Density Based Smart Traffic System

A Project Report

Submitted in partial fulfilment of the
requirements for the award of the Degree of

BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

By

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CERTIFICATE

This is to certify that the project entitled, **" Density Based Smart Traffic System"** is bonafide work of **SAIKUMAR KOLIPAKA** bearing Seat No: 18302D0010 submitted in partial fulfilment of the requirements for the award of degree of BACHELOR OF SCIENCE in INFORMATION TECHNOLOGY from University of Mumbai.

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Abstract

In the past few years, we all have seen an increase in the use of public transport due to globalization and an increase in private vehicles. Due to this higher use of public transport vending and traffic managing traffic signaling is becoming a complex task.

Traffic Management at signals has been a major problem in India. Unscientific methods, negligence, and overpopulation have led to mismanagement of traffic at traffic signals. It needs the introduction of new technology and a better approach to improve the traffic condition. A possible solution to this problem is the density-based traffic control system. The proposed model checks for the density of traffic at the traffic signal and changes the traffic lights accordingly.

The present era controlling traffic became very arduous because of the increase in automobiles such as cars, bikes, etc. Due to this, there is a long time delay in the signaling systems. To overcome this problem, we have designed the density-based traffic signal with a delay of 1000ms to control the traffic based on density at the crossings or four-side lane or road system using Arduino Uno.

The concept of smart roads integrates advanced control algorithms, improved sensors and computing and networking technology to predict and manage traffic flows. A smart road can improve travel time, road safety, and reduce traffic congestion. Internet of Things (IoT) is the connectivity of physical devices such as sensors and actuators with a unique identifier to allow remote access to objects and automation in application domains like healthcare, transportation, surveillance, and energy conservation.

Time control and communication networks. An optimal solution cannot be obtained in a conventional traffic light controller where the traffic lights change at constant cycle time. Here arises the need for an adaptive traffic light controller. With the rise of the Internet of Things (IoT), embedded Web technology goes into the mainstream at present, and various web scripts and servers support the program running on an embedded device. The system uses Arduino UNO which acts as a cloud server to collect, manage, and monitor traffic situations through the Web browsers and also to remotely control the vehicle's data.

ACKNOWLEDGEMENT

We would like to express our special thanks and gratitude to ur project guide **Mr. Sabir Shaikh** for guiding us to do the project work on time and giving us all support and guidance, which made complete our project duly. We are extremely thankful to her for providing such nice support and guidance.

We are also thankful for and fortunate enough to get constant encouragement, support and guidance from the teachers of information Technology who helped us in successfully completing our project work.

DECLARATION

I hereby declare that the project entitled, **"Density Based Smart Traffic System."** done at Vidyalankar School of Information Technology, has not been in any case duplicated to submit to any other universities for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other university.

The project is done in partial fulfillment of the requirements for the award of degree of **BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)** to be submitted as final semester project as part of our curriculum.

Name and Signature of the Student

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Chapter 1

Introduction

1.1 Background

The need for a Traffic Control System

Mostly in cities, traffic is becoming a prime problem for day to day life. The current traffic control systems in metro cities are inefficient due to randomness in the traffic density pattern. The traffic signal timers have a fixed time to switch traffic between different directions. In today's era controlling traffic has become very arduous because of the increase in automobiles such as cars, bikes, etc.
Due to this, the vehicles have to wait for a long time even if the traffic density is very less. The present era controlling traffic became very arduous because of the increase in automobiles such as cars, bikes, etc. Due to this, there are long time delays in the signaling systems. To overcome this problem, we have designed a density based traffic signal.

1.2 Objective

Present Traffic Signaling System

Traffic control in India is a serious problem after lots of improvement in today's digital hegemony. In present manual traffic control systems are used in many places in India. A comparable and matching education program is required, through driver-licensing authorities, to assure that those who operate motor vehicles understand the rules of the road and the actions that they are required or advised to take when a particular control device is in use. Each traffic control device is governed by standards of design and usage; for example, stop signs always have a red background and are octagonal.
Design standards allow the motor operator to quickly and consistently perceive the sign in the visual field along the road. Standard use of colors and shape aids in this identification and in deciding on the appropriate course of action. Under current circumstances, traffic lights are set on in the different directions with fixed time delay, following a particular cycle while switching from one signal to another creating unwanted and prodigal congestion on one lane while the other lanes remain vacant. The system we proposed identifies the density of traffic on individual lanes and thereby regulates the timing of the signals' timing. IR trans-receivers count the obstructions and

provide an idea about the traffic density on a particular lane and feed this response to a control unit which will make the necessary decisions while it is required.

1.3 Purpose, Scope, and Applicability

1.3.1 PURPOSE

To maintain a proper traffic system for smooth traffic flow and avoidance in the delay of traffic and congestion many metro cities are controlled by traffic signals for proper management.
Traffic control systems are used in areas like Air Traffic Control and Roads.

1) Detection using Sensors

In this project, the objective is to build a Traffic Management system for proper traffic management, which will track the density of vehicles in each lane. This system will eliminate the efforts taken by people for monitoring traffic and giving appropriate signals manually. This research is aimed at implementing a system that is capable of identifying the traffic density in the lanes and taking appropriate actions accordingly.

2) By Monitoring Lane Density

The concept of smart traffic is considered to be used for identifying the amount of traffic density in the lanes and keeping track of it for taking appropriate actions. This system will help in identifying the density of the lane through sensor monitoring. The amount of density in the lane will decide which lane will be provided with the green signal first.

1.3.2 SCOPE

Though the prototype model worked very efficiently with remarkable outputs, the real-life situation is going to be way more challenging and demanding. Few of the challenges that should be taken into account are listed as follows

• Low range IR sensors may not be an answer for long-range signaling systems. We may resort to ultrasound or radar techniques for big-scale set-ups.

• Next is the influence of stray signals that may alter the reading of sensory receptors and lead to conveying false information to the microcontroller.

• Periodic checking of the accuracy and precision is a must for the efficacious operation of this model prototype.

Safety first: it has to be made sure that no compromise is being made on safety issues, i.e. a secondary stand-by set-up that can switch over from automatic to manual mode should be provided in case of sensor or circuit malfunctions so that vehicular crowd does not go beyond control.

As part of future advancements, the traffic check post may be connected by wireless transmitters by which the crossings ahead may be an anticipation of the traffic that is approaching. This may be achieved by connecting the sensor network with GPS connectivity and short wave radio transmission signals. This will act as a feedforward system making the signaling system even more smooth and congestion-free.

1.3.3 APPLICABILITY

1. There is no need of traffic inspector at the junctions for supervising the traffic to run smoothly

2. The intelligent work which is done by traffic inspector will be perfectly done by the microcontroller in the circuit with the help of sensors and the program which will be coded to the microc

Benefits OF IoT based Traffic Signal Monitoring System

1. Reduces traffic jams at the signals and on the streets
2. Real-time vehicular movement monitoring
3. A large chunk of vehicles can transit the signals efficiently
4. Tracking lost vehicles using RFID
5. Efficient and accurate traffic monitoring
6. Instant traffic clearance for emergency vehicle

Chapter 2

SURVEY OF TECNOLOGY

2.1 Density based Smart Traffic Light Control System

Authors Anna Marine George, Mary Ann George, and V.I George have presented the research work being carried out to solve the challenges in vehicle detection and tracking. S. Indu et al, & H. H. Kenchannavar, et al proposed systems that use motion detection algorithms to identify the vehicles as moving blobs and keep track of those blobs for several successive frames. The methods used for day time vehicle detection include optical flow algorithm, frame differencing, and background subtraction.

Although these systems produce high accuracy in detecting and tracking vehicles at daytime, the system fails at night time due to poor illumination conditions. The night vehicle detection approach reported by Rajiv Kumar Nath was template matching. The method is not very effective as it involves the formation of a huge library of templates and estimation of correlation is a rigorous task. Pazoki, A. R, Wei Zhang et al proposed methods based on headlight pairing and tracking for nighttime vehicle detection.

A traffic model based on queuing theory and First in First out (FIFO) is developed to study the performance of traffic controllers under different situations. Also, a comparison is established between Vehicle actuated Controller (VAC) and Fuzzy Traffic Controller (FTC).

N. Dinesh Kumar, G. Bhargava Sai, K. Shiva Kumar proposed the LabVIEW Simulation model for controlling the traffic lights based on a time interval. The drawback of Traffic Light Controllers (TLC) based on microcontrollers and

microprocessors are that it uses the pre-defined hardware, that is it does not have the flexibility of modification on a real-time basis. A LabVIEW based Traffic control system is a relatively easier approach because it is very easy to design, redesign, and debug in a graphical programming language like LabVIEW.

This system provides IOT based roads that can improve travel time, road safety, and reduce traffic congestion. It will enable police officers to view real-time traffic conditions. Augmented reality used in traffic will increase safety and comfort for the drivers as well as pave the way for autonomous driving functions. With the help of augmented reality, critical information such as speed and navigation path can be seen while looking at the road ahead (on the windscreen).

2.2 Smart Traffic Management System Using the Internet of Things

Authors Abeen Javaid, Ali Sufian, Saima Pervaiz, Mehak Tanveer have presented a system that is partially deployed in Cambridge city where queue detectors are buried in the roads that detect the traffic queue and inform the central control unit which takes decisions accordingly. Since the system is centralized that can slow down due to networking issues. The researcher used surveillance cameras to detect traffic and OCR to identify the vehicles through number plate recognition which is a simple detection method but the system will fail in Pakistan as there are different kinds of traffic including cycles, donkey carts which have no number plate.

This system used fixed (predefined) thresholds that depend on several vehicles on road. An algorithm was used to set a time of red light for a particular lane of the intersection, which is determined by traffic density on-road and forwarded to the microcontroller and then server. Jadhav et al. used surveillance cameras, MATLAB, and KEIL (Microcontroller coding) to control traffic congestion. This paper also discusses the priority-based traffic clearance and red signal broker (Number plate detection). Due to using heavy hardware, it is difficult to manage and become costly.

Bui et al, Analyzed a real-time process synchronization based system to manage the traffic flow dynamically. Sensors were used to detect the traffic, where vehicle to vehicle and vehicle to infrastructure communication was done by using wireless communication devices. Controllers placed at the center of the intersection received vehicles' and pedestrians' information and requests and processes using the first come first serve method.

Apart from the cameras, this system is also using ultrasonic sensors to enhance accuracy. Sensors are an integral part used to detect traffic density in many traffic management system applications. It measures distance by sending out a sound wave of a specific frequency and listening for that sound wave to bounce back. This economical sensor measures the distance from 2 cm to 400 cm. There are three pairs of sensors at a certain distance that are embedded on each roadside of an intersection to calculate the traffic density. Each sensor's reading is 1 or 0 (Either that particular sensor detects the vehicle or not). At the node side, density is calculated by considering the readings of all the sensors embedded at that particular roadside.

2.3 Density Based Traffic Signal System Using Arduino Uno

Authors R. Bhargavi Devi, D. Kavya Reddy, and E. Sravani, Gaddam Srujan, Shiv Shankar have presented the system in which IR sensors are used to measure the traffic density i.e., the number of vehicles are counted that are passing through each IR sensor which is called as traffic density and the four IR sensors are interfaced with the Arduino Uno.

The model works on the principle of changing the delay of Traffic signals based on the number of cars passing through an assigned section of the road. There are four sensors placed at four sides of a four-way road which counts the number of cars passing by the area covered by the sensors. Here we are using IR sensors replacing traffic control systems to design a density based traffic signal system. IR sensor contains an IR transmitter IR receiver (photodiode) in itself. These IR transmitters and IR receivers will be mounted on the same sides of the road at a particular distance [3]. As the vehicle passes through these IR sensors, the IR sensor will detect the vehicle & will send the information to the microcontroller. The microcontroller will count the number of vehicles, and provide the glowing time to LED according to the density of vehicles. The lane or road which has a higher density, then the LED will glow for a higher time than average or vice versa. The traffic lights are initially running at a fixed delay of 1000 milliseconds, which in turn produces a delay of 1000+1 milliseconds in the entire process. This entire embedded system is placed at that junction. A microcontroller is interfaced with LEDs and IR sensors. The total number of IR sensors required is 4 and LED's are 8. Therefore, these are connected to any two ports of the Arduino.IR sensor module consisting of an IR transmitter and IR receiver. When the sensor finds any object vehicles the comparator output goes low else it gives high voltage.

2.4 Density Based Smart Traffic System with Real-Time Data Analysis Using IoT

Authors Naga Harsha J., Nikhil Nair, Sheena Mariam Jacob, and J. John Paul have presented the system in which they aim to develop a convenient traffic system that allows a smooth movement of cars which will help build a smarter city. The traffic system currently implemented in many areas is not based on the density of traffic and every road is allotted a preset time. This results in traffic congestion due to large red-light delays and timings allotted for roads in a city that should vary during peak on-off hours but in reality. These traditional systems are not adaptable and fail to support traffic during an unexpected situation or an accident, and this makes them inefficient. To calculate the density of traffic various sensors can be used, each having their merits and demerits. In our proposed system Ultrasound Sensors are used along with Image Processing (using a live feed from a camera) that works on a Raspberry Pi platform and calculates the vehicle density and dynamically allotted time for different levels of traffic. This in turn allows better signal control and effective management of traffic thereby reducing the probability of a collision. By using the Internet of Things (IoT) real-time data from the system can be collected, stored, and managed on a cloud. This data can be used to interpret the signal duration in-case any of the sensing equipment fail, and also for future analysis.

By using this system configuration, the possibilities of traffic jams caused by the currently implemented traffic system are reduced. This will in turn decrease the workload of officers, who have to direct traffic in case the traffic lights are not responding, or in the case of an event. The system has a low probability of malfunctioning and even if it does, a fail-safe system can be initiated by getting the average density in that area for a particular time frame from the cloud. Continuous monitoring of traffic can also be done simultaneously.

The project can further be extended to transfer the values from the cloud to an application so that the data collected by the system is accessible to the users. Be it people who just want to check the amount of traffic on a road, or for those who want to study the change in traffic densities over the years, this system can prove to be highly beneficial to everyone and not just to the traffic authorities.

2.5 Smart Autonomous Traffic Light Switching by Traffic Density Measurement through Sensors

Authors Y M Jagadeesh, G. Merlin Suba, S Karthik, and K Yokesh have presented the system in which Traffic light control is one of the serious technical hazards of the urban areas in almost every country around the world. This is due to a rapid increase in the number of vehicles. To reduce the time and complexity, a system has to combine the existing technology with artificial intelligence to think for themselves. This newly developed project will enable the traffic light to switch from red to green based on traffic density. This paper is concerned with the development and implementation of the Sensor-based Traffic Light System with Dynamic Control which in turn reduces the Average Trip Waiting Time (ATWT). It consists of IR sensors, Low Power embedded controllers, comparators, and storage devices.

This paper presented the low-cost real-time dynamic traffic light control system through sensors for reducing the trip time and neglecting the fixed delay in signals. The Dynamic Traffic Light switching is experimented and measured through infrared sensors and transmitted through a microcontroller in which dynamic time management is performed. Traffic research has the goal to optimize the traffic flow of people and goods. By introducing this system, we can manage any sort of increase in vehicle demand. These Traffic light systems, which are advanced signaling devices positioned at pedestrian crossings, road intersections, and other places to control the flow of traffic.

In future this system can be used to inform people about the traffic system by enhancing public transport, route guidance systems, traffic signal improvements, and incident management, congestion can be improved greatly. Data transfer between the microcontroller and computer can also be done through the telephone networks, data call activated SIM This technique allows the operator to gather the recorded data from a far end to his home computer without going there. Traffic light control can be increased to N number of traffic light controls that can be done for the whole city by sitting in a single place.

Chapter 3

REQUIREMENTS AND ANALYSIS

3.1 Problem Definition

People have been using the old traditional way of manually monitoring, which is hectic and also not very much efficient and also time-consuming. This system is to overcome the old situation and develop a new trend to give a better managing system, simply by using the density-based, traffic system. With the use of sensors where we can track the number of vehicles. The sensors will notify about the density and accordingly, proper actions will be taken. Traditional manual monitoring methods take a lot of time and resources. Also, the accuracy and time management of these systems is not up to the mark.

The model works on the principle of changing the delay of Traffic signals based on the number of cars passing through an assigned section of the road. There are eight sensors placed at four sides of a four-way road which analyze the number of cars passing by the area covered by the sensors. Here we are using IR sensors to design a density-based traffic signal system. Those sensors are placed in some particular distance between two sensors. If there is only one sensor will show activated, then it can be considered as a normal case but if both sensors seem activated, then this signal will give priority.

3.2 Requirement Specification

To achieve this the system will follow the below steps.

- IR Sensor and Vehicle Detection
- Input to Arduino
- Input Analysis
- Output phase

IR Sensor and Vehicle Detection

IR sensors are used to extract data from real-time environments by detecting the obstacles, in our case the obstacles are cars. The cars are detected to calculate the density of the road

Input to Arduino

IR sensors send the data to Arduino which will analyze the car density with that the density will be configured and the traffic signaling is decided based on a decision given by Arduino.

Input Analysis

According to the input received by the Arduino, the Arduino board will decide the action to be taken to prioritize the four signals i.e. A, B, C, and D. In this the denser lane will attract the traffic signaling.

Output phase

Depending upon the densities of the signals, either one of the signals (A, B, C or D) or two, or three or all the four of them will have priority. If the densities of all the four signals are either high or low, the signal will continue to flow normally. According to regular signal flow.

3.3 Planning and Scheduling

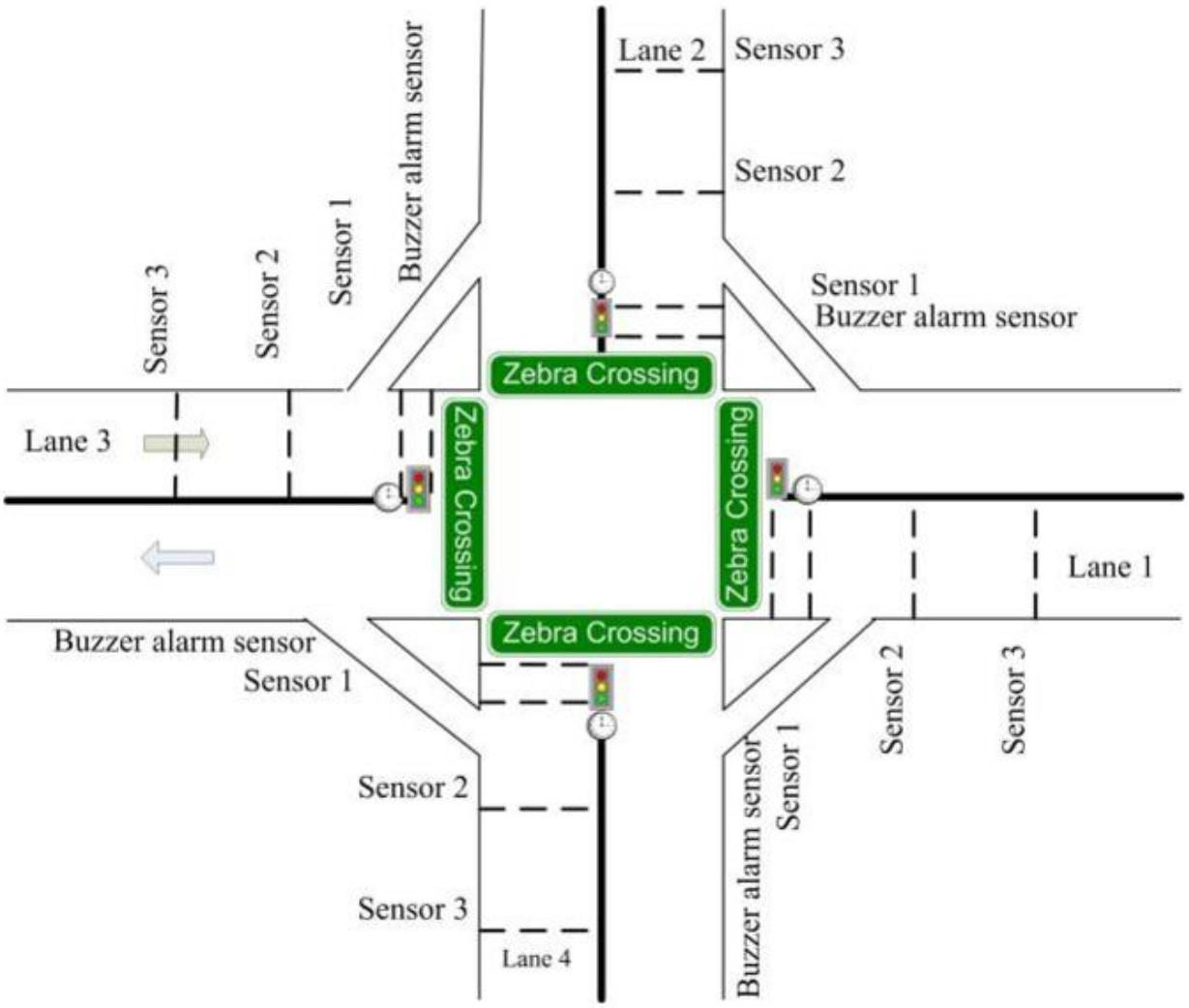


Fig 1 The model of the system

Fig 3.3

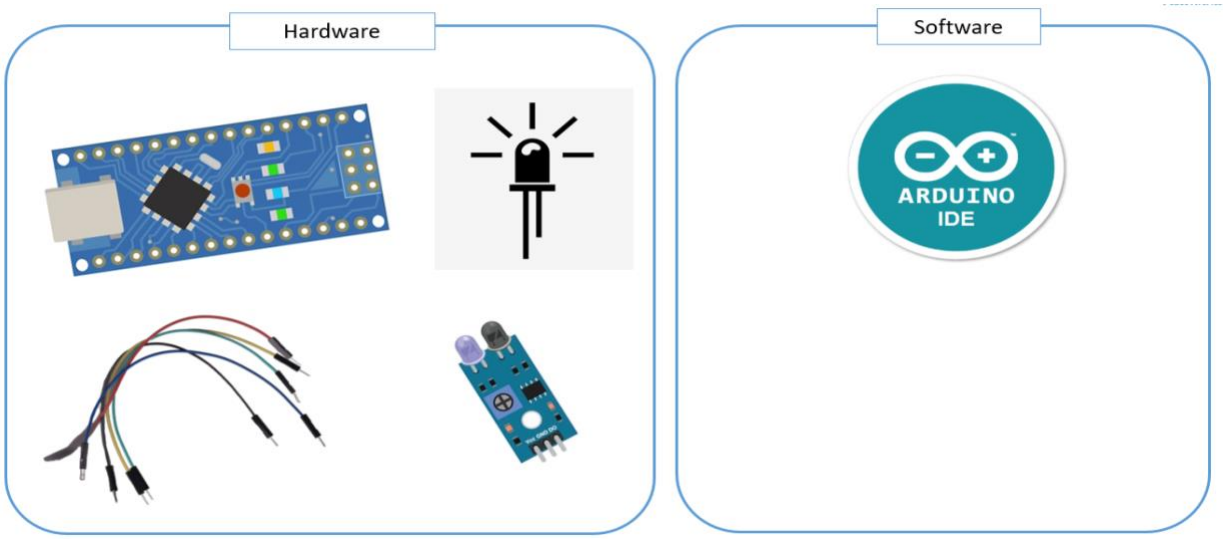
3.3 Software and Hardware Requirement

Hardware requirements:

Laptop/Desktop PC: This system is going to use the Windows desktop system as a server. On this server, we will store the data.

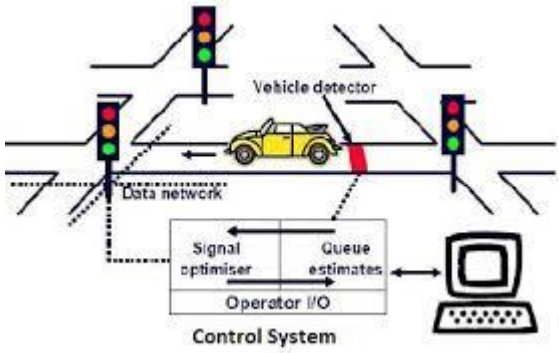
Software requirement

Operating System: - Any Operating System (OS) which can support Arduino IDE for



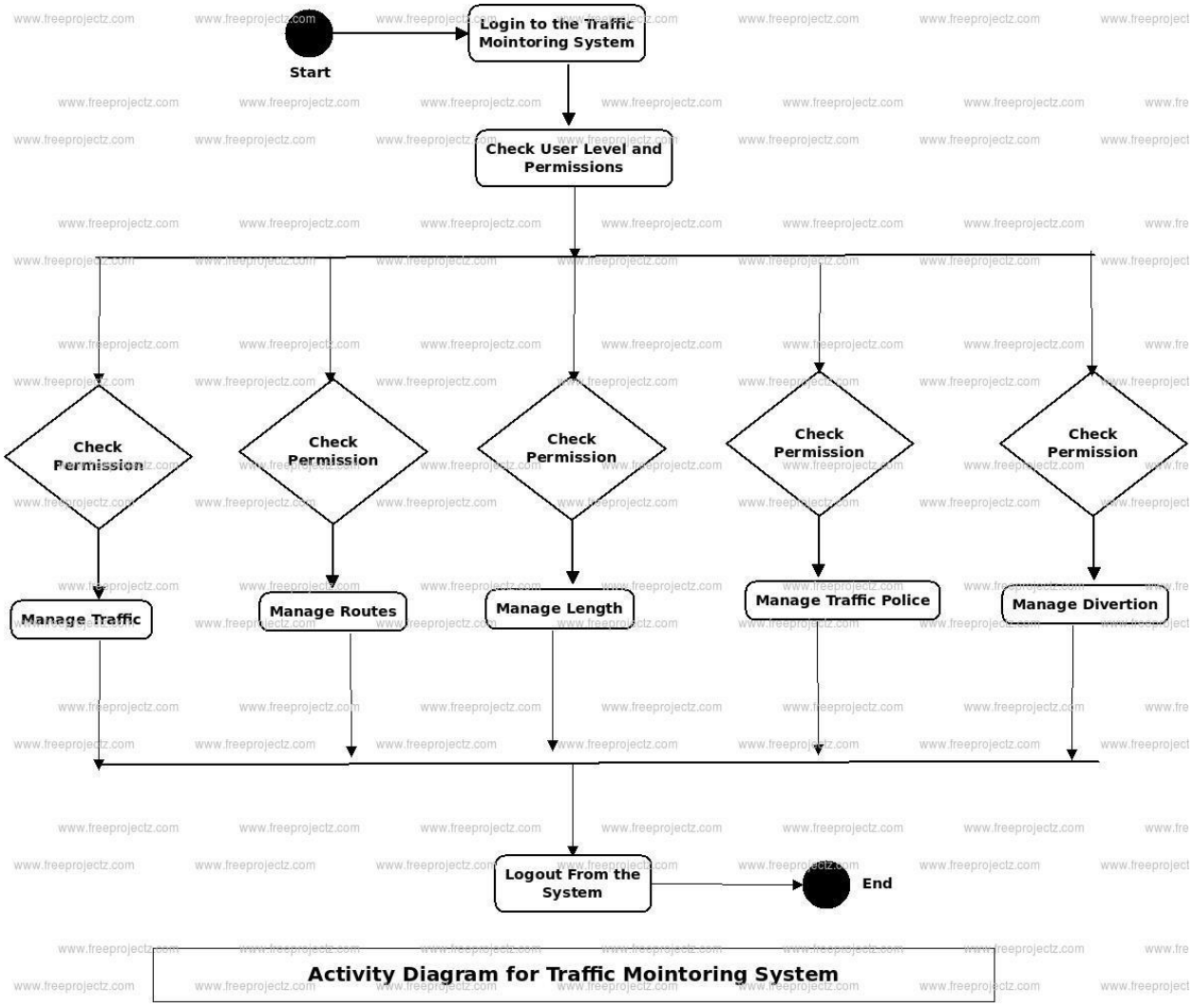
CHAPTER 4 SYSTEM DESIGNS

4.1 Basic Modules



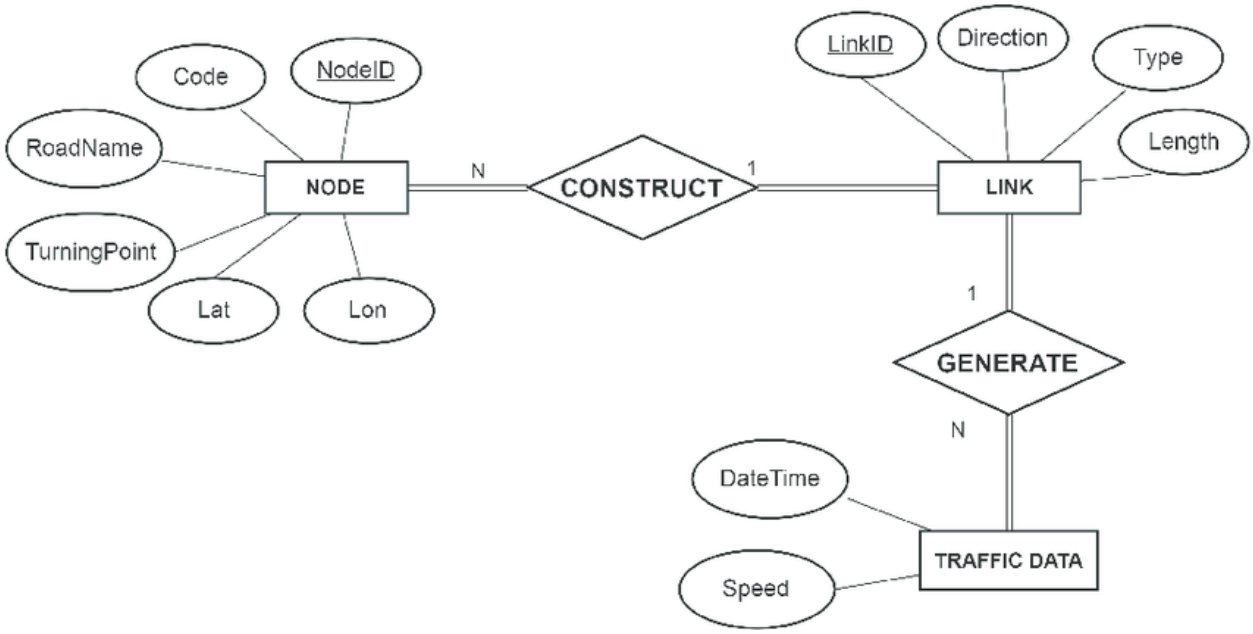
Traffic monitoring is one of the major factors in the smart or intelligent traffic management system. It deals with vehicle to vehicle communication and vehicle to various infrastructure communications for enhancing the availability of road ways to the user instead of construction of new road ways that needs major financial budget from the government for construction and maintenance.

4.2.1 Schema Design

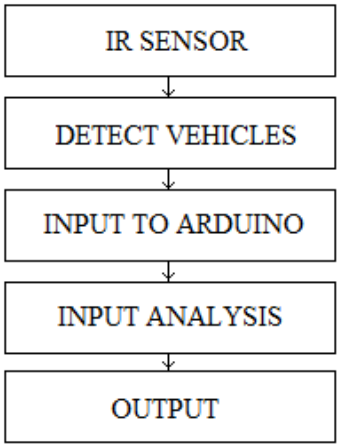


Activity Diagram for Traffic Mointoring System

4.3.1 ER Diagram



4.3.2 Data Flow Diagram



4.3.3 Sequence Diagram

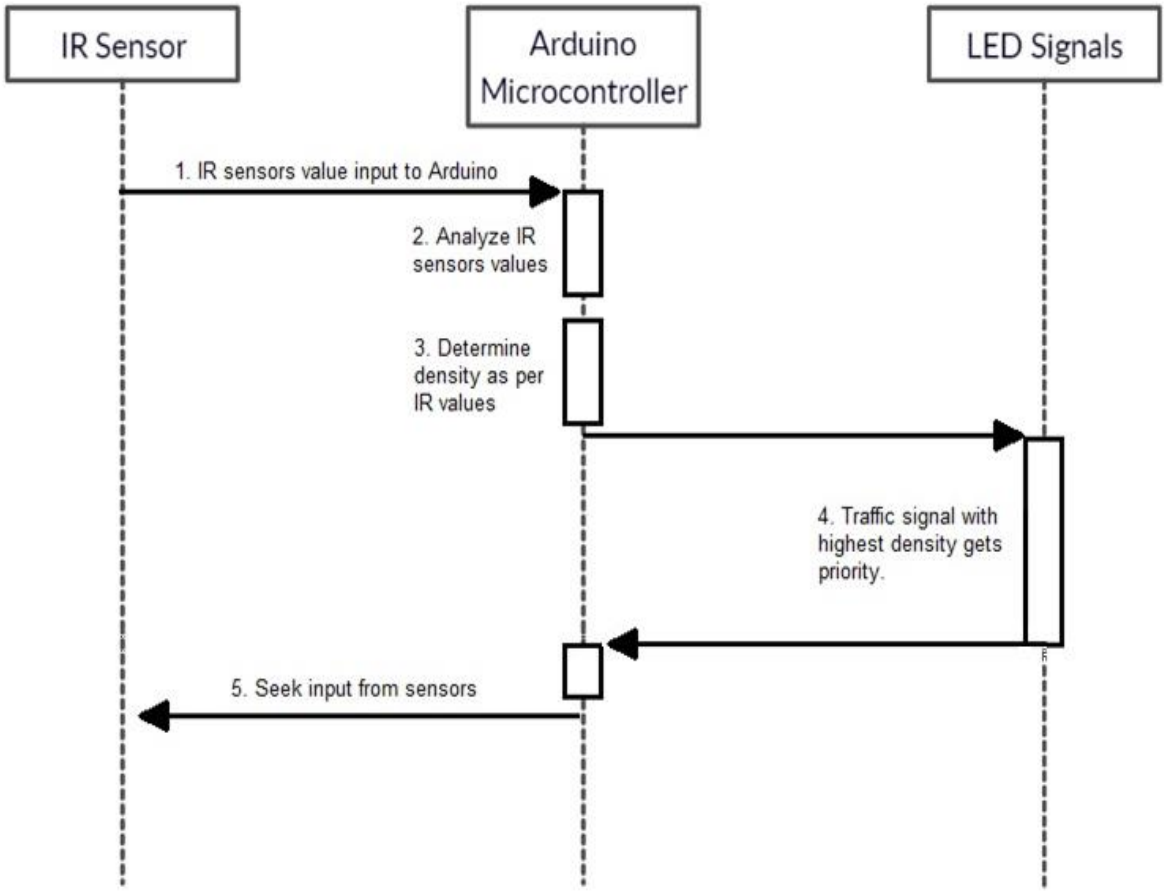
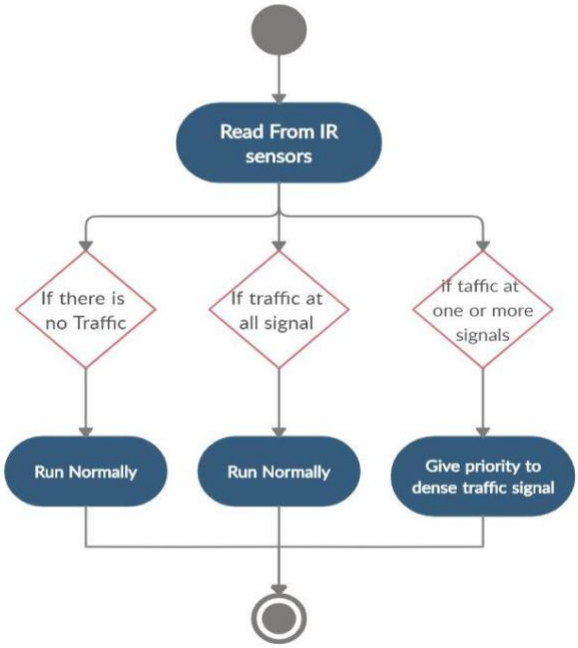
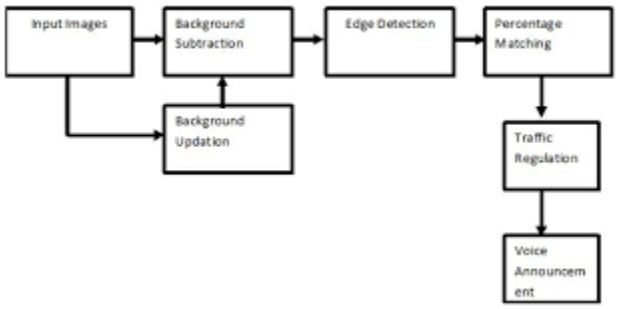


Fig 4.3.3

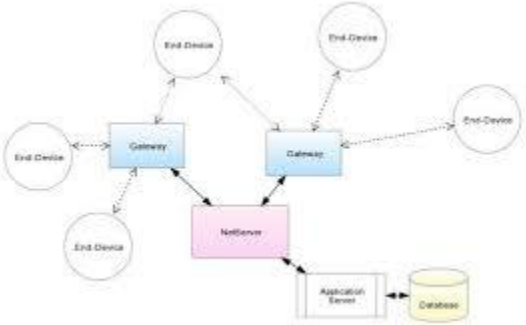
4.3.4 Activity Diagram



4.3.5 Component Diagram



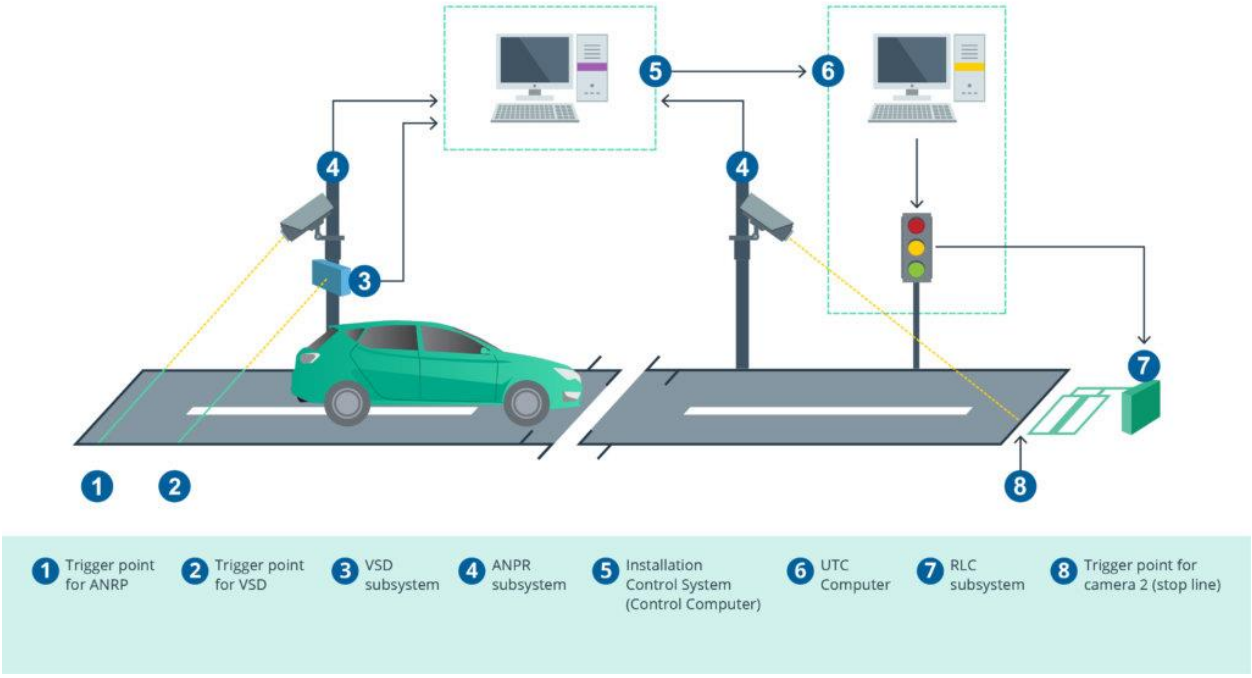
4.3.6 Menu Tree



4.3.7 Event Table

Cycle	Road 1	Road 2	Road 3	Road 4	Time Period
1st (Conventional)	15 sec 5 sec	20 sec 5 sec	40 sec	60 sec	60 sec
2nd (Conventional)	60 sec	15 sec 5 sec	20 sec 5 sec	40 sec	60 sec
3rd (Adaptive)	30 sec	50 sec	5 sec 5 sec	10 sec 5 sec	50 sec
4th (Adaptive)	15 sec 5 sec	35 sec	55 sec	10 sec 5 sec	55 sec

4.3.8 User Interface Design



4.3.10 Security Issues

Lack Of User Knowledge & Awareness

Over the years, Internet users have learned how to avoid spam or phishing emails, perform virus scans on their PCs, and secure their WiFi networks with strong passwords.

But IoT is a new technology, and people still do not know much about it. While most of the risks of IoT security issues are still on the manufacturing side, users and business processes can create bigger threats. One of the biggest IoT security risks and challenges is the user's ignorance and lack of awareness of the IoT functionality. As a result, everybody is put at risk.

IoT Security Problems In Device Update Management

Another source of IoT security risks is insecure software or firmware. Although a manufacturer can sell a device with the latest software update, it is almost inevitable that new vulnerabilities will come out.

Updates are critical for maintaining security on IoT devices. They should be updated **right after new vulnerabilities are discovered.** Still, as compared with smartphones or computers that get automatic updates, some IoT devices continue being used without the necessary updates.

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