Dynamic Traffic Management System

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Overview

Traffic management system is a cornerstone of a Smart city. In the current problems of the world, urban mobility is one of the major problems, especially in metropolitan cities people spend around 243 hours on average in traffic per year.This has turned out to be a daily problem in current times. At present, the traffic control frameworks in India, need insight and go about as an open-loop control framework, with no input or detecting system. Present technologies use Inductive loops and sensors to detect the number of vehicles passing by. It is a very inefficient and expensive way to make traffic lights adaptive

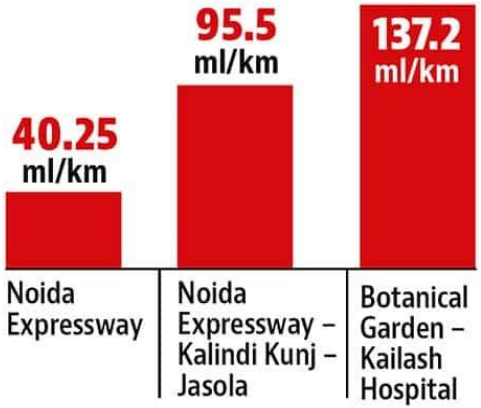
Overview (Cont.)

Using a simple CCTV camera can improve the conditions. The visual tracking of objects is amongst the most critical areas of computer vision and deep learning. The objective of this work was to develop the traffic control framework by presenting a detecting system, which gives an input to the current system, with the goal that it can adjust the changing traffic density patterns and provides a vital sign to the controller in a continuous activity. Using this method, improvement of the traffic signal switching expands the street limit, saves time for voyaging, and prevents traffic congestion. The framework additionally goes for consolidating exceptional arrangements for clearing the path for emergency vehicles using IoT sensors and simple decision algorithm.

Statistical Proof

Same car, different fuel spends

Here is the amount of fuel an SUV with 10-12 km per litre mileage consumes in different parts of Delhi/NCR



■ Fuel wastage across the country is pegged at ₹960 cr a day. HT

Here is the survey shows how much fuel has been wasted and the congestion level of vehicles.

RANK BY FILTER	WORLD RANK	CITY	COUNTRY	CONGESTION LEVEL
1	1	Bengaluru	India	71%
2	2	Manila	Philippines	71%
3	3	Bogota	Colombia	68% ↑5%
4	4	Mumbai	India	65% 0%
5	5	Pune	India	59%
6	6	Moscow region (oblast)	Russia	59% ↑3%
7	7	Lima	Peru	57% ↓1%
8	8	New Delhi	India	56% ↓2%
9	9	Istanbul	Turkey	55% ↑2%
10	10	Jakarta	Indonesia	53% 0%

Understanding the problems

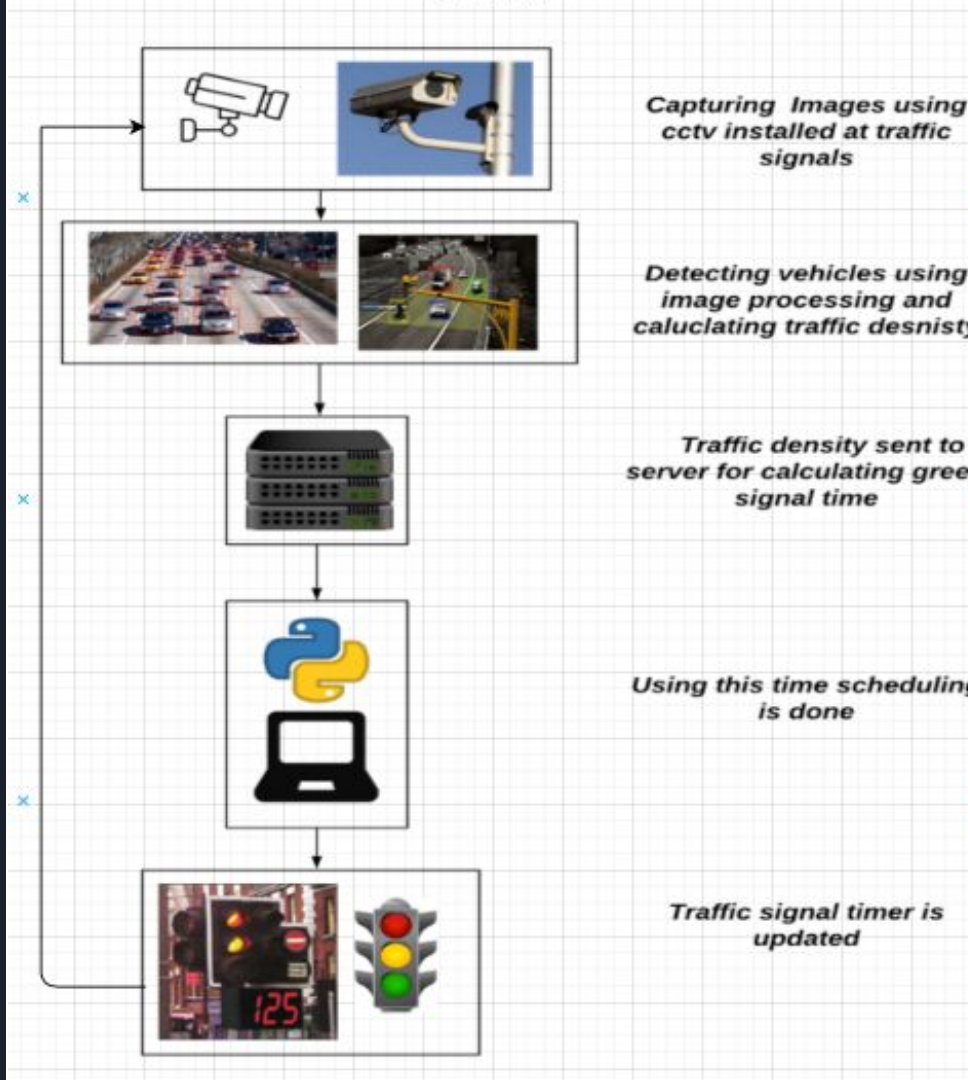
01 Traffic jams have become one of the main challenges for engineers and designers to create an intelligent traffic management system capable of effectively detecting and reducing the overall density of traffic.

02 Prioritizing vehicles like ambulances and fire brigades is important for its emergency aid capabilities.

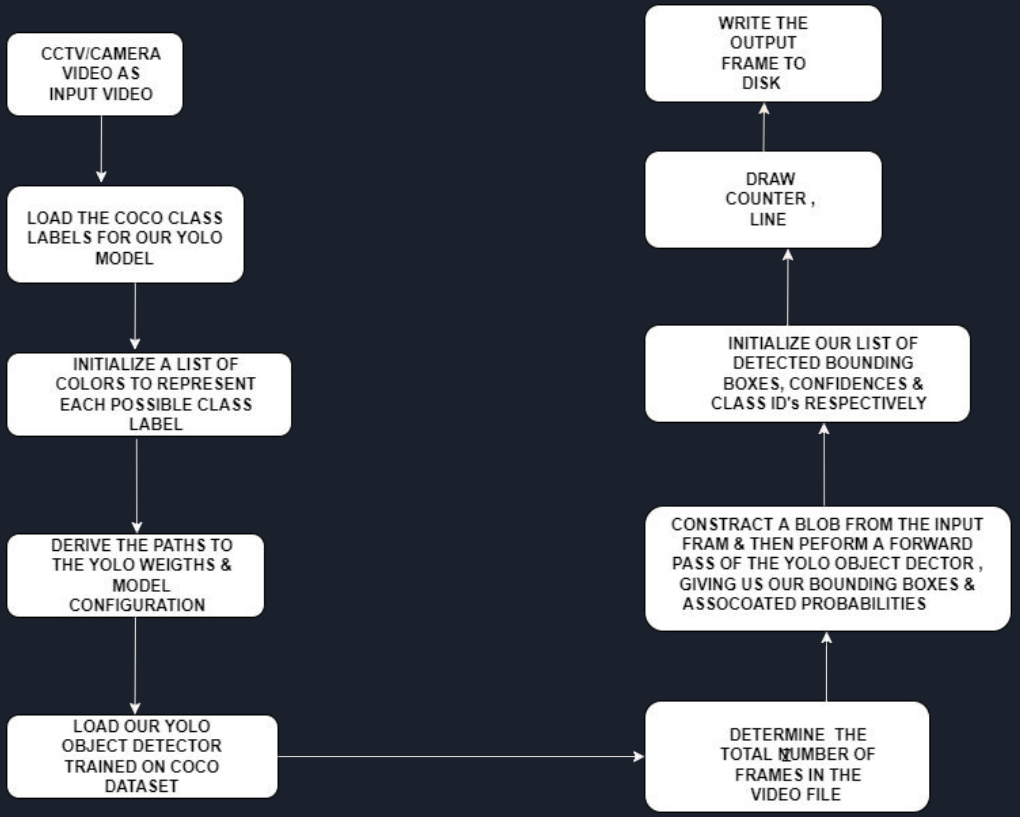
03 Violation of traffic Rules is a crime and might lead to accidents resulting in unexpected fatality.

Architecture:

This architecture shows the workflow of the traffic system.



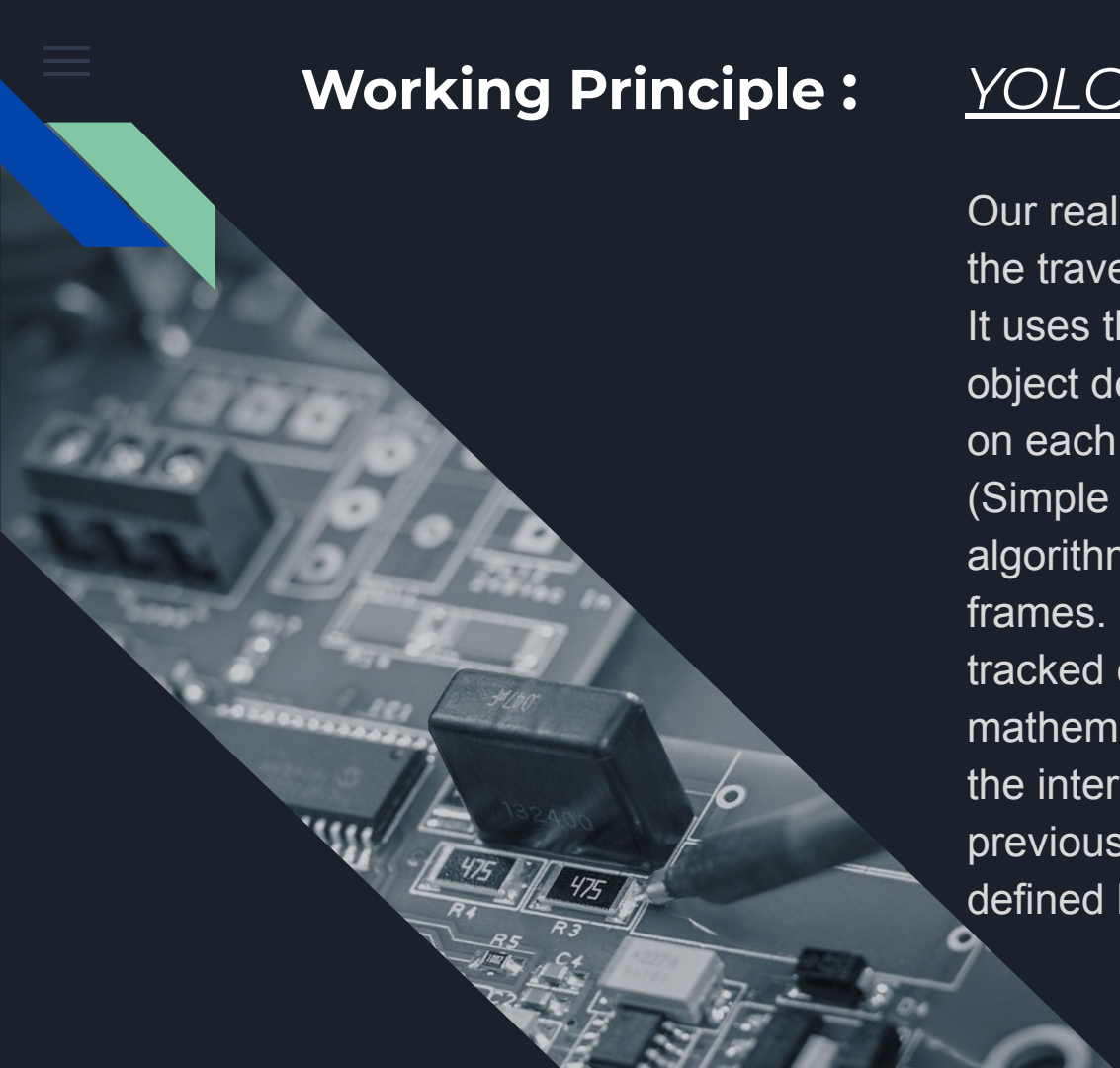
FlowChart


CCTV/CAMERA VIDEO AS INPUT VIDEO
LOAD THE COCO CLASS LABELS FOR OUR YOLO MODEL
INITIALIZE A LIST OF COLORS TO REPRESENT EACH POSSIBLE CLASS LABEL
DERIVE THE PATHS TO THE YOLO WEIGTHS & MODEL CONFIGURATION
LOAD OUR YOLO OBJECT DETECTOR TRAINED ON COCO DATASET
DETERMINE THE TOTAL NUMBER OF FRAMES IN THE VIDEO FILE
CONSTRACT A BLOB FROM THE INPUT FRAM & THEN PEFORM A FORWARD PASS OF THE YOLO OBJECT DECTOR , GIVING US OUR BOUNDING BOXES & ASSOCOATED PROBABILITIES
INITIALIZE OUR LIST OF DETECTED BOUNDING BOXES, CONFIDENCES & CLASS ID's RESPECTIVELY
DRAW COUNTER , LINE
WRITE THE OUTPUT FRAME TO DISK

Technology / Components Employed :

- Generic Road Track Monitoring System
- Siren Detector
- Automatic License Plate Recognition
-

Working Principle : *YOLO*

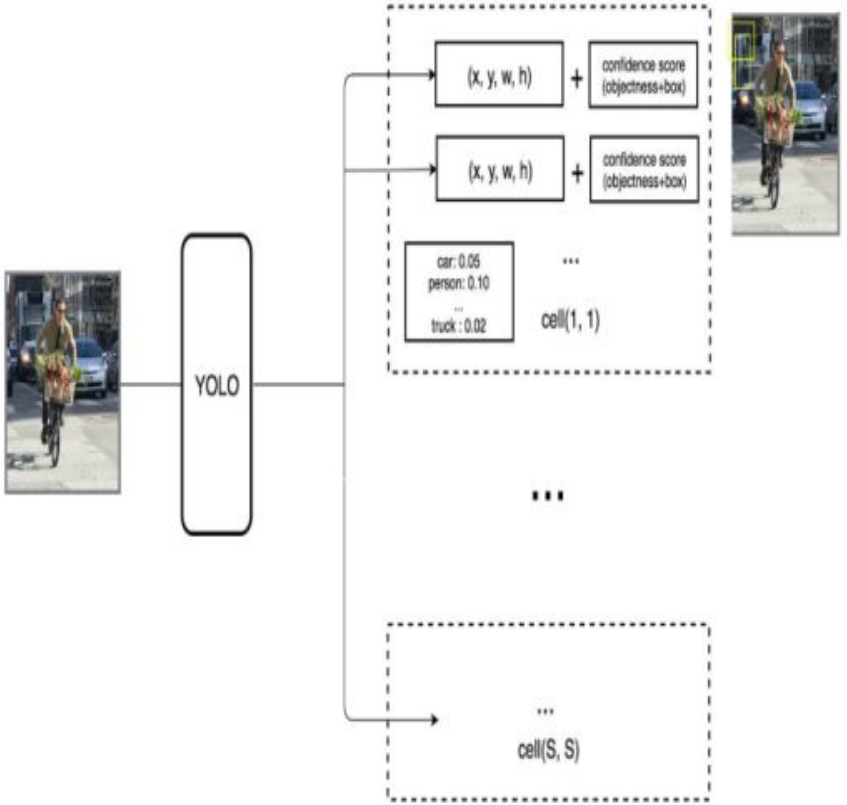


Our real target is to advance the deferral in the travel of vehicles in odd hours of the day. It uses the YOLO (“You Only Look Once”) object detection technique to detect objects on each of the video frames And SORT (Simple Online and Real-time Tracking algorithm) to track those objects over different frames. Once the objects are detected and tracked over different frames, a simple mathematical calculation is applied to count the intersections between the vehicle's previous and current frame positions with a defined line.

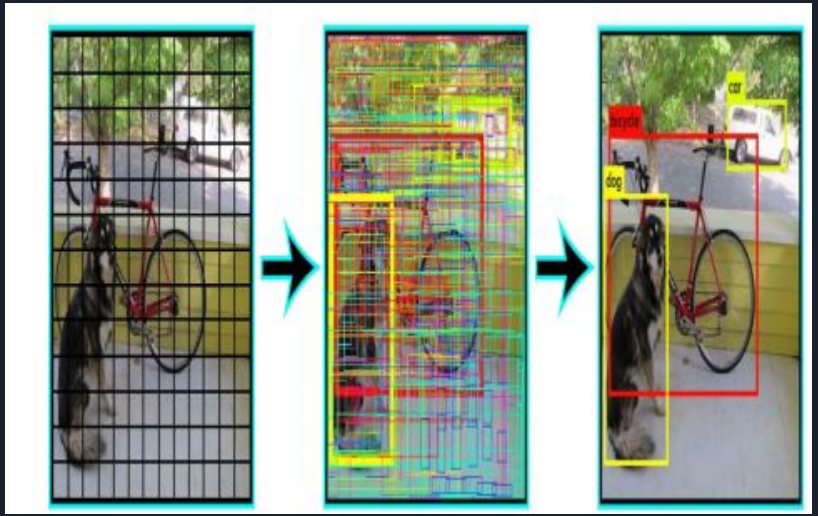
Workflow of YOLO Algorithm

The Boundary box has five elements: (x, y, w, h) and a score for the box confidence. This score tells us the probability of the box to contain an object and accuracy also. x and y are offsets. Every cell has 20 conditional class probabilities. YOLO's prediction has a shape of (S, S, B×5 + C) = (7, 7, 30)

The real idea behind You Only Look Once is to assemble a convolutional neural network system for anticipating a (7, 7, 30) tensor. It utilizes a CNN system to decrease the spatial measurement. YOLO plays out a linear regression using a couple of completely associated layers for making 7×7×2 boundary box predictions. To make the last prediction, we keep those with high box certainty scores (more than 0.25) as our previous predictions.



Categorization of objects using YOLO



The class confidence score for every prediction box is calculated by

using equation 1:

Class confidence score* = *box confidence score* ∗ *conditional class probability **(1)**

It's used to measure confidence in both ends, classification, and localization. Mathematical definitions used by YOLO: The image is divided into a S x S grid.

Every cell on the grid predicts B bounding boxes and the scores for confidence these boxes are calculated by

using equation 2 :

$$C = Pr(object) * IoU \quad (2)$$

IoU: **Intersection over Union** between the predicted box and the ground truth. If no object exists in a cell, its confidence score should be zero. Each bounding box consists of five predictions: x, y, w, h, and confidence where (x, y): Coordinates representing the center of the box. These coordinates are calculated concerning the bounds of the grid cells, as explained in equation 3.

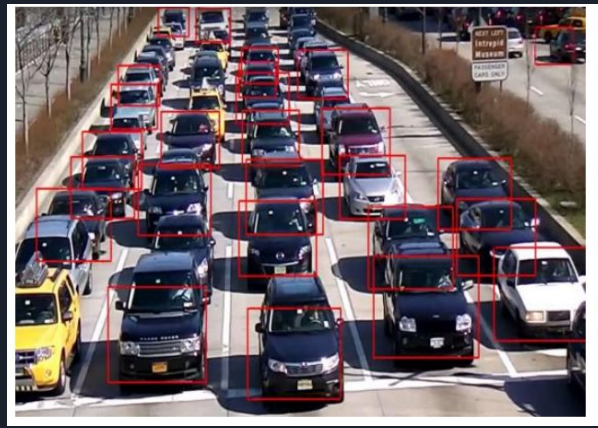
$$
\begin{aligned}
x&: x\ coordinate\ of\ center \\
y&: y\ coordinate\ of\ center \\
w&: width\ of\ bounding\ box \\
h&: height\ of\ bounding\ box \\
c&: Confidence
\end{aligned}
\quad (3)
$$

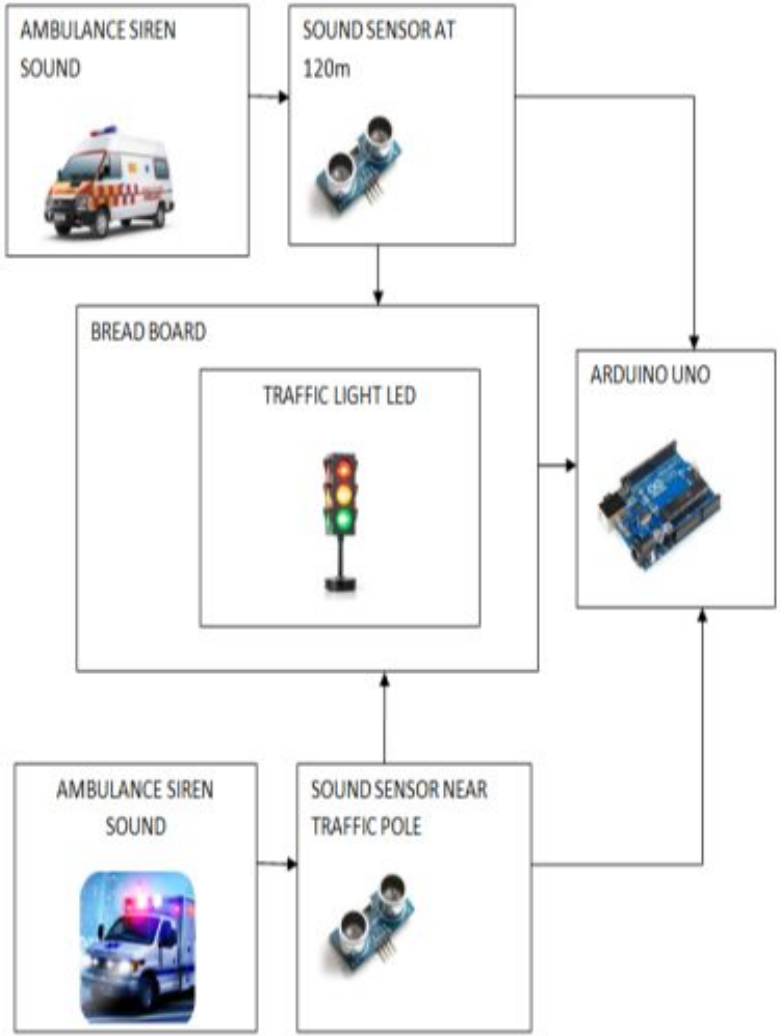
Each grid cell also predicts C conditional class probabilities. These scores show both the probability of that class and how well the box fits the object using the mentioned formula, as shown in equation 4.

$$Pr(Object) * Pr(Object) * IoU = Pr(Class\ i) * IoU \quad (4)$$

By using all the formulas and conditions, a YOLO model can be successfully implemented.

After successful implementation of YOLO(Object Detection)





Siren Detector(Acoustic Filter)

A system based on a modified pitch detection method is proposed that can be used for the detection of acoustical signals the frequency components of which vary according to specific periodic patterns. Usually, signals of this category are produced by the siren of an emergency vehicle.

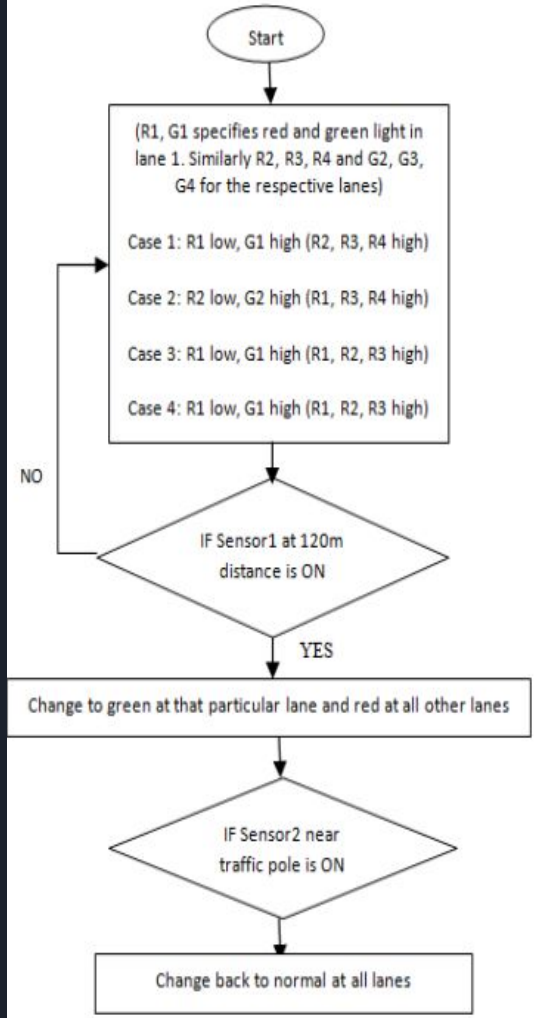
Initial Detection of Ambulance Sound:
When the ambulance passes by the lane and is at a distance of 120m, the sound sensor detects the ambulance by recognising its sound level which is 120dB.

Transmitting signal:
The detected sound is then transmitted by the sound sensor to the traffic controller which is located at the intersection. This in turn enables them to change the signal at correct time.

Switching the lights at the time of ambulance crossing:
The traffic light at a particular lane in which the ambulance passes is changed to green and all other lanes are changed to red, thus allowing the uninterrupted passage of ambulance.

Detecting ambulance sound near traffic pole:
When the ambulance crosses the lane and reaches the traffic pole, the sound sensor detects the ambulance by recognising its frequency.

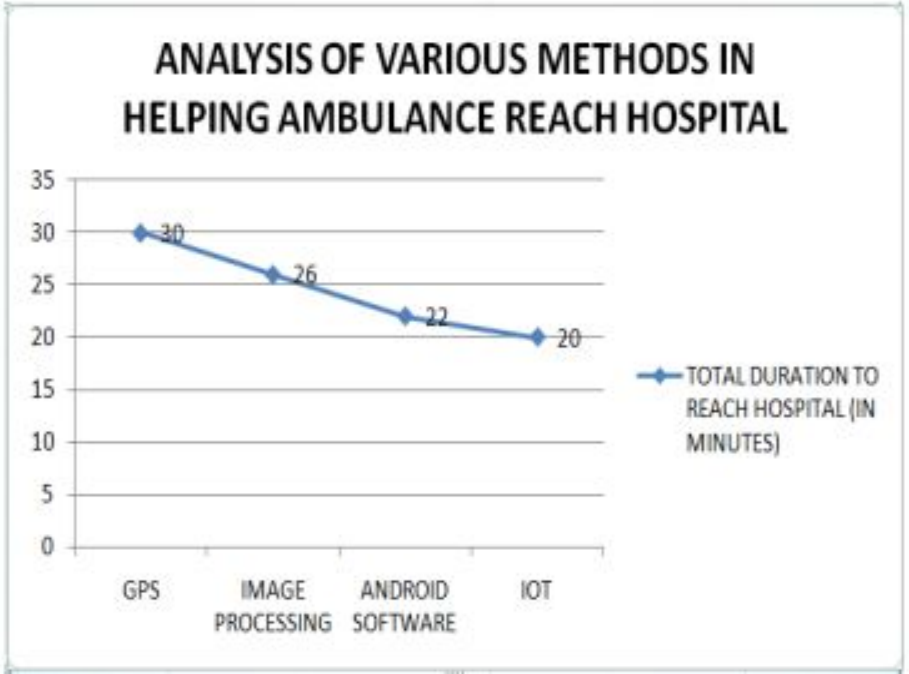
Directing signal after the ambulance crosses:
The detected sound is now transmitted by the sound sensor to the traffic controller again. This in turn enables them to change the signal. The traffic light at all the lanes meeting at the junction is changed back to normal form, thus allowing flow of vehicles in all the lanes. The traffic light is changed to normal form, thus allowing flow of vehicles in all the lanes.



Result of Implementing Siren Sensor

The aim of this design is to obtain a highly accurate model for recognising the ambulance by detecting the siren sound at all the lanes. This is deployed by making use of sound sensor at a distance of 120m and the other sensor near the traffic pole. The sound sensor detects the ambulance sound passing the lane at 120m distance. This detected sound is sent to the traffic controller. The traffic light at that particular lane is changed to green and all other lanes are changed to red using Arduino UNO. After the ambulance crosses the lane, the sensor placed near the traffic pole detects the ambulance sound, and concludes that the ambulance has passed

METHODS	TIME TO REACH THE HOSPITAL IN MINUTES
GPS	30
IMAGE PROCESSING	26
ANDROID SOFTWARE	22
IOT	20



ALPR

Automated License Plate Recognition (ALPR) is a technology that uses optical character recognition (OCR) to automatically read license plate characters.

As the vehicle moves, it photographs license plates and transmits plate data to a database. The database may be a national database or it may be created at the local level and downloaded into the vehicle's onboard computer at the beginning of each shift. If the system detects a match, the officer receives an alert on his computer. A mobile ALPR can read up to 1,000 plates per hour and cover two or more lanes of traffic at once.

Key Outcomes

The Adaptive traffic signal control system is to be installed at lane intersections of the city with high traffic congestion The project is leading to distribution of green phase (traffic signal) time equitably and faster response to traffic conditions & emergencies. The system also predicts traffic volumes and accordingly adjusts signal timings.

Impacts :The project will improve travel time reliability, reduce congestion, and related Greenhouse Gas (GHG) emissions.

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Thank you!

We appreciate the time and attention.

Feel free to shoot your questions.