Zigbee And Gsm Technology Based Irrigation Controll System

SCHOOL OF ELECTRONICS, TIANJIN UNIVERSITY OF TECHNOLOGY AND EDUCATION

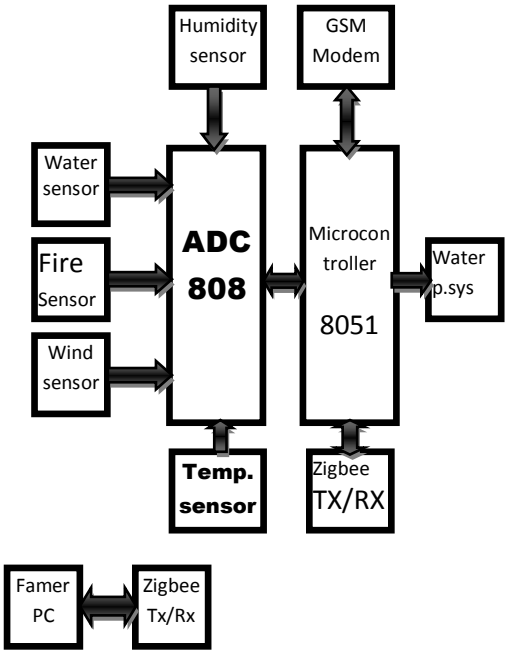
Zacharia Mzurikwao 1 , Dr.Wang Liqiang 2

Abstract: In this paper we are trying to explain few of the agricultural process such as Water pumping with a precise level as required by the crop. In our system we have automated the water pump to pump the water whenever the prescribed water level or humidity of the soil goes down below prescribed threshold level. For this case we use a water level sensor & Humidity sensor. If the water level is increased beyond the prescribed level during rain or flood, our system automatically lets the extra water and recycles them back to the water tank (if required).Our system also senses the wind speed to predict any storm & other natural calamities and warns the farmer by sending him an SMS using a GSM Modem. For safety purpose we also have fire and temperature sensors to alert the farmer on any kind of such eventualities. The prescribed water level for a crop varies depending on different crops and nature of the soil, so we have developed a user interface to feed the type of soil and crop to automatically set the water level. The farmer is able to control and monitor the field using his PC which is connected to the control system using Zigbee. Eventually a microcontroller was chosen for the heart of the system. A PC based solution could have been designed easier but a microcontroller based solution meant that the system was more independent and hopefully more reliable, with cheaper running costs.

1.0 Introduction:

It is well known that water resources are getting dried all over the world. Water restrictions have been introduced in most places for several years now trying to limit water consumption. By considering this, system was designed to solve part of the problem by trying to improve the efficiency of water use in irrigation systems. Common methods of water distribution can be enhanced or replaced by using recent technological advances. The system will be used to improve the efficiency of water distribution, to automate the process of irrigation management. This system provides an easy use of reporting interface and monitoring, and to provide a scalable, versatile base from which to expand or modify if needed. One of the main drawbacks with the old fashioned auto timer system is that they do not cater for changing environmental conditions. Temperature, wind, rainfall and other elements can dramatically affect the amount of water needed to sustain a plants health. If these elements were monitored and used to influence the watering cycles, then the water used should be more effective.

2.0 BLOCK DIAGRAM



2.1. GSM TECHNOLOGY

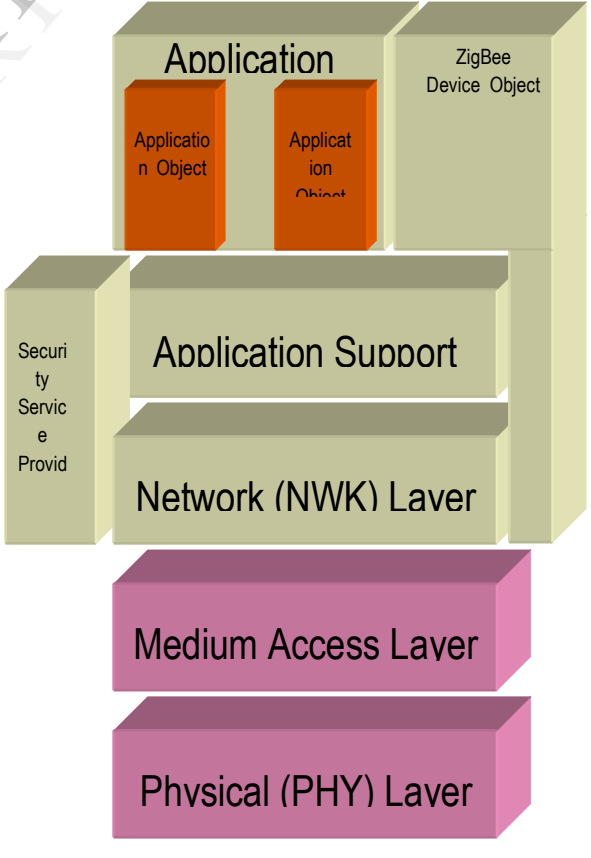
The Global System for Mobile communications (GSM) is the most popular standard for mobile phones in the world. Most GSM systems operate in the 900 MHz and 1.8 GHz frequency bands, except in North America where they operate in the 1.9 GHz band. A unique feature of GSM is the Short Message Service (SMS), SMS is a bi-directional service for sending short alphanumeric message in a store-and-forward process.SMS can be used both 'point-to-point' as well as in cell-broadcast mode.

2.2. ZIGBEE TECHNOLOGY

The past several years have witnessed a rapid growth of wireless networking. However, up to now wireless networking has been mainly focused on high-speed communications, and relatively long range applications such as the IEEE 802.11 Wireless Local Area Network (WLAN) standards. The first well known standard focusing on Low-Rate Wireless Personal Area Networks (LR-WPAN) was Bluetooth. However it has limited capacity for networking of many nodes. There are many wireless monitoring and control applications in industrial and home environments which require longer battery life, lower data rates and less complexity than those from existing standards. For such wireless applications, a new standard called IEEE 802.15.4 has been developed by IEEE. The new standard is also called ZigBee, when additional stack layers defined by the ZigBee Alliance are used. The low-cost hardware is 802.15.4 Standard compatible at the over-the-air level by its design, but as communication services become more complex or have higher levels of compatibility with standards, the software and development demands can become more costly. As with any product, a wireless application can have varying demands of cost, performance, and time-to-market goals, and these will drive the selection of the communication services.

2.2.1 WHY ZIGBEE?

There are various standards like Bluetooth and Wi-Fi 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. 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. Although ZigBee's underlying radio communication technology isn't revolutionary, It travels across greater distances and handles many sensors that can be linked to perform different tasks. **Fig.2 Below is the zigbee stack model.**



2.3 THE MICROCONTROLLER

Despite it's relatively old age, the 8051 is one of the most popular microcontrollers in use today. Many derivative microcontrollers have since been developed that are based on--and compatible with the 8051. Thus, the ability to program an 8051 is an important skill for anyone who plans to develop products that will take advantage of microcontrollers. Micro-controller can be compared to a small stand alone computer, it is a very powerful device, which is capable of executing a series of pre-programmed tasks and interacting with other hardware devices. Being packed in a tiny integrated circuit (IC) whose size and weight is usually negligible, it is becoming the perfect controller for irrigation monitor and control using wireless distributed sensor network. A single microcontroller can be sufficient to control the entire system. Any microcontroller contains a memory to store the program to be executed, and a number of input/output lines that can be used to interact with other devices, like reading the state of a sensor or controlling.

2.3.1 SERIAL COMMUNICATION

One of the 8051's many powerful features is its integrated UART, otherwise known as a serial port. The fact that the 8051 has an integrated serial port means that you may very easily read and write values to the serial port. If it were not for the integrated serial port, writing a byte to a serial line would be a rather tedious process requiring turning on and off one of the I/O lines in rapid succession to properly "clock out" each individual bit, including start bits, stop bits, and parity bits.

However, we do not have to do this. Instead, we simply need to configure the serial port's operation mode and baud rate. Once configured, all we have to do is write to an SFR to write a value to the serial port or read the same SFR to read a value from the serial port .The 8051 will automatically let us know when it has finished sending the character we wrote and will also let us know whenever it has received a byte so that we can process it. We do not have to worry about transmission at the bit level--which saves us quite a bit of coding and processing time.

2.4 SENSORS

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. For example temperature sensor, humidity sensor, water level sensor etc.

2.4.1 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. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air.

2.4.1ROLE OF LM35

The temperature sensor LM35 is used to measure the temperature around the field. In case of events

like fire in the field, this sensor will detect and respond to very high temperature. The system's response is to send an SMS alert to the farmer.

2.4.2 HUMIDITY SENSOR

A humidity sensor senses relative humidity. This means that it measures both soil temperature and moisture. Relative humidity, expressed as a percent, is the ratio of actual moisture in the soil to the highest amount of moisture soil at that temperature can hold. The warmer the soil is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature.

2.4.3 SOIL MOISTURE SENSOR

Soil moisture levels can be expressed in terms of soil water content. **Soil water content**: Most commonly expressed as percent water by weight, percent water by volume or inches of water per foot of soil. Other units such as inches of water per inch of soil also are used.

A predefined moisture threshold is used as a reference to control the water pumping if needed. If the water level is less than a predefined value then our sensor will detect this and will inform the system to pump the water. On the other hand if it exceeds the threshold value and the water pump is ON then our system will switch OFF the water pump. This will allow efficient usage of water.

3.0 SYSTEM FLOW CHARTS

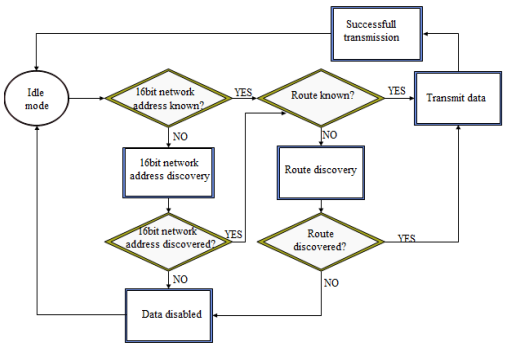
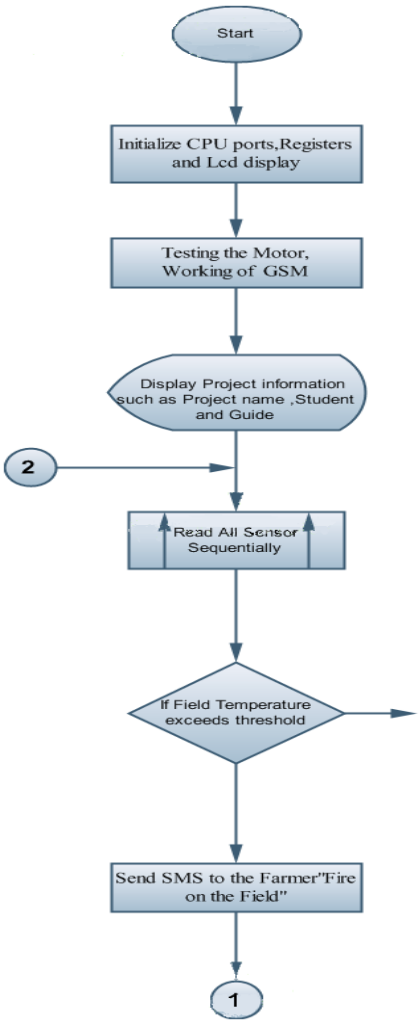


Figure 3.0: Flowchart of transmit mode sequence of ZIGBEE



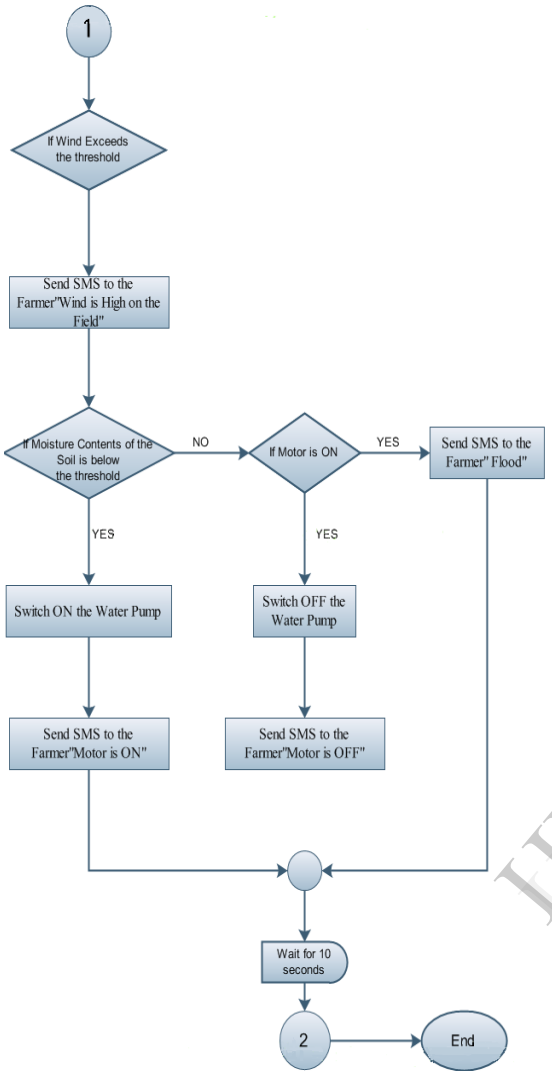


Figure 3.1: Main program flowchart

4.0 RESULTS AND ANALYSIS

While at home the farmer has the ability to Monitor the Sensors, set crop type and control the valve from his home PC. These choices are labelled as 1,2,3 or 4 as shown in the figure below.

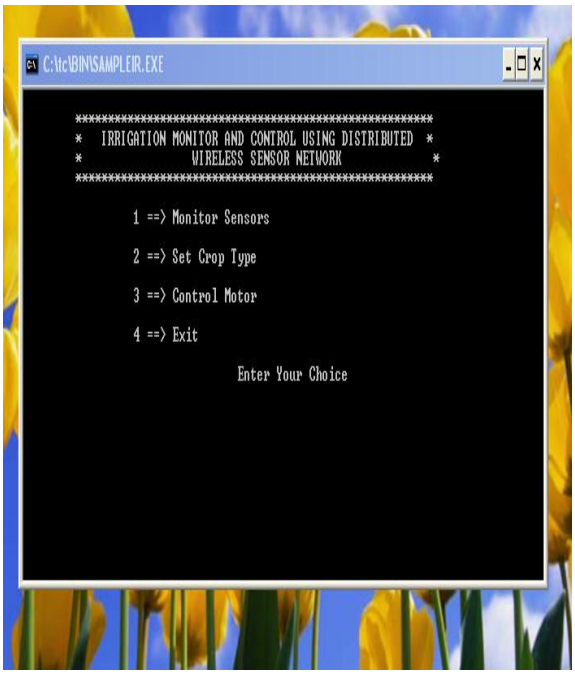


Figure 4.1: Main Menu

If the Farmer entered his or her choice as "1", he or she will be able to monitor the current sensor values; the following output screen displays the current reading of the sensors such as Humidity, temperature, wind speed, water level and soil moisture.

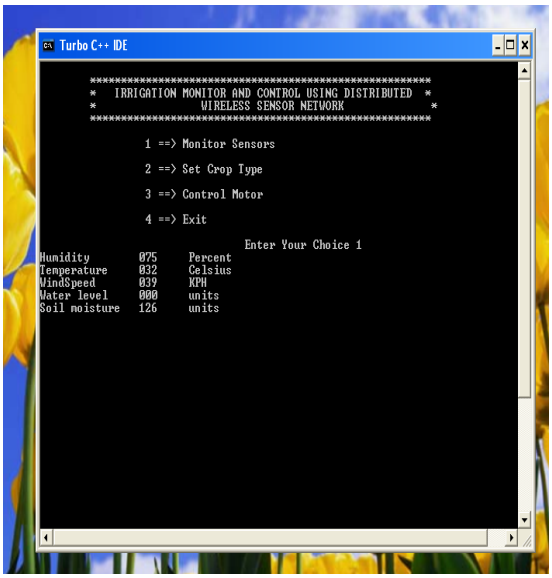


Figure 4.2: Sensor values display

Let's say in the main menu, the farmer selects choice 2.He will be able to select the soil and crop types. The soil type may contain red soil, black soil or brown soil. Also for a particular soil type, any crop type is selected. After making one of these choices he or she will observe the threshold value. Different combinations of soil and crop types will be displayed on the screen of fig 4.3.

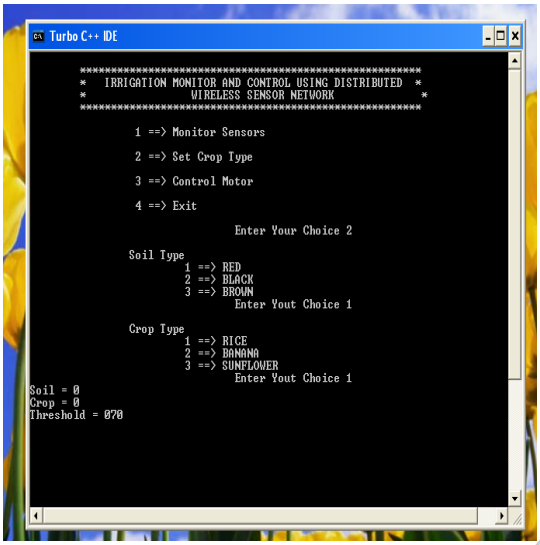
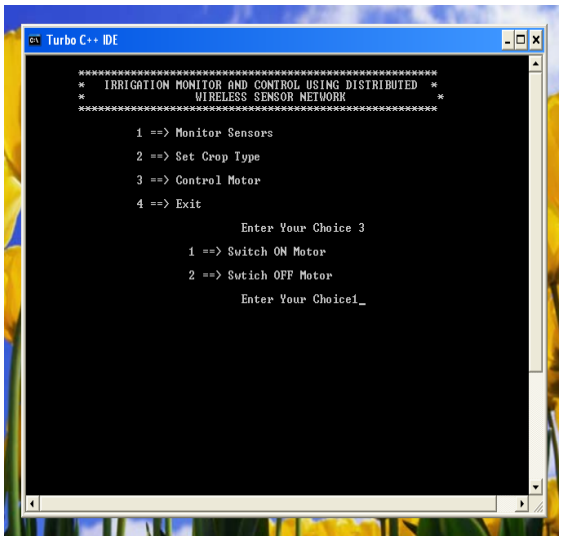


Figure 4.3: Setting soil and crop types



Choice 3 of the main menu allows the farmer to manually turn ON and OFF the motor. This is shown in **figure 4.4 above which is the manual motor control.**

5.0 CONCLUSION

What we managed to discover in the process of design and implementation of our project is that by combining the technologies of automation in the area of reticulation and weather sensing equipment, more efficient water delivery can be made possible. This can be achieved while maintaining simplicity, ease of use and ease of Implementation. The use of zigbee allows the flexibility in the system from the farmer point of view. The GSM interface used will be helpful for the farmer to receive notifications of the events occurring in the field and also about environmental changes near the field like cyclone ,fire in the field and flood.

Microcontroller has been reasonably easy to get up and developing as well as being very flexible. Occasionally the microcontroller would need resetting, which meant disconnecting the power source and reapplying it seconds later. This could have been caused by power supply fluctuations, faulty components, moisture in the controller or an undiscovered fault. We found it a bit disappointing that soil moisture sensors were priced out of reach as they could have simplified the process of estimating water requirements for the vegetation.

5.1. SCOPE OF IMPROVEMENT

The use of web interface will provide an excellent platform from which the system is developed.The portability of web interface technology means that the system could be controlled from anywhere in the world (if required).Different control mechanisms can be implemented depending on various types of crops. Also we can monitor the content of the soil.

6.0 REFFERENCE.

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