Improvement of Traffic Monitoring System by Density and Flow Control for Indian Road System Using IoT

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ABSTRACT

This paper presents a new signal timing method. The purpose is to make priority vehicles reach their destinations without delay at signalized interaction. That is, whenever the vehicles reach a signalized interaction, the signal light is always green. In this paper, an approach to make the traffic signal adaptive to the dynamic traffic flow using wireless sensor network is proposed. The proposed approach is simulated using Programmable Logic Controller and compared with the existing fixed time control scheme. Our objective is to use WSN to make the traffic signal adaptive to the dynamic traffic flow, so that the number of vehicles passing through the signal is maximized. From the results obtained it is observed that the proposed approach out performs the existing approaches.

Keywords - *Wireless Sensor Network, Traffic Congestion, Traffic Flow, Road Traffic, Signal*

1. INTRODUCTION

Internet of Things (IoT), also called Internet of Everything is the network of physical objects or "things" embedded with electronics, software, sensors, and connectivity to enable objects to exchange data with the production, operator and/or other connected devices [1]. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure [1]. Experts estimate that the IoT will consist of almost 50 billion objects by 2020[1].

Nowadays new technologies are emerging for high resolution traffic monitoring based on either mobile or fixed wireless-interconnected sensing devices. Traffic management is becoming an increasingly serious concern due the rapid rate of increase of vehicles. The growth and scale of vehicles today makes management of traffic a recurring problem. Increasing width of highway roads comes with a high premium of cost, time, effort and disruption of vehicle movement[5]. The basic traffic architecture is shown in fig. 1.

Traffic Congestion is a major concern in metropolitan cities. The existing system works based on a timing mechanism, meaning an equal time slot is provided for each junction. There is some modern traffic signal where timing are controlled manually[5]. Though uniform timing is a good mechanism when all routes have the same number of vehicles to cross the junction it does not necessarily mean that it works equally efficiently when there is non-uniform flow of vehicles in each route. Hence there is a need for a system which is adaptive in nature. Routes should have an option of being granted more time slots depending on the requirements for the given route[6]. Here we are going to propose a traffic congestion control system which would be adaptive in nature and provide time slot to each route based on traffic density.

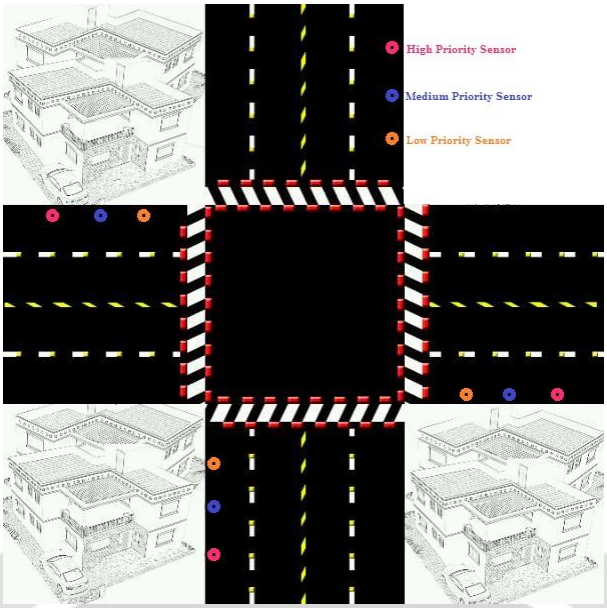

Fig-1: Basic Traffic System Architecture

In this paper, we are going to propose a traffic congestion control system which would be adaptive in nature and provide time slot to each route based on traffic density. The rest of this paper is organized as follows. Section-II gives background about traffic system. Section-III describes proposed system, Section-IV shows Experimental result and Section-V covers conclusion and future work.

2. BACKGROUND

Almost all urban cities in the world use traffic lights to control the traffic on the roads. The lights switch from red, which means stop, to green, which means move. Over time there has been a development of different types of traffic light control systems, the most commonly used being static traffic lights and vehicle actuated lights[4]. Static traffic lights' timing and switching patterns are predetermined despite prevailing traffic conditions for the different lanes. They do not operate with real time data[4]. Consequently this means they do not take into account the non-uniform and ever changing nature of traffic conditions. It does not matter whether at a particular period of time route one has more cars than route two; the green light allocation time and pattern still remains the same for all routes. The lack of intelligent strategies in these devices does very little in improving the road network performance and traffic congestion levels[4].

Smart traffic light controls are dynamic. This means that they use real time data to make priority based decisions. They use advanced communication systems based on sensors and/or RFID tags to collect data and provide the system with information on the current situation on the roads (such as number of vehicles on individual roads or how long vehicles have been waiting for green light). The smart system then processes this information and makes decisions; that is, it automatically determines the duration of each traffic light signal based on prevailing traffic situation on the roads[5]. Commonly used systems include:

- Fuzzy expert systems
- Artificial neural networks
- Wireless sensor networks

3. PROPOSED SYSTEM

The current Indian traffic condition works on the signal and clock based traffic monitoring system. The lack of sensors and traffic control causes wastage of money and fuel which also omits amount air polluters like carbon

monoxide every year, so we find that with the help of IoT, The road traffic problem can be solved on basis of the Internet of Things concepts.

Weakness of current traffic system:

Almost all urban cities in the world use traffic lights to control the traffic on the roads. The lights switch from red, which means stop, to green, which means move. Over time there have been developments of different types of traffic light control systems, the most commonly used being static traffic lights and vehicle actuated lights. Static traffic lights' timing and switching patterns are predetermined despite prevailing traffic conditions for the different lanes. They do not operate with real time data.

We have analyze the traffic conditions and various solution possible for the same in My Review Paper so finally we decided to improve traffic monitoring system with Density and Flow Control with IoT. The proposed System prototype model is shown in Figure 2.

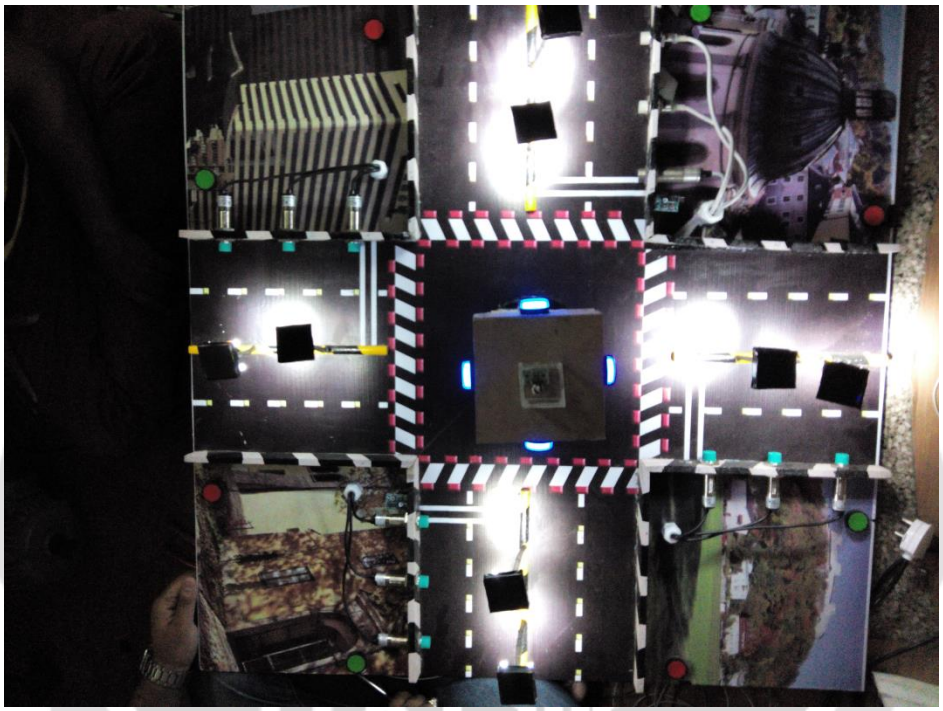

Fig-2: Prototype model of proposed system

The steps in the proposed algorithm are as below:

[1] Experiment setup (Hardware and Software)
- Setup the proximity/ultrasonic sensors to each lane
- Three types of sensors: Low, Medium and High

[2] Feed the sensor data to the system

[3] Identify the vehicle states and monitor it by WSN
- High on 1st Priority, Medium on 2nd Priority and Low on 3rd Priority and in default conditions perform clockwise

[4] Identify the special vehicles like Ambulance and Fire vehicles

[5] Provide the sensor data to the systemsoftware and change the traffic flow accordingly

[6] Measure the traffic flow and calculate the density and average waiting time

[7] Compare the results of existing and proposed system

4. RESULT ANALYSIS

Here, we have demonstrated the working model as well as the emergency vehicle module of the proposed system. The working model is shown in Figure 3 and the emergency vehicle module in Figure 4. From the

experiments performed we have achieved following results and thus we have compared existing traffic system with proposed system. The Figure 5 shows the results achieved for Low traffic and input for that is described in Table-1. Similarly, Figure 6 and 7 shows the results achieved for Medium and High traffic respectively and input for that is described in Table-2 and Table-3 respectively.

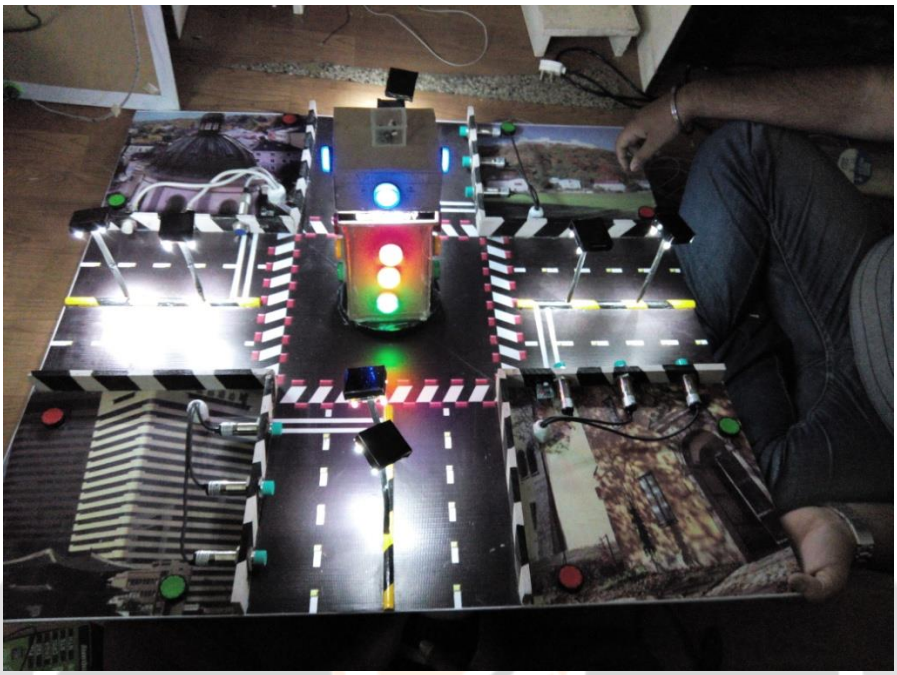

Fig-3: Prototype Model of Proposed System

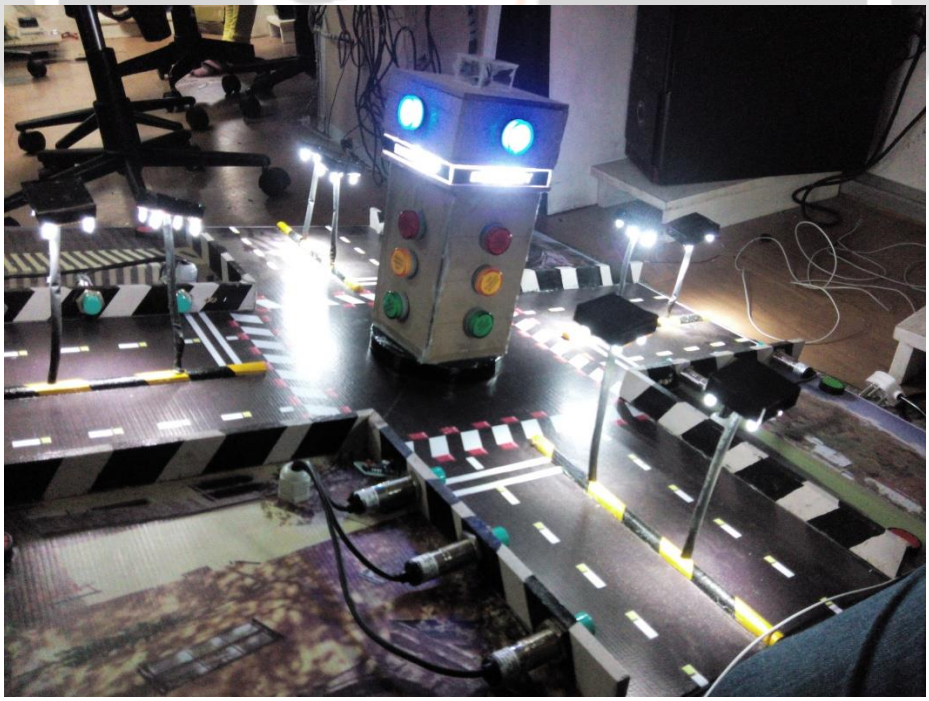

Fig-4: Emergency Vehicle Module

	Low Traffic	Actual Time of Existing System
Red (in seconds)	2.4	3.4
Yellow (in seconds)	0.4	1.4
Green (in seconds)	2.6	3.6

Table-1: Input for Low Traffic

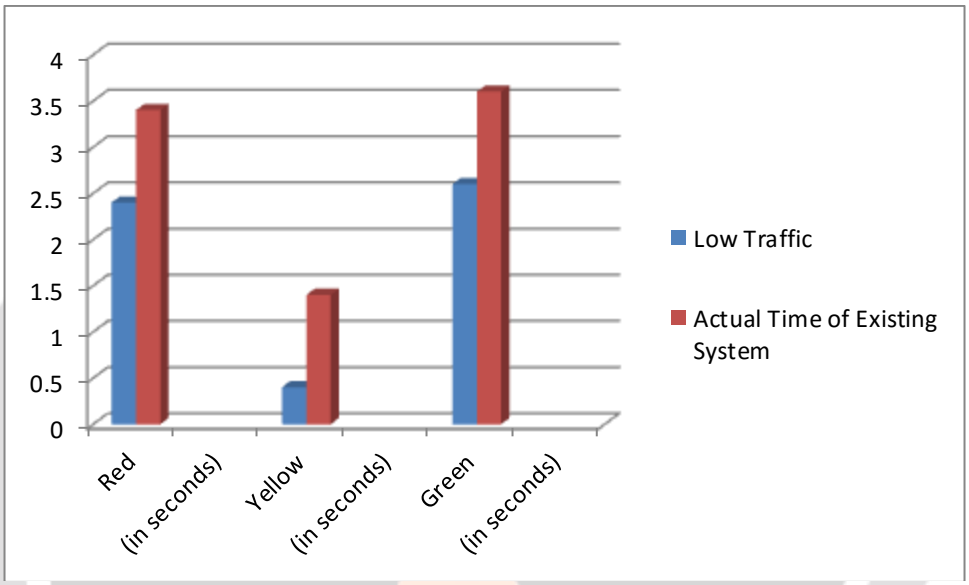

Fig-5: Results for Low Traffic

When there is low traffic the proposed system gives better time performance then existing system for 1 second.

	Medium Traffic	Actual Time of Existing System
Red (in seconds)	2.8	4.8
Yellow (in seconds)	0.5	2.5
Green (in seconds)	3.0	5.0

Table-2: Input for Medium Traffic

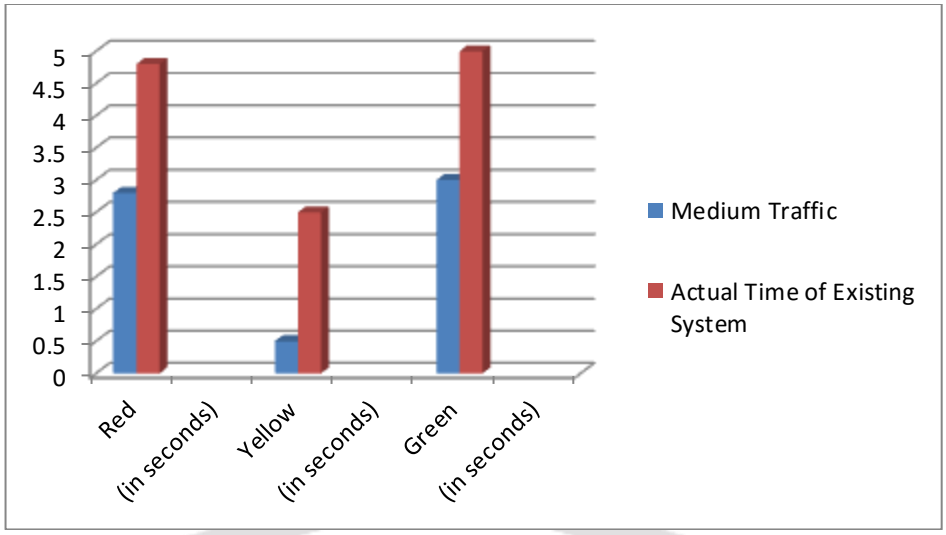

Fig-6: Results for Medium Traffic

When there is medium traffic the proposed system gives better time performance then existing system for 2 seconds.

	High Traffic	Actual Time of Existing System
Red (in seconds)	4.0	7.0
Yellow (in seconds)	0.6	3.6
Green (in seconds)	4.0	7.0

Table-3: Input for High Traffic

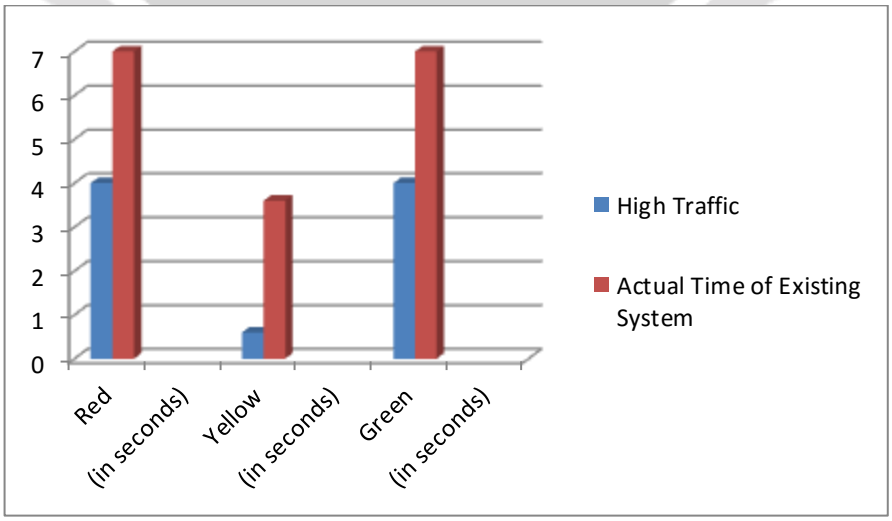

Fig-7: Results for High Traffic

When there is high traffic the proposed systemgives better time performance then existing system for 3 seconds.

5. CONCLUSION AND FUTURE WORK

The advantages of the proposed system include: 1) accurate monitoring and measurement of the vehicle number and vehicle speeds in real time due to the introduction of the WSN technology; 2) it is easy to append more functions to this system since the system not only know the statistical information but also the information of a special vehicle as well; and the roadside system can communicate with the vehicles. The current Indian traffic condition works on the signal and clock based traffic monitoring system. The lack of sensors and traffic control causes wastage of money and fuel which also omits amount air polluters like carbon monoxide every year, so we find that with the help of IoT, The road traffic problem can be solved on basis of the Internet of Things concepts. Our system is implemented on 2-lane road and we will also implement this approach on 4-lane road or on highways.

6. REFERENCES

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