

VEHICLE TRACKING SYSTEM FOR SMALL SCALE AREAS USING WIRELESS SENSOR NETWORK

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Abstract: A real-time vehicle tracking system is designed for specific covering zones based on wireless sensor network (WSN) technology. In this designed WSN infrastructure the location of the vehicles is tracked using a Neo-6MV2 UBLOX GPS module which is placed on the vehicles. Furthermore, the Enhanced ShockBurst protocol is employed to transmit wirelessly acquired location data to a master/center (destination) node using the NRF24101+PA LNA modules. The location information of the vehicle is graphically represented for a security center using an ADO.net-based desktop application. It is used to record the vehicle location information at certain time intervals (minutes) in the MSSQL database. This system intimates the system administrator about the long que/waiting time of vehicles outside the premeditated area. After the successful deployment of the proposed WSN system, it has been substantiated that the proposed system can be used as an alternative to other wireless network infrastructures like WIFI or GSM for the small-scale areas vehicle tracking

Keywords: GPS, Enhanced ShockBurst, vehicle tracking, NRF24101+PA LNA

I. INTRODUCTION

WSN is a wireless transmission network incorporated of numerous sensor nodes which are inexpensive and steadily situated either inside the contingency or adjacent to it. Due to various benefits of WSN such as, admiration to rising miniature micro electro-mechanical systems (MEMS), low-power detectors, digital electronics, wireless communications, low-cost and small size, it is being widely used in automation systems. The growth of wireless sensor networks (WSN), which in turn permit to develop an extensive range of applications based on it, for instance, the technological development in the semiconductor industry reviving to produce low-power, low-cost, and small-sized processors with excessive computational capacities. The deprecation of sensing and computing devices allows the development of small size, cost effective, and less-power consumption devices, controllers, and actuators. [1,2].

System capacity enhanced by WSNs allows the merger of numerous nodes of the sensor. Thus, WSNs establish supreme place such as data acquisition system for web-based observation using ZigBee [3], a system which provides a low-cost acquisition of data of CO and smoke toxic waste that can be read online for air pollution keep track of environmental cognizance[4], construction of monitoring server rooms using ZigBee based on WSN [5], Wireless Sensor Network monitoring system based on ZigBee technology, understand the system of monitoring of data acquisition module, which can obtain the mobile terminal equipment numerous sensors in the short distance wireless sensor network observing equipment[6], Monitoring of Agriculture and aquaculture with Low Power nodes using ZigBee and GPRS. The methodology of development repetitive and incremental considering building three electronic boards sensor nodes is implemented. Each electronic circuit operates independently and does not affect the other sensors data.

This data has is transmitted via wireless GPRS module by implementing ZigBee protocol. Sensor nodes are used for sending and acquisition of readings through microcontroller which saves energy and allows greater operating autonomy. Web server on the internet using a ZigBee Gateway-GPRS collect the data [7], ZigBee LNA Design for Wearable Healthcare Application a single-band 2.4 GHz low noise amplifier (LNA) is fully integrated and constructed by 0.18um CMOS technology for ZigBee applications. High power consumption for healthcare applications is not preferred. The receiver sensitivity is increased using LNA could be a resulting solution. The expression of impedance mathematically built into quadratic equation and guide to the solution by including the LC tank in the matching networks. At the input and output LC tank can be tuned by using voltage-controlled MOS varactor. This topology is convenient as it changes the frequency for process variation [8], ZigBee Wireless Network Applications in industrial control fields [9], To recognize a ZigBee wireless network's optimal placement, data flows, and linked database design and online analysis process (OLAP) this follows the SDLC system [10], In Industrial applications the desired characteristics of WSN system has a possibility of wide expectation [11]. In this work we construct a vehicle tracking system to find out the vehicle location data in real-time or previously. In recent years, WSNs based tracking systems employ on smart vehicle [12], configuration of the vehicle location system construct on WSN [13], Study of Vehicle Monitoring Application with WSN [14] and Position data shown gather from the system consist of wireless sensor network on the web and mobile platform is implemented.

The installed tracking object can simply be chased on the map transiently through the updated icons which are displayed on the map as shown in Figure 1. There will be no changes in the database when the application gets in contact with the web services. In this way, when there will be any change in database section of loaded application is made, the application has the capability to execute without requiring an update [15].

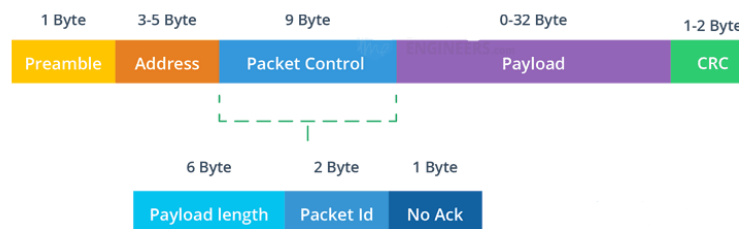


Figure 1: Enhanced ShockBurst protocol

In this study, a desktop application visual studio has also been constructed to visually contemporary the position of an automobile data in a safe database and at given intervals of time save them in the MSSQL database as in Figure 2. The developed application interface permits to detect data of vehicle locality by user in real time.

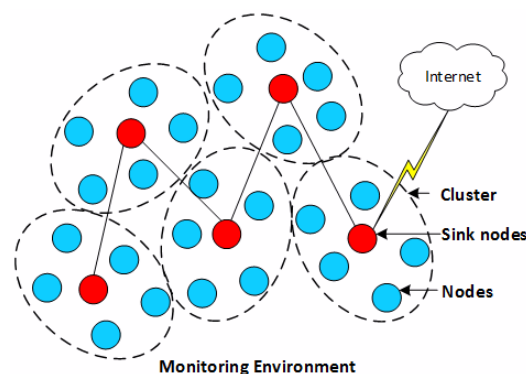


Figure 2: Architecture of WSN systems

The purpose of wireless sensor network-based vehicle tracking system in remote areas is that where there is no availability of cellular network and it is shown in Figure 3. Principally it is PRIVATE LOCAL AREA NETWORK (PLAN). There are two purposes of our project. The major goal is that it requires wireless sensors network building with master slave communication postulation. The GPS (global positioning system) module obtained the position information and at nrf24L01 wireless module by crossing communication using ISM band, so network is dominant because there is no need to buy bandwidth. The second major goal of the project is to record the position which is obtained by nrf24L01 wireless module device and show it on the serial monitor screen. Arduino IDE and in MSSQL database save this location and position of vehicle graphically shown on google map and in real time give out to admin over internet connectivity. To achieve this objective, we are constructing desktop application ADO.NET with visual studio.

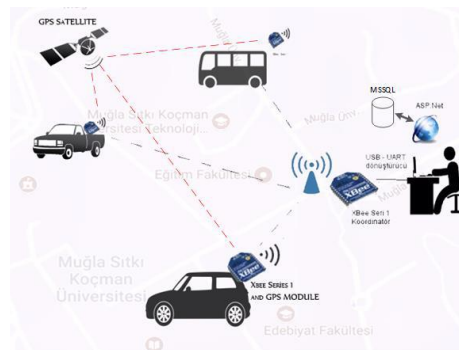


Figure 3: Designed Vehicle Tracking System

II. METHODOLOGY

WSN comprises of numerous inexpensive sensor nodes installed closely either inside the paradigm or adjacent to it as shown in Figure 4. Nodes of the sensor can be efficient for collecting, saving, and territory data processing in WSN. The unique qualities of Wireless Sensor Network are the integration of sensor nodes flow chart as shown in Figure 5. Thus, a huge sensing function is split in minor tasks in WSNs, which contain a variety of sensors arrange between themselves can be dispersed.

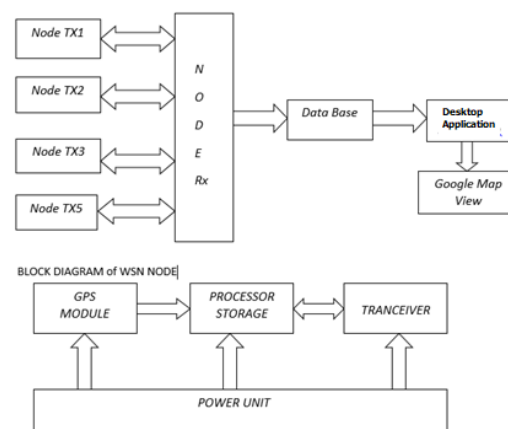


Figure 4: Block diagram

During the formation of real-time vehicle tracking system Various hardware and software components are connected to work jointly to achieve the real-time analysis of vehicle tracking system. This study presents the foundation of the system which is divided into two sections development of hardware and coding for microcontroller.

This project has four transponders, and one receiver are used called multi-receiver. In hardware node of the sensor comprises of Neom V2 U for extraction of vehicle position and communicate via nRF24L01 wireless module. This is done by Enhanced ShockBurst protocol, and at the Receiver/Gateway receiver receive the transmitted signal on recipient comprises of *nRF24L01+PA+LNA* wireless module and Arduino. Arduino operates as a controller and nRF24L01 is used as receiver. The receiver obtains information of movable vehicles and shows on Arduino IDE serial monitor in longitude and latitude configuration.

Another part of the project is software based that the data obtained from distinct wireless sensor nodes are recorded in database by using MSSQL and for graphical representation position presented to admin over the internet connectivity. A single screen interface helps the user and provides the information of the position from sensor nodes with the help of ADO.NET based desktop application. The software Google Map shows maps on other websites. It uses JavaScript to mark vehicles that are on the map. SSUET has various map options are given below.

```
var options = {
  zoom: 17,
  center: new google.maps.LatLng(37.165520, 28.373916),
  mapTypeId: google.maps.MapTypeId.TERRAIN,
  mapTypeControl: false
};
var map = new google.maps.Map(document.getElementById('map_canvas'), options);
for (var i = 0; i < locations.length; i++) {
  var resim = icons['dogru_park'].icon
  if (locations[i][4] == 'y') resim = icons['yanlis_park'].icon
  var marker = new google.maps.Marker({
    position: new google.maps.LatLng(locations[i][1], locations[i][2]),
    map: map,
    icon: resim,
    title: 'Arac ID' + (i+1)
  });
  (function(marker, i) {
    google.maps.event.addListener(marker, 'click', function(){
      infowindow = new google.maps.InfoWindow(
        { content: 'Arac: ' + locations[i][0] });
      infowindow.open(map, marker);
    });
  })(marker, i);
}
```

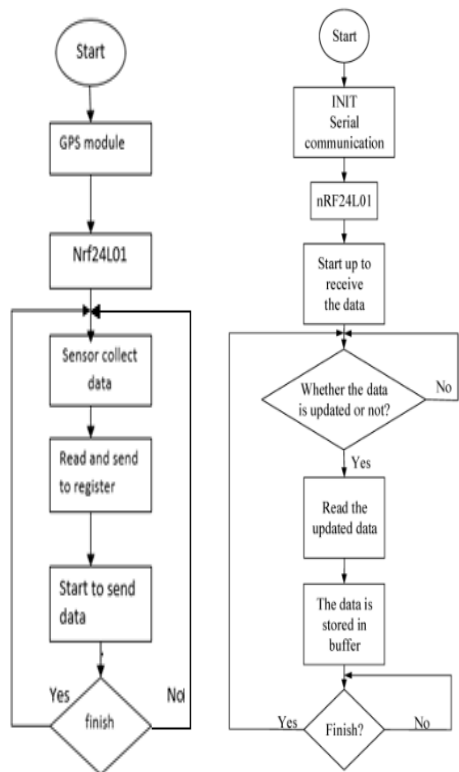


Figure 5: Flow Chart

A. Hardware Architecture

Space-based radio GPS (Global Positioning System) navigation system that transmits frequently encoded information with the help of 24 satellites. GPS sensors that uses satellite-based navigation with a network of 24 satellites to give real-time information, position and velocity. By applying an algorithm developed on satellite signal is estimated by GPS sensors. The location on ground is determined with the help of GPS receiver module which is receiving data from four various satellites. Moreover, numbers of satellites are directly proportional to the accuracy of horizontal position, it also depends on the sensor rate and the local surroundings [15]. This paper uses GPS module Neo6m V2 at the last junction to locate the location of vehicles to do supervision. GPS module is shown in Figure 6 and 7.



Figure 6: GPS module

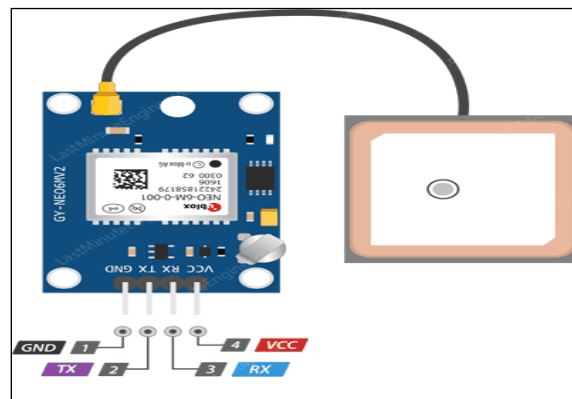


Figure 7: GPS Module

B. Transceiver Module

The transceiver module 2.4 GHz nRF24L01+ PA LNA is used to work globally ISM frequency band and to transmit data by utilizing Gaussian frequency shift keying modulation as shown in Figure 8. Data transmission speed of the proposed research ranges from 250Kbps to 2Mbps. The low noise amplifier of the receiver track and power amplifier of the transmitter track are connected to the transmitting ariel beside duplexer. The duplexer is to separate two signals and block the corresponding power amplifier to restrict (Low-Noise Amplifier) input. This provides us 125 different channels with spacing of 1MHz, low power, and data rate (250kbps, 1Mbps, or 2Mbps). The configuration registers are accessible via Serial Peripheral Interface.

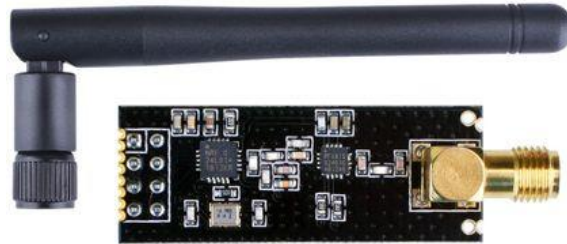


Figure 8: Transceiver Module

C. Adapter Module

Radio Frequency (RF) signal is produced by RF circuit which is elusive to noise of power supply and this is shown in Figure 9. The noise of the power supply is notably decreasing the coverage which is required. To reduce the noise an adapter is used which includes a built-in 3.3 v and a filter capacitor set, therefore, it is being powered by using a 5-volt power supply.



Figure 9: nRF24L01 Breakout Adapter with Voltage Regulator

D. Arduino UNO

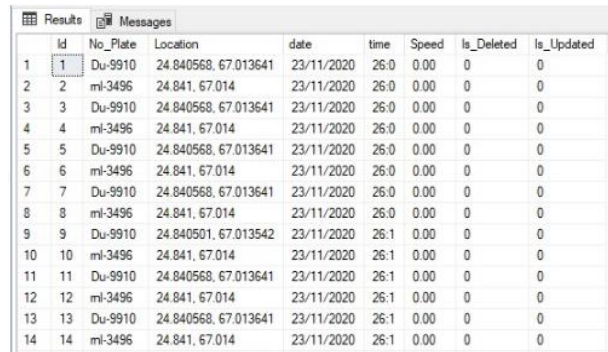
Figure 10 shows Arduino Uno and it is an open-source microcontroller board that depends on programming and tools which is easy to utilize for integration with multiple electronic devices as shown. This project utilizes C language for easy communication of all the devices among each other.



Figure 10: Arduino Uno

III. RESULTS AND DISCUSSIONS

The construction of vehicle allows infrastructure, which is modified into two different phases, when specific area on COM10 is received. The first phase establishes the analysis from comp, and to get the data and retain analysis in MSSQL database obtain button will be press as shown in Figure 11.



Id	No_Plate	Location	date	time	Speed	Is_Deleted	Is_Updated
1	Du-9910	24.840568, 67.013641	23/11/2020	26:0	0.00	0	0
2	ml-3496	24.841, 67.014	23/11/2020	26:0	0.00	0	0
3	Du-9910	24.840568, 67.013641	23/11/2020	26:0	0.00	0	0
4	ml-3496	24.841, 67.014	23/11/2020	26:0	0.00	0	0
5	Du-9910	24.840568, 67.013641	23/11/2020	26:0	0.00	0	0
6	ml-3496	24.841, 67.014	23/11/2020	26:0	0.00	0	0
7	Du-9910	24.840568, 67.013641	23/11/2020	26:0	0.00	0	0
8	ml-3496	24.841, 67.014	23/11/2020	26:0	0.00	0	0
9	Du-9910	24.840501, 67.013542	23/11/2020	26:1	0.00	0	0
10	ml-3496	24.841, 67.014	23/11/2020	26:1	0.00	0	0
11	Du-9910	24.840568, 67.013641	23/11/2020	26:1	0.00	0	0
12	ml-3496	24.841, 67.014	23/11/2020	26:1	0.00	0	0
13	Du-9910	24.840568, 67.013641	23/11/2020	26:1	0.00	0	0
14	ml-3496	24.841, 67.014	23/11/2020	26:1	0.00	0	0

Figure 11: MSSQL Database

Statistics are saved in the database like previous stage by pressing the Load grid button in next phase. Picture is shown in desktop for proper investigation as shown in figure 12.

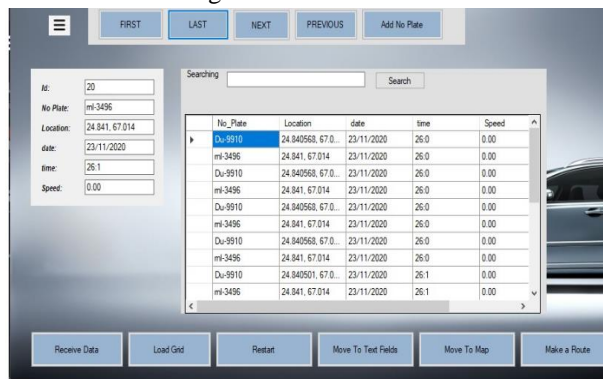


Figure 12: Application Page

Finally, all collected stats and location of preferred vehicle will appear on the Map and with the help of move button it can move the map at desired location. The located vehicle can be shown in an application using google map as shown in Figure 13.

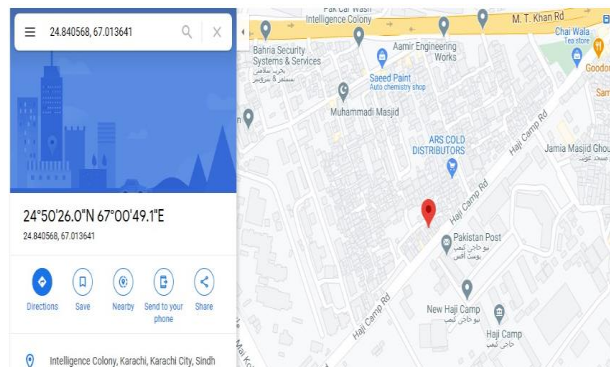


Figure 13: Sight of The Map

IV. CONCLUSIONS

In this research, a plot of a vehicle routing technique in a WSN area has been achieved with the help of nRF24L01 modules. A sensor node is a small and inexpensive device with low power consumption and compact in size. We have successfully examined the tracking system and the GPS module get the data of the location acknowledged graphically to permit end user on an application. It is explained that WSNs are operated as an alternative to wireless network frameworks such as Wi-Fi or GSM when vehicles are routed in small scale areas. If router devices are used in a system and network is constructed correspondent to mesh topology it is feasible to enhance capability and coverage of the constructed system.

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