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Real-time Auto Controllable Traffic Management System

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Abstract: **In India, road-traffic problem is taking serious shape, roads here, roads there, roads everywhere! But not a little place for your vehicle to take you to your destination. When you look at this entire traffic scene from the top, it only seems like hundreds of cars trying to make their way through the madness. As the current traffic light systems are not flexible for real time basis people have to wait for the green light while there is no traffic on the other lanes. This calls for the vital need of an Intelligent Traffic Systems (ITS). Keeping this thing in mind we are introducing a smart way of managing traffic specially for the peak hours, when there is a heavy traffic for just only one lane. To implement this smart traffic light system we are using sensors, microcontroller, image processing hardware, cameras etc. which helps us to decide the timing of red/green light signal according to the traffic on each lane. The key feature of this traffic system is that we are assigning priority to the important vehicles like Ambulance, Fire brigades and Police vans with the help of priority scheduling algorithms and round robin scheduling. Also GPS feature is added so that information about congestion will be available for the people, so that they can choose best available congestion free way. The hardware used will be of micro-programmed type, which makes this design easily adaptable according to real time situations, for example on republic day, Independence day, etc .**

1. INTRODUCTION

We all are very well aware of the increasing number of vehicles on road. Every household has one or two or in some cases more than two vehicles. This is because of the reason that people prefer to travel by their own vehicles rather than using the public transport. This leads to an increased traffic on roads.

On a lighter note, we live in a country where everybody is in a hurry but nobody reaches on time. This quest of reaching the destination on time is the result of exponential rise in number of vehicles on road. This situation is the reason behind many traffic problems like traffic jams, long queues at the toll gates, increased parking problems etc.

Focusing on the issue of traffic jams because of poor traffic management or lack of manpower to tackle this issue, the present research work is carried out. Here an attempt is made to write algorithms for an intelligent traffic light system which can respond according to the real time scenarios. Using GPS feature we can control congestion for the areas when there is one or more way towards the same destination, so that a driver can choose less busy road accordingly.

To put this system in practice, applications with easy to use user interface needs to be developed that can receive information from various traffic system base stations.

Also, in present traffic light systems it can be see that there is no separate provision for giving preference to emergency vehicles like ambulance, fire brigade, police van etc. In order to take care of such emergency situations we are proposing and introducing a feature which can be called as an 'interrupt signal'. Using this feature those lanes can be cleared on priority basis to which the emergency vehicles as mentioned above belong.

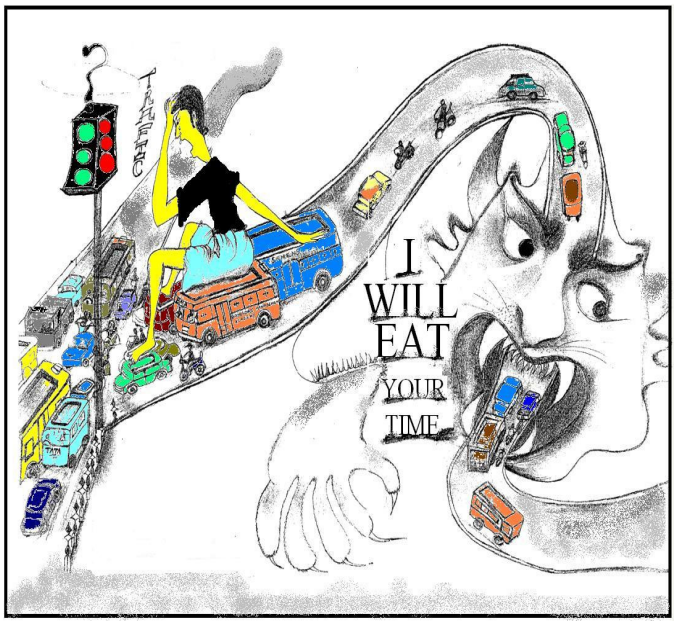

Fig. 1. Traffic Condition

2. LITERATURE SURVEY

Khalil M. Yousef, Jamal N. Al-karaki and Ali M. Shatnawi [1]: Vehicular traffic is continuously increasing around the world, especially in large urban areas. The resulting congestion has become a major concern to transportation specialists and decision makers. The existing methods for traffic management, surveillance and control are not adequately efficient in terms of performance, cost, maintenance, and support. In this paper, the design of a system that utilizes and efficiently manages traffic light controllers is presented. In particular, we present an adaptive traffic control system based on a new traffic infrastructure using Wireless Sensor Network (WSN) and using new techniques for controlling the traffic flow sequences. These techniques are dynamically adaptive to traffic conditions on both single and multiple intersections.

A WSN is used as a tool to instrument and control traffic signals roadways, while an intelligent traffic controller is developed to control the operation of the traffic infrastructure sup- ported by the WSN. The controller embodies traffic system communication algorithm (TSCA) and the traffic signals time manipulation algorithm (TSTMA). Both algorithms are able to provide the system with adaptive and efficient traffic estimation represented by the dynamic change in the traffic signals' flow sequence and traffic variation. Simulation results show the efficiency of the proposed scheme in solving traffic congestion in terms of the average waiting time and average queue length on the isolated (single) intersection and efficient global traffic flow control on multiple intersections. A test bed was also developed and deployed for real measurements. The paper concludes with some future highlights and useful remarks.

Shilpa S. Chavan, Dr. R. S. Deshpande, J. G. Rana [2]: Present Traffic Light Controllers (TLC) are based on microcontroller and microprocessor. These TLC have limitations because it uses the pre-defined hardware, which is functioning according to the program that does not have the flexibility of modification on real time basis. Due to the fixed time intervals of green, orange and red signals the waiting time is more and car uses more fuel. To make traffic light controlling more efficient, we exploit the emergence of new technique called as “Intelligent traffic light controller”. This makes the use of Sensor Networks along with Embedded Technology.

The timings of Red, Green lights at each crossing of road will be intelligently decided based on the total traffic on all adjacent roads. Thus, optimization of traffic light switching increases road capacity and traffic flow, and can prevent traffic congestions. GSM cell phone interface is also provided for users those who wish to obtain the latest position of traffic on congested roads. This is a unique feature of this project which is very useful to car drivers to take an alternate route in case of congestion. The various performance evaluation criteria are average waiting time, average distance travelled by vehicles, switching frequency of green light at a junction, efficient emergency mode operation and satisfactory operation of SMS using GSM Mobile.

The performance of the Intelligent Traffic Light Controller is compared with the Fixed Mode Traffic Light Controller. It is observed that the proposed Intelligent Traffic Light Controller is more efficient than the conventional controller in respect of less waiting time, more distance travelled by average vehicles and efficient operation during emergency mode and GSM interface. Moreover, the designed system has simple architecture, fast response time, user friendliness and scope for further expansion.

Raida al-alawi[3]: The ever increasing number of vehicles in most metropolitan cities around the world and the limitation in altering the transportation infrastructure, led to serious traffic congestion and an increase in the travelling time. In this work we exploit the emergence of novel technologies such as the internet, to design an intelligent Traffic Management System (TMS) that can remotely monitor and control a network of traffic light controllers located at different sites.

The system is based on utilizing Embedded Web Servers (EWS) technology to design a web-based TMS. The EWS located at each intersection uses IP technology for communicating remotely with a Central Traffic Management Unit (CTMU) located at the traffic department authority. Friendly GUI software installed at the CTMU is developed to select a specific node to monitor the sequence of operation of the traffic lights and the presence of traffic at each intersection as well as remotely controlling the operation of the signals. The system has been validated by constructing a prototype that resembles the real application.

3. PROPOSED MODEL

In this model we are using cameras for clicking the images of traffic, then the clicked image is send to the image processing system for calculating the length of traffic. This calculated length is used in calculating the time for traffic signal and then it sends a signal to microcontroller which allows traffic flow for that direction for calculated time.

We are also using sensors [9] to create interrupt for ambulance, fire brigade and some special vehicles like police van. Sensor [9] filters the siren of ambulance, fire brigade and other special vans and creates an interrupt signal to the system which quickly determines its direction and calculates its traffic length by processing the image for that particular direction. Then this length is sends for the time manipulation and microcontroller allows traffic for that direction for calculated amount of time.

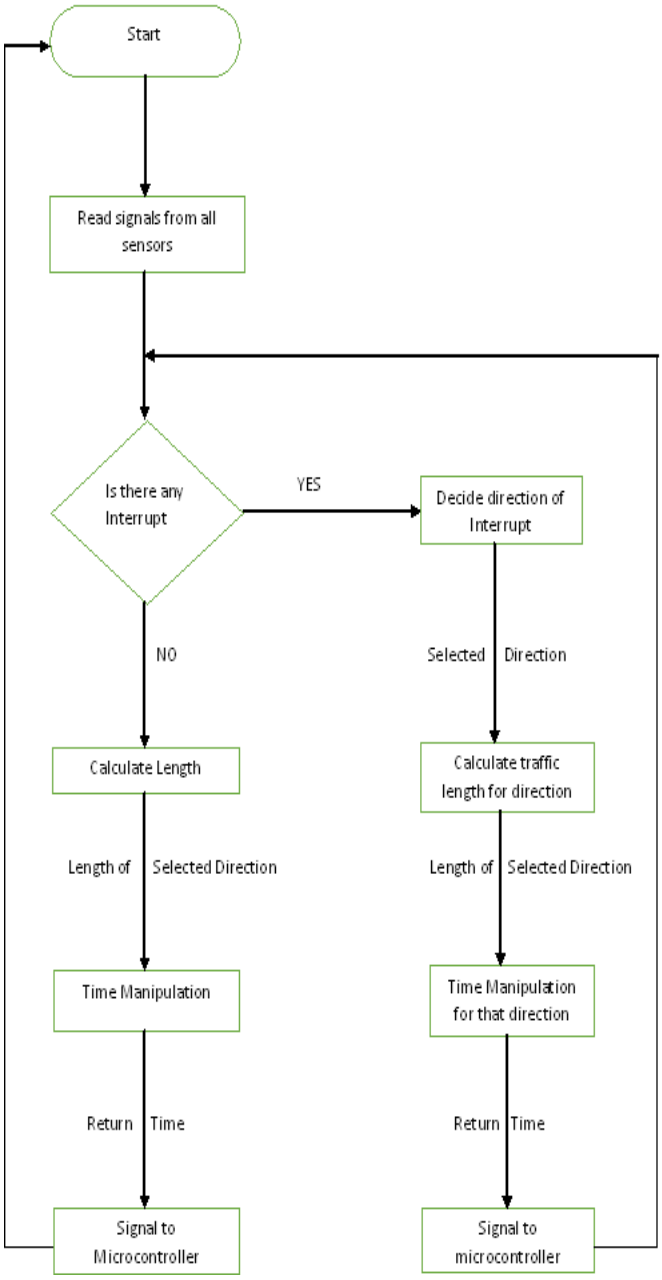

Fig. 2. Flow Chart

a. Algorithm

These are the algorithm used to implement Real time controllable traffic management system.

MAIN_ALGORITHM
1. Repeat 2 to 6 .
2. Check For interrupt.
a. If there is interrupt
call INTERRUPT_ALGORITHM
b. Else
Go to Step 3.
3. Set TRAFFIC_LENGTH = Find Length-Dir.
4. Check the value of TRAFFIC_LENGTH
a. If it is ZERO.
Continue in the loop.
b. Else
Go to Step 5.
5. Calculate the time using TIME MANIPULATION ALGORITHM (TRAFFIC_LENGTH).
6. Send signal to microcontroller with calculated time. It will ON the traffic for respected direction for calculated time.

Fig. 3. Main Algorithm for Traffic System

INTERRUPT_ALGORITHM
1. Check the Interrupt direction.
a. If there is only one Interrupt
Set Direction = Interrupt_Direction.
Go to Step 2.
b. Else
Check for which one arrived first.
Set Direction = select randomly.
Go to Step 2.
2. Set TRAFFIC_LENGTH = CALCULATE LENGTH INT (Direction).
3. Calculate the time using TIME MANIPULATION ALGOTIRHM (TRAFFIC_LENGTH).
4. Send signal to microcontroller with calculated time. It will ON the traffic for respected direction for calculated time.
5.Check for interrupt.
a. If there is interrupt
call INTERRUPT_ALGORITHM
b. Else
Call MAIN_ALGORITHM.

Fig. 4. Interrupt Algorithm

TIME_MANIPULATION_ALGORITHM
(Length in meter)
We are using a constant LENGTH having value 2 meter.
1. set len = TRAFFIC_LENGTH/LENGTH.
*2. set TIME = 15+(len*3).*
3. check
a. If (TIME<= 90 second)
Return TIME.
b. Else
Set TIME = 90 second.
Return TIME.

Fig. 5. Time Manipulation Algorithm

```
Find Length-Dir
Dir= {0, 1, 2, 3}, Set priority for each dir is 0.
1. Send the image of each Direction for process.
2. calculate the Traffic_len0, Traffic_len1, Traffic_len2
and Traffic_len3 Direction by IMAGE PROCESSING.
3. Set Selected_Dir = Direction(MAX(Traffic_len0,
Traffic_len1, Traffic_len2, Traffic_len3).
4. check
    For each Direction
        a. If (Priority[Dir] = -10)
                Selected_Dir = Dir
        b. Else
        Go to Step 5.
5. Check
    a. If (Priority[Selected_Dir]<10)
        Go to Step 6.
    b. Else
        Select the MAX_TRAF from
        Remaining 3 Direction
        Set Selected_Dir =
                Direction (MAX_TRAF).
6. For Each Direction
    a. If (Selected_Dir = Direction)
        Set Priority[Dir] =Priority[Dir] +5
    b. Else
        Set Priority[Dir] = Priority[Dir] - 5
7. Return Length of Selected_Dir.
```

Fig. 6. Find Length-Dir

```
CALCULATE_LENGTH_INT(Direction)
1. process the image of Direction and find Traffic_len.
2. Return Traffic_len.
```

Fig. 7. Calculate Length Interrupt (direction)

b. Algorithm Explanation

Main Algorithm

When system will boot for the first time it starts main algorithm, then it check whether an interrupt signal received from the sensors or not. If an interrupt signal is received it calls the Interrupt algorithm. If there is no interrupt signal it call Calculate length algorithm which return the traffic length for a particular direction, it store the length in TRAFFIC_LENGTH. Then it check whether length value is zero (if there is no traffic at any direction) or not, if it is zero it repeat the procedure otherwise it call Time manipulation algorithm and calculate the time for the traffic and then it sends a signal to microcontroller with information about direction and time. Microcontroller ON the traffic light for that particular direction for the particular period of time.

Time manipulation algorithm

Time manipulation algorithm makes use of the traffic length for a particular direction. It returns time in second to main algorithm. It calculated time in such a manner that the minimum time for a direction is 15 second and maximum time for a direction is 90 second. It add 3 second to each 2 meter of traffic, thus if there is traffic of 3 meter it gives 18s, for 5 meter it gives 21s.

Find length-Dir algorithm

This algorithm calculates the length of traffic for all directions using the image processing hardware and returns a direction with their traffic length to parent procedure. Initial it set the priority value to zero for all direction. Then use image processing to calculate the traffic length for all direction. It select the maximum traffic length direction and by checking priority select another direction if it is more appropriate and return it to main procedure with traffic length.

We are using priority scheme so that no direction has to wait too much with giving more preferences to heavy traffic lane. The priority scheme is such that a direction is selected if it has priority less than 10 and having highest traffic length otherwise the selected direction is from remaining direction having maximum traffic length. Each time a direction is selected for further processing its priority value is increase by 5 and remaining direction's priority value is decrease by 5. If a direction priority value reaches to -10 which means it waited for enough time then it selected first. This mechanism allows an efficient management of traffic if only one lane is getting very heavy traffic. It also prevent waiting time for low traffic lane from being excessive.

Interrupt Algorithm

In case if there is any Ambulance, Fire Brigade or any Special van comes Sensors send an interrupt signal to the system, after getting interrupt signal system start executing interrupt algorithm. This algorithm firstly checks whether there is only one interrupt or more than one. If there is more than one interrupt then it select randomly one of them by deciding their direction. After that it calculates the length of traffic for that particular direction by executing algorithm Calculate Length Interrupt. Then it calculate time for that particular length. After that it sends signal to microcontroller for ON the traffic for that Direction for calculated time period.

After that it checks for whether there is any other interrupt, if any then repeat interrupt procedure else call main algorithm. It helps to manage the emergency situation in traffic.

Calculate length interrupt(Direction)

It simply takes a direction and processes its image using image processing system and then calculates the length of traffic. Then it returns the calculated length of traffic for that direction to the parent procedure.

A separate procedure for calculating length at interrupt situation is used because image processing takes time, so if we are processing only one image at emergency situation then it is more efficient.

4. CONCLUSION

The researchers in this work, attempted to solve the problems of road traffic congestion in large cities through the design and implementation of an intelligent system based on image processing technology & sensors. With the implementation of this research paper in real world we can control the traffic in real time efficiently. This will help to reduce the waiting time of the vehicles. Therefore the system under question is not only highly efficient but also has curbed successfully the menace of traffic deadlock which has become a phenomenon on our roads.

Less waiting time will not only reduce the fuel consumption but also reduce air and noise pollution.

Assigning priority to special vehicles will help to manage traffic in emergency situation.

If we implement it with GPS system then it also gives useful information about congestion.

5. FUTURE SCOPE

Information technology (IT) has transformed many industries, from education to health care to government, and is now in the early stages of transforming transportation systems. While many think improving a country's transportation system solely means building new roads or repairing aging infrastructures, the future of transportation lies not only in concrete and steel, but also increasing the use of IT. IT enables elements within the transportation system vehicles, roads, traffic lights, message signs, etc. to become intelligent by embedding them with microchips and sensors and empowering them to communicate with each other through wireless technologies.

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