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Smart Wireless Sensor Network for Monitoring an Agricultural Environment

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***Abstract*— The ability to monitor environmental conditions is crucial to research in fields ranging from climate variability to agriculture and zoology. Being able to document baseline and changing environmental parameters over time is increasingly essential important and researchers are relying more and more on unattended weather stations for this propose. A Zigbee Based Smart Sensing Platform for Monitoring Environmental Parameters has been designed and developed. The smart weather station consists of microcontroller based measuring units which collect the value of the temperature, relative humidity, water level and soil moisture. These units send their data wireless to a central station, which collects the data, stores and displays them into a database. The facility of adding a few more sensors and a few more stations has been provided.**

***Index Terms*— Monitoring system, Wireless Sensor Network, Weather Station, Zigbee/IEEE802.15.4**

I. INTRODUCTION

In the last few years, the occurrences of natural Changes in atmosphere is a have been becoming the cause for the Fungus, Bacterial attacks on the agricultural. If such changes are not aware in time to us the precautions cannot be taken and there will be bad affect on the agricultural production

In this project, we present a system that can be used to monitor various parameters like Temperature, Humidity, Soil moisture, water level sensor and again supporting to this we are providing the facility for remotely ON/ OFF of the Motor.

We are using a wireless sensor network based on Zigbee/IEEE802.15.4 standard is utilized as a weather station network sending weather information.

This research focuses on developing devices and tools to manage, display and alert the weather/disaster warnings using the advantages of a wireless sensor network system.

Zigbee is new wireless technology guided by IEEE 802.15.4 Personal Area Network standard. It is primarily designed for the wide range controlling applications and to replace the existing non-standard technologies.

II. THE SYSTEM ARCHITECTURE

Form between each node and tuner network. Then transmits the data to Zigbee through a serial port, also can pass to PC to view real-time data.

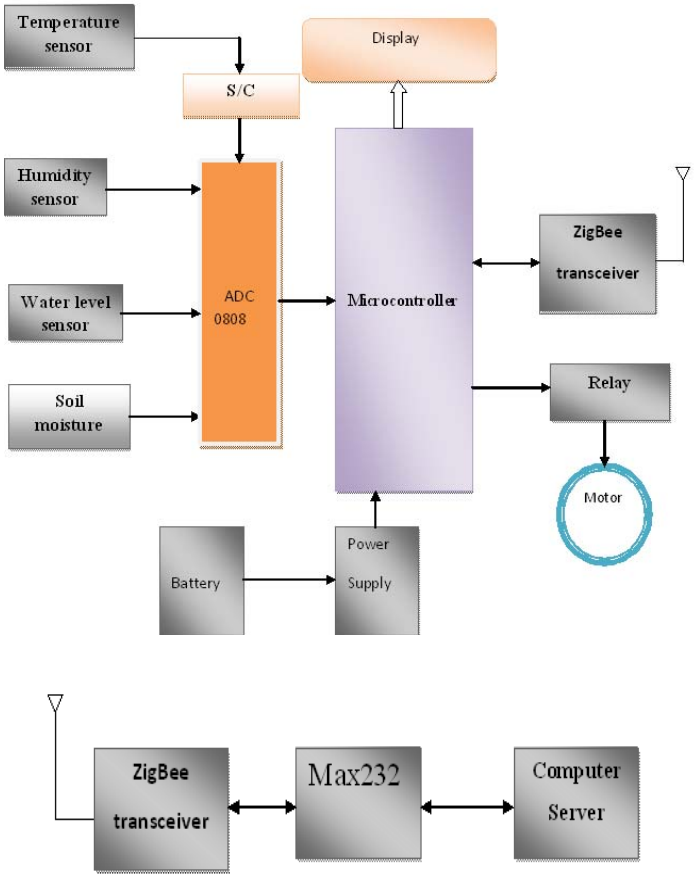

Fig.1: Block diagram of Smart Wireless Sensor Network

III. DESIGN OF WIRELESS SENSOR NETWORK

A. Wireless sensor network node hardware design

The wireless sensor network requirement to implement low cost, low power consumption, high performance and high sensitivity and the anti interference ability. In this paper, we choose Zigbee module XBee 1mW wire antenna, LM35 for Temperature sensor, SH 220 for Humidity sensor, Copper strips for water level detector, Soil Moisture Sensor with Interface Module.

1) Zigbee module Xbee

It is the only standards-based wireless technology designed to address the unique needs of low-cost, low-

power wireless sensor and control networks in just about any market. Since ZigBee can be used almost anywhere, is easy to implement and needs little power to operate, the opportunity for growth into new markets, as well as innovation in existing markets, is limitless.

2) LM35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°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.

3) SH 220

This module converts the relative humidity to the corresponding output voltage. Operating humidity: 30 – 90%RH, standard output: DC 1980mV (at 250C, 60%RH), accuracy: +/-5%RH (at 250C, 60%RH)

4) Soil Moisture Sensor

The porous ceramic tip is installed into the soil at the depth where the majority of the active root system is located. The vacuum gauge measures the soil moisture tension or suction. It measures how much effort the roots must put forth to extract water from the soil and is measured in centibars. This is a simple water sensor can be used to detect soil moisture when the soil moisture deficit module plant water device, so that the plants in your garden without people to manage.

5) WL400 WATER LEVEL SENSOR

WL400 Water Level Sensor submersible pressure transducer consists of a solid state pressure sensor encapsulated in submersible stainless steel 13/16" diameter housing. The water level gauge uses a marine grade cable to connect the water pressure sensor to the monitoring device. Each of Global Water's pressure transducers has a two-wire 4-20 mA high level output, five full scales ranges, and is fully temperature and barometric pressure compensated. Water level sensor level ranges of 0-3, 0-15, 0-30, 0-60, 0-120, 0-250 and 0-500 ft are available.

B. 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, etc.

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.

VI. DESIGN OF NETWORK MANAGEMENT PLATFORM

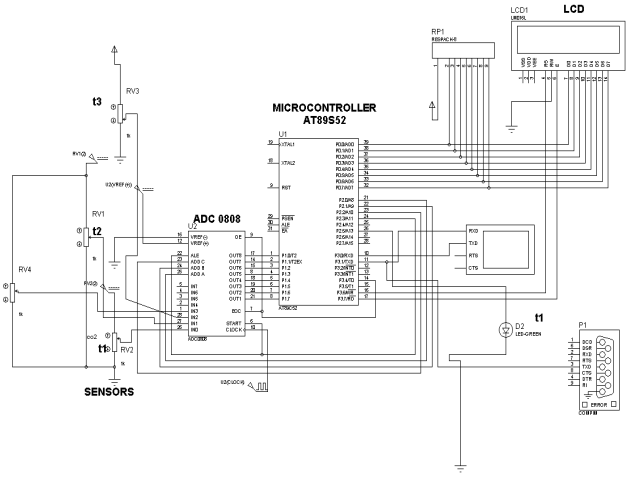

Fig 2: Connection Diagram

A information management and localization of wireless sensor network platform, need have quicker processing speed and strong information management functions. In this design, we focus the core Zigbee building wireless sensor network gateways hardware.

A. Plat form Hardware design

1) Zigbee

In this paper, we embed Zigbee coordinator node into the gateway, as a fully functional devices, collecting all nodes data. Communication between Coordinator and Zigbee is through serial, also can directly communicate with the PC, realizing real-time data checking and monitoring.

2) .Microcontroller 89C52

The Microcontroller IC 89S52 has 256x8 bit internal RAM which is most important feature for this application. Here eight to ten readings can be recorded in RAM after each half an hour to achieve data logging.

The Timer/Counter application of 89S52 is used to count the pulses from proximity sensor. The interrupt pin INTR0 is used to switch into different setting modes The serial channel is used to get interface with pc for data logger application.

The AT89C52 provides the following standard features: 8Kbytes of Flash, 256 bytes of RAM, 32 I/O lines, three 16-bittimer/counters, six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89C52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes.

B) **Software Design**

1) Embedded C

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular function. The software is installed on the controller, the brains of the electronic device. Each embedded system is used for one specific function.

The C language can also use very simple commands to control the device, freeing up the limited memory of the device to hold many commands or parameters. C can be written for both microcontrollers and digital signal processors. Code is written in C on a programmer's PC. Code is run through a compiler on the programmer's PC to create a software program. The embedded system software may be run through a simulator on the programmer's computer. The software program is copied onto the controller using a "programmer." The controller is then tested on a "test bed" to ensure that it works properly.

Programming in C makes the Embedded systems more reliable. C code written for a specific micro controller can easily be transferred to systems using different micro controllers of different vendors without little or no modification. It can be reused, easy to maintain and easy to debug and extend. The advantages of C as shown in the following:

1. Of higher level languages, C is the closest to assembly languages.
2. Most micro controllers have available C compilers.
3. Writing in C simplifies code development for large projects.
4. It is easier and less time consuming to write in C language than assembly.
5. C is easier to modify and update.
6. We can use code available in function libraries.
7. C code is portable to other micro controllers with little or no change.
8. Assembly is the fastest, however, it is difficult to find or train assembly experts. Then if a new processor is required, we have to start over!
9. C is mid-level, lots of good C programmers are available, C compilers are available. C can be used on 8-, 16-, 32-, and 64-bits processors.

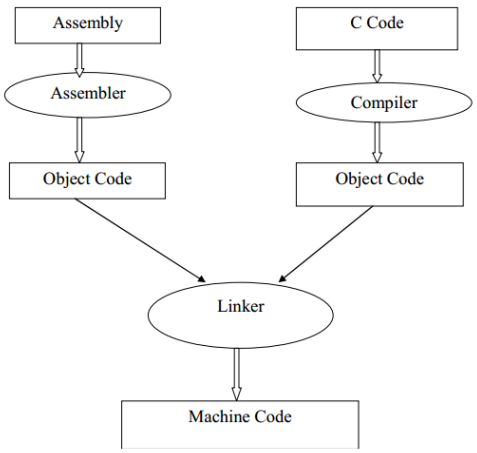

Fig3: Code Generation Flow for assembly and C

2) Visual Basic 6.0

The "Visual" part refers to the method used to create the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements, you simply add prebuilt objects into place on screen. If you've ever used a drawing program such as Paint, you already have most of the skills necessary to create an effective user interface.

Visual Basic has evolved from the original BASIC language and now contains several hundred statements, functions, and keywords, many of which relate directly to the Windows GUI. Beginners can create useful applications by learning just a few of the keywords, yet the power of the language allows professionals to accomplish anything that can be accomplished using any other Windows programming language.

VI. SYSTEM TEST

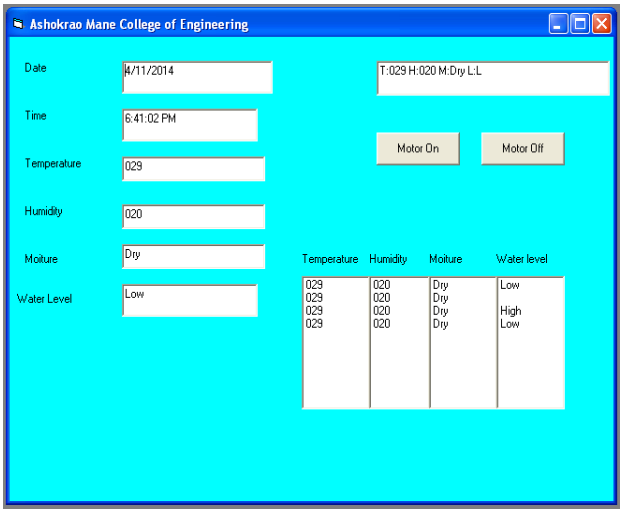

Fig 4: Visual basic Output

In 800square meters, we distributed six temperature humidity sensor nodes each node can achieve routing functions. Soil, temperature, humidity sensor node is set into soil for 8cm, completes the data collection, sending. Then the nodes will be dormant until the next one sampling period.

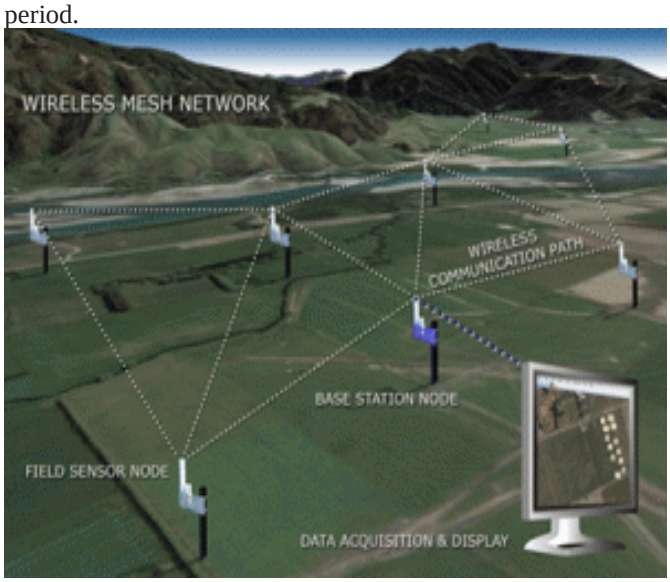

Fig 5: Implementation of Sensor And Data Acquisition

VII. CONCLUSION

Zigbee-based agriculture monitoring system serves as a reliable and efficient system for efficiently monitor the environmental parameters. Wireless monitoring of field not only allows user to reduce the human power, but it also allows user to see accurate changes in it.

This research focuses on developing devices and tools to manage, display and alert the weather/disaster warnings using the advantages of a wireless sensor network system.

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