

WIRELESS SENSOR NETWORK FOR CONTINUOUS MONITORING WEATHER IN THE ENVIRONMENT USING ZIGBEE

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ABSTRACT

This Research paper presents a wireless Sensor network (WSN) for continuous Monitoring weather in the environment using Zigbee. The objectives of the current study are for studying the effectiveness of Wireless Sensor Network (WSN) using Zigbee & to study the abnormal condition of the weather continuously through this Wireless Sensor Network using Zigbee to take appropriate remedial measure. Weather sensor is used to measure weather condition in the environment using Zigbee. 1st a proper sensor has to be selected for converting the sensed signals (which are electrical signals) in the form of analog signals. The analog signals have to be converted into digital signals by using a proper circuit. The digital signals are feed into the Peripheral Interface Controller (PIC) & its succeeding output is linked to the serial communication circuit. The serial communication circuit's output is feed into the Zigbee device & this Zigbee device's output is transmitted through transmitting antenna. In the receiver region, the above transmitted signal is received via the receiving antenna & passed into the Zigbee unit. Output of this Zigbee unit is passed into the RS-232 serial port communication interface & output of this RS-232 is passed into Personal Computer (PC) & sends Global System for Mobile communication (GSM) short message to the receiver. This receiver can utilize the PC or Personal Digital Assistant (PDA) to watch the sensed signals in the remote place. The PIC microcontrollers are supported with a full range of hardware & software development tools. The transmission section codes utilizing different software to function the transmission of sensed digital signals and software to operate the received signals were established. Since, Zigbee has lower power consumption the same is generally used for 24 hours monitor utilizing different soft wares to function the transmission of sensed digital signals and software to operate the received signals were established. Since, Zigbee has lower power consumption the same is generally used for 24 hours monitor of communication transmission system. In particular, when measured signals are over the standard value, the personal computer sends GSM short message to the pollution forecaster's mobile phone i.e., when there was an abnormality in weather, automatically a call is dialed to the weather forecaster. Also, weather signal are observed in the PC or PDA. Accordingly, appropriate remedial measures are taken.

Keywords - weather sensor, Zigbee, Relays, Voice Board, Low voltage power amplifier, Power supply, RS-232 serial communication interface, Timers & ADC module.

INTRODUCTION

ZigBee-style networks began to be conceived around 1998, when many installers realized that both Wi-Fi and Bluetooth were going to be unsuitable for many applications. Many engineers saw a need for self-organizing ad-hoc digital radio networks. The IEEE 802.15.4-2003 standard was completed in May 2003 and has been superseded by the publication of IEEE 802.15.4-2006. In the summer of 2003, the ZigBee Alliance announced in October 2004 that the membership had more than doubled in the preceding year and had grown to more than 100 member companies, in 22 countries. By April 2005 membership had grown to more than 150 companies and by December 2005 membership had passed 200 companies. The ZigBee specifications were ratified on 14 December 2004. The ZigBee Alliance announced availability of Specification 1.0 on 13 June 2005, known as ZigBee 2004 Specification. In September 2006, ZigBee 2006 Specification is announced. In 2007, ZigBee PRO, the enhanced ZigBee specification was finalized. The first stack release is now called ZigBee 2004. The second stack release is called ZigBee 2006 and mainly replaces the MSG/KVP structure used in 2004 with a "cluster library". The 2004 stack is now more or less obsolete. ZigBee 2007, now the current stack release, contains two stack profiles, stack profile 1 (simply called ZigBee), for home and light commercial use and stack profile 2 (called ZigBee Pro). ZigBee Pro offers more features, such as multi-casting, many-to-one routing and high security with Symmetric-Key Key Exchange (SKKE), while ZigBee (stack profile 1) offers a smaller footprint in RAM and flash. Both offer full mesh networking and work with all ZigBee application profiles. ZigBee 2007 is fully backward compatible with ZigBee 2006 devices: A ZigBee 2007 device may join and operate on a ZigBee 2006 network and vice versa. Due to differences in routing options, ZigBee Pro devices must become non-routing ZigBee End-Devices (ZEDs) on a ZigBee 2006 network, the same as for ZigBee 2006 devices on a ZigBee 2007 network must become ZEDs on a ZigBee Pro network. The applications running on those devices work the same, regardless of the stack profile beneath them. The ZigBee 1.0 ratified on 14 December 2004 and is available to members of the ZigBee Alliance. Most recently, the ZigBee 2007 specification was posted on 30 October 2007. The first ZigBee Application Profile, Home Automation, was announced 2 November 2007. Clustering and synchronization are common problems in

WSNs that have been addressed in some research works {e.g. [W.R.Heinzelman, A.Chandrakasan, and H. Balakrishnan, 2000, G.Gupta and M.Younis, 2003&V.A.Kottapalli, A.S.Kiremidjiana, J.P.Lyncha, E.Carryerb, T.W.Kennyn, K.H.Law, and Y.Lei, 2003]}. In Reference W.R.Heinzelman, A. Chandrakasan and H. Balakrishnan, 2000].

A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to monitor Physical or environmental conditions, such as temperature, sound vibration, pressure, motion or pollutants at different locations. The development of wireless sensor networks was originally motivated by military application such as battlefield surveillance. However, wireless sensor network are now used in many civilian application areas including environment and habitat monitoring, health care applications, home automation and traffic control.

After around a decade of active research on wireless sensor network recent standards released are stimulating the development of commercial products. One of standards is Zigbee. Zigbee is provided with lower consumption, small volume, high expansion, stylization and two way transmission etc.

The researcher first chose the proper sensors for the above application to convert the temperature, pressure & humidity signals into electrical signals which are in the form of analog signals. These analog signals were converted into digital signals by designing a proper circuit. These digital signals were fed into the PIC controller. The output of this PIC controller is fed into the serial communication circuit. The output of this serial communication circuit is fed into the Zigbee device and output of this Zigbee device is transmitted via transmitting antenna. In the receiver side, the said transmitted signal is received through the receiving antenna and fed into the Zigbee unit. The output of this Zigbee unit is fed into the RS-232 serial port communication interface and output of this RS-232 is fed into personal computer (PC) sends global system for mobile communication (GSM) short message to the receiver. The receiver can use the PC or personal digital assistant (PDA) to observe the sensed signals in the remote place.

The PIC microcontrollers are supported with a full range of hardware and software development tools. The researcher found the transmission section codes using software to operate the transmission of sensed digital signals. To operate the received signals using software the researcher found the same.

From the above it is very clear that the researcher designed not only circuits for the above applications but required software to operate the above projects and to get the good result outputs.

METHODOLOGY

As shown in the Fig.1 & Fig. 2 below, the researcher first chose the proper sensor for the above applications to convert the weather signal into electrical signal which was in the form of analog signal. This analog signal was converted into digital signal by designing a proper circuit. This digital signal was fed into the PIC controller. The output of this PIC controller was fed into the serial communication circuit. The output of this serial communication circuit was fed into the Zigbee device and output of this Zigbee device was transmitted via transmitting antenna.

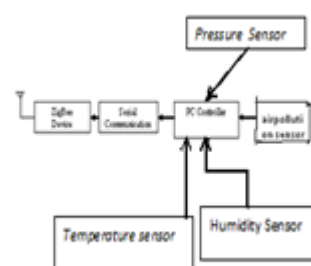
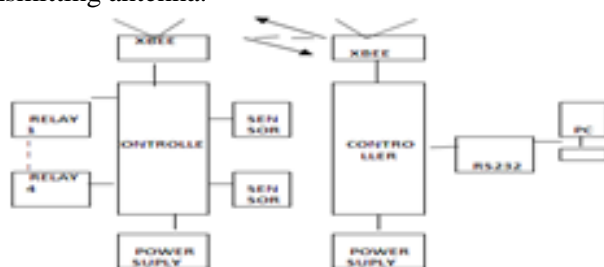


Fig. 1 Block diagram of transmission & receiver using ZigBee Fig. 2 Block Diagram of Transmitter Section

As shown in the under mentioned Fig. 3 in the receiverside the said transmitted signal was received through the receiving antenna and fed into the Zigbee unit. The output of this Zigbee unit was fed into the RS-232 serial port communication interface and output of this RS-232 was fed into Personal Computer (PC) which could be data collection. Global system for mobile communication (GSM) short message was sent to the receiver by this PC. The receiver could use the PC or personal digital assistant (PDA) to observe the sensed signals in the remote place. As discussed, the PIC microcontrollers were supported with a full range of hardware and software development tools. The researcher found the transmission section codes using various soft wares to operate the transmission of sensed digital signals. To operate the received signals using various soft wares the researcher found the same.

Tests:

In the research of the Researcher, 4 categories per day were made in which parameters such as temperature, humidity & pressure of the wind were detected or monitored or tested by using the above research Project. Category

A was the morning session. Category B was the afternoon session. Category C was the evening session and Category D was the night session. Firstly, the Researcher had taken temperature measurements in 11 tests in categories A, B, C and D. When abnormality was developed and the temperature was below or above the predetermined level then automatically a call was dialed to the weather forecaster indicating the critical condition of the temperature. Accordingly, precaution was taken. Hence, the phone or cell number of the forecaster which was entered in the above instrument was dialed automatically. Therefore, Research was 100% successful. Secondly, the Researcher had taken humidity measurements in 11 tests in categories A, B, C and D. When abnormality was developed and the humidity was below or above the predetermined level then automatically a call was dialed to the weather forecaster indicating the critical condition of the humidity. Accordingly, precaution was taken. Hence, the phone or cell number of the forecaster which was entered in the above instrument was dialed automatically. Therefore, Research was 100% successful. Next, the Researcher had taken wind pressure measurements in 11 tests in categories A, B, C and D. When abnormality was developed and the wind pressure was below or above the predetermined level then automatically a call was dialed to the weather forecaster indicating the critical condition of the wind pressure. Accordingly, precaution was taken. Hence, the phone or cell number of the forecaster which was entered in the above instrument was dialed automatically. Therefore, Research was 100% successful.

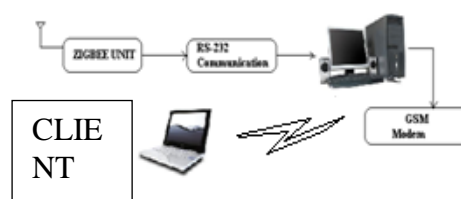


Fig. 3 Block Diagram of Receiver Section

RESULT ANALYSIS & DISCUSSION

In the research of the Researcher, 4 categories per day were made in which parameters such as temperature, humidity & pressure of the wind were detected or monitored or tested by using the above research project. Category A was the morning session. Category B was the afternoon session, Category C was the evening session and Category D was the night session. The duration of tests is given in table - 1.

Table. 1: The duration of tests

Category	Session	No. Of Test Conducted	Duration of Test
A	Morning	3	Continuous
B	Afternoon	3	Continuous
C	Evening	3	Continuous
D	Night	2	Continuous

Firstly, the Researcher had taken temperature measurements in 11 tests in categories A, B, C and D. When abnormality was developed and the temperature was below or above the predetermined level then automatically a call was dialed to the weather forecaster indicating the critical condition of the temperature. Accordingly, precaution was taken. Hence, the phone or cell number of the forecaster which was entered in the above instrument was dialed automatically. Therefore, research was 100% successful. The Success of research is given in table - 2.

Table.2. The Success of research

No. Of tests conducted	No. of test succeed	Percentage of Success
11	11	100%

Secondly, the Researcher had taken humidity measurements in 11 tests in categories A, B, C and D. When abnormality was developed and the humidity was below or above the predetermined level then automatically a call was dialed to the weather forecaster indicating the critical condition of the humidity. Accordingly, precaution was taken. Hence, the phone or cell number of the forecaster which was entered in the above instrument was dialed automatically. Therefore, Research was 100% successful. The Success of research is given in table - 3.

Table.3. The Success of research

No. Of tests conducted	No. of test succeed	Percentage of Success
11	11	100%

Next, the Researcher had taken wind pressure measurements in 11 tests in categories A, B, C and D. When abnormality was developed and the wind pressure was below or above the predetermined level then automatically a call was dialed to the weather forecaster indicating the critical condition of the wind pressure. Accordingly, precaution was taken. Hence, the phone or cell number of the forecaster which was entered in the above instrument was dialed automatically. Therefore, research was 100% successful. The Success of research is given in table - 4.

TABLE – 4

No. Of tests conducted	No. of test succeed	Percentage of Success
11	11	100%

DISCUSSION

In the research, firstly, pressure of the wind was measured. When abnormality was observed and the pressure of the wind drop was below or more the predetermined level then a call was dialed to the weather forecaster. Hence, the cell or phone number was dialed successfully to the weather forecaster. Therefore, research was successful. Also, sensed signals were observed through personal computer (PC) or personal digital assistant (PDA). Hence, the research was successful.

Secondly, weather temperature was tested. When the weather temperature was above the normal level or below the normal level this condition was identified as abnormal. Hence, in such a situation automatically a call was dialed to the weather forecaster. Therefore, the research was successful. Also, sensed signals were observed through personal computer (PC) or personal digital assistant (PDA). Hence, research was successful.

Next, humidity of the environment was tested. Humidity above the normal level or below the normal level was considered as abnormal condition. In such a situation automatically a call was dialed to the weather forecaster. Hence, research was successful. Also, sensed signals were observed through personal computer (PC) or personal digital assistant (PDA). Therefore, research was successful.

CONCLUSION

Hence, we have developed a successful research project that identifies the abnormal conditions of the weather in the environment. When there was an abnormality in weather, automatically a call was dialed to the weather forecaster and weather signal is observed in the PC or PDA. Accordingly, remedial measures were taken. So, a successful research project was developed to monitor the weather conditions. Thus, this wireless sensor network using ZigBee will be very useful to the human civilization and will be a revolutionary research and development in weather forecasting field.

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