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TRAFFIC SIGNAL MANAGEMENT USING SWARM INTELLIGENCE

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Abstract *– In today's 21st century developing countries like India are facing a common problem regarding vehicular traffic within major cities. This has become a serious problem in many major cities around the world. ATMS (advanced traffic management system) is a systematic effort towards the design of an integrated urban transportation system with new technologies. By regulating the traffic demand at each intersection in the road network, the ultimate goal is to avoid traffic conflicts and shorten the queue length at traffic signal intersections. Our aim is to develop the system at signals. This proposed system will have multiple operations. Firstly the system will measure the traffic density at different signals of single intersection and accordingly change the time delays for traffic lights viz. the side at which the traffic density is high the signal will remain green for more time. Secondly it will also communicate with the adjacent junction signal. Also for the sake of convenience of the people a display will show the traffic situation of the next signal. Both the signals will collectively manage the traffic depending on the density.*

Keywords *– Vehicular traffic, ATMS, Traffic density, Communicate, Adjacent intersection.*

I. INTRODUCTION

1.1 Primary concept: In traditional signals as we see it daily that signal timings are fixed irrespective of the traffic of either side. So many a times it happens that traffic on one side get queued resulting in the jam. Our task in this project is to sort the problem of fixed timing of signal and individual functioning of them.
This report introduces a SWARM Intelligence Based Traffic Density Management Using MATLAB and Zigbee. Swarm intelligence is used for communication between the signals using the Zigbee module. And the camera at signal will continuously take the picture at each switching, and by processing this picture we determines density and accordingly switch the timings of the signal. So that no vehicle have to wait for longer time at the signal in turn avoiding the traffic conflict.

1.2 Motivation**:** Most of the cities in India are facing Road Traffic Problems. Traffic congestion and cities, it seems, go hand in hand. Everyone complains about being stuck traffic. These congestions bring a lot problem like delay at office, school, colleges etc. So we have to adopt certain alternatives to make life easier. Our project helps to sort out this problem which needs no human attention at the signals. By just calculating the density it is possible to avoid the traffic congestion, specifically at the signals.

II. SURVEY

2.1 Market survey:
A) Traffic control system in India: Urban Traffic Management and Control (UTMC) is a way of monitoring, operating and controlling traffic lights through a computer. The computer uses information gathered from sensors in the road to decide whether traffic is getting heavy or congested on a particular road. When it does, the computer changes the timing of traffic lights to let the traffic move more freely, so reducing hold-ups. CMS in association with Peek Traffic Systems, UK has executed the first Area Traffic Control (ATC) project in India consisting of 47 junctions in the National Capital Region of New-Delhi using the SCOOT System. The aim of SCOOT is to optimize the capacity of the road network by way of minimizing stops and delays or any other desired objectives.

Fig.1 Typical ATC system and remote monitoring of the ATC system

B) Wireless Communication protocols: Presently in the market various communication protocols have been brought in market. Everyone has its own strong points and weak points. We have chosen a protocol named Zigbee. ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. Applications include wireless light switches, electrical meters with in-home-displays, and other consumer and industrial equipment that require short-range wireless transfer of data at relatively low rates. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbps best suited for periodic or intermittent data or a single signal transmission from a sensor or input device

ZigBee Characteristics:

The focus of network applications under the IEEE 802.15.4 / ZigBee standard include the features of:-

- Low power consumption, needed for only two major modes (Tx/Rx or Sleep)
- Low costs
- Simple implementation.
- Allocated 16 bit short or 64 bit extended addresses.
- Allocation of guaranteed time slots (GTSs)
- Carrier sense multiple access with collision avoidance (CSMA-CA) channel access Yields high throughput and low latency for low duty cycle devices like sensors and controls.
- Fully “hand-shake” acknowledged protocol for transfer reliability.
- Low power consumption with battery life ranging from months to years.
- Energy detection (ED)

2.2 Literature survey: While searching for the new ideas we thought IEEE explore would be best option, so we went on searching many documents out of which we first selected some. After discussing we thought on the given topic and understood that this swarm technique is fresh to electronics and we shall work on it. Because it was fresh and IEEE theme we finalized the idea with some modification like image processing and zigbee.

Traffic signal control is an effective way to regulate traffic flow to avoid conflict and reduce congestion. The ACO (Ant Colony) algorithm is an optimization technique based on swarm intelligence. This research investigates the application of ACO to traffic signal control problem. The decentralized, collective, stochastic, and self-organization properties of this algorithm fit well with the nature of traffic networks. Computer simulation results show that this method outperforms the conventional fully actuated control, especially under the condition of high traffic demand.

III. PRINCIPLE OF OPERATION

This system will use two important tan concepts:

3.1 SWARM intelligence*:* Swarm Intelligence (SI) is the property of a system whereby the collective behaviors of (unsophisticated) agents interacting locally with their environment cause coherent functional global patterns to emerge. SI provides a basis with which it is possible to explore collective (or distributed) problem solving without centralized control or the provision of a global model.

In our project we are using this concept. When a signal works individually itself and mob at that signal has no idea what is the situation of the traffic at other signals, which in turn increase the more congestion. While on the other hand if all signals work as group and there is congestion at any signal it will provide information of the same to other signals which in turn will take the necessary action to avoid the conflict.

3.2 Image processing: The concept of image processing here is used for calculating the density of the traffic at the signal. Camera at signal will continuously take the picture at each switching of the signal, and by processing this picture it determines density and accordingly switches the timings of the signal. So that no vehicle have to wait for longer time at the signal in turn avoiding the traffic conflict.

IV. BLOCK DIAGRAM

Unit at Signal 1:

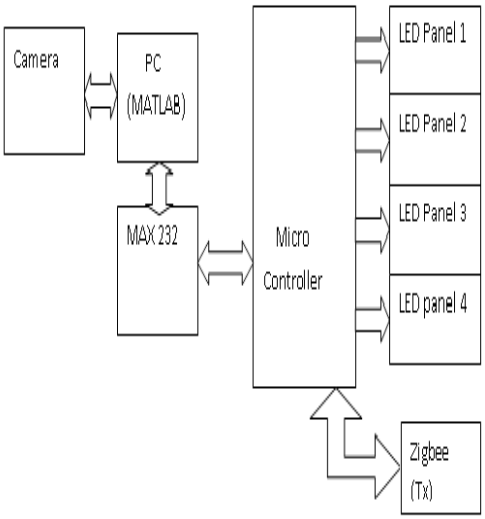

Fig 2.Block Diagram

From the figure 2 we can see that the attendance unit includes the following components:
PC with MATLAB and Webcam, Zigbee module, Microcontroller ATMEGA32-P, LED'S
To measure the traffic density the photos (images) will be taken using camera. These images will be processed using MATLAB to find the traffic density. Corresponding information of traffic density will be send to microcontroller. By measuring the traffic density we can automatically set the timings for different signals. Zigbee module is used for the communication

Unit at Signal 2:

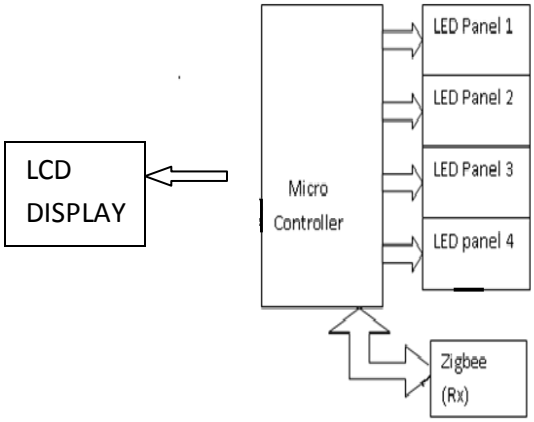

Fig 3.Block Diagram

From the figure above we can see that the server unit includes the following components:

Micro Controller AT MEGA 32-P., ZigbeeModule, LED panel.

V. ANT COLONY ALGORITHM

In computer science and operations research, the ant colony optimization algorithm (ACO) is a probabilistic technique for solving computational problems which can be reduced to finding good paths through graphs.

Initially proposed by Marco Dorigo in 1992 in his PhD thesis, the first algorithm was aiming to search for an optimal path in a graph, based on the behavior of ants seeking a path between their colony and a source of food. The original idea has since diversified to solve a wider class of numerical problems, and as a result, several problems have emerged, drawing on various aspects of the behavior of ants.

Because of the capabilities of the Ant Colony Optimization (ACO) approach, in comparison with other meta-heuristic optimization methods, the main part of the traffic control system uses an ACO based path planner

We have considered the traffic control problem as a case of a path planning problem and solved this problem with ACO. According to the theory of urban traffic , we defined six different levels to model the traffic flow in each link connecting two junctions, level A to F, in which level F defines the most congested mode and level A the lightest mode, while the other levels scale this interval linearly. In our proposed method, the traffic control system will guide drivers from their source to the desired destination by optimizing the path length and the level of traffic flow acquired by processing.

The new traffic control system which we call the ACO Based Urban Traffic Control System (ABUTCS), is designed to minimize the congestion time in the under control area by global management over most trips done in the area. As the new system optimizes travel time using a path with a minimum norm of traffic level and length, consequently, it will optimize the fuel consumption and air pollution. A driver's decision-making process for choosing a path to reach the desired destination could be modeled as follows, as shown in Fig.

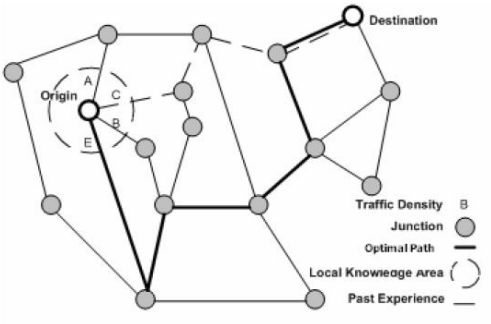

Fig 4.Ant colony optimization

The original version of ACO only optimizes the path length, but it is required to optimize at least two parameters of path length and path traffic. Applying these modifications to the original ACO solution used for the TSP problem, we can match this solution to the urban traffic control problem.

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