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RESEARCH ARTICLE

THE DESIGN OF GRANARY ENVIRONMENTAL MONITORING SYSTEM BASED ON ARM7 AND ZIGBEE

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ABSTRACT

Grain storage is a important role in the economy and the society. The quality and safety of grain storage are related to the hundreds of millions of people. In the process of grain storage, temperature and humidity are two major ecological factors that can produce an effect on the grain quality. Therefore, the parameters of temperature, humidity must be in lacking errors and real-time monitoring by supervisory systems in large granaries.

Grain is our county's important strategic resources. Due to the seasonality of its production, the storage of grain is the top priority event which relates to people livelihood. Here, we are still using our old method of storing the crops and because of this grains are spoiling soon. Also, we are unable to maintain the quality of the stored grains.

To overcome these problems, the automatic monitoring of the grain storage based on ARM7 and ZIGBEE is implemented which helps us to improve the operation levels of grains storage and reduce the grain losses during storage procedure and reduce the labor intensity. The sensors collect the information from environment, the collected signals through the analog to digital conversions. These conversions are sent to micro controller unit. This micro controller unit is connected to LCD to display the values of temperature, humidity and co2 values and using GSM to achieve the system's remote control, it greatly improves the flexibility and scalability of the warehouse management which sends available data to grain depot manager (Database management) in time and filters invalid data on the spot.

INTRODUCTION:

The aim of the work described in this project is to design and implement the granary environmental monitoring system based on ARM7 and ZIGBEE which can be used in large granaries. This project is used for economical, low power consumption. Grain storage is a important role in the economy and the society. Due to the seasonality of its production, the storage of grain is the top priority event which relates to people livelihood. In the process of grain storage temperature and humidity are two ecological factors that can produce an effect on the grain quality, the parameters of temperature, humidity must be in lacking errors and real-time monitoring by supervisory systems in large granaries. The automatic monitoring of the grain will help us to improve the operation levels grain storage, reduce the grain losses and reduce the labor intensity.

This project designs an automatic environment monitoring system and control system of the granary combining embedded and Zigbee wireless sensor network. Zigbee wireless sensor network can be used to complete acquisition and transmission of environment parameters and ARM7 is used to achieve precise control of data controller and GSM to achieve the system's remote control, it greatly improves the flexibility and scalability of the warehouse management which sends available data to grain depot manager in time and filters invalid data on the spot. It can be saves a lot of manpower and material resources and improves labor productivity.

This project is to use the technology in a closed environment for forming or agriculture industry to maintain the quality and to increase the productivity. The objective is to use embedded technology in storage procedure to maintain the quality and to increase the productivity. The system is being implemented as technical solution to monitor the current condition and controlling made easy by using wireless Zigbee and GSM technology. Sensors are used to collect the environmental information namely temperature, humidity, CO2 and light intensity.

To overcome these problems, the automatic monitoring of the grain storage based on ARM7 and ZIGBEE is implemented which helps us to improve the operation levels of grains storage and reduce the grain losses during storage procedure and reduce the labor intensity.

BLOCK DIAGRAM

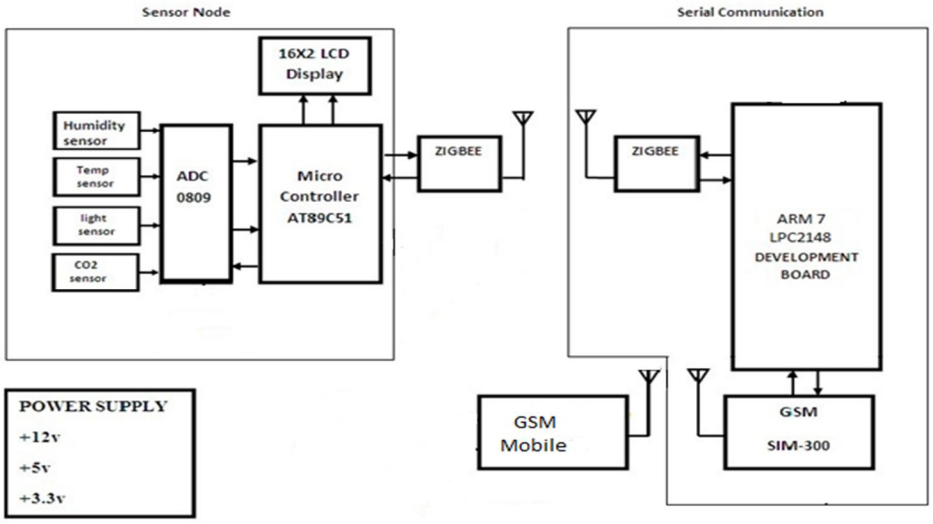

Figure1: System block diagram of the overall structure

In the block diagram the sensor node is responsible for collection of environment information such as temperature and humidity. The signals collected by the sensor through the ADC are sent to Micro Controller Unit. The MCU is connected to LCD to display the values of temperature, humidity, CO2 and LDR. The Zigbee communication module changes the data into data packets of zigbee communication protocol which are transmitted to the coordinator node. The coordinator node after receiving the data packets from the sensors node performs handshake communication by sending a confirmation language source to the sensor node to complete a full zigbee wireless communication process. On the other hand it should upload the data to the ARM processer. The ARM unit gathered the collected information data. The information collected by the ARM unit is sent to mobile through the GSM network.

Specifications of various grains humidity and temperature levels for safe and long term storage

Various grains	Temperature(c)	Humidity(%)
Wheat	26.6-30	75-90
Rice	15-20	30-40
Maize	15.5-20	45-50

The safe grain storage was observed at CO2 concentrations of 400 to 500 ppm. Higher concentrations of CO2 clearly showed mold spoilage or insect activity inside the grain storage silo. Carbon dioxide concentrations of

500 to 1200 ppm indicated onset of mold infection where as CO2 concentrations of 1500 to 4000 ppm and beyond clearly indicated severe mold infection or stored product insects infestation. Light influences movement and development of stored grain pests. In case of rice storage insects show photo negative response. Darkness is necessary for egg laying.

LPC2148 ARM processer:

The ARM7 is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core.

Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7 processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the ARM7 processor has two instruction sets:

- The standard 32-bit ARM set.
- A 16-bit Thumb set.

The Thumb set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code. Thumb code is able to provide up to 65 % of the code size of ARM, and 160 % of the performance of an equivalent ARM processor connected to a 16-bit memory system. The particular flash implementation in the LPC2148 allows for full speed execution also in ARM mode. It is recommended to program performance critical and short code sections (such as interrupt service routines and DSP algorithms) in ARM mode. The impact on the overall code size will be minimal but the speed can be increased by 30% over Thumb mode.

The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7 CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol

converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

ZIGBEE:

ZigBee is a specification of a joint of high level wireless communication protocols based on the wireless personal area network (PAN) standard IEEE 802.15.4. Its goal is the applications that require reliable communications, due to mesh topology, with low data transmission rate and long live batteries. ZigBee can be used in several types of applications as automation and security control, control of end devices as mouse or keyboards, remote control of electronic devices, monitoring patients or elder lies but the main and most successful is home automation.

The characteristics that make it so suitable for these purposes are:

- Low-cost: ZigBee devices are cheap as they do not need a high data rate and the microprocessor required for ZigBee devices is quite simple, due to the small size of the ZigBee MTU (Maximum Transmission Unit).
- Mesh topology: Provides a higher reliability because multiple transmission paths exist. This allow some nodes of the network to be asleep while others take the control of the propagation and avoid a whole network to block if ones node gets down.
- Low power consumption: As multiple nodes can be asleep until they receive some information, they do not consume too much power and the batteries can live even for 5 years.
- It operates in the industrial, scientific and medical (ISM) bands:
- It can operate globally in the 2.4 GHz frequency, but also in 868 MHz (Europe) and 915 MHz (USA).
- Its data rate is 250 kbps at 2.4 GHz, 20 kbps at 868 MHz and 40 kbps at 915MHZ
- Its reach range is from 10 m to 1000 m.
- It operates over 16 channels in 2.4 GHz and over 11 channels in 868 and 915MHZ
- A ZigBee network can have a maximum of 255 nodes, which mostly of time are asleep.

ZIGBEE WIRELESS NETWORK (TARANG-F4)

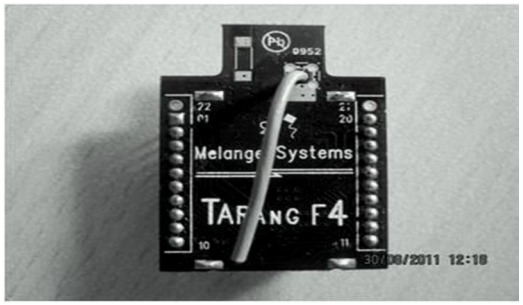

Figure : ZIGBEE

Zigbee is the two-way wireless, Half duplex, synchronous, low complexity, low power, low data rate, low-cost communication technology. Network communication protocol based on IEEE 802.15.4-2006 standard. Zigbee operates mainly at 2.400 to 2.484 GHz, 902 to 928MHz & 868.0 to 868.6MHz.Zigbee support an operating distance of up to 100 meters & a data rate of 20 to 250Kbps. Zigbee coordinator acts as the root of zigbee communication.

Specifications of Tarang F4

Supply Voltage	3.3 to 3.6V
Transmit Current	45mA
Idle/Receive Current	50mA
Power-down Current	<10 µA
Rating Frequency	ISM 2.4 - 2.4835 GHz
Data Rate	250 kbps
Receiver Sensitivity	-92 dBm
Serial Interface Data Rate	Up to 115200 baud
Operating Temperature	-40 to 85 °C
Antenna Options	Chip Antenna, Wire Antenna
Number Of Channels	16 direct sequence channels

Dimensions	37mm x 26mm.
Interface Connector	20 pin receptacles,

Tarang-F4 supports Point to point, point to multi point, and mesh and peer-to-peer topologies on proprietary stack. It uses direct sequence spread spectrum technology; each direct sequence channel has 64k unique network addresses. It has a transmit power of 0 dbm and rf data rate of 250 kbps. It includes acknowledgement mode communication with retries, power saving modes, source/destination addressing, uncast and broadcast communication, analog to digital conversion, digital i/o line support and default configuration for ready to use.

CONCLUSION

This project work aimed at designing the environment and controlling system with good performance, clear structure and good scalability. Our project is based on ARM7 and ZIGBEE wireless communication and sensor technology. In this GSM network is used to transferring data, it can guarantee the data collected transmitted to user, real-time at environmental timely and make right decisions. The system not only save the energy consumption but also reduce the labor intensity and material resources. Applying embedded technology and Zigbee wireless transceiver technology to the rapid deployment system of the incident detection of emergency food storage without complicated connections. It enhances the system flexibility, small size, low cost and good effective. It is to use.

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