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Touch Screen Based Data Acquisition using Zigbee Technology

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Abstract- **Data acquisition system, as the name implies, is a process used to collect information to document or analyse some phenomenon. This paper presents an efficient method to acquire data from a remote place through wireless Zigbee technology and display it on our personal computer. The proposed method makes use of embedded technology. In the control room we use a touch screen interface on which there are voltage and temperature icons. When we press on voltage or temperature icon the embedded system reads the touch screen icon data and generates a particular address which is converted to digital format and transmitted through wireless technology Zigbee. The receiver at the remote site contains an embedded system, which installed with sensors for recording voltage and temperature. The embedded chip has previously stored data which enables it to read either voltage or temperature as per the user's request. When this system receives transmitted data, it compares the data with the stored data. After conversion of data to suitable format for transmission, it sends the return voltage or temperature data this data is received at the control room and displayed on our PC. This data acquisition system can also be used to gather data of atmospheric condition in hazardous or remote areas where human intervention is a risk. Also the aim is to make the work of a control engineer less tedious and avoid travelling saving time and increasing efficiency.**

Keywords **- data acquisition; Zigbee; embedded system; control room; sensor;**

I. INTRODUCTION

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems typically convert analog waveforms into digital values for processing. The components of data acquisition systems include: i)Sensors that convert physical parameters to electrical signals. ii) Signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values. iii) Analog-to-digital converters, which convert conditioned sensor signals to digital values.

This paper proposes an efficient method to acquire data of vital parameters like voltage and temperature of remote machines, electronic equipment, etc. The main components required for this process include touch screen panel, wireless communication, microcontroller based embedded system and sensors.

By using this system we can check the different parameter conditions at a control room from remote. In this system, we use two parameters; one is voltage and another temperature. In control room, touch screen is present. On it, voltage and temperature icons are there. Suppose if you press on voltage icon, the embedded system reads the touch screen icon data and sends a particular address through wireless technology Zigbee. The transmitted address is received at receiver which is installed at remote place. At remote place, another system reads the voltage and temperature reading of the particular machine. When this system receives transmitted data it is compared with previously stored data. After compression, it sends return voltage data. The transmitted data from receiver at remote place is received at control room and displayed on the touch screen.

II. BLOCK DIAGRAM DESCRIPTION

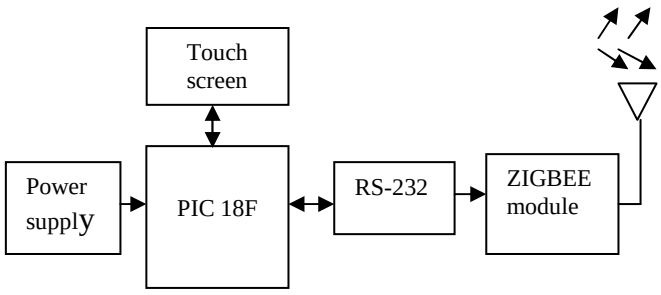

Fig 1.Block diagram of transmitter

A) Transmitter operation

When an icon is pressed on the touch screen, the embedded system reads the icon data and generates a particular address which is converted to a digital format and transmitted to the receiver through wireless technology ZIGBEE.

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The transmitter section shown in Fig.1 consists of the following-

i) *Power supply*:
A step down transformer is used to bring the voltage from 230V to 12V ac, a bridge rectifier is used to convert ac to dc, this is fed to LM 7805 through filter capacitors, and then the converted output of 5V fixed dc is supplied to PIC.

ii) *Touch screen – resistive type*: Resistive touch screens are touch-sensitive computer displays composed of two flexible sheets coated with a resistive material and separated by an air gap or microdots. There are two different types of metallic layers. When contact is made to the surface of the touch screen, the two sheets are pressed together. On these two sheets there are horizontal and vertical lines that, when pushed together, register the precise location of the touch.

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iii) *Embedded chip*: PIC18Fseries are an 8-bit microcontroller with RISC architecture and advanced features like flash memory, sleep mode, operating speed of 20MHz and 200ns instruction cycle.

iv) *RS-232 circuit*: It is a serial voltage level controller which includes MAX232. MAX232 consists of buffers; it converts voltage from 5V to 3.3V and vice versa.
In RS232 user data is sent at a time series of bits, both synchronous and asynchronous transmission are supported by the standard. Each data or control circuit operates in only one direction that is signalling from a DTE (Data Terminal Equipment) to the attached DCE (Data Circuit terminating equipment) or inversely (half duplex). Since transmit data and received data are separate circuit, the interface can operate in a full duplex manner, supporting concurrent data flow in both directions. The standard does not define character framing within the data stream, or character encoding.
The RS232 standard defines the voltage levels that correspond to logical one and logical zero levels for the data transmission and the control signal lines. Valid signal are ±3 to 15 volts. The range zero volts is not valid RS232 level. Unlike TTL logic, RS232 is bipolar using ± 13 to ± 15 volts. Hence MAX-232 is used to convert these logic levels of the computer, to TTL (transistor-transistor) logic, which is a ± 5 volt.

v) *ZIGBEE*: ZIGBEE is a bidirectional wireless communication technology based on IEEE standards which supports star and tree networks. ZIGBEE is targeted at RF applications.
Operating range: 1.6km
Operating frequency: 2.5GHz
Voltage: 3.3V

B) Receiver operation

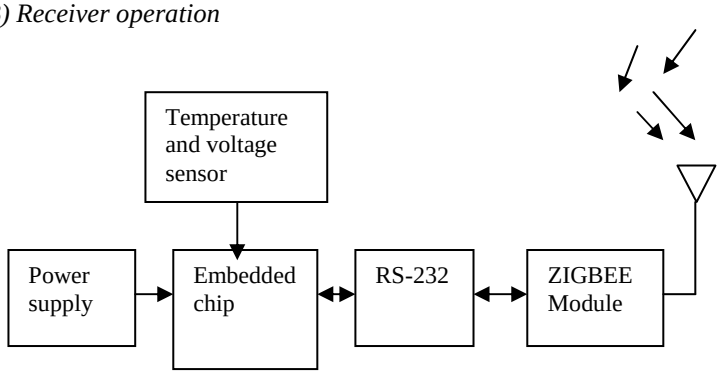

Fig.2 Block diagram of Receiver

As shown in Fig.2 the embedded chip has previously stored addresses which enable comparison.Received address data is compared to realize which parameter is required. Required information is retrieved from sensors (voltage or temperature).This retrieved information is converted to suitable format and returned. This is displayed on the PC on the transmitter side.

Temperature and voltage sensor LM35: The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

III. Zigbee Technology

ZigBee is a technological standard, based on the IEEE 802.15.4 standard, which was created specifically for control and sensor networks. WIthin the broad organization of the Institute of Electrical and Electronics Engineers (IEEE), the 802 group is the section that deals with network operations and technologies. Group 15 works more specifically with *wireless* networking, and Task Group 4 drafted the 802.15.4 standard for a low data rate wireless personal area network (WPAN). The standard for this WPAN specifies not only a low data rate but also low power consumption and low complexity, among other things. The data rate is limited to 250 kbps in the global 2.4 GHz Industrial , Scientific , Medical (ISM) band, 20 kbps in the 868 MHz band used in Europe , and 40 kbps in the 915 MHz band used in North America and Australia . The ZigBee standard is built on top of this IEEE standard, addressing remote monitoring and control for sensory network applications. This standard was created by an organization known as the ZigBee Alliance, which is composed of a large number of companies and industry leaders striving to enable such control devices based on said standard.

Figure 3 below shows the relationship between IEEE 802.15.4 and ZigBee. As can be seen in the figure, IEEE 802.15.4 develops the Medium Access Control (MAC) Layer and Physical (PHY) Layer, which address such things as the

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frequency and data rate specifications. The Physical Layer also allows for two types of devices: full function devices (FFD's) and reduced function devices (RFD's). ZigBee meanwhile develops the Network Layer and Application Layer, which includes the Applications Support Sub layer, the ZigBee Device Object, and the Security Services. The Network Layer and Application Layer are more specific than the IEEE layers and involve such things as how a ZigBee network is to be set up, how the devices in the network relate to one another, and so on.

Figures 3 below shows the ZigBee stack architecture and wireless comparisons.

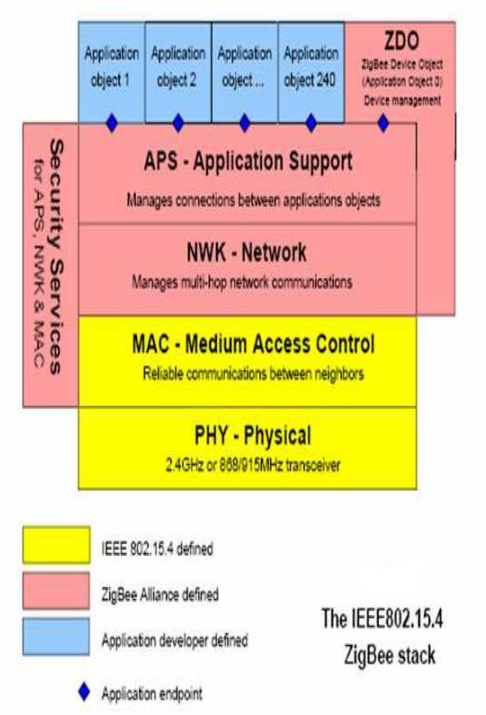

Fig 3: ZIGBEE stack

ZigBee works well because it aims low. Controls and sensors don't need to send and receive much data. ZigBee has been designed to transmit slowly. It has a data rate of 250kbps (kilobits per second), pitiful compared with Wi-Fi, which is hitting throughput of 20Mbps or more. But because ZigBee transmits slowly, it doesn't need much power, so batteries will last up to 10 years. Because ZigBee consumes very little power , a sensor and transmitter that reports whether a door is open or closed , for example , can run for up to five years on a single double-A battery . Also, operators are much happier about adding ZigBee to their phones than faster technologies such as Wi-Fi; therefore, the phone will be able to act as a remote control for all the ZigBee devices it encounters.

Zigbee has many advantages over other wireless technologies which is why the very approach is considered. This can be inferred from table 1.

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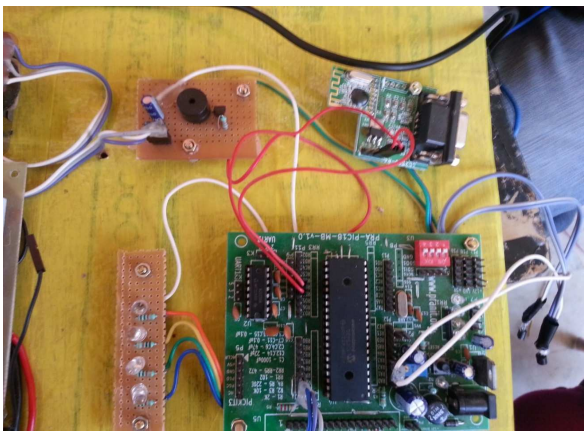
	ZigBee	802.11 (Wi-Fi)	Bluetooth	UWB (Ultra Wide Band)	Wireless USB	IR Wireless
Data Rate	20, 40, and 250 Kbits/s	11 & 54 Mbits/sec	1 Mbits/s	100-500 Mbits/s	62.5 Kbits/s	20-40 Kbits/s 115 Kbits/s 4 & 16 Mbits/s
Range	10-100 meters	50-100 meters	10 meters	<10 meters	10 meters	<10 meters (line of sight)
Networking Topology	Ad-hoc, peer to peer, star, or mesh	Point to hub	Ad-hoc, very small networks	Point to point	Point to point	Point to point
Operating Frequency	868 MHz (Europe) 900-928 MHz (NA), 2.4 GHz (worldwide)	2.4 and 5 GHz	2.4 GHz	3.1-10.6 GHz	2.4 GHz	800-900 nm
Complexity (Device and application impact)	Low	High	High	Medium	Low	Low
Power Consumption (Battery option and life)	Very low (low power is a design goal)	High	Medium	Low	Low	Low
Security	128 AES plus application layer security		64 and 128 bit encyption			
Other Information	Devices can join an existing network in under 30ms	Device connection requires 3-5 seconds	Device connection requires up to 10 seconds			
Typical Applications	Industrial control and monitoring, sensor networks, building automation, home control and automation, toys, games	Wireless LAN connectivity, broadband Internet access	Wireless connectivity between devices such as phones, PDA, laptops, headsets	Streaming video, home entertainment applications	PC peripheral connections	Remote controls, PC, PDA, phone, laptop links

Table 1: Comparison of wireless technologies

IV. RESULTS AND PERFORMANCE ANALYSIS



Snapshot of Hardware of Transmitter

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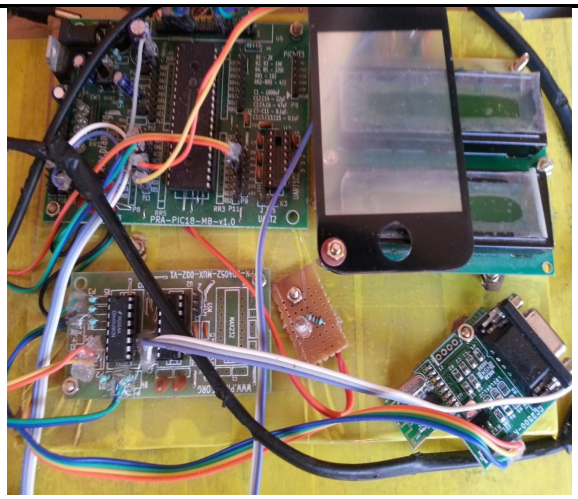

Snapshot of Hardware of Receiver

Advantages

Wireless ZIGBEE based solutions are universally accepted, familiar and user friendly systems. Touch screen LCD displays are advanced and have replaced manual push buttons and LEDs, etc. ZIGBEE technology can be used for long distance communication by using repeaters at regular intervals. The same principle can be applied for industrial purposes like chemical plants such as aluminium extraction plants. Touch screen interfaces for data acquisition can be used in paper industries and steel plants. This data acquisition voltage using corresponding sensors .In future we can implement many more sensors compared to the existing ones .

For example, we can make use of gas sensors at chemical industries for detecting leakage of poisonous gases, etc.

Also, we can add different applications to the existing system .We can also make use of new wireless technologies to implement this system.

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approach finds application in chemical industries, automobile industries, remote, electrical substations**.**

V. CONCLUSION

Sensors are used for detecting all parameters. An embedded chip (PIC 16f877A) is used for making quick decision about the parameters. The same embedded chip is also used for controlling the functioning of LCD, PIC assembly language and GSM AT commands are used to achieve the same .Finally, PC is used to display the parameter.

Since the system does not require manual inspection of the parameters it reduces the time overhead in detecting the parameter of the equipment installed in the industries, so it's an efficient one compared to the existing conventional technique of monitoring.

Flawless data transfer from sensor at remote area to touch screen interface is a key feature. Since all communication is wireless based, it translates into lowest cost compared to all others system .In this proposed work, all the database is stored in a central database .User has global access to consolidate data from many system or locations.

VI. FUTURE WORK

Technology is ever growing and there is always scope for improvement and advancements every field of work. In This paper, we have rely on a system which senses temperature ,

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