RESEARCH ARTICLE OPEN ACCESS

A secure Bluetooth-ZigBee gateway for IoT

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Abstract:

The inescapability of savvy remote gadgets is quickly developing independent to the innovation and applications. All these shrewd gadgets are associated with web for checking, breaking down and controlling. There are such a large number of remote conventions, for example, Zigbee, Bluetooth, Wi-Fi, Wi-max and ultra wide band. Each convention has its preferences and inconveniences in light of information rate, control, cost, measure. In the current time there is quick advancement of Zigbee in keen applications. In this paper we are building up a model plan of an ease remote checking and controlling framework utilizing Bluetooth, Zigbee by taking a shrewd home application. All the sensor hubs are arranged with Zigbee (TICC1101) convention and the passage comprises of Zigbee module and Bluetooth module. The passage is fit for changing over Bluetooth and Zigbee conventions the other way around. The got information at the passage is pushed into web through advanced cell. The paper depicts the plan and usage procedure of passage equipment what's more, programming. This paper comprehends the container neck caused by two convention transmission rates and presents a bi-bearing information change strategy.

Keywords — **Bluetooth , Gateway, IoT, Protocol converter, Zigbee.**

I. INTRODUCTION

The gathering of remote sensor systems can convey extensive variety of uses. It assumes fundamental part with regards to checking and investigating. Utilizing remote sensor systems is a major factor in applications, i.e for example, home services robotization, medicinal based services, condition checking, understanding observing and mechanical computerization. Bluetooth and Zigbee are two noteworthy remote system conventions that are utilized as a part of the majority of the applications. As they have numerous key factors that can bolster the vast majority of the applications. These two are short scope of utilizations where Bluetooth is balanced correspondence and Zigbee is one too much. Both are low power gadgets. Utilizing remote sensor organizes the gadgets can interface or contact over the web. Utilizing the web server the gadgets can publicize and work whenever and from anyplace. Web of things (IoT) is a framework that can possibly exchange the information over the system without human exertion. It gathers the information from sensor hubs and sends to web utilizing remote sensor systems. It assumes premier part in robotizations. By utilizing IoT one can control the gadgets from anyplace independent to the separation and time. The IoT framework is perfect with various sorts of correspondence conventions, for example, Zigbee, Bluetooth, WI-Fi, WI-Max and so on. It obeys multi-convention handset idea. A significant number of the IoT frameworks convey through Bluetooth. There are numerous unreservedly accessible IoT web servers which can be associated through PDA by a basic Bluetooth gadget. Web of things (IOT) gives free servers through one can screen and control the applications. Thingspeak is the of the uninhibitedly accessible server. The utilizations of the IoT framework are appeared in Figure 1. The encoding ability is one of the primary points of interest of IoT framework. Both Zigbee and Bluetooth perform at low recurrence i.e. 2.4GHz. Furthermore, they work for short separation applications. Both Zigbee portal and Bluetooth passage are composed and executed progressively. Together consolidating these two doors one can accomplish more noteworthy outcomes with low power and low information

misfortune and less cost. We can interface up to 65000 gadgets for a solitary Zigbee organize.

Fig. 1 Applications of IoT.

II. DESIGN AND IMPLEMENTATION OF HETEROGENOUS WIRELESS GATEWAY

Keeping in mind the end goal to accomplish the benefits of joining diverse sorts of conventions one should plan an entryway through which they can convey with each other. The entryway is a gadget which is having an information cushion in which the information will be put away. In the door the information from the source will be spared at whatever point there is a demand from the goal the transformation system will be done in view of the goal convention. HWG (heterogeneous wireless gateway) is extremely helpful with regards to information exchange between more than one sort of conventions or systems.

III. WIRELESS COMMUNICATIONS

A. BLUETOOTH COMMUNICATION

The Bluetooth low energy communication is established with a short radio signal with minimal range and desires least power to function the device. In many smart mobiles, this BLE is playing a dominant role in all the short range communications. The Energy consumption and the transmission energy are more efficient in BLE than the. In a star topology, the BLE operates on a combination of master and slave nodes. The slaves send hop messages to the master to enable their communication. To consume power the devices are held in sleep mode. Bluetooth range is (1to 10 m)

B. ZigBee

ZigBee is wireless communication. ZigBee is low power and low cost wireless mesh network standard target at the wide development of long battery life devices in wireless monitoring and controller applications. ZigBee range 1 to 20 meters. It can data rates vary from 20 kbit/s to 250kbit/s. it typically integrated with radios and microcontroller that have between 60-255 KB flash memory. ZigBee is one of the global standards of communication protocol formulated by the significant task force under the IEEE 802.15 working group.

1) ZigBee Coordinator (ZC):

The most capable device, the Coordinator forms the root of the network tree and might bridge to other networks. There is precisely one ZigBee Coordinator in each network since it is the device that started the network originally (the ZigBee Light Link specification also allows operation without a ZigBee Coordinator, making it more usable for over-the-shelf home products). It stores information about the network, including acting as the Trust Center & repository for security keys.

2) ZigBee Router (ZR):

As well as running an application function, a Router can act as an intermediate router, passing on data from other devices.

3) ZigBee End Device (ZED):

Contains just enough functionality to talk to the parent node (either the Coordinator or a Router) it cannot relay data fromother devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and, therefore, can be less expensive to manufacture than a ZR or ZC.

4) Typical application areas include:

Home Entertainment, Wireless sensor networks, Industrial control, embedded sensing, Medical data collection, Smoke and intruder warning and Building automation.

C. Wi-Fi Communication

Wi-Fi is a wireless communication it provides the internet. The combination of computer and interface controller is called a station. It is better wireless

communication compare to the Bluetooth and ZigBee and NFC. Because of these three is short range compare to Wi-Fi. The IEEE 802.11 standard is a set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN) Devices that can use Wi-Fi technology include personal computers, video games consoles, smart phone, digital camera, tablet computes, digital audio players and modern printers. Wi-Fi compatible devices can connect to the Internet via a WLAN network and a wireless access point. Such an access point (or hotspot) has a range of about 20 meters (66 feet) indoors and a greater range outdoors. Hotspot coverage can be as small as a single room with walls that block radio waves.

IV. IOT IN HOME AUTOMATION

Home automation can be done in many ways. Zigbee and Bluetooth are the most commonly used devices in home automation. Bluetooth's or ZigBee are connected to the home appliances these are paired up with the available devices in the controller side. They used to exchange the data continuously.

Internet of things is employed into devices required in independent housing means Home IoT. Home IoT is an industrial field that has close affiliation with human personal life and that the field that spells wide area that relevant to personal consumption. Home IoT relevant to industries there are such things as home network security, smart appliances/smart fusion devices, home health, smart running, green home building, home media Smart devices wired and wireless networks, IoT communication standard, control devices, operating platform, and content which is called the 6 components of home IoT's by dearth need use of home IoT by the user. In the smart device section there is introduction of active products in the manufacturing sections. The communication system will be based on smart phone devices. And it can be classified into two types

A. One-way communication:

The one way communication devices, the communication will be done in only one way that means the devices that works only in the purpose of delivering and displaying information of collected data and transmit it to the user.

B. Two-way communication:

The two way communication devices assign to devices that monitor and control the devices that connected to the home environment. The whole information will be sent to the administrator. In the two way system the users controls and monitor the devices by remotely using home network. The input that given to the two way devices are done based on the smart phone (smart devices) and makes the user perceive the transmitted data or information from the devices by displaying it in monitor or LED. Here the whole commands will be inputted in the smart phone through the internet is delivered through the IP router to the IoT gateway system to monitor and operate the connected home IoT devices.

According to the user needs the IoT devices are developed and it is being designed and developed so that various devices can be controlled and monitored in various environments. There is intended relation among the home environment and the asset tracking to enhance the security. The IoT devices in the home environment are reliable and don't have any failure in the communication. Many products such as gas, lighting, waterworks are having a ample response and relation with the IoT devices. The IoT devices must not be malfunctioned, if they experience any malfunctions the total control of the devices will run out and causes problems to devices in home environments. The security measures are employed so as to eliminate the cases of malfunctioning of devices.

V. IMPLEMENTED SYSTEM

Figure 2 shoes the block diagram of the Zigbee and Bluetooth converter. In this we placed three sensor nodes temperature sensor, LDR, and smoke sensor. All three sensor nodes are placed at a distance of 100 meters. In this each sensor node contains corresponding sensor module, a micro controller and a Zigbee module (TI cc1101). The two way communication is achieved through the data transfer between Zigbee to Bluetooth and from Bluetooth to Zigbee. We can use any type of sensors based on the application. The accuracy of

the results depends on the module performance. The Bluetooth and the Zigbee are connected serially to the Raspberry pi. Here we are using raspberry pi 3 module.

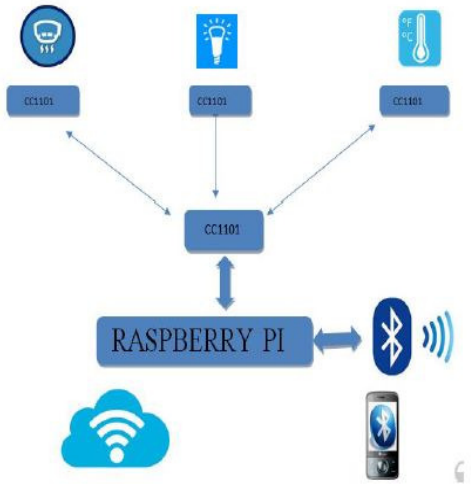

Fig. 2 Implementation of ZigBee to Bluetooth Converter.

The complete module is designed using four sub modules as Temperature Module, LDR Module, Smoke Sensor Module and Processor Module.

Each node consists of a regulated power supply and a LED (light emitting diode) and a sensor module based on the application, one zigbee transceiver and an ADC module. The zigbee transceiver used to send and receive the data form other zigbee modules to the sensor node. ADC is used to take the analog input and convert it into required digital form. Here we are 10 bit ADC.

Once the power is ON to the sensor node the microcontroller reads the sensor value through ADC converter at a resolution of 12 bit. So the maximum value will be 4096 bits. Once the data is read by micro controller it analysis the data and convert it into the required Zigbee format by using the formula

Temp = (value from ADC/51) * 3

LDR= (value from ADC/41) + 80

SMK= (value from ADC/54) +180

Once the data is converted it fed to Zigbee through UART. Now the Zigbee will encode the data as per 802.15.4 standards at 2.4 GHz and fed to antenna which radiates in to air. In the gateway side the Zigbee receives the data which is radiated to the air by the sensor node and gives to the processor through a serial communicator. The processor decodes the data and converts to the Bluetooth frame format from Zigbee frame format.

In order to analyze and monitor we developed a smart phone application as shown in figure 3 which is capable to control and analyze. The mobile Bluetooth is paired up with the Bluetooth module at the processor side. Now the data will display in mobile application.

Fig. 3 Android Application for monitoring the data.

All the received data is stored in thingspeak server through IoT cloud. It is a freely available IoT server. We can analyze and monitor the data through it. The data will be shown in a graphical format. Whatever the data received in the Bluetooth app will send to the thingspeak account based on the API. API is a unique identity code which is generated at the time of account creation.

VI. RESULTS

The results can be monitored in two ways. One is through BT-IOT mobile app. Second is through IOT server which we are using “thingsspeak”.

Data collected from sensor nodes given to Bluetooth through Zigbee and displaying results in

mobile app paired through Bluetooth shown in figure 4.

Fig. 4 Readings in Mobile Application.

Data uploaded to IoT server (Thingspeak) through mobile app the data will be uploaded after every 15 seconds. The variations in the reading are shown using graphical representation. All the sensor nodes are plotted separately. Figure 5 depicts the temperature reading. The Figure 6 depicts the LDR readings. The Figure 7 depicts the Smoke senor readings and depicted graphically.

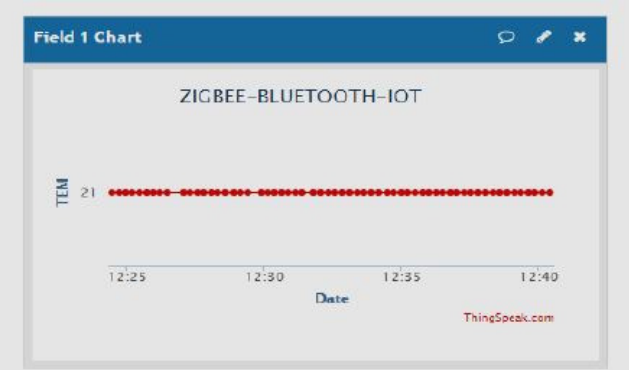

Fig. 5 Temperature readings in Thingspeak.

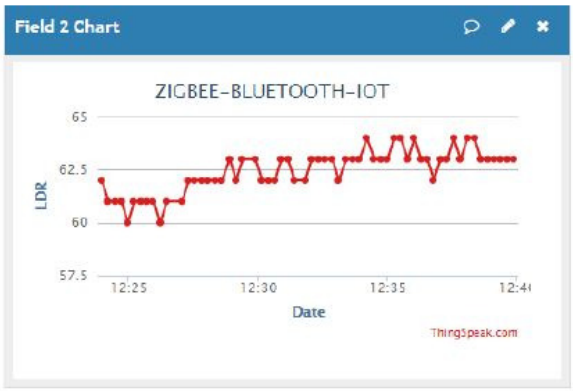

Fig. 6 LDR readings in Thingspeak.

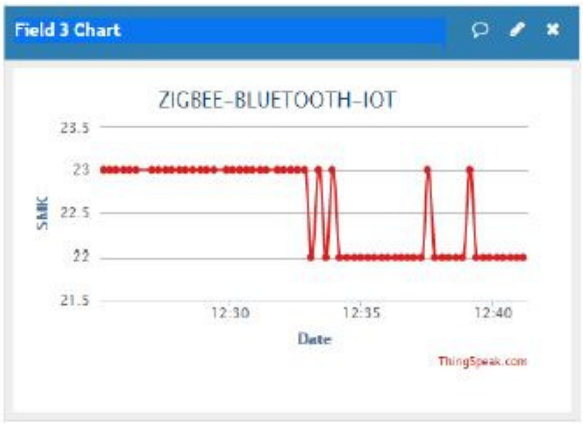

Fig. 7 Smoke Sensor readings in Thingspeak.

VII. CONCLUSIONS

The basic micro processor for this paper is raspberry pi. And the core devices for designing and implementation of wireless gateway are Bluetooth and Zigbee modules. The gateway establishes the short-distance transmission of Zigbee and remote data transmission of Bluetooth. It is effective in transforming Bluetooth protocol information or Zigbee protocol information vice versa and transmitting them to one another. Through performance test we can decide whether the performance and stability of wireless gateway suits for multipurpose. By using effective devices we can use this model for all types of automations and for monitoring at a low frequency with low cost. It is very effective in real time environment for data acquisition. By using Zigbee and Bluetooth conversion it is easy to monitor. By using IoT the ease for monitoring and controlling becomes easier.

ACKNOWLEDGMENT

The Authors are thankful to B.S.S.Tejesh and S.Neerja for their constant support to accomplishing this work.

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