Dr. D. Y. PATIL VIDYAPEETH, PUNE
(Deemed to be University)

DR. D. Y. PATIL SCHOOL OF SCIENCE AND TECHNOLOGY

TATHAWADE, PUNE

A Mini- Project Report on

Real – Time Signal Management

SUBMITTED BY:

NAME OF STUDENT	ROLL NUMBER
1. Jasmin Kaur Randhawa	BTAI-2316
2. Kumkum Kumari Singh	BTAI-2325
3. Advik Singh	BTAI-2302

GUIDED BY:

Mrs Akanksha Goel

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

ACADEMIC YEAR 2022-2023

Dr. D. Y. PATIL VIDYAPEETH, PUNE
(Deemed to be University)

DR. D. Y. PATIL SCHOOL OF SCIENCE AND TECHNOLOGY

TATHAWADE, PUNE

CERTIFICATE

This is to certify that the Mini- Project Report entitled

-“------------Real – Time Signal Management ----------“-

is a bonafide work carried out by Mr/Ms **Jasmin Kaur Randhawa** under the supervision of **Mrs Akanksha Goel** and it is submitted towards the partial fulfillment of the requirement Project Based Learning-I.

Mrs Akanksha Goel
Project Guide

Prof. Manisha Bhende
HOD (DYPSST)

ARTIFICIAL INTELLIGENCE & DATASCIENCE

ACADEMIC YEAR 2024-2025

ABSTRACT

In today's growing technology world, every person has it is own private vehicle to travel which leads to traffic congestion, mainly where there is intersection. Same timing of schools, colleges, as well as offices, also leads to traffic. Also in rainy seasons, most of the people prefer to travel through four-wheeler causing traffic. Traffic also leads to make drivers impatient because of which they take unnecessary risks such as cutting off other vehicles etc. The aim of this project is to develop smart traffic management system which can adjust traffic light timings by sensing real-time traffic conditions. The system analyzes traffic density and dynamically adjusts its signal time which not only reduces traffic flow, accidents but also fuel consumption. Traditionally, the traffic light uses fixed timing, it does not matter how many vehicles are waiting. Use of smart traffic management system helps to reduce congestion, delays and travel times.

Keywords: Smart Traffic Management, Adaptive Traffic Control , Traffic Density Analysis, Dynamic Signal Timing, Real-time Traffic Conditions, Congestion Reduction, Accident Prevention, Fuel Consumption Reduction, Traffic Flow Optimization, Fixed Timing Limitations.

INDEX

.

List of Figures

Chapter 1

INTRODUCTION

The primary objective of this project is to present a method that will assign a certain amount of time to each route according to traffic volume [1]. The number of cars on the road is growing in parallel with the planet's population growth, which means that traffic congestion are also increasing at a rapid rate [2]. On road networks, traffic congestion is characterized by slower speeds, longer travel times, and longer waits at the vehicle types. When there are greater numbers of cars than the available space traffic congestion happens on the road [3]. Traffic congestion has a significant impact on a number of things, including accidents, lost time, expenses, and emergency delays. When the traffic lane waits until the green light, time setting is almost same and fixed. A-road was always crowded with vehicles and go-head time is short. So vehicles can’t pass through in the time allowed. But sub lane has few vehicles and go-head time is relatively long [4]. The normal traffic signals systems increase the time of travel, thus be notable as one of the major issues in metropolitan cities [5]. Due to the heavy traffic on the roads, the standard traffic signal system extends travel times for cars, which is a serious problem, particularly for emergency vehicles that must get to their destination promptly. The ambulance is slowed down by slow-moving traffic, which results in fatalities [6]. The problem can be handled by using the Internet of Things to monitor traffic density for dynamic time delay arrangements [7]. When the traffic lane waits until the green light, time setting is almost same and fixed. A-road was always crowded with vehicles and go-head time is short. So vehicles can’t pass through in the time allowed. But sub lane has few vehicles and go-head time is relatively long [8]. Traffic lights have been a ubiquitous sight in cities all around the world since their creation in 1912. But as the number of cars on the road rises, many nations today have serious traffic issues that have a detrimental influence on transportation and produce congestion [9]. Emergency cars are not considered. (For example, fire engines and ambulances have priority over other traffic. The two lanes should both wait them to pass through.) Because the traffic control system is lack of emergency measures, the crossroads always meets a traffic jam and leads to unnecessary economic losses [10]. Traffic congestion has a significant impact on a number of things, including accidents, lost time, expenses, and emergency delays.

1.1 OBJECTIVES :

The objectives of the program include:

- **Traffic Detection**: Traffic detection helps to better manage traffic and cut down on delays by maintaining an eye on vehicle flow, speed, and congestion.
- **Dynamic Signal Adjustment:** Dynamic signal adjustment improves traffic flow and cuts down on wait times.
- **Data Analysis:** The process of collecting and studying traffic data in order to identify patterns improves traffic control and signal timing.
- **Centralized Control Center**: A central control center gathers and maintains updated on traffic data, which helps managers deal with crashes and traffic jams quickly.

PROBLEM STATEMENT:

To develop and design an intelligent traffic management system utilizing Internet of Things (IoT) technology to dynamically monitor traffic density and adjust signal timings in real-time, prioritizing emergency response vehicles and reducing congestion, thereby enhancing public safety and minimizing travel delays and financial losses.

Author	Methodology	Limitations
[1]	Real-time traffic analysis in urban areas with IoT devices to regulate traffic flow and adjust signal timings.	Focused on small-scale urban application; minimal discussion of scalability to larger cities.

[2]	Developed a smart traffic system that analyzes and manages traffic patterns dynamically using hidden sensors and microcontrollers.	Limited testing; no comparison with alternatives such as methods based on machine learning.
[3]	A smart traffic control system with GPS and traffic cameras was proposed for real-time vehicle tracking and congestion management.	Relies on GPS accuracy, which may fluctuate in densely populated urban areas; no consideration for data privacy.
[4]	Optimised traffic flow by dynamically adjusting traffic signal timings in real time using sensor-based detection.	The system fails to prioritize emergency vehicles and does not account for uncertain traffic conditions
[5]	Created an IoT and RFID-based system to open up traffic lanes for emergency vehicles by manipulating traffic lights at crossings	Primarily focused on emergency vehicles, lacking features for managing routine traffic congestion and pedestrian mobility
[6]	Proposed an IoT and data-analytics-based system for detecting and clearing emergency vehicles at crossings that uses real-time data processing.	The system is limited to emergency vehicle recognition and clearing, with little emphasis on optimizing general traffic circumstances.
[7]	This study, like the previous one, focuses on using IoT and sensor networks for emergency vehicle identification and traffic signal adjustment.	The same issue applies: the technology is designed for emergency situations but lacks broader traffic control skills.
[8]	We talked about a sensor-based traffic light management system that modifies signal timing based on real-time traffic flow data.	It does not cover specific edge circumstances such as emergency vehicle prioritizing or sensor failure.
[9]	Introduced a machine-learning-based strategy for recognizing emergency vehicles and modifying traffic lights to clear the path.	The machine-learning methodology requires huge datasets for accuracy, which may not be available in all places, impacting performance.
[10],[4]	Optimised traffic flow by dynamically adjusting traffic signal timings in real time using sensor-based detection.	The system fails to prioritize emergency vehicles and does not account for uncertain traffic conditions

Chapter 2

DESIGN

System design involves planning and structuring software or hardware components to fulfill specific requirements or functionalities efficiently and effectively. It encompasses architectural decisions, module interactions, data flow, and system behavior to ensure scalability, reliability, and maintainability

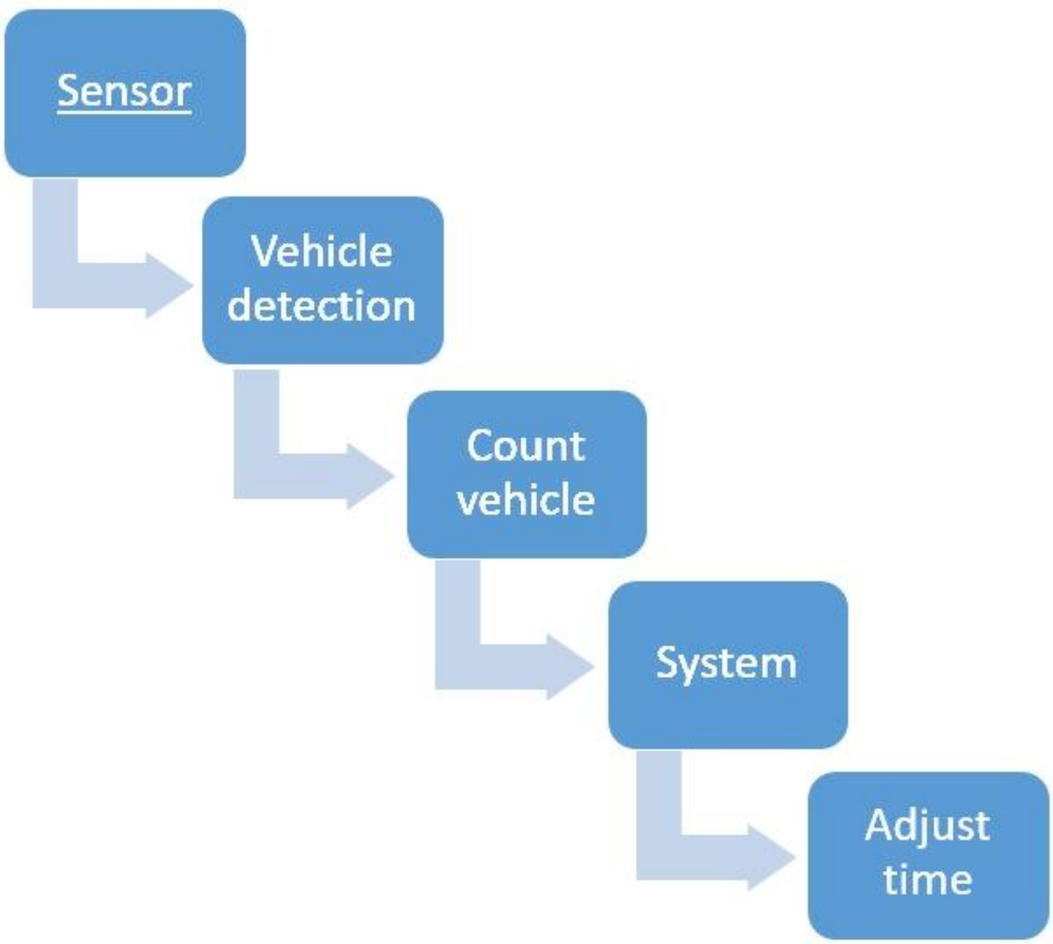


Fig 2.1

Use Case Diagram:

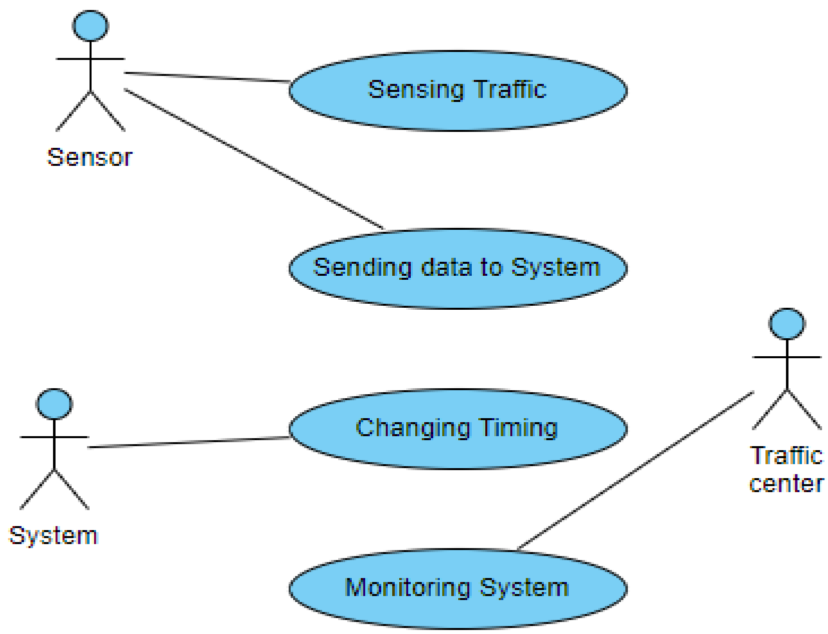


Fig 2.2

Chapter 3

ALGORITHMS & FLOWCHARTS

3.1 Vehicle Detection :

Step 1 : Start the function

Step 2 : Declare an integer variable signal.

Step 3 : Enter 1 if a vehicle passed and 0 to stop detection and store it in variable Signal.

Step 4 : **Check if the vehicle has passed**:

- If the value of signal is 1, return true (indicating that a vehicle has been detected.

Return false if no vehicle has passed:

- If the value of signal is 0, return false to indicate no vehicle is detection.

Step 5 : End of the function.

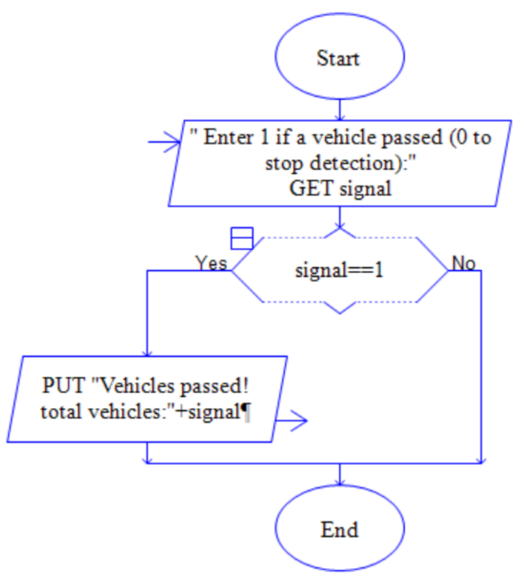


Fig 3.1

3.2 Vehicle Count:

Step 1 : Start the function.

Step 2 : Declare an integer variable vehicle_count and set it to 0.

Step 3 : Declare a boolean variable vehicle_detected to store whether a vehicle has been detected or not.

Step 4 : Print "Starting vehicle detection..." to indicate that vehicle counting is about to begin.

Step 5 : Enter a loop that will continue checking for vehicles until the detection is stopped by the user or sensor.

Step 6 : Call the function sensor () to check if a vehicle is passing. Store the result in the vehicle_detected variable.

- If vehicle_detected == true:
  - ✓ Increment vehicle_count by 1.
  - ✓ Display the message: "Vehicle passed! Total vehicles: X", where X is the current value of vehicle_count.

- If vehicle_detected == false:
  - ✓ Break out of the loop, indicating that vehicle detection has stopped.

Step 7 : End of the function.

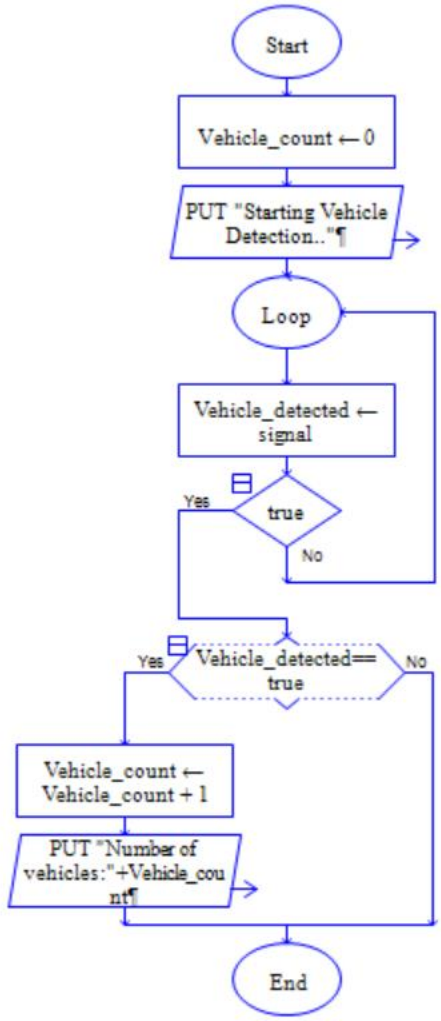

Start
Vehicle_count ← 0
PUT "Starting Vehicle Detection.."¶
Loop
Vehicle_detected ← signal
Yes
true
No
Yes
Vehicle_detected== true
No
Vehicle_count ← Vehicle_count + 1
PUT "Number of vehicles:"+Vehicle_count¶
End

Fig 3.2

3.3 Adjust Time :

Step 1: Start the function.

Step 2: Declare an integer variable green_light_duration.

Step 3 : Check the value of vehicle count

- If the vehicle count = = 0 , set green_light_duration to 5 seconds.
- If the vehicle count < = 5 , set green_light_duration to 10 seconds.
- If the vehicle count < = 15 , set green_light_duration to 20 seconds.
- Else set green_light_duration to 30 seconds.

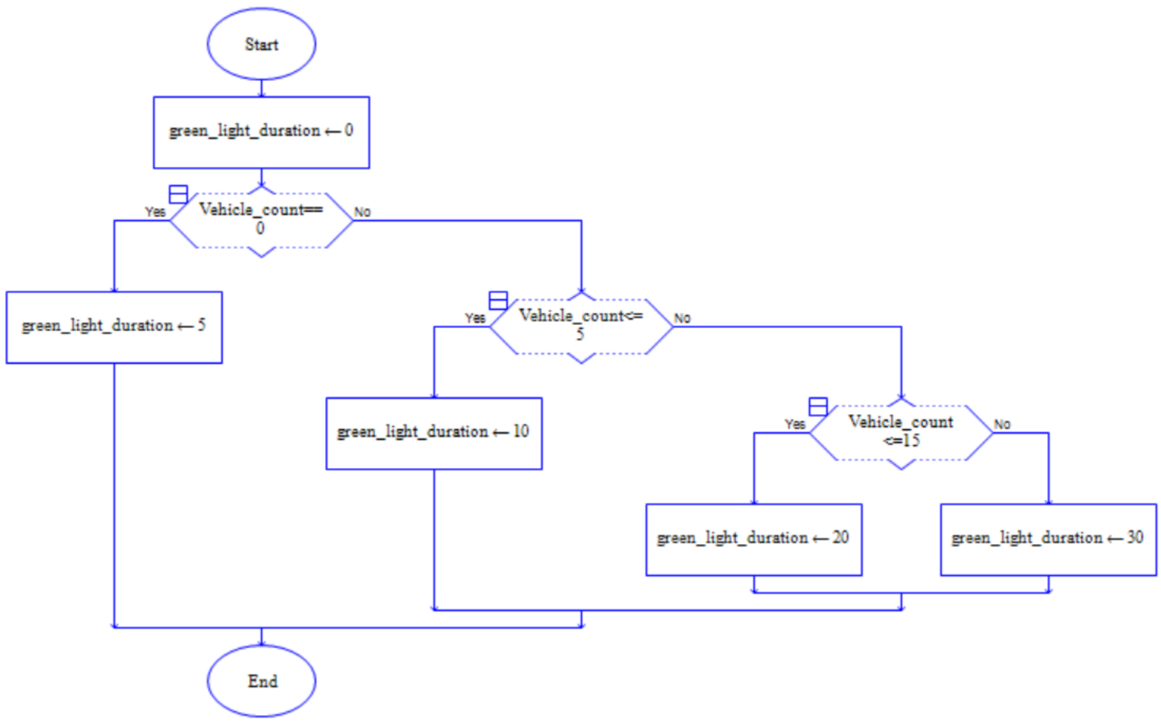
Step 4 : Print a message showing the green light duration.

For each second, print the remaining time and wait 1 second.

Step 5 : After the green light finishes, print a message indicating the yellow light duration.

Step 6 : After the yellow light finishes, print a message indicating the red light duration.

Step 7 : End of the function.



Start
green_light_duration ← 0
Yes
Vehicle_count== 0
No
green_light_duration ← 5
Yes
Vehicle_count<= 5
No
green_light_duration ← 10
Yes
Vehicle_count <=15
No
green_light_duration ← 20
green_light_duration ← 30
End

Fig 3.3

3.4 MAIN FUNCTION :

Step 1: Start

Step 2 : Print the message traffic light control system started.

Step 3 : Enter an infinite loop :

- Call sensor() function.
- Call Vehicle_count( ).
- Call Adjust_time ( ).
- Print a message “Starting a new cycle…”.

Step 4 : End.

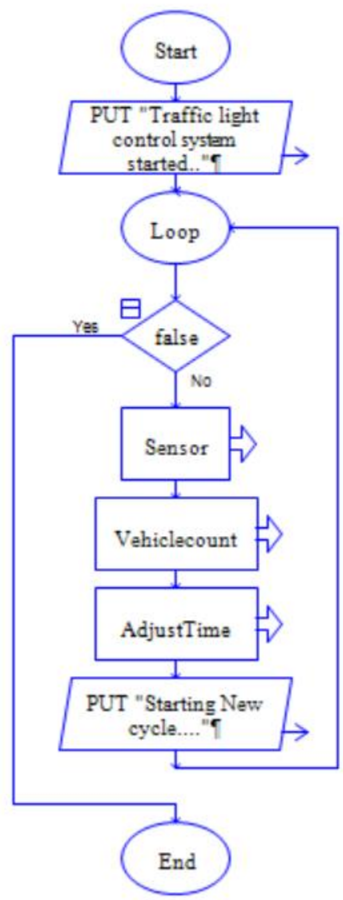


Fig 3.4

Chapter 4

IMPLEMENTATION OF CODE

```
#include <stdio.h>
#include <stdbool.h>
#include <unistd.h>

int vehicle_count = 0;

bool sensor() {
    int signal;
    printf("Enter 1 if a vehicle is passed (0 to stop detection): ");
    scanf("%d", &signal);
    return signal == 1;
}

int count_vehicles() {
    bool vehicle_detected;

    printf("\nStarting vehicle detection...\n");
    while (true) {
        vehicle_detected = sensor();
        if (vehicle_detected) {
            vehicle_count++;
```

```
        printf("\nVehicle passed! Total vehicles: %d\n", vehicle_count);
      } else {
        break;
      }
    }
    return vehicle_count;
}

void adjust_time() {
    int green_light_duration;

    if (vehicle_count == 0) {
        green_light_duration = 5;
    } else if (vehicle_count <= 5) {
        green_light_duration = 10;
    } else if (vehicle_count <= 15) {
        green_light_duration = 20;
    } else {
        green_light_duration = 30;
    }

    printf("\nGreen light for %d seconds...\n", green_light_duration);
    for (int i = green_light_duration; i > 0; i--) {
```

```
        printf("%d seconds remaining...\n", i);
        sleep(1);
    }
    printf("Yellow light for 5 seconds...\n");
    sleep(5);
    printf("Red light for 10 seconds...\n");
    sleep(10);
}
int main() {
    printf("Traffic light control system started...\n");

    while (1) {

        vehicle_count = 0;

        count_vehicles();

        adjust_time();

        printf("\nStarting new cycle...\n");
    }
    return 0;
}
```

Chapter 5

OUTPUT

```
Traffic light control system started...

Starting vehicle detection...
Enter 1 if a vehicle is passed (0 to stop detection): 1

Vehicle passed! Total vehicles: 1
Enter 1 if a vehicle is passed (0 to stop detection): 1

Vehicle passed! Total vehicles: 2
Enter 1 if a vehicle is passed (0 to stop detection): 1

Vehicle passed! Total vehicles: 3
Enter 1 if a vehicle is passed (0 to stop detection): 1

Vehicle passed! Total vehicles: 4
Enter 1 if a vehicle is passed (0 to stop detection): 0

Green light for 10 seconds...
10 seconds remaining...
9 seconds remaining...
8 seconds remaining...
7 seconds remaining...
6 seconds remaining...
5 seconds remaining...
4 seconds remaining...
3 seconds remaining...
2 seconds remaining...
1 seconds remaining...
Yellow light for 5 seconds...
Red light for 10 seconds...

Starting new cycle...

Starting vehicle detection...
Enter 1 if a vehicle is passed (0 to stop detection):
```

Fig 5.1

When a vehicle is detected, the traffic light control system modifies the time of the signal. The system employs a fixed sequence of 10s for green, 5s for yellow, and 10s for red lights, contingent on the quantity of cars identified inside each cycle. Additional optimization of the system is possible for dynamic real-time modifications.

LIMITATIONS

- ❖ Fixed Timing Limitations: The system modifies signal timing according to established rules. Although it adjusts dynamically according to the number of vehicles, it is not flexible enough to handle unforeseen events or increases in traffic.

- ❖ Emergency Vehicle Management: There is currently no strong process in place to handle emergency vehicle priorities, which could cause delays for fire engines or ambulances during periods of high traffic.

- ❖ Data Privacy Issues: If data is not adequately anonymized or secured, using cameras and GPS to track cars may give rise to privacy issues.

- ❖ Weather and Environmental Factors: Unfavourable weather circumstances, like heavy rain or fog, can have a detrimental impact on the functioning of some sensors, including cameras, which lowers the system's reliability.

Chapter 6

CONCLUSION

In this project, we successfully created a simple smart traffic management system that dynamically adjusts traffic signal timings in response to real-time vehicle detection. In order to improve traffic flow, the system counts the number of vehicles that cross a junction using basic sensors, and then adjusts the duration of the green light. It additionally helps in reducing vehicle wait times, minimizing traffic congestion, and maybe cutting down on pollution and fuel use. The research study shows how real-time traffic monitoring can help with more effective urban traffic management by using a rule-based system. The system, which focuses on a small-scale implementation that may be further expanded, is functional yet offers a fundamental solution to the issue of traffic congestion.

Future Work:

Future iterations of the system can use machine learning techniques to better predict traffic flow and modify signal timings. By doing this, the system would become adaptive rather than rule-based, able to forecast peak traffic times based on past traffic patterns.

REFERENCES

1] Jacob, Sheenamariam & Rekh, A. & Manoj, Gayathri & Paul, J.. (2018). [6]. International Journal of Engineering and Technology(UAE). 7. 348-351.

2] Bhuvan S T1 , Manjunath H.R2 , Abhiman H.R3 , Ranjan Kumar4 , Sachin G Rao5 Department of Information Science and Engineering, Alva's Institute of Engineering and Technology, Karnataka, India1-5

3] Lanke, Ninad & Koul, Sheetal. (2013). Smart Traffic Management System. International Journal of Computer Applications. 75. 19-22. 10.5120/13123-0473.

4] & 10] Mahajan, Sunil & Tonde, Jeevan. (2014). Real time traffic signal management. 10.13140/2.1.2209.9203.

5] Challa, Padma. (2016). Smart Traffic Control System for Emergency Vehicle Clearance. 3. 435-442.

6] Ariffin, Mohamad & Khairam, Haziq & Abu Seman, Mohamad. (2022). Smart Traffic System: Detection of the Emergency Clearance. 10.1007/978-981-16-8129-5_124.7.

7] Ariffin, Mohamad & Khairam, Haziq & Abu Seman, Mohamad. (2022). [7]: Detection of the Emergency Clearance. 10.1007/978-981-16-8129-5_124.

8] Mahajan, Sunil & Tonde, Jeevan. (2014). [8]. 10.13140/2.1.2209.9203.

9] .M, Gowtham. (2023). [9]FOR EMERGENCY VEHICLE. International Journal of Environmental Technology and Management. 7. 266-274. 10.46647/ijetms.2023.v07i03.034.

10] Mahajan, Sunil & Tonde, Jeevan. (2014). [10]. 10.13140/2.1.2209.9203.

11] R M, Savithramma & Ranganathaiah, Sumathi. (2020). Road Traffic Signal Control and Management System : A Survey. 104-110. 10.1109/ICISS49785.2020.9315970.

12] Mahesh Lakshminarasimhan, “Advanced Traffic Management System Using Internet of Things”, March 2016

13] G.Lakshminarasimhan1,V.Parthipan, Mohammed Irfan Ahmed,Sri Harsha K Nvm , Dr.D.Dhanasekaran, “TRAFFIC DENSITY DETECTION AND SIGNAL AUTOMATION USING IOT”,International Journal of Pure and Applied Mathematics,Volume 116 No. 21 2017, 389-394

14] G.Lakshminarasimhan1,V.Parthipan, Mohammed Irfan Ahmed,Sri Harsha K Nvm , Dr.D.Dhanasekaran, “TRAFFIC DENSITY DETECTION AND SIGNAL AUTOMATION USING IOT”,International Journal of Pure and Applied Mathematics,Volume 116 No. 21 2017, 389-394

15] Vigneash, L. & Samraj, S. & Bhuvaneswari, S. & Saravanan, Thibashini & Saritha, Gt. (2023). Vehicle Density and Emergency Vehicle Detection for Smart Traffic Control. 542-549. 10.1109/ICTACS59847.2023.10389918.