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Online Monitering of Geological Parameters Based on Wireless Sensor Networks

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Abstract: *The system designed here is to monitor weather data from the remote field. The weather data is then communicated or transmitted to the central server through Zigbee wireless connection. Different nodes have different Zigbee modules which are having unique Id's, so it is easy to find the location of the field. The server collects information from the entire remote field and transmits to the monitoring station i.e. through WI-FI. The microcontroller is used as a computer and the WI-FI is used to connect the microcontroller to a Router which is provided with internet, so that acquired geological parameters are monitored from any part of the world. Here Web page is used to display the sensors data.*

Keywords: *ZigBee, wi-fi, sensor.*

1. INTRODUCTION

A Wireless sensor network (WSN) is a network consisting of distributed devices that provide sensing features such as temperature, humidity, gas, smoke, motion etc. The last few years systems applied on WSN are becoming more and more noticeable. An added feature in any embedded system is its ability to communicate. The communication can be via Bluetooth, WI-FI, GSM, or Ethernet cables. The WI-FI protocol is a widely used standard for modern digital communication. A weather station is a facility with instruments and equipment to make weather observations by monitoring atmospheric conditions. The project we have undertaken includes the three Concepts embedded systems, WI-FI Communication and weather station. It provides real time data of weather in remote/inaccessible locations through a wireless /wired connection. Main objective of the project is to make Internet/IP enabled embedded device serving as advanced remote data logger which can be accessed remotely via workstation. The internet enabled device will be interfaced with various sensors like temperature sensor, humidity sensor. Router is meant to act as a data Forwarder thus enabling the end nodes to Communicate with the Master node. The Master node specifications are different from end node and router. Master node Communicates with central station through Zigbee depending on the distance at which Master node needs to be deployed.

2. PROPOSED SYSTEM

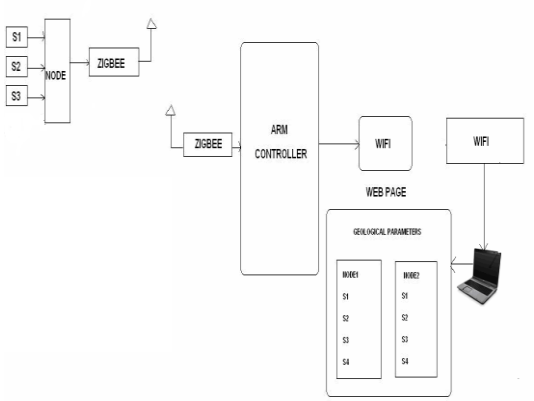

Fig1. *Block Diagram*

In the proposed system, the microcontroller is used as a computer and the WI-FI is used to connect the microcontroller to a Router. Different sensors are interfaced to controller in sensors node called wireless sensor network. The communication between sensor node and central node happens through ZigBee. At central node, the controller sends data to remote station through WI-FI.

Temperature, humidity & gas sensors are interfaced to sensor node. At the remote station PC displays the GUI with updated geographical parameters.

3. HARDWARE IMPLEMENTATION

3.1. PIC Microcontroller

PIC microcontrollers come in a variety of "flavors", each with different components and capabilities. The PIC is a very general purpose microcontroller that can come with many different options. General Instruments produced a chip called the PIC1650, described as a Programmable Intelligent Computer. This chip is the mother of all PIC chips. Maybe that is why most people think PIC stands for Peripheral Interface Controller. Microchip has never used PIC as an abbreviation, just as PIC and recently. PIC microcontrollers are finding their way into new applications like smart phones, audio accessories, video gaming peripherals and advanced medical devices. Microchip Provides solutions for the entire performance range of 8-bit microcontrollers, with easy-to-use development tools, complete technical documentation and post design-in support through a global sales and distribution network. There are hundreds of 8-bit PIC microcontrollers to choose from ranging from 6 to 100 pins and up to 128 KB Flash that are pin and code compatible.

3.2. ARM9 S3C2440A

The ARM processor is a Reduced Instruction Set Computer (RISC). The ARM920T processor is a member of the ARM9TDMI family of general purpose microprocessors includes the ARM9TDMI core plus cache and MMU.

ARM9TDMI processor:

- Harvard architecture
- 5-stage pipeline
- 32-bit ARM instruction set and 16-bit THUMB instruction set.

Samsung's S3C2440A is designed to provide hand-held devices and general applications with low-power, and high-performance microcontroller solution in small die size. The S3C2440A is developed with ARM920T core. It adopts a new bus architecture known as Advanced Micro controller Bus Architecture (AMBA). ARM920T views memory as a linear collection of bytes numbered upwards from zero. The S3C2440A offers outstanding features with its CPU core, a 16/32-bit ARM920T RISC processor designed by Advanced RISC Machines, Ltd. The ARM920T implements MMU, AMBA BUS, and Harvard cache architecture with separate 16KB instruction and 16KB data caches, each with an 8-word line length. Bytes 0 to 3 hold the first stored word, bytes 4 to 7 the second and so on. ARM920T can treat words in memory as being stored either in Big-Endian or Little-Endian format.

3.3. Humidity Sensor

Humidity is an important factor in personal comfort and in quality control for materials, machinery etc. Now we are using SYH2 and SYH-2S humidity sensors in most of the circuits.

Humidity sensors are gaining more significance in diverse areas of measurement and Control technology. Manufacturers are not only improving the accuracy and long-term drift of their sensors, they are improving their durability for use in different environments, and simultaneously reducing the component size and the price.

Following this trend, Swiss-based Sensation AG has introduced a new generation of integrated, digital, and calibrated humidity and temperature sensors using CMOS "micro-machined" chip technology. The new products, SYH2 and SYH-2S, are a single chip relative humidity and temperature multi sensor module with a calibrated digital output which allows for simple and quick system integration.

Conventional sensors determine relative air humidity using capacitive measurement technology. For this principle, the sensor element is built out of a film capacitor on different substrates (glass, ceramic, etc.).

3.4. Features

- Operating humidity 20-95%RH
- Standard characteristics 33KQ (At 25degree centigrade, 60%RH)
- Storage temperature -30—85° centigrade
- Storage humidity within 95%RH
- Humidity accuracy +/- 5%RH (at 25degrees centigrade,60%RH)
- Humidity response time <60sec (40-80%RH)

3.5. Gas Sensor

Gas sensor (MQ-5) detects the gas leakage. They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, natural gas, town gas, avoid the noise of alcohol and cooking fumes and cigarette smoke. Resistance value of MQ-5 is difference to various kinds and various concentration gases. So, when using these components, sensitivity adjustment is very necessary. When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

3.6. Temperature Sensor (LM35)

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 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.01°C of the surface temperature. This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature.

3.7. Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full -55° to +150°C range

3.8. Wi-Fi (IEEE Standard 802.11)

Wi-Fi is the wireless way to handle networking. It is also known as 802.11 networking and wireless networking. The big advantage of Wi-Fi is its simplicity. Mobile connectivity for computers is a rapidly growing requirement. Of the schemes that are available the IEEE 802.11 standard, often termed Wi-Fi has become the de-facto standard. With peak operating speeds of around 54 Mbps it is able to compete with many wired systems. As a result of the flexibility and performanceofthe system, many Wi-Fi “hotpots” have been set up and more are following. These enable people to use their laptop computers as they wait in hotels, airport lounges, cafes, and many other places using a wireless link rather that needing to use a cable.

3.9. Zigbee

ZigBee is a wireless networking standard that is aimed at remote control and sensor applications which is suitable for operation in harsh radio environments and in isolated locations, It builds on IEEE standard 802.15.4 which defines the physical and MAC layers. Above this ZigBee defines the application and security layer specifications enabling interoperability between products from different manufacturers. In this way ZigBee is a superset of the 802.15.4 specification. With the applications for remote wireless sensing and control growing rapidly estimated that the market size could reach hundreds of millions of dollars as early as 2007. This makes ZigBee a very attractive proposition, and one, which warrants the introduction of a focused standard.

Fig2. *Zigbee module*

Zigbee is the product of the Zigbee Alliance, an organization of manufacturers dedicated to developing a new networking technology for small, ISM-band radios that could welcome even the simplest industrial and home end devices into wireless connectivity ZigBee uses a basic master-slave configuration suited to static star networks of many infrequently used devices that talk via small data packets. It allows up to 254 nodes. Bluetooth's protocol is more complex since it is geared towards handling voice, images and file transfers in ad hoc networks. Bluetooth devices can support scatter nets of multiple smaller non-synchronized networks (piconets). It only allows up to 8 slave nodes in a basic master-slave piconet.

4. HARDWARE RESULTS

The receiver node is developed on the ARM9 based S3C2440 micro controller. For data receiving from sensor node we are using zigbee module. For long range data transmission we using Wi-Fi.

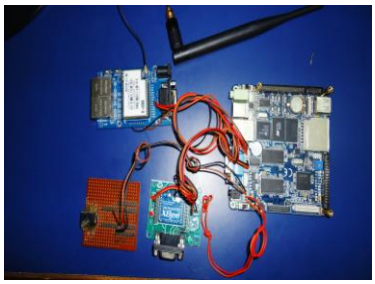

Fig3. *Receiver Node*

The sensor node is having the sensors of humidity, temperature and gas sensor. The sensor data is displayed on the LCD.

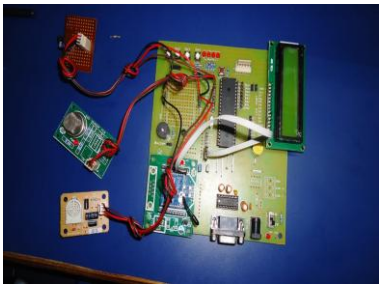

Fig4. *Sensor Node*

Fig5. *Wi-Fi Module*

The Graphical User Interface is used to display the data in an understandable format and is also shown using graph.

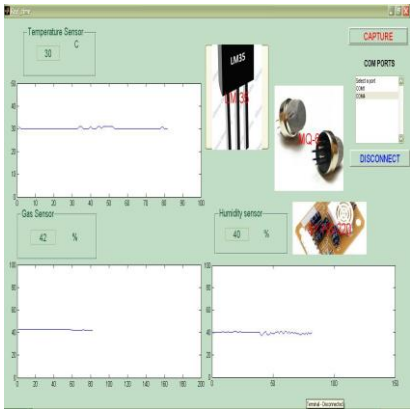

Fig6. *GUI*

5. CONCLUSION

The system designed in this project is applied to monitor weather data from the remote field. The weather data is then communicated or transmitted to the central server through Zigbee wireless connection. Different nodes have different Zigbee modules which are having unique Id's, so it is easy to find the location of the field. The server collects information from the entire remote field and transmits to the monitoring station i.e. through WI-FI. The WI-FI protocol is to monitor the sensor. The sensors used are the temperature, humidity, gas, smoke Sensors.

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