SMART AMBULANCE ALERT SYSTEM

“An IoT and Machine Learning-Based Approach for Improving Emergency Medical Services on Roads"

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ABSTRACT

This project proposes a system for ambulance detection on roads using a combination of Machine Learning (ML) and Internet of Things (IoT) technologies. The aim of the system is to reduce the response time of emergency medical services (EMS) by detecting ambulances on the road and alerting the nearest traffic signal. The system comprises microphones placed at intersections and along the roads that detect ambulances based on their movement in the roads and an ML algorithm that analyzes the data collected from these microphones to identify and locate the ambulance. The IoT component of the system is responsible for receiving and processing the response from the ML model to the respective nearest traffic signals and updating them in real-time to clear traffic. The proposed system can potentially reduce the response time of emergency medical services (EMS), thereby increasing the chances of saving lives.

PROBLEM STATEMENT

The purpose of this project is to develop a system that uses IoT and machine learning technologies to detect ambulances and alert traffic signals in real-time. The system will use various components, such as microphones and buzzers, to collect data on the movement and location of vehicles on the road network. The machine learning algorithms will then

process this data to identify patterns and trends that indicate the presence of an ambulance.

The system will also use IoT technologies to transmit the data collected by the cameras and machine learning model to a central server, where it can be analyzed and used to generate alerts and notifications for emergency services and other relevant parties. The aim of this system is to improve the efficiency and effectiveness of emergency response services by providing real-time information on the location of ambulances and other emergency vehicles.

OBJECTIVE:

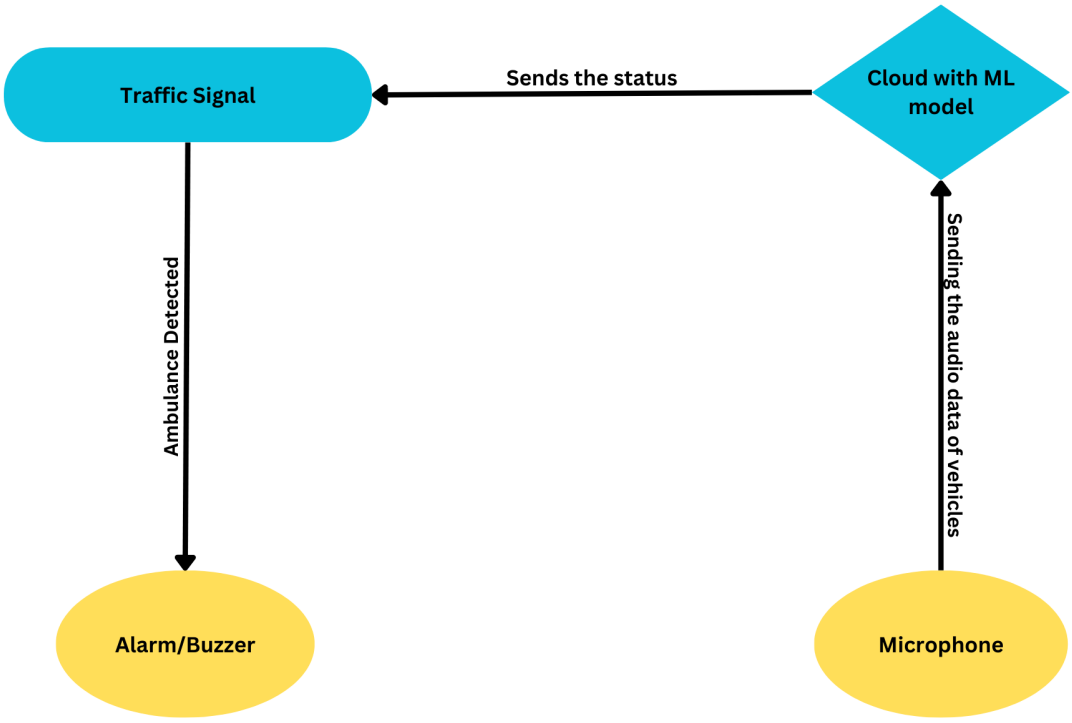
The objective of ambulance detection and alarming on roads using Machine learning and IoT is to develop a system that can accurately detect the presence of ambulances on the roads and provide real-time information to traffic signals and other vehicles in the vicinity to clear out traffic for the ambulance.

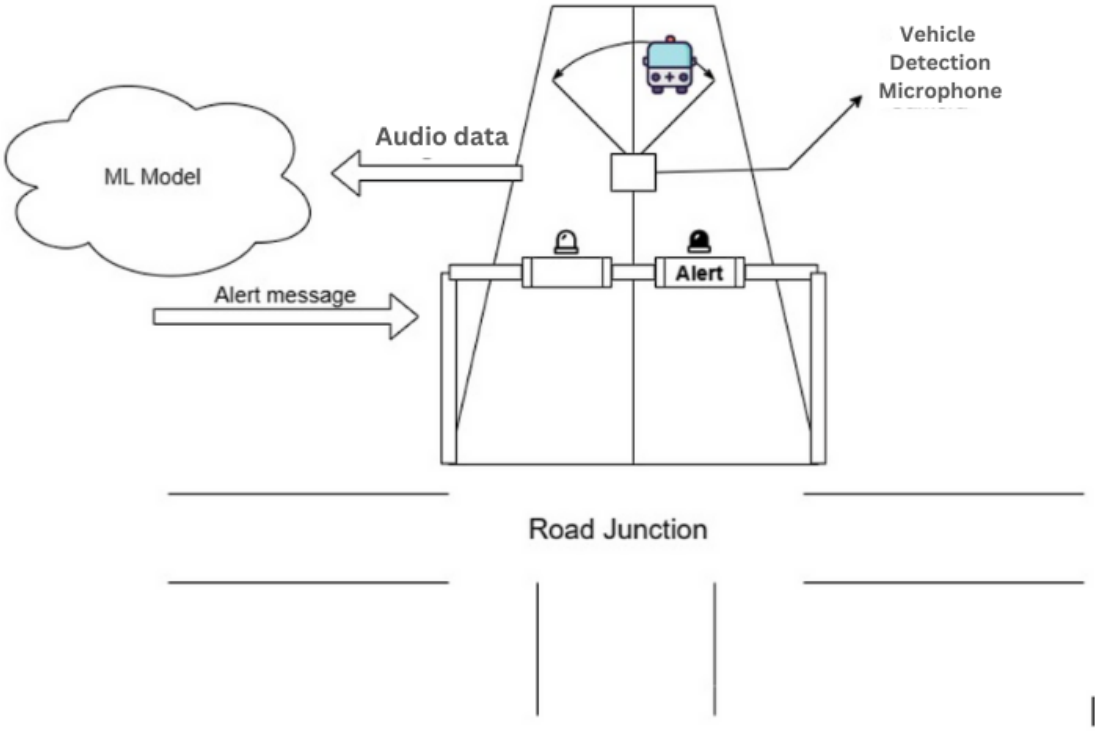
The system will leverage IoT sensors and microphones installed on roads and intersections to capture audio data on the movement of vehicles. Machine learning algorithms will be used to process the data and identify the ambulances in the roads

Once an ambulance is detected, the system will automatically send an alert to traffic signals, informing them of the ambulance's approach and the direction in which it is heading. This will help emergency services respond more quickly to emergencies, and other vehicles can make way for the ambulance, reducing the time it takes for the ambulance to reach its destination.

The system will also be able to collect data on ambulance siren sounds, which can be used to identify traffic patterns and optimize emergency response times in the future. Overall, the objective of this project is to improve emergency response times and save lives by leveraging the power of IoT and Machine learning.

PROCESS FLOW:





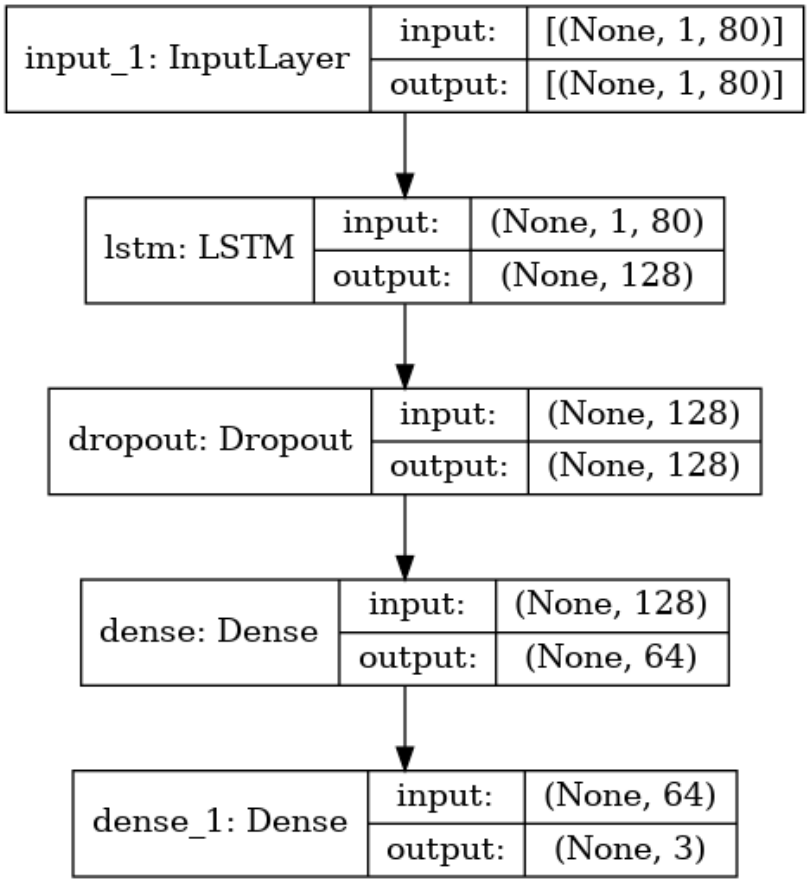
Machine Learning Model:

Convolutional Neural Network (CNN) and Long Short-Term Memory (LSTM)

In this section, we describe the architecture and training process of the Machine Learning Classification Model developed for emergency vehicle classification using Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks.

1) Model Architecture:

The classification model consists of two main components: the CNN stage for feature extraction and the LSTM stage for capturing temporal dependencies.



2) Convolutional Neural Network (CNN) Stage:

The CNN stage is responsible for extracting meaningful features from the input images or video frames. We utilized a pre-trained CNN model (e.g., ResNet, VGG, or Inception) as the base architecture and fine-tuned it on our dataset to leverage transfer learning. This approach allows the model to benefit from the learned features of the pre-trained model, improving both efficiency and performance.

3) Long Short-Term Memory (LSTM) Stage:

The LSTM stage, which is a type of recurrent neural network, is used to capture temporal dependencies and sequential information from video data. We designed the LSTM layer to take sequences of feature vectors extracted from the CNN stage as input. This enables the model to learn spatiotemporal patterns of emergency vehicle movement, leading to accurate classifications over time.

Results Obtained:

ML Model:

1) **From CNN:**

```
]: _, acc = model_cnn.evaluate(X_test_features, y_test)
   print("Test Accuracy : ", acc)

   4/4 [==============================] - 0s 7ms/step - loss: 0.0916 - acc: 0.9583
   Test Accuracy :  0.9583333134651184
```

2) From LSTM:

```
]: _,acc = model_lstm.evaluate(x_test_features, y_test)
print("Accuracy:", acc)
```

```
4/4 [==============================] - 0s 6ms/step - loss: 0.0694 - acc: 0.9833
Accuracy: 0.9833333492279053
```

From Arduino:

3) Connection of Arduino:

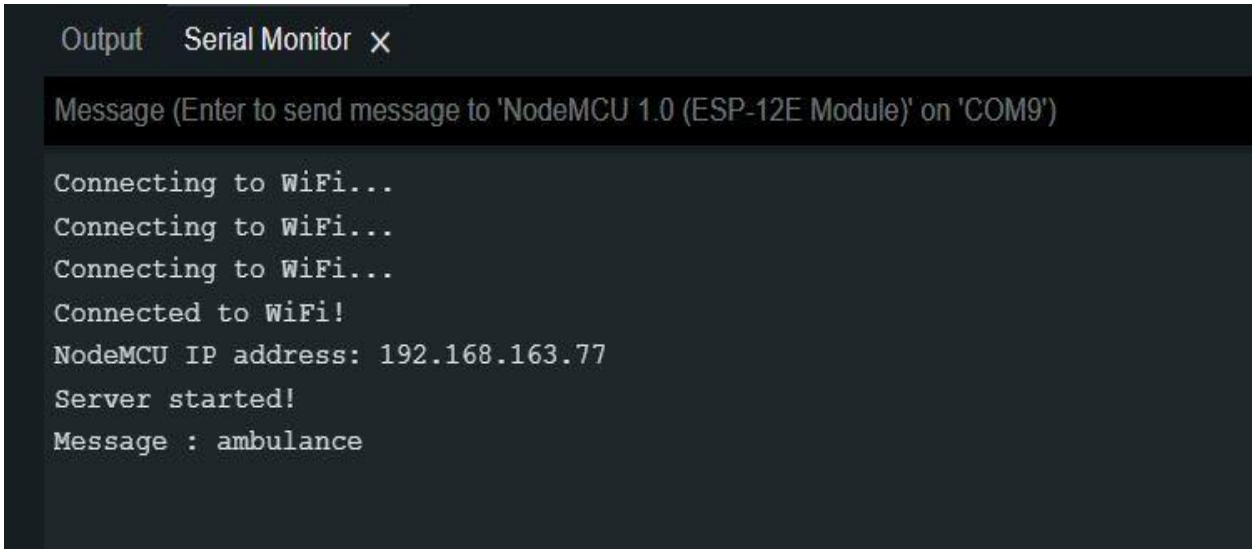
4) Sending response to Arduino:

```
[53]: import requests
def sendrequest(prediction):
    # 'http://<nodemcu-device-ip>:<nodemcu-device-port>/process'
    url = 'http://192.168.163.77:80/post'
    data = {'prediction': prediction}
    print(data)
    response = requests.post(url, json=data)
    if response.status_code == 200:
        print('POST request successful')
    else:
        print('POST request failed: ', response)
```

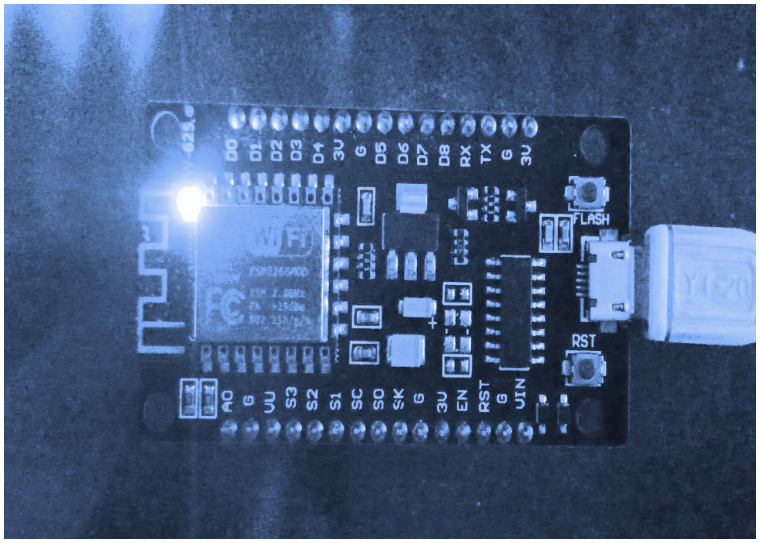
```
[54]: sendrequest(answer)
```

```
{'prediction': 'ambulance'}
POST request successful
```

5) Response on Arduino serial monitor:



6) Response on circuit:



Conclusion:

This project utilized audio processing techniques to detect ambulance sirens in real-time, contributing to the improvement of emergency response systems. By analyzing audio data, the system was able to identify the unique sound patterns of ambulance sirens amidst various background noises. This approach offered a non-intrusive and cost-effective solution for detecting emergency vehicles without the need for complex hardware. Moreover, the system's potential integration with existing IoT infrastructure and smart city initiatives makes it a valuable tool for optimizing emergency services and traffic management in urban environments, ultimately leading to safer and more efficient emergency responses