface, Interrupt Handling, and I/O Ports etc.

From the above statement, it is clear that the Software part of an Embedded System is equally important to the Hardware part. There is no point in having advanced Hardware Components with poorly written programs (Software).

There are many programming languages that are used for Embedded Systems like Assembly (low-level Programming Language), C, C++, JAVA (high-level programming languages), Visual Basic, JAVA Script (Application level Programming Languages), etc.

In the process of making a better embedded system, the programming of the system plays a vital role and hence, the selection of the Programming Language is very important.

Factors for Selecting the Programming Language

The following are few factors that are to be considered while selecting the Programming Language for the development of Embedded Systems.

- **Size:** The memory that the program occupies is very important as Embedded Processors like Microcontrollers have a very limited amount of ROM.
- **Speed:** The programs must be very fast i.e. they must run as fast as possible. The hardware should not be slowed down due to a slow running software.
- **Portability:** The same program can be compiled for different processors.
- **Ease of Implementation**
- **Ease of Maintenance**
- **Readability**

Earlier Embedded Systems were developed mainly using Assembly Language. Even though Assembly Language is closest to the actual machine code instructions, the lack of portability and high amount of resources spent on developing the code, made the Assembly Language difficult to work with.

Chapter 6

TEST CASES AND RESULTS

CHAPTER 6

RESULT AND DISCUSSION

6.1 Testing:

This chapter gives the outline of all testing methods that are carried out to get a bug free system. Quality can be achieved by testing the product using different techniques at different phases of the project development. The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components subassemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

6.1.1 Test Environment:

Testing is an integral part of software development. Testing process certifies whether the product that is developed compiles with the standards that it was designed to. Testing process involves building of test cases against which the product has to be tested. write about the testing process used for the project.

6.1.2 Advantages and Application:

Applications:

- The concept can be used in hospitals for making the things smart.
- The concept can be applied in industries for automation purpose.
- It can be used in multi-national companies for digital facilities.

Advantages:

- It avoids problems that usually arise with present traffic control systems.
- It provides an efficient time management scheme, in which a dynamic time schedule is worked out in real time for the passage of each traffic column.
- Power Issues Can be resolved with the use of renewable Sources

6.1.3 Limitations:

- System failure may occur due to tampering
- System failure may also take place in the absence of power to the entire unit attached to the vehicle.

6.1.4 Unit Testing:

Unit testing is a software development process in which the smallest testable parts of an application, called units, are individually and independently scrutinized for proper operation. Unit testing is often automated but it can also be done manually. The goal of unit testing is to isolate each part of the program and show that individual parts are correct in terms of requirements and functionality. Test cases and results are shown in the Tables.

Unit Testing Benefits:

- Unit testing increases confidence in changing/ maintaining code.
- Codes are more reusable.
- Development is faster.
- The cost of fixing a defect detected during unit testing is lesser in comparison to that of defects detected at higher levels.
- Debugging is easy.
- Codes are more reliable.

Table 6.1: Sense The Density Test UTC-1

Sl # Test Case : -	UTC-1
Name of Test: -	Sense the Density
Items being tested: -	Tested for uploading different number of vehicles
Sample Input: -	Input to ir sensors
Expected output: -	Vehicle density should be calculated
Actual output: -	Vehicle Density Calculated
Remarks: -	Pass.

Table 6.2: Ambulance Detection Test UTC-2

Sl # Test Case : -	UTC-2
Name of Test: -	Ambulance Detection
Items being tested: -	RFID Reader
Sample Input: -	Input to RFID reader through Tag
Expected output: -	Ambulance Detection should happen
Actual output: -	Ambulance detected
Remarks: -	Pass

6.1.5 Integration Testing:

Integration testing is a level of software testing where individual units are combined and tested as a group. The purpose of this level of testing is to expose faults in the interaction between integrated units. Test drivers and test stubs are used to assist in Integration Testing. Integration testing is defined as the testing of combined parts of an application to determine if they function correctly. It occurs after unit testing and before validation testing. Integration testing can be done in two ways: Bottom-up integration testing and Top-down integration testing.

- **Bottom-up Integration:**

This testing begins with unit testing, followed by tests of progressively higher-level combinations of units called modules or builds.

- **Top-down Integration:**

In this testing, the highest-level modules are tested first and progressively, lower-level modules are tested thereafter.

In a comprehensive software development environment, bottom-up testing is usually done first, followed by top-down testing. The process concludes with multiple tests of the complete application, preferably in scenarios designed to mimic actual situations. Table below shows the test cases for integration testing and their results.

Table 6.3: Working of Density based Traffic Management

Test ITC-1

Sl # Test Case : -	ITC-1
Name of Test: -	Working of Density based Traffic Management
Item being tested: -	IR Sensors with Arduino
Sample Input: -	Different number of vehicles in each lane
Expected output: -	Traffic timing should be allotted as per density in each road
Actual output: -	Signal operated as per density
Remarks: -	Pass.

Table 6.4: Signal Operation on ambulance detection

ITC-2

Sl # Test Case : -	ITC-2
Name of Test: -	Signal Operation on ambulance detection
Item being tested: -	Place different number of vehicles and with ambulance
Sample Input: -	Input to RFID Reader
Expected output: -	Signal LED's should operate green for ambulance lane irrespective of density
Actual output: -	Traffic signal Status operated as required for ambulance lane
Remarks: -	Pass.

6.1.6 System testing:

System testing of software or hardware is testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. System testing falls within the scope of black-box testing, and as such, should require no knowledge of the inner design of the code or logic. System testing is important because of the following reasons:

- System testing is the first step in the Software Development Life Cycle, where the application is tested as a whole.
- The application is tested thoroughly to verify that it meets the functional and technical specifications.
- The application is tested in an environment that is very close to the production environment where the application will be deployed.
- System testing enables us to test, verify, and validate both the business requirements as well as the application architecture.

Table 6.5: ITM System Test Case 1

Test Case ID	System Test Case 1
Description	Intelligent Traffic Monitoring
Input	Threshold value
Expected output	Density Calculation & Ambulance Detection
Actual Result/Remarks	Working as expected output.
Passed (?)	Yes

6.2 Results:

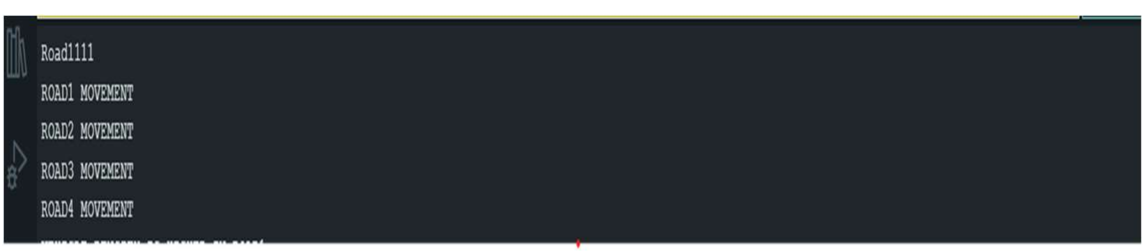


Figure 6.1 : Lane change according to timer

```
ROAD1 MOVEMENT
ROAD2 MOVEMENT
ROAD3 MOVEMENT
ROAD4 MOVEMENT
VEHICLE DENSITY IS HIGHER IN ROAD2
ROAD2 MOVEMENT
Card4:
EMERGENCY VEHICLE PASSING IN ROAD 1
ROAD1 MOVEMENT
ROAD1 MOVEMENT
ROAD2 MOVEMENT
ROAD3 MOVEMENT
ROAD4 MOVEMENT
Card2:
EMERGENCY VEHICLE PASSING IN ROAD 2
ROAD4 MOVEMENT
EMERGENCY VEHICLE PASSING IN ROAD 2
ROAD4 MOVEMENT
ROAD1 MOVEMENT
```

Figure 6.2 : Lane change according to density based detection using IR

```
VEHICLE DENSITY IS HIGHER IN ROAD1
ROAD1 MOVEMENT
VEHICLE DENSITY IS HIGHER IN ROAD2
ROAD2 MOVEMENT
VEHICLE DENSITY IS HIGHER IN ROAD3
ROAD3 MOVEMENT
VEHICLE DENSITY IS HIGHER IN ROAD4
ROAD4 MOVEMENT
ROAD1 MOVEMENT
ROAD2 MOVEMENT
ROAD3 MOVEMENT
ROAD4 MOVEMENT
VEHICLE DENSITY IS HIGHER IN ROAD2
```

Figure 6.3 : Lane change based on emergency vehicle detection using RFID

Figure 6.4 : Traffic System Representation

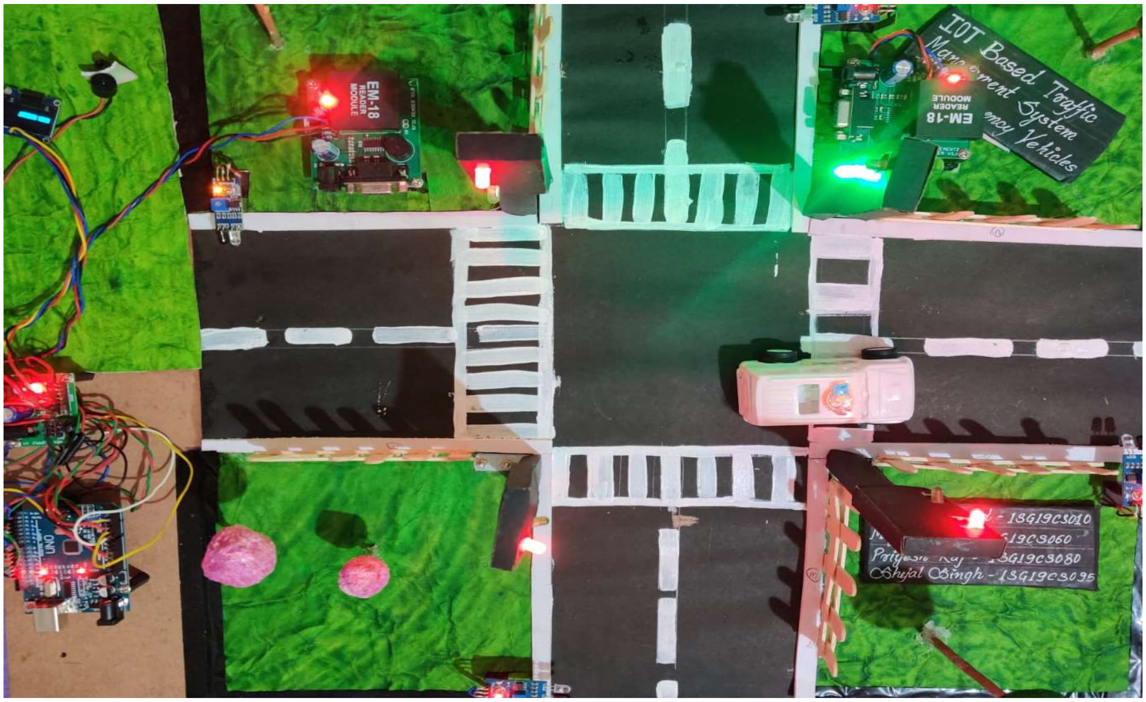


Figure 6.5 :Working Model Representation

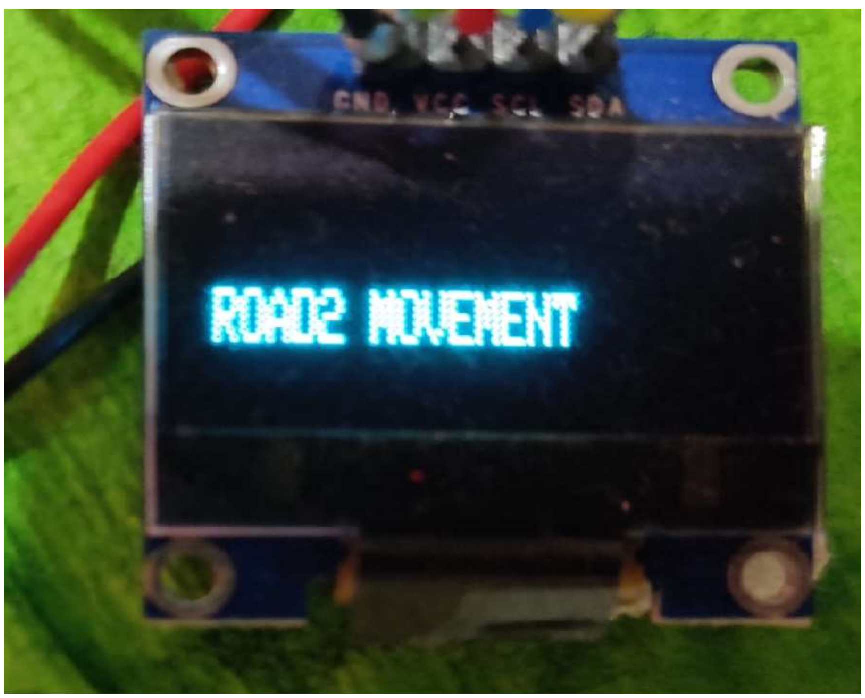


Figure 6.6 : Road Representation using OLED screen

Chapter 7

CONCLUSION AND FUTURE WORK

CHAPTER 7

CONCLUSION AND FUTURE WORK

7.1 Conclusion:

In conclusion, the proposed traffic management system is a remarkable development that incorporates cutting-edge technologies such as infrared (IR) sensors and radio-frequency identification (RFID) readers to monitor traffic density and manage traffic signals efficiently. This system's ability to adjust traffic lights in real-time based on the volume of vehicles on the road will be instrumental in reducing congestion during peak hours, improving traffic flow, and reducing travel times.

Moreover, the system's ability to prioritize emergency vehicles by giving them the right of way is a crucial feature that will help reduce response times during medical emergencies, fire outbreaks, or police chases. This will potentially save lives and make a significant contribution towards ensuring public safety.

The project's emphasis on reducing pollution levels is also noteworthy, as it aligns with global efforts to mitigate climate change and improve air quality. By managing traffic patterns and reducing congestion, the system will lead to a reduction in carbon emissions and contribute towards a cleaner environment.

The successful implementation of this project is a significant milestone in the development of intelligent traffic management systems. It has the potential to transform traffic management in urban areas, enhance urban mobility, improve road safety, and reduce travel times, ultimately contributing to a better quality of life for citizens. Overall, this project has the potential to revolutionize traffic management and set new standards for sustainable transportation in urban areas.

7.2 Future Work:

- Developing a more comprehensive mobile application for emergency vehicle drivers that includes features such as route planning, real-time traffic information, and communication with other drivers
- The system can be integrated with other technologies such as GPS systems to provide more accurate information about the vehicle's location and surroundings.
- Integration with public transportation systems: Integrating with public transportation systems could help emergency vehicles navigate through congested areas more efficiently.

REFERENCERS

REFERENCES

[1] K. S. Sandhya & B. Karthikeyan; Automatic Traffic Diversion System Using Traffic Signals ; International Conference on Nextgen Electronic Technologies , 978-1-5090-5913-3/17/ ©2017 IEEE .

[2] Shubhankar Vishwas Bhate, Prasad Vilas Kulkarni, Shubham Dhanaji Lagad & Mahesh Dnyaneshwar Shinde; IoT based Intelligent Traffic Signal System for Emergency vehicles ; Proceedings of the 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT 2018) .

[3] A.S.Dhatrak & Dr.S.T.Gandhe; Automatic Traffic Signals in Smart Cities for Speedy Clearance of Emergency Vehicles; 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA) 978-1-5386-1974-2/18/©2018 IEEE .

[4] Diksha A. Chaudhari, Lakxmi S. Gadhari, Gaurav H. Damale & Abhijit R. Dutonde; A Survey on Traffic Control Mechanism for Emergency Vehicles; International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV9IS060832 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by : www.ijert.org Vol. 9 Issue 06, June-2020 .

[5] Anilloy Frank, Yasser Salim Khamis Al Aamri & Yasser Salim Khamis Al Aamri; IoT based smart traffic density control using image processing ; 978-1-5386-8046-9/19/$31.00 ©2019 IEEE .

[6] Sabeen Javaid, Ali Sufian, Saima Pervaiz & Mehak Tanveer; Smart Traffic Management System Using Internet of Things, 2018 .

[7] Rachana K P , Aravind R, Ranjitha M, Spoorthi Jwanita & Soumya K; IoT Based Smart traffic Management System , Published by, www.ijert.org, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org NCCDS - 2021 Conference Proceedings .

[8] Syed Misbahuddin, Junaid Ahmed Zubairi, Abdulrahman Saggaf, Jihad Basuni, Sulaiman A-Wadany and Ahmed Al-Sofi, IoT Based Dynamic Road Traffic Management For Smart Cities , 978-1-4673-9268-6/15/ ©2015 IEEE .

[9] Goshwe, Y. Nentawe, Okewu A. Victor and Kureve D.Teryima; Radio Frequency Sensor-Based Traffic Light Control For Emergency Vehicle ; International journal of scientific & technology research volume 8, issue 08, august 2019 .

[10] Naga Harsha.J, Nikhil Nair , Sheena Mariam Jacob and J. John Paul; Density Based Smart Traffic System with Real Time Data Analysis Using IoT ; Proceedings of 2018 IEEE International Conference on Current Trends toward Converging Technologies, Coimbatore, India.

REVIEW PAPER

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

Implementation on IoT Based Traffic Management System for Emergency Vehicles

Mayank Raj[1], Anubhaw Anand[2], Priyesh Raj[3], Shejal Singh[4], Ms. Hemalatha K[5]
[1, 2, 3, 4]Student, Sapthagiri College of Engineering Bangalore, Karnataka-560057
[5]Assistant Professor, Sapthagiri College of Engineering Bangalore, Karnataka-560057

Abstract: In many Indian cities along with those in other nations, congestion caused by traffic is a serious issue. Traffic congestion is caused by signal failure, ineffective law enforcement, and poor traffic administration. The economy, the environment, and general quality of life are all negatively impacted by traffic congestion. Therefore, it is imperative that the traffic congestion issue be managed efficiently. The proposed system's goal is to suggest a smart traffic control and management system that makes use of the Internet of Things, a decentralised strategy and algorithms to handle all traffic circumstances more precisely. The shortcomings of the existing traffic control systems will be fixed by the proposed system. To reduce traffic congestion, a forecast of upcoming traffic density will be made using an algorithm. The proposed method enables an emergency vehicle to travel directly to its location by turning all red lights on its route into green ones, thereby reducing traffic congestion. The system manages traffic signals and reduces wait times during emergencies. This makes it an endeavour that can save a life.
Keywords: Smart cities, sensors, RFID, internet of things, traffic control, and monitoring of emergency vehicles.

I. INTRODUCTION

Reduced velocities, extended travel durations, and elongated vehicle queues are among the repercussions of traffic congestion on highways. The occurrence of traffic congestion arises when the number of vehicles on a particular route surpasses its capacity. This is a prominent issue in the primary urban areas of India. Traffic congestion materialises when the demand outstrips the capacity of the highways.

In the contemporary era, rapid mobility has become ubiquitous. This has led to a surge in traffic on highways, often resulting in uncontrollable congestion and high volume. These occurrences are particularly prevalent in major metropolitan areas, forcing numerous individuals to endure extended periods of stagnation in tedious traffic jams. Furthermore, traffic congestion increases the likelihood of road accidents, impeding the response time of emergency vehicles such as paramedics, fire engines, and police cars, thus contributing to the loss of innocent lives. This project is intended for densely populated urban areas with high traffic volumes.

In the city of Bangalore, for instance, traffic congestion is a prevalent issue. It is common for traffic to extend over a minimum distance of 100 metres. Under such circumstances, the sound of the ambulance siren may not reach the traffic police officers in a timely manner. Consequently, paramedics are compelled to wait until the traffic clears before proceeding with their emergency response, which could result in adverse outcomes for the patient. The implementation of this project mitigates these challenges.

This project aims to address the challenges posed by traffic congestion in densely populated urban areas with high traffic volumes, such as Bangalore. In such areas, it is common for traffic to extend over a minimum distance of 100 metres, making it difficult for the sound of an ambulance siren to reach the traffic police officers in a timely manner. As a result, paramedics may have to wait for the traffic to clear, potentially endangering the patient's life. However, our system provides a solution by automatically halting the traffic lights and granting the ambulance a green light when it approaches a traffic signal. This is achieved through an IoT-enabled device that monitors and controls traffic signals, reducing traffic congestion and providing emergency vehicles with expedited access through designated green lanes The proposed system involves the installation of Radio Frequency (RF) readers at traffic junctions, which are designed to read the Radio Frequency ID tags on approaching vehicles. Radio Frequency ID technology utilises integrated circuits to store digital data, which is transmitted to Radio Frequency readers via a small antenna embedded within the Radio Frequency ID tag.

II. LITERATURE REVIEW

1) The authors propose an autonomous traffic diversion system that utilises sensors and a computer to modify traffic signals based on vehicle volume, with an emergency override for emergency vehicles. The main aim is to enhance traffic flow and alleviate congestion. MATLAB simulations demonstrate that the suggested approach substantially boosts transportation efficiency and reduces traffic congestion.

2) The proposed solution utilises IoT technologies such as RFID, GPS, and GSM to identify approaching emergency vehicles and prioritise them in the traffic management system. A mobile application is also developed to allow emergency vehicle drivers to interact with the system and receive real-time traffic information. The system's performance was evaluated using Raspberry Pi and Arduino, and the findings demonstrate a significant improvement in emergency vehicle mobility by reducing response times in urban traffic.
3) The researchers have proposed an autonomous traffic light system that prioritises emergency vehicles, resulting in reduced response times and improved survival rates. The system employs sensors on emergency vehicles to communicate with traffic signals, thereby facilitating their passage. Additionally, the authors recommend integrating the system with GPS to calculate the most efficient path for emergency vehicles to reach their destination. Furthermore, the device can notify hospitals of the approaching emergency vehicles.
4) The paper underscores the importance of reducing emergency vehicle response times and highlights the limitations of conventional traffic management systems. The authors examined several systems that employ IoT, RFID, GPS, and wireless communication technologies to prioritise emergency vehicles while ensuring smooth traffic flow. The report evaluates the strengths and weaknesses of each approach and proposes potential areas for future research in this field.
5) The proposed method aims to alleviate traffic congestion by adjusting traffic signal timings based on traffic density. Using an IoT platform, the system communicates with traffic signal management, and the controller modifies the signal timings accordingly. The research provides empirical evidence that the proposed approach improves traffic flow and reduces congestion. However, since the study primarily focuses on visual processing for traffic density assessment, emergency vehicle recognition and priority are not incorporated into the method.
6) The article proposes a sophisticated traffic control system to address the issue of traffic congestion. The system employs sensors, cameras, and IoT devices to collect traffic flow and road condition data, which is analysed in real-time to regulate traffic flow and dynamically adjust traffic signal timing. Furthermore, a mobile application is provided for users to obtain real-time traffic updates and modify their routes accordingly. The expected outcomes of the system include a reduction in traffic congestion, shorter commute times, and improved fuel efficiency.
7) In order to enhance the effectiveness and safety of vehicle traffic, a smart traffic management system based on IoT is being developed, consisting of sensors, a microprocessor, and a web-based program. The sensors gather data on traffic density, which is then processed by the microcontroller to determine the timing of traffic signals. Internet application users can obtain real-time traffic information through the system. The system's primary objective is to improve traffic flow by decreasing wait times at traffic signals and reducing accidents.
8) The proposed system aims to mitigate congestion and enhance traffic flow by utilising real-time traffic data from sensors and cameras. It includes a sensor network, cloud-based data processing and analysis, and an end-user mobile application. Machine learning algorithms are employed to predict traffic patterns and adjust traffic signals accordingly. The authors contend that their technology has the potential to reduce travel time and improve traffic flow, making it a promising solution for smart cities.
9) The system prioritises emergency vehicles by utilising RF sensors to detect them and activate the traffic light control system. A limited-scale implementation and testing of the system demonstrated its effectiveness in managing traffic for emergency vehicles. However, the research did not address the system's ability to scale to larger regions, which could pose a drawback.
10) The article suggests a density-based smart traffic system that utilises IoT for real-time data processing to alleviate traffic congestion. Ultrasonic sensors are employed to detect vehicle density on the road, and the data is transmitted to a central processing unit (CPU) for further analysis. A decision-making process is used by the CPU to determine the optimal traffic light timings and synchronises them with nearby signals. Furthermore, a web application is provided to offer users real-time traffic statistics.

III. LITERATURE TABLE

S.No	YEAR	DESCRIPTION	LIMITATION
1.	2017	The traffic signal's microcontroller transfers data to the preceding signal to enable users to choose a diversion route instinctively. A "fourth light" is required to indicate the stopped route's direction at each traffic signal.	• The usage of pressure tubes causes roadblocks. • Ultrasonic technology raises the cost of installation.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

2.	2018	The concept calls for the use of technologies such as the Raspberry Pi, Node MCU, RFID Tag, and Reader to allow traffic signals to interact with emergency vehicles and adjust signal timing accordingly.	• Lua is slower than C • MQTT has a security problem.
3.	2018	Microcontrollers, CPUs, sensors, GPS, GSM, RF, and IoT principles were used to build the system. Its major function is to alleviate traffic congestion.GPS is used since it is simple to set up and does not require any input from the driver.	• High cost • Acoustic system delay is more • GPS is inaccurate in the range of 75 m to 100 m
4.	2020	The model is primarily based on technologies that may use GPS coordinates of emergency vehicles and institutions to which the automobile is headed to clear the highways of traffic.	• GIS is very expensive • It will cause additional congestion on other paths, it will be time consuming.
5.	2019	The recommended technique would be built on calculating real traffic density along the route. For this, real-time video and image processing tools would be employed.	• Obstruction caused by fog or mist Classification and segmentation are challenging tasks.
6.	2018	The suggested system uses a hybrid method to maximise traffic circulation on the roadways, and software is developed to manage diverse traffic circumstances efficiently.	• The testing range of ultrasonic sensors is limited. • Surveillance Fog or mist might obscure the camera.
7.	2021	The technique tackles earlier obstacles in traffic management by extracting sensor data and traffic density from cameras using digital image processing technology, resulting in signal data and number plate identification.	• Cloud data is readily manipulable.
8.	2015	This study proposes IoT-based traffic management systems for smart cities, allowing on-site traffic officials to control traffic dynamically using their mobile phones or monitor it remotely and govern it via the internet.	• Due to the participation of authorities, a quick conclusion is not feasible.
9.	2019	The intelligent traffic control system for emergency vehicles prototype employs RF with normal and emergency sequencing modes. In an emergency, sends an override signal to disrupt traffic flow.	• Multiple receiving might lead to interference. • The ASK approach is ineffective.
10.	2018	This system, which runs on Raspberry Pi, employs Ultrasound Sensors and Image Processing via a live camera feed. It calculates vehicle density and sets dynamic traffic schedules.	• The inductive loop must be reinstalled. • False detection as a result of multipath propagation.

IV. PROPOSED SYSTEM

Here, we describe a ground-breaking IoT-based method for automated traffic signal monitoring that fully automates the operation of the traffic light system. The proposed system operates normally in normal traffic, but if the volume of traffic reaches a certain threshold, it can efficiently control the density of traffic signals by using an Arduino-based circuit system that uses infrared (IR) sensors to detect the volume of traffic on a particular lane. The effective management of traffic conditions on the highways is made possible by this sophisticated traffic control system, which shows the present traffic density.When emergency vehicles or other high-priority vehicles pass by, the suggested system may also change the timings of the traffic lights in real-time, making them green while maintaining the other signals red.RFID tags and a receiver work together to enable this capability.To maintain smooth traffic flow, the system uses a powerful control algorithm that can analyse the traffic density data gathered by the IR sensors and modify the traffic lights as necessary. The system connects to other city traffic light systems using IoT technology, providing effective traffic control over the whole road network.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

The block diagram for the internet of things traffic management system we provide is shown below.

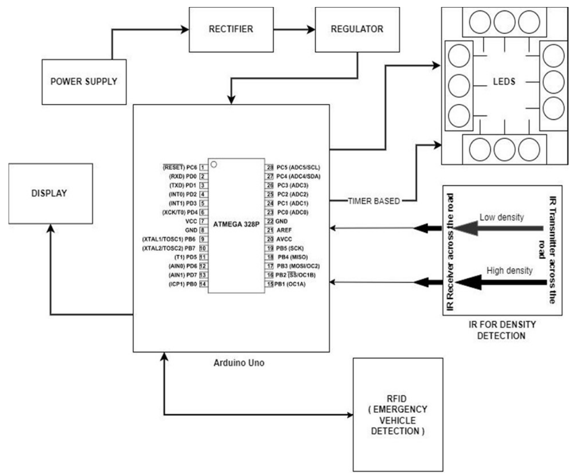


Figure 1: Block Diagram

V. MATERIALS USED

A. Atmega 328 Microcontroller.

It is the most crucial element since it acts as the central nervous system for all other elements. The micro-controller's components are turned on by the power source. A microcontroller board called the Arduino Uno is based on the ATmega328. It has 6 analogue inputs, a ceramic resonator running at 16 MHz, 14 digital input/output pins, a USB connection, a power jack, an ICSP header, and a reset button. The microcontroller is connected to every component, including the power supply, sensors, speech recognition module, relays, dc motors, buzzer, and others.

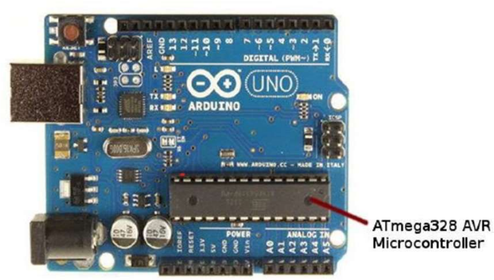


Figure 2: ATmega 328 microcontroller

B. IR Sensors

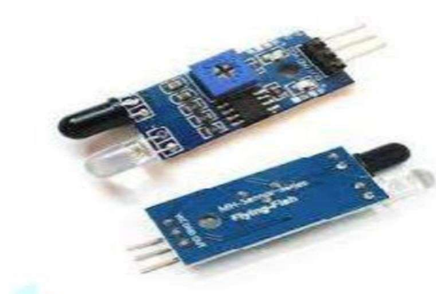


Figure 3: IR Sensor

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

An electrical device called an IR (infrared) sensor can be used to perceive certain aspects of its environment by either generating or detecting radiation. It can also gauge an object's temperature and spot movement. It detects items in front of them by using infrared light to map or estimate their distance.

C. EM-18 RFID

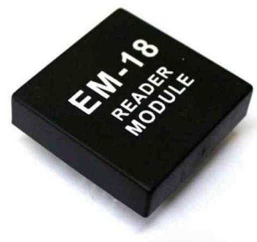


Figure 4: EM-18 Reader Module

Radio waves are used by Radio frequency identifying, often known as RFID, a wireless identifying technology, to detect the presence of RFID tags.RFID technology is used to identify the presence of persons, things, etc., just like a barcode reader.

RFID based system has two basic elements

1) *RFID Tag:* An RFID tag consists of a radio-frequency microchip placed on a substrate that has a 12-byte unique identification number.
2) *RFID Reader:* To read distinctive IDs from RFID tags, use an RFID reader. The RFID reader detects each RFID tag's unique ID as soon as it is within range and sends it serially to the microcontroller or PC.
3) *EM18 RFID Reader:* EM18 is a RFID reader which is used to read RFID tags of frequency 125 kHz.

After reading tags, it sends a serial unique ID to the PC or microcontroller using Wiegand format or UART connection on the appropriate pins.

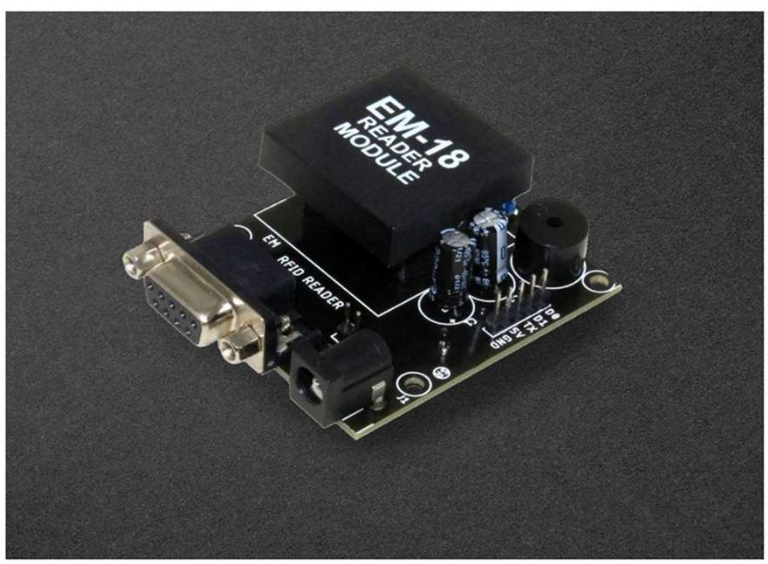


Figure 5: EM-18 RFID

EM18 RFID reader reads the data from RFID tags which contains stored ID which is of 12 bytes.

D. Buzzer

A buzzer is an electronic device that produces a buzzing or beeping sound. It is typically used as an audible alert or warning signal in electronic devices such as alarms, timers, and electronic games. Buzzer circuits typically consist of a small electromechanical component, such as a magnetic coil or piezoelectric crystal, which vibrates to produce sound when an electrical signal is applied. The sound produced by a buzzer can vary depending on the specific circuit design and the application, but is typically a loud and distinctive tone that is easily recognizable. Buzzers can also be used in musical instruments and sound effects generators to produce specific tones or effects.

Figure 6: Buzzer

E. OLED Display

Figure 7: OLED Display

OLED stands for Organic Light Emitting Diode. It is a type of display technology used in electronic devices such as smartphones, televisions, and computer monitors. Unlike traditional LED displays, OLED displays do not require a backlight to produce images, as each pixel is self-emitting. This allows for deeper blacks, higher contrast ratios, and wider viewing angles compared to other display technologies. OLED displays also tend to have better energy efficiency, as they consume less power when displaying dark or black images. However, OLED displays can be more expensive to produce than other display technologies, and can suffer from issues such as burn-in and image retention.

F. Power Module

Figure 8: Power Module

Linear regulators are simple and easy to use, but they are not very efficient, and they generate a lot of heat, especially if the input voltage is significantly higher than the output voltage.

When choosing a power module for an IoT project, make sure to consider your power requirements, power source, and any size or weight constraints. It's also important to choose a reliable and reputable supplier for your power module to ensure the safety and reliability of your IoT project.

VI. IMPLEMENTATION

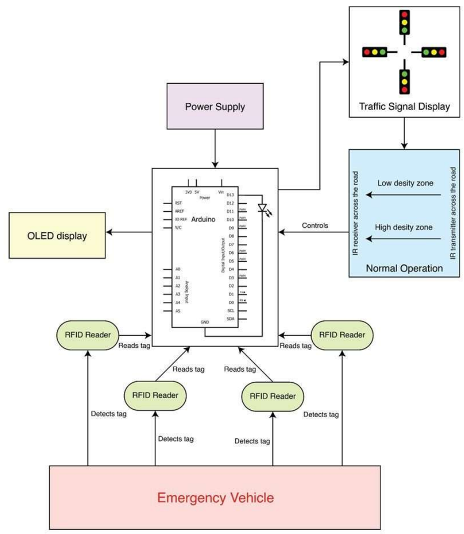


Figure 9: Overall System Architecture

A. Timer-Based Technique

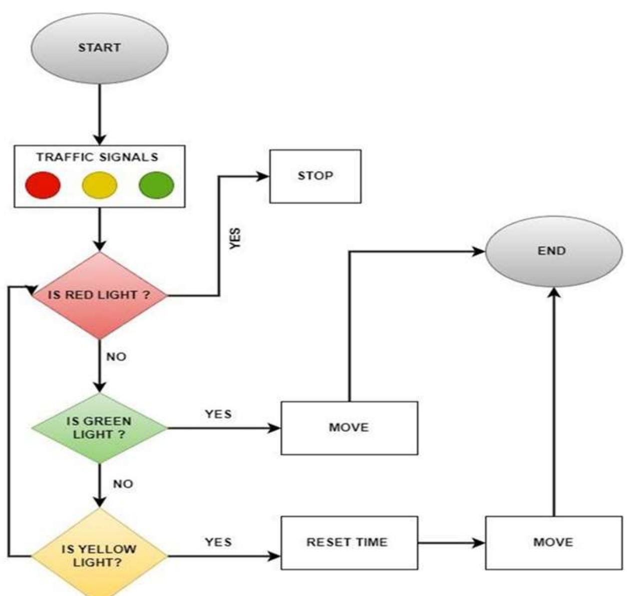


Figure 10: Flow Chart of Timer-Based technique

The timer-based traffic approach is a cutting-edge method of traffic control that is commonly used in many contemporary cities all over the world. In this method, traffic lights are timed according to a signal system, ensuring that cars may cross intersections in a coordinated manner. The timer-based traffic approach aids in ensuring a smooth and effective flow of traffic by regulating the timing and sequence of traffic lights. This in turn may contribute to lessening traffic congestion, enhancing traffic flow, and improving road safety.

The timer-based traffic control method's capacity to lower the chance of accidents is one of its main advantages. This strategy reduces confusion and avoids collisions at junctions by giving drivers clear directions on when to stop and go. Additionally, by ensuring that traffic passes intersections in an orderly and effective manner, this technique aids in maximising the utilisation of road space.

B. IR Sensors

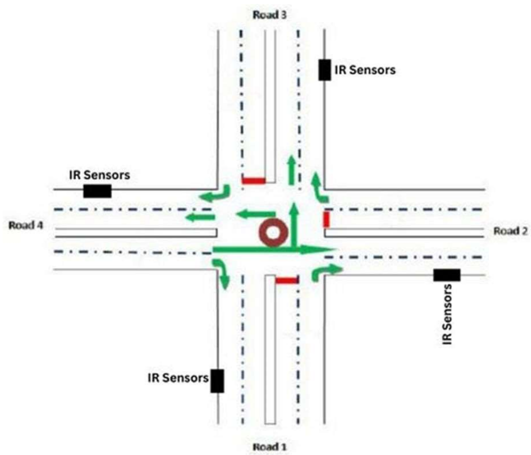


Figure 11: IR Sensors placed on road

The manner that transport authorities control traffic on roads and highways has been completely transformed by the introduction of IR sensors in traffic management systems. These sensors are able to determine the presence of cars on the road and the volume of traffic in particular lanes or regions of the road. In order to change traffic signals and flow patterns, particularly in locations with larger traffic densities, transportation authorities can use the important data that IR sensors give by tracking traffic flow in real-time. Traffic management systems can modify traffic signals and flow patterns utilising this information to improve traffic flow and lessen congestion. For instance, if an IR sensor notices a large number of cars in one lane or area of the road, the traffic management system may give that lane precedence or change the timing of the signal to let more vehicles pass. Similar to this, the traffic management system can take proactive steps to redirect traffic or change signal timing to ease congestion if an IR sensor detects a potential hotspot for congestion.

C. RFID Technique

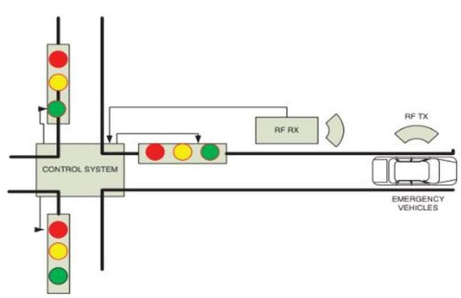


Figure 12: RFID Technique

Modern traffic control systems now frequently include the usage of RFID tags on emergency vehicles. These tags can be attached to the cars directly or integrated into already installed communication devices like radios or GPS systems. When an emergency vehicle with an RFID tag approaches a traffic light, the system instantly recognises the tag and may change the traffic signal to allow the vehicle to safely and quickly pass through the junction.

It is obvious how useful RFID technology is in emergency circumstances. The technology can assist to minimise delays in emergency response times, potentially saving lives by lowering the length of time that emergency vehicles must wait at traffic signals. Because emergency vehicles are given preference over other cars in traffic flow, the adoption of RFID tags can also serve to lower the probability of accidents involving these vehicles.

The application of RFID technology in traffic management systems can help the general flow of traffic in addition as reducing the response times for emergency vehicles. RFID technology can assist to enhance traffic flow and shorten travel times for all cars on the road by decreasing congestion and delays brought on by emergency circumstances.

VII. CONCLUSION

In conclusion, this project represents a major effort to create a more effective and efficient traffic management system. The project has focused on several key objectives, including reducing congestion and improving safety, reducing emergency vehicle response times, saving time at traffic junctions, reducing pollution, enabling timely organ transportation, and providing real-time adjustments to traffic light patterns. By incorporating these features, the system has the potential to improve traffic flow, enhance road safety, and reduce pollution levels, ultimately resulting in a better quality of life for citizens. The project is a significant step forward in the development of intelligent traffic management systems, with the potential to make a substantial impact on traffic management in urban areas. The outcomes of this project will contribute towards making the roads safer and more efficient, ensuring that traffic moves smoothly, reducing travel times, and improving overall traffic flow.

VIII. ACKNOWLEDGEMENT

We would like to offer our heartfelt appreciation to everyone who helped and supported us during this effort. We would like to express our heartfelt gratitude to Dr. Kamalakshi Naganna, Professor and Head, Department of Computer Science and Engineering, Sapthagiri College of Engineering, and our project guide Ms. Hemalatha K, Assistant Professor, Department of Computer Science and Engineering, Sapthagiri College of Engineering, who have provided constant guidance, support, and encouragement throughout the project. Their excellent views and comments have been important in designing our project. Finally, we are grateful to our friends and family for their unwavering support and encouragement.

REFERENCES

1 K. S. Sandhya & B. Karthikeyan; Automatic Traffic Diversion System Using Traffic Signals ; International Conference on Nextgen Electronic Technologies , 978-1-5090-5913-3/17/ ©2017 IEEE
2 Shubhankar Vishwas Bhate, Prasad Vilas Kulkarni, Shubham Dhanaji Lagad & Mahesh Dnyaneshwar Shinde; IoT based Intelligent Traffic Signal System for Emergency vehicles ; Proceedings of the 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT 2018)
3 A.S.Dhatrak & Dr.S.T.Gandhe; Automatic Traffic Signals in Smart Cities for Speedy Clearance of Emergency Vehicles; 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA) 978-1-5386-1974-2/18/©2018 IEEE
4 Diksha A. Chaudhari, Lakxmi S. Gadhari, Gaurav H. Damale & Abhijit R. Dutonde; A Survey on Traffic Control Mechanism for Emergency Vehicles; International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV9IS060832 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by : www.ijert.org Vol. 9 Issue 06, June-2020
5 Anilloy Frank, Yasser Salim Khamis Al Aamri & Yasser Salim Khamis Al Aamri; IoT based smart traffic density control using image processing ; 978-1-5386-8046-9/19/$31.00 ©2019 IEEE
6 Sabeen Javaid, Ali Sufian, Saima Pervaiz & Mehak Tanveer; Smart Traffic Management System Using Internet of Things, 2018
7 Rachana K P , Aravind R, Ranjitha M, Spoorthi Jwanita & Soumya K; IoT Based Smart traffic Management System , Published by, www.ijert.org, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org NCCDS - 2021 Conference Proceedings
8 Syed Misbahuddin, Junaid Ahmed Zubairi, Abdulrahman Saggaf, Jihad Basuni, Sulaiman A-Wadany and Ahmed Al-Sofi, IoT Based Dynamic Road Traffic Management For Smart Cities , 978-1-4673-9268-6/15/ ©2015 IEEE
9 Goshwe, Y. Nentawe, Okewu A. Victor and Kureve D.Teryima; Radio Frequency Sensor-Based Traffic Light Control For Emergency Vehicle ; International journal of scientific & technology research volume 8, issue 08, august 2019
10 Naga Harsha.J, Nikhil Nair , Sheena Mariam Jacob and J. John Paul; Density Based Smart Traffic System with Real Time Data Analysis Using IoT ; Proceedings of 2018 IEEE International Conference on Current Trends toward Converging Technologies, Coimbatore, India.

CERTIFICATES

SAPTHAGIRI College of Engineering
Creating Tomorrow

SAPTHAGIRI COLLEGE OF ENGINEERING

Accredited by NBA (CSE,ECE,EEE,ISE & ME)
Accredited by NAAC with 'A' Grade
An ISO 9001:2015 and 14001:2015 Certified Institution

INTERNATIONAL CONFERENCE

on

Global Convergence in Technology, Entrepreneurship, Computing & Value Engineering: Principles and Practices: ICGCP-2023

5 – 7 May, 2023

ISBN: 9798392733033

In association with

SCE IQAC

INSTITUTION'S INNOVATION COUNCIL (Ministry of Education Initiative)

CERTIFICATE

This certificate acknowledges and honors

PRIYESH RAJ

of

Computer Science & Engineering, SCE

for participating and presenting a paper titled

IOT based traffic management system for emergency vehicles

in International Conference on ***Global Convergence in Technology, Entrepreneurship, Computing & Value Engineering: Principles and Practices, ICGCP-2023*** organized by Sapthagiri College of Engineering, Bengaluru during 5–7 May, 2023.

Dr. R.G.Deshpande
Conference Co-ordinator
Associate Professor,
Dept of Mechanical Engg, SCE

Dr. Harish.R
Conference Co-Chair
Prof & Head, Dept of Physics, SCE

Dr. H Ramakrishna
Conference Chair
Principal, SCE

ISSN No. : 2321-9653

iJRASET

International Journal for Research in Applied Science & Engineering Technology

IJRASET is indexed with Crossref for DOI-DOI : 10.22214

Website : www.ijraset.com, E-mail : ijraset@gmail.com

ISRA Journal Impact Factor: 7.429

45.98 INDEX COPERNICUS

THOMSON REUTERS Researcher ID: N-9681-2016

10.22214/IJRASET

TOGETHER WE REACH THE GOAL SJIF 7.429

Certificate

It is here by certified that the paper ID : IJRASET51614, entitled

Implementation on IoT Based Traffic Management System for Emergency Vehicles

by

Priyesh Raj

after review is found suitable and has been published in

Volume 11, Issue V, May 2023

in

International Journal for Research in Applied Science & Engineering Technology

(International Peer Reviewed and Refereed Journal)

Good luck for your future endeavors

Editor in Chief, iJRASET

STUDENT DETAILS

NAME	USN	EMAIL ID	CONTACT	PHOTO
Anubhaw Anand	1SG19CS010	anubhawanand111@gmail.com	7488946510	
Mayank Raj	1SG19CS060	27mayankraj@gmail.com	8789464952	
Priyesh Raj	1SG19CS080	priyeshraj2803@gmail.com	8210141542	
Shejal Singh	1SG19CS095	2010shejal@gmail.com	9970611755