Intelligent Adaptive Traffic Surveillance System Using Swarm Technology

Pallavi Wadkar, Reshma Andhare, Priyanka Kadam, Anagha Kamthe

***Abstract*— Traffic signal control is an effective way to regulate traffic flow to avoid conflict and reduce congestion. It 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. Basically this concept works on hierarchy of three stages in the manner coordinator ,router and end device which work in a coordinated manner and can take their own decisions. Till date Swarm Technology was implemented only in the field of robotics. In the proposed system, Swarm Technology is used to solve the current traffic problems in such a way that the traffic signals will communicate with each other.**

***Index Terms*—Traffic Surveillance, ACO, Swarm Technology.**

I. INTRODUCTION

Swarm Technology is basically a system which works on real time conditions and the members in the group interact with each other in a decentralized manner to achieve a particular objective via self organization. Natural examples are ant colonies, schooling of fishes, etc. Swarm intelligence is a field of artificial intelligence. Artificial Intelligence of machine or software is that which studies and develops intelligent machine and software to make day to day life of humans much easier. Swarm behaviour is a collective behavior exhibited by similar types of species which all together perform a particular task. Till date swarm technology is been used only for robot-torobot implementation. This system uses nano bots to do a specific dedicated task. Basically this concept works on hierarchy of three stages in the main signal, sub signal and end signal which work in a coordinated manner and can take their own decisions. Now in our project we are implementing this swarm technology for the purpose of traffic by signal-to-signal control. Currently the systems that are implemented are based on fixed timers or fixed length signals leading to traffic jam. The fixed length timers can be used in smaller areas of low traffic; but for larger area or dense traffic junctions can lead to congestion. Our aim is to reduce this problem by implementing the variable timers. Depending upon the density of traffic, the adaptive timers will be set by using various algorithms. We are developing a scale able and distributed algorithm which can easily adapt the traffic signal plans. This project will also develop a realistic traffic signal development plans. Also safety will be given top priority in this system.

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II. LITERATURE SURVEY

Now a day, everyone has to speed up their life so as to reach their respected destinations in the stipulated time. But rather than reducing the time by speeding up their vehicles, it leads to traffic congestion and traffic problems. This will lead to a huge traffic problem.In India, for the year 2010-2011; around 141.8 million vehicles have been registered. Thus for the control of such large amount of vehicles, there has to be a strong traffic system. On 10 December 1868, the first traffic lights were installed outside the British Houses of Parliament in London to control the traffic in Bridge Street, Great George Street and Parliament Street. The design combined three semaphore arms with red and green gas lamps for night-time use, on a pillar, operated by a police constable. The gas lantern was turned with a lever at its base so that the appropriate light faced traffic. Although it was said to be successful at controlling traffic, its operational life was brief. It exploded on 2 January 1869, as a result of a leak in one of the gas lines underneath the pavement, injuring or killing the policeman who was operating it. With doubts about its safety, the concept was abandoned until electric signals became available. The first electric traffic light was developed in 1912 by Lester Wire, an American policeman of Salt Lake City, Utah, who also used red-green lights. On 5 August 1914, the American Traffic Signal Company installed a traffic signal system on the corner of East 105th Street and Euclid Avenue in Cleveland, Ohio. It had two colours, red and green, and a buzzer, based on the design of James Hoge, to provide a warning for colour changes. [2]

III. METHODOLOGIES

A. EXISTING METHEDOLOGY

1. *Ant colony algorithm*

Ant colony algorithm is a meta-heuristic approach for solving computationally hard combinatorial optimization (CO) problems .Inspired by the behaviour of the ants in real world, ant colony algorithm is a multi-agent system, in which each single agent is called an artificial ant. It is one of the most successful examples of swarm intelligent systems and has been applied to solve many different types of problems, including the classical travelling salesman problem, path planning and network routing. [1]

2. *Reservation based system*

Dresner and Stone (2004) moved away from a traditional view of traffic light operation, proposing an architecture in which intersections reserve time and space for vehicles to

cross the junction. Using this approach, the space inside an intersection is divided into an N x N grid of 'reservation tiles', each of which may contain at most one vehicle at any time (to prevent collisions). Driver agents then communicate with each other.

3.*Genetic Programming*

A genetic programming parse tree is evaluated at every second, with the Boolean value of this tree resulting in either phase change (true) or no change (false). The parse tree uses typical Boolean functions (AND,OR, NOT, >) as well as a number of terminals such as number of vehicles approaching a light, whether vehicles are backed up to a sensor downstream and how long the current light has been in operation.

B. PROPOSED METHODOLOGY

Swarm Technology for traffic is used to optimize the traffic to a lot higher level. This system will have an adaptive nature just like ANN (Artificial Neural Network) and will adapt to the surroundings. Then the main advantage of this system is that it can be used on priority basis. That is the system will give an advantage for the priority vehicles such as ambulance and government vehicles. This will give an advantage for solving the congestion of traffic.

IV. SYSTEM DESIGN

The End device will sense whatever data or situation is present on the road and the respective action will be performed depending on the real time situation. The task performed or the decision to be made is informed to the Router. The Router will then inform the. Then the Co-ordinator will make the decision and then actual action is performed. If there are simple decisions then the End device will do it, in case of some other decisions such as sensing traffic and setting the timer, the Router will take the decision and in some extreme cases such as ambulance or fire-brigade running on the road, then the Co-ordinator will take the decision. In this way the system will work in a complete hierarchy and the goal is achieved. The signals are connected in the fashion is such a way that the signal with large traffic is said to be Co-ordinator. Then the signal with less traffic than Co-ordinator is called Router and then End device. The signals communicate with each other with the help of Zigbee. Zigbee broadcasts the message to the other signals and accordingly the action will be taken. Fig.4 shows block diagram of each unit in system .It includes ATmega16L microcontroller, RFID, sensor. According to o/p from sensor controller will take action &turn on respective signals.[3]

RFID

There are two types of tags used mainly active and passive tags. In our project we are using passive tags for priority assigning purpose. The priority for fire brigade will be given the first priority. Then the ambulance and then the government vehicles. RFID reader will be kept at a distance away from the signal so that the reader will sense the priority and accordingly inform the signal. At the signal, the Zigbee will broadcast the message to the other signals. In this way, the communication can be done for priority vehicles.

Sensor

The sensors that we are using are the Infrared (IR) sensors. The IR sensors (TSOP-17) are used to measure the density and respond accordingly. The IR sensor will sense the data (traffic density) and the output of the IR sensor are applied to the controller in PWM form. On chip ADC is present on TSOP-17.

V. SYSTEM IMPLEMENTATION

The fig.5 shows working model of system. Middle unit is nothing but Co-ordinator & three units around this are Router &units below respective Router are End device. They all are work in coordinated manner &take controlling action. Co-ordinator &right hand side Router has RFID connection for ambulance, fire brigades etc.

VI. RESULTS

1. Adaptive System

The system is an adaptive system in the sense that according to the ANN (Artificial Neural Network) technology unlike humans, the system will adapt itself to the environmental conditions and accordingly the actions will be taken. The timer will be set accordingly and the system will adapt itself to the surrounding.

2. Density Based

The system will sense the density of the traffic and accordingly the timer of the signals will be set. By setting the timer, there will be an easy flow of traffic.

3. Totally Wireless

Due to the use of zigbee for communication purpose, there will be effective way so that the communication will be faster by broadcasting the message. Due to the use of wireless communication, the cost of placing of wire is reduced and thusit is more feasible.

4. Dynamic System

The decision will be changed i.e. the system will not work on fixed timer but the timers will be kept variable and thus unnecessary wastage of space and time will be avoided.

5. Priority Based System

The priority of various vehicles is set according to the requirement of the system. The vehicles with highest priority will be served first and then the other vehicles.

6. Accident Detection

Accident detection can be done by the help of IR sensors. If for a large amount of time if the density is constant then there can be a possibility of accident. Also a separate switch can be kept for the purpose of accident detection and directly the hospitality system can be warned about the accident.

7. Auto Bypass and Route Generation

Auto bypass can be done in a way that if there is a huge traffic or if there is any procession then the signal will block that particular road and then it will bypass the traffic to some other path or road. By doing this, the traffic will be diverted and the amount of time required is saved.

VII. FUTURE SCOPE

1. Auto Recovery

The workings of the signals are based on the Swarm and in case any of failure in a module then the nearest module will take charge of it.

VIII. CONCLUSION

It is a new optimization technique based on swarm intelligence. In this paper, ACO algorithms are applied to control signals at traffic intersection to reduce the vehicle waiting time. Initial test results show this method performs the conventional fully actuated control under the situation of high traffic demand. Further evaluation and testing on this approach will be performed.

FIGURES

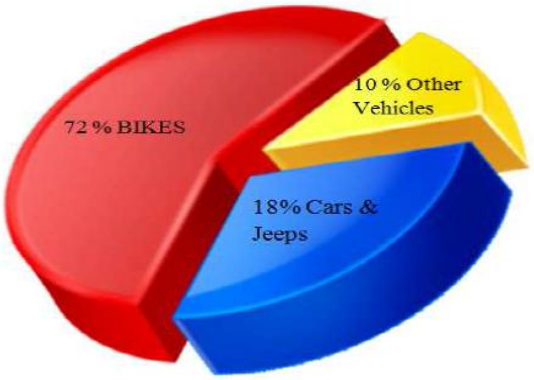

Figure 1: Pie Chart showing vehicles in India

Figure 2: Semaphore arms used as traffic signals

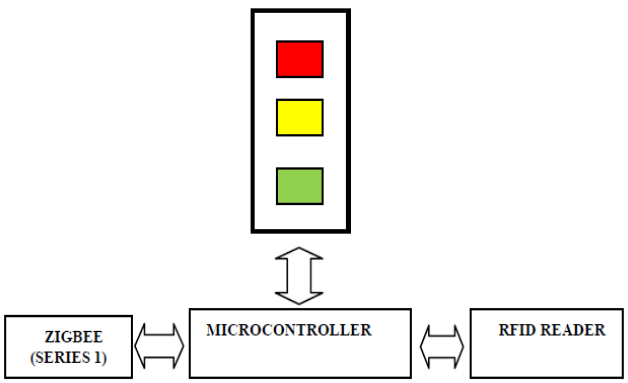

Figure 3:Actual Figure Block Diagram

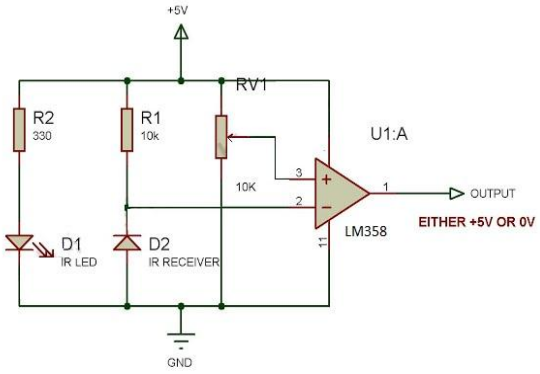

Figure 4:IR SENSOR

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