

Smart Automation Tollgate Using Bloom Filter Algorithm

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Abstract: 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. 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. 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. 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.

Keyword: Wireless sensor networks, On-Board Unit, Zigbee, RSSI, Bloom Filter.

1. Introduction

A Wireless Sensor Network (WSN) consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance. They are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control.

In addition to one or more sensors, each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motest" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from hundreds of dollars to a few pennies, depending on the size of the sensor network and the complexity required of individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth.

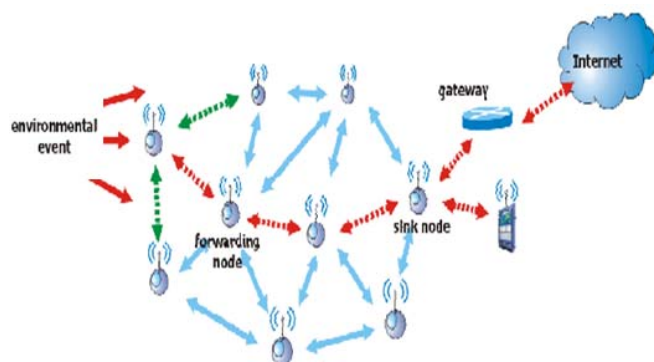


Figure 1: Wireless Sensor Network

A sensor network normally constitutes a wireless ad-hoc network, meaning that each sensor supports a multi-hop routing algorithm (several nodes may forward data packets to the base station).

2. Block Diagram

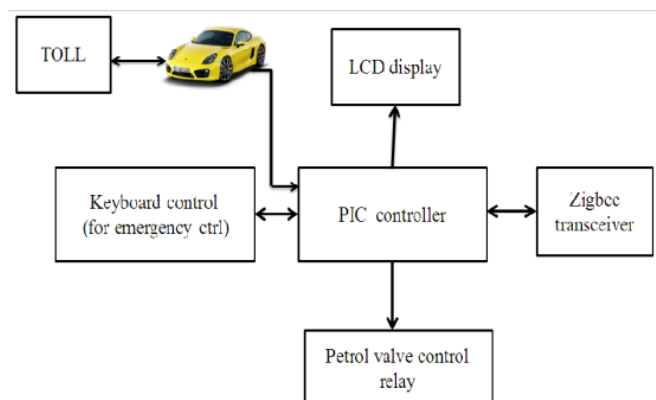


Figure 2: Transmitting Unit On-Board

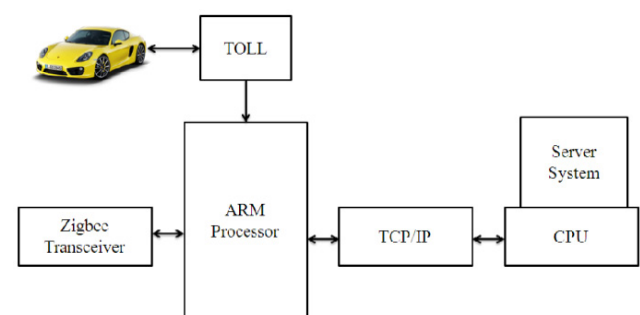


Figure 3: Receiving Unit and Control Unit

The main concept of this project is to reduce power while transmitting through zigbee. Here temperature and humidity sensors are used. After sensing it transmits the data to fusion center through zigbee. And the sensed value displayed in the Liquid crystal display. In the transmitting unit there are two nodes. And the receiving unit is considered as the fusion center. By finding the accurate distance of the node power is allocated.

3. Algorithms

3.1 Bloom Filter Algorithm

Bloom's motivation was to reduce the time it took to lookup data from a slow storage device to faster main memory. And hence could dramatically improve the performance. However, they were found to be particularly useful in data management for modeling, storing, indexing, and querying data and services hosted by numerous, heterogeneous computing nodes.

3.2 Bloom Filter Types and Analysis

Step 1: Collaborating in overlay and peer-to-peer networks: Bloom filters can be used for summarizing content to aid collaborations in overlay and peer-to-peer networks.

Step 2: Resource routing: Bloom filters allow probabilistic algorithms for locating resources.

Step 3: Packet routing: Bloom filters provide a means to speed up or simplify packet routing protocols.

Step 4: Measurement: Bloom filters provide a useful tool for measurement infrastructures used to create data summaries in routers or other network devices.

3.3 Properties of Bloom Filters

Step 1: Bloom filters B and B' , with the same number of bits and using the same number of hash functions. Then a Bloom filter B that represents the union $S = S \cup S'$ of the two sets can be obtained by taking the OR of the two bit vectors of the original Bloom filters, that is $B = B \cup B'$.

Step 2: Bloom filters can easily be halved in size. Suppose the size of the filter is a power of 2. When hashing, the high order bit can be masked.

Step 3: Bloom filter bit arrays are robust in the presence of errors. If part of the array was corrupted, merely substitute all 1's for the corrupted bits. This will slightly increase the false positives rate, but no false negatives will be introduced.

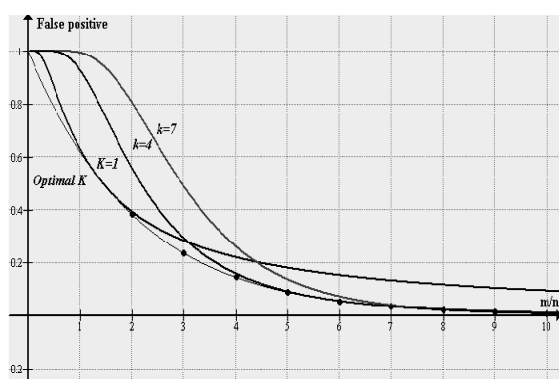


Figure 4: False Positive

3.4 Bloom Filter Standard

To store an element $x \in S$, the bits $h_i(x)$ are set to 1 for $1 \leq i \leq k$. A location can be set to 1 multiple times, but only the first change has an effect.

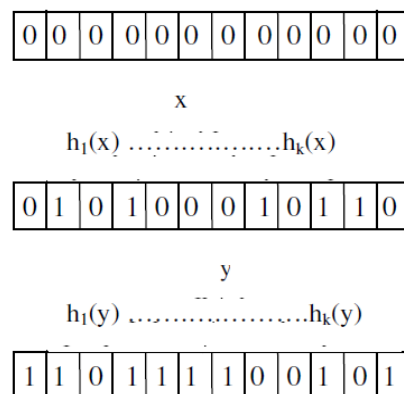


Figure 5: Bloom filter Standard

Peer-to-peer applications are a natural place to use Bloom filters, as collaborating peers may need to send each other lists of URLs, packets, or object identifiers. The smallest square sub regions have size 1 and the size of the original square is k , there will be $\log_2 k + 1$ levels in this recursive structure.

3.5 Solid State Relay

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. Relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing. If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a spike of voltage and might cause damage to circuit components.

3.6 RSSI Measurement

RSSI is the received signal strength in a wireless environment, in arbitrary units. It is an indication of the power level being received by the antenna. Therefore, the higher the RSSI number, the stronger the signal. It is a measurement of the power present in a received radio signal. RSSI is a generic radio receiver technology metric, which is usually invisible to the user of the device containing the receiver, but is directly known to users of wireless networking of IEEE 802.11 protocol family.

3.7 Ethernet Module

The ENC28J60 is a stand-alone Ethernet controller with an industry standard Serial Peripheral Interface (SPI™). It is designed to serve as an Ethernet network interface for any controller equipped with SPI. It incorporates a number of packet filtering schemes to limit incoming packets.

3.8 Ethernet Controller Features

Step 1: Integrated MAC and 10BASE-T PHY.

Step 2: Receiver and collision squelch circuit.

- Step 3:** Supports one 10BASE-T port with automatic polarity detection.
Step 4: Supports Full and Half-Duplex modes.
Step 5: Programmable automatic retransmit on collision.
Step 6: Programmable padding and CRC generation.
Step 7: Programmable automatic rejection of erroneous packets.
Step 8: SPI™ Interface with speeds up to 10 Mb/s.

3.9 Simulated Results

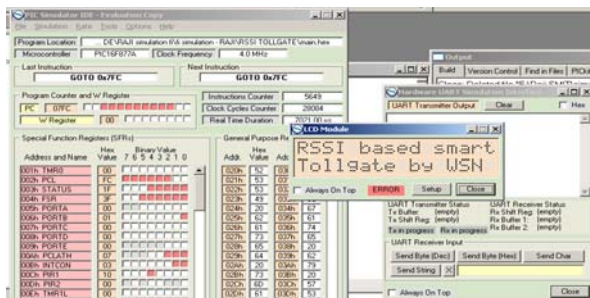


Figure 6: On-Board Unit

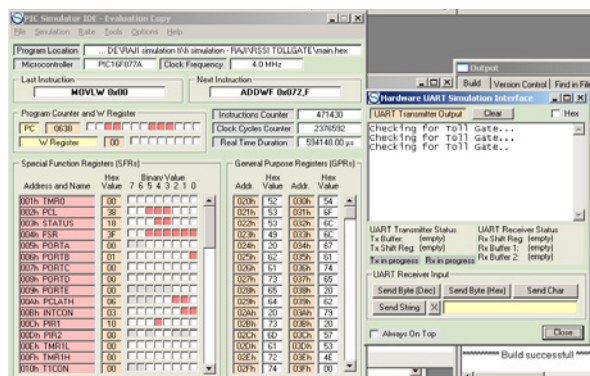


Figure 7: Zigbee testing

ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. It starts finding the one hop neighbour process and get backs the RSSI from each and every node. Next it selects the node with higher RSSI and transmit the packet.

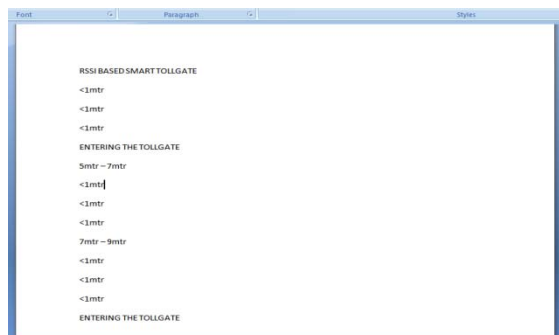


Figure 8: Distance of RSSI

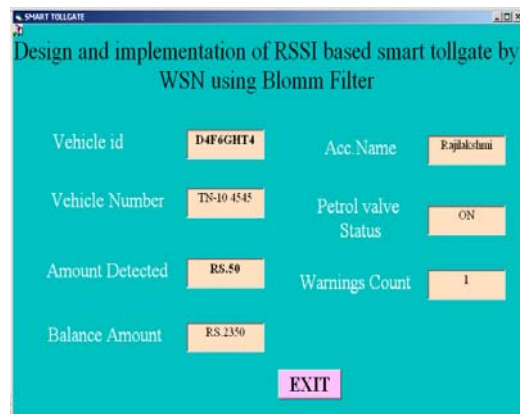


Figure 9: Server Monitor

4. Conclusion

The accurate distance of the node is measured based upon the Received signal strength indication using bloom filter algorithm the network collision avoidance of the data's is being avoided. The gate will not be provided in the tollgate. Each and every vehicle will be installed with the On-board unit. Which identifies the vehicle id and information through the Zigbee signal and information will be provided in the LCD (Liquid crystal display).The User database will be stored in the server. The amount will be automatically debited from the user account. By using this traffic at the tollgates can be avoided and the users can pass the toll gates without stopping. This report describes that this system is fully automated and reduces the human error which brings a great evolution in the method of toll system by its flexibility and it's fully an authenticated.

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