

DESIGN OF WIRELESS GATEWAYS FOR REMOTE PARAMETER MONITORING AND CONTROLLING

Avinash Babu Uttarkar, Suresha H.S.

Abstract—Being fashionable and important protocols in short range Wi-Fi communication, Bluetooth Low electricity (BLE/Bluetooth clever) and ZigBee square degree basically applied in web of factors and wireless Sensor community (WSN). Simplest way to talk with those protocols over the internet is to use a gateway. This paper proposes a fashion of gateway to talk with every protocol using a single gateway. This fashion reduces the rate of mistreatment separate gateways for separate protocol. The Bluetooth module is embedded on the gateway for all Bluetooth enabled sensors. One radio modules of ZigBee square measure embedded on the gateway, one for expertise gathered at durations and any other for streaming understanding. Programming is finished with the assistance of a windows gadget. This fashion furnishes blessings of every the protocols and conjointly will boom the info transmission rate of ZigBee with decreased latency, with addition to that a TFT touch display module is attached at the transmitter cease to manipulate wireless sensors.

Index Terms—TFT, Bluetooth Low Energy, Gateway Module, ZigBee, windows, Wireless Sensor Network.

I. INTRODUCTION

Wi-Fi Sensors Networks are advanced exponentially over the past decade. it is been terribly high-quality and a key think about the occasion of maximum of the domains like domestic automation, attention and clinical applications, environmental parameter looking, and many others. two of the foremost used protocols in short distance wireless communication are Bluetooth low energy (BLE) and ZigBee, thanks to their low strength development. Devices having ZigBee or BLE will talk over the net employing an entree that stands between records processing and wireless protocol. Mistreatment entree, information processing addresses will access the Wi-Fi tool without delay as though detector node and significant server are related locally. The crucial server can do process and garage. Facility of visualization and interpretation of the detector node understanding from

wherever whenever is offered mistreatment net interface. Gateway may also be prepared using a internet interface. data

Manuscript received May, 2016.

Avinash Babu Uttarkar, Dept. of ECE, Don Bosco Institute of Technology, Bengaluru, India, 7795337716

Suresha H.S., Dept. of ECE, Don Bosco Institute of Technology., Bengaluru, India, 9845188404.

processing belongings is provided mistreatment local area network or wireless. Low-electricity radio technology region unit most outfitted for internet of factors. BLE features a heap of capability for belongings with records science [1]. Most of customer physical technological know-how devices region unit prepared with BLE. ZigBee is primary in domains like WSN and residential automation, with topology being predominant function. In some packages like putting observance and residential automation, know-how is monitored at durations or on demand. but, in applications like care and clinical appliances, expertise needs to be monitored constantly, for which streaming of facts is critical. Consequently, in the gateway fashion 1 radio modules of ZigBee area unit embedded. One is being hired for understanding to be monitored at durations or on call for and different being committed for streaming information. BLE has almost fourfold better rate as compared there to of ZigBee. hence, one BLE channel is respectable. ZigBee entranceways and BLE gateways are enforced on an man or woman basis considering the assorted options for a gateway like low energy consumption, optimized charge and occasional value. ZigBee entranceway is meant victimization 1 radio modules in [2] for growing information transmission price of ZigBee and serves low latency. domestic automation entranceway is enforced victimization multiple interfaces hired inside the residence placing [3]. A carrier-oriented detector network is enforced victimization internet primarily based frequently technical framework [4]. Golem based frequently multi-protocol wireless entranceway with net interface is moreover enforced [5]. till now, the discussion is limited to the immovableness of gateways; however, there may be a scarcity of dialogue on actual time verbal exchange among finish gadgets and observance servers. In IEEE 802 standards circle of relatives, ZigBee and BLE eat terribly low electricity in comparison to exceptional protocols in the regular. but, ZigBee and BLE encompass a lower fee compared to distinct protocols inside the family. wireless has terribly high rate compared to unique protocols, however consumes fairly a number of strength. The modulation fee for ZigBee and BLE is 250Kbps and 1000Kbps severally. Mesh networking of ZigBee gives excessive reliableness and substantial range. This low cost, low power protocol is appropriate for short distance wireless embedded packages, building automation, scientific expertise packages, commercial control, and so on. BLE assist significant amount of superstar networked gadgets. a tool will act as a vital and a peripheral at same time. A imperative will connect to multiple peripherals and a peripheral will connect to a couple of centrals [6] [7]. BLE is common in consumer physical technological know-how applications, healthcare, cellphone software improvement and without a doubt extensive utility

domain names. every ZigBee and BLE place unit foremost contenders in the protocols race for internet of things (IoT). Protocol stacks for each protocols region unit pretty completely distinctive. Protocol stack for ZigBee resembles with the OSI version with main 4 layers. BLE stack differs extensively with the former variations of Bluetooth. Bluetooth true prepared devices place unit twin mode gadgets that location unit compatible with each Bluetooth traditional and coffee power. Touch screen is likewise blanketed to reveal and control of Wi-Fi Sensors Networks which might be to be had at far flung location network.

This paper is coordinate as follows: Section II describes the overall representation of the system and section III tells about the Overview of Gateway. Architecture of Gateway in section IV. Finally conclusion is formulated at the end of this paper.

II. OVERALL STRUCTURE OF SYSTEM

A device node in wireless device network collects the information unendingly or sporadically and passes the information to the entree through the network. The destination address of all nodes is ready to the address of the entree. The entree provides information processing property to wireless device network. The collected knowledge area unit transferred to observance sever. The server stores the collected knowledge. If action is needed to be taken, sever sends back the response to wireless device network through the entree. Collected knowledge is monitored in real time by work in to the server employing a applications programed. Fig. 1 shows the summary of remote parameter observance system.

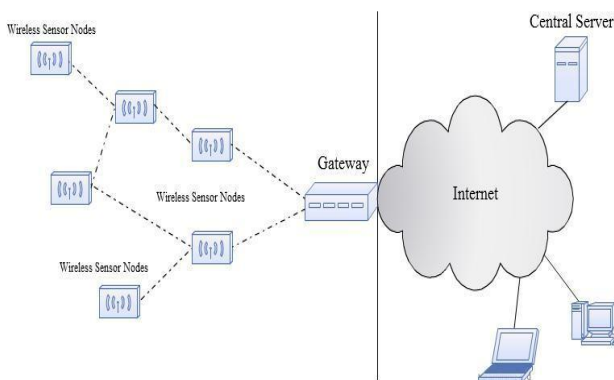


Fig.1. Remote Parameter monitoring System

Sometimes giant knowledge is collected to predict likelihood of the close to future incidence of an incident. This kind of knowledge assortment is finished in weather observance. This kind of knowledge wants not be collected unendingly. It is detected in interval of minutes or once a modification within the knowledge happens. In some applications, like medical applications electrocardiogram device knowledge, knowledge has to be collected unendingly with minimum sampling time. this kind of applications wants knowledge streaming. Data output rate of low power wireless protocol is additionally less. Thus low power wireless network has to be optimized for knowledge streaming. As knowledge output rate of ZigBee is below BLE, dedicated channel is provided for streaming at the entree. ZigBee is optimized for knowledge streaming to urge knowledge output rate up to 256Kbps [8] [9].

III. OVERVIEW OF GATEWAY

Design of entree is made on high of 32-bit MCU with windows based. The planning of processes on the entree is completed by Windows primarily based OS. In the main 3 processes associated with the entree can run on the Windows i.e. BLE knowledge transfer method, ZigBee polling knowledge transfer method and also ZigBee knowledge streaming transfer method. Every method has multiple threads running. These processes are delineated within the design of the gateway. A BLE radio module and ZigBee radio modules are embedded on entree with their various interfaces (UART or I2C) for wireless network property. For scientific discipline property on the opposite aspect of the entree, local area network further as Wi-Fi interface is provided.

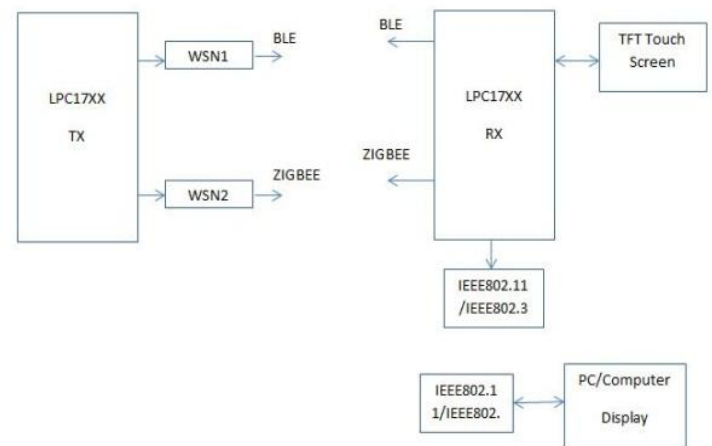


Fig.2. Block Diagram of Gateway

IV. ARCHITECTURE OF GATEWAY

This block describes the design of gateway in sections. First ZigBee network data format and connection is represented that is common for each polling knowledge and so BLE network data format and knowledge transfer sequence is represented these two data information can be displayed on the TFT touch Screen.

A. ZigBee Network Initialization

Fig.3 Illustrates the format of the network with a ZigBee organizer on the gateway and ZigBee finish device as device node. The ZigBee device node is organized with sleep mode.

- 1) To type a private space Network (PAN), organizer broadcast beacon request for existing occupied PAN-IDs.
- 2) If the other PAN exists within the vary of organizer, organizer of adjacent network can respond with occupied PAN-IDs. Consequently organizer chooses the acceptable PAN-ID.
- 3) To connect with device node, user has to log in to the webpage of the entryway. Upon scanning request from user, organizer can scan the beacon requests from device nodes. On the device aspect, the ZigBee finish device broadcasts the beacon request for connection a PAN with PAN-ID 0xFFFF in intervals of many seconds.
- 4) As organizer gets letter of invitation from device node, organizer responses with its own PAN-ID if the user permits to attach therewith ZigBee finish device. The user ought to attest the top device by recognizing the raincoat ID of the top device.

- 5) Now, ZigBee finish device requests for network association. This request is encrypted with a secret key.
- 6) Coordinator checks the coding with a secret key. If the coding fails, then gateway problems a warning to user. If coding matches, then all the subsequent communication becomes encrypted.
- 7) For fortunate association, organizer accepts association request by providing 16-bit address for node. Information overheads will be reduced victimization this 16-bit address for communication.

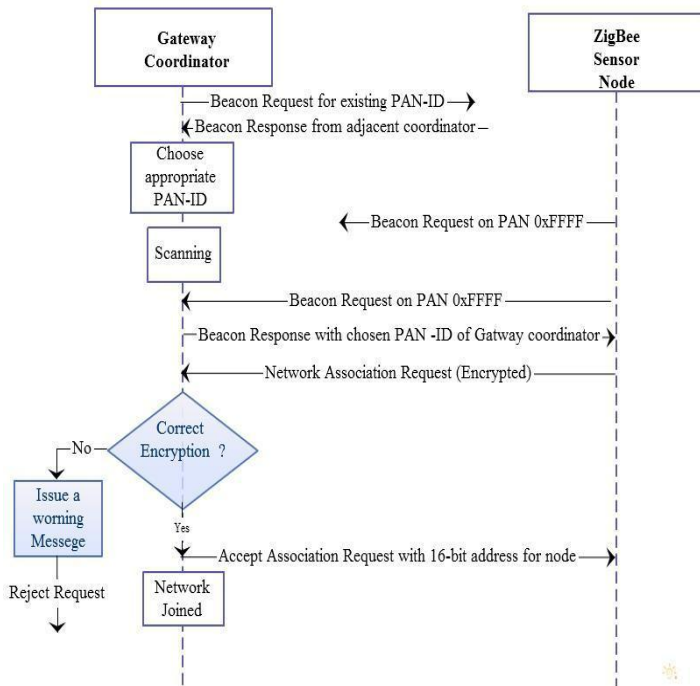


Fig.3. ZigBee Initialization

B. Polling data transfer sequence for ZigBee

Fig.4 illustrates the polling information transfer sequence over ZigBee. To piece the sensing element node for causation periodic information, user has to produce an applicable profile in keeping with sensing element hooked up on the node. The profile has values of interval period for information assortment and sensing element association configuration.

- 1) Coordinator sends the user elect profile to the sensing element node.
- 2) According to the profile, ZigBee finish device starts causation perceived information in profile such intervals.
- 3) Coordinator collects the info and checks whether or not the info is in applicable format. If not, information gets rejected. If the info is attested then acknowledgement is shipped back to sensing element node.
- 4) At entryway, the info is collected in buffer. Collected data is shipped to observation server victimization SSL enabled transmission control protocol socket wherever it gets keep in information base.
- 5) Monitoring server sends back the acknowledgement response to the gateway and user will monitor.

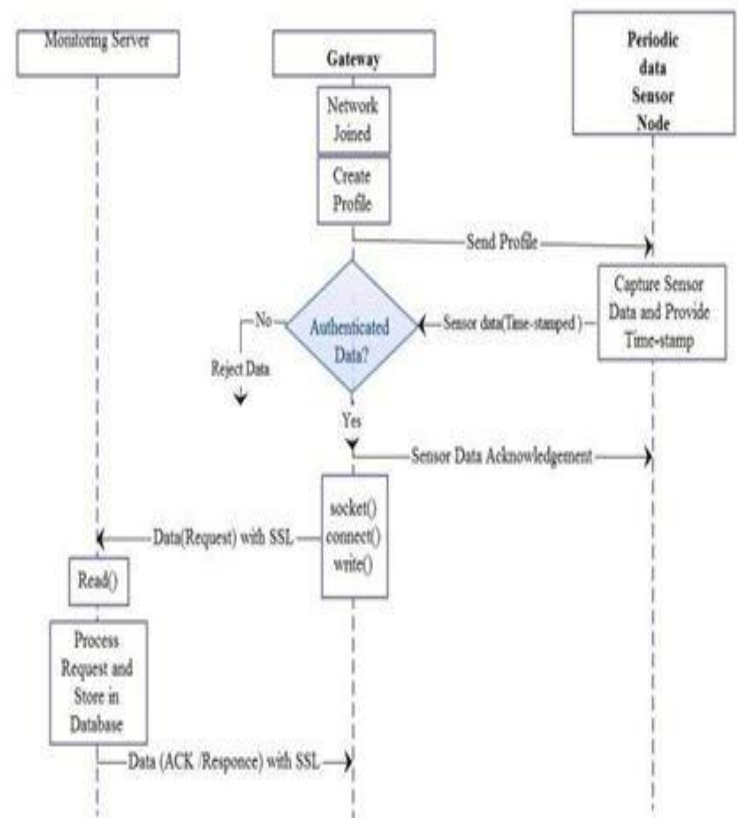


Fig.4. ZigBee Polling data Transfer

C. Bluetooth Low Energy data transfer Sequence

Fig. 5 illustrates the network low-level formatting and knowledge transfer sequence for Bluetooth Low Energy. GATT profile services and characteristics must be accessed for act with the BLE device. Conjointly UUID for BLE device must be familiar to access the profile. User must log in to website of gateway to tack the remote BLE device and to line the profile.

- 1) BLE device node acts as peripheral and broadcasts packaging on the packaging channel for affiliation.
- 2) Gateway BLE radio acts as central and acknowledges the peripheral once scanning. User must settle for the pairing with peripheral.
- 3) Gateway sends service discovery request to peripheral for accessible services in GATT profile. To that peripheral provides a response with accessible services on device node device.
- 4) Central chooses the specified service and request the peripheral for relevance change characteristic of the service.
- 5) Central writes the values thereto characteristic to change that device. Currently device on the node becomes enabled.
- 6) To browse the device price, central obtains relevance browse characteristics. Price there to characteristic provides the device reading.
- 7) Notify price request for corresponding characteristic can give device reading price once parameter changes. Similarly, knowledge streaming may also be done on BLE.
- 8) The collected knowledge is transferred to observation server mistreatment SSL enabled socket. And user will monitor the info by work in to the server employing a application.

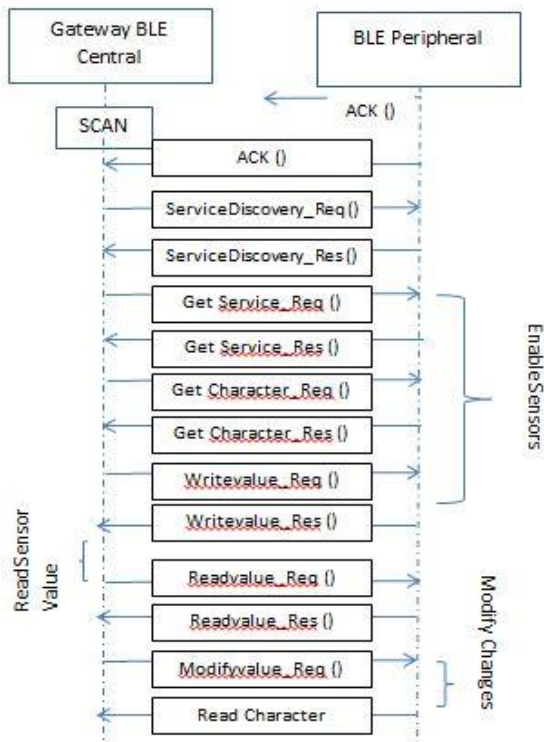


Fig.5. Bluetooth Data Transfer

C. TFT Touch Screen Module

A 'thin-film-transistor liquid-crystal show' (TFT LCD) could be a variant of a liquid-crystal display (LCD) that uses thin-film electronic transistor (TFT) technology to boost image qualities like addressability and distinction. A TFT alphanumeric display is associate degree active-matrix alphanumeric display, in distinction to passive-matrix LCDs or straightforward, direct-driven LCDs with a couple of segments. TFT LCDs area unit utilized in appliances together with tv sets, pc monitors, mobile phones, hand-held computer game systems, personal digital assistants, navigation systems and projectors. TFT LCDs also are utilized in automotive instrument clusters as a result of the permit the motive force to customize the cluster, moreover as having the ability to supply associate degree analogue-like show with digital parts. External shopper show devices sort of a TFT alphanumeric display feature one or additional analog VGA, DVI, HDMI, or Display Port interface, with several that includes a range of those interfaces.



Fig.6. TFT touch Screen 320X240

Within external show devices there's a controller board that may convert the video signal mistreatment color mapping and image scaling typically using the separate circular function rework (DCT) so as to convert any video supply like CVBS, VGA, DVI, HDMI, etc. into digital RGB at the native resolution of the board. During a portable computer the

graphics chip can directly manufacture a symbol appropriate for affiliation to the intrinsic TFT show. An impact mechanism for the backlight is sometimes enclosed on an equivalent controller board. The low level interface of STN, DSTN, or TFT show panels use either single complete TTL 5 V signal for older displays or TTL three.3 V for slightly newer displays that transmits the component clock, horizontal correct, vertical correct, digital red, digital inexperienced, digital blue in parallel. Some models (for example the AT070TN92) additionally feature input/display modify, horizontal scan direction and vertical scan direction signals. New and huge LVDS transmits seven bits per clock per knowledge line, with six bits being knowledge and one bit wont to signal if the opposite six bits got to be inverted so as to keep up DC balance.

Quality TFT displays usually have 3 knowledge lines and thus solely directly support eighteen bits per component, whereas higher ones have a fourth knowledge line in order that they will support twenty four bits per component that delivers tricolor. Immoderate high finish models will support even additional colors by adding additional lanes that is however 30-bit color is supported by 5 knowledge lanes. Panel makers square measure slowly replacement LVDS with Internal Display Port and Embedded Display Port, which permit six fold reduction of the amount of differential pairs. Backlight intensity is typically controlled by variable some volts DC, or generating a PWM signal, or adjusting a potentiometer or just mounted. This successively controls a high-voltage (1.3 kV) DC-AC electrical converter or a matrix of LEDs. the tactic to manage the intensity of diode is to pulse them with PWM which might be supply of harmonic flicker.

The clean board can solely settle for a digital video signal at the resolution determined by the panel component matrix designed at manufacture. Some screen panels can ignore the LSB bits of the color info to gift a uniform interface (8 bit,6 bit/color x3). With analogue signals like VGA, the show controller additionally must perform a high speed analog to digital conversion. With digital input signals like DVI or HDMI some straightforward rearrangement of the bits is required before feeding it to the rescale if the input resolution does not match the board resolution.

All two data transfer sequences are processed in three different processes of Windows. Each process is made with multiple threads for multiple sensors. The windows efficiently execute each process and threads to provide real-time performance

V CONCLUSION

Windows based mostly ZigBee and BLE entranceway provides an occasional price resolution to attach each protocols with internet. BLE and ZigBee square measure most well-liked protocols owing to their low energy consumption. To integrate each protocol gateways in one embedded platform provides smart solution for style of ZigBee and BLE sensors and their options to be at identical time. 1 channel for ZigBee protocol will increase the information transmission rate of ZigBee and scale backs the latency. SSL and DTLS association provides security in i nternet cloud and 128-bit AES secret writing withknowledge authentication provides security in wireless network. TFT touch screen displays the values from the other end of wireless sensors which can be controlled and Monitored.

Future work is devoted to boost entranceway with Bluetooth 4.2 that has direct compatibility IPv6 and also the data can be received as alert SMS to the mobile.

REFERENCES

- [1] J. Nieminen, C. Gomez, M. Isomaki, T. Savolainen, B. Patil, Z. Shelby, M. Xi, and J. Oller, "Networking solutions for connecting bluetooth low energy enabled machines to the inter net of things," *Network*, IEEE, vol. 28, no. 6, pp. 83–90, Nov 2014.
- [2] H. Y. Tung, K. F. Tsang, H. C. Tung, K. T. Chui, and H. R. Chi, "The design of dual radio zigbee homecare gateway for remote patient monitoring," *Consumer Electronics, IEEE Transactions on*, vol. 59, no. 4, pp. 756–764, November 2013.
- [3] G. Song, Y. Zhou, W. Zhang, and A. Song, "A multi-interface gateway architecture for home automation networks," *Consumer Electronics, IEEE Transactions on*, vol. 54, no. 3, pp. 1110–1113, August 2008.
- [4] X. Wei, L. Jian-fu, and Z. Guo-dong, "Applications of web technology in wireless sensor network," in *Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference on*, vol. 5, July 2010, pp. 227–230.
- [5] K. Nanda, K. Nayak, S. Chippalkatti, R. Rao, D. Selvakumar, and H. Pasupuleti, "Web based monitoring and control of wsn using wingz (wireless ip network gateway for zigbee)," in *Sensing Technology (ICST), 2012 Sixth International Conference on*, Dec 2012, pp. 666–671.
- [6] K. Townsend, C. Cufi, and R. Davidson, *Getting Started with Bluetooth Low Energy: Tools and Techniques for Low-Power Networking*, ser. EBSCOhostebooks online. O'Reilly Media, 2014. [Online]. Available: <https://books.google.co.in/books?id=24N7AwAAQBAJ>.
- [7] M. Benocci, E. Farella, L. Benini, and L. Vanzago, "Optimizing zigbee for data streaming in body-area bio-feedback applications," in *Advances in sensors and Interfaces, 2009. IWA SI 2009. 3rd International Work-shop on*, June 2009, pp. 150–155.
- [8] D. Brunelli and L. Teodorani, "Improving audio streaming over multi-hop zigbee networks," in *Computers and Communications, 2008. ISCC 2008. IEEE Symposium on*, July 2008, pp. 31–36.