



PROPOSED INTELLIGENT TRANSPORTATION SYSTEM (ITS) ON SELECTED CORRIDOR OF AHMEDABAD CITY

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Abstract: - Transportation plays a very important role when it comes to achieving fast economic growth of India. Over last few decades congestion is becoming a major issue in urban areas and is now one of the severe issues on the roads. The development of the infrastructure and proper traffic management is not able to cope up the increase in congestion.

Intelligent Transportation System through sensors, communications, computer technologies, etc. offer new tools in the continual effort to develop an accessible, safe and sustainable transportation system. ITS can be broadly defined as the advanced use of Information and Communication Technology (ICT) in the transportation context, is build upon data collection, storage and processing.

The study area is a transportation corridor of Ahmedabad city area which in turn generates high demand. The basis of study is to propose an Intelligent Transportation System for selected corridor of Ahmedabad City.

Keywords: -Intelligent Transportation System, ultrasonic sensor network, urban area, Algorithm, Arduino, replica.

I. INTRODUCTION

ITS systems and services have great potential to enhance individuals' daily, mobility and transportation experiences. Advancements in positioning and mobile systems allow for increasingly precise and continual measurements of the locations and movements of individuals and objects over time. These tracking and monitoring capabilities facilitate the collection of position, movement and activity data, which enables further development of services and devices, for instance, to provide information for pre- and on-trip planning.⁽²⁾

One of the problems of traffic, demand and capacity determines the condition of traffic on the road. The flow of vehicles increases the capacity of road then the flow of traffic is hampered. The ITS system can help understand the flow of traffic with the help of various sensors and communication channel can provide information regarding the flow of traffic.

During the last few years, continuous progress in ultrasonic technology have opened new research fields in transportation networking, aimed at extending data networks connectivity to environments where wired solutions are impracticable. Among these, vehicular traffic is attracting a growing attention from both academia and industry, due to the amount and importance of related distributive applications to users.

With the advances in the technology of micro-electromechanical system (MEMS), developments in ultrasonic communications and ultrasonic sensor networks have also emerged. Ultrasonic sensor networks are usually composed of small, low-cost devices that communicate ultrasonically and have the capabilities of processing, sensing and storing. Ultrasonic Sensor is based on measuring the properties of sound waves which have frequency above human hearing aid. The frequency of Ultrasonic Sensor is 40 kHz. It operates by generating a high frequency pulse of sound, and then receiving and evaluating the property of echo pulse. It is an infrastructure comprised of sensing (measuring), computing, and communication elements that gives the user the ability to instrument, observe, and react to events and phenomena in specified environment.⁽¹⁾

The reason to adopt Ultrasonic Technology is that it is a cost effective and efficient traffic monitoring system which overcomes the high cost and limitation of traditional data collection methods. This system has gained popularity because:

- Hardware and software are least expensive.
- Large amount of data can be collected over the period of time.
- It could be installed for temporary or permanent use.
- It can be used to measure travel time in a road network.⁽⁵⁾

II. OBJECTIVES OF STUDY

The objectives of study based on problems at location. The objectives are:

- To perform the Volume Count and calculate the speed of vehicles with the help of Ultrasonic Sensor Network for prepared model.

III. SCOPE OF STUDY

The scope of study was limited to following

There is need to conduct survey on the traffic flow of vehicles on the study area to determine the number of vehicles moving in a given interval of time. The major objective involved preparation of replica of proposed Intelligent Transportation System along with an algorithm suitable for the same framework that could be easily implemented on station area and could be replicated on other Streets of the Ahmedabad City.

IV. METHODOLOGY

The study will follows following steps.

1. The first step is to study and identification of study area location.
2. Various literature research paper, book, thesis report, related to study are referred.
3. Study area profile give existing situation of Ahmedabad city w.r.t study corridor.
4. Portion of road is selected to suggest ITS system.
5. A proposed replica of the system has been prepared with the help of Arduino Software.

V. STUDY AREA LOCATION

Ahmedabad lies at 23.0300° N, 72.5800° E in western India at 53 meters above sea level on the banks of the Sabarmati river, in north-central Gujarat. The City of Ahmedabad has area of 464.16 sq.km (179 sq mi). According to the Bureau of Indian Standards, the town falls under seismic zone 3, which is in the scale of 2 to 5 (in order of increasing vulnerability to earthquakes). Ahmedabad city is governed by Municipal Corporation which comes under Ahmedabad Metropolitan Region. The location of study area with reference to India, State of Gujarat and Ahmedabad City is given in fig below:⁽⁴⁾

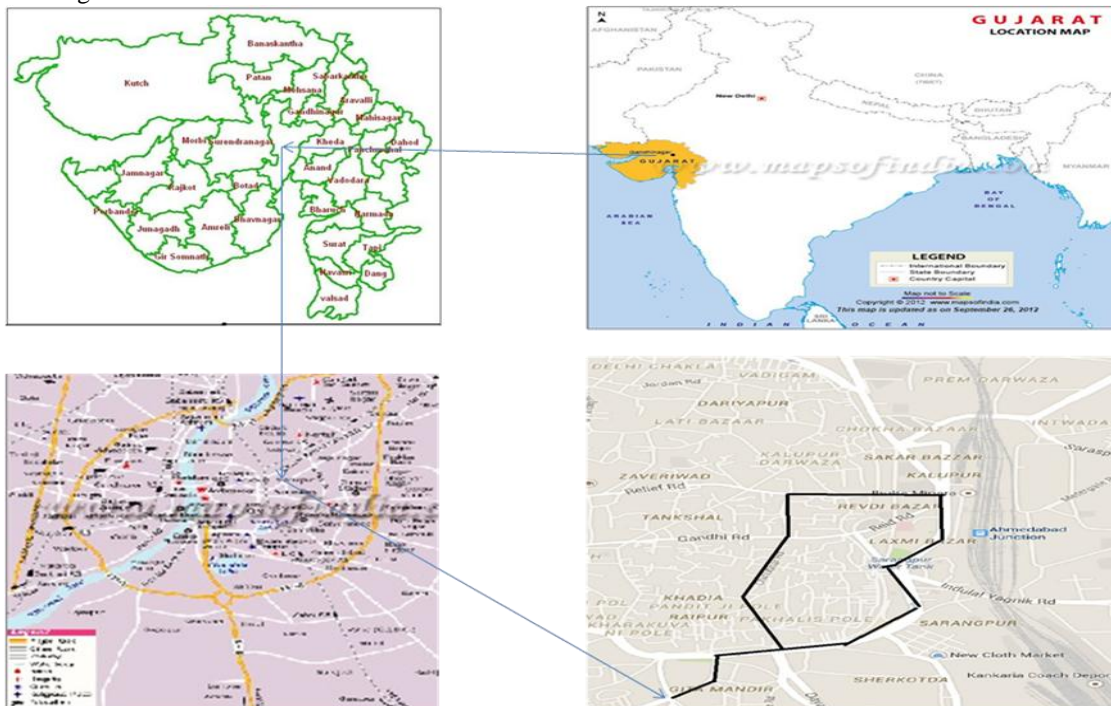


Figure 1 study area profile

VI PREPARATION OF ITS SYSTEM FOR CORRIDOR

Design Requirements:-

- Network Topology: Monitoring vehicles is one of the main objective considered here using ITS. By having accurate information about the locations of each node, we can obtain accurate information about the events taking place on the roads.
- Power Consumption: Power is the primary conservation in implementation of sensors and routing protocols. The sensors has limited amount of storage and processing capabilities, there is an upper limit on the performance to be achieved.
- Scalability and Network Cost: For traffic estimation only a small fraction of the road system will be measured and monitored using ULTRASONIC SENSOR NETWORK. Traffic estimation can be used to estimate traffic data at locations where sensors are not deployed. Hence there is a significant drop in the cost of ULTRASONIC SENSOR NETWORKs and the ULTRASONIC SENSOR NETWORKs can become more scalable.
- Fault Tolerance: ITS can be deployed in both cities and rural areas. It is generally preferred in urban areas in order to minimize the instable environment conditions and sensor failures.
- Security: The ULTRASONIC SENSOR NETWORKs are soft targets for intruders and hackers. They can display the fake image of traffic condition or manipulate the data collected by sensor nodes which could cause a serious problem. We can enter sophisticated encrypted algorithms to achieve higher level of security.⁽¹⁾

Proposed Architecture:-

Here a replica of the proposed system has been developed with the help of Ultrasonic sensors and Arduino Processor board. The Arduino Processor board is connected with the sensors with the help of wires. The Arduino processor board used here is UNO. The Ultrasonic Sensor used here is HC-SR 04. It is 45*20*15 mm in size with working voltage of 5V (DC).⁽³⁾

The Arduino UNO processor board is the microcontroller board based on ATmega328 a flash memory which can retain the data even in the absence of power supply. It has 14 digital input/output pins, a 16MHz ceramic resonator, a USB connection, an ICSP header, a power jack, and a reset button. Just simply connecting to the computer with a USB cable or power with a AC to DC adapter or battery to start it. The specifications of the processor board are given below:

Microcontroller: ATmega328

Operating Voltage: 5V

Input Voltage (Recommended): 7-12 V

Digital I/O Pins: 14

Analog Input Channels: 6

PWM (Pulse Width Modulation): 6

DC Current for 3.3V pin: 50 mA

Flash Memory: 32 KB

Length: 68.6 mm

Width: 53.4 mm

Weight: 25 gm

The detailed components of Arduino UNO can be seen in Figure 2

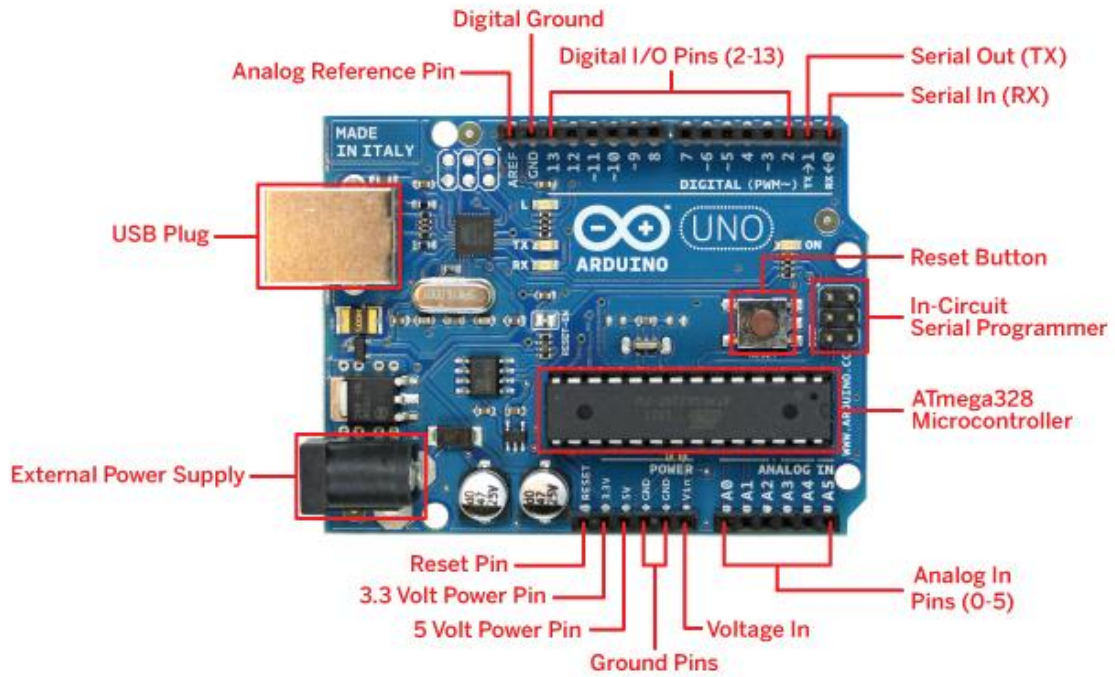


Fig 2 Components of Arduino UNO Programming board

The basic connection of the components is shown in Fig 3

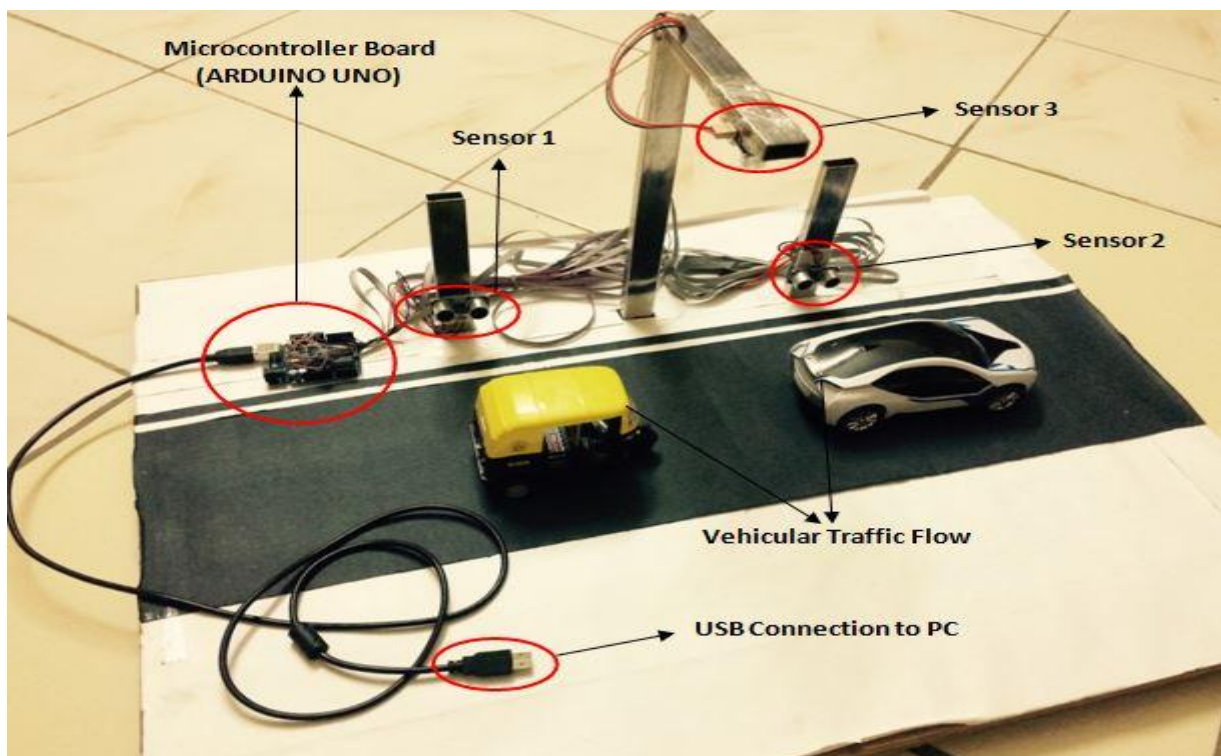


Fig 3: Connection between Programming Board and ultrasonic sensor

The proposed flowchart for the ULTRASONIC SENSOR NETWORK is shown in fig 4

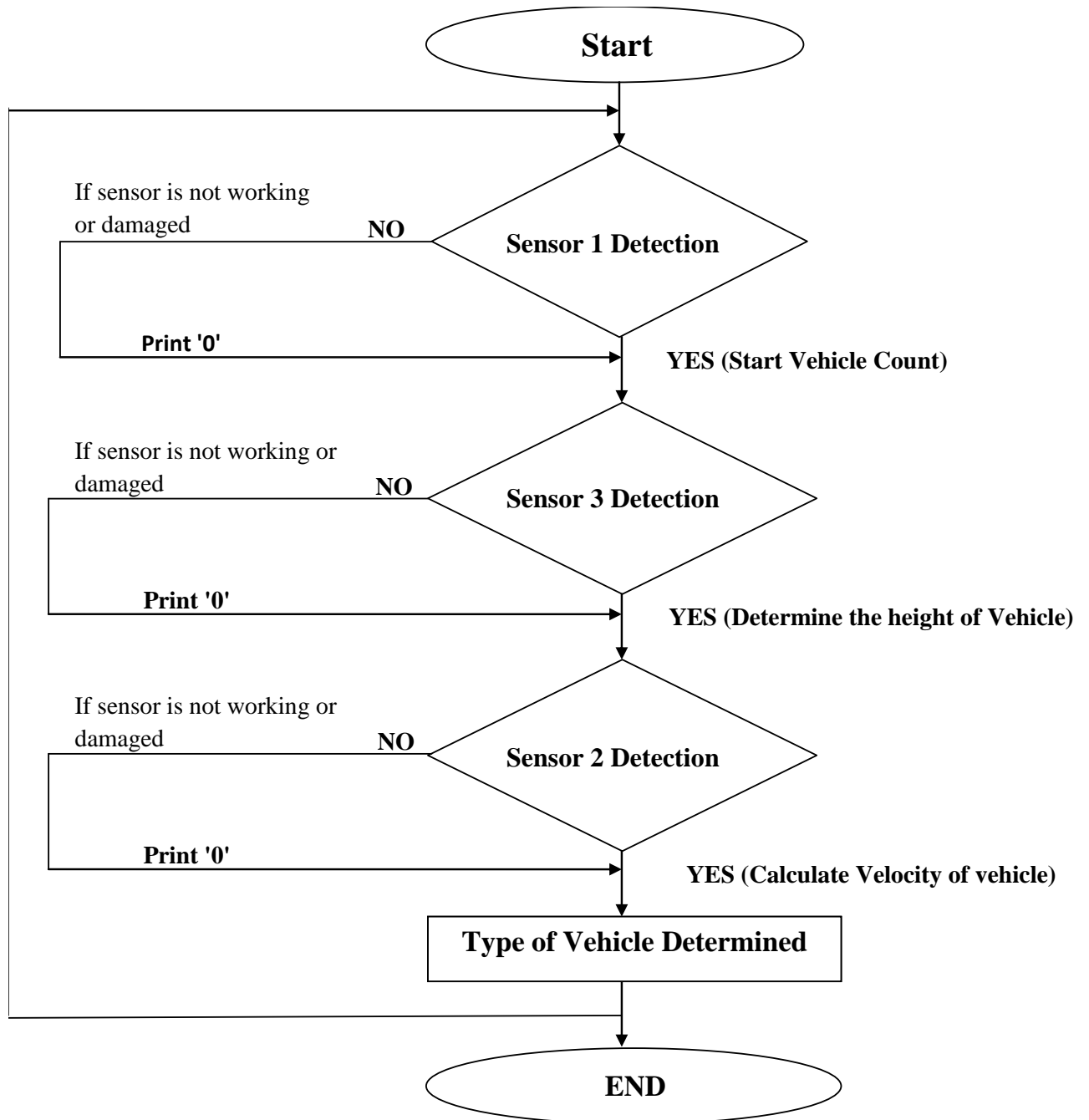


Fig 4 Proposed Flowchart for Ultrasonic Sensor Network

The Flowchart of the algorithm can be defined by the following detail coding of various variables in Arduino Software version 0022. The Arduino Integrated development Environment (IDE) is written in Java, C and C++ and it includes code editor with features of syntax highlighting, brace matching and is also capable of compiling and uploading a programme with a single click. The algorithm of the proposed logic is as follows:

- Step:1 Initialise sensors. Start the system.
- Step:2 Start detection of any incoming vehicles.
- Step:3 When vehicle detected in sensor 1, Start timer. If sensor 1 is not working, then print 0.
- Step:4 Go to the next step.
- Step:5 Sensor 3 detection starts.
- Step:6 If vehicle detected in sensor 3, print height of vehicle. If sensor 3 is not working, then print 0. Go to the next step.
- Step:7 Sensor 2 detection starts.
- Step:8 If vehicle detected in sensor 2, print speed and length of vehicle. If sensor 2 is not working, then print 0. Go to the next step.
- Step:9 Display the type of vehicle, speed of vehicle, vehicle count of vehicles as output in serial monitor.
- Step:10 Go to 1st step.

The system is applicable for the selected site. With the help of this program it is able to determine the Speed of vehicle in kmph and Total count of vehicle can also be maintained. The sample results of this program can be seen in the figure below.

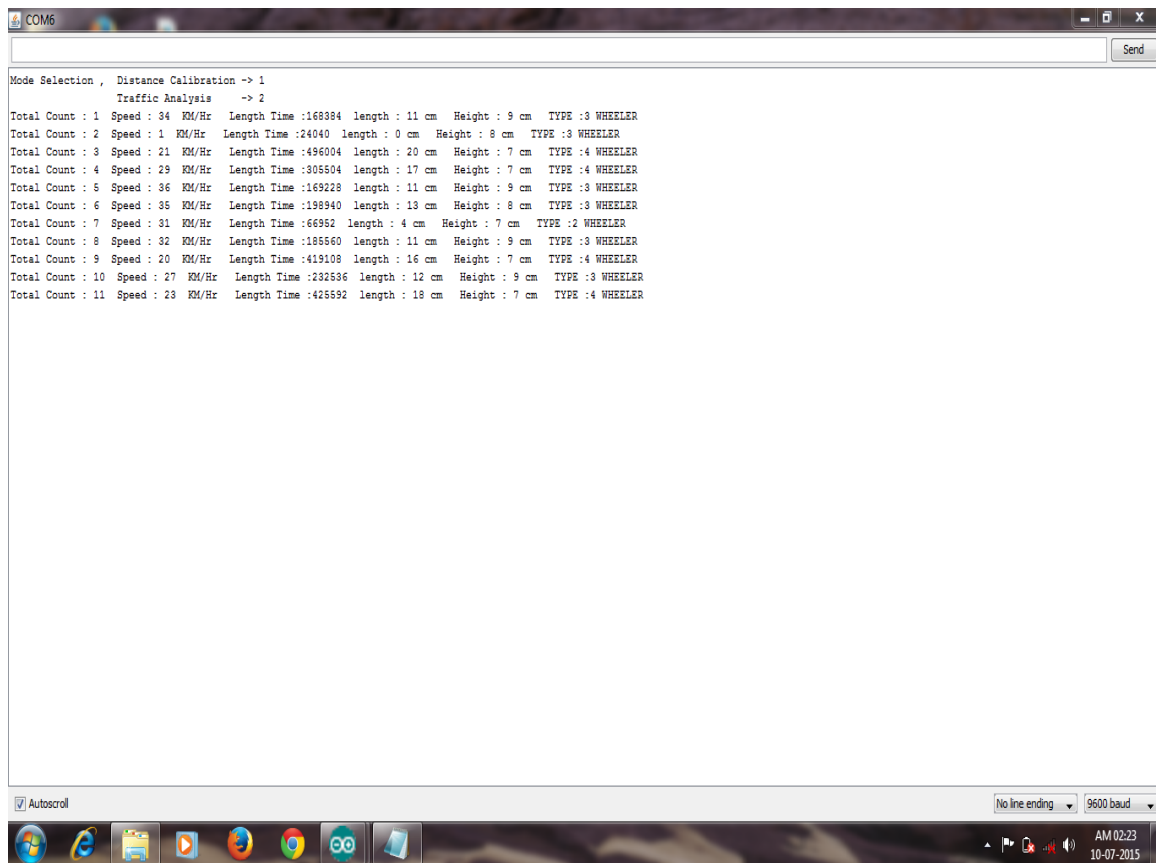


Fig 5 Analysis Output of Arduino Software.

The type vehicle is determined by the length and height of the passing vehicle. Here it is assumed that vehicles follow Lane Pattern on the road. For sample, 500 count of vehicles were collected of which 52 samples were error term hence the error in the system is of 10.4%. The table 1 shows the distribution of vehicles of 500 samples.

The observations of vehicles with ultrasonic network model is displayed in the table 1.

Table 1: Sample of reading taken by Ultrasonic System network model.

SAMPLE DATA COLLECTED FOR THE PROPOSED ULTRASONIC SENSOR SYSTEM				
TOTAL COUNT	SPEED (Km/Hr)	LENGTH(CM)	HEIGHT(CM)	TYPE OF VEHICLE
1	28.95	19	7	4 WHEELER
2	25	24	7	BUS
3	26.21	19	7	4 WHEELER
4	27.06	25	7	BUS
5	27.8	24	11	TRUCK
6	15.49	25	7	BUS
7	18.98	24	11	TRUCK
8	20.93	10	8	3 WHEELER
9	13.51	16	10	UNCLASSIFIED
10	15.8	23	11	TRUCK

Proposed System for the Corridor:

With the validation of the prototype for proposed ITS system, the location for providing this system has been plotted on the road network with the help of Corel Draw software. Fig 6 shows the places of implementation of the proposed Ultrasonic Sensor Network system.

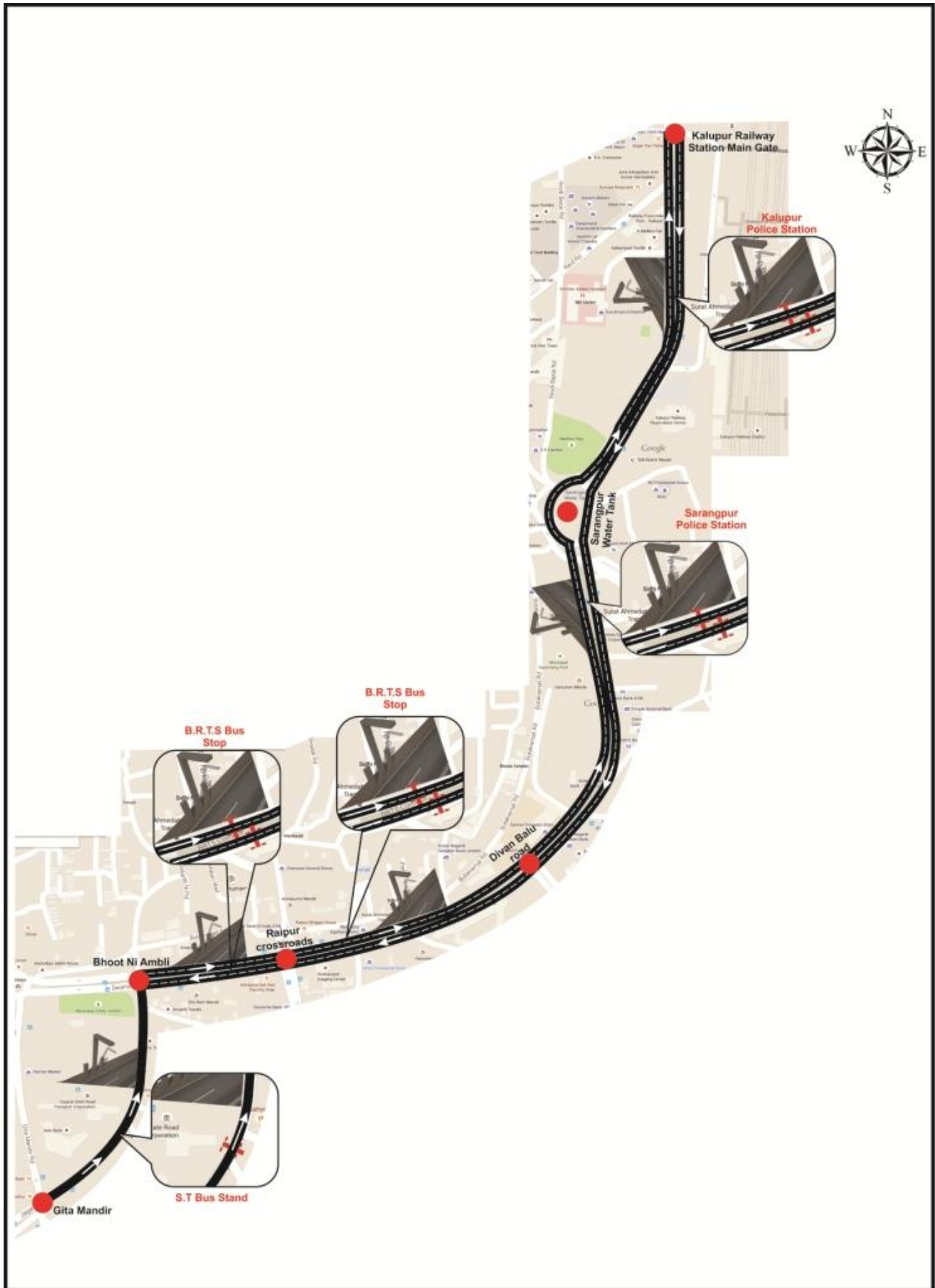


Fig 7. Location of proposed Ultrasonic Sensor Network

Cost of system implemented:

The cost of various parameters are considered for proposing this ultrasonic sensor network on the selected study area. According to the location proposed the cost of required materials and components for a single location are in given in table 3.

Table 3. Estimated cost of proposed ITS system for implementation

COST OF SYSTEM IMPLEMENTATION						
Sr No.	Item Description	No	Specifications	Cost per unit	Cost (in Rs.)	Total Cost
1	Steel section (straight)	2	LxBxT = 1.5 m x 0.3 m x 0.15 m	meter	300	1170
2	Steel section (L - Section)	1	LxBxT = 6.5 m x 0.3 m x 0.15 m (vertical), LxBxT = 2 m x 0.3 m x 0.15 m (horizontal)	meter	300	2820
3	Ultrasonic Sensors	3		unit	110	330
4	Arduino Microprocessor board (UNO)	1		unit	1500	1500
5	Wires for electric connection	3	5 meters for each steel section	meter	20	900
6	Wires for connecting Arduino board and Sensors	4	8 mts for L-section, 2 mts for straight section each	meter	10	480
7	Excavation of pit	3	LxWxH = (0.35 x 0.35 x 1.00)m	cu. meter	1500	7650
8	Concrete Pedestal	3	LxBxT = (0.30 x 0.30 x 0.15) m	cu. meter	500	1125
9	Reconstruction Cost	3	resurfacing the excavated place	cu. meter	1500	4500
11	Labour Cost	5		person	400	2000
TOTAL COST						22475
12	Maintenance Cost		10% of total cost (Assumed)	yearly		2247.5
GROSS TOTAL COST						24750

For implementing the ultrasonic sensor system at one place the cost is Rs. 24,750/-. In the selected corridor the proposed places are at 18. So the total cost of the system on whole corridor is Rs. 4,45,000/-.

VII. CONCLUSIONS

This paper addressed the approach of sensor networks to implement an efficient ITS that increase the availability of classified volume counts and speed of vehicles. To deploy a reliable ITS, it is proposed to deploy the ULTRASONIC SENSOR NETWORK at important places to collect data and know LOS or congestion conditions.

VIII. REFERENCES

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