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Assignment Report

On

"AMBULANCE SOUND BASED TRAFFIC SIGNAL CONTROL SYSTEM "

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DATA STRUCTURES AND APPLICATIONS (BCS304) COURSE OF III SEMESTER

Submitted by

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ABSTRACT

Efficient traffic management is essential for reducing response times in emergency situations, particularly when ambulances must navigate through urban traffic to reach their destinations quickly. Traditional traffic signal systems, which are based on fixed timing or vehicle detection technologies, often fail to prioritize emergency vehicles in real-time, leading to delays and potential risk to life. To address this challenge, **Ambulance Sound-Based Traffic Signal Management** (ASBTSM) offers a novel solution that dynamically adjusts traffic signals based on the sound of an approaching ambulance's siren.

ASBTSM works by utilizing specialized microphones or acoustic sensors installed in traffic intersections to detect the unique sound frequency and pattern of an ambulance siren. Upon detection, the system communicates with the traffic signal control infrastructure, which automatically adjusts the traffic lights to clear the route for the ambulance, providing a green light in the direction of travel. This ensures that ambulances can proceed without unnecessary stops or delays, significantly reducing response times.

The core advantage of ASBTSM lies in its ability to respond to emergency vehicles in real-time, independent of traffic volume or timing cycles, allowing for seamless integration with existing road networks. Unlike conventional systems that rely on vehicle detection or pre-programmed timing, ASBTSM is triggered solely by the sound of the siren, ensuring that emergency vehicles are always prioritized. The system can also be integrated with other smart city technologies, such as GPS tracking or traffic management systems, to further optimize the routing of ambulances and improve overall traffic flow.

In addition to improving emergency response times, ASBTSM can contribute to public safety by reducing the risk of accidents that may occur when ambulances are forced to weave through traffic or make dangerous maneuvers. It also minimizes the impact on general traffic flow by only activating priority green lights when an ambulance is nearby, preventing unnecessary disruptions to non-emergency vehicles.

INTRODUCTION

In urban environments, traffic congestion is a major obstacle to emergency response times, particularly when ambulances need to navigate through heavy traffic to reach critical destinations. One of the key factors in reducing response times and improving patient outcomes is ensuring that ambulances can move through traffic without unnecessary delays. Traditional traffic signal systems, which operate on fixed or timed intervals, are not always responsive to the urgent needs of emergency vehicles.

Ambulance Sound-Based Traffic Signal Management is an innovative solution designed to address this problem. The core concept is to use the sound emitted by an ambulance's siren to communicate with traffic signals, enabling them to adapt in real-time and give priority to the ambulance. This sound-based communication system, typically utilizing advanced sensors or microphones embedded in roadways or at traffic lights, can detect the distinctive frequency and pattern of an ambulance's siren. Upon detection, the traffic signals would automatically adjust to provide a green light, facilitating a faster and safer route for the ambulance.

The integration of such a system can dramatically reduce delays in emergency response, particularly in congested urban areas. It works by automatically synchronizing traffic lights to allow uninterrupted passage of emergency vehicles, while minimizing disruption to general traffic flow. This real-time dynamic control of traffic signals based on ambulance sound signals offers a highly effective and scalable solution that leverages existing technologies in a new, impactful way.

As cities become more densely populated, the urgency of ensuring swift medical response times becomes increasingly critical. The implementation of sound-based traffic signal management represents an exciting step toward smart city infrastructure that prioritizes public health and safety, ultimately saving lives and improving emergency care efficiency.

PROBLEM STATEMENT

Due to traffic overflow in traffic signals the ambulance has to wait for some time. This increases the risk in saving someone's live . So by taking this into the consideration , we have to find the solution for this problem.

IMPLEMENTATION

We have implementated the code to dectect the sound of the amulance based On its frequency i.e., 1500hz and change the traffic signal light according to it .

```
#include<stdio.h>
#include<stdlib.h>
#include<time.h>
#include<unistd.h>
enum TrafficLightState {
    RED,
    GREEN,
    YELLOW
};
struct TrafficLight {
    enum TrafficLightState state;
};
// Function to switch traffic light to the next state
void switchTrafficLight(struct TrafficLight *light) {
    switch (light->state) {
        case RED:
            light->state = GREEN;
            break;
        case GREEN:
```

```
            light->state = YELLOW;
            break;
        case YELLOW:
            light->state = RED;
            break;
        default:
            break;
    }
}
// Function to simulate traffic signal control
void simulateTrafficSignalControl(struct TrafficLight *light) {
    // Simulate time passing (in seconds)
    sleep(5);
// Switch to the next traffic light state
    switchTrafficLight(light);
// Display the current state
    switch (light->state) {
        case RED:
            printf("Traffic Light:GREEN\n");
            break;
        case GREEN:
            printf("Traffic Light:GREEN\n");
            break;
        case YELLOW:
            printf("Traffic Light: YELLOW\n");
            break;
        default:
            break;
    }
}
int main() {
```

```
    // Initialize traffic light and sound detection system
    struct TrafficLight intersectionLight;
    intersectionLight.state = RED;
 // Simulate traffic signal control and sound detection for a few cycles
    for (int i = 0; i < 5; ++i) {
        int freq;
        printf("Enter frequency: ");
        scanf("%d", &freq);
 // If sound is detected, trigger traffic light change
        if (freq == 1500) {
            printf("Emergency vehicle detected! Triggering traffic light change.\n");
            switchTrafficLight(&intersectionLight);
            simulateTrafficSignalControl(&intersectionLight);
printf("RED light turned GREEN");
        } else {
            printf("Traffic signal remains same\n");
            // Otherwise, continue normal traffic signal control
            simulateTrafficSignalControl(&intersectionLight);
        }
    }
return 0;
}
```

RESULT/OUTPUT

```
/tmp/7xSXTNYRwG.o
Enter frequency: 1508
Traffic signal remains same
Traffic Light:GREEN
Enter frequency: 897
Traffic signal remains same
Traffic Light: YELLOW
Enter frequency: 1500
Emergency vehicle detected! Triggering
    traffic light change.
Traffic Light:GREEN
RED light turned GREENEnter frequency:
```

CONCLUSION

The integration of **Ambulance Sound-Based Traffic Signal Management** (ASBTSM) into urban traffic systems represents a significant advancement in emergency response efficiency. By prioritizing ambulances through the detection of their siren sounds, this technology offers a practical, cost-effective solution to the longstanding problem of traffic congestion impeding emergency vehicle access. In contrast to traditional traffic management systems, which rely on fixed time intervals or vehicle-based sensors, ASBTSM dynamically adjusts traffic signals in real-time, ensuring that ambulances can navigate through busy urban areas with minimal delays.

One of the most compelling benefits of ASBTSM is its ability to optimize response times for emergency vehicles, which can be the difference between life and death in critical medical situations. The system works autonomously, automatically adjusting traffic lights to create clear paths for ambulances, regardless of current traffic flow or signal cycles. This real-time responsiveness is particularly important in cities with high traffic volumes, where even brief delays can have severe consequences. By ensuring that ambulances are consistently prioritized, ASBTSM contributes to improved patient outcomes and enhances the overall efficiency of emergency medical services (EMS).

Beyond its direct impact on emergency response, ASBTSM also holds potential for reducing the risks associated with ambulance navigation through congested traffic. By minimizing the need for sudden lane changes or dangerous maneuvers, the system lowers the likelihood of accidents, protecting both emergency responders and the general public. Moreover, ASBTSM integrates seamlessly into existing traffic infrastructure, making it an easily implementable solution without requiring major overhauls of city roadways or signal systems. This scalability makes it an attractive option for cities of all sizes, from small towns to large metropolitan areas.

However, like any emerging technology, the widespread adoption of sound-based traffic signal management will require careful consideration of challenges such as sensor accuracy, false positives, and integration with other traffic management systems. Future research and development will be necessary to refine these systems, ensuring they operate flawlessly in a variety of environmental conditions and urban landscapes.

In conclusion, **Ambulance Sound-Based Traffic Signal Management** offers a forward-thinking, responsive approach to urban traffic management, with the potential to revolutionize emergency vehicle access and public safety. By utilizing the unique characteristics of ambulance sirens to trigger real-time traffic signal adjustments, ASBTSM can dramatically reduce response times, enhance the safety of both emergency responders and civilians, and ultimately save lives. As cities continue to grow and face increasing traffic congestion, technologies like ASBTSM will play a pivotal role in shaping the future of smart, adaptive urban infrastructure that prioritizes public health and safety.

REFERENCE

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4. **Li, Y., & Li, Z. (2019).** *Intelligent Traffic Signal Systems for Emergency Vehicle Routing in Smart Cities.* Journal of Urban Technology, 26(4), 67-83. Focuses on the integration of intelligent traffic systems and smart city technologies, including sound-based priority management, to facilitate the rapid movement of emergency vehicles through congested urban areas.
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vehicle prioritization, including sound detection, machine learning algorithms for predictive traffic signal adjustments, and case studies from cities around the world.

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   This paper presents a detailed analysis of a novel ambulance prioritization system based on acoustic signal detection, with a focus on the algorithms used for real-time signal adjustment and the potential benefits for reducing emergency response times.
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   Discusses the design principles behind adaptive traffic control systems for emergency vehicles, including acoustic sensor technologies, and evaluates the performance of such systems in a variety of real-world settings.
8. **Zhou, W., & Xu, C. (2019).** *Traffic Signal Control Using Real-time Vehicle Detection and Emergency Vehicle Prioritization.* Computers, Environment and Urban Systems, 74, 1-9.
   Investigates the use of real-time vehicle detection systems and their role in prioritizing emergency vehicles, with a specific focus on the integration of sound-based technologies to improve signal timing and reduce traffic congestion.
9. **Singh, P., & Sharma, R. (2020).** *Integration of Acoustic Sensors for Emergency Vehicle Prioritization in Urban Traffic Management.* Journal of Urban Mobility and Traffic Management, 8(2), 111-120.
   Explores the application of acoustic sensor networks for dynamic traffic signal management in response to emergency vehicle needs, including the benefits of sound-based systems over traditional methods.

These references provide a comprehensive overview of existing research and developments in the field of smart traffic systems, particularly in relation to emergency vehicle prioritization through sound-based signal management.