Technical journals online.com

Research Article

DESIGN AND DEVELOPMENT OF AUTOMATION SYSTEM ON UPS, STAND ALONE MODULE WITH ZIGBEE

[1] Mr. A.A.Patel, [2] Mrs. A.P.Gharge, [3] Mr. B.L.Solanki

Address for Correspondence

[1]M.E.[EC] Student, [2] Asst. Professor, Department Of Electronics and Communication Engineering, Parul Institute of Engineering And Technology, Wagodiya,Gujarat

[3] Engineer, Aplab Ltd., Ahmedabad ,Gujarat

ABSTRACT

Wireless communication and industry has opened many challenges and opportunities for innovation. ZigBee is an IEEE 802.15.4 standard for data communication with business and consumer devices. In industry ZigBee is being used for next generation automated manufacturing, with small transmitters in every device, allowing for communication between devices to a central computer or personal computer for each device. This system design User friendly easy to use stand alone module with highly reliable communication method which eliminates the need of external servers/computers, and may control any type of industrial device which can be programmed easily in the system.

KEYWORDS Wireless standard, Zigbee, IEEE 802.15.4, prevent memory problem, Medium Access Control (MAC) and Physical Layer (PHY),without main device.

I : INTRODUCTION

ZigBee is an IEEE 802.15.4 standard for data communication with business and consumer devices. It is designed around low-power consumption allowing batteries to essentially last forever. In industry ZigBee is being used for next generation automated manufacturing, with small transmitters in every device, allowing for communication between devices to a central computer or personal computer for each device. This new level of communication permits finely-tuned remote monitoring and manipulation. ZigBee technology used in this system and communicate between two system and record all the data during running condition. ZigBee used in this system for communication also developed interface of devices to arm7 processor kit. User friendly easy to use stand alone module with highly reliable communication method which eliminates the need of external servers/computers, and may control any type of industrial device which can be programmed easily in the system. The ZigBee standard provides network, security, and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard but it does not specify any requirements for higher networking layers. ZigBee is a new industrial standard for ad hoc networks based on IEEE 802.15.4. It is used for low data rate wireless networks and sensor networks. ZigBee technology has become the standard of choice among other wireless technologies by overcoming speed limitations found in other wireless commercial automation technologies and by allowing for more devices on a single network. These standards provide higher data rates at the expense of power consumption, application complexity and cost.

II: ZIGBEE WIRELESS SYSTEM

ZigBee is most preferred for wireless sensor network because of its low data rates and low power consumption characteristics but in Bluetooth or Wi-fi there is no low data rate han zigbee and its range is also low in this device. The comparison between ZigBee with Bluetooth and IEEE 802.11 WLAN helps for understanding how ZigBee differentiates itself from existing established standards.[4] Moving to desirable features of ZigBee-based systems, installation should be automatic or semiautomatic so that consumers can easily set up wireless networks. Additionally, adding new hardware to an existing system should be straightforward. Since ZigBee replaces wires and other wireless systems, cost must be kept low to make the change to ZigBee advantageous.The ZigBee standard was developed for wireless communications. It was developed by the ZigBee Alliance, which is a global ecosystem of over 200 major OEMs creating wireless solutions for home, commercial and industrial applications. It is the only global wireless communications standard that allows the development of easily deployable, low-power monitoring and control products. The ZigBee Alliance is supported by several multi-billion dollar OEMs, as well as major suppliers. ZigBee technology is being embedded into a growing number of products across consumer, commercial, industrial and government markets worldwide. The ZigBee communication standard is key to the growth of wireless home and building automation applications where various end products need to communicate with each other.[3]

Sophisticated zigbee automation systems use server or computer for data logging and touch screen module can be placed instead of server/computer for data logging and controlling the device. RF, Wi-Fi system, Bluetooth etc. such types of protocol used for data transmission but instead of this zigbee can be used because of its low data rates and low power transmission use which is much better than the other system not only this but maximum data rates allowed for each of this frequency bands, High throughput and low latency for low duty cycle applications (<0.1%), Addressing space of up to 64 bit IEEE address devices, 65,535 networks, Fully reliable “hand-shacked” data transfer protocol, 50m typical range so because of this types of features zigbee is preferable for data transmission over wireless sensor networks. This table is just shown for comparison between two standards which is described in

reference and it is just only for understanding purpose.

Table1: basic characteristics of three standards [9]

	Bluetooth	Wi- Fi	Zigbee
Band	2.4 Ghz	2.4Ghz	2.4Ghz, 868Mhz, 915Mhz
Power	100Mv	~10mv	30mV
Target Battery life	Days- month	1-2 year	6 month- 2 year
Range	10-30 m	10m	75m
Data rates	1-3 Mbps	1Mbps	25-250 Kbps
Network Topologies	Ad hoc, point to point, star	Ad hoc, point to point, star	Ad hoc,mesh, star

III: Relationship between ZigBee and IEEE 802.15.4 standard

ZigBee wireless networking protocols are shown in Figure 1. ZigBee protocol layers are based on the Open System Interconnect (OSI) basic reference model. As shown in Figure 4.1, the bottom two networking layers are defined by IEEE 802.15.4 standard. This standard is developed by IEEE 802 standards committee and was initially released in 2003. IEEE 802.15.4 defines the specifications for PHY and MAC layers of wireless networking, but it does not specify any requirements for higher networking layers. The ZigBee standard defines only the networking, applications and security layers of the protocol and adopts IEEE 802.15.4 PHY and MAC layers as a part of the ZigBee networking protocol. Therefore, ZigBee-compliant device conforms to IEEE 802.15.4 as well. High density of nodes per network: ZigBee's use of the IEEE 802.15.4 PHY and MAC allows networks to handle any number of devices. This attribute is critical for massive sensor arrays and control networks. Addressing space of up to64 bit IEEE address devices, 65,535 networks. High throughput and low latency for low duty-cycle applications (<0.1%).Low cost (device, installation, maintenance). Low cost to the users means low device cost, low installation cost and low maintenance. ZigBee devices allow batteries to last up to years using primary cells (low cost) without any chargers (low cost and easy installation). ZigBee's simplicity allows for inherent configuration and redundancy of network devices provides low maintenance. Fully reliable "hand-shaked" data transfer protocol.[8]

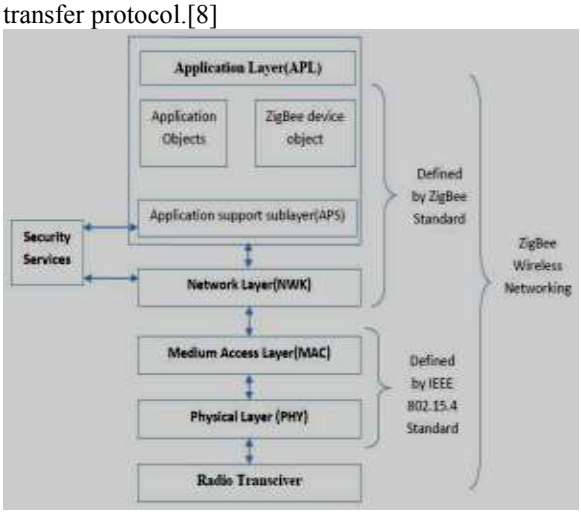


Fig. 1 Relationship between 802.15.4 and Zigbee.

The 868MHz band is used in Europe for a number of applications, including short range wireless networking. The 915MHz and 2.4GHz bands are part of industrial, scientific and medical (ISM) frequency bands. The 915MHz frequency band is used mainly in North America, where as the 2.4GHz band is used worldwide.[7] The overview survey of emerging wireless technologies – 802.11n, 802.15.4 and 802.16. 802.11n is arecent extension of the popular 802.11a/b/gtechnology known as WiFi. UW B on the other hand is standardized as IEEE 802.15.4 for low power, low-data rate applications. This technology innovation called ZigBee will make it possible toremotely monitor various types of sensors-for airconditioning, lighting, smoke alarms, and many more. "the next big thing" predicted in wireless access is the introduction of large Broadband Fixed Wireless Access cells using technologies such as WiMAX. The emerging IEEE 802.15.4 (ZigBee) standard aims to provide low data rate wireless communications with high-precision ranging and localization, by employing UWB technologies for a low-power and low cost solution. WiMAX (Worldwide Interoperability for Microwave Access) is a standard for wireless data transmission covering a range similar to cellular phone towers.[8]

IV: STAND ALONE MODULE SYSTEM

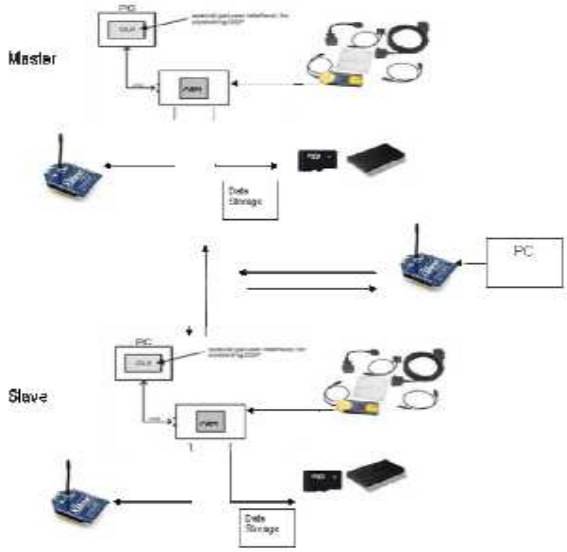


Fig.2 Structure of the basic model

Shown in figure3 two devices master and slave devices which operate with the main PC or sever computer. Above figure indicates that the two devices which can perform independently or separately and it is connected to main pc. All devices connected with zigbee which can transferred data over network.[2] In this module we develop the system of stand alone type. System continue running at that time if master device is fail then slave continue process from that situation it doesn't stop process and continue working. In this system one advantage is that if server computer or main pc stop working at that time all data can be stored in to memory card and data transfer process can be done by zigbee. It can transferred data to main pc and other device. Device also working condition although failure of main device. This is the main advantage of the system. This system perform main working of stand alone device and also performing load sharing option in that if master device has particular some limit and above that limit range can be extended then that limit can be shared by the stand alone device and over load can be done by slave device. When main

device is off then all the data can stored in each device after continue main device the data can display by main device from continue process. All the condition of master ans slave during main device off condition is also shown by the main device because all data stored in memory card which is allocate to all master and slave device. UPS based system in that UPS can be connected for testing purpose. UPS system can be connected with relay driver circuit and output of the relay is in digital form which can be given to the arm processor. Mains is the main power supply system connected with arm. Zigbee can transferred data over network it can be share data over network which also can be stored by slave device in the system just interfacing can be done. Distributed UPS systems support UPS units and critical loads flexibly located in an interconnected electrical power network. In order to add reliability and expandability to the system, redundant and parallel UPS systems are usually integrated into the power system.[5]. In UPS system lots of parts can be included but we studied basically signal conditioning and relay circuit parts. Just basically overview and detailed studied if the two parts can be described in this paper.

V: DIFFERENT PARTS OF THE SYSTEM

1) Signal conditioning circuit

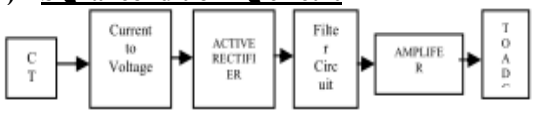
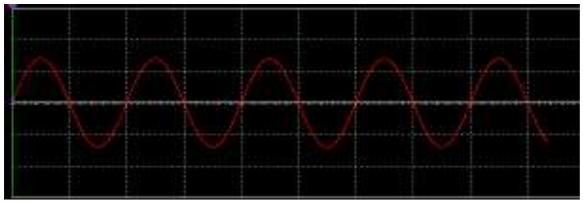


Fig 3. Structure of the signal conditioning circuit

Current transformers are also known as instrument transformers. When current in a circuit is too high to directly apply to measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments. A current transformer also isolates the measuring instruments from what may be very high voltage in the primary circuit. Like any other transformer, a current transformer has a primary winding, a magnetic core, and a secondary winding. The alternating current flowing in the primary produces a magnetic field in the core, which then induces current flow in the secondary winding circuit. A primary objective of current transformer design is to ensure that the primary and secondary circuits are efficiently coupled, so that the secondary current bears an accurate relationship to the primary current. The most common design of CT consists of a length of wire wrapped many times around a silicon steel ring passed over the circuit being measured. The CT's primary circuit therefore consists of a single 'turn' of conductor, with a secondary of many hundreds of turns. A 4000:5 CT would provide an output current of 5 amperes when the primary was passing 4000 amperes. Over here we are using 700:1 CT.



INPUT SIGNAL

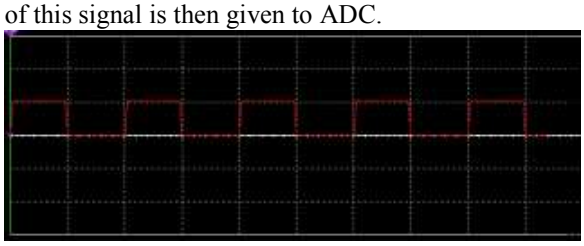
The output of the current transformer is Current. Which is then given to a Current to voltage convertor i.e. basically it is given across a resistor(R1) so the voltage generated is V= I x R1.

The two diodes are used to make sure the voltage does not get above +0.7 & -0.7v. This is done for circuit protection i.e. to make sure the output of the circuit dosent go above 5v.

This AC signal is then given to an active rectifier circuit. A rectifier converts ac signal to dc. Normally diodes are used to create a rectifier. But the voltage drop across a diode is 0.7v so we cannot rectifie signals ledd than 0.7v. For this purpose active rectifier is used.

The output of the rectifier circuit is a pulsating DC signal. Basically this circuit converts the pulsating DC signal into fixed DC signal.

Then the signal is then given to an amplifer circuit. We are using opamp in non inverting mode. The o/p of this signal is then given to ADC.



Output signal at amplifier.

2) Relay circuit

Relays are components which allow a low-power circuit to switch a relatively high current on and off, or to control signals that must be electrically isolated from the controlling circuit itself. To make a relay operate, you have to pass a suitable pull-in and holding current (DC) through its energizing coil. In each case the coil has a resistance which will draw the right pull-in and holding currents when it is connected to that supply voltage. So the basic idea is to choose a relay with a coil designed to operate from the supply voltage you.re using for your control circuit (and with contacts capable of switching the currents you want to control), and then provide a suitable relay driver circuit so that your low-power circuitry can control the current through the relays coil. Typically this will be around 70ma.

A diode (1N4007/1N4148) is connected across the relay coil; this is done so as to protect the transistor from damage due to the back emf generated in the relay's inductive coil when the transistor is turned OFF. When the transistor is switched OFF the energy stored in the inductor is dissipated through the diode & the internal resistance of the relay coil. Normally 1N4148 can be used as it is fast switching diode with a maximum forward current of 300ma. This diode is also called as free-wheeling diode.The LED is used to indicate that the RELAY has been turned ON. The resistor defines the current flowing through the LED thereby defining the LED’s intensity.

VII : BASIC HARDWARE OF THE SYSTEM

In basic hardware of the system contain one signal conditioning circuit for the convert high voltage signal in to low voltage signal because circuit does not attempt more voltage so this circuit can reduce the voltage and at last this signal can convert analog signal in to digital circuit and then give that signal to the arm7 processor. The other basic part of that signal

is the relay circuit which can use as a switch in this circuit. Relays are components which allow a low-power circuit to switch a relatively high current on and off, or to control signals that must be electrically isolated from the controlling circuit itself. To make a relay operate, you have to pass a suitable pull-in and holding current (DC) through its energizing coil. In this system same all device used as a slave deice, master and slave system used in that system if one device is fail then other device can continue in that situation and work continuously and keep the system in the running process. The main pc which is connected to both of the devices and load the situation of the both devices if main pc is stop working then all procedure can be done by the master and slave device can store in the memory card and then when the main pc is come in working condition then all data can transferred to the main device or pc. The other main benefit of the device is that if load of the master increase and it can't handled the situation at that time system fail but in this system it can't fail and overload can be transferred to the slave device or other device.

VI : CONCLUSIONS

The conclusion of this paper is that there were several major hurdles that needed to be overcome in order for successful device implementation. This leads into the question of how suitable the Zigbee protocol is in the development of relatively simple embedded systems or processor. After that how we can use this system in industry as a operating module in any kind of the continuous running instruments.

REFERENCES

[1] Wei Wang, Guangyu He, Junli Wan." Research on Zigbee Wireless Communication Technology". transactions on Engineering, 16-18 Sept. 2011.

[2] Li Xinchun Wang Na." Research and realization of on-line monitoring system for high voltage circuit breaker based on ZigBee technology." Control and Automation, 2009. ICCA 2009. IEEE International Conference. 9-11 Dec. 2009.

[3] "Zigbee Wireless Communication Overview" Texas instruments. "Texas Instruments, Incorporated [SLYB127,*]"

[4] Dr.S.S.Riaz Ahamed." The role of zigbee technology in future data communication system". **:** Journal of Theoretical and Applied Information Technology , © 2005 - 2009 JATIT

[5] J.M. Guerrero, L. Hang, J. Uceda." Control of Distributed Uninterruptible Power Supply Systems.", IEEE Trans. on Industrial Electronics, vol. 55, no. 8, pp. 2845-2859, August 2008.

[6] ZigBee Alliance, ZigBee Specification. Version 1.0 ZigBee Document 053474r06, December 14th, 2004.

[7] Homepage of ZigBee™ Alliance, http://www.zigbee.org

[8] Bhavneet Sidhu, Hardeep Singh, and Amit chhabra." Emerging Wireless Standards - WiFi, ZigBee and WiMAX" World Academy of Science, Engineering and Technology 25 2007.

[9] John Kooker,"Bluetooth, zigbee and wibree : A comparision of WPAN technologies", CSE 237A, November 20, 2008.