A Novel Approach Towards Traffic Monitoring System Using Adhoc Networking

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Abstract: In a network there are two or more than two devices, each device can communicate with each other depending upon the topology used. For instance, in a simple point to point topology only two devices can communicate with each other and in mesh topology each device can communicate with each other device. If a new device joins the network, it notifies the coordinator using hand shake mechanism. The same technique is applied in a way that whenever a vehicle (represented by a node) enters in a network, it becomes a part of it. Just like cars have different registration numbers, each node in a network have a unique MAC address. Whenever there is a new device join the network or in our case vehicle comes in to the range of other vehicles then a notification is created to inform all other members of the network. Traffic jam is caused due to heavy number of vehicles on road and the number of vehicles on road is increasing day by day. It becomes very important to organize the traffic flow on a road with extremely intelligent manner. The nodes in the network take intelligent decisions to avoid the route having traffic jam. This paper is about traffic monitoring system using ad-hoc networking to efficiently control the traffic on roads and avoid any type of accident or other mishaps.

Keywords: *Adhoc Networking, Traffic Monitoring System, ITCS, ITS, DSRC.*

1. Introduction

Automobile industry has exponential growth and since its birth it has achieved many advancement thanks to mechanical and electrical engineering. Nowadays engineers are working on intelligent cars e.g. Google has manufactured an intelligent car [1]. So, a need of the day to have an intelligent monitoring system for identifying the traffic density and to automatic route selection.

Different possible ways of doing this, for example the new technology called VANET vehicular adhoc network is one of its example and it works on ITS intelligent transport system [2]. Another way is to plot a surveillance camera and monitor each vehicle in real time, but its drawback is that we cannot get the clear view of car when there is big number of cars. To solve this issue engineers made a solution to take picture of each vehicle and implement camera on all four sides of a chock. However, for monitoring of automatic vehicle this technique is not suitable because there is a difference when operating manually and automatic, so we need an automatic system for automatic cars in which each vehicle can communicate with other and can exchange information and update its memory.

This can be done by creating adhoc network so that each node can communicate with every other present node and interchange information like density of vehicles and temperature of engine and speed etc. the range is an important factor as we must manage the density of nodes within its range.

One of the possible approaches to monitor the traffic system is to create an adhoc network of all the entities.

In this project XBee module is used as its range is significantly better than RF modules and Bluetooth or Wi-Fi etc. another important advantage is that XBee guarantee 100% data transfer within its range [3]. XBee can be configured by using XCTU software which provide simple and easy interface, we have two choices either to configure XBee by AT commands or simply select desired command in GUI.

Now that we created a network of vehicles we need a microcontroller for processing the data and display the results such as device number and any required information. To create notification of new device we used most common microcontroller Arduino. Arduino has very simple way of getting serial data and display it on LCD. It also provides direct interface with XBee by using XBee Arduino Shield. We can bypass the shield by simply connecting the receiver and transmitter of microcontroller to transmitter and receiver of XBEE

In this era of emerging technology there is advancement in every phase of life including automobile, according to BI intelligence there will be TEN million self-driving cars on road for public use by the year 2020 [4]. Now for this type of technology we need advanced monitoring system as well, the system of red yellow green light and counter will be not suitable for self-driving cars. So, there must be something which suits the technology, something which is as fast and robust. There are many systems working for

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manual cars which are suitable yet can be improved, systems like ITS intelligent transport system. These types of systems are not very robust and cannot do multitasking and cannot handle big number of vehicles. Now at a same time when traffic is monitored something is required to tell the incoming vehicles about the condition of route vehicle is going to follow.

Beacon is a frame which contains all the data about network. Switch transmits beacons with interim of 15 to 251ms to affirm their nearness to different hubs [5]. Hub just should be dynamic when beacon is transmitted. Hubs may rest when beacon is not transmitted to lower obligation cycle and broaden battery life.

Non-beacon enabled network is very surprising from beacon networks, at whatever point there is an occasion happen in network the sensor wakeup and transmit the outcome. The procedure utilized is CSMA/CA (carrier sense multiple access collision avoidance) in which hubs endeavor to send information at whatever point the network is sensing to be 'sit'. This sort of networking is utilized where customer rests often e.g. security framework [6]. A few gadgets are dynamic dependably while a few rests often.

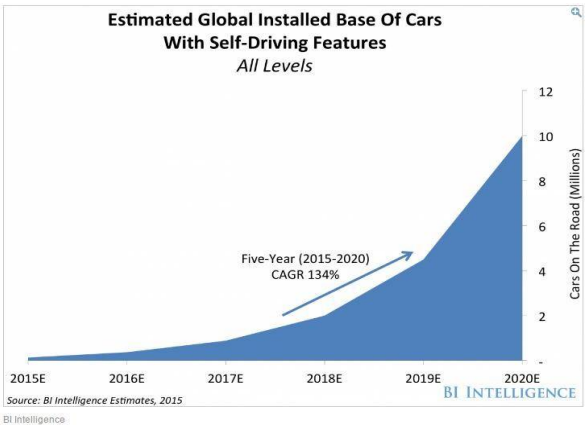

Figure 1. BI intelligence prediction graph

In an adhoc network one device can communicate with other easily. They use a share communication channel and communicate wirelessly. these networks are type of MHWNs multi-hop wireless network [7]. Adhoc network have several advantages over others such as they are more flexible and better at mobility, they can turn up and turn down in a short time, it can be economical, and it is considered a robust network because of its non-hierarchical distribution of control and mechanism. A group of people can exchange their data without having a centralized point. It is very much suitable where there is no network infrastructure. Its issue is that it has limited range for wireless communication and packet loss is also an issue. Battery constraints are issue and route for each packet changes. Nodes in network are equipped with limited batteries so it is an issue and because of mobility of nodes we have time varying network topology and scalability is also an issue because we sometime have huge number of node and on same channel it become difficult to manage. Wireless networks are less reliable and can be affected by environment factors. Resources like bandwidth are also limited. Sometime there is hidden node problem that both senders try to send data to same receiver and both fails.

2. Methodology

The proposed methodology includes number of steps, which are discussed below in detail..

2.1 Modulation Technique Proposed

ZigBee utilizes OQPSK (offset quadrature phase shift keying) and DSSS (direct sequence spread spectrum) for modulation in physical layer [8]. OQPSK has 180-degree phase shift in flag however without modulation of sufficiency. the approaching sign is partitioned into two bits I and Q which are then transmitted considerably image term.

DSSS is a spread spectrum system in which the first flag is increased with a counterfeit made clamor. It gives security against sticking signs and makes flag less recognizable. It likewise gives security which is the reason it was additionally utilized for military purposes in 1940.

2.2 ITCS (Intelligent Traffic Control System)

A red-light traffic signal is not any more productive for now's vehicle and transport framework; this is a period for innovation and shrewd autos and buyers require something effective, practical and vigorous, for example, "smart movement control framework".

ITCS is no more an extravagance with expanding vehicles on street and insightful autos accessibility. Its points of interest are that it oversees standard movement to easily as well as caution vehicle to dodge rush course through vehicle to vehicle communication.

Pakistan is sixth biggest populated nation with assessed populace of 195,620,451 as indicated by world live populace meter. With this populace Pakistan has 18 vehicles for every capita equivalent to India by the year 2014 and 158th position around the world. It is seen repulsive street blockage issues in its urban areas. Framework development is ease back when compared to the development in number of vehicles. Additionally, Pakistani activity is non-path based and disorderly in nature. It needs a movement control arrangement which is unique in relation to created nations. Remote networks are generally utilized as a part of the street transport as they give administration of movement streams in more practical way. Innovations, for example, ZigBee, GSM and RFID can be utilized as a part of movement control to give better arrangement.

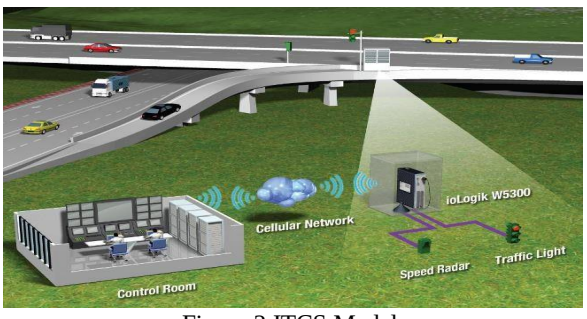

Figure 2 ITCS Model

This innovation manages multi vehicle, multi path and multi street intersection zones. It gives productive time administration in which a dynamic time calendar is worked out progressively for entry of every vehicle segment. The quantity of autos in every segment and steering calculation are properties whereupon computation for real activity is finished.

The burden of this system is that it doesn't examine strategy for communication between activity flag and crisis vehicle.

2.3 ITS (Intelligent Transportation System)

Term vanet is referred to vehicles that change into PC on the wheels or network on the wheels. In vanet there are two fundamental sorts of communication frameworks V.2.V which is vehicle to vehicle and second is V.2.I which is vehicle to foundation communication. The benefit of utilizing vehicle communication framework is that we can share data and driving in agreeable way. We can likewise include administrations like route, web access and so on the communication amongst V.2.V and V.2.I are adhoc in nature since network they shape require in no way like switch and hubs are included consequently. This uncommon sort of communication is referred as V.A.N.E.T. It will soon turn into world's biggest adhoc network.

Every vehicle is a hub with one of a kind I.D, for steering we have three choices, one is proactive directing in which gadget tries to keep up courses to all goals. In receptive directing gadget starts course revelation in demand of information movement. Position construct steering utilizes directing situated considering goal's position.

Utilizations of vanet are for the most part incorporate security, comfort and commercialization.

For communication there is W.A.V.E remote access in vehicular condition and I.E.E.E 1609.2 standard otherwise called D.S.R.C 802.11p. it bolster multi bounce communication for vehicles out of range where as D.S.R.C range in 1000m. O.B.U locally available unit which is a gadget situated within a vehicle to handle the information gathered from different sensors fitted inside the vehicle and ready states of the vehicle and likewise it oversees communication with outside network for instance different vehicles and framework. R.S.U street side unit is framework for communication between the autos for sharing data between vehicles. I.T.S permits safe and uncongested activity flow.it likewise utilizes gps prepared gadgets. It likewise utilizes different innovations like remote communication, computational advances, detecting innovation, inductive circle identification and Bluetooth discovery. V.2.V communication utilizes multi bounce method and utilizations two sorts of broadcasting, credulous and canny telecom.

V.2.I communication requires high bandwidth to keep up connection amongst vehicle and roadside gear. High bandwidth is to suit all vehicles and to give productive transmission and gathering of information. Roadside units communicate messages since it is for all vehicles for instance communicate congested driving conditions or course is shut and so on.

2.4 DSRC (Dedicated short range communication)

In VANET there is routing based communication and it uses multi hop unicast. Example is illustrated below,

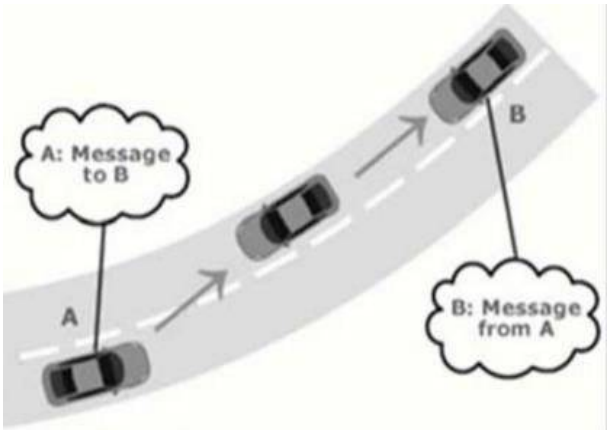

Figure 3 DSRC Scenario

There are two main components in DSRC one is antenna and other is street device. Antennae are installed on roadside pole and transmit data wireless wave to the ETC onboard unit. When the vehicle comes under the sensor i.e loop coil the DSRC wave is sent from antenna and it is when matches with onboard ETC then we can perform any action against it for example open a gate or signal.

The street device used obtain ID number for the ETC onboard and when it matches with its data base the device generate signal to perform required action.

3 . Results

A system can be judged by multiple parameters, those parameters are discussed below along with there results achieved against those parameters.

3.1 XBee Range Test

Figure4 shows the practical range of XBee module, for range test we must select local and remote device. We witnessed that the RSSI ranges from -30 dBm to -70 dBm. And minimum success rate is 26 %. Graph shows that when we start moving the remote module from Local module the RSSI value begin to decrease until there becomes a point when TX error occurs, and we lost packet this was the point 33 meter away from local module. This indicates that the practical range of XBee module is 33 meters.

3.2 Spectrum Analyzer

Spectrum analyzer helps us to find the data transmission report of all fifteen channels, it indicates current, minimum, average and maximum value of data transmitted through each channel. We can also estimate the noise level of each channel.

In above figure we can see that maximum transmission occurs through channel 10 with strength of -65 dBm.

Figure 4. XBee Range Test

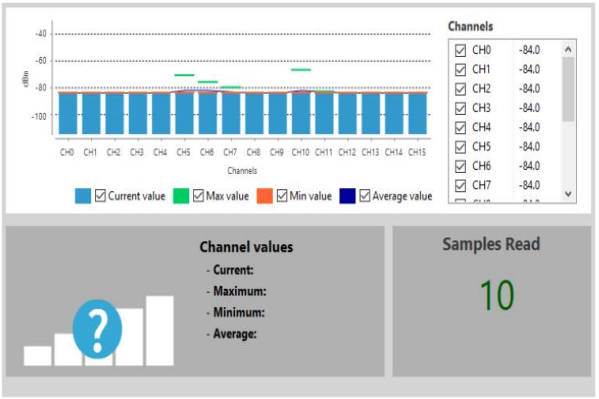

Figure 5. Spectrum Analyzer

3.3 Throughput

Throughput is the ratio of data transfer between two XBee. Its unit is Kbps. Below example is unidirectional data transfer for 10 seconds. Total 54 packets were transferred in 10 seconds with payload of 100 bytes. If we increase payload from 100 bytes, then total packets transferred will be reduced. It is same as more the weight less speed.

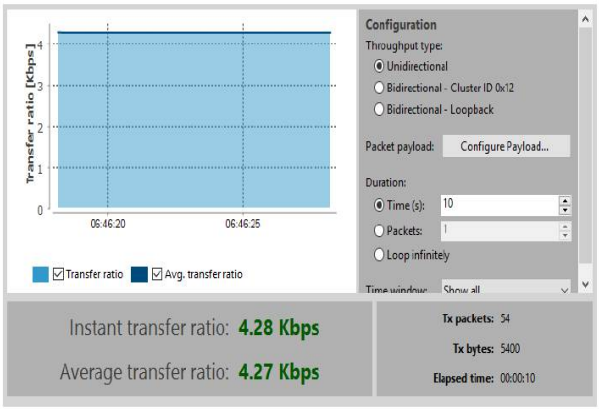

Figure 6. Throughput

4. Conclusion

Traffic monitoring system using adhoc network is an idea for emerging technology automatic cars. This monitoring system is an intelligent system based on automatic detection of vehicles and generating notification depending upon vehicle density. The devices used in adhoc network are xbee which are very efficient as we witnessed there 100% data delivery within 33meter range. Throughput shows us the 4.28 Kbps average data rate. Xbee provides 16 channels to send data and provides effective communication.

For future purposes this project can be further enhanced to get the more precise information about traffic density, for example we can use sensors to indicate the vehicle density in either side of rode.

There is also other way of doing it is to operate xbee on different channels for one side of road, but it can cause problem of automatic channel switching, here we required manual channel selection whenever vehicle enter into other side of road.

According to report of BI intelligence by the year 2020 there will be 10 million driverless cars on road for public use so this small and effective system can fulfill the need of time by implementing it for the intelligent cars for monitoring purposes.

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