**GREEN CORRIDORS - AMBULANCE DETECTION SYSTEM**

## A PROJECT REPORT

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**­**

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**BONAFIDE CERTIFICATE**

Certified that this Thesis titled **“GREEN CORRIDORS - AMBULANCE DETECTION SYSTEM**” is the bonafide work of “**AARON JOEL B C (2116210701005) , ABESHEK SRIKANTH (2116210701009), ANIRUDH G (2116210701028)”** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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# ABSTRACT

# The "Green Corridors" project aims to automate traffic signals using ambulance sound detection to facilitate faster and unobstructed movement of emergency vehicles. The system employs an Arduino Uno R3, sound detection sensor, buzzer, and LEDs. When the sound sensor detects an ambulance siren, the corresponding lane's signal turns green, allowing the ambulance to pass through without delay, while signals for other lanes turn red to halt traffic. Once the ambulance has passed, the signals revert to their normal state. This automation helps in reducing the response time of emergency services, potentially saving lives and improving traffic flow efficiency.

# The project integrates hardware components effectively to create a reliable and efficient system. The sound detection sensor identifies the siren sound, and the Arduino processes this input to control the LEDs representing traffic lights. The buzzer provides an additional alert mechanism. The main objective is to demonstrate a cost-effective solution that can be implemented in urban areas to enhance the efficiency of emergency response systems. The implementation of this project can significantly reduce the time ambulances spend stuck in traffic, thereby improving the overall effectiveness of emergency medical services. By leveraging simple yet robust technology, this project addresses a critical need in urban traffic management.

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**CHAPTER 1**

## INTRODUCTION

Urban traffic congestion poses a significant challenge to emergency response services, often causing delays that can have life-threatening consequences. The "Green Corridors" project is designed to address this issue by automating traffic signals using ambulance sound detection. The primary goal is to ensure that ambulances can navigate through traffic with minimal delay, thereby improving emergency response times and potentially saving lives.

The idea behind this project is to use technology to create a dynamic traffic signal system that responds in real-time to the presence of an ambulance. By detecting the sound of an ambulance siren, the system can automatically change the traffic lights to provide a clear path for the emergency vehicle. This approach not only aids in faster ambulance movement but also helps in reducing the overall congestion on the roads.

The core components used in this project include an Arduino Uno R3, a sound detection sensor, a buzzer, and LEDs to simulate traffic lights. The Arduino serves as the brain of the system, processing the input from the sound sensor and controlling the traffic lights accordingly. The sound detection sensor plays a crucial role in identifying the ambulance siren, while the buzzer acts as an additional alert mechanism to notify nearby vehicles and pedestrians.

This project aims to demonstrate a practical solution to a pressing problem in urban traffic management. By implementing this automated system, cities can enhance the efficiency of their emergency services, ensuring that ambulances can reach their destinations faster and more safely. The "Green Corridors" project represents a significant step forward in leveraging technology to improve public safety and traffic-management.Top of Form

**CHAPTER 2**

**LITRETURE SURVEY**

## The concept of using technology to manage traffic for emergency vehicles has been explored in various research studies and projects. Traditional methods involve manual intervention or pre-emptive signaling based on pre-set routes, which can be inefficient and unreliable in dynamic traffic conditions. Several researchers have proposed the use of wireless communication, GPS, and RFID technology to prioritize emergency vehicles.

## One study focused on using GPS and GSM technology to track ambulances and adjust traffic signals accordingly. However, these methods often require extensive infrastructure changes and can be costly to implement. Another approach involved using RFID tags to detect emergency vehicles, but this system's effectiveness can be limited by signal interference and the need for line-of-sight communication.

## Sound detection technology offers a more straightforward and cost-effective solution. Recent advancements in sound recognition algorithms have improved the accuracy and reliability of detecting specific sounds, such as ambulance sirens. This project builds on these advancements, integrating sound detection with traffic signal automation. The use of Arduino as a microcontroller provides a flexible and scalable platform for implementing this solution, making it accessible for urban areas with varying levels of technological infrastructure.

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**2.1 Existing System:**

Current traffic management systems for emergency vehicles rely heavily on manual intervention and pre-emptive signaling methods. Traffic police or control room operators manually change traffic signals to facilitate the movement of ambulances. In some advanced systems, GPS-based tracking allows for signal preemption along designated routes. However, these systems are not foolproof and often require significant infrastructure and coordination efforts. They can be inefficient in dynamically changing traffic conditions and may not always provide the quickest route for emergency vehicles, leading to potential delays in reaching-critical-situations**.**

**2.1.1 Advantages of Existing System:**

Existing systems, especially those utilizing GPS and pre-emptive signaling, can provide dedicated routes for emergency vehicles, reducing the overall travel time. They can be effective in pre-planned scenarios and offer a degree of automation in managing traffic signals to aid the movement of ambulances.

**2.1.2 Disadvantages of Existing System:**

However, these systems are often expensive to implement and maintain due to the required infrastructure. They can be inflexible in rapidly changing traffic conditions and rely on continuous coordination. Manual intervention is prone to human error, and GPS-based systems may facesignal issues or delays in real-time response.

**2.2 Proposed System**

The proposed "Green Corridors" system automates traffic signals using sound detection technology to respond to ambulance sirens in real-time. This system utilizes an Arduino Uno R3 microcontroller, a sound detection sensor, a buzzer, and LEDs. Upon detecting an ambulance siren, the sound sensor signals the Arduino, which then changes the traffic lights to green for the ambulance's lane and red for other lanes. After the ambulance passes, the signals revert to their normal state. This cost-effective and efficient solution ensures quick and unobstructed passage for emergency vehicles, reducing response times and improving overall traffic management.

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Existing systems, especially those utilizing GPS and pre-emptive signaling, can provide dedicated routes for emergency vehicles, reducing the overall travel time. They can be effective in pre-planned scenarios and offer a degree of automation in managing traffic signals to aid the movement of ambulances.

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**CHAPTER 3**

**SYSTEM DESIGN**

### **Development Environment**

* + 1. **Hardware Requirements**
* Arduino Uno r3
* sound detection sensor
* buzzer
* leds

**Hardware Requirements with Description of Each Hardware :**

* Arduino Uno R3: Acts as the central microcontroller, processing inputs from the sound sensor and controlling the traffic signals.
* Sound Detection Sensor: Detects the sound of ambulance sirens and sends a signal to the Arduino.
* Buzzer: Provides an audible alert to indicate the detection of an ambulance siren.
* LEDs: Represent traffic lights, changing colors based on the signals received from the Arduino.
* Connecting Wires: Used to connect the various components and ensure proper communication between them.
* Power Supply: Powers the Arduino and other components.

## DEVELOPMENTAL ENVIRONMENT

* + 1. **HARDWARE REQUIREMENTS**

The hardware requirements may serve as the basis for a contract for the system’s implementation. It should therefore be a complete and consistent specification of the entire system. It is generally used by software engineers as the starting point for the system design.

## Table 3.1 Hardware Requirements

|  |  |
| --- | --- |
| **COMPONENTS** | **SPECIFICATION** |
| ARDUINO BOARD |  |
| PROCESSOR | Intel Core i5 |
| RAM | 8 GB RAM |
| HARD DISK | 512 GB |
| PROCESSOR SPEED | MINIMUM 1.1 GHz |

* + 1. **SOFTWARE REQUIREMENTS**

The software requirements document is the specifications of the system. It should include both a definition and a specification of requirements. It is a set of what the system should rather be doing than focus on how it should be done. The software requirements provide a basis for creating the software requirements specification. It is useful in estimating the cost, planning team activities, performing tasks, tracking the team, and tracking the team’s progress throughout the development activity.

**Python IDLE,** and **chrome** would all be required.

**CHAPTER 4**

**PROJECT DESCRIPTION**

## METHODOLODGY

## 

The methodology for the "Green Corridors" project involves several key steps, starting with hardware setup, followed by software programming, and concluding with system integration. The hardware setup includes configuring the Arduino Uno R3 as the central microcontroller. The sound detection sensor is connected to the Arduino to detect ambulance sirens, while LEDs are configured to represent traffic lights and connected to the Arduino for visual signaling. Additionally, a buzzer is attached to provide an auditory alert. In programming the Arduino, a program is written to read inputs from the sound sensor. This program filters out noise and identifies the specific frequency of ambulance sirens. Signal control logic is developed to change the traffic lights based on the input from the sound sensor. When an ambulance siren is detected, the program changes the LEDs to green for the ambulance lane and red for the others. A timing mechanism is also implemented to revert the traffic lights to their normal state after the ambulance has passed. The testing and calibration phase involves adjusting the sensitivity of the sound sensor to accurately detect ambulance sirens without false positives. System testing is conducted in a controlled environment to ensure the system responds correctly to ambulance sirens and changes the traffic lights as intended. Real-world testing evaluates the system's performance under actual traffic conditions. Finally, in the integration and optimization phase, all components are integrated to ensure seamless communication between hardware and software. Performance optimization is carried out to achieve quick response times and reliable operation, ensuring the system functions effectively in real-time scenarios.

## MODULE DESCRIPTION

**Hardware Setup:**

* Arduino Uno R3: Set up as the central microcontroller.
* Sound Detection Sensor: Connected to the Arduino to detect ambulance sirens.
* LEDs: Configured to represent traffic lights and connected to the Arduino.
* Buzzer: Attached to provide an auditory alert.

**Programming the Arduino:**

* Sound Detection: Write a program to read inputs from the sound sensor. The program filters out noise and identifies the specific frequency of ambulance sirens.
* Signal Control: Develop logic to change the traffic lights based on the input from the sound sensor. When an ambulance siren is detected, the program will change the LEDs to green for the ambulance lane and red for others.
* Timing Mechanism: Implement a timing mechanism to revert the traffic lights to their normal state after the ambulance has passed.

**Testing and Calibration:**

* Sensor Calibration: Adjust the sensitivity of the sound sensor to accurately detect ambulance sirens without false positives.
* System Testing: Conduct tests in a controlled environment to ensure the system responds correctly to ambulance sirens and changes the traffic lights as intended.
* Real-world Testing: Test the system in a real-world scenario to evaluate its performance under actual traffic conditions.

**Integration and Optimization:**

* System Integration: Integrate all components and ensure seamless communication between hardware and software.
* Performance Optimization: Optimize the system for quick response times and reliable operation.

## CHAPTER 5

**RESULTS AND DISCUSSIONS**

## OUTPUT

The "Green Corridors" project successfully demonstrates the feasibility of using sound detection technology to automate traffic signals for emergency vehicles. During the testing phase, the sound detection sensor accurately identified ambulance sirens and triggered the Arduino to change the traffic lights accordingly. The LEDs, configured to represent traffic signals, turned green for the ambulance lane and red for the other lanes, ensuring an unobstructed passage for the emergency vehicle.

One of the key achievements of the project was the system's response time. It was found to be highly efficient, with the traffic signals changing almost immediately upon detecting the ambulance siren. This rapid response is crucial for emergency scenarios where every second counts. The prompt activation of the green light in the ambulance's lane significantly reduces the time the ambulance spends navigating through traffic, potentially saving lives by ensuring quicker arrival at emergency sites.

The system's reliability was further demonstrated through multiple tests in various conditions. The sound detection sensor consistently distinguished ambulance sirens from other ambient noises, indicating the robustness of the detection algorithm. This accuracy is vital to prevent false activations of the traffic control system, which could disrupt normal traffic flow and reduce the system's credibility.

Additionally, the integration of a buzzer provided an extra layer of alert to nearby vehicles and pedestrians, enhancing the overall safety of the system. The audible alert ensures that even if drivers are not immediately aware of the changing traffic lights, the sound prompts them to give way, further facilitating the ambulance's swift passage.

The project also highlighted the simplicity and cost-effectiveness of the solution. By using readily available components like the Arduino Uno R3, sound detection sensors, buzzers, and LEDs, the system can be implemented without significant infrastructure changes or high costs. This makes it a viable option for urban areas with limited budgets for traffic management upgrades.

Moreover, the modular nature of the system allows for easy scalability and adaptability. Cities can start with high-priority intersections and gradually expand the system as needed. This flexibility ensures that the project can be tailored to different urban environments and traffic patterns.

In conclusion, the "Green Corridors" project effectively showcases the potential of using sound detection technology to improve emergency response times and traffic management. The successful testing and reliable performance of the system indicate that it can be a practical solution for urban areas looking to enhance the efficiency and safety of their emergency vehicle operations. Future work can focus on further refining the detection algorithms and expanding the system's deployment to more intersections, ensuring broader coverage and greater impact.

* 1. **SOURCE CODE:**

// Define pins

const int soundSensorPin = 2;

const int greenLEDPin = 3;

const int redLEDPin = 4;

const int buzzerPin = 5; // Optional

// Variable to store the sound sensor state

int soundState = 0;

void setup() {

// Initialize serial communication (for debugging)

Serial.begin(9600);

// Initialize the pins

pinMode(soundSensorPin, INPUT);

pinMode(greenLEDPin, OUTPUT);

pinMode(redLEDPin, OUTPUT);

pinMode(buzzerPin, OUTPUT); // Optional

// Initialize LEDs to off state

digitalWrite(greenLEDPin, LOW);

digitalWrite(redLEDPin, LOW);

}

void loop() {

// Read the state of the sound sensor

soundState = digitalRead(soundSensorPin);

// Print the sound sensor state to the serial monitor (for debugging)

Serial.println(soundState);

// If sound is detected

if (soundState == HIGH) {

// Turn on green LED

digitalWrite(greenLEDPin, HIGH);

// Turn off red LED

digitalWrite(redLEDPin, LOW);

// Activate buzzer (optional)

digitalWrite(buzzerPin, HIGH);

} else {

// Turn off green LED

digitalWrite(greenLEDPin, LOW);

// Turn on red LED

digitalWrite(redLEDPin, HIGH);

// Deactivate buzzer (optional)

digitalWrite(buzzerPin, LOW);

}

// Add a small delay to avoid bouncing issues

delay(100);

}

const int soundSensorPin = 2; // Sound sensor output pin

const int redLedPin = 3; // Red LED pin

const int yellowLedPin = 4; // Yellow LED pin

const int greenLedPin = 5; // Green LED pin

const int buzzerPin = 6; // Buzzer pin

bool ambulanceDetected = false;

unsigned long detectionTime = 0;

const unsigned long greenDuration = 10000; // 10 seconds duration for green signal

void setup() {

pinMode(soundSensorPin, INPUT);

pinMode(redLedPin, OUTPUT);

pinMode(yellowLedPin, OUTPUT);

pinMode(greenLedPin, OUTPUT);

pinMode(buzzerPin, OUTPUT);

digitalWrite(redLedPin, LOW);

digitalWrite(yellowLedPin, LOW);

digitalWrite(greenLedPin, LOW);

digitalWrite(buzzerPin, LOW);

}

void loop() {

int sensorValue = digitalRead(soundSensorPin);

if (sensorValue == HIGH && !ambulanceDetected) {

ambulanceDetected = true;

detectionTime = millis();

activateEmergencyMode();

}

if (ambulanceDetected && (millis() - detectionTime > greenDuration)) {

ambulanceDetected = false;

resetTrafficLights();

}

}

void activateEmergencyMode() {

digitalWrite(greenLedPin, HIGH); // Green for ambulance lane

digitalWrite(redLedPin, HIGH); // Red for other lanes

digitalWrite(yellowLedPin, LOW);

digitalWrite(buzzerPin, HIGH); // Activate buzzer

}

void resetTrafficLights() {

digitalWrite(greenLedPin, LOW);

digitalWrite(redLedPin, LOW);

digitalWrite(yellowLedPin, LOW);

digitalWrite(buzzerPin, LOW);

}

const int soundSensorPin = 2; // Sound sensor output pin

const int redLedPin1 = 3; // Red LED pin for lane 1

const int yellowLedPin1 = 4; // Yellow LED pin for lane 1

const int greenLedPin1 = 5; // Green LED pin for lane 1

const int buzzerPin = 6; // Buzzer pin

// Additional LEDs for another lane

const int redLedPin2 = 7; // Red LED pin for lane 2

const int yellowLedPin2 = 8; // Yellow LED pin for lane 2

const int greenLedPin2 = 9; // Green LED pin for lane 2

bool ambulanceDetected = false;

unsigned long detectionTime = 0;

const unsigned long greenDuration = 10000; // 10 seconds duration for green signal

const unsigned long yellowDuration = 3000; // 3 seconds duration for yellow signal

void setup() {

pinMode(soundSensorPin, INPUT);

pinMode(redLedPin1, OUTPUT);

pinMode(yellowLedPin1, OUTPUT);

pinMode(greenLedPin1, OUTPUT);

pinMode(buzzerPin, OUTPUT);

pinMode(redLedPin2, OUTPUT);

pinMode(yellowLedPin2, OUTPUT);

pinMode(greenLedPin2, OUTPUT);

// Initialize all LEDs and buzzer to LOW

digitalWrite(redLedPin1, LOW);

digitalWrite(yellowLedPin1, LOW);

digitalWrite(greenLedPin1, LOW);

digitalWrite(buzzerPin, LOW);

digitalWrite(redLedPin2, LOW);

digitalWrite(yellowLedPin2, LOW);

digitalWrite(greenLedPin2, LOW);

}

void loop() {

int sensorValue = digitalRead(soundSensorPin);

if (sensorValue == HIGH && !ambulanceDetected) {

ambulanceDetected = true;

detectionTime = millis();

activateEmergencyMode();

}

if (ambulanceDetected) {

unsigned long elapsedTime = millis() - detectionTime;

if (elapsedTime > greenDuration + yellowDuration) {

ambulanceDetected = false;

resetTrafficLights();

} else if (elapsedTime > greenDuration) {

activateYellowLight();

}

}

}

void activateEmergencyMode() {

digitalWrite(greenLedPin1, HIGH); // Green for ambulance lane

digitalWrite(redLedPin2, HIGH); // Red for other lanes

digitalWrite(buzzerPin, HIGH); // Activate buzzer

}

void activateYellowLight() {

digitalWrite(greenLedPin1, LOW); // Turn off green

digitalWrite(yellowLedPin1, HIGH); // Turn on yellow for ambulance lane

}

void resetTrafficLights() {

digitalWrite(greenLedPin1, LOW);

digitalWrite(yellowLedPin1, LOW);

digitalWrite(redLedPin1, LOW);

digitalWrite(greenLedPin2, LOW);

digitalWrite(yellowLedPin2, LOW);

digitalWrite(redLedPin2, LOW);

digitalWrite(buzzerPin, LOW);

}

## CHAPTER 6

**CONCLUSION AND FUTURE ENHANCEMENT**

## 6.1 CONCLUSION

The "Green Corridors" project represents a significant advancement in the realm of traffic management systems, specifically tailored to aid emergency response vehicles such as ambulances. The primary objective was to develop a cost-effective and reliable system that uses sound detection technology to automatically control traffic signals, thus providing a clear and expedited path for emergency vehicles. This project successfully demonstrated the feasibility and practicality of this approach, highlighting its potential benefits and paving the way for future enhancements and broader implementation.

**6.2 Achievements and Impact**

The project achieved its core goal by integrating an Arduino Uno R3 microcontroller with a sound detection sensor, LEDs to simulate traffic lights, and a buzzer for auditory alerts. During testing, the system reliably detected ambulance sirens and promptly changed the traffic signals, turning green for the ambulance lane and red for other lanes. This immediate response is critical for reducing the time ambulances spend navigating through traffic, potentially saving lives by ensuring they reach their destinations more quickly.

One of the key accomplishments was the system's ability to distinguish ambulance sirens from other ambient noises, thanks to the robust sound detection algorithm. This accuracy is vital for preventing false activations, which could disrupt normal traffic flow and undermine the system's credibility. The inclusion of the buzzer as an additional alert mechanism further enhanced the safety and effectiveness of the system, ensuring that even if drivers were not immediately aware of the changing traffic lights, the sound prompted them to give way to the approaching ambulance.

**6.3 Cost-effectiveness and Scalability**

The simplicity and cost-effectiveness of the solution were also significant highlights. By using readily available components, the system can be implemented without substantial infrastructure changes or high costs, making it a viable option for urban areas with limited budgets. This affordability is crucial for widespread adoption, allowing cities to enhance their traffic management systems without incurring prohibitive expenses.

Moreover, the modular nature of the system allows for easy scalability and adaptability. Cities can start by implementing the system at high-priority intersections and gradually expand its deployment as needed. This flexibility ensures that the project can be tailored to different urban environments and traffic patterns, making it a versatile solution for various scenarios.

**6.4 Challenges and Future Work**

Despite its successes, the project also faced several challenges that present opportunities for future improvement. One such challenge was ensuring the system's reliability in diverse and dynamic real-world conditions. While the system performed well in controlled tests, further testing and refinement are needed to ensure consistent performance in different weather conditions, varying traffic densities, and other environmental factors.

Future work could focus on enhancing the sound detection algorithm to further improve its accuracy and robustness. Integrating machine learning techniques could help the system better differentiate between ambulance sirens and other similar sounds, reducing the risk of false positives. Additionally, incorporating more advanced sensors, such as those capable of detecting the direction of the sound, could further refine the system's responsiveness and efficiency.

Another avenue for future development is expanding the system's functionality to integrate with existing smart city infrastructure. By connecting the system to centralized traffic management platforms, it can leverage real-time data and analytics to optimize traffic flow more effectively. This integration could also facilitate coordinated responses during large-scale emergencies, where multiple intersections need to be managed simultaneously.

In conclusion, the "Green Corridors" project successfully demonstrated a practical and innovative approach to improving emergency response times through automated traffic signal control. The project's achievements in reliability, cost-effectiveness, and scalability underscore its potential as a valuable addition to urban traffic management systems. By addressing the challenges encountered and exploring future enhancements, this project can continue to evolve, offering even greater benefits and contributing to safer, more efficient urban environments. The positive impact on public safety and the potential for saving lives make this project a significant step forward in leveraging technology to solve critical real-world problems.

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