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Proposed Smart Technique for Traffic Light System

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الملخص :
في هذه الايام الازدحامات في الاشارات المرورية مشكلة حقيقية تواجه المدن في جميع بلدان العالم.
هذه الازدحامات قد تكون بسبب التاخير في زمن الاشارة الحمراء حيث تبرمج الاشارات بمنحها وقت ثابت لا يعتمد على الازدحام او كمية المركبات في تقاطع معين.
في هذا البحث اقترحنا خوارزمية لتنظيم انسيابية المركبات في عينة لمجموعة تقاطعات مرتبطة فيما بينها لا سلكيا بواسطة تقنية Zigbee و كل تقاطع يحتوي على متحسسات ليزرية لحساب عدد المركبات المارة في كل شارع ضمن فترة زمية محددة و بعد انتهاء هذه الفترة في احد التقاطعات يقوم بارسال عدد المركبات المارة في كل شارع الى التقاطع المجاور لذالك الشارع و استلام عدد المركبات المارة في الشوارع للتقاطعات المجاورة ثم اعادة حساب و توزيع الوقت على الاشارات في ذلك التقاطع بالاعتماد على عدد السيارات المارة فيه و في الشارع في التقاطع المجاور عن طريق معادلة وضعت لهذا الغرض بحيث يكون الوقت الممنوح لكل تقاطع ثابت و لكن توزيعه على الشوارع يعتمد على الازدحامات في ذلك الشارع و الشارع المجاور في التقاطع المجاور.
بعد اجراء محاكات للتقنية المقترحة باستخدام ماتلاب وجدنا ان الزمن الذي تحتاجه المركبة للانتظار في كل تقاطع قد نقص بنسبة 67 % و هذا يقلل من صرف المحروقات بنسبة 60 % تقريبا.

Abstract:

these days' jam in traffics is big problem in all countries. This traffic jam because of delay in red signal in intersections because it programmed with static period of time for each street in intersections and not depended on how many vehicles in concerned traffic.
In this paper we suggested new algorithm to enhance vehicles following through sample intersections distributed in somehow and connected using Zigbee technique, each intersection contains laser sensors to count the number of vehicles passed thorough each street in each intersection during period of time then transmit the number of vehicles passed to adjusted neighbors of intersections and receive the number of vehicles in adjusted intersections and then count the appropriate delay time and distribute to the streets depending on number of vehicles passed on that street and adjusted street in neighbor intersection.

After simulation of suggested technique, we got the delay time required for vehicles to wait in each intersection is reduced by 67 % and that reduce the consumption of fuel by almost 60 %.
***Index Terms*— Traffic Light, Zigbee, LDR, CDMA, TDMA.**

I. INTRODUCTION

Wireless sensor networks (WSN) is technique can be applied in different ways to achieve smart traffic lights, what we need to reach in all researches is to reduce the delay time that the vehicles should wait in the queues on intersections.

Many techniques have proposed previously for this purpose. Joyo [1] proposed smart dynamic traffic lights that can adapt their signaling times according to the traffic density, exploiting Direction of Arrival and Timing Advance data transmitted from mobile phone carried by the vehicle drivers, to cellular base stations. [2]. Xbee Pro Series 1[3] radios have been used for RF communication also a fixed directional antenna system has been used at each intersection.

In this paper, we proposed a technique that balance the load of the traffic in specific area with multiple intersections using Microcontroller in each intersection connected to Xbee Pro Series (to communicate the intersections in the specific area) and laser sensor (to account the number of vehicles passed through each road of each intersection).

Smart traffic lights can be programmed with static period of time and this cause jam or can be programmed with dynamic period of time depending on traffic jam on that signal [4]. Fuzzy logic0 can determine the action that traffic should do according to number of cars passed through the concerned street and its neighbor, Karakuzu and Demirci [5] propose a fuzzy logic traffic controller.

II. SINGLE INTERSECTION DEPLOY

We proposed a technique that balances the load of the traffic in specific area with multiple intersections using Microcontroller in each intersection connected to Xbee Pro Series (to communicate the intersections in the specific area).

A. Vehicles Counter

We used LDR resistor and laser transmitter in each road of each intersection as shown in Fig.1, the laser transmitters are transmitting the laser to the LDR resistors making the resistance very high and the voltage

through it almost zero out of (+5V) supplied to LDR resistor when the laser light obstructed by vehicle the resistance will be almost zero and (+5V) will be supplied to the Microcontroller input pins and then increase the number of vehicles by one.

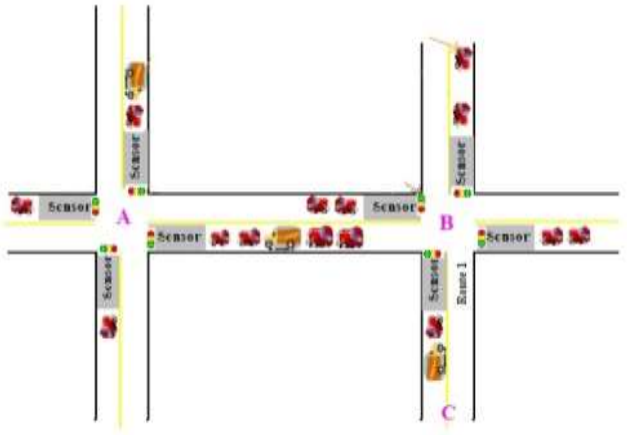

Fig.1 Laser Sensors Deployment in each intersection

Dynamic Time Distributing in Traffic Signal

The time distributed to the traffic signals in each intersection will be dynamically estimated depending on the number of vehicles crossed each road and the number of vehicles passed through neighbor road of adjusted intersection which will be transferred by the Xbee connected on each intersection as shown in Fig.2.

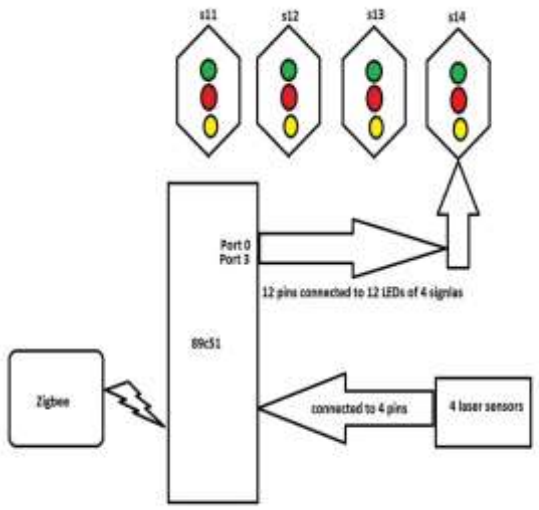

Fig.2 Circuit connected in each intersection

B. MULTIPLE INTERSECTIONS BALANCING

In this paper multiple intersections are connected to each other through zigbee technique as shown in figure 2.

The distance between two controller boards is around 1 - 1.5 km. However, initially we give (1 minute) to green light to each street, the sensors are calculating number of vehicles periodically each five cycles:

Cycle periods = (60 s * 4 street)

= 240 seconds

In intersection1 and street 1 number of vehicles is s11, s12,s13,and s14 and so on for all intersections we can calculate the total number of vehicles in intersection 1 by equation 1 below:

S1=s11+s12+s13+s14… (1)

By using equation1 above we can calculate the total number of vehicles in all intersections in our sample area S2, S3, and S4.

Now we have specific time for each intersection we need to distribute it to each street according to the number of vehicles during 5 cycles period for the intersection1 using equation (2)

$$T11 = \frac{s11}{S1} * 240 \ldots (2)$$

Where:

S11 is number of vehicles passed through intersection 1 from intersection 2 side.

S1 is total number of vehicles passed through intersection 2 during five cycle's periods.

Equation (2) above did not take in consideration the jam in attached intersection by the other word the vehicles passed from the intersection3 toward intersection1 in Fig.3 , so we need to increase or decrease the time for the street in intersection1 according to jam in street attached in intersection3 we proposed the equation bellow:

Fig.3 intersections connected to each other

$$T11 = \frac{s11}{S1} * 240 * \frac{s33*2}{S3} \ldots (4)$$

Where:

S33 is number of vehicles passed through street from intersection 2 side.

S3 is total number of vehicles passed through intersection 1 during five cycle's periods.

The values for intersection3 are transmitted using Zigbee.by the same way above we can calculate the time for streets using equation (4).

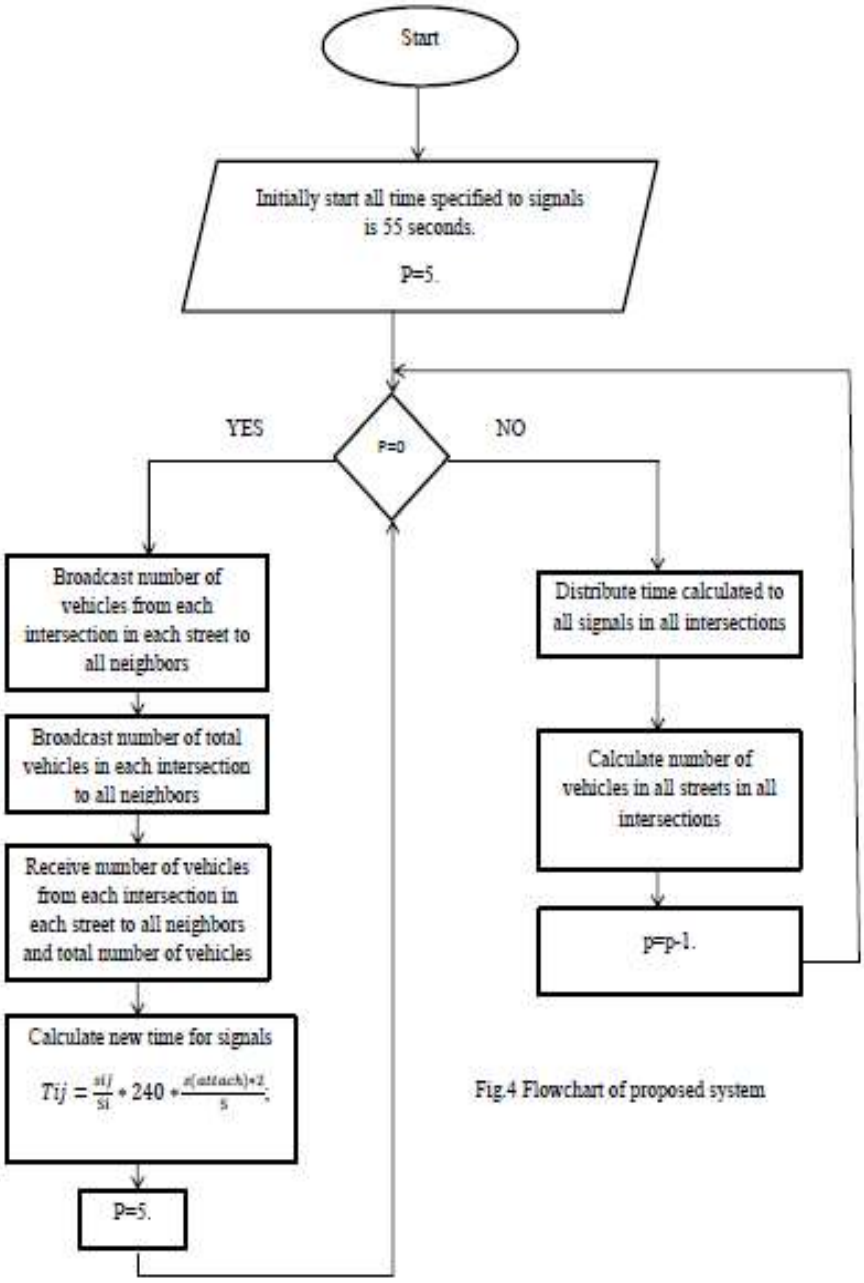

Fig.4 Flowchart of proposed system

III. ANALYSIS RESULTS

In this paper we supposed there are four intersections placed as shown in Fig.3.all vehicles are in the same speed and each vehicle take 20 minutes to complete one cycle (i.e passing from intersection 1 and back to intersection 1), if we supposed there are 200 vehicles distributed in the area as in Fig.4. And then we supposed that all vehicles consume the same amount of fuel by a time then by applying our proposed algorithm above and a static traffic algorithm with setup values shown in table 1 below:

Table 1: setup values

Term	Value
Number of vehicles	200
area	5 km^2
Fuel consumption	Equal for all vehicle
Simulation time	50 minutes

Our simulation results shows that the waiting time required for vehicles in our dynamic technique is less than in static technique as show in Fig.5.

Also the results shows that the fuel consumption by vehicles used our dynamic technique is less than the static technique.Fig.6 shows the result of fuel consumption for both techniques.

Fig.4 vehicles distributed through selected area

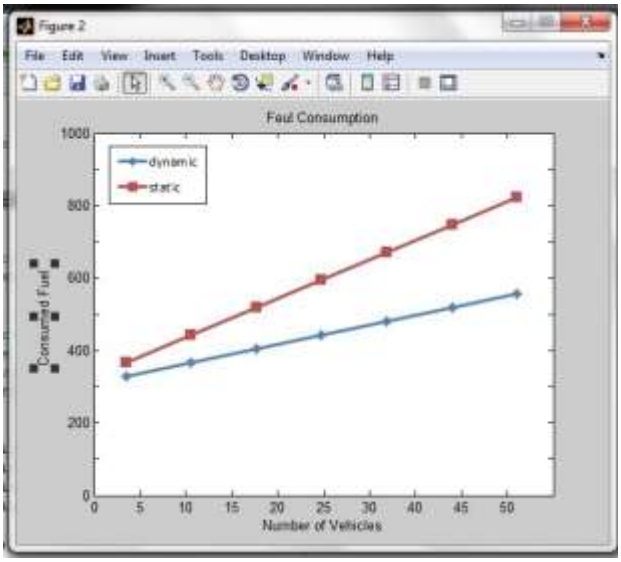

Fig.6 Fuel Consumption for dynamic and static techniques

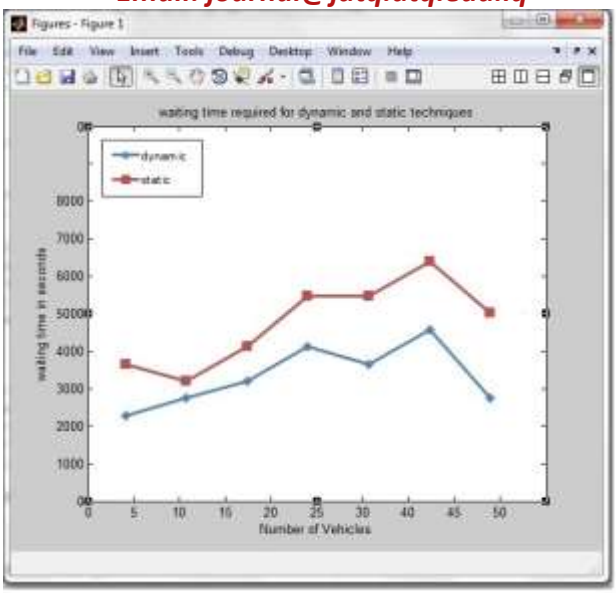

Fig.5 waiting time required for vehicles

IV. CONCLUSION

This paper proposes a solution for controlling traffic lights at intersections; our approach is cost effective due to a number of reasons such as reducing fuel consumption and the time delay required is reduced by 67%.

Such an approach is simple building and low cost.

References

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