GALGOTIAS UNIVERSITY

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ANALYSIS AND UPGRADATION OF TRAFFIC CONTROL SYSTEM TO SMART TRAFFIC CONTROL SYSTEM USING IOT

A Report for the evaluation 3 of project 2

Submitted by

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BONAFIED CERTIFICATE

Certified that this project report "**Smart Traffic Control System**" is the bonafide work of "**ALI UDDIN ,(1613113003)**" who carried out the project work under my supervision.

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ABSTRACT

SMART TRAFFIC CONTROL SYSTEM is all about the smart control of the vehicles on the road. The main features of the system is dynamic management of road traffic based on the real time data in order to avoid traffic jams and congestion which is one of the main cause of increasing air pollution and many other problems .

Earlier the traffic management was done by using the combined efforts of traffic police and traffic light system, which was not flexible and needed human intervention. Nowadays the traffic signals are being made automated which have a fixed point of time for the change of phases of signals, which in a way reduced human effort but had a flaw that it is not flexible and doesn't work on basis of real time scenario. Which can be put right using the smart traffic management system which works on the basis of real time data.

The growing population and increased vehicle count is the main challenge in the urban life these days which not only effect the individual on the road but also effects the growth of the country as it leads to wastage of Power, Wastage of Resources (Fuel), Increased average time on road, Increases the cost of living.

In recent years the advancement in the technologies has been acting as an aid to cope up with the growing need of the country. Technologies like IOT and Industry 4.0 has lead to the growth of idea of smart city of which smart traffic management is a sub module which can be achieved using the real time data of the traffic collected using the Ultrasonic sensors and various image and video processing techniques which helps to know about the traffic density. It is implemented by using ARDUINO UNO, WIFI module, RFID Tags to process the real time data. Therefore the proposed system is advantageous over the present traffic management system as it is more

reliable, easy to install and cost efficient. Which leads to Optimum utilization of resources and save time and power. It also have the ability to recognize the emergency vehicles such as Ambulance, Fire Brigade etc and also can be used to detect and track suspected vehicles.

ABBREVIATION

IOT – Internet of Things

ITS - Intelligent Transportation System

VIN – Vehicle Identification Number

RFID – Radio Frequency Identification Tag

US wave - Ultrasonic wave

INTRODUCTION

The growth of industrialization and urban population causes the tremendous increase in the traffic. The traffic control has become one of the severe problem today with the increase in traffic jams and congestion, due to which arises a number of problems such as heavy traffic jams, violation of traffic rules, Long waiting time, Wastage of resources and time, etc.

Some problems of conventional traffic system includes :

1. Wastage of time and heavy traffic jams during office hours.
2. Have to wait even when there is no traffic.
3. Emergency vehicles stuck in traffic jams resulting in loss of lives.
4. Increase in accidents due to traffic jams.
5. Not recognition of stolen vehicles.

To overcome such problems which are increasing with growing population the trending technologies are helping to make things better one of such aid is IOT which stands for Internet of Things is being utilized to reduce human intervention and to make everything smart enough to gather the data and process it according to the requirement. One of the most important use of this is SMART CITIES PROJECTS which includes smart traffic control system.

The proposed system is a part of smart traffic control using the sensors and micro controllers which are able to perform the tasks with more efficiency and less human intervention.

Managing the traffic signal's time is the key thing to overcome traffic jams instead of thinking to increase the road width or working on infrastructures as it is costlier and less effective. The issue of traffic jams and congestion is common in cities and towns around the world. Peoples face losses in terms of time , money and health. To overcome this efforts are being made from early 70's in different part of the world according to the needs. Various models have been designed using different technologies some are as below:

1. SCATS- Sydney Co-ordinated Adaptive Traffic System, Which is adapted in mini cities in New Zealand, Tehrain, etc. Which uses a centralized computer to process the real time data gathered from the junctions to reduce delay. The lag of the system is the cost and manual implementation of the process and lack of traffic module as it is based on adaptive approach.

2. SCOOT- Which is acronym of Split Cycle Offset Optimzation Technique, United Kingdom uses this mechanism to manage the traffic. It also uses the adaptive approach for the traffic control an process the data but the results are more optimized.
3. INSYNC- The INSYNC adaptive traffic control system is an intelligent transport system developed in 2005 and is used as more than 900 intersections in US. The system uses the IP video and a processor to gather data and process it in real time.
4. UTOPIA – It stand for (Urban Traffic Optimization by Integrated Automation)- SPOT (System for Priority and Optimization of Traffic) and is been used in Italy ,Turain e.t.c. The main difference between the adaptive traffic control system and this is that the first also improve the public transport efficiency whereas the this system aim to uplift private transportation. The architecture consist of central system which is responsible for the overall traffic control statigies and the lower level where the trffic light is controlled using the SPOT Software.

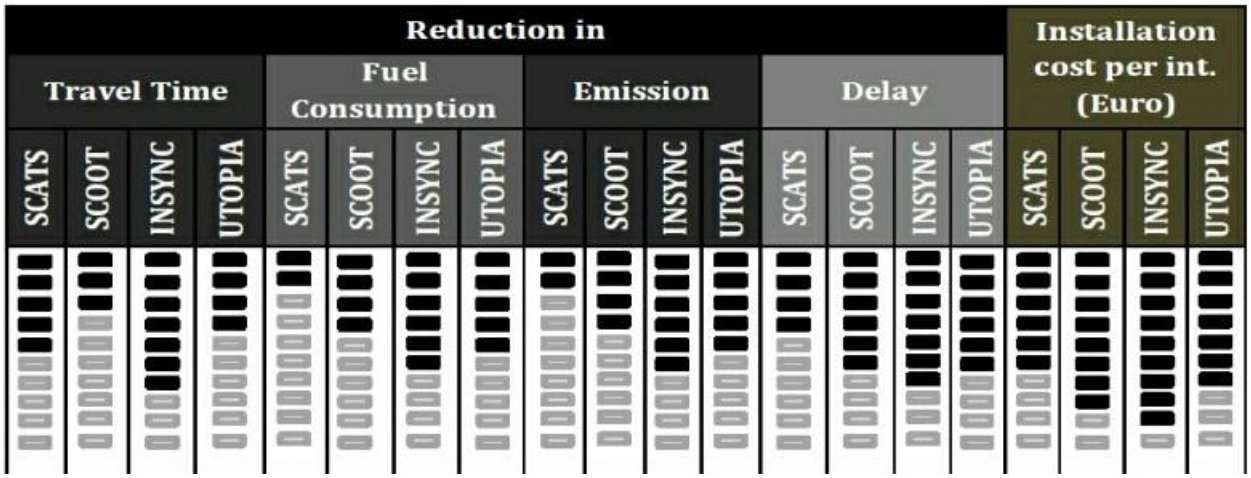


Fig 1. Comparision between the effectiveness of SCATS , SCOOT , INSYNC & UTOPIA model.

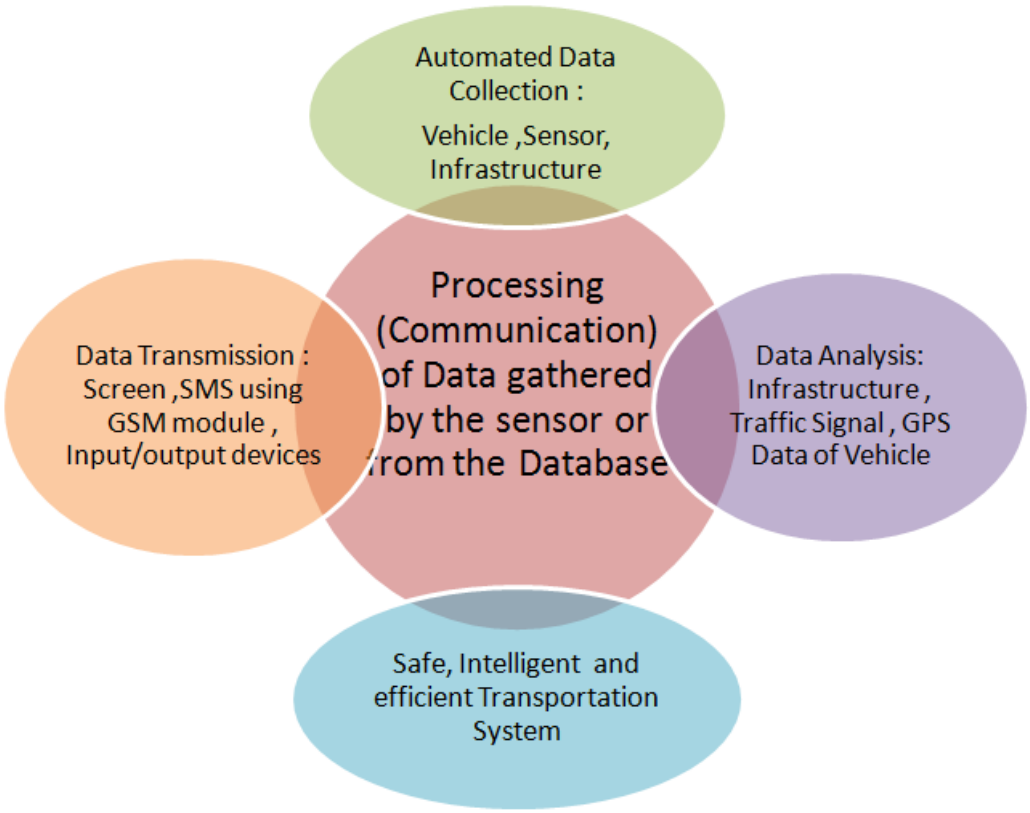
Many other such systems are been developed to manage and control the traffic flow using different models and technology. The proposed system is being implemented considering the need of the traffic at the Indian Junction. As we know the safety begins right from ourselves so for the success of any model it should be followed otherwise it reduces its efficiency.

The focus of the system is to improve the current traffic system in India to reduce the traffic congestions to some extent. The system uses the Ultrasonic Sensors, ARDUINO UNO board, ARDUINO Mega board, LEDs, and RFID Tags to get the real time data about the traffic density on road and to use it for changing the phases of the traffic lights based on the processed data.

EXISTING SYSTEM

The traffic signal was developed in 1868 in London since then effort are being made to use it to control the traffic flow. Previously , the traffic flow was handled with the help of human intervention where a Traffic Police in charge is allocated to manage the traffic at the junction. But with the growth of technology efforts are being made to develop such model that need less human efforts. Many model were designed to automated the traffic signal so it need no human intervention to change it's phases.

Traffic signal were made automated by using the principle of fixed – time scale to change its phases but such system reduced the human effort but is not reliable and efficient as it not adaptive in nature and result in loss of time even when there is no traffic on the lanes.



Structure of Intelligent Transportation System (ITS)

Many ITS(Intelligent transportation System) are being implemented these days to overcome the need of the control flow of the traffic which is increasing with the growing population as its is very easy to buy Vehicles these days and it's the symbol of the growth of the nation but it also contribute to increasing vehicle count on the road. Some of the known ITS are given mentioned below:

SURTRAC- It stands for 'Scalable Urban Traffic Control ' is a smart traffic light control system that optimizes the flow of traffic at signalized intersection through priority software with existing control machine. The System uses the Detector to interface with the sensors located at the intersection, the Scheduler is used to allocate green signal time based on the incoming traffic flow as the system communicate with the neighbor System to provide the information about the incoming traffic flow using the Communicator and the Executor interfaces with the controller to implement schedules generated by the Scheduler.

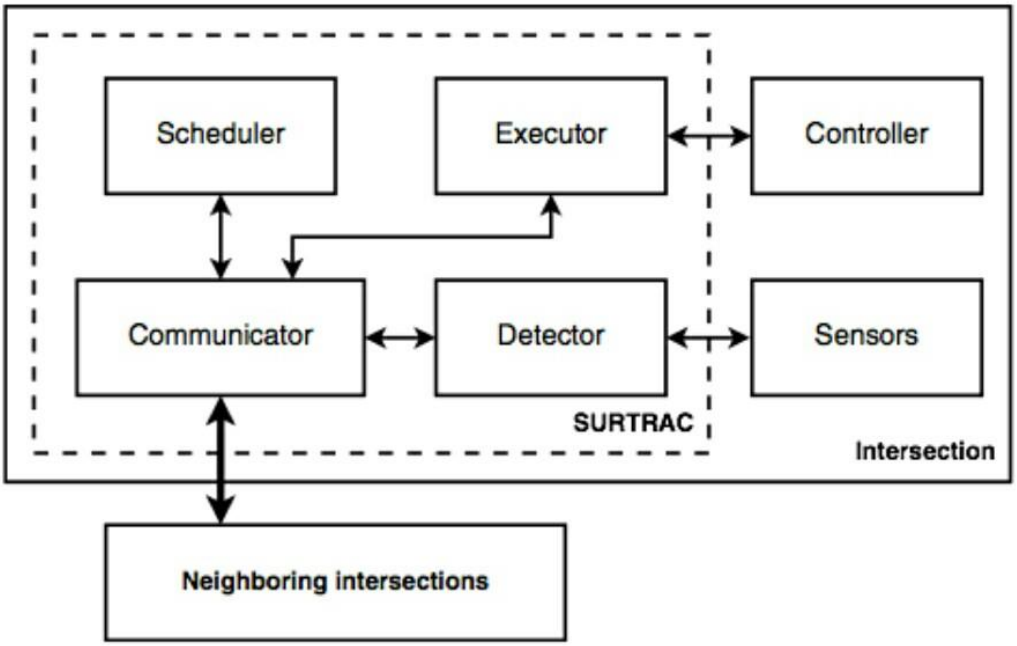


Fig 2. SURTRAC INFRASTRUCTURE

Various other research been made on using PIC microcontroller for calculating the vehicle count and the data is sent to the central station where the administrator manages the traffic

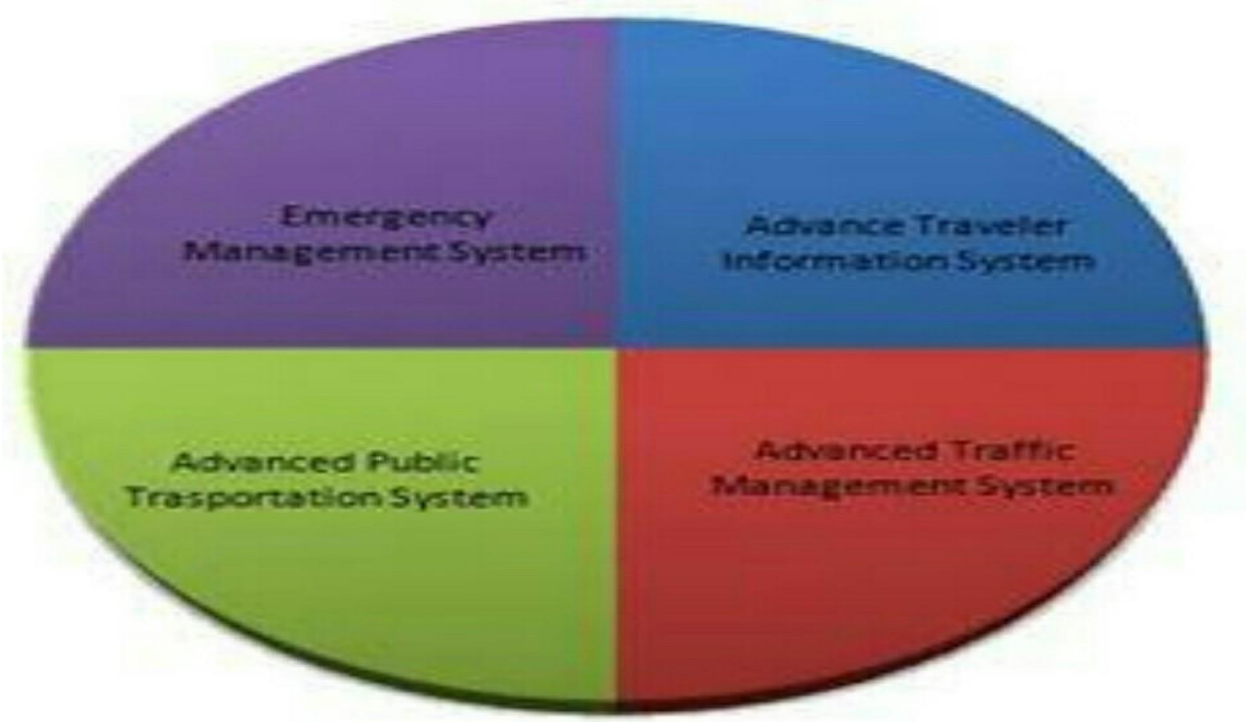
based on the data received but this also need human intervention at the server side for the processing of the data and successful implementation of the system.

Another research was made on Density Based Traffic Signal System using image and video processing techniques such as Edge detection, Background Substraction Method , Frame Differencing and Motion Based Method for Processing the data obtained by CCTV OR Sensors to know the density of the vehicles in real time on the roads but the System is complex and need a high value for implantation and is not reliable in all environment and need proper environment for implementation and functionality.

The other ITS system includes:

1- **Advanced Traffic Management System(ATMS) –** It is used to manage traffic flow with the help of Traffic Police and devices which collect the data about the flow of the traffic and send it to the authority for the use and processing according to the need.
2- **Advanced Public Transportation System – This** system aims at the increase in services provided by the public transportation services and the changes which are needed for the system with time.
3- **Advanced Traveler Information System-** It aims at providing information of the traffic and other data such as available routes with less congestion and public transport and other vehicles available to reach to a destination instead of own vehicles to the traveler in order to save their time and money.
4- **Emergency Vehicle Detection System –** It aim at providing congestion free routes to any emergency vehicles to reach it destination without delay . The system provide priority to lanes with such vehicles and allow its passage on priority with respect to other lanes to reduce delay.

Fig 3. Subsidiaries of ITS



The other technologies used to design Traffic Control System are

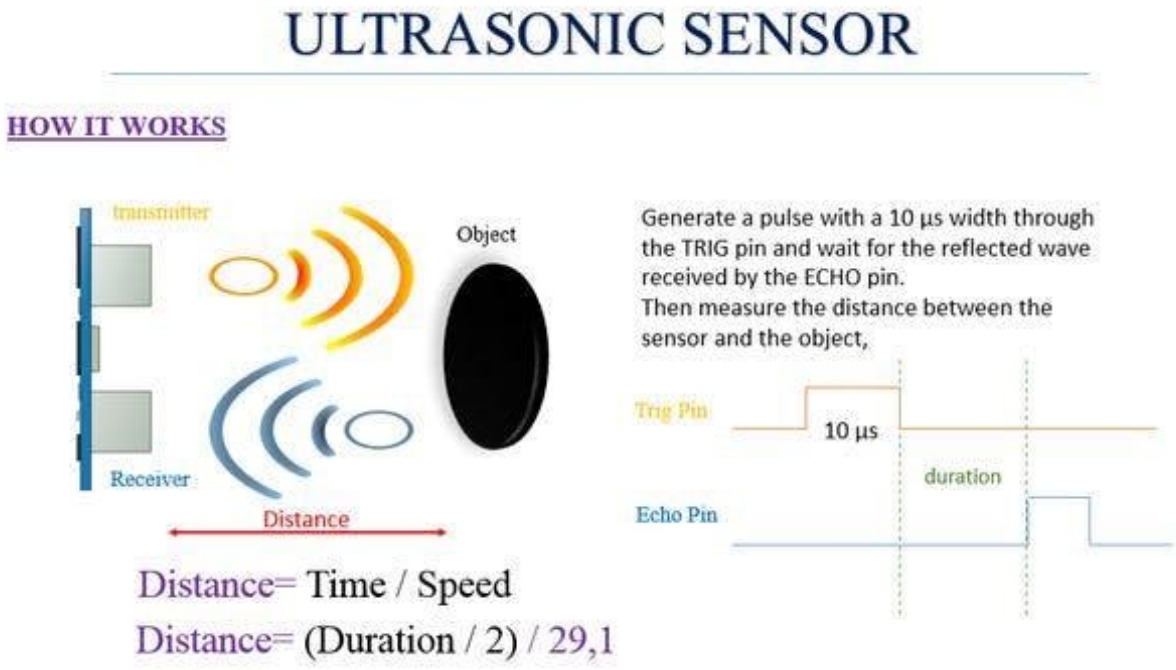
- Inductive Loops - They are placed on the roadbed and are used to estimate the speed of the vehicles .But the system implementation is tedious task and are easily result in error of the output.
- Magnetometer – It uses the concept of the Magnetic field change . The magnetometer detect the change in magnetic field of the earth when object like vehicles moves over the road. It is used to detect the traffic flow.

The other model include the use of IR Sensor to gather the density of vehicles on the road and to use it to change the phase of the traffic light based on the density of the vehicles .The system is prone to error as the IR Sensor result get varied with small change of the environment such as rain or obstacle like stone or other object resulting in erroneous result which cost in term of loss of time and loss of efficiency of the System.

The problem faced with the IR Sensor is overcome using the Ultrasonic Sensor which can work in harsh condition and the results are also less prone to error.

PROPOSED MODEL

In this section we focus on the Ultrasonic Sensor which is being used to know the density of the vehicles on the road. Basically in our Proposed System we install a Ultrasonic Sensor on each lane at the railings of the two lane roads .The Sensor sends the US waves at regular interval and they get reflected back to the Sensor in a particular time which is used to calculate the distance between the obstacle and the sensor so whenever a vehicles passes by the waves are reflected and take less time as compared to the time taken by them to reflect back after hitting the divider of the other lane or a known obstacle using this phenomena the density is estimated and each time result vary the counter of the vehicles is increased by 1 which is later used to compare the density of the vehicles on different vehicles based on the counter value .



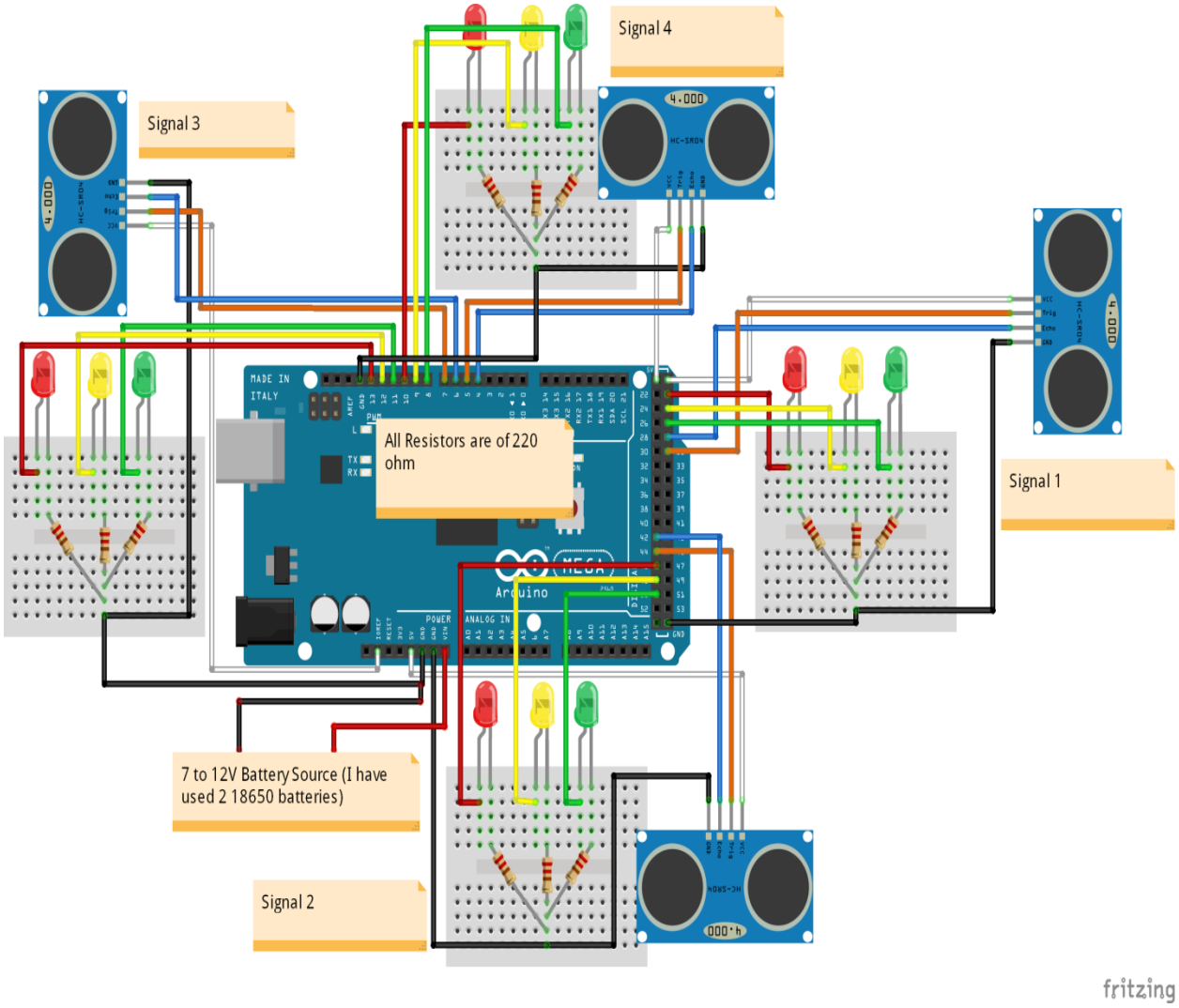
The data of Ultrasonic Sensor is send to the Aduino Uno board which change the phase of the signal after comparing the data received by the different Ultrasonic Sensor installed at different lanes and uses it to change the Signal from Red-Green-Yellow according to the processed data.

So, the system work on real – time data and will result in reduced traffic jams and congestion .As the system compares the density of the different lane and the lane with highest number of vehicle is provided with more time for the Green Signal so it overcome the drawback of the fixed scale change of phase of Traffic light System.

Fig 4. Use of RFID to detect Emergency vehicle

The System also comes with a facility of Emergency Vehicle Detection using the RFID which are installed at each lane and are used to detect the tags on the emergency vehicles as soon as the Tag is detected an interrupt is send to the Arduino for the priority of the lane and the lane with such vehicles are given the Green Signal for easy passage of the vehicle for a fixedinterval of time and after tha t the system resume back to the original procedure of passage of vehicles on the lanes based on the density of vehicles present in real time.The RFID are used to detect the VIN (Vehicle Identification Number)which have to be provided for the validation earlier to the System for it validation.

Fig 5. ARDUINO WITH ULTRASONIC SENSOR AND LED'S



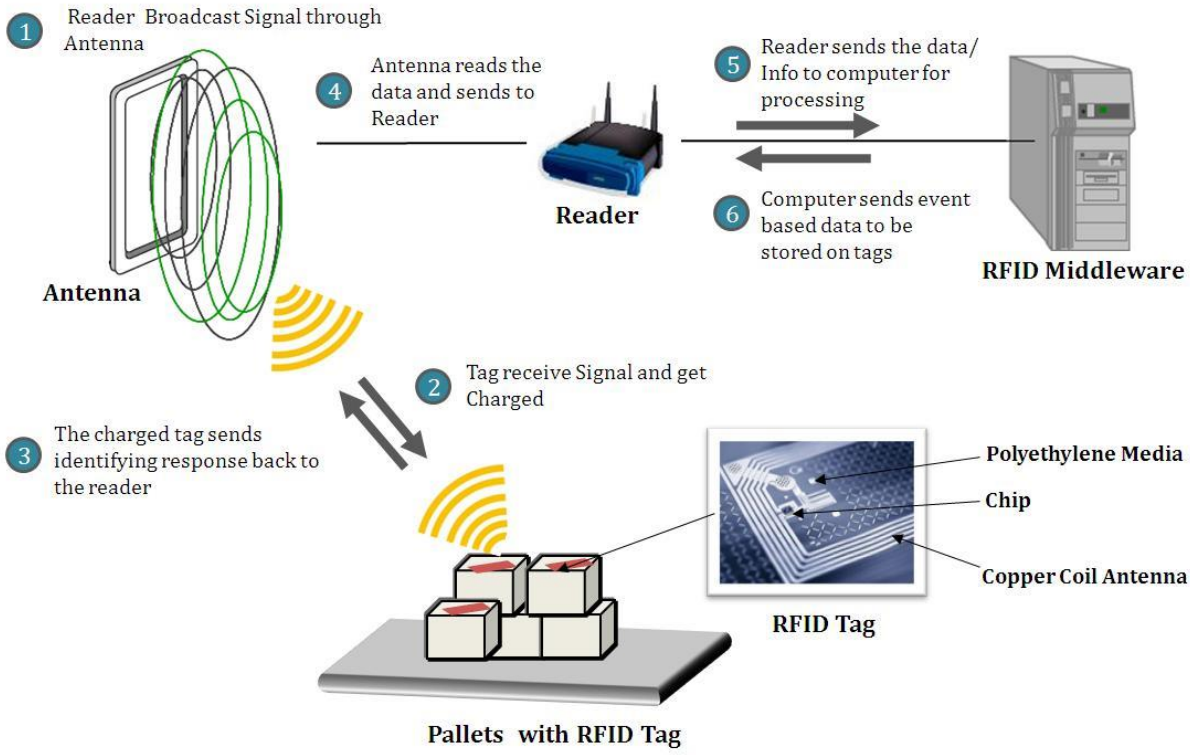
IMPLEMENTATION

For the implementation of the system the required hardware component:-

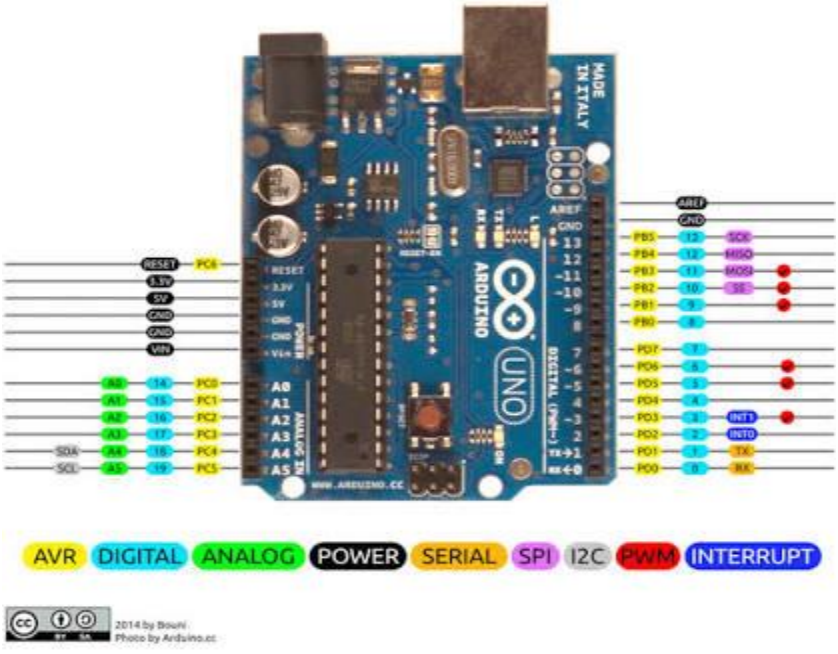
- **Ultrasonic Sensor**- The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object. It comes complete with ultrasonic transmitter and receiver modules. Its specification include
  - Power supply - +5vDC
  - Working current - 15mA
  - Effectual Angle - <15°
  - Ranging Distance - 2cm-400cm
  - Trigger Input pulse width - 10us
  - The same concept is used in the model the US wave are reflected back by obstacle and received by the receiver. The time taken is used to calculate the distance So, whenever a vehicle passes by the ultrasonic sensor it sense and send the data to the microcontroller which increases the vehicle count use it to determine the density of the vehicle on the lane.

- **LED's –** These are the Red, Green, Yellow light used to demonstrate the traffic light phases.

- **RFID Tags –** The acronym stands for (Radio Frequency Identification Tag) which uses radio wave to automatically identify object, extract data, and feed it into integrated computer with minimal or no human intervention. The System mainly consist of three components RFID Reader, RFID tag and an antenna.
    - It is used in the model to detect the emergency vehicle. The system requires that the vehicle should have a RFID tag which have an inbuilt antenna which transfer the vehicle data to the RFID Reader installed on the lane and if the data extracted match with the VIN uploaded to the system as emergency vehicle the lane with such vehicle will be control with priority.



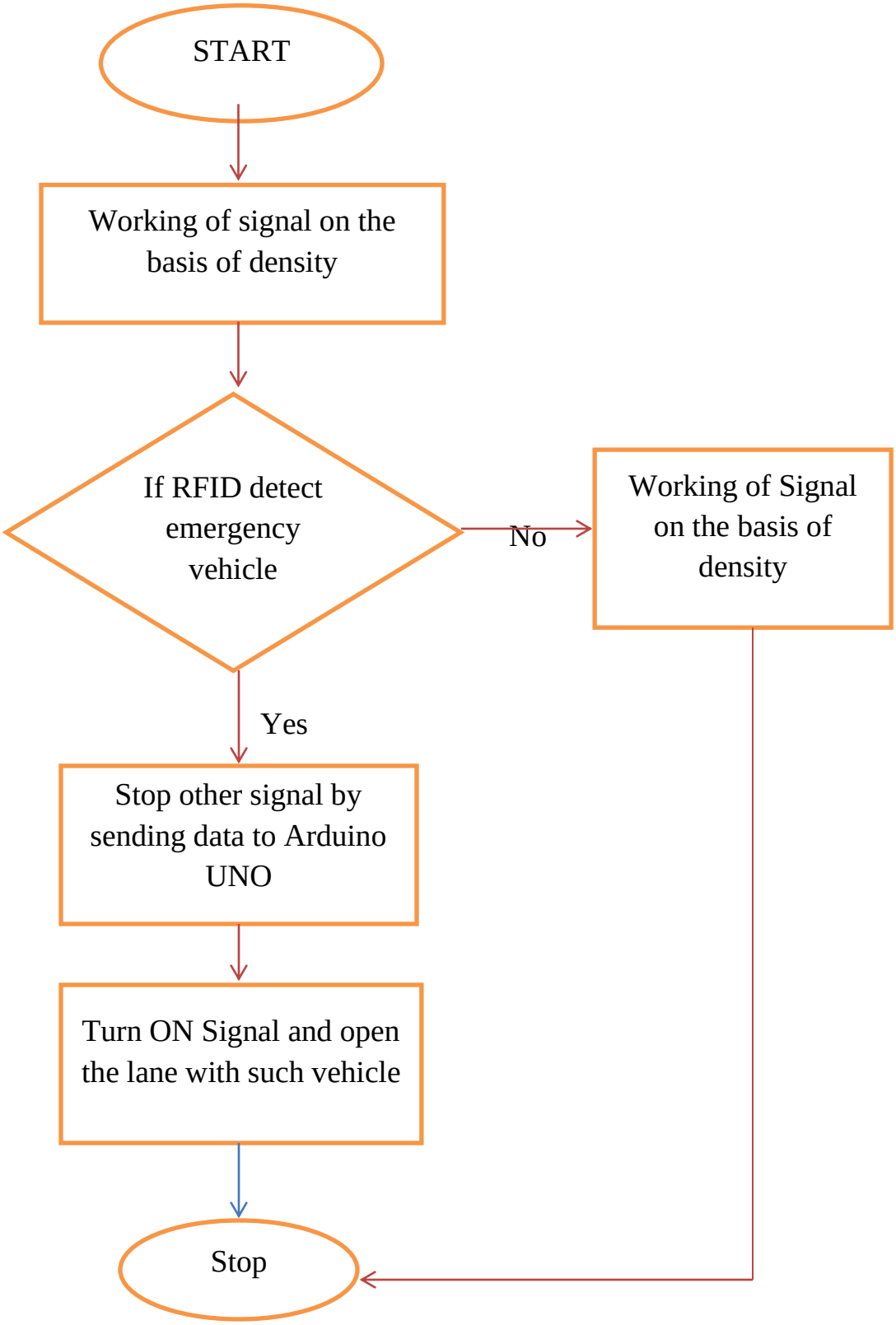
- **Arduino UNO –** Arduino UNO is a microcontroller board based on the Atmega 328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM output), 6 analog input, a 16MHz ceramic resonator a USB connection, a Powerpach, an ICSP header and a reset button. It is used to control the traffic signal based on the data received from the ultrasonic sensor.



- **Arduino Mega 2560 R3** – Arduino Mega 2560 R3 is also a microcontroller board based on the ATmega 2560. It has 54 digital input/output pin (of which 15 can be used as PWM output) 16 analog input, 4 UARTs, a 16MHz Crystallator, an ICSP header, USB connection and a reset button. RFID are connected to it for the detection of the vehicles and it is connected to the Arduino UNO using wires.

FLOWCHART AND ALGORITHM

FLOWCHART FOR WORKING OF ARDUINO MEGA BOARD



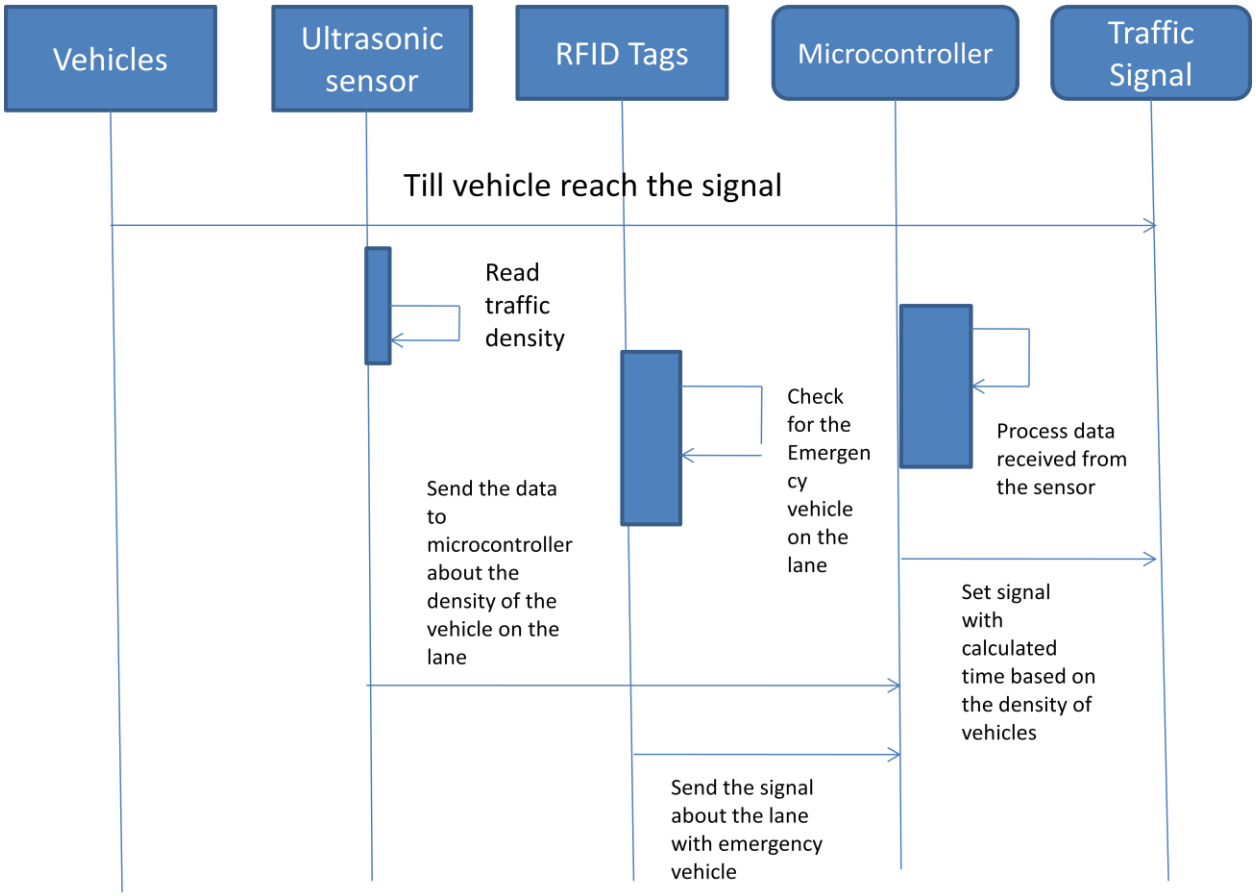
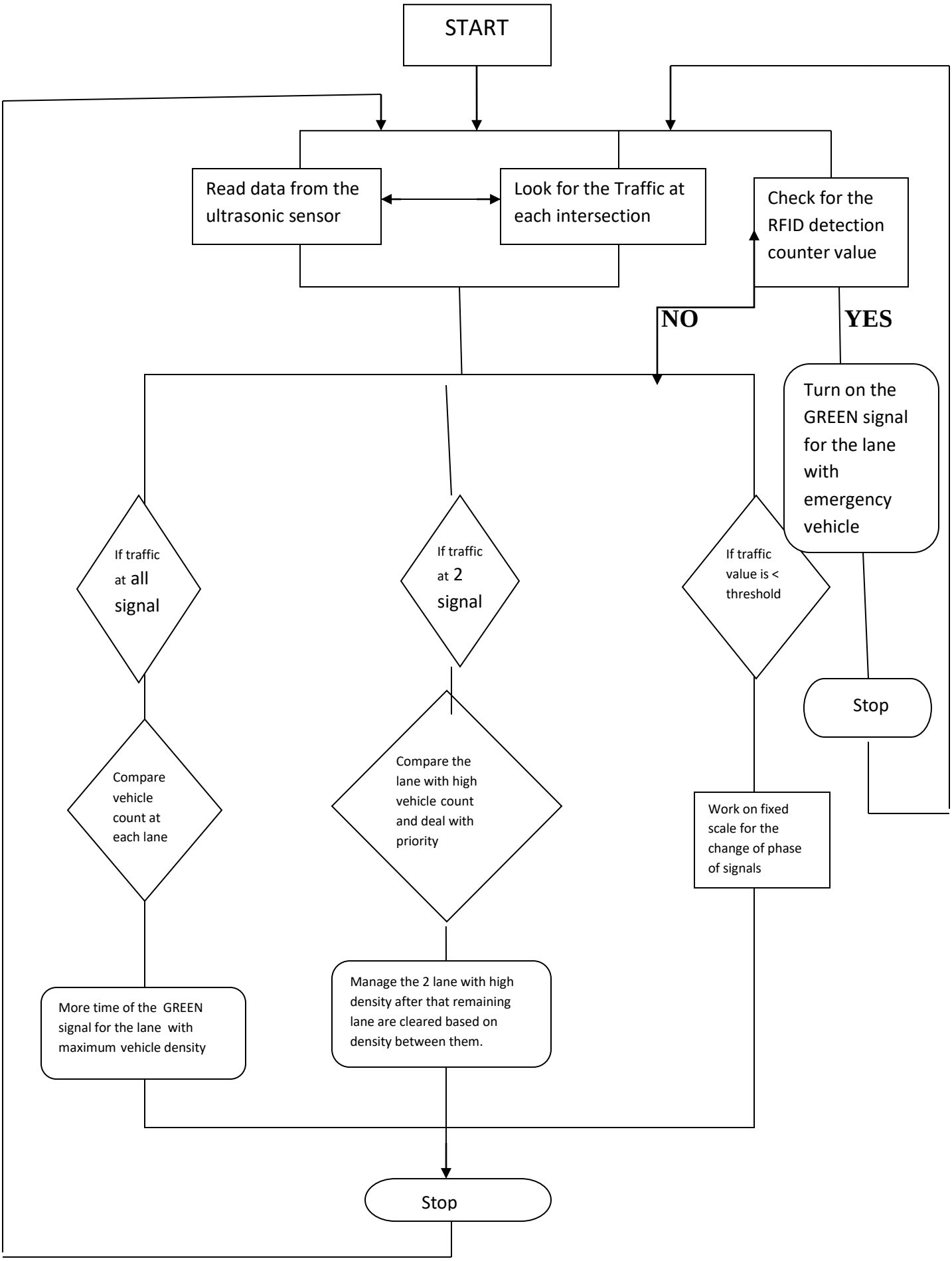


Fig 6. SEQUENCE DIAGRAM

FLOWCHART FOR ARDUINO UNO BOARD


START
Read data from the ultrasonic sensor
Look for the Traffic at each intersection
Check for the RFID detection counter value
NO
YES
Turn on the GREEN signal for the lane with emergency vehicle
If traffic at all signal
If traffic at 2 signal
If traffic value is < threshold
Stop
Compare vehicle count at each lane
Compare the lane with high vehicle count and deal with priority
Work on fixed scale for the change of phase of signals
More time of the GREEN signal for the lane with maximum vehicle density
Manage the 2 lane with high density after that remaining lane are cleared based on density between them.
Stop

SOFTWARE REQUIREMENT

- **Arduino IDE**
- **Proteus design**

Following are the library used for the communication between sensor and the Arduino board-;

- **Serial Peripheral Interface(SPI) –** It allow us to communicate with the peripheral devices quickly over short distance
- **RFID** – A library for interfacing RFID Reader with Arduino board.

- **MFRC522 –** Read and write different type of Radio Frequency Identification cards on Arduino.

Alogorithms

Vehicle Counter Algorithm

Assuming the object detected by the Ultrasonic Sensor to be vehicles,

Int counter = 0;

Int hitObject = False;

Int val;

Step 1: Read value from the sensor (val). Sensor gives output 0 if car is detected and 1 when no car is detected

Step 2: If val==0 , hitObject = False then increment the counter by 1 and set the hitObject = True.

Else if val == 1, hitObject = True

Then set hitObject = False.

Step 3 : Go to Step 1

Traffic Control Algorithm

No of sensor = 4 and are denoted by S1,S2,S3,S4

RFID1 , RFID2, RFID3 , RFID4 are the RFID detector present at the four corresponding lane(L1,L2,L3,L4)

ID.RFID are the specific rfid details of emergency vehicle present in the area.

No of cars in lane 1= N1

No of cars in lane2 =N2

No of car in lane 3 =N3

No of car in lane 4 =N4

Step 1 : Start

Step 2 : Sensor will read the number of vehicles on each lane(L1,L2,L3,L4)

Step 3 : if (Vehicle Count < Threshold)

Then status = Normal Traffic. Turn ON the green signal for all the lanes one after the another in a sequential manner(L1-L2-L3-L4). When signal is green for one lane ,the other remain red except the next signal which shows Yellow signal .

Step 4 : Else if (Vehicle Count> Threshold)

Then status= Congestion.

Step 5 :COMPARE (N1,N2,N3,N4), Select the lane with highest number number of vehicle density , turn ON the green signal for that lane with more time for the clearance of traffic as compared to green signal for lane with less vehicle .

Step 6 : COMPARE (N2-N3-N4) For the vehicle density and turn ON the green signal for the lane with maximum vehicle count

Step 7: COMPARE(N3-N4) lane and turn ON the green signal for the lane with more vehicle count .

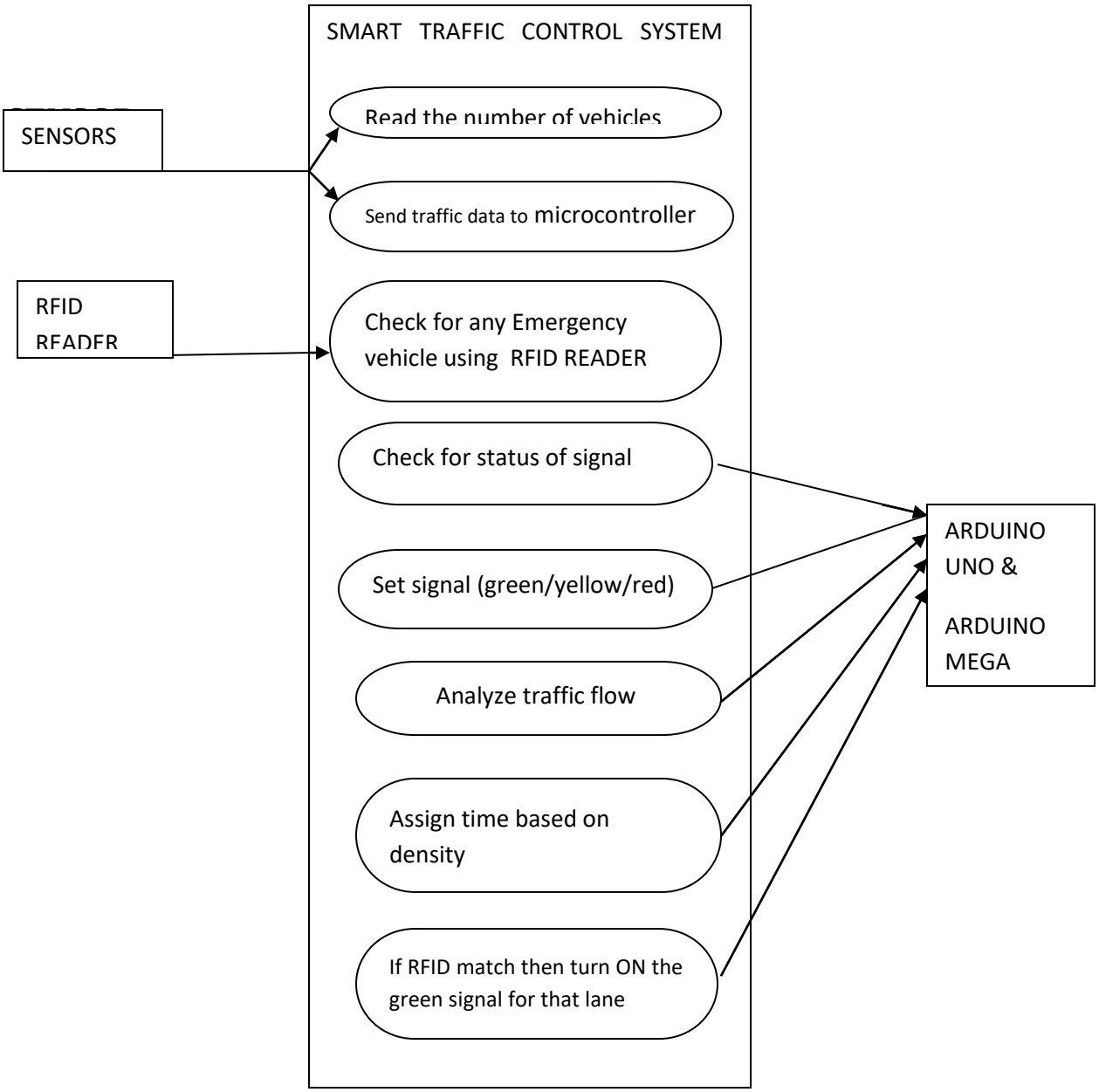
Step 8 : The last remaining lane automatically get selected and it turn ON the green signal.

Step 9: Else if (RFID1,RFID2,RFID3,RFID4 == ID.RFID)

The lane with such vehicle is given priority even if the vehicle density is low and it turn ON the green signal for that specific lane (i.e L2) for a fixed time of 2 minutes whenever such situation occurs.

Step 10 : Jump to Step 3.

USE CASE DIAGRAM



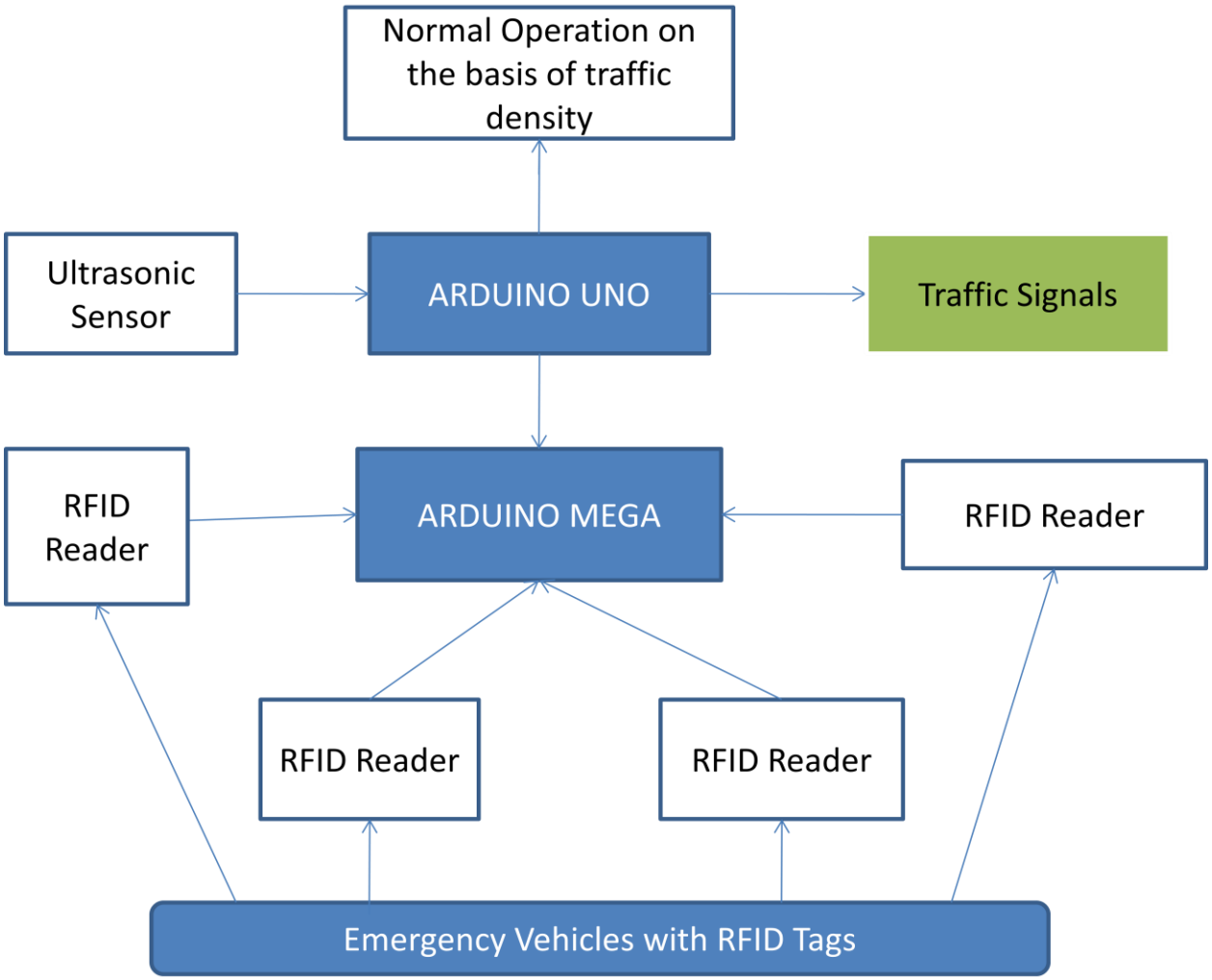


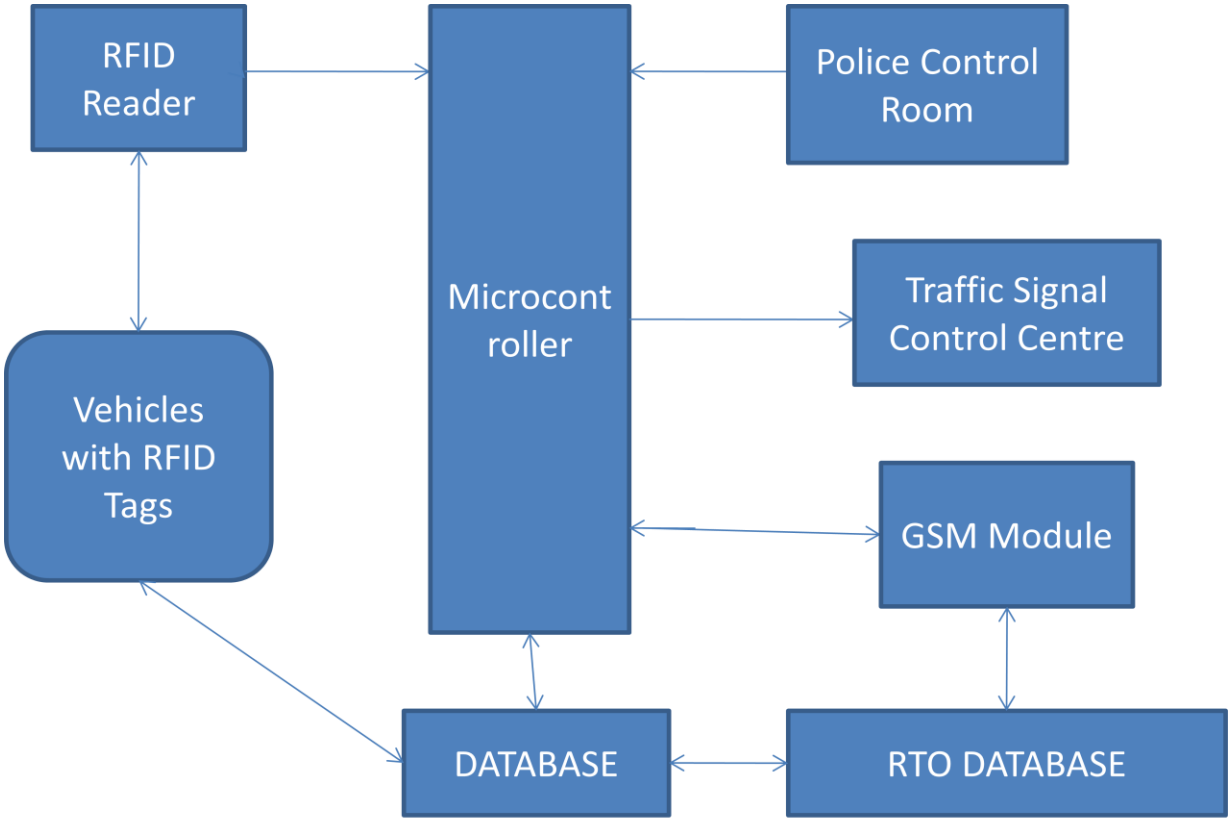
Fig 7. BLOCK DIAGRAM

Output

The aim of the system is to reduce the traffic congestion at the junction due to lack of (ITS).The proposed system is reliable and overcome the fault of previous model. Such as IR Sensor are not able to detect vehicle in bad weather condition this is overcome by using ultrasonic sensor which are placed on the railing and not on the road so water or other obstacle doesn't interfere with the result and the outcome is correct and reliable and as the system work in real-time so it reduces the congestion and the facility of emerging vehicle detection act as a helping hand for reducing losses due to delay and it can be further enhanced by providing the microcontroller with data of different vehicle for the detection at the intersections.

Scope

The System can also be further enhanced using GPS and GSM Module to detect and and trigger the location of any stolen vehicles present on the lane and is by using the RFID tag on the vehicle for such implementation all the vehicle have to be installed with the RFID tags and the data should to send to the local server for detection and validation . Using the same concept it can also be used to detect the speed of the vehicle by calculating the time taken by the vehicle to cover the distance between two RFID Reader present at at some distance from one another .



System with GSM Module and RFID Tags for vehicle detection

The system can be enhanced by connecting it to central server or different unit setup for the collection and processing of the data by the sensor and using this different facilities like best routes or traffic at the next intersection or the fine or challan for breaking of traffic rules can be

imposed from the central unit according to the data collected by the sensors.Further the emergency vehicle detection can be enhanced using the server and providing it with the data about the vehicles and the location where the emergency vehicle is needed to monitor the whole route through the system.

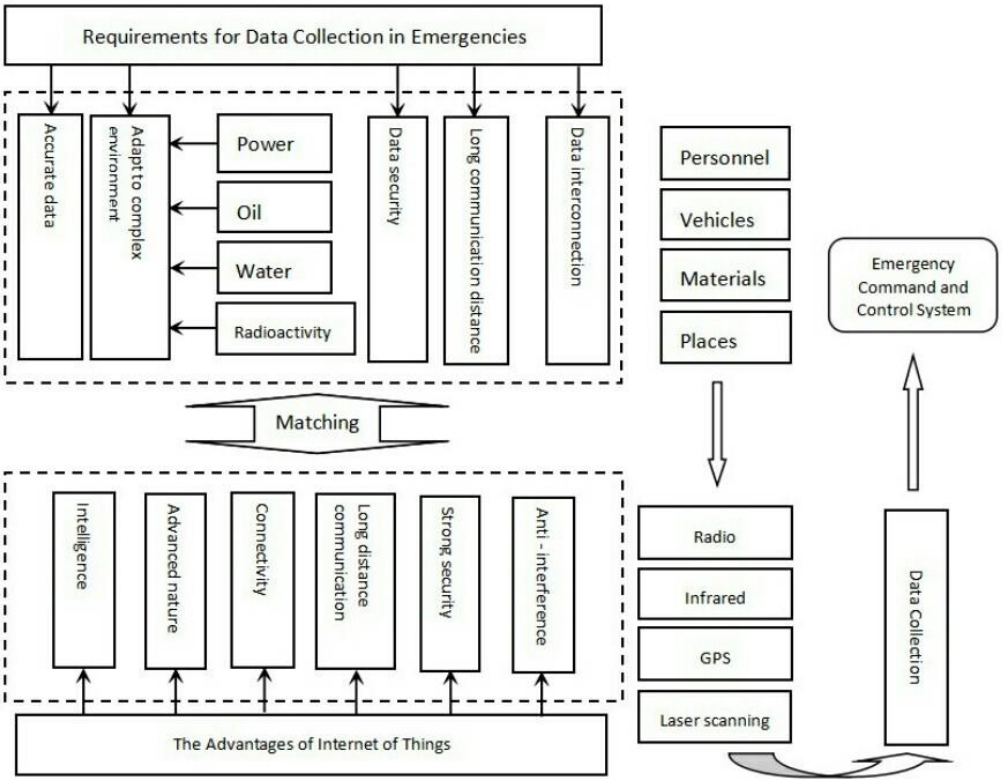


Fig 8. Emergency Vehicle Detection System used in China to Tackle Emergency Situation

The effectiveness can be increased for density prediction using Video and image processing techniques or the use of Radar instead of IR Sensor or Ultrasonic Sensor and sending the gather data to the central server for processing and controlling of the vehicle flow at the intersection and the data can be transferred using the Wi – Fi Modules to the central server or using GSM Modules to send text msg to the authority about any instance with the location of the incident and data can be stored for future references with the help of the Cloud. The main problem with the scope is that the system will need high value for the implementation and require a complex installation procedure and the other issue related to the model is the security of the data as IOT is not fully secured and need proper setup for its data security at each layer of data transmission.

CONCLUSION

- Hence, we can conclude that by using the System there are few chances of congestion and traffic jams and reduce in number of accident caused by them. Also, the system helps to reduce the delay of emergency vehicle to reach their destination. The provided System is reliable and effective and the overall cost of the system will be less as compared to the benefit by imposing such model on the roads.The other advantage includes:
- Minimization in the count of road accidents .
- Reduced fuel wastage due to traffic jam and also saves time .
- Low budget.
- Easy implementation and maintenace .
- Remotely controllable.
- Minimizes average cruise time on road.
- Emergency vehicle detection help such vehicles to reach to the destination on time without being stuck in Jams.

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