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Cloud Computing based Real-Time Vehicle Tracking and Speed Monitoring System

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ABSTRACT

Real-time vehicle tracking and speed monitoring system is an electronic device which can be equipped in any automobile to enable the owner/parent/a third party to track the location and monitor the speed of the vehicle in cloud server. The system proposed in this paper is an Internet of Things (IoT) application which uses Global Positioning System (GPS) as well as Global system for mobile communication (GSM) technology, the most efficient source of vehicle tracking/monitoring. The proposed IoT device, acting as an anti-theft mechanism, involves Intel Galileo Gen 2 development board, a quadband GPS/GPRS/GSM module, Vehicle speed sensor, LCD display and a Open source Cloud Server.

Keywords: Vehicle tracking, Speed Monitoring, Intel Galileo Gen2, Thingspeak, GPS, GPRS, GSM, SIM908,

1. INTRODUCTION

Real-Time vehicle tracking and speed monitoring system ensures the safety of public and private vehicles as a theft prevention and retrieval device. The continuous uploading of the vehicle location in cloud helps police in the tracking of a stolen vehicle. Vehicle tracking systems are commonly used by fleet operators for fleet applications which include management functions such as routing, dispatch, on-board information, speed monitoring and vehicle security. The proposed system uses Intel Galileo Gen 2 development board which incorporates Intel Quark SOC processor. This Microcontroller is interfaced to GPS/GPRS/GSM quadband module SIM908. SIM908 continuously monitors a moving Vehicle using GPS and gives the latitude and longitude corresponding to the position of the vehicle. The GSM/GPRS(General Packet Radio Service) is used to post this vehicle location data from a remote place to a Cloud Server using a HTTP POST request. Thingspeak, an open-source cloud server is used in the proposed system. The speed of the moving vehicle is given by the vehicle speed sensors to the microcontroller. When the speed of the vehicle exceeds a threshold value, the system automatically sends an SMS alert to a pre-determined mobile number. At the same time, it flashes a warning message on the LCD monitor. The speed monitoring feature of the device helps in monitoring driving behavior/capability of the driver, such as an employer of an employee, or a parent with a teenage ward. The automatic SMS alert mechanism to the employer/parent/third party when extreme rash driving happens is a novelty which can be very helpful to enforce discipline. The LCD display of a Warning Message when speed limit is breached acts as an instant alert to the driver. This paper is organized in the following manner. Review of the Literature survey is given in section II. Section III discusses about the design of the proposed vehicle tracking and speed monitoring system and Section IV gives a detailed description about Implementation of the proposed model. Section V, Conclusion of the work explains about the Merits and Demerits of the proposed model, area of application and future scope of work.

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2. LITERATURE SURVEY

Research on real-time vehicle tracking and speed monitoring devices have gained momentum due to the advancements in the field of Internet of Things and its capability to act as an anti-theft mechanism.

El-Medany, W. et al implemented the system using GM862 cellular quadband module for vehicular tracking. Also, they used a self-designed website made of MS-SQL SERVER 2003 and ASP.Net for posting the vehicle location and speed information.

Iman M. Almomani et al provided 2 types of end-user applications in their Ubiquitous GPS Vehicle tracking and management system.

Le-Tien, T et al utilizes a similar design model.

Sadagopan, V.K et al has a special locking system built-in to serve as an anti-theft model.

Hu Jian-ming et al utilizes a special vibration sensor to serve as an anti-theft model.

Pankaj Verma et al designed a system using Atmega microcontroller MAX 232 and SIM 300. A web application was designed to post the location details.

3. DESIGN OF THE PROPOSED SYSTEM

The proposed vehicle tracking and speed monitoring system utilizes the Integrated development Environment (IDE) of Intel Galileo Gen2 board for design and implementation of the prototype. The schematic of the proposed system is given in figure 1.

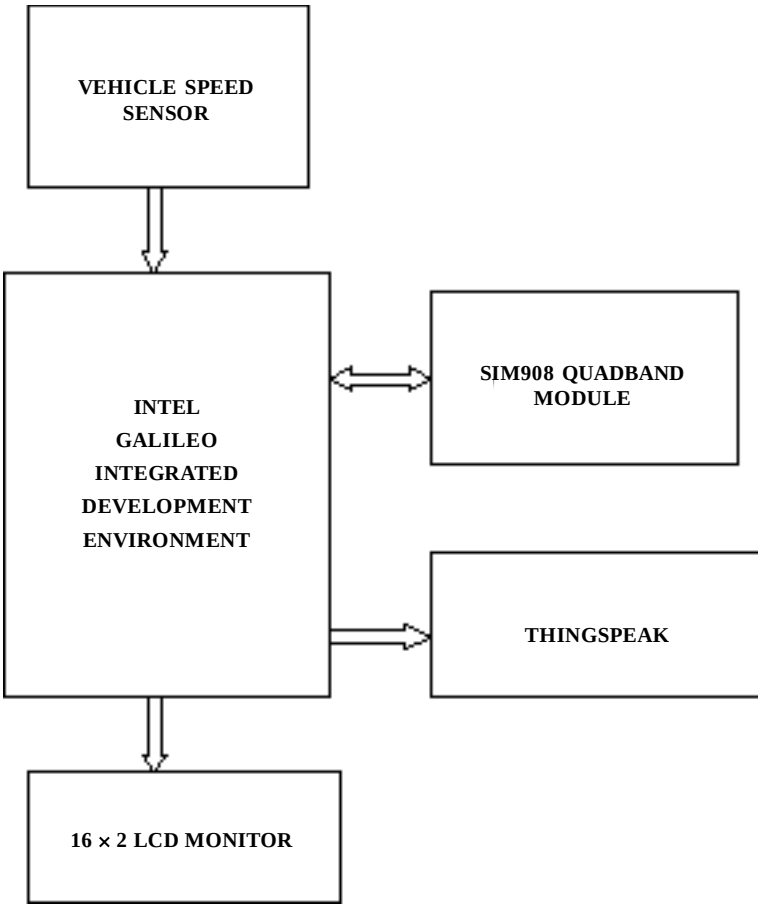

Figure 1: Schematic of Cloud based Vehicle Tracking and Speed Monitoring system.

It uses vehicle speed sensor to get the speed of the moving vehicle. GPS/GPRS quadband module SIM908 is used to locate the current location of the moving vehicle. It is also used as GSM module for posting the data on Thingspeak, an open source cloud server. A detailed description about the various building blocks of the proposed system is as follows:

Intel Galileo Gen2 Board: The processor used by Intel Galileo Gen 2 board is Intel Quark SoC X1000, a 32-bit Intel Pentium-class system on a chip (SoC). The board inherits Intel architecture and has been designed to have software and hardware(pin) compatibility with shields designed/developed for the Arduino Uno R3. Arduino, the Integrated Development Environment (IDE) can be used by the Galileo board for design and development of the proposed model. The layout of Galileo Gen2 development board is given in figure. 2.

GPS/GSM/GPRS Technology: The Global Positioning System (GPS) is the only efficient method used for Global Navigation System (GNSS). GPS uses Medium Earth Orbit satellites, the constellation ranging from 24 to 32, in order to transmit precise microwave signals, which enable GPS receivers to determine the

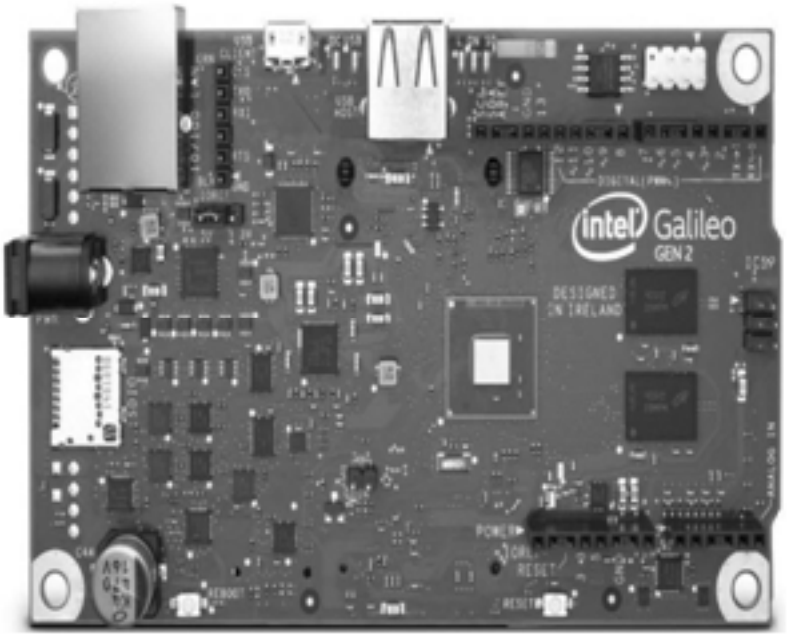

Figure 2: Intel Galileo Gen2 development Board

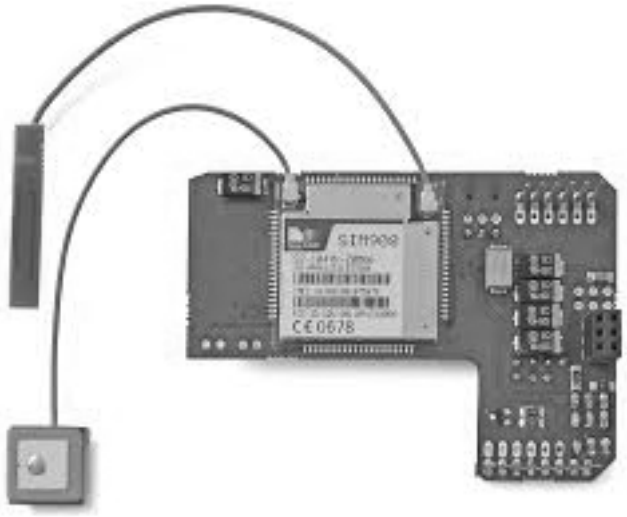

Figure 3: GPS Tracker SIM908 for Intel Arduino

location, speed, direction, and time of the object which is being monitored. The proposed system uses the GPS technology to arrive at the vehicle location. The GPS and GSM/GPRS quadband module SIM908 is use in the proposed model. SIM908 module, a Quad-Band GPS/GPRS module, has both GSM/GPRS and GPS technologies, the key for real-time tracking applications. It reads the GPS coordinates (longitude and latitude) and send them by using a HTTP request to a web server. The main advantage of SIM908 is its special design, which integrates GPS and GPRS. This off-the-shelf model with a standard interface drastically reduces both time and cost in the development of GPS enabled applications allowing moving objects to be tracked seamlessly at any location and at any time, for the fact that there is signal coverage. GPS tracker SIM908 is shown in Figure 3.

AT commands are used to connect SIM908 to the internet using GPRS and to read and send GPS data from the SIM908 to the server. AT is an ATTENTION command and is used as a prefix to other parameters in a string. The AT command combined with other parameters can be set up in the communications package or typed in manually as a command line instruction.

- *16 × 2 LCD Display:* The LCDs have a parallel interface. The interface consists of the pins, register select (RS) pin that controls where in the LCD's memory the data is written to and A **Read/Write (R/W) pin** that selects reading mode or writing mode. An **Enable pin** that enables writing to the registers 8 **data pins (D0-D7)**. The commands associated with LCD display are:

```
// Include the relevant header file
# Include <LiquidCrystal.h>

// Set up the LCD's number of rows and columns
lcd.begin(16,2);

// Clear the Screen
lcd.clear();

//Display each character onto the screen
lcd.write(Serial.read())
```

The wiring diagram between Intel Galileo board and 16 × 2 LCD is shown in Figure 4.

Vehicle speed sensor: The Vehicle Speed sensor (VSS) is generally located at the transaxle or transmission and is used to measure transaxle/transmission output or wheel speed. This wheel speed is utilized by Engine Control Module (ECM) to modify engine functions such as, AF ratio, ignition timing, transmission shift points, and to initiate diagnostic routines. The VSS can be tested with a scan tool or it can also undergo a resistance check. The Schematic of Vehicle Speed Sensor is shown in Figure 5.

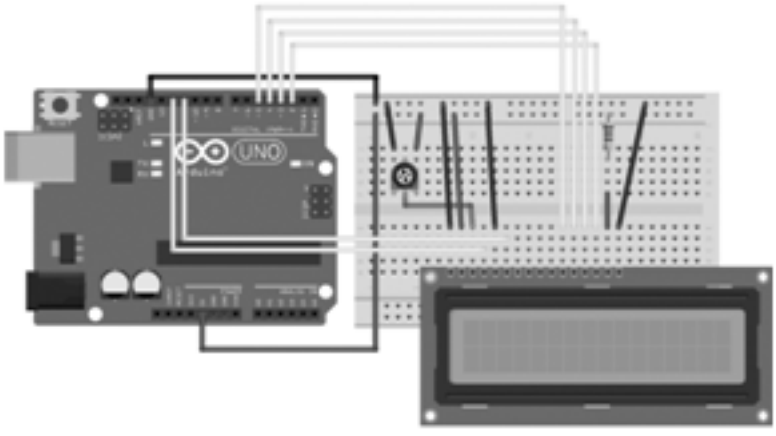

Figure 4: Wiring diagram between Intel Galileo Board and LCD Display

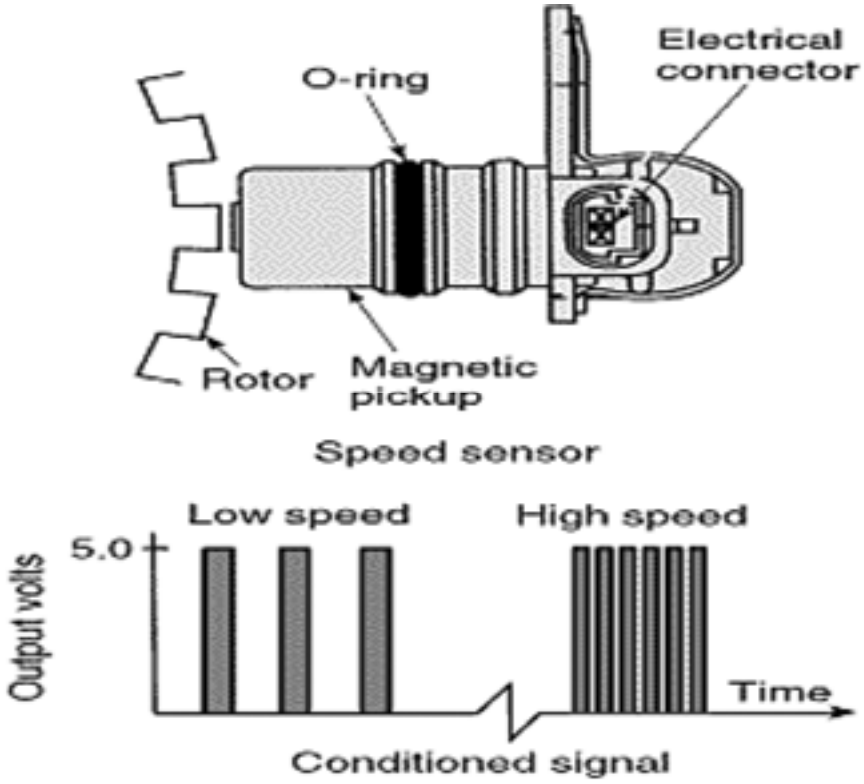

Figure 5: Schematic of Vehicle Speed Sensor

Thingspeak: It is an open source cloud server which is a popular choice for Internet of Things applications. It is an API as well as a data platform that allows an user to gather, save, process and generate reports on the collected data. It can process data received from sensors or actuators, such as Raspberry Pi, Arduino, BeagleBone Black, etc. The numerous computations and processes that Thingspeak can perform are storing numeric and alphanumeric data, numeric data computation, processing HTTP requests, location tracking and current status updates. ThingSpeak can be very effective in creating location-tracking applications, sensor-logging applications and status update applications. The key element of ThingSpeak activity is the *channel*, which contains data fields, location fields, and a status field. Data can be written to the channel fields and processed, after creation of a ThingSpeak channel. With the help of MATLAB code, the data can be used to create tweets or alerts. ThingSpeak follows the below given processes in order for real-time applications to use them:

- Creating a Channel and related fields
- Data collection
- Analyze, process and Visualize the data
- Act on the data

Arduino reads the analog input from the sensor using one of its Analog pins and updates a ThingSpeak Channel by sending a HTTP POST via the Arduino Ethernet Shield or the Arduino Ethernet.

4. IMPLEMENTATION OF THE PROPOSED MODEL

The Intel Galileo Gen2 development board is coupled with a GPS+GPRS SIM908 Quadband Module, one GPRS-GSM antenna and one GPS antenna to transmit the location of a vehicle in real-time. A 16 × 2 alphanumeric LCD display, JHD162A is used for displaying a warning message when the breach of threshold speed-limit occurs. For prototype design, a Triple Axis Accelerometer MMA7361 is used to simulate the

speed of the moving vehicle. It has 3 axis X, Y and Z, whose movements produce corresponding output values. For design and development of the proposed system in the Arduino IDE, accelerometer is used in place of Vehicle speed sensor. Thingspeak, an open source cloud server is used for Real-Time posting of data. A 9-volt alkaline battery is used to power the system. The inter-connection between the accelerometer and Intel Galileo Gen2 board is shown in figure 6.

After connecting the accelerometer to the Galileo board, the X, Y and Z axes are moved in varying directions. Due to the differing movements, the sensor values provide differing output values, whose range is provided by the Accelerometer Datasheet. These values of the 3 axes, X, Y and Z, are displayed on the serial monitor of Arduino IDE which is shown in figure 7.

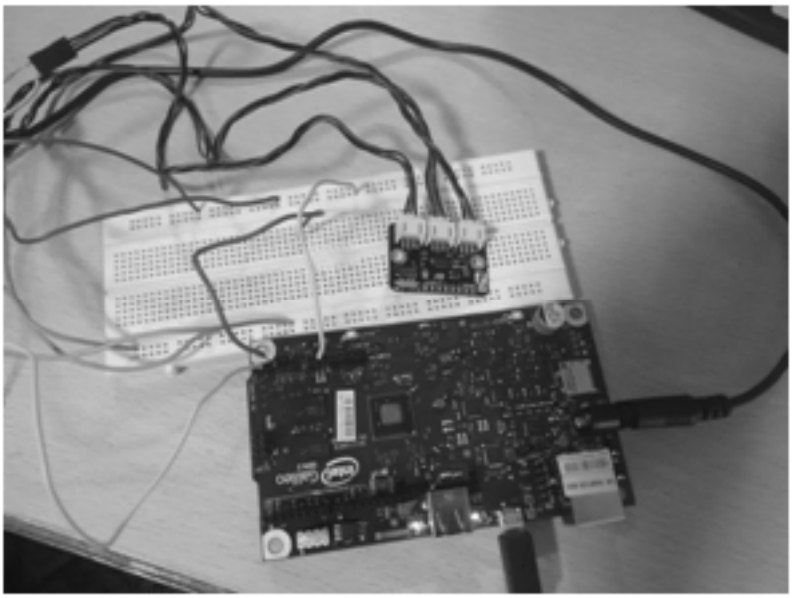

Figure 6: Intel Galileo and Accelerometer Inter-connection

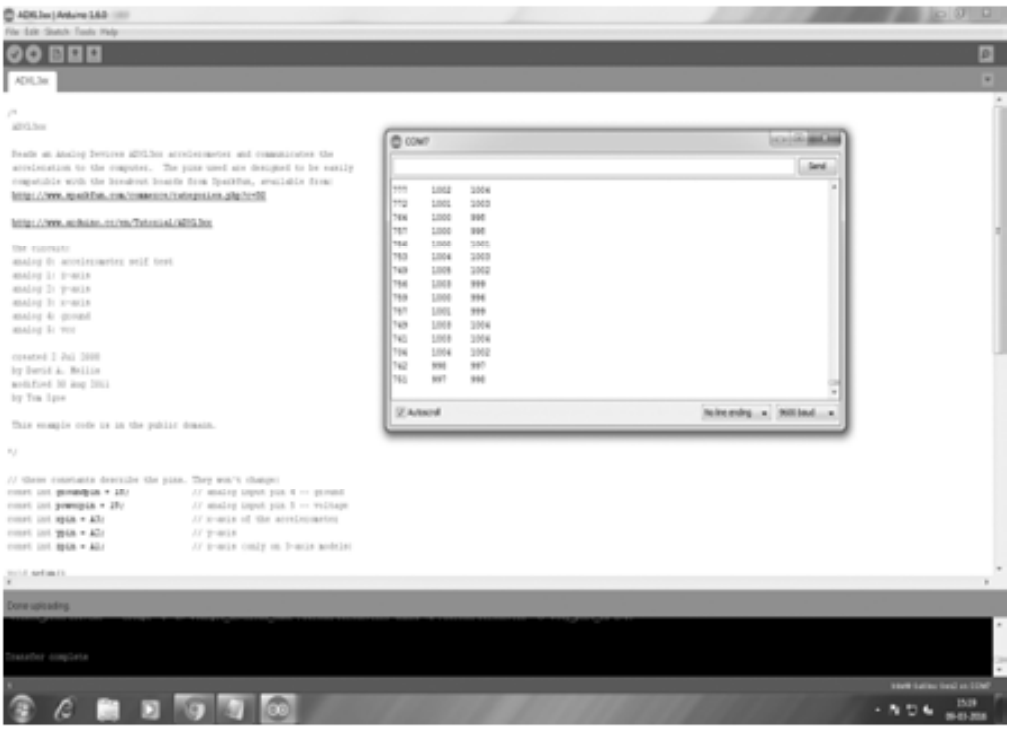

Figure 7: Accelerometer values displayed in serial Monitor of Arduino IDE

The POST command is used by the prototype to post the x-axis value of the accelerometer to the Thingspeak cloud server. The x-axis data is taken from analog pin A0. The POST command is as given below:

POST/update HTTP/1.1
Host: api.thingspeak.com
Connection: close
X-THINGSPEAKAPIKEY: (MK2KRTMLKY1I47MC)
Content-Type: application/x-www-form-urlencoded
Content-Length: 4
Field1= (x-axis data)

The x-axis data of the accelerometer being posted in Thingspeak channel is shown in figure 8.

Figure 8: Accelerometer Values posted in ThingSpeak channel

When speed limit exceeds the threshold value, the speed value and the current vehicle location is sent to a pre-determined mobile number using SIM908. At the same time, a warning message is also displayed on the 16 X 2 LCD monitor, which can be mounted in a strategic location in the direct view of the driver to create maximum impact.

5. CONCLUSION

The proposed design based on Intel Galileo Gen 2 board with SIM908 GPS/GPRS quadband module is an efficient, easy to implement vehicle tracking and speed monitoring device. This efficient IoT device acts as an anti-theft mechanism since at any given point of time, the current location of the vehicle is posted in a channel in the cloud server ThingSpeak. The current speed of the vehicle is also posted into the Thingspeak channel. The novel idea of sending a warning message to a pre-defined mobile number when the speed

threshold is exceeded acts as an instant alert mechanism for the owner/parent/third party in case of over-speeding. The warning message displayed on the 16 × 2 LCD Monitor provided in the dashboard gives instant warning to the driver. Future scope of work includes adding special features to the existing model such as accidents / emergency health situations alert mechanism to emergency services.

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