A PROJECT REPORT

on

"ADVANCED TRAFFIC MANAGEMENT SYSTEM USING CLOUD"

Submitted to

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In Partial Fulfillment of the Requirement for the Award of

BACHELOR'S DEGREE IN COMPUTER SCIENCE AND ENGINEERING

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CERTIFICATE

This is certify that the project entitled

"ADVANCED TRAFFIC MANAGEMENT SYSTEM USING CLOUD"

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is a record of bonafide work carried out by them, in the partial fulfillment of the requirement for the award of Degree of Bachelor of Technology(Computer Science & Engineering) at KIIT Deemed to be University, Bhubaneswar. This work is done during year 2023-2024, under our guidance.

Date: / /

(DR SUBHRANSHU SEKHAR TRIPATHY)
Project Guide

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ABSTRACT

The primary objective of the project is to enhance the functionality of the traffic management system by employing Internet of Things (IoT) and infrared sensor technology, thereby ensuring greater efficiency in traffic flow. Existing traffic management automation systems typically rely on periodic operations to control traffic lights, utilizing technologies such as GSM and NFC to manage the basic switching between red and green lights.

Our project aims to introduce an automated solution based on IR sensors, enabling traffic signals to adjust dynamically between red and green lights. Initially, we plan to implement this solution at a single junction as a 'proof-of-concept.' This implementation will involve the integration of traffic lights, IR sensors, a Wi-Fi transmitter, and an Arduino micro-controller. The IR sensor data will be collected and transmitted via the Wi-Fi transmitter to the Arduino controller. Using this data, the system will dynamically adjust the timing of red signals, providing users with real-time updates on signal status. The Arduino controller will serve as a central console, determining the opening and closing of road signals. Additionally, it will aggregate sensor data and store it in the cloud, enabling mobile devices to access real-time traffic status updates and facilitating priority passage for emergency vehicles such as ambulances.

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CHAPTER 1 INTRODUCTION

The Advanced Traffic Management System (ATMS) plays a crucial role within the broader framework of the Intelligent Transportation System (ITS). Its primary focus is leveraging technology to regulate traffic flow and enhance safety. Real-time data sourced from various devices like cameras and speed sensors is collected and processed at a Transportation Management Center. This data serves to identify incidents and prompt actions, such as rerouting traffic or displaying messages on dynamic message signs, all aimed at improving traffic flow. The National ITS Architecture sets forth fundamental objectives and metrics for ITS, encompassing the ATMS.

ATMS represents a holistic solution for managing highway traffic by gathering, processing, analyzing, and disseminating real-time data to users, organizations, and stakeholders. The provision of accurate and timely information regarding road conditions, traffic, incidents, and weather is crucial for ensuring safety at all times. Interventions are also vital to maintaining smooth, safe, and efficient traffic flow, which may involve offering assistance to users to alleviate congestion.

1.1. Existing System

Contemporary traffic management methods, such as magnetic loop detectors embedded in roads and infrared and radar sensors, offer limited traffic data and necessitate separate systems for both counting and surveillance. Our research was prompted by the persistent use of timer-based signal allocation in many cities worldwide. However, the timer approach has a drawback: even when a road experiences low traffic, it maintains a green signal until its timer runs out, whereas a busier road is subjected to a red signal, resulting in congestion and delays for commuters. Furthermore, most existing systems lack automation and are susceptible to human errors.

Our approach integrates surveillance and traffic control technologies to provide more comprehensive information. These systems are easy to install and can be scaled up with advancements in image processing techniques, offering a promising solution to current traffic management challenges.

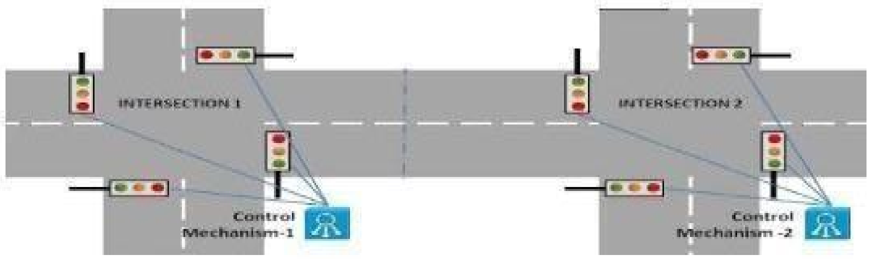

Fig 1.1: Block diagram of the existing traffic control system.

The objective of this paper is to evaluate the process, advantages, and drawbacks associated with utilizing image processing for traffic management. By implementing our project, the necessity for traffic personnel at various junctions to manage traffic could be eliminated, rendering this technology invaluable for analyzing and enhancing road traffic performance overall. Moreover, prior research has investigated the prioritization of emergency vehicles, adding to the potential benefits of our proposed approach.

1.2. Proposed System

One proposed approach for identifying these vehicles relies on Radio-Frequency Identification (RFID). However, the implementation of this technology necessitates additional hardware to be installed at each junction and in every vehicle, which might be deemed unnecessary. Alternatively, research has investigated the identification of these vehicles by analyzing vehicle counts through sensors and employing an android application control system.

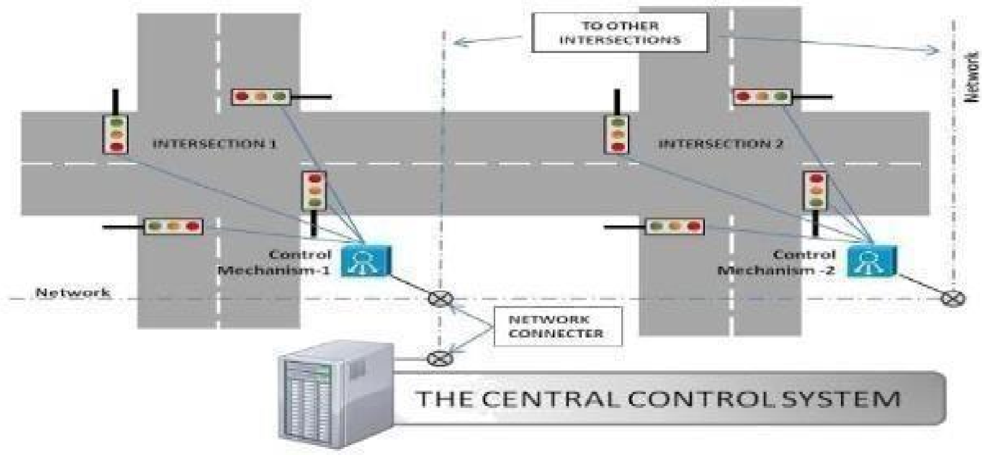

Fig 1.2: Block diagram of the proposed traffic control system.

Nevertheless, this technology is also susceptible to the accuracy of vehicle count and demands supplementary hardware for implementation.

1.1. Problem Definition

The objective of this challenge is to develop a series of machine models for traffic flow management at a four-way intersection controlled by traffic lights. We assume a consistent road layout and a regular sequence of signal switching from red to green to amber. Moreover, we presume that drivers adhere to traffic regulations, and the system layout aims to prevent collisions, facilitate ambulance passage, and furnish real-time traffic data to relevant authorities.

Our research motivation arises from the prevalent use of timer-based signal allocation in numerous cities globally. However, the timer approach has a drawback: even if a road experiences low traffic, it maintains a green signal until its timer expires, while a busier road faces a red signal, leading to congestion and commuter delays. Additionally, most existing systems lack automation and are prone to human errors.

One manual method employed by traffic inspectors is to yield to ambulances manually and reset the timer signal system after permitting ambulance passage.

1.2. Objective of the Project

- The main objective of this project is to enhance the efficiency of the city's road network system to ensure smoother traffic flow and boost overall productivity. This encompasses several key goals:

- - Smooth and Uninterrupted Traffic Flow: This involves analyzing the interactions among vehicles, drivers, and infrastructure to devise an optimized road network that reduces congestion and facilitates seamless traffic movement.

- - Increase in Transportation System Efficiency: The aim is to enhance energy efficiency in transportation by maximizing the distance traveled by passengers or goods relative to the energy consumed.

- - Reduction in Journey Time and Inconvenience: The motivation behind this research is the prevalent use of timer-based signal allocation in many cities worldwide. The drawback of this timer approach is that even when a road has low traffic, it retains a green signal until its timer expires, causing congestion and delays for commuters on busier roads facing red signals. Most existing systems lack automation and are prone to human errors.

- - Enhancement of Road Safety: Measures will be implemented to enhance road safety, including the installation of road safety barriers to protect drivers and vehicles, thereby improving overall safety on the roads.

- - Smart Mobility: The project aims to develop a smarter road network system to optimize traffic flow and enhance the city's overall productivity.

CHAPTER 2 LITERATURE REVIEW

Traffic congestion is a temporary phenomenon observed on road networks, occurring as demand increases, and is marked by reduced speeds, longer travel durations, and heightened queuing. It arises when the volume of traffic is sufficiently high and diverse, causing interactions between vehicles to impede traffic flow. As demand nears the capacity of a road or its intersections, congestion ensues. In situations where vehicles come to a complete standstill for a prolonged period, this is commonly referred to as a traffic jam.

2.1. GEOGRAPHIC INFORMATION SYSTEM (GIS)

GIS, or Geographic Information System, is a computerized tool utilized for mapping and analyzing Earth's features and processes. It combines database functionalities such as querying and statistical analysis with the advantages of mapping and landscape analysis. This unique capability distinguishes GIS from other information systems and renders it highly valuable for a wide array of applications, including event interpretation, outcome prediction, and planning strategies (Moses Santkumar, 2010). The concept has demonstrated its indispensability in addressing real-world issues, ranging from tracking controlled delivery vehicles to modeling global atmospheric circulation. Unlike traditional static paper maps, GIS has the capacity to display multiple layers of information simultaneously, offering a novel approach to integrating, visualizing, manipulating, and managing data. This enables GIS to map, integrate information, visualize scenarios, solve complex problems, draw powerful inferences, and provide effective development solutions that were previously unattainable.

2.2. STUDY OF RISK CRETERIONS

As described in the preceding paragraphs, there are multiple steps involved in identifying the particular shapes and configurations that lead to accidents and examining the actual factors contributing to risk. The overlapping shapes are categorized into four groups: geometric properties, traffic characteristics, land use, or road characteristics.

2.2.1. Geometric characteristics

Geometric characteristics pertain to the geometric attributes of the roadway that impact the level of service of the link. These characteristics encompass the static features of the road infrastructure.

- - Roadway width in meters (RW).
- - Carriageway width in meters (CW).
- - Stopping sight distance in meters (SSD).
- - The number of curves on the link (NC).

2.2.2. Traffic characteristics

- Traffic characteristics encompass the dynamic attributes of the road that impact the level of service of the link. These characteristics are:
- - Headway in seconds (H).
- - V/C Ratio (VCR).
- - The intensity of Parking (PBE), business activities, and roadside activities encroachments on a point scale.
- - Speed in kmph (V).
- - Delay in seconds (D).

Traffic characteristics are indeed intricate, given the diverse types of road users with varying motives. The examination of vehicular characteristics is a fundamental aspect, and conducting various studies on actual traffic involves analyzing traffic flow.

2.2.3. Land use or Roadside characteristics

These static elements of the link significantly impact the operational efficiency of the link:\

- \- Quantity of access points on the link (NA)
- \- Commercial area along the roadside of the link in sq. km (CA)
- \- Residential area along the roadside of the link in sq. km (RA)
- \- Semi-residential area along the roadside of the link in sq. km (SRA)
- \- Industrial area along the roadside of the link in sq. km (IA)

This data is gathered from satellite imagery, field surveys, and municipal authorities..

2.2.4. Utility characteristics

Utility characteristics of the link provide insights into the degree of utility of the link, considering both static and dynamic analyses.

- \- Overlap size of the link from static analysis (OS)
- \- Trip intensity on the link (TI) in trips per day

These utility characteristics are gathered from field observations and Origin-Destination (OD) surveys.

CHAPTER 3 SYSTEM REQUIREMENTS

When acquiring software or hardware for our computer, it's crucial to ensure that our computer meets the system requirements. Every computer software relies on specific hardware components or software resources to function properly. These prerequisites are referred to as system requirements and are typically provided as guidelines rather than strict mandates. The majority of software typically outlines two sets of system requirements: minimum and recommended. As newer versions of software demand greater processing power and resources, system requirements tend to escalate over time.

System requirements can be categorized into two primary groups: hardware and software requirements. The former outlines the minimum hardware specifications required in a system for the project to operate smoothly. The latter specifies the essential software components necessary to construct and execute the project.

3.1. Hardware Requirements

The most common set of requirements specified by any operating system or software application relates to the physical resources of the computer, often referred to as hardware. A hardware requirements list typically accompanies hardware compatibility (HCL) information.

3.1.1. Arduino Uno R3

The Arduino Uno R3 is a microcontroller board centered around the Atmega328P chip. It is widely favored by beginners and hobbyists owing to its user-friendly nature and diverse array of applications. Here are its key features:

- - Digital I/O Pins: 14 (6 of which can function as PWM outputs)
- - Analog Input Pins: 6
- - Clock Speed: 16 MHz
- - Flash Memory: 32 KB (Atmega328P), with 0.5 KB utilized by the bootloader
- - SRAM: 2 KB
- - EEPROM: 1 KB

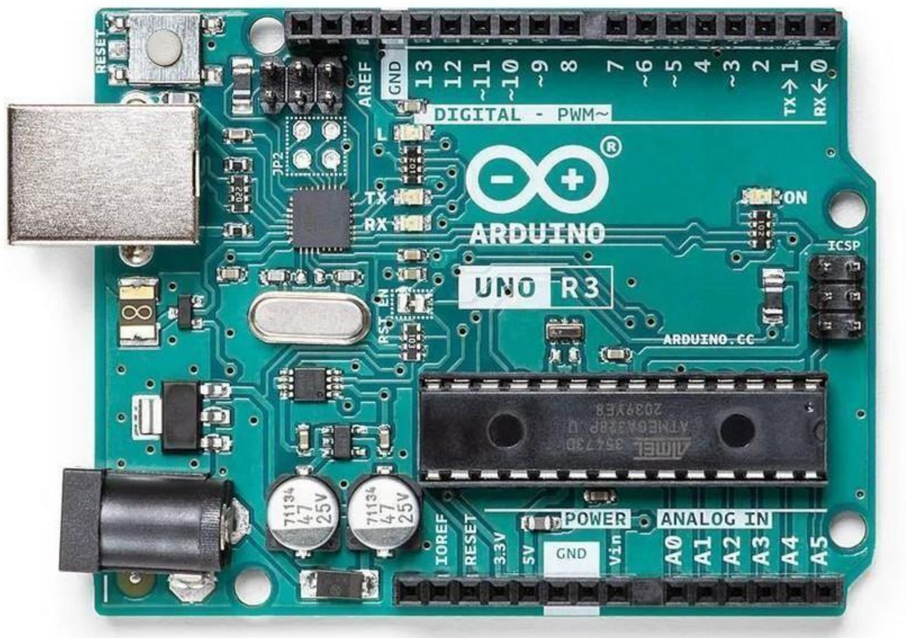

Fig 3.1: Arduino Uno R3 microprocessor board.

- Input Voltage (limits): 6-20 V
- Operating Voltage: 5V

Additionally, the Arduino Uno R3 features a USB connection, a power jack, an ICSP (In-Circuit Serial Programming) header, and a reset button. Designed with simplicity in mind, it is tailored for individuals new to electronics and coding. Users can begin experimenting with the Uno confidently, as the microcontroller chip is replaceable if necessary.

3.1.2. IR Sensors

An infrared sensor is an electronic device that emits and detects infrared radiation to perceive various aspects of its surroundings. It has the capability to measure the heat emitted by an object and detect motion. Passive infrared (PIR) sensors, in particular, only measure infrared radiation emitted by objects in their field of view, without emitting any infrared radiation themselves.

Fig 3.2: IR Sensors.

IR LED Transmitter: IR LEDs emit light within the infrared frequency range. This light is invisible to the human eye because its wavelength (ranging from 700nm to 1mm) is higher than that of visible light. IR LEDs typically have a light-emitting angle of approximately 20-60 degrees and a range varying from a few centimeters to several feet, depending on the type of IR transmitter and the manufacturer. Some transmitters even have ranges extending to kilometers. IR LEDs are often white or transparent in color, allowing them to emit the maximum amount of light.

Photodiode Receiver: A photodiode serves as the IR receiver as it becomes conductive when exposed to light. The photodiode is a semiconductor device with a P-N junction that operates in reverse bias. When light strikes the photodiode, it starts conducting current in the reverse direction, and the magnitude of current flow is directly proportional to the intensity of the incident light. This characteristic makes it well-suited for IR detection. Physically, a photodiode resembles an LED, but it typically features a black coating on its outer surface. The black color helps absorb a higher amount of light, enhancing the photodiode's sensitivity to IR radiation.

Variable Resistor: The variable resistor mentioned here is utilized for calibration purposes, specifically to adjust the distance range at which the object should be detected. The system operates with a 5VDC operating voltage, and its input/output (I/O) pins are compatible with both 5V and 3.3V levels.

Features of IR sensor module

Here are the specifications for the device:

- - Operating Voltage: 5VDC
- - I/O Pins Compatibility: Compatible with both 5V and 3.3V levels
- - Sensing Range: Up to 20cm
- - Adjustable Sensing Range
- - Built-in Ambient Light Sensor
- - Supply Current: 20mA
- - Mounting Hole: Present

Applications of IR sensor module

- - Automatic Door: Utilizes infrared or microwave sensors to detect the presence of a human body and open/close the door accordingly.
- - Smoke Alarm: Utilizes smoke resistance sensors to measure the concentration of smoke in the air and trigger an alarm when smoke is detected.
- - Mobile Phones & Digital Cameras: Utilize optical sensors, such as image sensors, to capture images and videos.
- - Electronic Scale: Utilizes mechanical sensors, such as conductor strain gauge technology, to measure the pressure exerted by an object, which correlates to the variable being measured, such as weight.
- - Water Level Alarm: Utilizes water level sensors to detect the level of water in a container or reservoir and trigger an alarm when the water level reaches a certain threshold.
- - Temperature Alarm: Utilizes temperature sensors to measure the ambient temperature and trigger an alarm when the temperature exceeds or falls below a preset threshold.
- - Humidity Alarm: Utilizes humidity sensors to measure the humidity level in the air and trigger an alarm when the humidity exceeds or falls below a preset threshold.
- - Optical Alarm: Utilizes optical sensors to detect changes in light intensity or presence of specific light patterns, which can be used for various alarm applications, such as intrusion detection or fire detection.

3.2. Software Requirements

Software requirements encompass defining the necessary software resources and prerequisites required for optimal functioning of an application on a computer. These requirements or prerequisites are typically not bundled within the software installation package and must be installed separately prior to installing the software.

3.2.1. Languages Used

In computer science, a high-level programming language is characterized by its strong abstraction from the intricacies of the computer's hardware. Unlike low-level programming languages, high-level languages often incorporate elements of natural language, making them easier to use. They may also automate or conceal significant aspects of computing systems, such as memory management, thereby simplifying and enhancing the understanding of the programming process compared to lower-level languages. The degree of abstraction offered determines the "high-level" nature of a programming language.

C

The C programming language, created in the early 1970s by Dennis Ritchie at Bell Labs, is renowned for its procedural and structured nature, featuring a static type system. It supports structured programming, lexical variable scope, and recursion, and is primarily designed for compilation to afford low-level access to memory and efficient mapping to machine instructions. The language's impact is pervasive, evident in numerous other languages such as C++, Java, and Python. Recognized for its efficiency and meticulous control over system resources, C is particularly well-suited for firmware development or crafting portable applications, retaining its status as one of the most widely used programming languages worldwide.

3.2.2. Application software

Application software, often referred to as apps, encompasses programs or collections of programs tailored for end-users. Examples include word processors, spreadsheets, accounting software, web browsers, email clients, media players, file viewers, flight simulators, console games, and photo editors. The term "application software" collectively denotes all such applications. This is distinct from system software, which primarily handles the operation of the computer.

Applications may be bundled with the computer and its system software, or they may be distributed separately. They can be proprietary, open-source, or developed as university projects. Applications developed for mobile platforms are referred to as mobile apps.

Firebase: Firebase is a comprehensive mobile and web app development platform that equips developers with a wide range of tools and services to facilitate the creation of high-quality applications, expand their user base, and increase revenue. By offering essential features, Firebase enables businesses to monetize their products effectively while prioritizing user experience.

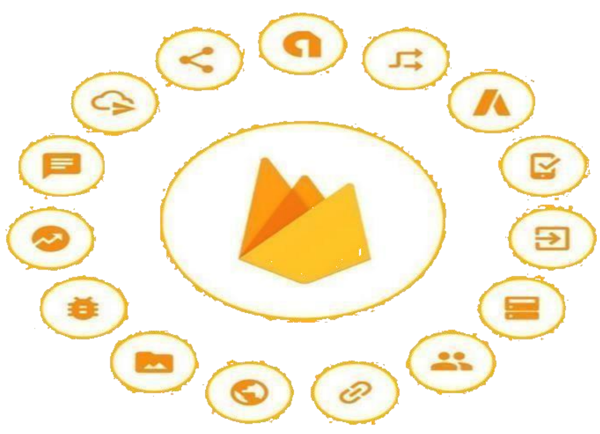

Fig 3.3: Firebase applications.

Firebase is a mobile and web app development platform that offers developers a rich array of tools and services to create high-quality applications, expand their user base, and increase profitability. Interestingly, before it became Firebase in 2011, it started as a startup named Evolve. Initially, Evolve provided developers with an API for integrating online chat functionality into their websites. However, developers began utilizing Evolve to synchronize application data, such as game states, in real-time across users. Recognizing this trend, Evolve's founders, James Templin and Andrew Lee, decided to separate the chat system from the real-time architecture. In April 2012, Firebase was established as an independent company, offering Backend-as-a-Service with real-time capabilities.

Following its acquisition by Google in 2014, Firebase underwent rapid evolution, transforming into the multifunctional mobile and web platform it is today. Among its many features, the Firebase Realtime Database stands out as a cloud-hosted NoSQL database enabling real-time data storage and synchronization among users. Managed as a single large JSON object, developers can manipulate the Realtime Database in real-time to enhance their applications.

CHAPTER 4 SYSTEM DESIGN

The project comprises six primary phases. Initially, we gather vehicle density information using IR sensors at 10-second intervals. The data collected from the sensors is then transmitted to the Google Cloud using a real-time database bucket ID allocated in the Google Cloud Traffic. Within this database, density is updated under nodes labeled signal1, signal2, signal3, and signal4. Each node contains child nodes representing different traffic densities, categorized as loose, moderate, and congested. This experiment focuses on evaluating traffic density under these three distinct conditions.

4.1. System Architecture

The module implements a density-based traffic control system utilizing IR technology. The PIC architecture, known for its efficiency, is employed for low-end security systems, while IR technology serves as a widely adopted communication method. The current work emphasizes the effective utilization of IR and PIC controllers for digital security systems, aiming to enhance the functionality and reliability of traffic control systems.

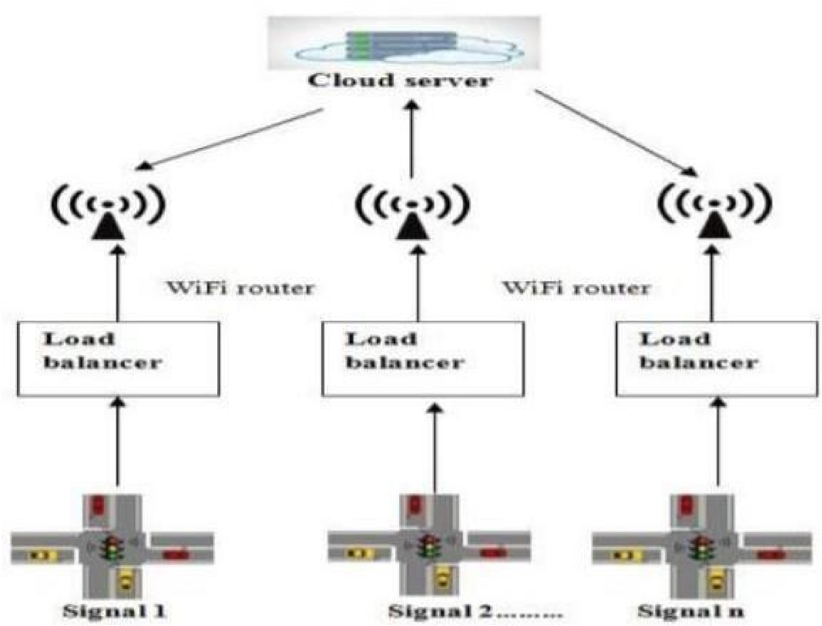

Fig 5.1: Block diagram of the advanced traffic management system.

The proposed system aims to provide real-time vehicle count information for each side of a junction when vehicles are in proximity to the junction. Upon connecting and coding the circuit, it undergoes testing using IR sensors. These sensors utilize optoelectronic principles for photodetection. During testing, it's crucial to align the transmitter and receiver in a straight position facing each other to ensure proper functionality.

The system encompasses hardware and software components required for traffic control. The hardware typically includes IR sensors, PIC controllers, and possibly additional components like LEDs or LCD displays for output visualization. Software requirements entail coding the PIC controllers to process sensor data and manage traffic flow effectively.

The output of the system for a given input would be real-time vehicle count information for each side of the junction. This data can be displayed on an output device, such as an LCD display or sent to a remote server for further analysis.

4.2. Flow Diagram

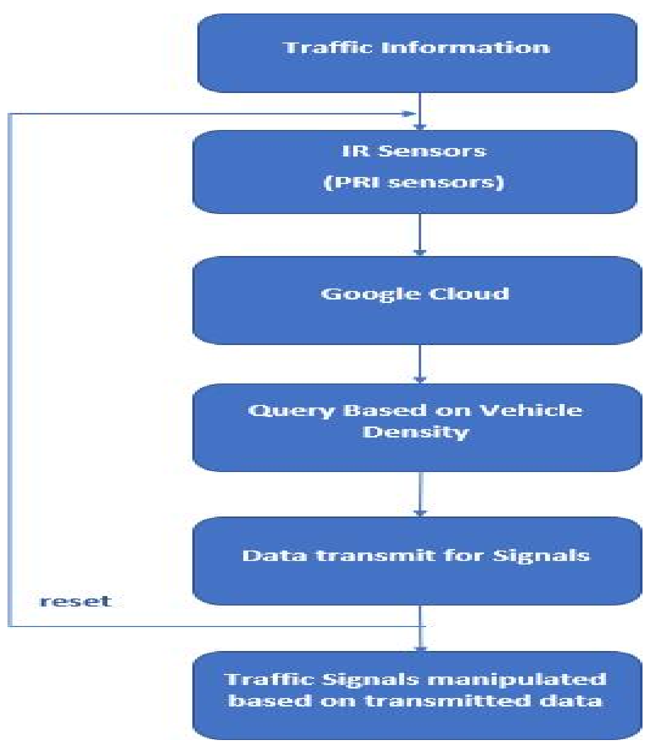

Fig 5.2: Flow chart of an advanced traffic management system.

Based on the three traffic conditions—Loose, Moderate, and Congested—the system queries the Google Cloud for relevant information. Signals are then manipulated based on the data received from the Google Cloud. Finally, the system iterates through this process, transmitting control back to the top of the flowchart.

- - Loose: Indicates low vehicle density.
- - Moderate: Indicates moderate vehicle density, higher than in the Loose case.
- - Congested: Indicates high vehicle density, exceeding a predefined limit.

The module implements a density-based traffic control system using IR technology. The PIC architecture, known for its efficiency, is utilized for low-end security systems, while IR technology serves as a widely adopted communication method. The current work emphasizes the effective utilization of IR and PIC technologies to enhance traffic control systems.

The proposed traffic control system aims to provide real-time vehicle counts for each side of a junction when vehicles approach the area. Upon connection and coding of the circuit, testing is performed using IR sensors. These sensors utilize optoelectronic principles for photodetection. During testing, it's crucial to maintain alignment between the transmitter and receiver, ensuring accurate sensing.

CHAPTER 5 IMPLEMENTATION

The proposed system aims to detect vehicles using Radio-Frequency Identification (RFID), but this technology requires additional hardware installation at junctions and in vehicles, which may be deemed unnecessary. Another approach involves analyzing the sound of vehicle sirens, but this method can be affected by noise and requires additional hardware at traffic signals.

In contrast, our project proposes an automated solution based on IR sensors to dynamically adjust traffic signals. This system utilizes IR sensors, Wi-Fi transmitters, and Raspberry Pi microcontrollers to gather and transmit data. The IR sensor detects vehicle presence, and the data is transmitted via Wi-Fi to the Raspberry Pi controller. Based on this data, the system dynamically adjusts traffic signal timings.

In our proof-of-concept implementation for one junction, traffic lights, IR sensors, Wi-Fi transmitters, and Raspberry Pi microcontrollers will be deployed. The Raspberry Pi controller serves as a central console, determining signal timing for each road direction. Data from sensors is collected and stored in the cloud, providing real-time traffic status updates to mobile devices.

This system offers a more efficient and dynamic approach to traffic management compared to traditional automation systems, which often rely on periodic signal control using technologies like GSM and NFC. By leveraging IR sensors and cloud-based data processing, our solution enhances traffic flow and improves overall transportation efficiency.

5.1. Module description

The module implements a density-based traffic control system using IR technology. The PIC architecture is chosen for its efficiency, particularly in low-end security systems, while IR technology is widely adopted for communication purposes. The focus of the current work is on effectively utilizing IR and PIC controllers for digital security systems.

The proposed system provides real-time vehicle counts for each side of a junction when vehicles are near the area. Once the circuit is connected and coded, testing is conducted using IR sensors. These sensors utilize optoelectronic principles for photodetection, with the transmitter and receiver aligned in a straight position during testing.

Hardware requirements for the system include IR sensors, PIC controllers, and possibly additional components such as LEDs or LCD displays for output visualization. Software requirements involve coding the PIC controllers to process sensor data and manage traffic flow effectively.

Overall, the system aims to improve traffic management by providing accurate vehicle count information in real-time. Through the utilization of IR technology and PIC controllers, the system offers a cost-effective and efficient solution for traffic control and management. It also explains the process of managing the traffic in a city bymaking a connection to the cloud server.

5.1.1. Vehicle Sensing

For practical applications, vehicles can be detected using appropriate sensors. However, in our demonstration, we utilized IR sensors for vehicle identification. Infrared (IR) sensors can be categorized into two types: active and passive. Active infrared sensors function by emitting energy from either a light-emitting diode (LED) or a laser diode. In non-imaging active IR detectors, an LED is employed, whereas an imaging active IR detector utilizes a laser diode. For typical IR sensors used in educational projects, the detection range typically spans up to 4–5 meters.

5.1.2. Signal Updating

In our project, the control flow operates in a round-robin fashion, moving through signals in a circular format. Initially, control is directed to signal one based on density. After execution, control flows to the next signal, and the value is updated in Firebase. The update is based on the density, which reflects the number of vehicles detected within a specific time interval. The density value is then stored in Firebase node in JSON (JavaScript Object Notation) format, organized as key-value pairs.

5.2. Code

```
#include <FirebaseArduino.h>

#include <IRremote.h>


const int IR_PIN = 2; const

int IR_PIN2 = 3; const int

IR_PIN3 = 13; const int

IR_PIN4 = 4;

int count1 = 0; int count2 = 0;

int count3 = 0; int count4 =

0; void setup() {

Serial.begin(9600);

Firebase.begin("https://minor1-
smarttrafficcontrol-default-
rtdb.asia-
southeast1.firebasedatabase.app
/","5b8dc9e18a9f00eaa8bfdc35
aa442eca383463d4");
```

```
pinMode(IR_PIN,
INPUT)Mode(IR_PIN2,
INPUT);

pinMode(IR_PIN3, INPUT);

pinMode(IR_PIN4, INPUT);

}


void loop() {

int something = digitalRead(IR_PIN);

int something1 =digitalRead(IR_PIN2);

int something2 =digitalRead(IR_PIN3);

int something3 = digitalRead(IR_PIN4);


if (something == LOW)

{ count1++;

handleTraffic("signal1", count1);

count1 = 0;

}

if (something1 == LOW)

{ count2++;

handleTraffic("signal2", count2);

count2 = 0;

}

if (something2 == LOW)
```

```
{ count3++;

handleTraffic("signal4", count3);

count3 = 0;

}

if (something3 == LOW)


{ count4++;

handleTraffic("signal3", count4);


count4 = 0;

//Delay to bouncing delay(100);

}

void handleTraffic(String
signalPath, int count) {

String trafficDensity;

 if (count < 2)

{ trafficDensity = "loose";

}
 else if (count >= 2 && count < 5)
 {

trafficDensity = "moderate";

} else if (count >= 5)

{ trafficDensity = "congested";

}
```

```
// Log to serial monitor

Serial.print(signalPath + " traffic density: ");

Serial.println(trafficDensity);

// Update Firebase

Firebase.setFloat(signalPath + "/density", trafficDensity);

}
```

5.3. RESULTS AND SNAPSHOTS

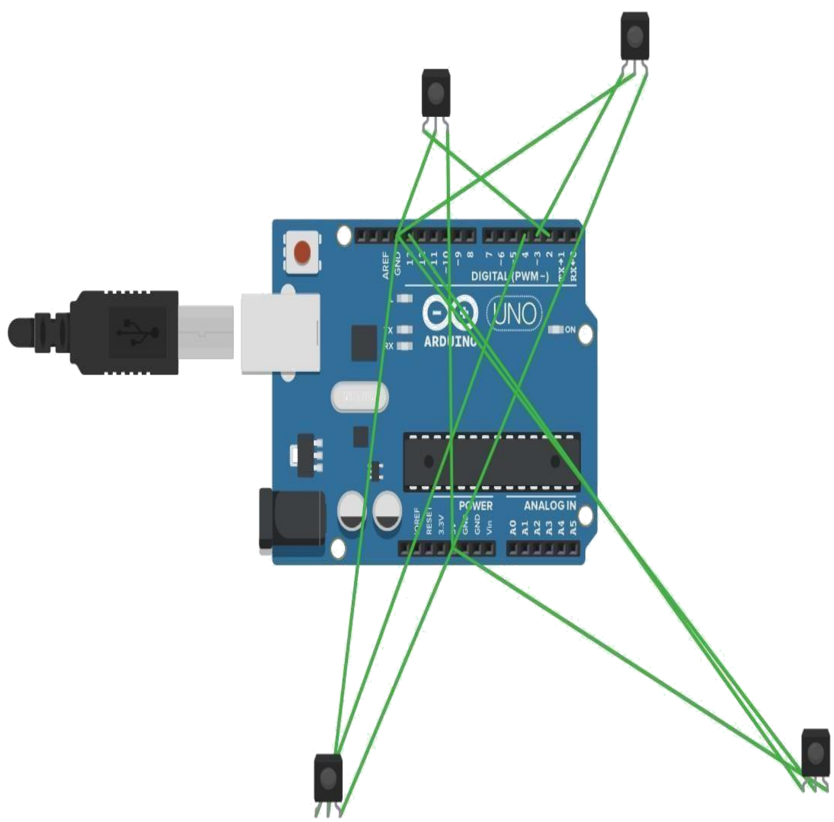

Fig 5.1 Circuit Design of Working Model

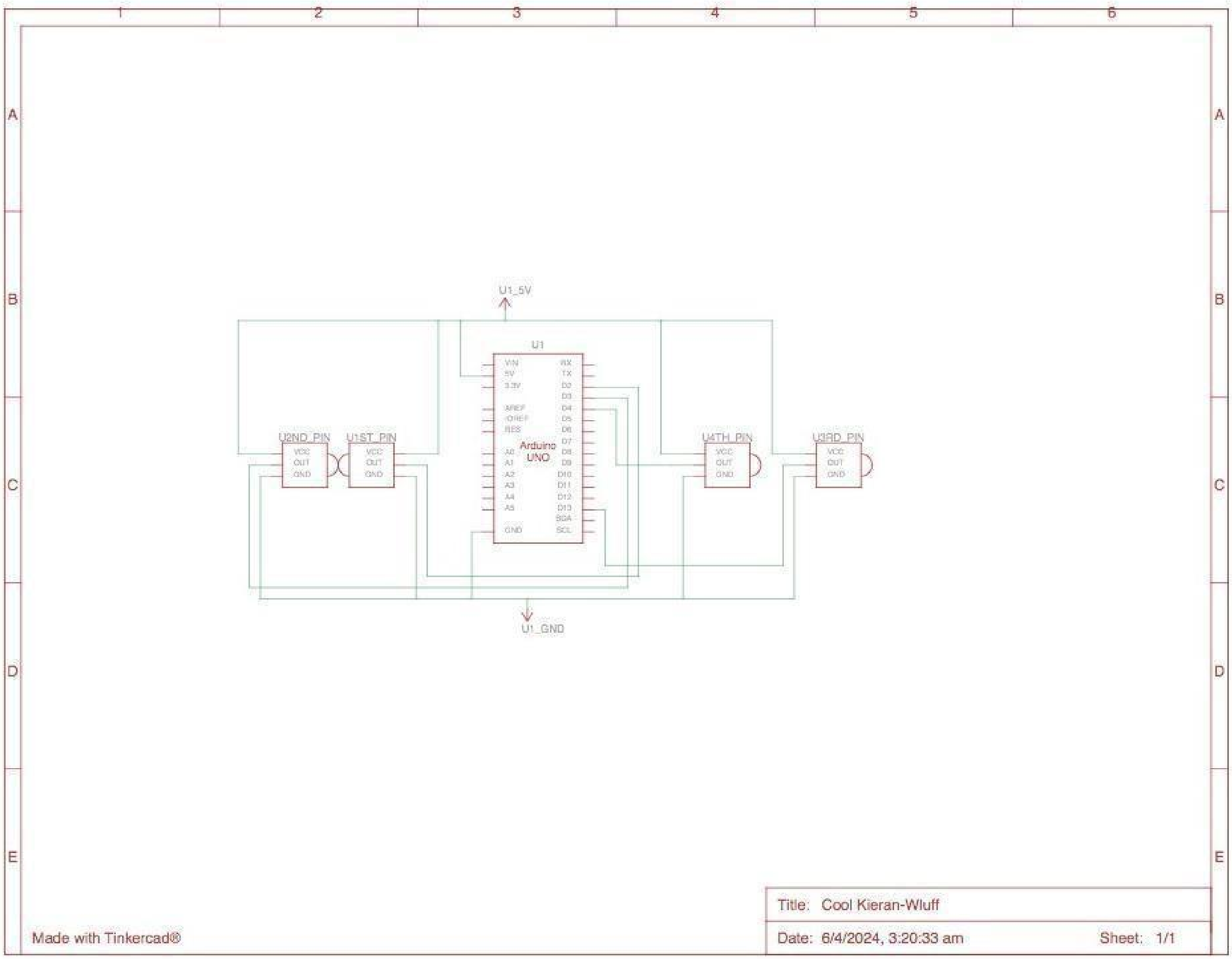

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Fig 5.2: Schematic View of Working Model

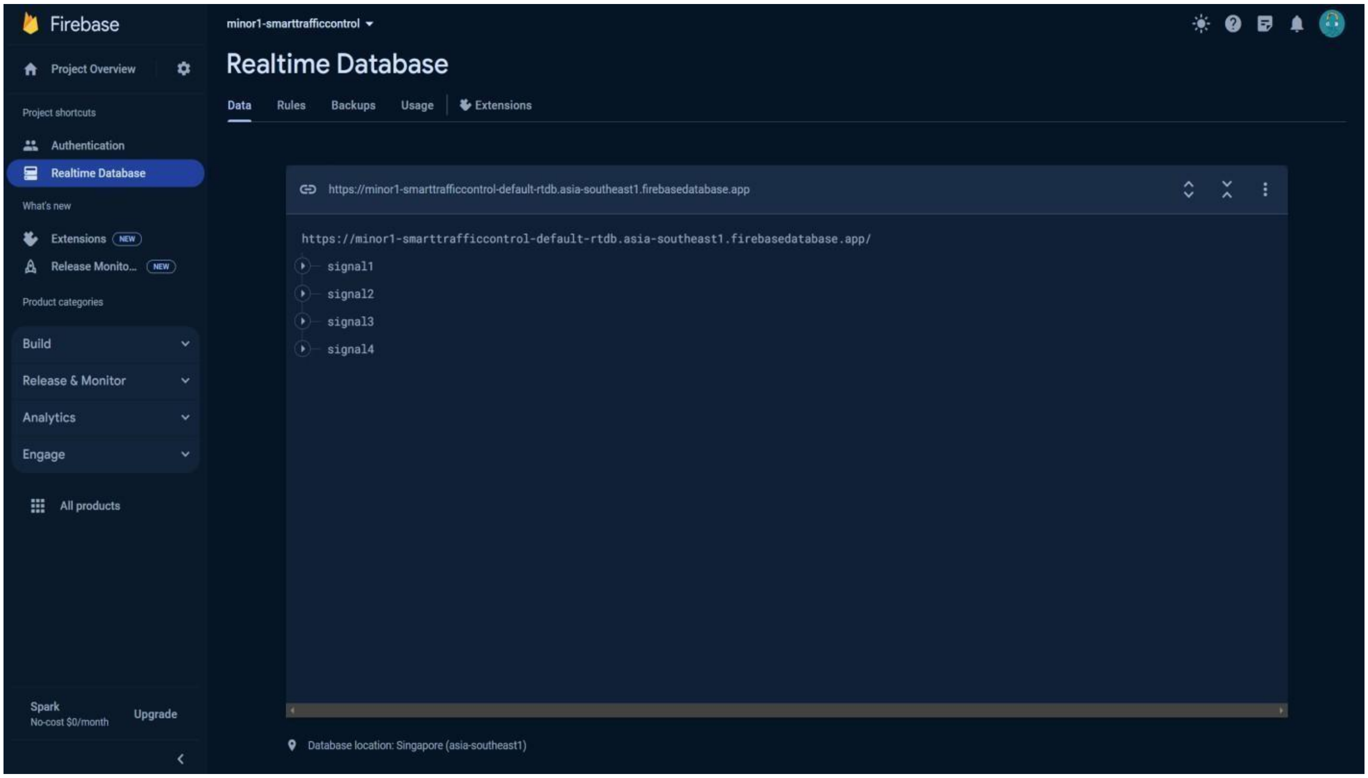

Fig 5.3: Dashboard of the Firebase Realtime Database.

Figure 6.4 illustrates the hierarchical structure of the data from each IR sensor stored in JSON format. The main root node is the signal name, while the density serves as a sub-node within it, containing the density value of the IR sensor.

Name	Quantity	Component
U1	1	Arduino Uno R3
U1st PIN, U2nd PIN, U3rd PIN, U4th PIN	4	IR sensor

Fig 5.4: Component List of Working Model

```json
{
  "signal1": {
    "density": 0
  },
  "signal2": {
    "density": 0
  },
  "signal3": {
    "density": 0
  },
  "signal4": {
    "density": 0
  }
}
```


Fig 5.5: Data Rules of Firebase Real Time Database

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1. CONCLUSION

In conclusion, the implementation of an Advanced Traffic Management System (ATMS) utilizing cloud technology presents a pivotal advancement in modern traffic management. By leveraging the scalability, flexibility, and efficiency offered by cloud computing, our ATMS provides real-time insights, enhances coordination, and improves overall traffic flow and safety.

6.2. FUTURE SCOPE

Looking ahead, there is immense potential for further enhancement and expansion of cloud-based ATMS. Future endeavors could focus on integrating artificial intelligence and machine learning algorithms to enable predictive analysis for proactive traffic management. Additionally, advancements in connected and autonomous vehicle technology can be integrated into ATMS to create smarter and more adaptive traffic control systems. Collaboration with urban planners, environmentalists, and policymakers can also lead to the development of holistic smart city solutions that prioritize sustainability and livability. Ultimately, continued innovation and collaboration will be key in realizing the full potential of cloud-based ATMS in shaping the future of transportation.

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ADVANCED TRAFFIC MANAGEMENT SYSTEM USING CLOUD

Swapnajit Sarkar

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Abstract: The project aims to enhance traffic management through IoT and infrared sensor technology to improve traffic flow. Current systems use GSM and NFC for basic traffic light control. The project proposes an automatic solution using IR sensors to dynamically adjust traffic lights. Initially tested at one intersection, the system includes IR sensors, Wi-Fi transmitter, and Arduino microcontroller. Data is collected by sensors, transmitted to Arduino, and used to adjust signal timing. Arduino acts as a central console for controlling traffic lights, storing sensor data in the cloud for real-time updates. The system also prioritizes emergency vehicles like ambulances for smooth traffic flow.

Individual contributions and findings: As a team member, I helped in gathering sources and materials for reference for this project, helped in conducting thorough research on prior project reports in this domain to identify areas of enhancements. As a key role, I developed complete codebase for the microcontroller board and designed appropriate circuit for the system simulation and integrated the whole system in the simulation platform.

Individual contribution to project presentation and demonstration: As a team member, I helped in documenting implementation and results in the project report and in reviewing the final report and presentation documents thoroughly.

ADVANCED TRAFFIC MANAGEMENT SYSTEM USING CLOUD

Saransh Kumar

2105488

Abstract: The project aims to enhance traffic management through IoT and infrared sensor technology to improve traffic flow. Current systems use GSM and NFC for basic traffic light control. The project proposes an automatic solution using IR sensors to dynamically adjust traffic lights. Initially tested at one intersection, the system includes IR sensors, Wi-Fi transmitter, and Arduino microcontroller. Data is collected by sensors, transmitted to Arduino, and used to adjust signal timing. Arduino acts as a central console for controlling traffic lights, storing sensor data in the cloud for real-time updates. The system also prioritizes emergency vehicles like ambulances for smooth traffic flow.

Individual contributions and findings: As a group part, I made a difference in gathering sources and materials for reference for this venture, made a difference in conducting exhaustive investigate on earlier venture reports in this space to distinguish regions of improvements. As a key part, I helped in creating the codebase for the microcontroller board and in planning suitable circuit for the framework recreation.

Individual contribution to project presentation and demonstration: As a team member, I documented the complete project report and reviewed the final report and presentation documents thoroughly.

ADVANCED TRAFFIC MANAGEMENT SYSTEM USING CLOUD

Sayan Adhikari

2105577

Abstract: The project aims to enhance traffic management through IoT and infrared sensor technology to improve traffic flow. Current systems use GSM and NFC for basic traffic light control. The project proposes an automatic solution using IR sensors to dynamically adjust traffic lights. Initially tested at one intersection, the system includes IR sensors, Wi-Fi transmitter, and Arduino microcontroller. Data is collected by sensors, transmitted to Arduino, and used to adjust signal timing. Arduino acts as a central console for controlling traffic lights, storing sensor data in the cloud for real-time updates. The system also prioritizes emergency vehicles like ambulances for smooth traffic flow.

Individual contributions and findings: For the project report, I took responsibility for critical elements such as formatting, alignment, table of contents, list of figures, acknowledgments, abstract, references and formatting of the introductory section. This careful attention to detail ensured a consistent and professional presentation of our research.

Individual contribution to project presentation and demonstration: In preparation for the presentation of the project, I was responsible for creating the presentation segment, structuring the content and organizing the various materials to optimize clarity and engagement. This involved carefully organizing the flow and parts of the presentation to effectively convey the goals and meaning of our project.

ADVANCED TRAFFIC MANAGEMENT SYSTEM USING CLOUD

Aprajeeta Dutta

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Abstract: The project aims to enhance traffic management through IoT and infrared sensor technology to improve traffic flow. Current systems use GSM and NFC for basic traffic light control. The project proposes an automatic solution using IR sensors to dynamically adjust traffic lights. Initially tested at one intersection, the system includes IR sensors, Wi-Fi transmitter, and Arduino microcontroller. Data is collected by sensors, transmitted to Arduino, and used to adjust signal timing. Arduino acts as a central console for controlling traffic lights, storing sensor data in the cloud for real-time updates. The system also prioritizes emergency vehicles like ambulances for smooth traffic flow.

Individual contributions and findings: For the extend report, I took obligation for basic components such as organizing, arrangement, table of substance, list of figures, affirmations, unique, references and designing of the basic segment. This cautious consideration to detail guaranteed a steady and proficient introduction of our investigate.

Individual contribution to project presentation and demonstration: In arrangement for the introduction of the extend, I was dependable for making the introduction section, organizing the substance and organizing the different materials to optimize clarity and engagement. This included carefully organizing the stream and parts of the introduction to viably pass on the objectives and meaning of our venture.

TURNITIN PLAGARISM REPORT

ADVANCED TRAFFIC MANAGEMENT SYSTEM USING CLOUD

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