International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 07 | July-2016 www.irjet.net p-ISSN: 2395-0072

An Internet of Things Based Real Time Traffic Light Control to Reduce Vehicles CO_2 Emissions

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Abstract - *Noway day's traffic flow control became a major problem in transportation and city traffic management system. The pollution level is increase due to uneven traffic management and from also number of vehicles waiting at the junction than the driving vehicles. The main purpose of this work is to reduce the carbon dioxide level which is emitted by vehicles at the junction. In order to reduce the city traffic light management and at the same time is to control traffic flow. We proposed traffic light management based on pollution sensing by the MQ7 sensor which implemented over IoT architecture. The proposed system states that the traffic light timing is adjusted based on observed pollution value using MQ7 sensor. This work integrates that traffic simulation framework is provide based on real time pollution sensing mechanism. The result shows that reduce the pollution level with the traffic light control and also reduce the overall traffic congestion in city.*

Key Words: **Internet of Things, Mq7 sensor, Vanet, Intel Edison kit**

1. INTRODUCTION

Internet of Things (IoT) refers to an interconnected device when these devices are connected to internet in such a way that each device communicates with every other device one which is connected to internet. Such infrastructure is called Internet of Things. The Internet of Things is not only interconnection of devices with physical world which can intercommunicate with each other. The physical world is nothing but things refer to as physical entity. The physical entity could be a microcontroller, microprocessor, sensor, actuators etc. IoT includes, for example home lighting system where controlling of entire lighting system of building through internet because all devices connected with the internet.

Global warming becomes one of the serious problems in all over the world. The global warming caused due to modernization of cities and increase in number of vehicles. The traffic is one of the major reason for global which cause due to improper traffic management system. In the junction area, where vehicles are switched on and waiting for longer period of time at the junction. So it will emit more carbon dioxide gas which affects the ozone layer and human beings and so on.

The author's [1], they focused on main in changing the green light timing rather than reducing emission levels. The green light timing is increased where more numbers of vehicles are waiting at the junction. In this, green light timing is increased based on queue length which is means number of vehicles are measured using ETC technology. The queue length is more than green light timing is more.

In this work, our aim is to reduce the CO_2 emissions level from the vehicles at various junctions. Hence we proposed that the traffic light timing is changed based on emissions of CO_2 gas from the vehicles. In our work, we proposed that traffic control is done for whole city to reduce the CO_2 level but in the experiment, we considered for only one junction for traffic control. In this, the mq7 sensor is a gas sensor which observed the gas and displays the values in ppm and sensor is connected to IoT device. The IoT device connected both power supply and system. The mq7 sensor is used to measure the CO_2 gas and CO_2 gas level values are push to vanet simulator where simulation is running on the system. This will reduce the traffic congestion as well as CO_2 emission level.

The main objective of this work is to reduce the pollution level by controlling the traffic which managed based on carbon dioxide level.

The rest of the paper is accomplished as follows. Section 2 represents the literature related work. Section 3 states the problem statement. Section 4 provides the details of the proposed method. The

system analysis results performed in section 5 then we conclude the paper and scope of future works in section 6.

2. RELATED WORK

Now days the global warming is become major problem due to increasing in urbanization, transportation. It affecting the human beings, ozone layer and surrounding environment.

The author's [2][3], proposed that the a real time traffic is control by increasing the green light timing at the intersection point. The traffic is control using ETC technology where ETC card inserted into vehicles using OBU and RSU used at the tollgates. Here making the communication between vehicles and traffic to obtain the real time traffic flow situation at the intersection and it can be done by dedicative short range communication (DSRC) technology. The average waiting time of vehicles estimated using decision tree algorithm and compute the amount of CO_2 reduction from vehicles.

Intelligent Traffic Monitoring System can be implemented using Internet of Things [4], the author focused on identifying the vehicles which emits more CO_2 gas. It can be carried out by three steps as follows: In first step, insert the global unique EPC code to vehicles through which we can identify the vehicle and RFID is used to read EPC code of vehicle by electromagnetic waves which is worked on all weather conditions. In second step, the vehicles location is find out using GPS technology. In third step, GPRS is provides high speed wireless communication to mobile user and transmit data to mobile. This can be automatically detect and transmit the data provides a concept for building an intelligent traffic monitoring system.

The author's states in [5], that first step is to detecting the traffic congestion and abnormal condition by considering two main roads and 4 intersections of each road. The system is collecting information by video image processing system and it capture the traffic image, and then computes the number of vehicles. The collected information transmits to another system using genetic algorithm. Based on this information green light timing is computed. It manages the traffic flow.

The author proposed in [6], is by building of intelligent transportation system using Internet of Things. In this work, the system consists of three parts such as sensor system, monitoring system and display system. In sensor system consists of GPS, near field system, temperature and humidity sensor, these are connected to internet via GSM to find the location, commuter and ambience inside the bus. The monitoring system is used to extract the overview information from sensor database, convert it into events and provide this activity to bus driver. The display system is used to display the information about travelling route and bus.

The author says in [7], ITS technology used to monitor the traffic flow condition. This technology is capable of guiding the driver decision and direction with the goal of reducing vehicles CO_2 emission. The proposed system uses the intelligent traffic lights, mobile device and wireless communications. The solution is to minimize the number of stop-starts due to red light signal at intersection and keeping acceleration of to hit the green light. It can be achieved by continuously broadcasting traffic light information status of current light color. This is done by decision tree algorithm. The role of the algorithm is to inform the driver well in advance to make the decision as to avoid red light and hit the green light. This achieves the less fuel consumption and reduction of CO_2 gas emission.

The proposed scheme has main focus on achieving traffic flow monitoring and controlling using urban IoT platform [8], the IoT devices are connected to internet and these devices are interconnected with each other and also interact with every other device to provide real world information. The proposed system is implemented to solve the traffic monitoring and controlling by computing real time traffic monitoring system. This can be achieving by traffic management department which uses real time traffic information to detect dangerous situation on the road and it will take immediate action. In whole scenario, the IoT is plays main role in traffic controlling and managing. It will improve the efficiency.

The author states in [9], the proposed scheme worked based on vehicular based mobile system technique. This technique used to measure the pollution emitted by each vehicle and pollution controlled by traffic management system. The pollution is measured using mq7, mq4 and so on sensors. The observed information send to road side unit, which then transmit to server. The server will manage the traffic flow.

3. PROBLEM STATEMENT

Traffic flow is based on junction traffic light control under the research of long period of signal timing however this system fails to reduce gas emission from the vehicles. The main focus is given on adjusting traffic light timing at the junction area. The pollution is attributed by, type of engine in vehicles; the fuel consumed by vehicles, the age and speed of the vehicle.

Therefore present system fails to implementation in reduction of CO2 gas from the vehicles for traffic management.

We intent to solve this problem of pollution reduction which persists even after adaptation of machine learning base traffic flow control and traffic light management system.

4. PROPOSED METHOD

The proposed scheme is based on IoT platform to reduce the pollution in the environment. It can be implemented by measuring the pollution level at the junction and the pollution is observed by sensor and observed value send to the vanet simulator where simulation running on the system. Based on pollution value traffic light timing is

changed. We ensure that city traffic is control smoothly and reduction of CO_2 emission level from the vehicles.

The some modules are used as follows:

1) SENSING MODULE:

Sensor is basically a device that converts any physical parameter into electrical signal. The physical parameters such as temperature, humidity, windspeed, light intensity so on. The Mq7 sensor is used in this work. The Mq7 sensor is a gas sensor which observes the CO_2, CO, methane and other gases from environment as well as emitted by the vehicles. The sensor reads only analog values. So it cannot read by digital device. We require A/D convertor. The Intel Edison board has six readymade A/D convertors, whenever we connect the sensors to analog pin; it directly converts the analog value into digital value using A/D convertor.

The formulae is given to calculate the CO2 value,

PPM=a*(Rs/R0)^b (1)

Where, a and b are constant factors (a=116.602 and b=-5.96)

Rs is resistance factor depend on output voltage

R0=41000

The resistance factor (Rs) is calculated as follows:

Using basic formulae,

Voutput=Vinput-Vdrop

Voutput=Vinput-(I.Rs) Where, using ohm's law V=IR

Rs= (Vinput-Voutput)/Inormal (2)

Rs= (5-Voutput)/Inormal Where, Vinput=5v is a normal Voltage

The Voutput is calculated as follows:

Voutput= (5*x)/1000 (3)

Where x is a analog real computing value sensed by the sensor and assuming that 1000-bits is output digital value from the ADC for normal voltage of 5v.

Substituting equ (3) in equ (2),

Rs= (5-((5*x)/1000))/Inormal (4)

2) *COMMUNICATION MODULE:*

The MQTT Protocol basically is a light weight machine to machine communication protocol. When we say about machine those are IoT devices, mobile so on. MQTT is basically a cross platform protocol that enables devices to communicate with each other, that enables the client machines to communicate with each other, that enables mobiles to communicate with each other, mobiles communicate with IoT devices, vice-versa, IoT devices to communicate with servers and so on. This whole concept is also known as pub –sub protocol (publisher and subscriber protocol).So this protocol works as few number of devices can subscribe to an event in the MQTT server so there will be a server in the internet, now different devices may want to exchange different kind of data of the server. RHCN (Road Hazards Control Notification) module used to avoid the damage roads by intercommunication between vehicles.

3) INTEGRATION WITH SIMULATION MODULE:

The IoT device is integrated with Vanet simulation module. The simulation can start using package called IotSimulatorInterface.java. We connect the Mqtt server which is machine to machine communication protocol, also known as pub-sub based service. The channel create over here is to publish and subscribe the message from user is roam/simulator. First connect to the Mqtt broker, if broker is connected. The message showed that broker is connected. Then we show a local plot of the CO2 variations in simulation manner.

4) TRAFFIC LIGHT CONTROL MODULE:

The traffic lights will be placed at a specific junction. Every junction had a junction name. At specific junction putting the traffic lights, they are green, yellow and red. There are three variables used which are redphaselength where red light time period will be active, greenphaselength where green light will be active and same for yellowphaselength.The specific traffic light will be given by junction and the time period of red, yellow, green phase which is consistence throughout the simulation. We want to alter the greenphaselength as keeps on varying in CO_2 emissions. The change phase is one where traffic light shifts from red to green, green to yellow and yellow to red. The green light timing is given by:

GreenLightPeriod=GreenPhaseLength+1000*(VanetSim.iot SimulatorInterface. ParameterValue-400)/10

This is the formulae for calculating green light period during traffic flow.

5) MAP HELPER MODULE:

Map Helper is open street map which enclosed the components are nodes, waypoints and junction. The MapHelper.java used for loading open street map. The function used is calculate distance point to street which distance function, that gives distance between any two points in the map. Find nearest point on the street is used for finding the next point where that vehicle goes. The every street have several points in Open Street map is basically known as waypoints connecting the dots present in the street. The waypoints are nodes and junction.

6) VEHICLE MODULE:

In open street map the vehicles are known as nodes. The vehicles are avoid the damage roads to reduce the fuel consumption, set up the speed of the vehicles, selecting the number of vehicles, one vehicle informed about relocation to another vehicle.

The block diagram shown in "Fig-1,".The block diagram includes hardware devices such as Intel Edison board and software used netbeans to run the simulation. In hardware part, sensor observed the gas and sensed gas value is in ppm and it will convert to digital value by the ADC convertor. The gas values transmit to client system using mqtt protocol.

The simulation is running in the client system using netbeans software. The traffic light timing is changed based on co_2 gas value.

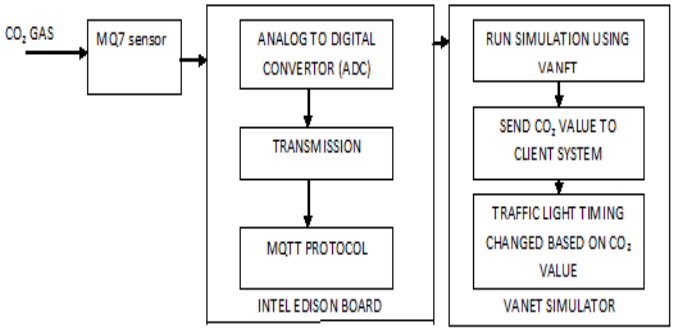

Fig-1: Block Diagram

The "Fig-2", in the experimental sensor observes the gas and display value in PPM. The Intel Edison board is required a power supply hence battery is connected to board. The Mq7 sensor connected to IoT device which connected to the system to complete the whole scenario of simulation result. The simulation results are display on the system.

The experimental setup is shown below "fig.2".

Fig-2: Intel Edison Board connected with Mq7 gas sensor

5. RESULT ANALYSIS

The result analysis computes the green light timing based on CO_2 gas observed by sensor which emitted from number of vehicles' at the various junctions. The simulation result shown on the system console. Here computing the green light timing by real time using IoT device. The observed value transmit to the system when it is connected to internet using mqtt protocol as shown in "fig.3".

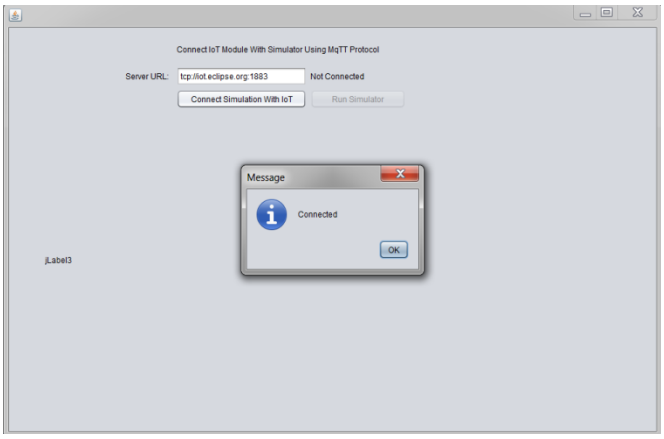

Fig-3: connecting IoT device with simulation

The "fig.4" indicates open street map which taking for experimental setup.

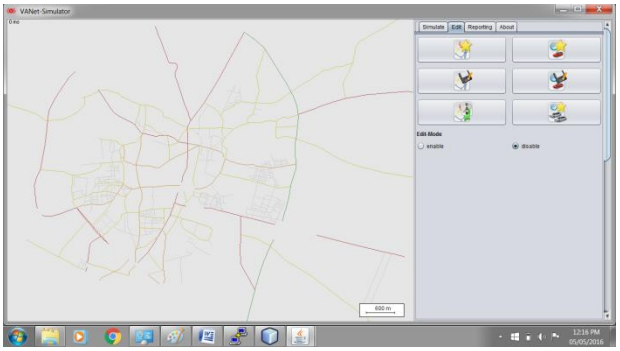

Fig-4: open street map

The "fig.5" indicates simulation running in the system. The street light and vehicles are put on the road when simulation runs, the vehicles are moving through the traffic light which placed at the junction.

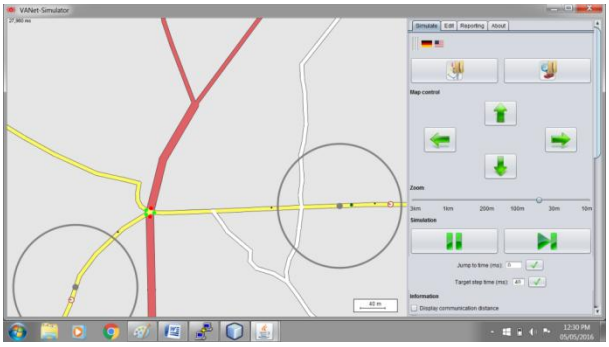

Fig-5: simulation result

The "Fig.6" shows simulation result which display on the console. In this the changed green light timing value is display based on CO_2 gas observed from the vehicles'. The green light timing increased when gas level increased. Hence traffic is flow smoothly.

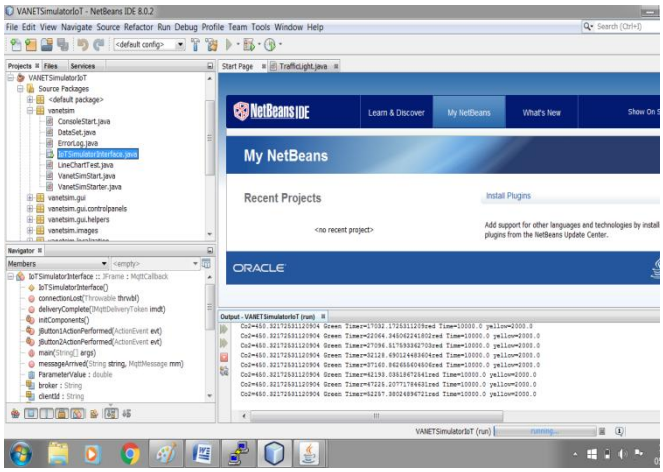

Fig-6: displaying the green light timing

The chart-1 shows simulation result of green light timing versus CO_2 gas level value.

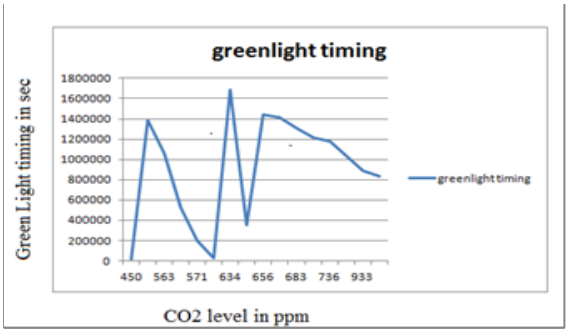

Chart -1: simulation result of green light timing versus CO_2 level

The green light timing is depending on both pollution and vehicles density.

6. CONCLUSIONS

Day today life pollution level is increasing which causing due increase in the number of vehicles'. This is affecting the human beings and ozone layer etc. Managing the city traffic is to reduce the traffic congestion and pollution has been one of the major challenges of 21st century across the globe.

In this work, we have proposed a not only reducing the pollution level of city traffic as well as reducing traffic congestion and make the traffic flow smoothly. This is achieved by using a novel IoT technology which helps in managing real time traffic flow control and same time reducing pollution level.

The result indicate that the proposed scheme is successfully able to reduce the pollution level which emitted by vehicles. It also helps in reducing waiting time and traffic congestion.

ACKNOWLEDGEMENT

I express my deep gratitude to my guide Dr. Sujatha Terdal, for providing continuous suggestions extended to me with immense care and zeal throughout my project.

This work is partially supported by Intel Software Innovator Program. The program has provided us with Intel Edison Kit and other necessary hardware for completion for the work.

I would like to thank Mr. Sourav Lahoti, Community Manager, Ms Wendy Bosswell, Program manager, Intel Software Innovator Program and the Intel Software Innovator Program itself for their generous support with resource grant and assistance with technology support. I would also like to thank Mr. Rupam Das, Intel Software Innovator for his assistance and support for completion of the work.

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