EMERGENCY VEHICLE DETECTION AND AUTOMATED PEDESTRIAN CROSSING

A MINI-PROJECT REPORT

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in partial fulfilment of the award of the degree

of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

An Autonomous Institute

CHENNAI

APRIL 2024

BONAFIDE CERTIFICATE

Certified that this project **“EMERGENCY VEHICLE DETECTION AND AUTOMATED PEDESTRIAN CROSSING**” is the bonafide work of “**KAARNESHV.S (210701100), KAMAL PRASHANTH C (210701102) and KARTHICK RAGAV R (210701108)”** who carried out the project workunder my supervision.

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Submitted for the **ANNA UNIVERSITY** practical examination Mini-Project work viva voce held on___________

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

We express our sincere thanks to our beloved and honorable chairman **MR. S. MEGANATHAN** and the chairperson **DR. M. THANGAM MEGANATHAN** for their timely support and encouragement.

We are greatly indebted to our respected and Honorable principal **Dr. S.N. MURUGESAN** for his able support and guidance.

No words of gratitude will suffice for the unquestioning support extended to us by our head of the department **Dr. P. Kumar** for being ever supporting force during our project work.

We also extend our sincere and hearty thanks to our internal guide **Dr.N.Duraimurugan,M.E., Ph.D** for his valuable guidance and motivation during the completion of this project. Our sincere thanks to our family members, friends and other staff members of information technology.

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LIST OF ABBREVIATION

ABBREVIATION	ACCRONYM
PIR - Sensor	Passive Infra-Red Sensor
LED	Light Emitting Diode
RFID	Radio Frequency Identification

ABSTRACT

The goal of this project is to prioritize emergency vehicle passage and improve pedestrian safety by implementing an innovative smart crossing system that makes use of the Internet of Things. The system uses an Arduino microcontroller to incorporate a number of sensors, such as microphones and passive infrared (PIR) sensors, to produce a thorough and clever solution.
To identify the sirens and horns of oncoming emergency vehicles, microphones will be positioned in strategic locations. The Arduino will use this data to process and initiate real-time steps that guarantee emergency responders have a safe and easy way to proceed. In order to notify the system when a pedestrian approaches the crosswalk area, PIR sensors will also be installed.

The project focuses on how RFID (Radio-Frequency Identification) technology might be integrated. The technology can accomplish more accurate detection by integrating RFID tags into approved emergency vehicles, thereby removing false positives caused by other cars' sirens. Traffic light timings will be dynamically adjusted based on data gathered from these sensors, giving priority to emergency vehicles and guaranteeing pedestrian safety at crosswalks. To further increase awareness and avert possible collisions.

The overall objective of this project is to show how easily accessible sensor technology may be used to build an intelligent, reasonably priced smart crossing system. Using an Arduino microcontroller offers a versatile and adjustable platform for practical implementation. Significant increases in pedestrian safety at crosswalks and accelerated access for emergency vehicles are among the expected results

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Ensuring pedestrian safety at busy junctions is crucial in our ever-crowding cities. By creating a smart system for emergency car detection and pedestrian safety at crosswalks, our project addresses this problem. This system integrates a variety of sensors, including microphones, RFID tags, and passive infrared (PIR) sensors, by utilizing the capabilities of the Arduino microcontroller platform. Our goal is to provide a comprehensive solution that improves pedestrian awareness and enables safe passage in emergency car scenarios by merging various technologies. The primary goal of this project is to create a working prototype system that employs easily available sensors and an Arduino microcontroller to detect emergency vehicles and ensure pedestrian safety at crosswalks.

1.2 SCOPE OF THE WORK

This document explores the design, functionality, and possible uses of the suggested system in detail. We start by going over each of the system's constituent parts, from the adaptable Arduino microcontroller to the well-placed sensors that serve as its eyes and ears. After that, we go into the operational logic of the system, explaining how it recognizes emergency vehicles, initiates different warning systems, and maybe communicates with the traffic infrastructure already in place. The system's advantages and possible uses are then discussed, emphasizing how it might increase pedestrian safety, improve traffic flow, and be more economically viable overall. The project culminates with a summary of the most important lessons learned and a list of possible directions for further study and advancement. This project intends to contribute to a future where emergency vehicles and pedestrians can traverse our increasingly complicated urban surroundings with greater peace of mind by concentrating on the crucial convergence of technology and public safety.

1.3 PROBLEM STATEMENT

Ensuring the safety of pedestrians negotiating a steady flow of automobiles offers a challenging task in the hectic center of modern cities. There are a number of reasons why designated crosswalks, which are meant to offer a safe sanctuary for crossing busy streets, may not always be reliable. Impatience with traffic congestion can lead to drivers being impatient and possibly disregarding the safety of pedestrians. The prevalence of mobile devices contributes to distracted driving, which raises the risk to walkers at crosswalks. While they serve as a warning mechanism, conventional traffic lights and emergency vehicles' audible sirens might not be enough for prompt and effective communication. Ambient noise can mask sirens, while poor visibility due to blind spots or inclement weather can mask visual signs. These restrictions put drivers in potentially hazardous situations at intersections, especially when there are emergency vehicles around.

Because of the urgency of their task, they must pass immediately; nonetheless, pedestrians may be seriously endangered if warnings are ignored or delayed. This project tackles this critical challenge by aiming to significantly enhance pedestrian safety at crosswalks, particularly during the crucial moments when emergency vehicles are approaching.

1.4 AIM AND OBJECTIVES OF THE PROJECT

The goal of this initiative is to greatly increase pedestrian safety at crosswalks, especially when emergency vehicles are approaching. In order to do this, we will create a system that uses a mix of PIR sensors and microphones to accurately identify emergency vehicles. After that, this data will be utilized to efficiently notify pedestrians through audio and visual alerts; it may even be integrated with current traffic signals to provide a more complete warning system. The operational logic of the system, including data collection, processing, and warning activation, will be specified in the project. Ultimately, in order to provide the groundwork for future research and practical use, we will construct a functioning prototype that will showcase the system's fundamental features in a controlled setting.

CHAPTER 2

LITERATURE SURVEY

In [1] this study the article discussed about the interest in Radio Frequency Identification (RFID) technology which has grown in both academia and industry. RFID has cost-effective uses in supply chain management, non-destructive testing (NDT), and access control. It is also a viable option for ubiquitous monitoring. Battery-free RFID tags can be employed as standalone electromagnetic sensors or as an interface for data transmission and energy harvesting in sensor modules for various measurement applications.

Globally, there is a constant rise in the volume of vehicles on the road, particularly in big cities. The performance, cost, maintenance, and support of the current traffic management, surveillance, and control systems are all insufficiently efficient. This [2] paper presents the design of an efficient system that makes use of traffic light controllers. Specifically, we introduce an adaptive traffic control system built upon a novel traffic infrastructure that makes use of Wireless Sensor Networks (WSN) and novel methods for regulating the traffic flow patterns.

Traffic congestion is a serious issue worldwide, that has turned into a nightmare for the locals. It is brought on by signal delays, improper traffic light timing, etc. Traffic light delays are hard coded and independent of flow of traffic. Thus, there is a growing need for systematic quick automatic systems to optimize traffic control. The goal of this [3] study is to use Arduino to create a density-based traffic controller system. As soon as the junction's traffic density is detected, the signal time automatically adjusts. The Arduino microcontroller is used for the project.

Crosswalk traffic signals aid in controlling vehicle flow to ensure smooth operation and prevent congestion. A traffic control light system that is not ideal because it still uses a fixed timer system and so has less efficient light duration been one of the causes of traffic congestion. The streets are empty while the green light is on. Nevertheless, another road is congested with traffic. Thus, in order to achieve efficient timing, the notion of traffic light timing needs to be devised. The goal of this [4] project is to develop a traffic light control system that, depending on the degree of traffic, uses an ultrasonic sensor based on the Arduino Mega2560 microcontroller and a PIR (Passive Infrared) motion sensor.

The Radio Frequency Identification System, or RFID, has grown in popularity and is now used in most industries, including supply chain management, toll bridges, and the defense industry. As a result of the production cost being reduced, RFID systems are being implemented widely. It is crucial to comprehend tag technology and its applications as a result. In this [5] study, we present a thorough analysis of the diverse RFID tag technologies that have been documented in the literature and categorize them.

The RHODES real-time traffic-adaptive signal control system is the subject of this [6] paper. The system "optimally" regulates the flow via the network using detector data as input for real-time traffic flow measurement. The traffic control problem is divided into multiple subproblems by the system's control architecture, which also predicts traffic flows at appropriate resolution levels to enable proactive control.

Different optimization modules are allowed to solve the hierarchical subproblems, and the system makes use of data structures and computer/communication techniques to solve the subproblems quickly. This ensures that each decision can be downloaded in the field within the allotted rolling time horizon of the corresponding subproblem.

In this [7] work, they presented a simple and practical acoustic sensing-based traffic monitoring system that records vehicle sound using an ad hoc microphone array. Ad hoc microphone array signals are asynchronous, thus compensating for sampling frequency mismatch and the difference between the beginning and ending of the recording to achieve channel synchronization. Using peak detection of the power envelopes to monitor traffic by estimating the number of cars and classifying the traffic lane based on the difference in the microphones' propagation periods.

This [8] article describes the Arduino microcontroller's operation and applications. Furthermore, an explanation of how to use the Arduino microcontroller as a research and study tool is given. It is claimed that the Arduino microcontroller is a handy tool for rapidly building modest, sensor-based projects. Their programming and ease of comprehension are excellent. The Arduino IDE makes it easier to program microcontrollers for Arduino. The Arduino IDE is presented as an application created especially for creating code for Arduino boards. It is stated that this free software can be installed and downloaded on a computer.

CHAPTER 3

SYSTEM SPECIFICATIONS

3.1 HARDWARE SPECIFICATIONS FOR APPLICATION

Processor	:	Pentium IV Or Higher
Memory Size	:	256 GB (Minimum)
HDD	:	40 GB (Minimum)

3.2 SOFTWARE SPECIFICATIONS

Operating System	:	WINDOWS 10 AND PLUS
Application	:	ARDUINO IDE

3.3 HARDWARE COMPONENTS FOR PROTOTYPE

Sensor	:	PIR-Sensor, Microphone sensor
Board	:	Arduino Uno
Actuator	:	LED LIGHT

CHAPTER 4

MODULES DESCRIPTION

Arduino Uno

This is microcontroller setup for the emergency vehicle detection and automated pedestrian crossing which acts as the CPU of the whole system. This takes inputs from the Sensors and triggers the actuators.

MICROPHONE- Sensor

This sensor is used to trigger an event at the time of emergency vehicle’s entry sends theinformation to the controller.

PIR-Sensor

This module is used to identify people’s motion in the pedestrian crossing and send information to the RFID.

LED Lights

This module is the actuator of the system which acts as the traffic light for our system and controlled based on the decisions taken by the controller of the system.

RFID

This is used as a communication medium between the LED module and the vehicle just utilizing 4 digital pins from the controller for communication.

CHAPTER 5

SYSTEM DESIGN

5.1 FLOW CHART

A flowchart is a type of diagram that represents an algorithm, workflow or process. The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows. This diagrammatic representation illustrates a solution model to a given problem.

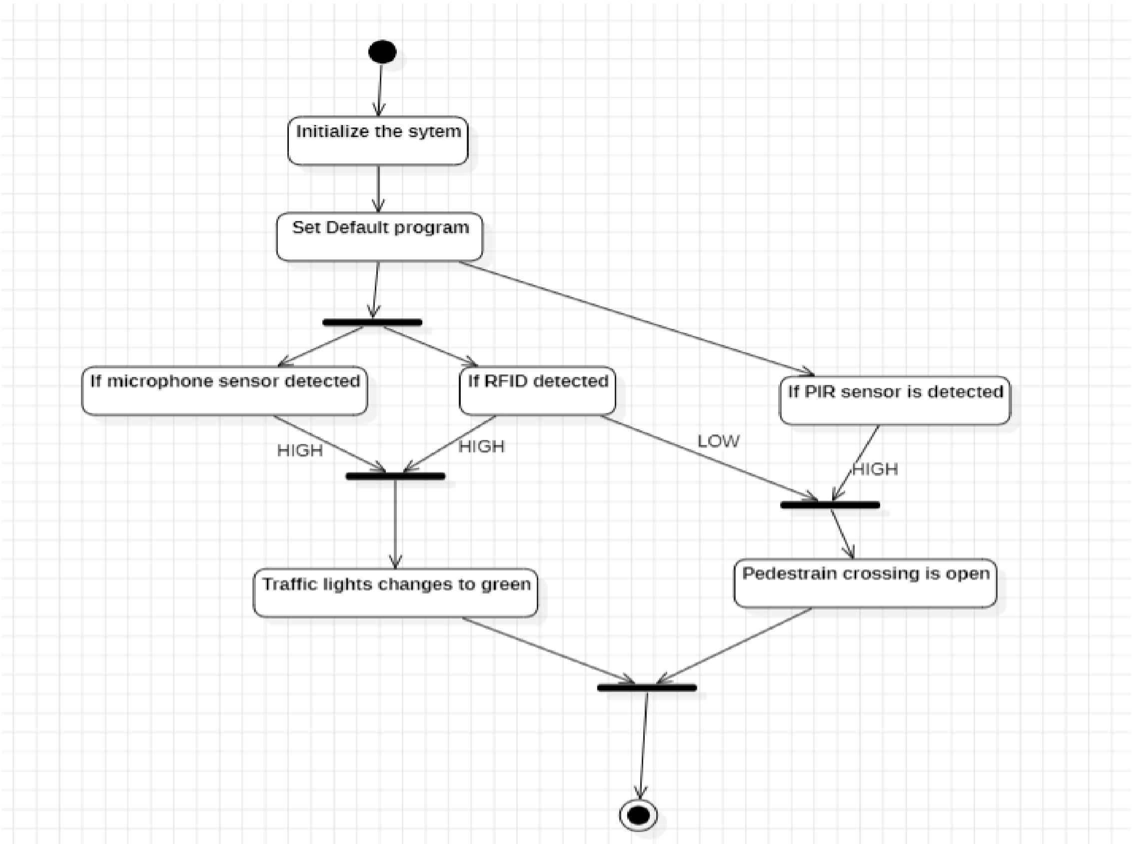

Figure 5.1 Flow Chart

5.2 CIRCUIT DIAGRAM

The circuit diagram explains the connections made with the hardware componentsand the board. The Arduino uno is connected with the breadboard as the VCC and GND are connected with the rails. The Sensors, LED and RFID Reader module is given connection with the rails and the other input/output pins are connected to digital as per the requirements.

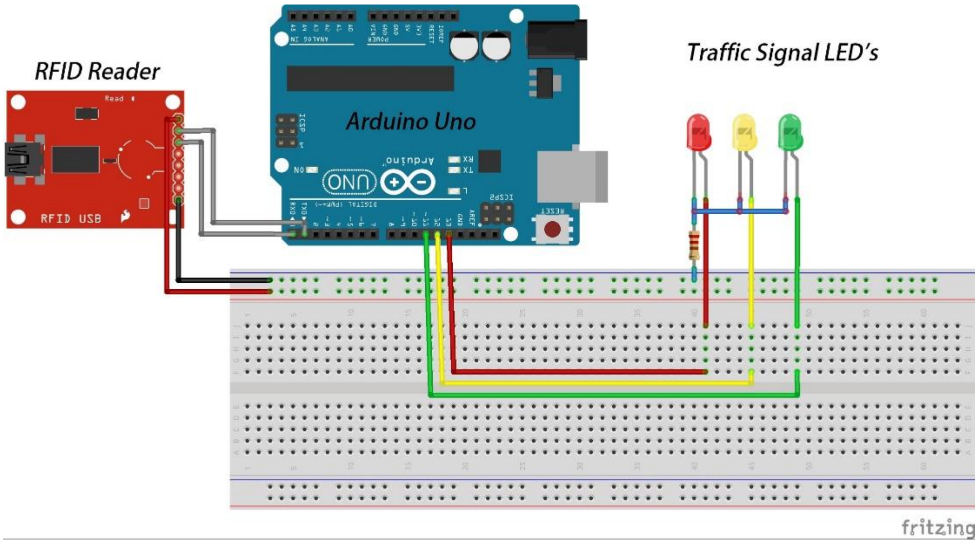

Figure 5.2 Circuit diagram

from the above figure 5.2, the connections are made

CHAPTER 6

CODING

1. Setup

```
int PIR_SENSOR_PIN = 2
int RFID_MISO_PIN =12
int RFID_MOSI_PIN =11
int RFID_SCK_PIN =13
int RED_LIGHT_PIN= 8
int YELLOW_LIGHT_PIN = 9
int GREEN_LIGHT_PIN = 10

const byte authorizedTags[] = {0x1234, 0x5678};


const int soundThreshold = 500;
unsigned long lastSampleTime = 0;
int sampleWindow = 50; // Adjust sampling window size (number of readings)
int soundReadingSum = 0;

byte tag;

void setup() {
  // Initialize PIR sensor pin as input
  pinMode(PIR_SENSOR_PIN, INPUT);

  // Initialize microphone sensor pin as input
  pinMode(MIC_SENSOR_PIN, INPUT);

  // Initialize RFID reader (SPI communication example)
  SPI.begin();
  SPI.setDataMode(SPI_MODE_0);
  SPI.setBitOrder(MSBFIRST);
  SPI.setClockSpeed(SPI_CLOCK_DIV2);



  pinMode(RED_LIGHT_PIN, OUTPUT);
  pinMode(YELLOW_LIGHT_PIN, OUTPUT);
  pinMode(GREEN_LIGHT_PIN, OUTPUT);
}
```

2. Loop

```
void loop() {

  int pirReading = digitalRead(PIR_SENSOR_PIN);
  if (pirReading == HIGH) {
    pedestrianCrossing();
  }

  if (isTagDetected()) {
    tag = readRFIDTag();
    if (isAuthorizedTag(tag)) {
      emergencyVehiclePassage();
    }
  }


  if (detectEmergencyVehicleSound()) {
    emergencyVehiclePassage();
  }

  defaultTrafficLightSequence();
}

void pedestrianCrossing() {
  digitalWrite(GREEN_LIGHT_PIN, HIGH);
  digitalWrite(RED_LIGHT_PIN, LOW);
  digitalWrite(YELLOW_LIGHT_PIN, LOW);
  delay(5000);


  digitalWrite(GREEN_LIGHT_PIN, LOW);
  digitalWrite(RED_LIGHT_PIN, LOW);
  digitalWrite(YELLOW_LIGHT_PIN, HIGH);
  delay(1000);
}

void emergencyVehiclePassage() {
  // Turn on red light for all other directions
  digitalWrite(RED_LIGHT_PIN, HIGH);
  digitalWrite(GREEN_LIGHT_PIN, LOW);
  digitalWrite(YELLOW_LIGHT_PIN, LOW);
  delay(3000);
}
```

```
void defaultTrafficLightSequence() {

  digitalWrite(GREEN_LIGHT_PIN, HIGH);
  delay(5000);

  digitalWrite(GREEN_LIGHT_PIN, LOW);
  digitalWrite(YELLOW_LIGHT_PIN, HIGH);
  delay(1000);

  digitalWrite(YELLOW_LIGHT_PIN, LOW);
  digitalWrite(RED_LIGHT_PIN, HIGH);
  delay(3000);

bool isTagDetected() {
  byte status = SPI.transfer(0x00);
 RFID reader
  return status;
}
```

CHAPTER 7

SCREEN SHOTS

1. CONNECTION

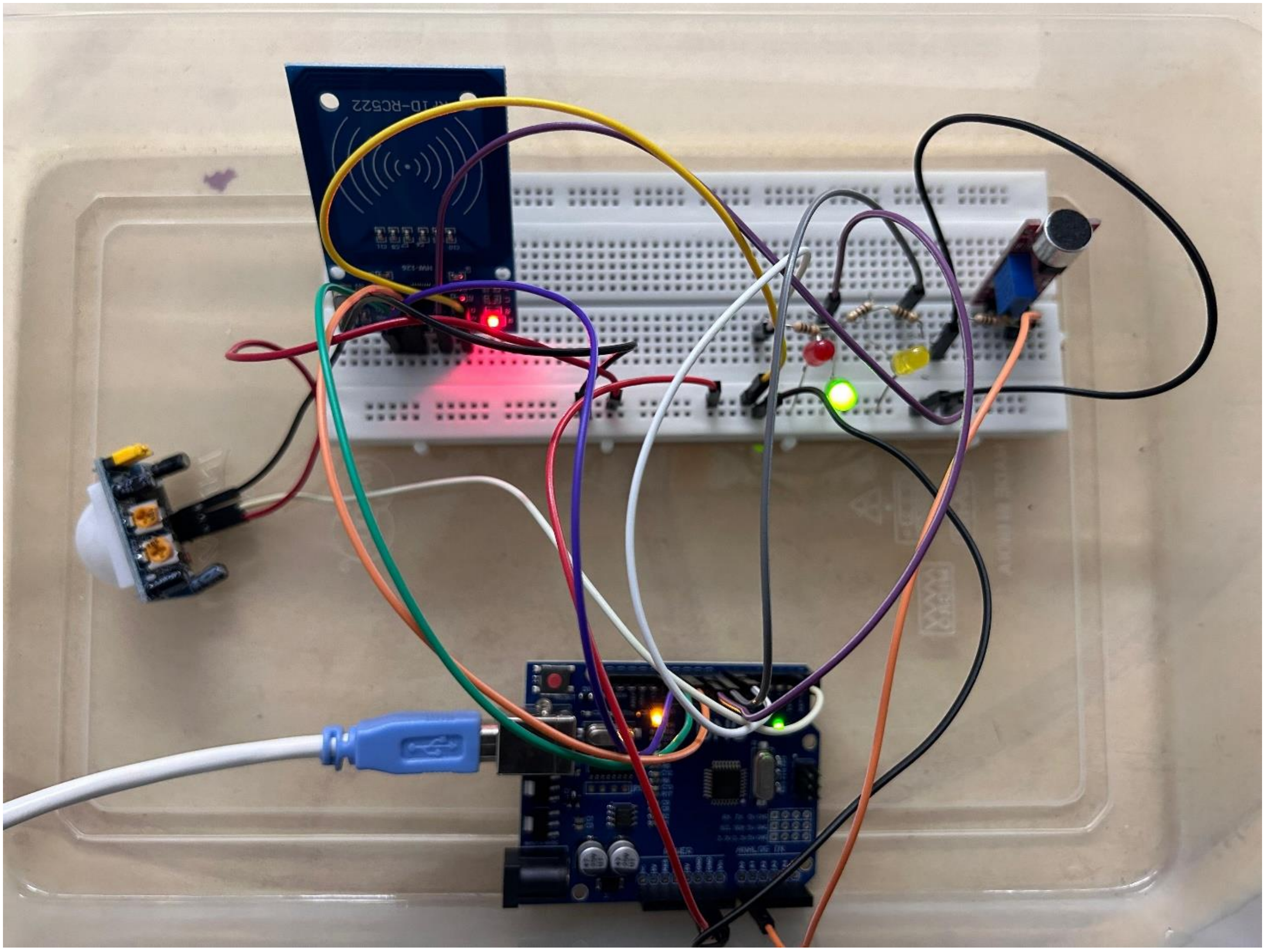

Figure 7.1 Connection Setup

This project simulates a smart traffic light system. It uses an Arduino to control LED lights based on sensors. A PIR sensor detects pedestrians for crosswalk timing. An RFID reader (optional) identifies emergency vehicles with tags, giving them priority. The system prioritizes pedestrian and emergency vehicle safety.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENT

For countries that are developing, this project proposes a smart traffic management system concept that gives priority to emergency vehicle movement during peak hours. Constructed using an Arduino, an RFID reader, an optional microphone, and LED displays, the prototype effectively replicated real-time traffic situations and showcased the essential features

To control genuine traffic lights, the existing breadboard configuration must be modified; this may involve using stronger weatherproofing and higher power components for outside operation. A larger traffic management network integration would enable coordinated signal changes at several crossroads for easier emergency vehicle access. RFID provides accurate identification, but further research into techniques such as connecting emergency vehicle dispatch systems or using cameras that can recognize license plates could improve detection accuracy even more. Strong security measures must be put in place to stop unwanted access and system manipulation. Expanding the usage of this technology in developing nations would require identifying components that are affordable and optimizing power consumption.

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