Implementation of Automated Water Saving Irrigation System Using Zigbee Technology

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Abstract— The main aim of project is to monitor the status of the plants in a field and to save the water for irrigation by using ZIGBEE Technology. The purpose of this project is to check the status of plant growth and to save water in order to avoid unnecessary wastage of water in the process of irrigation. Irrigation is the process of artificially supplying water to land where crops are cultivated. Automated irrigation system which automates the irrigation of land by combining various software and hardware for field irrigation. ZigBee provides facilities for carrying out secure communications, protecting establishment and transport of cryptographic keys, ciphering frames, and controlling devices. This part of the architecture relies on the correct management of symmetric keys and the correct implementation of methods and security policies.

Keywords— *Irrigation Control, Soil Water, Water-Saving Irrigation, Zigbee.*

I. INTRODUCTION

The health of a plant is influenced by many factors. Water monitoring and control system will measure various parameters like soil moisture, volume of soil water, rain fall. One of the most important is being the ready availability of moisture in the soil. Irrigation without soil moisture monitoring is like driving a car without a speedometer but with the potential for much greater penalties. Monitoring tells us more than when and how much to irrigate, it helps to improve the bottom line experience has proven that manipulating moisture levels allows a grower to influence the balance between canopy size and fruitfulness, to manage stress, to maximize growth days and increase control over fruit yield and quality thereby improving farm revenue. Soil moisture plays a decisive role on the growth of crops. It is the basic content of precision agriculture to realize the water-saving irrigation on the basis of soil moisture data collected from soil.

Water controlling is the monitoring and analyzing of data that are received at a distance from their source. Monitoring and controlling the water conditions manually is difficult. This is the implementation of an automated system which monitors the water conditions like soil moisture, rainfall, and sends the details through the SMS to a central station. Benefits of weather monitoring system reliable & efficient data offload storage & display. High quality equipment built to specification. Modular design was adopted in this design; it could realize the signal collection for real time monitoring, data display, data processing, control signal output, and other functions. The whole software system operation had friendly interface, convenient development and maintenance. In a word, the system use fuzzy control technology, sensor technology, and agricultural irrigation technology, this can realize the intelligent agricultural irrigation and increase the efficiency of agricultural water.

II. OPERATING PRINCIPLE OF SYSTEM

A. Selecting Water-Saving Irrigation Automatic Control System

Irrigation system, it could make sure of adequate soil water of plant roots and For different plants, different seasons, system get plant water demand information by BLY plant viability analyzer, through soil water sensor's acquisition of two different depths of soil water information, and transmit information to irrigation monitoring controller or computer to analyze through system monitor, which make irrigation decision and control start-up and shutdown of the sprinkler meet the demand of plant growth, and enable substratum soil water stable near a default value, avoid excessive irrigation which result in a waste of water resources, prevent excessive irrigation away fertilizer and the pollution of underground water resources. Figure1 shows the block diagram of transmitter section.
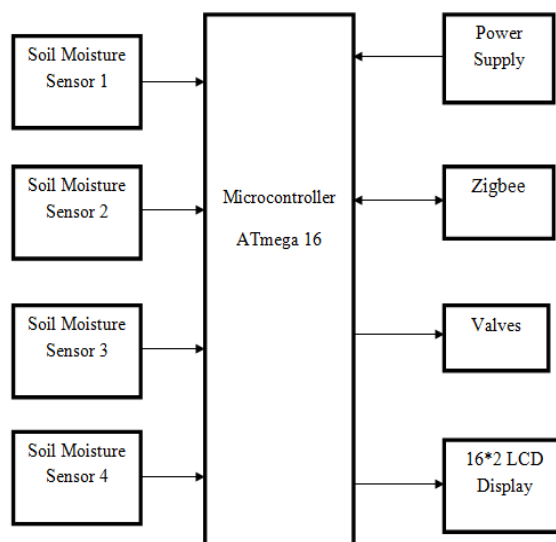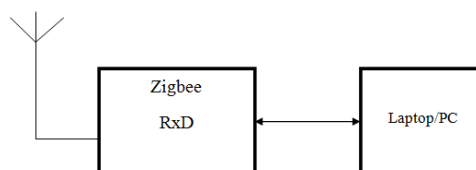

Figure 1 Block Diagram of Transmitter Section.

Figure 2 Block Diagram of Receiver Section

In receiver section the Zigbee receiver and laptop/PC is used as shown in figure 2. Zigbee module and laptop/PC will connect.The software is designed to be easy to develop on small, inexpensive microprocessors. Zigbee devices have low latency, which further reduces average current. Zigbee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB of flash memory. The SMS or data

sends by the transmitter Zigbee module will receive by the receiver zigbee module and SMS will display on the laptop/PC to the user.

B. System Irrigation Control Strategy

The function of the system is carried out by irrigation area, round irrigation area and round irrigation area set. Irrigation area is the smallest control unit of system, including a number of soil water information acquisition points, plants water demand information acquisition point and a number of electromagnetic valves. System control electromagnetic valve in the irrigation area in accordance with the soil water content information of irrigation area and plant water demand information. So that soil water of the irrigation area is stable near the default value. Default values of soil water content in various irrigation areas are different as a result of different types of vegetation. Default value of soil water content in the same irrigation area is different as a result of plant growth stage and the changes of seasons. Round irrigation area composes of a number of irrigation areas, and equips with an irrigation monitoring controller.

Automatic mode includes automatic control and time control, users can choose any one. In automatic control mode, users only need to set corresponding status parameters, system can automatically complete soil water acquisition, data analysis and control of irrigation system without manual intervention. However, in the time control mode, the users need to set the start time and stop time for each valve, according to the time table, system controls irrigation systems automatically. In semi-automatic mode users need to operate upper monitoring computer to complete data acquisition and valve, automatic mode settings no longer work. Manual mode system could be switched to manual mode by control switch on cabinet knobs, the system can normally acquire soil water content information right now, but cannot control irrigation system, need manual control electromagnetic valve. Water resource of round irrigation area is unique as far as possible, and not shared with other round irrigation areas. In soil type consistent principles, soil type in the round irrigation area should be consistent.

The water requirements of different plants are different, water requirement of the same plant in different stage of growth and season are also different. It is no need to have the greatest biomass for landscape plant, a certain level to watch is just good. In this principle, do a series of drought resistance estimate for plant in irrigation area, set soil water default value based on estimate results.

System status parameter is mainly parameter setting of irrigation monitoring controller includes, Controller working time is used to limit the time in which it is suitable to irrigate for greenbelt, system will not start irrigation outside the scope of the set time. Control area is used to set attribute for every irrigation area in the round irrigation area, including area title, sensor attribute and valve attribute. Valve open time is used to set the length of time in every irrigation area every time and minimum time interval between twice irrigation. Task setting is used for the time control mode.

III. THE DESIGN OF SYSTEM

A. Design of System Hardware

Irrigation system, it could make sure of adequate soil water of plant roots and For different plants, different seasons, system get plant water demand information by BLY plant viability analyzer, through soil water sensor's acquisition of two different depths of soil water information, and transmit information to irrigation monitoring controller or computer to analyze through system monitor, which make irrigation decision and control start-up and shutdown of the sprinkler meet the demand of plant growth, and enable substratum soil water stable near a default value, avoid excessive irrigation which result in a waste of water resources, prevent excessive irrigation away fertilizer and the pollution of underground water resources. For controlling and monitoring the system zigbee technology is used. Zigbee is a low-cost, low-power; wireless mesh network standard targeted at the wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. The Wi-Fi is a WLAN technology that consumes more energy, but it can provide a much higher data rate. Moreover, in our real world networking experiments on the nodes with regular antennas, the ZigBee can support a longer- range outdoor communication up to 300 meters, while the Wi-Fi is only up to 100 meters.

A comprehensive description of the ZigBee protocol can be found in the literatures. We have presented only a partial description of the ZigBee protocol in this section so that the readers have enough background to understand the rest content of the paper. The ZigBee technology was introduced by the ZigBee Alliance. The ZigBee technology has evolved based on a standardized set of solutions called 'layers'. These optimally designed layers have provided the ZigBee with unique features including low cost, easy implementation, reliable, low power, and high security.

Released specifications

1. Zigbee Home Automation 1.2
2. Smart Energies 1.1
3. Telecommunication Services 1.0
4. Health Care 1.0
5. RF4CE – Remote Control 1.0
6. RF4CE – Input Device 1.0
7. Remote Control 2.0
8. Light Link 1.0
9. IP 1.0
10. Building Automation 1.0
11. Gateway 1.0
12. Green Power 1.0 (Optional battery-less remote control feature of ZigBee 2012)
13. Retail Services

Specifications under development

1. Zigbee Smart Energy 2.0
2. Smart Energy 1.2/1.3
3. Light Link 1.1
4. Home Automation 1.3

B. Design of Software

In this system 3 softwares are used for implementing the system. These are:

PCB Artist: The PCB Artist is an electronic design system. The system is built on an integrated design environment providing all the tools required to capture a schematic through to the design and layout of the printed circuit board (PCB).PCB Artist is a user friendly, fully integrated schematic capture & Free PCB Layout Software that you will find easy to use. PCB Artist is an easy-to-use, powerful and handy application that enables you to design circuit boards. It has two main advantages that make it truly appealing .it is free and it includes a really comprehensive library of board components and layouts.

Atmel Studio 6: The Atmel Studio 6 IDP gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code. Atmel Studio 6 is free of charge and is integrated with the Atmel Software Framework (ASF)—a large library of free source code with 1,600 ARM and AVR project examples. ASF strengthens the IDP by providing, in the same environment, access to ready-to-use code that minimizes much of the low-level design required for projects.

SinaProg: SinaProg is a Hex downloader application with AVR Dude and Fuse Bit Calculator. This is used to download code/program and to set fuse bits of all AVR based microcontrollers.

CONCLUSION

This seminar describes system structures which is a blend of software and hardware. This proposed system will offer flexible mode of operation, reliable control and data transmission. It is low cost water saving irrigation system. It requires only low soil moisture sensors, irrigation monitoring controller, system monitor and upper monitor computer hardware with related software. They will control electromagnetic valve, realize the drip irrigation, sprinkler irrigation, micro-irrigation, and low-pressure pipe irrigation methods such as the automation of irrigation mode, achieve the purpose of a highly efficient precision. Irrigation process has extremely important in any areas or specially in agricultural areas. To avoid more human efforts this technology used. It allows the user to monitor and also maintain the moisture remotely regardless of time

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