Utilization of WSN Modules Using Rssi Localization For Smart Tollgate Automation

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Abstract- *In this project, we proposed an improved form of tollgate billing system. An efficient utilization of communication link using wireless sensor network (WSN) module to facilitate vehicle monitoring, In our project, once the end user (motorist) comes to chargeable zone; the ZigBee transceiver receives the signal that the vehicle has entered the chargeable zone particular LANE, then automatically the unique id of the motorist (Vehicle ID) has been read via on-board unit, which has been attached to every vehicle and collects the daily road pricing charge. Vehicle authentication and automated toll collection on the highways is proposed. The system is implemented to automatically register vehicles getting on or off a motor way or highway, cutting the amount of time for paying toll in large queues. Initially the motorist enters to toll booth with the wireless transceivers attached with vehicle. The wireless transceivers read the signal from the on-board wireless device using RSSI localization and check the database for the motorist record exists if yes it will display the motorist and vehicle information to the screen.*

Keywords- Received Signal Strength Indicator (RSSI), Localization, Wireless Sensor Network(WSN)

I. INTRODUCTION

In our project we have anticipated an enhanced version of tollgate billing system. a proficient way of communication link between wireless channels to simplify vehicle monitoring. In our project, once the motorist comes into the chargeable zone, the ZigBee transceiver receives the acknowledgement that the vehicle has arrived the chargeable region specific lane then eventually the unique Id of the motorist has been recited via on board unit.

Researchers have implemented a variety of techniques to accomplish this, such as the inclusion of ultrasonic sensors for measure the time of flight between transmitting and receiving sound, directional antennas for broadcasting exclusively in a certain direction and laser scanners which project a beam of light across a distributed network with light sensors equipped to each node, it is more efficient if the nodes can determine their own locations since networks tend to consist of hundreds of devices, and it would be incredibly tedious to prepare each one with an individual location.

Location estimation is a common application of wireless sensor networks (WSN). In WSNs, it is desirable to keep each node as inexpensive and small as possible and increase battery life as long as possible. The inclusion of additional hardware for localization purposes makes these constraints more difficult to comply. It would be preferable to use radio propagation to estimate distance as the network is already using wireless transmissions to communicate. There are two methodologies primarily used to interpret distance from wireless transmissions: time delay on arrival and signal strength attenuation. There is one major factor that complicates distance estimation from wireless transmissions - the multipath effect. The multipath effect occurs when a wireless signal finds multiple paths from the transmitter to the receiver by reflecting off of other objects within the environment, such as walls and floors. This causes the signal to attenuate or amplify depending on the phase of the reflected signals and the line-of-sight signal when combined at the receiver. The multipath effect is more prominent in indoor environments, however, it still exists in outdoor environments as well, but usually the signal scattering is more predictable. Time delay on arrival techniques are less sensitive to this effect as they do not interpret distance from attenuation as signal strength-based techniques do. Time delay techniques also require precise oscillators, as well as clock synchronization across the network, which demands higher quality and more expensive hardware.

Signal strength attenuation is represented by received signal strength indicator (RSSI) in negative decibel mill watts (-dBm). In free space, signal strength attenuates logarithmically with respect to the distance between transceivers. There are a few models that are used to estimate distance based on the attenuation. The most common models are the free space propagation model and the log-distance path loss model.The log-distance path loss model is a general propagation model. It can be used in both indoor and outdoor environments. The log-distance path loss model provides a logarithmic attenuation model which has several parameters which can be tuned to make it fit nearly any environment. The RSSI (in dBm) for this model is expressed as:

$$RSSI = 10n\log10\ (d) + A$$

Where n is the path-loss exponent, d is the transmission distance in meters, and A is the reference value, which is the RSSI at 1 meter away from the transmitter.

II. LITERATURE REVIEW

In [1] “Reducing the effect of signal multipath fading in RSSI-distance estimation using Kalman filters,” by S.Shue and J.Conrad, in 2016.

In [2] “Angle-of-arrival localization based on antenna arrays for wireless sensor networks,” P.Kułakowski, J.Vales-Alonso, E. Egea-Lopez, W. Ludwin, and´ J. Garc´ıa-Haro in 2010.

In [3] “RF Time of Flight Ranging for Wireless Sensor Network Localization,” S.Lanzisera, D.T.Lin, and K.S.J.Pister in 2006

In [4] “Development of a portable XBee C library and RSSI triangulation localization framework,”S.Shue and J.Conrad in 2014.

III. EXISTING SYSTEM

Every time the person passes a tollgate he/she has to wait in the queue and should swipe his smart card for making payment. This is time consuming and tollgates must have staffs to assist in this process (man power). The Gate which is available in the toll gate takes a minimum amount of time to open/close by the motor action every time though the motorist made the payment in time. The existing system provides the customer with a smart card which contains the details about him. Few of 8 existing projects based on RFID tag, which consume more power because reader and tags required power. Active tags are expensive because of their complexity. Active tags comprise an antenna, microchip, and radio transceiver, increasing the cost of the system. The other disadvantage is collision.

IV. PROPOSED SYSTEM

The system we propose doesn't need smart card. The vehicle is enabled with a on-board unit that contains the vehicle id and information. Since WSN can addressing 16-bit addressing, more number of vehicles can pass freely. Uses bloom filter for network traffic problem. In our project, once the end user (motorist) comes to chargeable zone the ZigBee transceiver receives the signal that the vehicle has entered the chargeable zone particular LANE, then automatically the unique id of the motorist (Vehicle ID) has been read via on-board unit, which has been attached to every vehicle and collects the daily road pricing charge. Here, we going to use two nodes. Each Node contains two individual tags to identify the authentic person. Tags are based on passive RFID (Radio-frequency identification), so that one tag of one node cannot be used in another node. Each Tag has unique code number for authentication. If we use another tag instead of specified tag, then buzzer will produce a sound. And usage of tags can be monitored in host.

V. DESCRIPTION

HARDWARE REQUIREMENTS:

- MICROCONTROLLER
- LCD DISPLAY
- BUZZER
- ADC
- UART
- RELAY
- SMAC

SOFTWARE REQUIREMENTS:

- KEIL IDE
- EMBEDDED C

VI. METHODOLOGY

To confirm a validity of the proposed topology, an experimental setup is constructed with PIC16F877A microcontroller, Watchdog timer, Analog to Digital converter. A power supply section consist of a transformer, a bridge circuit, a filter and regulator. To remove the ripples from the output of the rectifier, the Capacitive filter is used which also smoothens the Dc. A power supply of 5V and 12V are obtained by using 7805 and 7812 voltage regulator. A power supply provides the constant output regardless of the voltage variations. The ZigBee transceiver receives the signal that the vehicle has entered the chargeable zone of the particular LANE when the end user comes in contact with the chargeable zone. Onboard unit reads vehicle id and information. The unique id (Vehicle ID) given to each vehicle has been read via on-board unit which collects the daily road pricing charge. Tags are based on passive Radio frequency identification, so that tag of one node cannot be used in another node. Each tag has unique code number for authentication. If we use another tag instead of specified tag then the buzzer will produce a sound. Once the vehicle cross the chargeable zone the unique id from the ZigBee (on-board unit id) information will send to the central server system through the ZigBee transceiver. When the complete 69 motorist data has been received by the central server then it will compare motorist information from the database which initially was collected when the motorist registered their vehicle with the help of onboard id.

Each vehicle need to be register to get the on-board unit with fuel control system. The unique on-board id and fuel control will be provided at the time of registering.

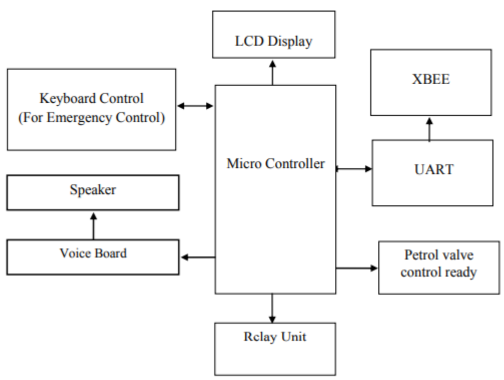

Fig. 1. Block diagram of On board unit(Vehicle side).

Once the vehicle cross the chargeable zone the unique id from ZigBee(on-board unit id) information will send to the central server system through the ZigBee transceiver.

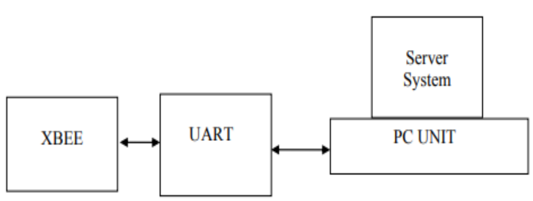

Fig. 2. Block Diagram of Master transceiver and control in tollgate side

Once the motorist data has been received by the central server system then it will compare motorist information from the database which initially was collected when motorist registered their vehicle with the help of on-board id.

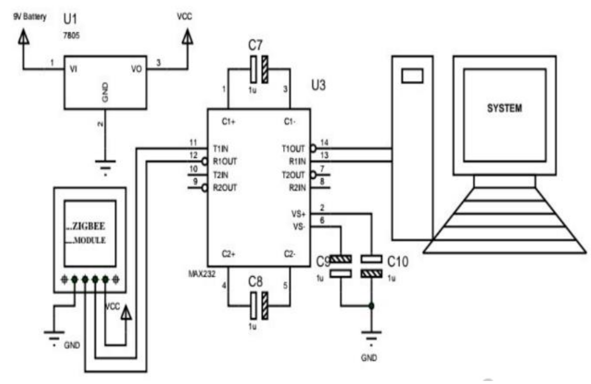

Fig. 3. Schematic diagram of tollgate side unit

The appropriate amount will be deducted from the motorist Bank account and the transaction information will be forward to the motorist onboard unit, if the motorist account have insufficient fund then the failed transaction details with warning message will be forward to the motorist onboard unit. Every CLIENT and SERVER action has been stored via Page to the database. The tollbooth data will be stored in the database through the internet in a remote server.

VII. RESULT AND CONCLUSION

When testing RSSI localization algorithms, utilizing a development platform saves time in implementation and debugging. However, existing WSN development platforms are expensive, or obscure most of the system from researchers through proprietary design. Depending on the popularity of the platform, support may also be limited. The development platform described here was designed with the overarching concept of selecting inexpensive components and software with a large development community so support would be readily available at all levels.

It is voluntary at this stage of implementation. However the possibility of its being made mandatory at some locations in future cannot be ruled out entirely. This system is likely to be used for other services also like payment for parking charges at parking lots and various other payments at wayside amenities. In future it is expected that more banks and mobile wallet operators will join the endeavor. The online payments systems are likely to improve transparency in toll transactions and reduce revenue leakages. There is no need to carry cash for payment toll charges. SMS alerts are issued on payment of toll charges or when the balance becomes low etc. It also helps in reducing the pollution, traffic congestion, vehicle operation cost, relieving the driver's load. It will abide by the current technological development and make the payment through digital transaction. Hence making the billing transparent and corruption free.

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