Eco friendlyEnergy Efficient Smart Wireless Automatic Traffic Light Controllerbased on Hybrid Usage of Solar Panel, Embedded Systems, Vehicle Sensor, VANET, ZigBee and GSM

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***Abstract*— Traffic coordination in intersections is a very studied and challenging topic.Recently, management of road traffic is fast becoming a matter of grave concern. Traffic congestion has significant detrimental impacts on the economy, environment and life of the community. The traffic congestion has greatly increased the number of accidents on roads and also increased CO2 emissions from vehicles, due to increased idle time, so it is the necessity to build a safer, Environment friendly, Energy Efficient and much more reliable system for traffic.**

In this paper, we are going to achieve a more efficient traffic light controller. We have exploited the emergence of new technique called as "Eco friendly Energy Efficient Smart Wireless Automatic Traffic Light Controller". Fordesign and implementation of theintelligent traffic light controller, TC-QT50, a vehicle sensor is connected to the Embedded System (ES) which in turn is connected to the server through Global System for Mobile Communication (GSM) for sharing information regarding congestion .The server controls the TLC of all the Signal Junction (SJ) and manages the traffic density in more efficient way. A GSM device is installed in all the vehicles, so that they can choose to reroute and the Emergency services can get green signal when it reaches a junction.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 one of unique feature of this project which is very useful to car drivers to take an alternate route in case of congestion and by adding, the devices form a mobile ad-hoc network (VANET), which allows cars to communicate information about road conditions. One of the major renewable and non-polluted Solar Power source supply at each pole eliminates power supply wiring from one source and also eliminates high power consumption and this way the maximum power can be saved. It also uses Zigbee Wireless Communication between all the poles to eliminate communication wiring andthis system efficiently avoids the congestion without any barrier.

***Index Terms*— Energy efficient, Smart Wireless Automatic Energy Efficient Traffic Light Controller, Embedded System (ES), Traffic Light Controller(TLC), Microcontroller, Vehicular Ad-hoc Networks(VANET), Solar Panel,ZigBee wireless communication network, Vehicle Sensor (VSC)and Global System for Mobile Communication (GSM)**

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I. INTRODUCTION

Fast transportation systems and rapid transit systems are nerves of economic development for any nation. Transportation of goods, manpower,industrial products, and machinery are the important factors which influence the rate of industrial development. Since mismanagement and traffic congestion results in long waiting times, loss of fuel and money, therefore it is utmost necessary to have a fast, economical and efficient traffic control system for national development.

Traffic research has the goal to optimize traffic flow of people and goods. The number of road users is constantly rising, and resources available in present infrastructures are limited, thus an intelligent control of traffic has become a very important issue. Traffic congestion has also significant detrimental impacts on quality of life of the community as evidenced by:

1) Increase in transportation costs associated with road and shipments of goods, which negatively affect overall productivity and competitiveness.

2) Increased CO2 emissions from vehicles, due to increased waiting time on traffic signals.

3) The public discontent about the lack of effective traffic management as destination travel time is increased.

Another major concern is the consumption of electricity .Providing road traffic lighting is one of the most important and expensive responsibilities of a city. Lighting can account for 10–38% of the total energy bill in typical cities worldwide. Traffic lighting is a particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability [10]. Inefficient lighting wastes significant financial resources every year, and poor lighting creates dangerous situations. Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically [9]. One of such possibility is solar power to traffic systems and street lights. So, the solar power saver system is implemented for street lights and automatic traffic control unit [11]. Traffic congestion also reduces the efficiency of transportation infrastructure and increases travel time, air pollution, and

fuel consumption. Several types of Traffic Light Controller have been proposed earlier but none of them were 100% effective for overcoming the congestion problem. Traffic View: a driver assistant device for traffic monitoring based on car-to-car communication [1], "but this system is not 100% accurate. Intelligent traffic control system proposed in [2] is based on the spacing between the vehicles but this system is not 100% reliable. Design of intelligent traffic control system based on DSP and Nios II. Using Dual-CPU, Intelligent Traffic Control System combined with logic control in FPGA has been discussed in [3]. But this system is not cost effective. Transportation Systems (ITS), aiming at improving driving safety and traffic efficiency. By adding short- Vehicular Ad-hoc Networks (VANETs), allowing cars to exchange information about road conditions. This is referred to Traffic safety in the focus of current research on VANETs and the main motivation of deploying this technology and to make it ubiquitous. However, there are a number of other applications that could improve the way we drive today. A novel traffic control system framework, the Mobile Intelligent Traffic Control System (MITCS), designed for Taiwan is proposed in [4]. Similarly, an intelligent traffic control system is operational in Beijing by the name SCOOT [5]. This paper examines the possibility of deploying an adaptive signal control system with other technology like VANET, ZigBee and GSM for efficient congestion control. Although there are variety of the techniques have developed to overcome the traffic congestion as we discussed earlier but there are still lot of problems are remaining due to poor traffic problems in developing countries. So, after researching on all the different kind of techniques, we proposed a hybrid model techniques based on **Eco friendly Energy Efficient Smart Wireless Automatic Traffic Light Controller** which is Automated Smart, Eco friendly, Energy efficient traffic management and congestion controller based on hybrid usage of Solar panel, Embedded Systems, vehicles sensor, Zigbee wireless communication network and GSM model. This Traffic Controller uses the combination of all the smart techniques and also contributes to reduce the fuel consumption and the gas emissions which pollute the environment, such as CO2. This hybrid technique uses various ways for handling the traffic, improves road safety, supports Eco driving, reducing energy consumption protects the environment and reduces pollution.

In our proposed system we are going to use TC-QT50-D, radar-based sensor wired to Embedded System with GSM technology. Hence, Energy Efficient Automated Traffic Light Controller is designed which manages the traffic efficiently and automatically without any human support. GSM acts as a wireless network to send warning signals to server, Signal Junction (SJ), Congested Signal Junction (CSJ), Highly Congested Adjacent Signal Junction (HCASJ), Less Congested Adjacent Signal Junction (LCASJ) and emergency vehicles. After receiving warning signal, the vehicles can reroute if possible and emergency services can get green signal if needed without any human interference. We are also adding Vehicular Ad-hoc Networks (VANETs), short-range wireless communication capabilities to vehicles, the devices form mobile ad-hoc network(VANET), allowing vehicles to exchange information about road conditions and also connected with GSM networks. This proposed model Uses Zigbee Wireless Communication between all the poles to eliminate communication wiring .Solar Power Supply at each pole eliminates power supply wiring from one source (State Electricity Board) and Battery Backup for required number of hours makes the system to work independent of Power Supply Failures. There are no other cables / wires required to be laid across the junction. Hence eliminates the Road Trenching. High Bright LEDs in Traffic lamps and Count Down timer are used for more reliability, longer view and low power consumption. GSM connectivity is used to monitor the signal status from Central place and also connected to each junction who reports all the failures to the central place for example, any Lamp permanent ON or OFF, Power Supply Failures or any kind of Communication Failures etc. In the design of Wireless Automatic Energy Efficient Traffic Light Controller, The micro-controller used inside the Embedded System is 89V51RD2 which is MCS-51 family based and this microcontroller is connected to the TC-QT50-D vehicle sensor and ZigBee device. The TC-QT50-D vehicle sensor automatically gets activated whenever any vehicle passes on road near to traffic signal. Microcontroller controls the TC-QT50-D sensor and counts number of vehicles crossing the signal. Microcontroller also keeps track of vehicles count and the microcontroller takes decision based vehicles count received from the vehicle sensor, and updates the traffic light delays accordingly. The traffic light is situated at a certain distance from the TC-QT50-D sensor system. Thus based on vehicle count, microcontroller defines different ranges for traffic light delays and updates those accordingly. The entire system is also connected to the GSM networks, Vehicular Ad-hoc Networks and cell phone to the drivers and car users. So, the updated traffic information is shared to all the vehicle users from the central place of Traffic Controllers. So, Drivers can easily get the traffic update and also reroute their vehicle to different traffic signal in case of emergency or high congestion time period. Administrator sitting on computer can command system (microcontroller) to down-load. recorded data, update light delays, erase memory, etc. Thus administrator on a central station computer can access traffic conditions on any approachable traffic lights and nearby roads to reduce traffic congestions to an extent. In future this system can be used to inform people about different places traffic condition.

II. EXISTING SYSTEM

In general, Intelligent Traffic control System is based on microprocessors and microcontrollers using inductive loop, IR sensor or the other sensors in which, the traffic light in every lane around the signal junction changes according to fixed time intervals so that even the empty lane used to get the green signal for fixed time. And these traffic light controllers are based on the external power supply for traffic light and for controller also. Although the traffic light controller is automated, there is still a need for Human supervision to let the emergency services pass and to control the vehicles violating the law. Sensors are also not effective and are used for shorter distance. Even though this traffic controller is automated, still it requires remote monitoring by

wireless networks. Therefore, it takes more time to free the congested lane, which increases the traffic in other lanes. Hence, fuel consumption is increased which further impacts the environment pollution.

"An Automatic Traffic Light Management Using Vehicle Sensor and GSM Model [7-[8]"has been already developed using vehicle sensor and GSM network in Embedded System. This smart automated controller is highly efficient in solving the congestion problem as compared to other existing controller which uses the same concept of traffic handling techniques. Even though the traffic controller is automated and well equipped with highly sensitive vehicle sensor and GSM connectivity, there is still few shortcoming existing with this Automated Traffic Light Controller which can cause failure of the system .The author have mentioned the limitation of these shortcoming as the future scope of the enhancement. The system is not effective in case of auto shut down of the Central server which is connected to the adjacent traffic signal and vehicles. Apart from this, there is no alternative technique used in this system for providing with a reroute map to all the vehicles when a particular junction gets congested and also this traffic light controller is not effective if any of the vehicle count sensor fails or any of the adjacent traffic light signal network failure. So, we have proposed a traffic control model which is a modified version of previous existing ATLC and this new model have objective to overcome all the shortcoming and failure of the existing system and is implemented major critical situation of traffic handling, auto shutdown with alarms when there is sensor failure occurs and providing with a reroute map to all the vehicles when a particular junction gets congested.

Apart from this ,The existing traffic light controllers does not support Eco Driving which means less consumption of fuel and also support environment from the harmful emission of pollutants likes CO2 and supports for protection of Global Warming. A typical Eco driver can reduce his fuel consumption and CO2 emissions by 15%. We can modify the above existing Traffic light controller with some other hybrid technique for effective way of traffic congestion and management also which supports for effective use of natural Solar resource for the power consumption and support advance technologies like **vehicular ad hoc network** (**VANET**) and ZigBee for controlling the better way of traffic. And by using all the effective mechanism and techniques , we proposed the model of Smart and Eco friendly Wireless Automatic Energy Efficient Traffic Light Controller , which can eliminates the traffic congestion, cost reduction, extra fuel consumption and helps in environment protection.

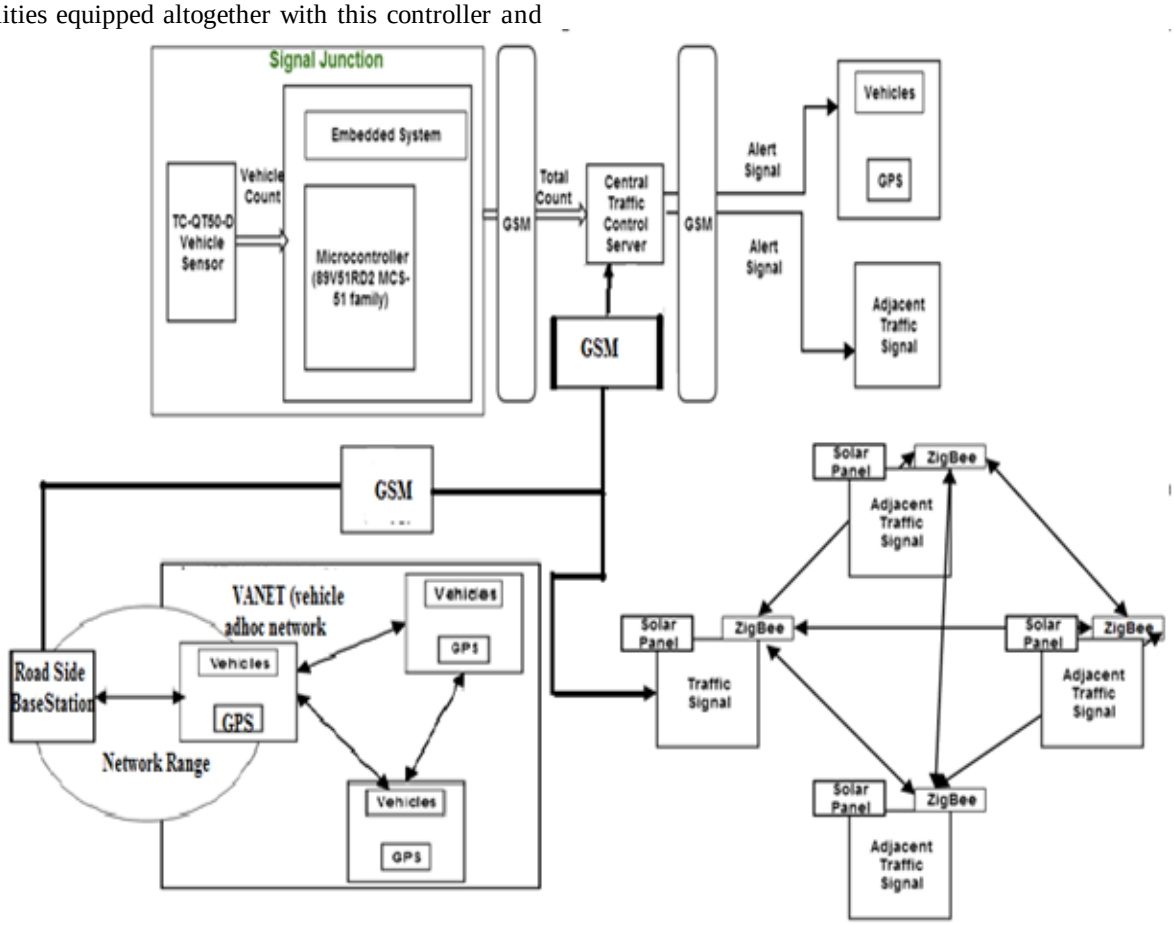
III. METHODOLOGY OF AUTOMATIC STREET LIGHTINGSYSTEM

Three parts have been included under this topic for completed this study. Design architecture is the main block function for the proposed design. While, the hardware specification will detail out the components involved in this design from the sensor components, Zig Bee, VANET until the controller selectionandin the last part, the system implementation and operation are elaborated in details.

A. Design Architecture

The system development is start with the design architecture of the proposed design of **Eco friendly Energy Efficient Smart Wireless Automatic Traffic Light Controller (EESWTLC).**A simplified block diagram of **Eco friendly Energy Efficient Smart Wireless Automatic Traffic Light Controller (EESWTLC)**is shown in Fig.1.In this smart **EESWTLC**, we have used TC-QT50, a vehicle counter sensor mounted on the TLC on each lane. An Embedded System(ES), which consists of Microcontroller(89V51RD2) and GSM interface will be placed on each Signal Junction and is wired to each vehicle counter sensor (TC-QT50), so that the vehicle count from sensor will be given as input to the ES. Based on the count received from vehicle sensor, the traffic signals are displayed in each Signal Junction (SJ) and the total count added for each lane will be send to the server with corresponding lane name via GSM wireless interface. Finally, the server will send the warning signal about the congested lanes and SJ to the ASJ and vehicles using GSM technology. We have used the Solar Panel at each pole to eliminate external power supply and also reduced the power consumption as well cost. This system usesZigbee Wireless Communication between all the poles to eliminate communication wiringasshownin Fig.2 and no other cables / wires are required to be laid across the junction, hence eliminates the Road Trenching.ZigBee wireless communication also maintains the Synchronized Sequences in a series of Junctions for a given speed between the junctions and helps to maintain the synchronization between the all junctions for free flow of traffic. ZigBee communication plays a vital role when there is a vehicle sensor failure occurs at particular lane which affects the traffic signal operation, then ZigBee communicate to the other junction to reroute the traffic flow to overcome traffic density at particular junction. It also helpful in case of auto shutdown of central traffic server, then Signal junction communicate to adjacent signal junction through ZigBee wireless communication and send the warning signals to vehicles to vehicles(VANET)through GSM and as shown in Fig.3 . The VANET supports vehicles approximately 100 to 300 meters of each other to connect and, in turn, create a network with a large range. As cars fall out of the signal range and drop out of the network, other cars can join and connects vehicles to one another so that a local network is created hence vehicle network can easilycontrol the traffic congestion. Each pole uses Solar Power and Wireless Communication for controlling traffic light. So, it is easy to relocate or rearrange them in case of road widening. Battery The system has sufficient Battery Backup for required number of hours, makes the system to work independent of Power Supply Failures in bad weather condition. This Traffic light controller is Eco friendly, reduced the fuel consumption 10 -15% by managing traffic efficiently, energy efficient, uses the solar power for operation and save energy, wireless ,eliminates physical cabling by using wireless connectivity

between traffic lamp and also avoid road trenching, smart, effective ,uses smart traffic controlling techniques ,so all these qualities equipped altogether with this controller and we called our proposed model **Smart Eco friendly Wireless Automatic Energy Efficient Traffic Light Controller**



Eco friendly Energy Efficient Smart Wireless Automatic Traffic Light Controller with implementation of Vehicle Sensor, ZigBee , Solar panel, VANET (Vehicle Adhoc Network)and GSM

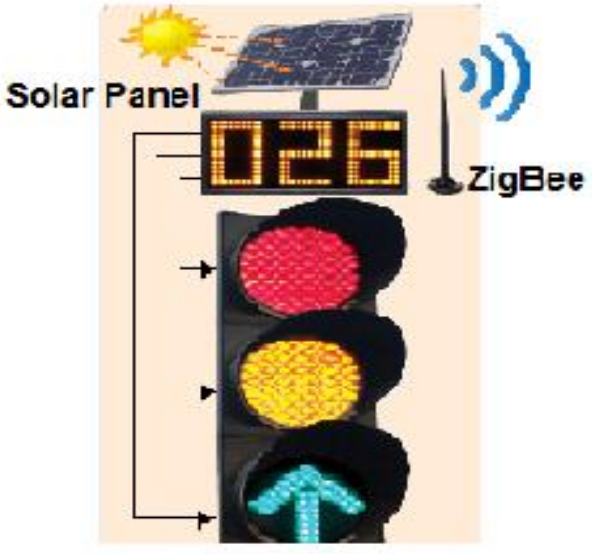


Fig.2

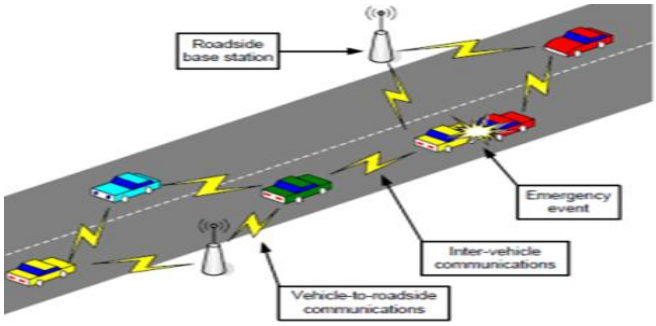


Fig.3

B. Hardware Specification

In hardware specification, the components for the proposed system have been classified based on architecture design of the **Eco friendly Wireless Automatic Energy Efficient Traffic Light Controller. The description of each component is shown below:**

1) *Global System for Mobile Communication (GSM)*

The GSM standard originally described a digital, optimized circuit switched network for full duplex voice telephony. The packet data transport is done through General Packet Radio services (GPRS) and it is increased via EDGE (Enhanced Data rates for GSM Evolution) referred as EGPRS. GSM uses a variation of time division multiple access TDMA and is the most widely used of the three digital Wireless telephony technologies (TDMA, GSM and CDMA). GSM operates at either the 900 MHz or 1800 MHz frequency band.

2) TLC

The normal function of traffic lights requires sophisticated control and coordination to ensure that traffic moves as smoothly and safely as possible and that pedestrians are protected while crossing the roads. A variety of different control systems are used to accomplish traffic congestion , ranging from simple manual mechanisms to sophisticated computerized control and coordination systems that self-adjust to minimize delay to people using the road.

1) Vehicle Sensor (TC-QT50-D)

The***Vehicle Sensor (***TC-QT50-D) is a radar-based sensor and it is used for detection of moving or stationary vehicles. Fully weatherized, this sensor can work effectively in any bad weather conditions like extreme temperatures, wind, snow and ice. The mounted TC-QT50-D works effectively up to 40 feet away from passing vehicles.

2) Embedded System

An embedded system is programmable combination of computer hardware by using software.It is specifically designed to operate a particular function. There are various fields like Industrial applications, automobiles; medicalhospital equipment, digital cameras, household electronic appliances, vending machines and toys (as well as the more obvious cellular phone and PDA) are among the myriad possible hosts of an embedded system.

3) Zig-Bee

ZigBee is an IEEE 802.15 standard specificationprotocols networks built from small, low-power digital radios for high level communication. Although it is low-powered, but ZigBee devices can transmit data over long distances by passing data through intermediate devices to reach more longer distance, creating a mesh network. The decentralized nature of such wireless ad hoc networks makes them suitable for applications where a central node can't be relied upon. ZigBeeApplications include wireless light switches, electrical meters with displays and traffic congestion management.

4) VANET

A **vehicular ad hoc network** (**VANET**) uses cars as mobile nodes to create a mobile network.by using car as a wireless router or node. The VANET supports cars approximately 100 to 300 meters of each other to connect and, in turn, create a network with a large range. As cars fall out of the signal range and drop out of the network, other cars can join and connects vehicles to one another so that a mobile Internet is created. By integrate this technology, trafficpolice and fire vehicles are able communicate with each other for safety purposes and for traffic control.

5) Solar Panel

A **solar panel** is a set of solar photovoltaic modules which are electrically connected and mounted on a supporting structure. A photovoltaic module is a packaged andconnected assembly of solar cells which can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications.

B. Signaling Management System

Traffic signal management System can be defined as using improved tools, efficient techniques, and equipment to make existing traffic signal control systems operate more efficiently. The Signaling Management system includes management of traffic light time, signal management andfinally Connection management. Time management system fix a waiting time as 2 minutes for every lane getting a green signal and pedestrian walk. The function of Signal management includes signaling based on congestion, adjacent signal junction and emergency services. Signaling based on congestion generates light signals for every lane according to order of its congestion count sensed by the sensor. The function of connection management is to provide wired and wireless connection between different devices which includes ZigBee,Vehicle Sensor, Traffic Signal and Traffic Control Centre. It is shown in Fig. 4.

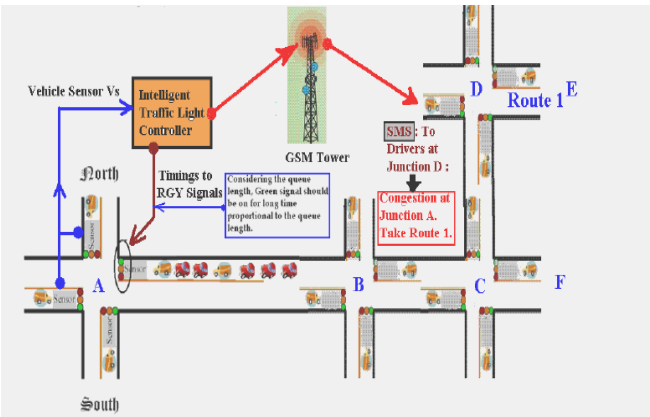


Fig.4

Signaling based on nearby adjacent side junction (ASJ) is further categorized accordingly the density of the congestion, emergency condition, failure of central control junction and failure of the any adjacent side junction. In case of high congestion of any ASJ the lane getting highest congestion traffic from the congested SJ will get cleared first according to the number of vehicle counts received from the Vehicle Sensor (VS), as shown in Fig.5 and then successively followed by Less Congested ASJ (LCASJ) which will get

cleared according to the normal traffic control algorithm for its own Vehicle traffic count received from the Vehicle count sensor as shown in Fig.6. In case of least traffic congestion at particular adjacent side junction (ASJ), the green signal will be given to two opposite facing lane for 2 minutes followed by normal traffic Vehicle count priority according to traffic control algorithm. It can be clearly illustrated in Fig.7

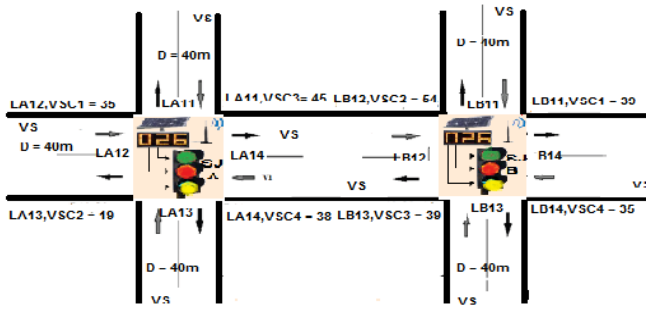


Fig.5

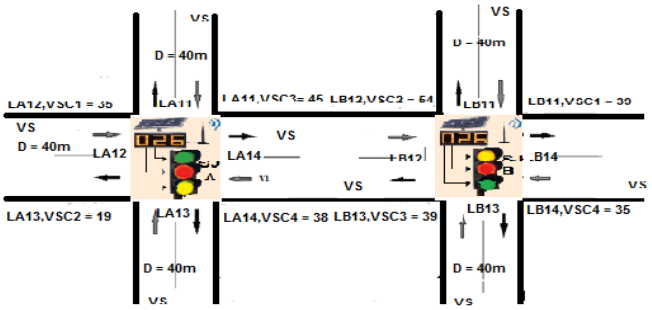


Fig.6

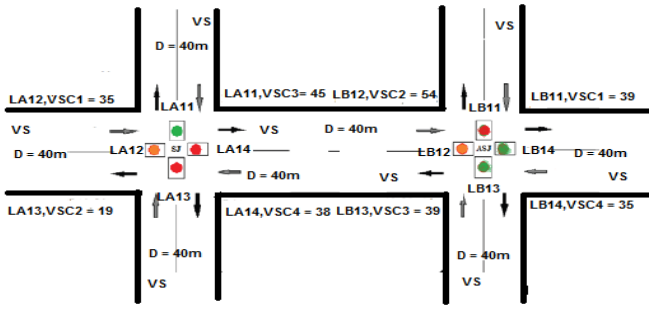


Fig.7

The traffic algorithm works totally different for emergency critical vehicle like fire brigade, ambulance or any other emergency vehicle .In this critical condition green signal will be given for the lane having emergency services and other side lanes are followed by normal Vehicle count traffic control algorithm. It can be seen inFig. 8

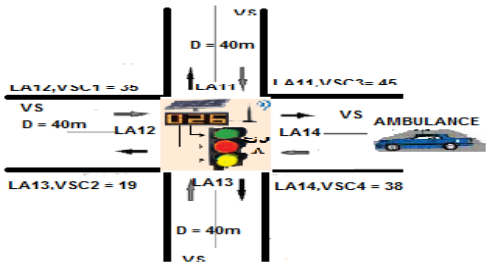


Fig.8

In case of failure of any particular side junction (ASJ), the ZigBee network will inform the status of failure ASJ to the other adjacent traffic signal along with Central Traffic Control and which are connected in form of mesh network. Other adjacent traffic signal(ASJ) will controllthe traffic flow of the failure ASJ and again the High traffic conjesation lane will be given green signal first and then followed by less conjested lane as per the traffic control algorithm.In case of Central Traffic Control centre failure, the Side junction and Adjacent Side Junction will control the traffic control with the helpof ZigBee wireless device ,VANET and GSM. Vehicles will get the traffic status of particular ASJ by using Vehicle to Vehicle VANET-Adhoc Network through GSM and Vehicles can easily reroute to a less conjested ASJ according to the traffic conjestion status.

C.Connection Management System

Connection management includes wired and wireless connection. Wired connection is made between vehicle sensor (VSC) and TLC to send the count and wireless is made through GSM between TLC to Server which in turn to vehicles and also all the traffic light controllers are connected through ZigBee wireless network, SJ's and ASJ's and emergency services to server for sending warning signals as shown in Fig. 9.

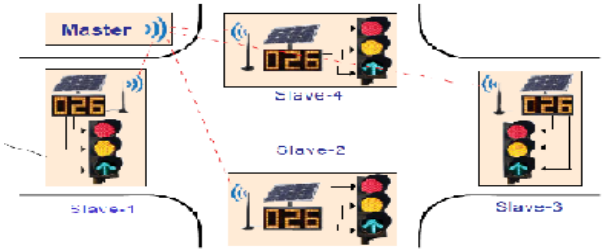


Fig.9

IV. IMPLEMENTATIONAL AND WORKING PRINCIPLE

In implementation, four vehicle counter sensors (VSC) are mounted on the every Signal Junction (SJ) and Adjacent Signal Junction (ASJ) which are pointed towards eachlane, say L1, L2, L3 and L4 respectively. The sensors are fixed at a given distance, say (D=40m) in each lane around the junction to sense vehicles from that particular view up to the given distance. Then the sensors are wired to connect to the Embedded System, which is placed on the TLC of each SJ, so that it can receive the vehicle count (VSC) information say (VSC1, VSC2, VSC3, and VSC4) for every lane for every particular junction.

Embedded System is composed of Microcontroller (89V51RD2) and interfaced through GSM network, so that Microcontroller can easily communicate VSC count information between all the traffic signal and Central Traffic Control server through GSM and ZigBee. GSM interconnects all the SJ to the server and also all the traffic signals are interconnected through ZigBee wireless network

and also connected to the Central traffic Control Server through GSM. Therefore, after collecting the vehicle count (VSC) information from the vehicle sensor, system will compare and sort the vehicle count (VSC) in descending order. Lane which is having the highest vehicle count (VSC) will get the Green signal first and the followed by lane having next highest number of vehicles , the Yellow signal, the next, successively Red signal and so on ending up with pedestrian walk. A time period say (T=2min) is maintained for each cycle from one signal to another. Finally after a complete cycle, the system will be resumed and restarted. Then the Embedded Systemadd up the vehicle counts for every SJ with its SJ name say ((VSCA=VSC1+VSC2+VSC3+VSC4) for junction A, VSCB for junction B and so on and send to the server via GSM. Server then capture and analyze the vehicle count data and if it detects that the vehicle count(VSC) is high say(VSC>= 200) for VSCA, then it will senda warning signal to junction A and its adjacent SJs and all vehicles to inform about the congested traffic condition and also inform about the rerouting towards the less congested junction.

In case, the ASJ is also highly congested, then it will clear those lanes which are getting traffic signal warning from SJ first, followed by previous traffic handling operation. In case of LCASJ, it will give the green signal to two lanes opposite to each other. In case of failure of Central Traffic Control Server or any adjacent traffic signal (ASJ) or signal junction (SJ) , VANET network with the help of ZigBee,which is connected to all the traffic signal and central control serverGSM warned to the vehicles to reroute themselves to the less congested junction. The emergency services also warns the server about the lane it gets to reach through when it is in range of 50m from the SJ, so that it will get green signal when it reaches the SJ.All the traffic lights are attached with solar panelso their reduced power has another potential benefit related to energy efficient and power saving. Short term backup battery power is used if electric power is cut to TLC because of inclement weather or some other emergency. In these cases, the signal could revert to a normal flashing mode for several hours, without effecting the normal TLC operation. This advanced traffic light controller uses modern techniques for congestion control so vehicles will save fuels and protect the environment from the harmful CO2system The System reduces the waiting time, fuel consumption, prevents tampering, prevents environment, supports Eco driving, reduced cost and also manages the traffic efficiently before the junction gets congested.

V. RESULT AND DISCUSSION

Automation and Eco friendly way of traffic control can have a significant impact on environment/energy through better vehicle control, better traffic operations, and better information systems. Advanced and Eco friendly traffic controller have significant role in mitigating traffic congestion for smother traffic flow ,Environmental friendly transportation through Eco driving and better traffic management system and also conserve the fuel and energy by using natural Solar Energy resource[12-15].Each automation strategy can potentially save 5 – 15%; all strategies can be additive for greater savings and the experimented results and related graphs are shown below in Fig.10, Fig.11 and Fig.12.

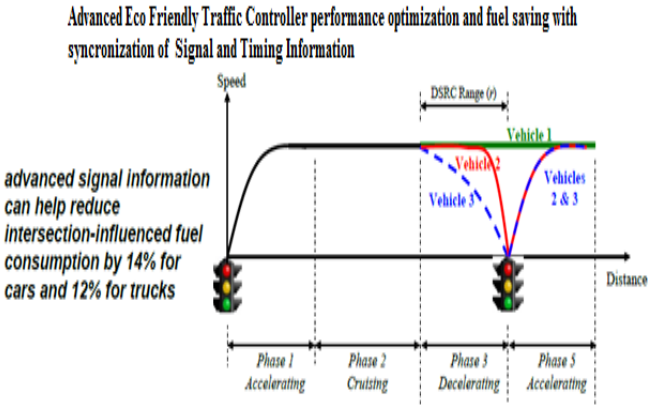


Fig.10

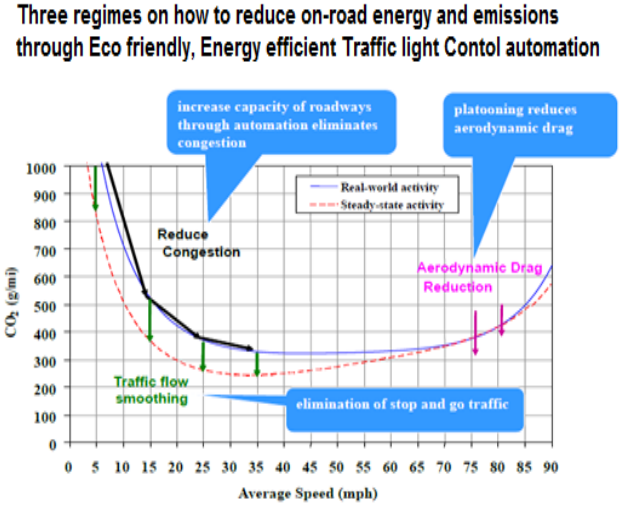
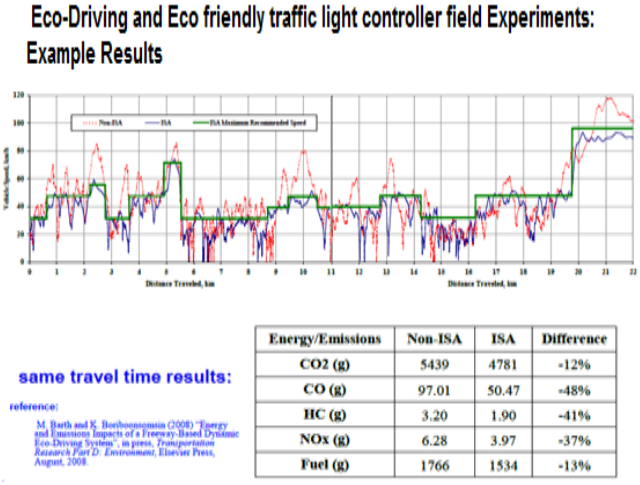


Fig.11



Energy/Emissions	Non-ISA	ISA	Difference
CO2 (g)	5439	4781	-12%
CO (g)	97.01	50.47	-48%
HC (g)	3.20	1.90	-41%
NOx (g)	6.28	3.97	-37%
Fuel (g)	1766	1534	-13%

Fig.12

VI. CONCLUSION

In this work of **Eco friendly Energy Efficient Smart Wireless Automatic Traffic Light Controller**, the trafficcount is measured by the sensor for about 40 m in each lane and accordingly the traffic is managed in the respective junction and also in the adjacent junctions as they are notified

about the congestion by the server through GSM technology and vehicle to vehicle adhoc –network (VANET). Even all the vehicles are informed about the congestion so that they can reroute towards less congested signal junction. Vehicles can easily exchange information through VANET network and GSM wireless network and easily get the latest information about the congestion through server. In case of failure of Server or any traffic signal or any junction, ZigBee,a wireless device, communicate between traffic signal and handle the traffic overflow .The various performance evaluation criteria are average waiting time, green light frequency switching at a junction, fuel consumption by vehicles, traffic control efficient emergency mode operation, less pollution emission, less power consumption and satisfactory operation of SMS using GSM Mobile. It is observed that the proposed Intelligent Traffic Light Controller is more efficient than the conventional fixed Mode or Intelligent Traffic Light Controller in respect of less waiting time at signal junction, more distance traveled by average vehicles, less CO2 and other polluted contains emission due to managed traffic handling, efficient operation during emergency mode and failure condition of traffic server or any traffic signal. Moreover, the designed system has simple architecture, fast response time, user friendliness, environmental friendliness and energy efficient and scope for further expansion.

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