IoT based Theft Detection and Alarming System for Farm Equipment

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Abstract--The Internet of Things (IOT) is the driving force for a great deal of innovation and economic activities. It is interconnection of uniquely identifiable embedded devices within the existing internet infrastructure. In this project the concept of IoT has been expanded to agriculture. As we know that farm equipments are costly and their theft is a very common problem faced by our farmers. The purpose of this project is to make a device which will help them to monitor their farm equipments and prevent theft. Implementation consists of sensing parameters like motion of the object and location of the device and alerting them in case of any variation in their position or motion through mobile phone. A wireless network is setup between farm devices and a central server which will further communicate with Android Application which will receives alarm of theft and location of the device using global positioning system (GPS) of theft device.

Keywords— IoT, embedded, wireless, networking, Xbee.

INTRODUCTION

Electronics gadgets are not only for urban and smart cities, it is equally important for rural areas as well. Agro electronics products are aiming to improve the productivity and lifestyle of farmers. With the expansion of technology and connectivity, it is now possible to provide solutions to many problems faced by the farmers. One of such problem is theft of agricultural equipments lying on the farm. In this project an attempt has been made to provide security to the farm equipments using IoT. This project is divided into three units. The first unit is attached with the concerned equipment. This first unit consist of four element GPS, accelerometer, X-bee transmitter and Arduino. This unit is used to detect the motion and vibration of equipment. It will send the position of equipment and alert message to the server.

The second unit consisting of two elements Raspberry pi, X-bee receiver and Wi-Fi capability. This unit is used to receive the message and location of equipment using unit one. The position of equipment is stored in micro SD card and this data is put on web server.

Interconnectivity of devices is achieved through combination of different protocols. On ground wireless network X-bee is used which uses IEEE 802.15.4 standard [1]. In order to send the data a server is connected with sufficient data storage capacity and efficient database management system. Two database management choices MYSQL and Mongo dB can be used . Here MYSQL is used to store structured data generated by GPS and message.

To receive the message an android application has been developed. This android application has the feature to notify about the theft and location of the device. With the help of this app and google map the device can be tracked easily. There is also provision of resending the message to alternate number if notification is not received within 15 minutes of sending the message.

2. DESIGN AND FLOW CHART OF THEFT DETECTION DEVICE

The theft detection device is a portable small device can be attached to any of the farm equipment as desired. With central server different devices can be connected simultaneously as shown in Fig 1. Each device consists of four blocks, Accelerometer, GPS tracker, Arduino and zigbee transmitter as shown in Fig 2.
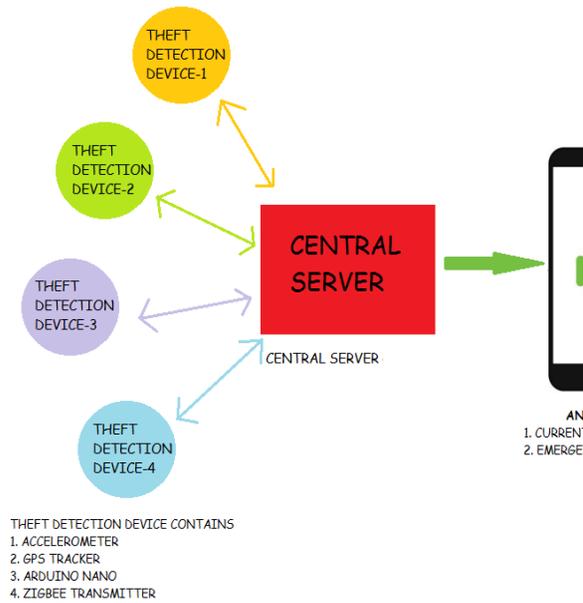
digital interface can either communicate over I2C or SPI communication protocols.

Here the accelerometer will detects the motion of the object to which it is attached and Passive Infrared (PIR) sensor detects the thermal energy emitted by any human body.

Accelerometer show acceleration through varying voltage levels when interface with an analog mode. These values fluctuate between ground and the supply voltage level. The microcontroller can read these values on analog to digital converter (ADC), it is used analog mode because it is less expensive than digital accelerometers. It is connected to accelerometer which takes vibration or motion as input and convert into analog value which have range of (0 – 255) it gives value equal to zero when there is no vibration or motion on the equipment and it gives maximum value 255 when maximum vibration and motion occur on equipment.

THEFT DETECTION DEVICE CONTAINS
1. ACCELEROMETER
2. GPS TRACKER
3. ARDUINO NANO
4. ZIGBEE TRANSMITTER
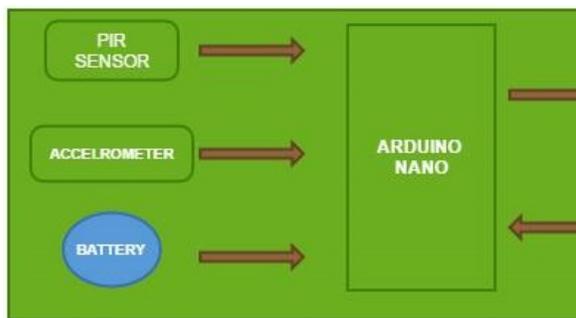
Fig 1. Block Diagram of System

Fig 2. Theft Detection Device

This device has separate hardware and software control for switching ON / OFF. It has visual indication for its state through different color of light emitting diode (LED). Indications are also provided to check that the device is working correctly.

Accelerometers are devices that measure acceleration, which is the rate of change of the velocity of an object. Accelerometers are useful for orientation applications or for sensing vibrations in systems. Accelerometers with a
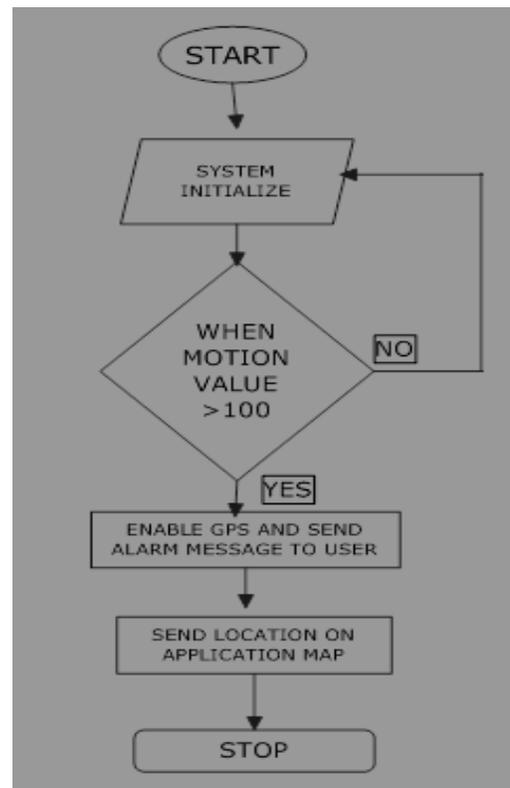

Fig 3 Flow Chart of Device

	Parameters	Wi-Fi	Bluetooth	Zig-bee
1	IEEE standard	802.11 a/b/g	802.15.1	802.15.4
2	Frequency	2.4 GHz, 5 GHz	2.4 GHz	2.4 GHz
3	Power consumption	High	Low	Lowest
4	Communication range	100 m	10 m	10 m-100m
5	Data Security	32 - bit CRC	16 - bit CRC	16 – bit CRC
6	Max number of nodes	2007	8	>65000
7	Application	Computer to computer connection	cordless mouse, keyboard	wireless monitoring and control

These tend to have more functionality and be less susceptible to noise than analog accelerometers.

Arduino is an open source electronics platform. It is easy to use hardware and software. It's intended for anyone making interactive program for their projects.

Arduino senses the environment by receiving input from many sensors, and effect it's surrounding by controlling lights, motors and actuators.

Fig 3 indicates the flow of event of the device. A cut off value is set for accelerometer readings which when exceeded enables the GPS and send alarm message about theft to the application and then it sends GPS location of device to the application.

ZigBee based on IEEE 802.15.4 specifications is used as communication protocol to create personal area network (PAN) enabling low power communication. It is less expensive and low energy consuming than the wireless personal area network (WPAN), Bluetooth and Wi-Fi. Mesh networking is used to connect different ZigBee device to each other to increase the distance of communication. It can also be used for point to point and point to multipoint communication by forming mesh network. Table 1 gives the comparison of various protocols which can be used and helped us to select the most appropriate one.

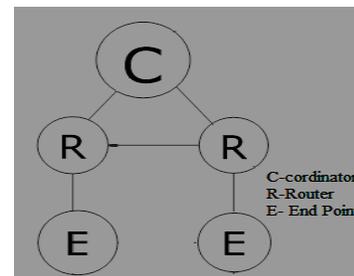Table 1: Difference between different protocols:

Fig 4 Diagram of ZigBee configuration

2.2 ZIGBEE NETWORKING

Zigbee networking is employed in this project. The configuration is shown in Fig4. There are three types of devices:

1. Network Coordinator – It select PAN ID and channel to   start the network and allows routers and end point devices to join the network. It can assist router for data. It will never sleep.

2.Router – It must join the ZigBee PAN before transmitting and receiving data. Multiple routers are possible in a network. After joining network it can be connected with end point devices. It will also never sleep.

3.End devices – Multiple end point devices can be connected with routers. End point devices must connect with ZigBee PAN. They enter a low power mode (sleep mode) when not in use.

2.3 PAN ID

Personal area network ID is required for each ZigBee network. ZigBee network is a personal area network. Coordinator device must select a unique PAN ID. To connect each device to coordinator they should match with coordinator's PAN ID. End point devices can be connected with routers. These routers become parent devices for end point devices. End point devices can be sleep. So parent device must be able to retain or buffer incoming data till the end device able to wake and receive data.

Another important block of the project is a central server which will receive location and alert message from theft device. It has raspberry pi which is interfaced with X bee receiver and enable Wi-Fi which is further connected to web server and receives data form raspberry pi [4][5]. The Raspberry Pi is a series of credit card–size single board computer which is developed by the Raspberry Pi Foundation with the intention of promoting the electronics knowledge in schools.

The Raspberry Pi is based on the Broadcom BCM2835 system on a chip (SoC), which includes an 700 MHz ARM1176JZF-S processor, Video Core IV GPU and RAM. It has a Level 1 cache of 16 KB and also have a Level 2 cache of 128 KB. The Level 2 cache is used primarily by the GPU. The system on chip (SoC) is stacked underneath the RAM chip[6][7].

The received data is used to send on android application. For making web server HTML and PHP is used where we can store our information of received data it contains current location of device and also store previous location of the device [8].

The last unit of design is making a android application which is made using JAVA language, MYSQL and Android studio. Android studio is an official IDE which is based on IntelliJ IDEA for Android Application development.

A working model of server is shown in Fig 5.

Fig 5. Working model of Central Server

Android studio offers flexible gradle which is based build system. It also contains code template to help you build common application features. It also contains rich layout with support for drag and drop theme editing.

Using Android studio three sections are made in which first section consist of login page of the application. Second section contains enable and disable the device using sending command to the device which will took the device in sleep mode. It also has display of unique identification number (ID) of each device. In third section of android application which have facility to display the correct location of the device and it also help to track the device when it is theft [6][7].

For display of Google Map, use of Google Application Programming Interface (API) is preferred. This API is a set of routines, protocols, and tools for building software applications. It specifies how software components should interact and it is used when programming graphical user interface (GUI) components required [9]. It is a free web mapping service which provides various types of geographical information. To customize maps and the information provided by the maps and include these in web page, Google Maps provides a JavaScript API [10].

A complete unit is assembled and successfully tested. It is capable of detecting any motion or vibration above the cut off value. It also sends alarm message and enable GPS to locate the current position. Further

Arduino uses it to send to raspberry pi which inturn is connected to the central server to alert the user through to the android application over mobile phone.

Results are satisfactory and meet the requirement of the end user.

4. CONCLUSION

Theft detection device is a successfully designed and tested to meet the specifications. Further attempt can be made to reduce the cost and make it commercially viable.

5. REFERENCES

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