IOT Asset Tracking System

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Abstract

Today, the growth of technology is rapid and provides all necessary and effective solutions for the requirements. One of the most important areas of concern is security. In this scenario, IOT Asset tracking system is developed to increase the safety of women, children, people with mental disorder and any valuable items through the technology of Radio Frequency along with IOT. Radio Frequency module consists of transmitter and receiver. The transmitter is placed with the object to be tracked which sends radio waves to the receiver. If the object being tracked moves out of frequency range, an alert message and call will be sent to specified guardians through Global System for Mobile communication. Further the location of the object can be tracked whenever required through Global Positioning System. In addition, sound and vibration sensors are used to sense human behavior like loud voice and movement of human body. If the sensor reading exceeds threshold value, messages are sent to specified mobile numbers. The frequency range between transmitter and receiver and location of assets are displayed in ThingSpeak which is an open-source IOT platform.

Keywords: Asset Tracking, Radio Frequency (RF), Internet of Things (IOT), Global System for Mobile communication (GSM), Global Positioning System (GPS)

1 INTRODUCTION

Nowadays, safety is one of the major issues as crime is rapidly growing across the world. IOT Asset Tracking System is focused with the safety and security of women, children, people with mental disorder and any valuable things. This system is going to help people to monitor and track the location of assets.

1.1 Overview

The system uses RF technology which refers to communicating through wireless electromagnetic signal with radio frequency that ranges from 3 kHz to 300 GHz. RF modules comprises of RF transmitter and RF receiver. The transmitter is placed within the asset to be tracked and the receiver is with the owner/ guardian of the asset. The transmitter and receiver communicate with each other through RF signal.

GSM is used to alert the person who is monitoring the asset with a message and call when the transmitter is unable to communicate and transmit serial data to the receiver due to decrease of signal strength as it moves far away from the receiver. Once the asset goes out of frequency range the location of the object can be tracked using GPS. The system is also embedded with sound and vibration sensor to sense human behavior in case of emergency.

IOT plays a vital role in the development of the system which allows devices to connect, interact and exchange data over the internet and can be remotely controlled and monitored. There are many IOT platforms. One such platform is ThingSpeak which is an open-source Internet of Things application to store and retrieve data from things using the HTTP protocol over the internet or through Local Area Network. Here, IOT ThingSpeak displays all the sensor data and location information via widget on smart phone.

1.2 Objective

The Main objective of IOT Asset Tracking System is to track the location of assets and send quick messages via Short Message Service and call when it moves out of bound. The major goal is to ensure maximum security and enable tracking by providing current location.

2 RELATED WORK

2.1 Child Safety and Tracking Management System

The Child Safety Application was proposed by Aditi Gupta, Vibhor Harit to ensure maximum security and live tracking for kids because parents' worries are genuine. This application proposed a model for child safety through smart phones that provides the option to track the location of the children and the child can send SMS in case of emergency through GPS technology.

2.2 Vehicle Tracking Device

Vehicle Tracking Device (VTD) developed by Fatin Balkis Binti Alzahri, Maziani Sabudin will give information of location coordinate to mobile phone

whenever there is a request for it through the SMS. VTD is an integration of hardware and software.

2.3 Human tracking in certain indoor and outdoor area by combining the use of RFID and GPS

Daniel Patricko, Hendry Hendry, Jonathan Adiel Pranoto, Adi kurniawan proposed this application to track the human position for both indoor and outdoor using RFID tag and GPS. An RFID tag was carried by a user and continuously read whenever he/she accesses a room while GPS was used mainly when the user was staying outdoors. GPS will be activated automatically whenever the user leaves the room 3 meters away.

2.4 RFID for personal asset tracking

Steven Chan, Adam Connell, Eribel Madrid, Dongkuk Park, Ridha Kamoua used Radio Frequency Identification (RFID) that keeps track of registered objects that are within range of the user. The goal is to provide a new security for keeping belongings that are carried around like keys, wallets, passports, jewelry, watches, glasses, medicine, cell phone, laptops, etc,. If the object was lost and not stolen, RFID reader and GPS receiver gives the user information on where the object was last detected.

3 SYSTEM SPECIFICATION

IOT Asset Tracking System has two devices, one at the transmitter side and the other at the receiver side with the combination of hardware and software components. The hardware components employed are nano micro controller, battery, vibration sensor, sound sensor, LCD display, RF modules, GSM module with inbuilt GPS technology and WIFI module. The software specification is development of widget on mobile phone to know strength and website to determine the location of assets.

3.1 Hardware Specifications

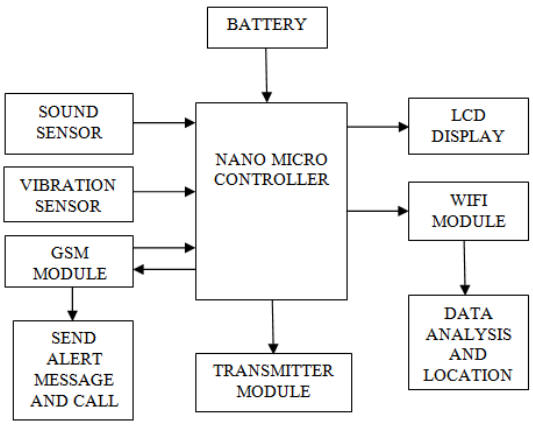

Fig.1. Transmitter Block

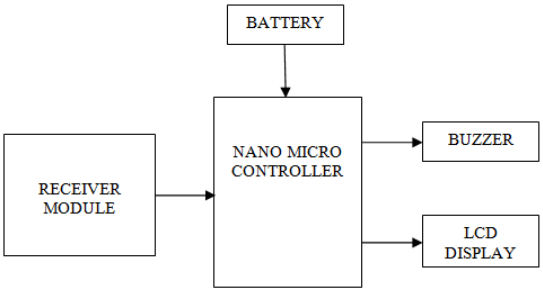

Fig.2. Receiver Block

3.1.1 Micro controller

The Nano micro controller (MEGA328-p) is the brain of the entire system. It is breadboard friendly and can be powered via the mini-B USB connection. The required power supply is 6V to 20V. The power source of higher voltage is automatically selected. The nano micro controller accepts input from Sound sensor, Vibration sensor, Transmitter module and Receiver module. Both the transmitter block and receiver block contains nano micro controller that is applicable for controlling all operations.

3.1.2 Sound Sensor

Sound sensor detects the sound intensity of the environment. LM393 sound detection sensor is used to detect whether sound has exceeded a threshold value (greater than 70dB) via microphone. The power supply required for sound sensor is 3.3V to 5V. When the sound level exceeds 70dB, an alert message is sent to mobile phone.

3.1.3 Vibration sensor

Vibration sensor LM393 is used to detect if there is any vibration beyond the threshold range. The required power supply is 3.3V to 5V. The average frequency of vibration of human body is 62 to 68Hz. When the sensor recognizes movement or vibration greater than 68Hz, it sends alert message to mobile phone.

3.1.4 RF

RF module is a small electronic device used to transmit and receive radio signals between two devices wirelessly. It operates at radio frequency and has a wide operating voltage range i.e. 3V to 12V. The RF module comprises of transmitter module and receiver module. Transmitter and receiver modules are duly interfaced to two nano micro controller for data transfer. The data is sent serially from the transmitter through an antenna which is received by the tuned receiver.

RF modules are used for transmitting and receiving data because of its high volume of application than IR. RF signals travel between transmitter and receiver despite any obstruction. It operates at a specific frequency of 433MHz. when the frequency range between transmitter module and

receiver module increases above 433MHz (i.e. when transmitter moves far away from receiver), the receiver is alerted with a buzzer sound and an alert message.

3.1.5 GSM

GSM SIM800C (Global System for Mobile communication) is a mobile communication modem that digitizes and reduces the data, then send it down through a channel with two different streams of client data, each in its own particular time slot.

SIM800C is a complete Quad-band GSM/GPRS solution in a SMT type with a SIM card holder. It supports Quad-band 850/900/1800/1900MHz and can transmit voice, SMS and data information with low power consumption. It smoothly fit into slim and compact design. The major benefit of using SIM800C is that it comes with inbuilt GPRS technology.

In the proposed system, when the nano micro controller requests the GSM to send alert message, the modem fitted with SIM card sends text message and call to specified mobile numbers. Any number of mobile numbers can be specified. After performing the assigned task, GSM respond to the request of nano micro controller by sending acknowledgement.

3.1.6 GPS

Global Positioning System (GPS) allows to obtain the location of asset from anywhere in the world. State of reception of GPS depends upon the strength of GPS signal. In the proposed system, location information is displayed on map at ThingSpeak website.

3.1.7 WIFI

The ESP8266 WIFI module is a self contained SOC with integrated TCP/IP protocol stack that gives micro controller access to WIFI network. It is capable of hosting applications and has a powerful onboard processing and storage capability that allows it to interface with sensors. In the proposed system, WIFI module provides facilities to view the frequency and location of assets from anywhere at any time.

3.1.8 LCD Display

A 16*2 Liquid Crystal Display (LCD) screen is used which is an electronic display module. It displays 16 characters per line and there are 2 such lines. LCD has two registers, namely, command and data. The command register stores the instructions given the LCD. The data register stores the data (ASCII) to be displayed on the LCD. LCDs are economical and easily programmable.

3.1.9 Battery

Batteries are electrical devices that provide power supply to the hardware components of the system. Each component of the system has a specific voltage range.

3.1.10 Buzzer

Buzzer or beeper is a device that emits short, high pitched sound as a signal. In the proposed system, buzzer is placed at the receiver side device to alert when the asset goes out of specific range.

3.2 Software Specifications

3.2.1 Embedded C

The Nano micro controller which is the brain of the entire system is most frequently programmed with embedded C language. It is an extension of C programming language with some additional header files that provides support for developing efficient programs for embedded devices. Each controller has specific header files which may vary from the other.

Embedded software is the soul that governs the functioning of embedded system. These programs monitor and control external devices by directly operating and using the internal architecture of the micro controller. Features of embedded programming are code speed and code size.

3.2.2 ThingSpeak

ThingSpeak is an open-source IOT platform and API to store and retrieve data. ThingSpeak enables developers to store the data and information like sensor values, location of an asset with periodic status updates. The number of fields to be displayed can be specified by the user. ThingSpeak widget allows creating custom visualization for each channel.

In the proposed system, a channel has been created named “IOT Asset Tracking System” which provides information about the asset condition through frequency range and also locates the asset on map.

4 IMPLEMENTATION

IOT Asset Tracking System is implemented at two phases, namely, Tracking phase and Monitoring phase.

4.1 Tracking Phase

The transmitter kit is placed with the asset to be tracked. The central nano micro controller is connected with LCD display, sound sensor, vibration sensor, WIFI module, GSM module and RF transmitter. LCD screen displays the proper functioning of device when the system is ON. Further, it also displays condition of asset. The sound sensor and vibration sensor continuously read the sensors data. If the sensed value exceeds threshold value, call and alert messages indicating that the asset is in trouble are sent to the specified mobile numbers through GSM.

The RF transmitter modules at transmitter phase communicate with the RF receiver module at receiver phase continuously by transmitting radio signals. The maximum threshold frequency range is 433MHz. When the transmitter moves away from the receiver,

the signal strength between them decreases and call and alert messages are sent to specified mobile numbers indicating that the asset is lost. Further, alert message are also sent when the kit has been disconnected.

4.2 Monitoring phase

The receiver kit is with the person monitoring the asset. The central nano micro controller is connected with LCD display, RF receiver module and buzzer.

LCD screen displays an alert message stating that the asset is lost when the distance between the transmitter and receiver exceeds the maximum threshold frequency range and also when the transmitter kit is disconnected. Further, buzzer sound is emitted to indicate an alert under such situation.

5 RESULT

The sound sensor and vibration sensor reads the input data continuously. When the value greater than threshold value (70dB), alert message is sent to the specified mobile number via GSM.

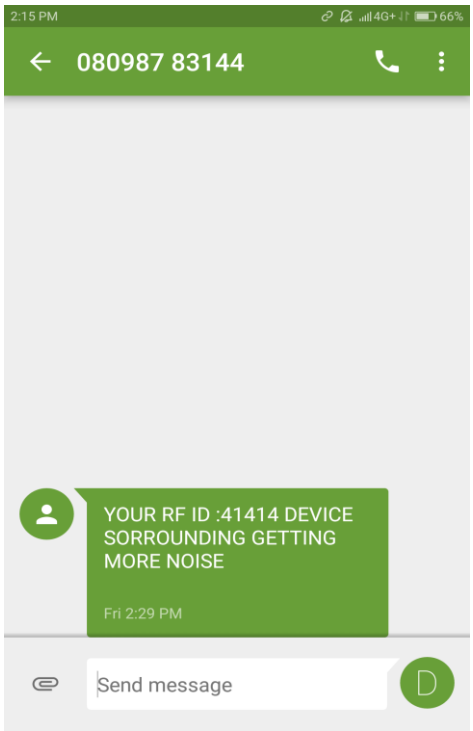

Fig.3. Alert message when more noise is detected

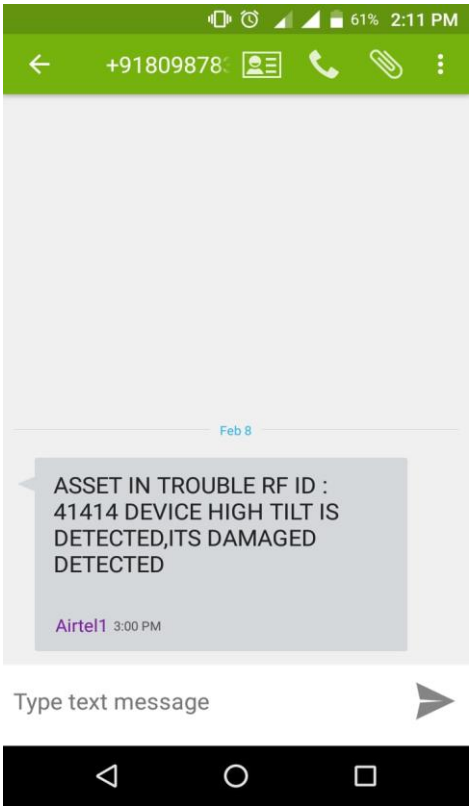

Fig.4. Alert message when vibration is detected

Widget is created using ThingSpeak which is an open-source IOT platform. Widget displays the frequency range between the transmitter and receiver.

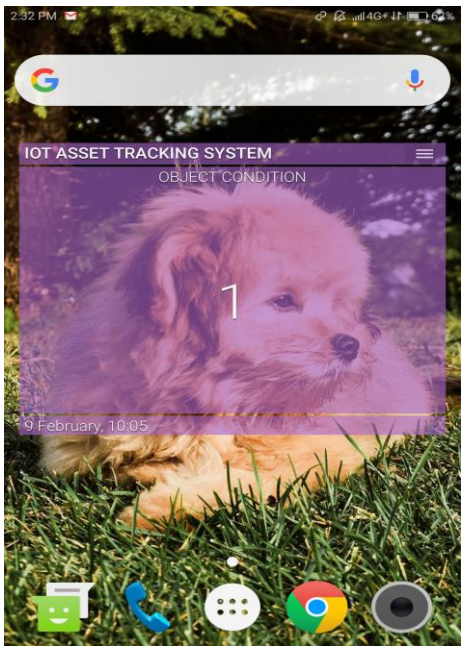

Fig.5. ThingSpeak widget displaying object condition

When the transmitter moves away from the receiver or when the transmitter device is disconnected, the buzzer at the receiver device emits sound along with the alert message on the LCD screen.

Fig.6. LCD screen displaying signal lost message

The website created at ThingSpeak displays the sensors values and the frequency range between the transmitter and receiver along with the location of the asset.

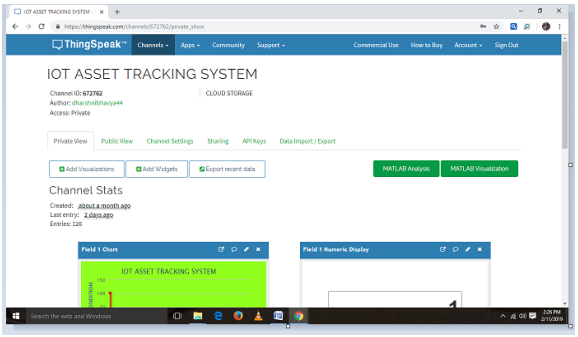

Fig.7. Creation ThingSpeak website

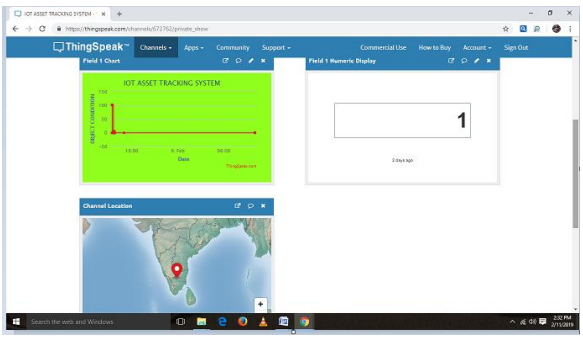

Fig.8. Display of location and frequency fields

6 CONCLUSION AND FUTURE SCOPE

The proposed IOT Asset Tracking System has been developed to ensure safety and security of assets like people with psychological disorder, women, children and any valuable objects. The major advantage is the use of sensors like sound sensor and vibration sensor that sense and alert. IOT Asset Tracking System can be used for both personal and business purpose. In future, IOT Asset Tracking System is going to play a major role in our day to day life.

EEPROM can be used to store the previous navigation position up to 256 locations by increasing its memory. The accuracy of GPS receiver can be increased by increasing its cost. The size of the kit can be reduced by employing GPS and GSM in the same module. The system can be extended to track vehicle and with the help of high sensitivity vibration sensors accidents can be detected and send the location to the owner, hospital and police.

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