Smart Traffic Signals using Autonomic Computing

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Abstract

In the recent days, the traffic density has risen to a very high level. Increase in traffic density has resulted in spending long hours in traffic for short distances. The solution can be implemented by automating the traffic signals using the concept of "Autonomic Computing"-computing systems that can manage themselves. Using the characteristics of Autonomic computing and Wireless Sensor Networks [8], the traffic signals can me made smarter and intelligent by making it react to the traffic density and thus increasing or decreasing the waiting time accordingly.

Keywords: Self-optimizing, Self-healing, Self-configuring, autonomic.

I. INTRODUCTION

Autonomic computing reduces the complexity and human involvement by acting to the policies set by the administrator and then acting on its own thus minimizing human involvement. This concept can be introduced in various domains. One such domain where this concept could be used is in the network of traffic signals. Using the autonomic computing concepts like self-configuring, self-optimizing, self-healing[3][6] in effective working of traffic signals thus forming an efficient and smart way to control the traffic providing easy way for routing the traffic. Two or more traffic signals can work hand in hand to control the traffic flow by decreasing the wait time for the lane with lengthy traffic and increasing the wait time for lane with less traffic thus minimizing the density of vehicles and freeing up the traffic.

II. CHARACTERISTICS

Autonomic Computing has three characteristics which can be used as the characteristics of the traffic signal. These characteristics are self-configuring, self-optimization and self-healing.

A. Self-optimization

The signals optimize themselves with the traffic density. If one side of the lane has high traffic density and if the other side has low traffic density, the waiting time gets increased in the low density lane and the waiting time decreases in high density lane. If both the lanes have comparable density of traffic, then the waiting time remains the same for both the lanes. Thus the concept of self-optimization.

B. Self-healing

If an error or a problem occurs, the signals return to the normal mode of operation, works on the problem and tries to solve on its own. If that is not possible, it sends an alert to the control room alerting the administrator to take care of the error thus doesn't affect the overall signal network. This characteristic is self-healing.

C. Self-configuring

Suppose if a new signal is added in the network, the other signals adapt to the new signal and thus synchronizing the timing among themselves. Similarly, if an existing signal is removed from the network the other signals synchronizes itself thus exhibiting the characteristic of self-configuring.

III. METHODOLOGY

The idea of traffic signal can be achieved by the use of sensors. Sensors are placed on the lane of the road for a particular distance. As the sensors get covered, the waiting time in that lane decreases from the next cycle which indicates that the traffic density is getting higher. Similarly if the sensors are uncovered, the waiting time increases given that the other lane has high traffic density.

Taking an example of a four lane road, each lane has white strips running through the middle of the lane for the entire length of the road. These stripes can be taken as reference for placing the sensors. The stripes usually would be 10 feet in length and a 30 feet gap between each stripe. Hence it would be reasonable to place the sensor at the divider perpendicular to the mid-section of each stripe Fig.1. Thus the distance between each sensor would be 35 feet. These sensors are connected which to a sensor node which has a radio transceiver, a microprocessor and a power source. Hence, if four lanes intersect, then there are four sensor nodes which forms a sensor network Fig.2. The sensor node transmits the signal to a WSN host and the host which is autonomic, controls the traffic signals. The length up to which the sensors are placed depends on the usual traffic density in that road.

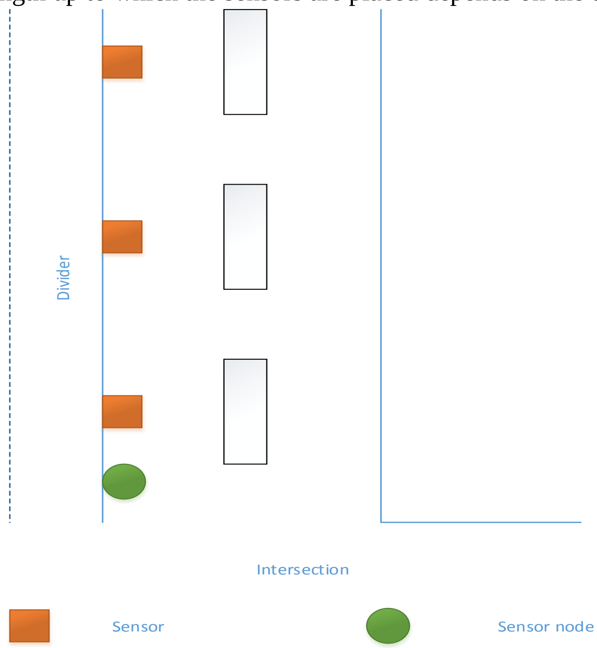

Fig. 1: Sensor placement

Increase or decrease of the waiting time always happen in the next cycle. That means, if the traffic light is red and if the traffic density gets suddenly higher, the traffic signal does not turn green suddenly, the waiting time gets reduced after the red signal appears thus preventing accidents due to sudden change in signals.

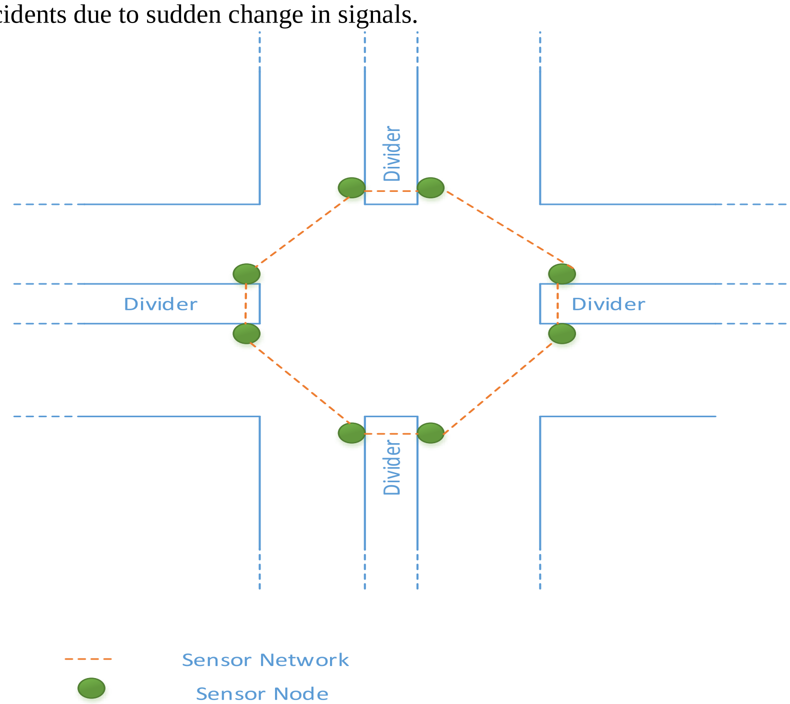

Fig. 2: Sensor Node network

IV. CONCLUDING

Implementation of this idea in traffic signals helps in effectively managing the traffic density in the cities thus allowing smooth traffic flow. Since the traffic signals become "autonomic", they "sense" the traffic density and accordingly routes the traffic effectively thus allowing uniform traffic flow. But, this idea has disadvantages. If the vehicles cover only the sensors, leaving other spaces free, the traffic signal might think there is a traffic density and decreases the waiting time even though there is no traffic density. Even though the traffic signals may be autonomic, if there is a problem that cannot be solved by any method then manual overriding has to be done and this manual overriding can be done by any bystander not necessarily be an authorized person. Thus, protection becomes an issue.

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