

ZIGBEE BASED INTEGRATED ALERTING AND MONITORING SYSTEM FOR INDUSTRIAL APPLICATIONS

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Abstract— This paper presents design and implementation of wireless sensor network for measuring environmental factors in industry surroundings. Industrial environment is regulated in varying degrees across the world by many environmental and safety policies. The adherence of these policies makes necessary a continuous and distributed measurement of different factors like temperature, oxygen levels and the presence of contaminants. The analysis of this data may help prevent violations in work conditions and environmental damage. A multi-platform and multi-layer sensor platform has been utilized using ZigBee for enhancing the wireless communication quality in a factory environment. It is mainly used for collecting and transferring the various monitoring information in any industrial sector. Then the data will be analyzed and processed in the monitoring system outside, so that we can ensure the safety of the person's life and effectiveness better.

Index Terms—Wireless Sensor Networks, Zigbee, Vibrations, Monitoring, Environmental Factors.

I. INTRODUCTION

With the increasing importance and following regulation of the impact the Industrial Environment has on the health of workers and denizens of nearby industrial areas, arises the necessity of monitoring environment factors. In the United States, the agency accountable for regulation work conditions is the Occupational Safety and Health Administration (OSHA). On sites many cases of work associated injuries and diseases which could be prevented with the correct Environment monitoring and alerting.

In today's competitive industrial sector, it's a challenge for the manufacturer to ensure that the plants function with full capacity and efficiently without zero downtime and with zero downtime output quality. To achieve their productivity goals, companies often tend to invest on complex IT systems with a network of sensors to support controlling and monitoring the production processes by real-time data collection. However, most existing sensor based data collection technologies in the market are based on rigid, wired-sensor network infrastructures that require high investments for installations and setup. In addition, the wired systems also do not provide flexibility. Conventional production machines often have to be converted and computerized in order to be able to collect data from them. To overcome these restrictions of wired-sensor networks, this paper proposes and develops a cost-effective technique using Wireless Zigbee Based Sensor Networks for real-time production monitoring and control.

Owing to the excellent cited characteristics, Zigbee technology has developed as a preferred technology for short-range communication in wireless industrial area. Within the industrial environments, remote switching, monitoring, supervisory or spread control are the key challenges that require wireless sensor networks for doing all those

operations in which price, distance cover and speed of data transfer are the parameters to be considered.

Industrial environmental monitoring is the expansion to the mechanization process where various sensing devices like LDR, oxygen level, gas level, temperature sensors are processed by various control strategies. In a field level, all these sensors are connected with the communication bus which gathers all the parameter values to a main controller. In a control level, all these parameters are monitored and analyzed. Problem occurs when the distance is increased between the control room and monitoring system. That's where Zigbee comes into picture.

Zigbee is mainly designed for low cost, low data rate and low-power consumption wireless personal area networks (WPANs). It grips and stores the information for receiving and transmitting operations within the network. In the transmitter section, the Zigbee module is constructed in such a way that it receives the data collected from the microcontroller and sends it to the remote receiver. At the receiver side, the Zigbee module receives all the sent data from a Zigbee transmitter within the range of communication. This data is then analyzed. If any parameter exceeds its limit, then an alarming system sets to ON.

II. RELATED WORKS

While doing the survey the source of information is secondary data from different sources as thesis, articles and books. To validate the proposed network implementation test were realized.

Raj Kumar Boddu, P.Balanagu & N.Suresh Babu [2] presented a mine safety monitoring system based on wireless sensor networks and hardware and software design of wireless sensor network. Their system can detect Concentration of the gas, temperature, humidity, wind speed and trace the location of miners in underground Mine tunnels. Wireless sensor networks applied in monitoring mine security breaks through the traditional methods and ideas, which improves the practical ability and flexibility of monitoring system. This system not only monitor all kinds of parameters under the coal mine, but also alarm automatically when environment parameters are abnormal to exceed the limitation, which help improve the level of monitoring safety production and reduce accident in the mine.

Lauro Manoel Lima da Gama, Joao Batista, Hidaka de Oliveira Gaia, Antonio de Padua Soares Junior, and Almir Kimura Junior [1] have studied the Architecture for Wireless sensor networks for monitoring Environmental factors. Environmental monitoring through sensor networks is a promising technology. With the advances in the miniaturization of sensors and low power micro-controller systems. Become more prevalent and gain more applications. In the future other sensor nodes will be deployed in an office ambient to also monitor the luminance and noise.

Mert Bal [3] proposed a real-time production monitoring framework through ZigBee based wireless sensor network. The proposed approach uses vibration, acoustic noise, and motor current

signal measurements in order to analyze the runtime status of production machines. The proposed work provides a cost-effective and simple solution for real-time production monitoring applications mainly in small-to-medium size metalworking industry.

Thoraya Obaid, Halemah Rashed, Ali Abou-Elnour, Muhammad Rehan, Mussab Muhammad Saleh, and Mohammed Tarique[4] have presented a technical overview of the ZigBee technology. The main features of the ZigBee technology have been highlighted. It has been shown that the ZigBee based WHAS outperforms other technology based WHAS. A comprehensive survey work on the ZigBee based WHAS, some limitations and challenges of the ZigBee based WHAS have also been listed in this paper. Based on this survey work we can conclude that the ZigBee can be considered as the most suitable technology for wireless data transform.

S.C. Panchal, Prof.S.P.Dhanure [5] derived the statistical information about gas leakage and send it through mail so that we can acquire data from anywhere without human interaction. The IEEE 802.15.4 covers the physical layer and the MAC layer of low rate WPAN. It is feasible to construct a WSN for emergency response notification using IEEE 802.15.4 and ZIGBEE. Moreover there is a range of sensing applications which can be developed using 802.15.4 MAC and PHY along with ZIGBEE stack this system has the potential to reduce the response time in a cost effective way.

Shilpa Lande [6] demonstrated that the gas sensor is more sensitive to the carbon monoxide but can sense methane, butane, LPG, hydrogen, smoke etc. found more heating of sensor if operated for long time. The ZigBee communication is noise free. With the use of sophisticated sensors, the system can work with more accuracy in real time. It can be modified in industrial monitoring. Thus, they showed that the alerting and monitoring can be done and thus sensors and respective data can be obtained.

Amr El Zawawi & Ali Ibrahim[7] have presented the design and implementation of a web based Distributed Control System DCS built on wireless communication protocols IEEE 802.15.4, Zigbee and Digimesh. They have executed the data acquisition and monitoring by dividing the overall system into many subsystems, each carries only the code necessary for a specific set of activities in contrast to a centralized control system that requires complex programming needed to govern the entire system. The monitoring and process control unit for each subsystem is geographically distributed in the controlled plant, each subsystem node is based on the wireless Xbee modules Series I or Series II, which are capable to be configured to work in a network under some different topologies like star, cluster tree and mesh.

Hsien-Wei Tseng, Yang-Han Lee, Liang-Yu Yen, Su-Yi Yu, and Yi-Lun Chenu[8] have presented a paper that discusses and performs lab experiment of detecting LQI value from ZigBee wireless sensor network and from the variation of LQI values to determine is there any intrusion. After the system was validated they also developed an in house intrusion monitor system that when someone enters into the house the system will turn on and the alarm will be set on. A message is sent to the user on his cell phone thus ensuring the security of the house.

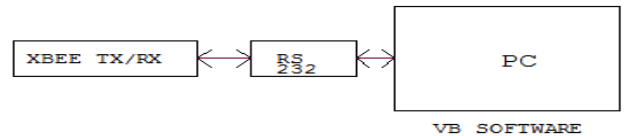
Yuki Hirakata, Akira Nakamura, Kohei Ohno, Makoto Itami[9] have proposed a navigation system for the large parking area by using ZigBee. In this ZigBee navigation system, with the help of ZigBee terminal at the parking entrance the shortest route is provided to the vehicles. The driver can find the vacant space smoothly. The navigation route can be updated by the ZigBee network. The average time for parking is evaluated by computer simulations. As results, when the area is crowded the time spent for parking becomes shorter. The vehicle can park the parking space near the entrance of the shopping mall. From the results, the drivers stress and the vehicles congestion might be mitigated.

N.Javaid, A. Sharif, A. Mahmood, S. Ahmed, U. Qasim, Z. A. Khan[10] discussed different hardware techniques for power monitoring, power management and remote power controlling at home and transmission side and also discussed the suitability of Zigbee for required communication link. Zigbee has major role in controlling and monitoring for efficient power utilization. It works on low data rate of 20Kbps to 250Kbps with minimum power consumption and covers enough area needed for communication. This paper describes the user friendly control home appliances, power on/off through the internet, PDA using Graphical User Interface (GUI) and through GSM cellular mobile phone. They also discussed the role of ZigBee in saving power.

III. PROPOSED METHOD

We illustrate our proposed method in this section
PC Master:

We are making Zigbee based wireless network for industrial applications. Here we have master and slave structure for these application. The range of Zigbee is about 30 meters. So, the whole area cannot be covered by a single Master and slave combination. For this we are covering the whole industrial area by a master and slave combination.



We have a main PC master terminal which has the VB software on it. The PC master terminal is used for monitoring the status of all the slaves which covers the whole area.

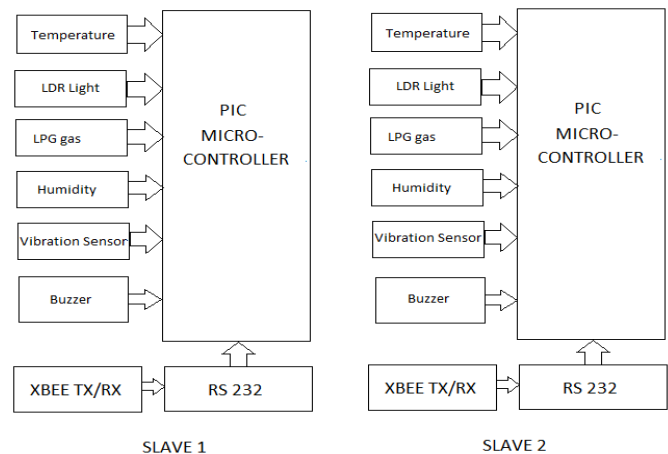
Collision Avoidance Protocol:

Here we are using a master Request and slave response protocol. In this system the Master sends request to the all slaves. In the request frame the master mentions the slave ID. The request frame is received by all the slaves which are in covered range. The slave who are in range receive the incoming frame and also store it in its internal RAM memory. Then they check the slave ID. If the incoming slave ID matches with their own slave ID then they Accept the frame and send the parameter back to the master. If the ID does not match then the slave discards these frame.

In this system we have

- 1 Master PC terminal.
- 2 Slaves Terminal

So in total we have 2 slaves. The Idea is that if the one slaves goes out of range of the PC then the communication fails. So we are placing 2 slaves which will be placed in such way that they will be always in range of the PC master.



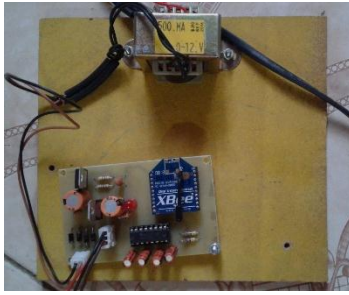


Fig. Circuit of Master

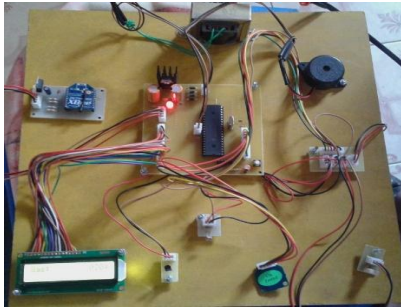
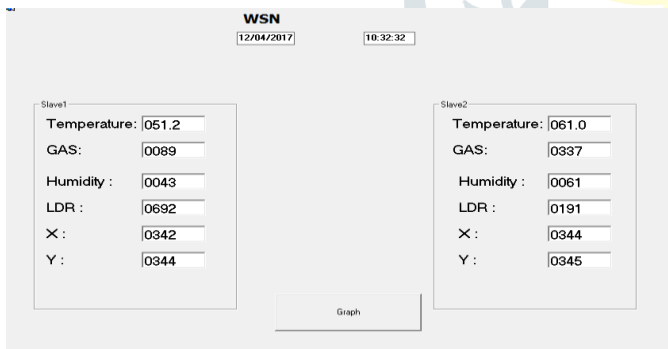


Fig. Circuit of Slave

These two slaves are under the PC based masters supervision. Therefore the PC master will communicate with the slaves via Wireless Zigbee module.

IV. WEPERIMENTAL RESULTS AND ANALYSIS

This is the final result obtained through on the VB software. The environmental parameters that have been collected with the help of the ZigBee module are analyzed and compared with the threshold value already feed in the code. An alarm system is set up when any parameters crosses the threshold value. Thus ensuring the safety on the workers and also the safety of the people living near the industrial area.



V. CONCLUSION AND FUTURE WORK

Hence we propose a system that is mainly used for collecting and transferring the various monitoring information in any industrial sector. This collected data is analyzed as well as processed in the monitoring system outside, so that we can ensure the safety of the person's life and effectiveness better.

A ZigBee Module is used for increasing the range of the system. In the transmitter section, the Zigbee module is configured in such a way that it receives the data collected from the microcontroller and sends it to the remote receiver. At the receiver side, the Zigbee module receives all the sent data from a Zigbee transmitter within the range of communication. This data is then analyzed. If any parameter exceeds its limit, then an alarming system is set ON thus alerting the worker of the abnormal levels in any of the parameter presented in the system which leads in ensuring the safety of the worker and also the people present in the whole industrial area.

The system can also be easily extended with zigbee wireless image transmission facility in future. We can improve scalability of industrial alerting as well as monitoring and extend environmental accurate position of workers safety. In future, with the help of zigbee module and GUI, we can avoid accidents. We can also interface this model with a control system.

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