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Wireless Sensor Network Based Agro-Industrial Applications Using ARM7 Controller

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ABSTRACT

Generally many plants need water always. From the beginning of the seed also some plants needs water so that we have to maintain the water continuously for such type of plants. And also we will estimate the temperature and humidity in the field. If any abnormal conditions occur in field then automatically the controller will send an SMS to the owner through GSM & at the same time it will send that data to farmers also through ZIGBEE.

The simple implementation here makes this system to alert the farmers. The procedure of this project is to insert a soil moisture sensor at the roots of the wet plants. Our project won't have any affect while water is up to the mark. Whenever water is not sufficient it automatically gives a buzzer sound. Farmer has to turn on the motor through wireless technology as ZIGBEE. Programs are developed using Embedded C, compiled using KEIL tool. LPC2000 Flash utility software is used to dump the code into microcontroller.

This proposed research work would be implemented using embedded system design methodology, which includes embedded hardware and firmware design modules. This project would be carried out with Low cost 32 bit LPC2148 Micro controller, PCB Design Software Tools and industry driven Embedded EDA Tool kit and Embedded 'C' Programming Language.

Introduction

In the field of soil environmental monitoring, real-time monitoring the temperature and humidity of soil can correctly guide agricultural production and improve crop yield. It also can provide scientific basis for high-precision monitoring and calculating for farmland drought and flood area. Traditional wired communications exist many problems It has broad application prospects in soil environmental monitoring field.

The age of the Internet of things comes; wireless sensor networks become the core of networking. In order to achieve greater things on the technical requirements of the Internet of things, we adopt the technology of wireless sensor network based on Zigbee, GPRS and Web Services technology designing a set of low cost, low power Since the function requirement of The Internet of things and temperature humidity monitoring system of soil, this paper uses the overall structure as figure 1 shows.

The system consists of wireless sensor network nodes and network management plat form . Zigbee nod e (1 to n) respectively transmits acquisition of the temperature and humidity data to the Zigbee stations of gateways node. The automatic networking realizes through the many jump routing consumption, flexible automatic networking temperature humidity monitoring system of soil. And the system is a

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complete set of wireless sensor network induction, acquisition, storage, application, reporting, solution, has a good mancomputer exchange interface. Users need not go into farmland, in a corner anywhere in the world, could prompt understand the changing condition of farmland soil temperature and humidity, and scientifically guide agricultural production. Remainder of the paper is organized as follows. Section II Introduces the General Structure Design Section III. Describe about Wireless Sensor Network Node Design Section IV Gives Network Management Platform Design and finally Section V Describe System Test will test the proposed system.

System Architecture

Transmitter section

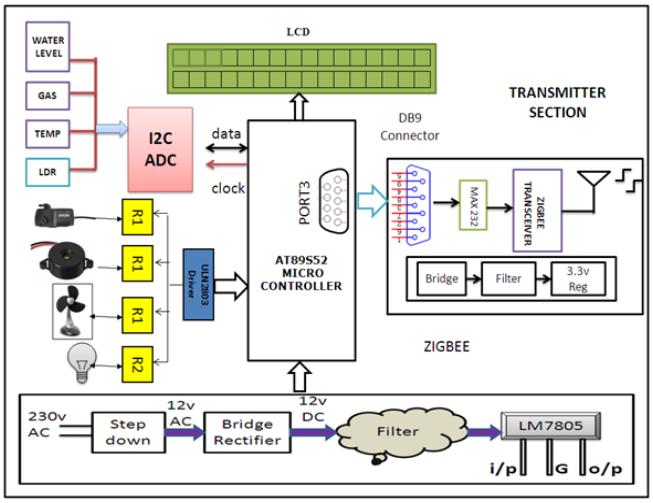

Fig.1.System Architecture

Receiver section

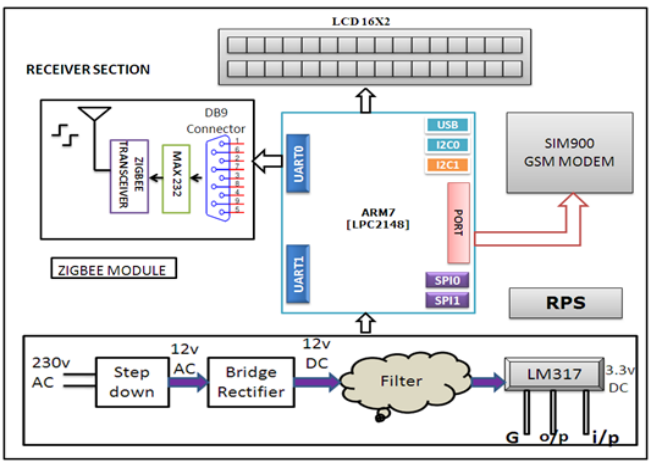

Fig.2.System Architecture

ARM (LPC 2148) :

ARM stands for Advaced RISC Machine developed by ARM Ltd which is most widely used in number of Embedded systems. Today ARM family accounts for approximately 75% of all embedded CPUs making it one of the leading architecture in the world. Previous designs used 8 bit/16 bit devices, but the designers are looking for highly integrated high performance ARM based 32-bit microcontroller. Heart of the design is ARM 32 bit RISC processor, hence brief description was given about its specifications below.

The basic block diagram of the system is as shown in fig 1, The vehicle emission indicator, reading, can be interrogated along with the corresponding tag ID through a wireless connection among traffic lights and vehicles. By monitoring the emissions data reading from gas sensor.

The body temperature will be directly sent to the microcontroller by the LM 35 temperature sensor.
The LPC2148 board consists of ARM7TDMI as its core and it is designed by NSK. ARM7TDMI family has good performance in situations where the energy consumption is critical design goal. LPC2148 has ARM7TDMI as its core is called CPU core. The modules inside are connected by the CPU high performance bus called Advance High performance bus (AHB) and the peripherals are connected by VLSI peripheral bus (VPB).

µC (AT89S52):

The AT89S52 is a low-power, high-performance CMOS 8- bit microcontroller with 8K bytes of in-system programmable Flash memory. The Atmel AT89S52 is a powerful microcontroller provides advantages like high flexibility and cost-effective solution to many embedded control applications. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the

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AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes one is idle and other is power saving mode [5].

LCD DISPLAY:

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in most applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence. The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in colour or monochrome. Liquid crystals were first discovered in 1888.[2] By 2008, annual sales of televisions with LCD screens exceeded sales of CRT units worldwide, and the CRT became obsolete for most purposes.

MCP3208:

The Microchip Technology Inc. MCP3204/3208 devices are successive approximation 12-bit Analog to-Digital (A/D) Converters with on-board sample and hold circuitry. The MCP3204 is programmable to provide two pseudo-differential input pairs or four single ended inputs. The MCP3208 is programmable to provide four pseudo-differential input pairs or eight single ended inputs. Differential Nonlinearity (DNL) is specified at ±1 LSB, while Integral Nonlinearity (INL) is offered in ±1 LSB (MCP3204/3208-B) and ±2 LSB (MCP3204/3208-C) versions.Communication with the devices is accomplished using a simple serial interface compatible with the SPI protocol.The devices are capable of conversion rates of up to 100 ksps. The MCP3204/3208 devices operate over a broad voltage range (2.7V - 5.5V). Low current design permits operation with typical standby and active currents of only 500 nA and 320 µA , respectively .The MCP3204 is offered in 14-pin PDIP, 150 mil SOIC and TSSOP packages. The MCP3208 is offered in 16-pin PDIP and SOIC packages.

Temperature sensor:

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies.

GAS SENSOR:

The MQ series of Gas Sensors used in this research work are simple and cost effective sensors useful for sensing gases in the air. There is a wide range of sensors available each of which are made to detect a specific gas like Methane, NOx, SOx, LPG, CNG, Carbon Monoxide and Alcohol.

Gas leak detection is the process of identifying potentially hazardous gas leaks by sensors. These sensors usually employ an audible alarm to alert people when a dangerous gas has been detected. Common sensors include infrared point sensors, ultrasonic sensors, electrochemical gas

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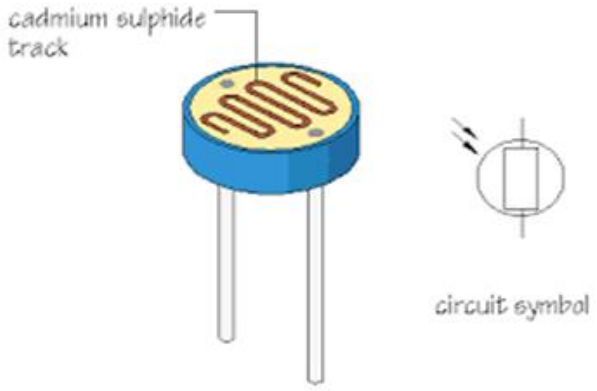
sensors, and semiconductor sensors. More recently, infrared imaging sensors have come into use. All of these sensors are used for a wide range of applications and can be found in industrial plants, refineries, waste-water treatment facilities, vehicles, and homes.

LDR:

A photo resistor or light dependent resistor or cadmium sulfide (CdS) cell is a resistor whose resistance decreases with increasing incident light intensity. It can also be referenced as a photoconductor.

A photo resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, e.g. silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities, also called dopants, added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (i.e., longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.



Zigbee:

Zigbee communication protocol realizing The digital frequency part, the direct sequence spread spectrum (DSSS) technology, not only can easily realize 802.15.4 short-range wireless communication standard compatible, and greatly improve the reliability of wireless communications10. The protocol stack design is precise and reliable, including very important AES processing technology, CSMA/CA energy-saving technology, etc4 . In the past, due to the low consumption, we more used star topology in the networking. But the coverage and the efficiency will be limited by the structure of the network by star, and failure of Cluster nodes can lead to the failure of the network structure. Relative to the star network, the scope preventing ordinary lithium battery power supply time short and cannot continue ,making a foundation for using the tree topology. of physical of tree network is bigger, the number of nodes for more. In this paper, we use the solar power supply. Internal protocol, between layer and layer, realize information communication through the API, API provides the interfaces to 802.15.4 protocol stack management and data services11. Direct executive function directly executes those operation codes that realize a MAC; Callback function accesses date through the parameters of the function, only is effective during the implementation. These API functions execute in MAC environment.

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NEED FOR ZIG-BEE TECHNOLOGY

ZIGBEE is the only wireless standards-based technology that addresses the unique needs of remote monitoring and control, sensory network applications. Sensors and controls don't need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays.

There are a multitude of standards that address mid to high data rates for voice, PC LANs, video, etc. However, up till now there hasn't been a wireless network standard that meets the unique needs of sensors and control devices. There are a multitude of proprietary wireless systems manufactured today to solve a multitude of problems that also don't require high data rates but do require low cost and very low current drain.

These proprietary systems were designed because there were no standards that met their requirements. These legacy systems are creating significant interoperability problems with each other and with newer technologies.

This network has large number of nodes when compared to other technologies. It is easy to deploy and configure i.e., if any new node enters into the network it automatically senses and configure it. The Zigbee device is interoperable.

GSM Module

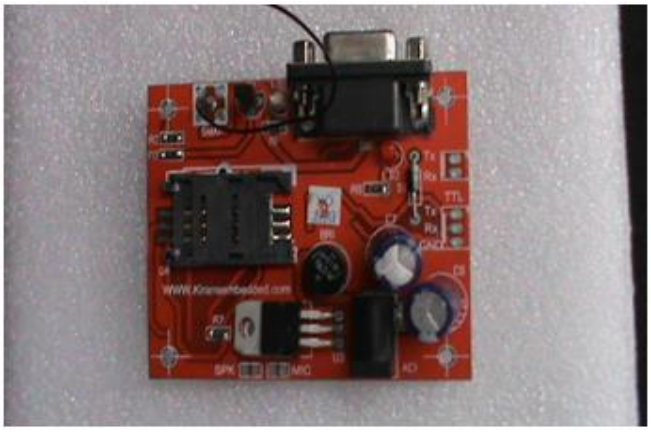

Figure: GSM Modem

GSM supports voice calls and data transfer speeds of up to 9.6 kbit/s, together with the transmission of SMS (Short Message Service). GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. The 850MHz band is also used for GSM and 3G in Australia, Canada and many South American countries. By having harmonized spectrum across most of the globe, GSM's international roaming capability allows users to access the same services when travelling abroad as at home. This gives consumers seamless and same number connectivity in more than 218 countries. Terrestrial GSM networks now cover more than 80% of the world's population. GSM satellite roaming has also extended service access to areas where terrestrial coverage is not available.

PROPOSED METHOD:

We can overcome the disadvantages of the existing method by Remote control is a new feature and used in agriculture and industrial automation systems. However providing a mechanism for interaction between devices in this environment is quite challenging. The communication protocol has been mostly used to connect personal computers so far, but shortly all kinds of appliances with embedded computers will exchange information over the wireless network. In this project the main purpose is to provide a single control point which provides access to all building services with low cost reduction factors. A remote monitoring allows the quick detection of failing devices without needing long searches and wasting personal time. The system uses a compact circuitry built around LPC2148 (ARM7) microcontroller Programs are developed in Embedded C. Flash magic is used for loading programs into Microcontroller.

EXPERIMENTAL RESULTS

The developed system is tested by installing the Smart sensing units and setting up a ZigBee based WSN agriculture filed. Interconnecting ZigBee network. Integrated system was continuously used and generated real-time graphical representation of the sensing information.

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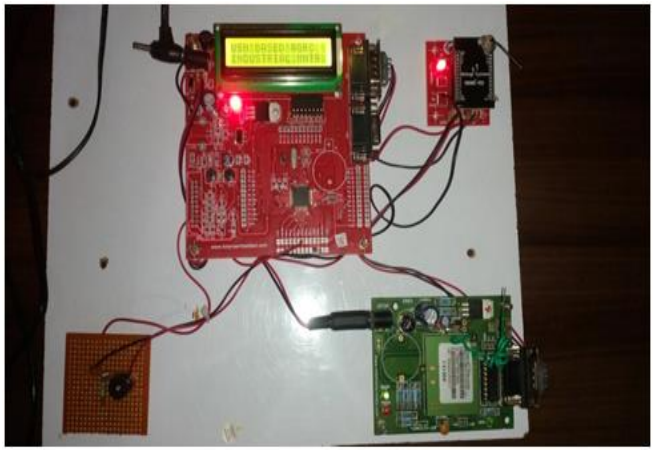
Fig. 6(a,b,c) shows the type # 1 sensing unit information in real-time. Measurements related to temperature, light intensity, Gas leakage detection and water level indication are shown in Fig. , system of the sensor entities has been reflected for better remote utilization and controlling through an effective wireless communication.

Figure

Figure transmitter



CONCLUSION

This paper demonstrates designing of embedded controlled sensor networks used for controlling the external loads as well as monitoring the environmental parameters. The features of GSM and Zigbee are explored to design the system for long distance as well as short distance.. Embedded controlled sensor networks have proven themselves to be a reliable solution in providing remote control and sensing for indoor environmental monitoring systems. Four commercial sensors had been integrated with the system to monitor and compute the level of existence of CO gas, temperature, to calculate the light intensity using LDR sensor and moisture level, water level sensor to measure water levels in agriculture field to control the motor automatically by using communication technologies.

FUTURE SCOPE

Future work will include a comparative study between the proposed system and other wired system, focusing on energy efficiency, Smart Grid capabilities and installation and Maintenance costs.

Further implementations will be done in order to extend the proposed system to other standards or technologies of lamps, luminaries or lightning communication and control protocols.

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