The ARM Based Granary Environmental Monitoring and Controlling System using ZigBee

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Abstract: **Grain storage is the important factor for seasonal production. Grain is an important strategic resource of the country. This article designs Granary Environment Monitoring and Controlling system which is having combination of Embedded system and ZigBee Wireless Sensor Network technology. The design of wireless sensor network using ZigBee which is used for multipoint acquisition and transmission of environment parameters using AVR Processor to the Grain storage manager and transmission of control signals through ARM7 which improves the Scalability and flexibility of grain storage management.**

Keywords: **ARM Based Granary Environmental, Controlling system.**

I. INTRODUCTION

Grain is our country's important strategic resources. The seasonal production of the grain makes it very difficult to maintain the grain quality level for a long time. Due to different environment conditions and the variation in the environment parameters in grain storage depot the quality level decreases also there is a loss of grain also. So the cost of labor increases. So the storage of grain in the proper environment should be our top priority event. Because it effects people's livelihood. The automatic monitoring of the grain storage will help us to improve the operation levels of grain storage, reduce the grain losses during stored procedure and reduce labor intensity. This article designs Granary environment storage monitoring system which is having combination of Embedded system and ZigBee Wireless Sensor Network technology. The design of wireless sensor network using ZigBee which is used for multipoint acquisition and transmission of environment parameters using ARM7 to the Grain storage manager which improves the Scalability and flexibility of grain storage management. Using the powerful data collection capabilities of embedded microcontroller to process all kinds of data, which sends available data to grain depot manager in time and filters invalid data on the spot which saves a lot of manpower and material resources and improves labor productivity.

II. THE OVERALL SYSTEM PLAN

The system is mainly made up of the main ARM7 and AVR controller, wireless monitoring and control unit. Parts of the wireless monitoring and control unit using star network mainly include sensor node (or control node) and the coordinator nodes. The sensor node (or control node) is the key part of the wireless monitoring unit and control unit, and also is the focus of this paper. This node is mainly responsible for the collection and transmission of the environment information (such as temperature, humidity, smoke, gas etc.).The signals collected by the sensor through the A/D conversion are sent to the MCU processing. The ZigBee communication module changes the data into the data packets of ZigBee communication protocol which are transmitted to the coordinator node. After the coordinator node receiving the data packets sent by the sensor node (or control node), on the one hand, it would start handshake communication, i.e., it sends a confirmation language source to the node of sending data according to the original path in order to complete a full ZigBee wireless communication process. On the other hand, it should upload the data to the ARM master unit through the serial port. The ARM master unit gathered the collected information data, So environment of grain storage is achieved

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intelligent control. The ARM master accesses network and provides network services by connecting GPRS modules. Storage managers can focus the storage information received through system. and send control instructions to the grain storage depot to maintain the necessary environmental conditions. When any abnormal situations appear, then system can send a timely parameters to the storage manager also if parameters crosses its limit then a control signal will be transmitted to the transmitter to maintain the favourable environment.

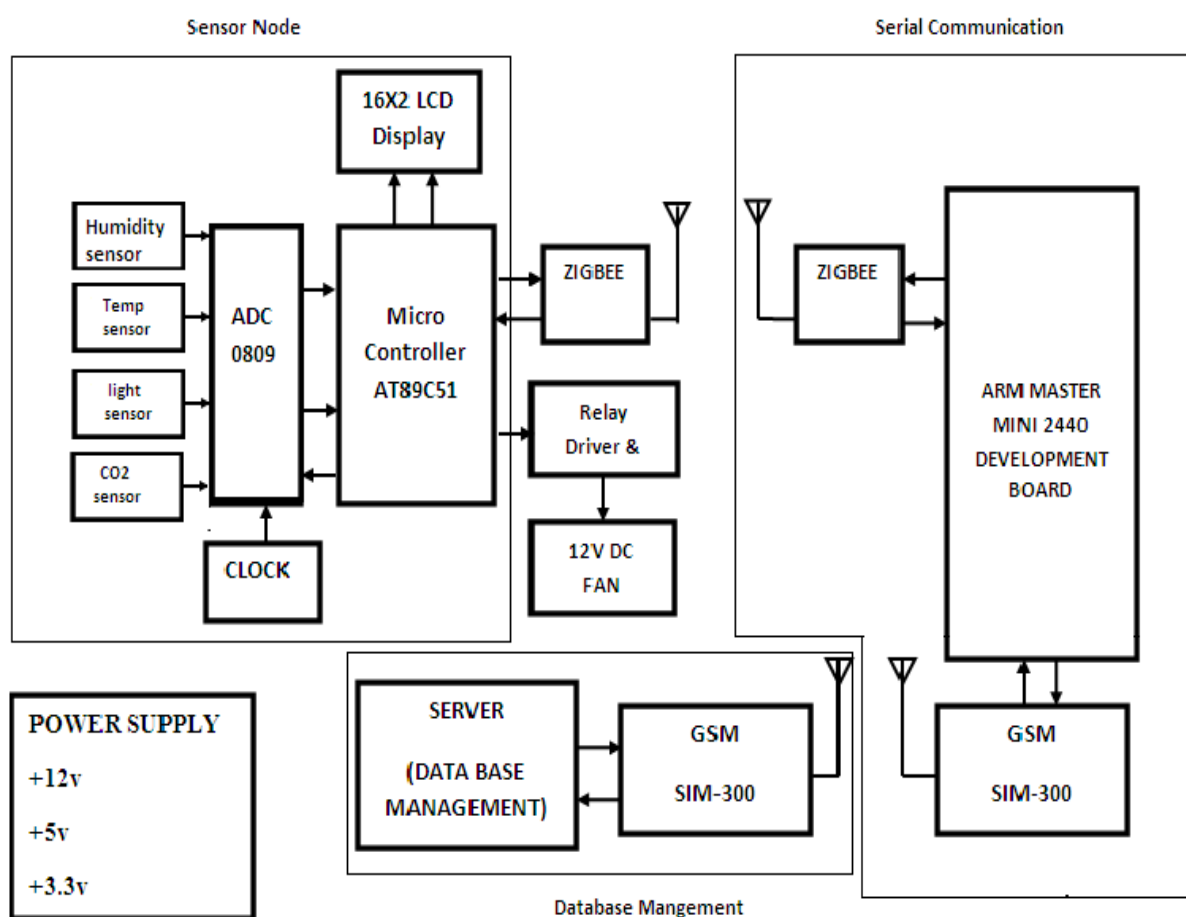The overall structure of the system is shown in the Figure 1.

Figure 1: The overall system plan of system

III.   SYSTEM HARDWARE DESIGN

The hardware of the system is mainly composed of theARM7 processor based on LPC2148 and wireless transceiver transmission network.

(A) Processor is designed to provide hand-held devices and general applications with low-power, and high-performance microcontroller solution in small die size. To reduce total system cost, the LPC2148 minimizes overall system costs and eliminates the need to configure additional components.

Features of ARM7 (LPC2148)

• Integrated system for hand-held devices and General embedded applications.

• 8kB to 40 KB onchip static RAM

• USB 2.0 full speed compliant

• Two 32-bit timer/ external event counter

• 16/32-Bit RISC architecture and powerful. Instruction set with ARM7 CPU core.

• Enhanced ARM architecture MMU to support WinCE, EPOC 32 and Linux operating system.

- Instruction cache, data cache, write buffer and Physical address TAG RAM to reduce the effect of main memory bandwidth and latency on Performance.

- ARM7 CPU core supports the ARM debug Architecture.

- Internal Advanced Microcontroller Bus Architecture(AMBA) (AMBA2.0)

(B) The design of terminal nodes:

ZigBee is the latest proposed, two-way wireless communication technology which is close, low complexity, low power, low data rate, low-cost. ZigBee uses self-organization network. The architecture is known as wireless infrastructure wireless local area network. This architecture has no restriction on the number of devices within the network, and can always create a wireless communications link.

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 main and most successful is home automation.

ZigBee devices are cheap as they do not need a high data rate and the microprocessor required for ZigBee devices is quite simple.

 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 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.

Temperature Sensor:

This sensor gives a variable output voltage with respect to the temperature variations in a granory. The LM-35 can be used as temperature sensor which is a precision integrated circuit temperature sensor, calibrated directly in ° Celsius (Centigrade).

 Humidity Sensor:

Humidity is the quantity of water content in atmosphere. The sensor output is a variable voltage with respect to humidity level and expressed in terms of %. The SY-HS-220 humidity sensor can be used which converts relative humidity to the output voltage. Here, we have used DTH11 which can sense both temperature as well as humidity.

 Light Sensor:

Light sensor is nothing but a light dependent resistor (LDR) in which the resistance will vary with respect to the light intensity that falls on it. LDR is a variable resistor and its output will be read in terms of lux. The light dependent resistor is used to detect the light intensity. This sensor will give a variable output voltage with respect to the light intensity variations in a granary.

 CO_2 Sensor:

This sensor is used to sense the concentration of CO_2 in a granary. This sensor is also used as gas sensor to detect the smoke if occurs in granory. This sensor will give a variable output voltage with respect to the variations of CO_2 concentration. MQ-7 sensor is used as CO_2 sensor which has high sensitivity to LPG, natural gas, sensitivity to alcohol, smoke. The CO_2 concentration detection range is 200ppm to 10,000ppm. The concentration of CO_2 can be expressed in terms of PPM or in percentage.

IV.   SOFTWARE DESIGN

Embedded C: Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations.

In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.

Embedded C use most of the syntax and semantics of standard C, e.g., main() function, variable definition, datatype declaration, conditional statements (if, switch. case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, unions,etc.

ARM Programming: Keil uVision.

For ARM Programming, we can use Keil Vision Software. It combines project management, run-time environment, build facilities, source code editing, and program debugging in a single powerful environment. It provides a single environment in which we may test, verify, and optimize the application code. The debugger includes traditional features like simple and complex breakpoints, watch windows, and execution control and provides full visibility to device peripherals.

AVR Programming: CodeVision.

For AVR Programming, we can use Code Vision Software.

V. CONCLUSION

The Granary Environment Monitoring system is developed based on the integrating with ARM control technology, ZigBee wireless communication and sensor technology. By using this system we can intelligently monitor the different environmental parameters remotely which provide greater scalability with superior performance. This system provides real time information on the secured network of ZigBee.It can guarantee the data collected transmitted to the user management center real-time, to ensure that the user can barn environment timely and make the right decisions. This system reduces the energy consumption significantly, but also reduces a large number of inputting on the human and material resources in the management. The system designed is very simple, it enhances the system's flexibility, low cost, small in size and easy to use, also it is easy to install and migrate.

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