Smart and Automatic Irrigation System for Agriculture Fields using WSN and GPRS Module

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Abstract— *Agriculture plays the vital role in economics and survival of people in India. Nowadays Indian agriculture faces a two major problem. We know the government has promoted a free supply of electricity to farmers for irrigation purpose to run their motors and pumps. But it is found that the farmers misusing the electricity to run their home appliances such as radio, TV, fans, and etc. This misuse of electricity has brought a considerable problem for government to supply free electricity. The main objective of this project is to design low cost Automated Irrigation System using a Wireless Sensor Network and GPRS Module. The main aim of this project is to provide embedded based system for irrigation to reduce the manual monitoring of the field and GPRS gives the information. This proposed system recognizes whether the free electricity has been used excluding electric motors for pumping water and if so electricity is being misused, it shuts the total stockpile for the farmers through a tripping circuit. By using wireless networks we can intimate the electricity board about this mal convention. The development of this project at experimental level within rural areas is presented and the implementation has to exhibit that the automatic irrigation can be used to reduce water use.*

Keywords— Automation, Internet, Irrigation system, Wireless Sensor Network (WSN)

I. INTRODUCTION

Indian economy is basically depends on agriculture. Agriculture uses most of available fresh water resources and this use of fresh water resources will continue to be increases Because of population growth and increased food demand. Increased labour costs, stricter Environmental regulations and increased competition for water resources from urban areas Provide strong motivation for efficient Irrigation system. The automated irrigation system is feasible and cost effective for optimizing water resources for agricultural production. Using the automated irrigation system we can prove that the use of water can be reduced for different agricultural production. The irrigation system provide only required amount of water to crop. This automated irrigation system allows it to be scaled up for larger greenhouses or open fields. An automated irrigation system was developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil moisture and temperature sensors placed in the root zone of the plants and water level sensor is placed in tank for checking the water level in tank. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm was developed with threshold values of temperature, soil moisture and water level that was programmed into a micro-controller based gateway to control water quantity.

A. An Overview on Some Previous Irrigation System

In some of the irrigation system irrigation scheduling is achieved by monitoring soil, water status with tension meters under drip irrigation by the automation controller system in sandy soil. It is very important for the farmer to maintain the content in the field. In this the design of a Micro-controller based drip irrigation mechanism is proposed, which is a real time feedback control system for monitoring and controlling all the activities of drip irrigation system more efficiently. Irrigation system controls valves by using automated controller allows the farmer to apply the right amount of water at the right time, regardless of the availability of the labour to turn valves[1]. Some irrigation systems are used to implement efficient irrigation scheme for the field having different crops. The system can be further enhanced by using fuzzy logic controller. The fuzzy logic scheme is used to increase the accuracy of the measured value and assists in decision making

The green house based modern agriculture industries are the recent requirement in every part of agriculture in India. In this technology, the humidity and temperature of plants are precisely controlled. Due to the variable atmospheric conditions sometimes may vary from place to place in large farmhouse, which makes very difficult to maintain the uniformity at all the places in the farmhouse manually. For this GSM is used to report the detailed about irrigation. The report from the GSM is send through the android mobile [3]. The software and hardware combine together provide a very advanced control over the currently implemented manual system. The implementation involves use of internet for remote monitoring as well as control of Drip Irrigation system. This system uses sensors like humidity, soil moisture. These sensors send values to micro-controller. Micro-controller sends values to PC using serial communication. According to real time sensors values continuous graph is display on PC and Android Based mobile using Internet and Android application. Here threshold value is keep, if sensor values cross the threshold value then Drip Irrigation components can be control automatically by micro-controller. User can also control Drip Irrigation from anywhere via Android mobile [4]. In the Micro-controller based drip irrigation mechanism, this is a real time feedback control system for monitoring and controlling all the activities of drip irrigation system more efficiently. Irrigation system controls valves by using automated controller to turn ON OFF. This allows the farmer to apply the right amount of water at the right time, regardless of the availability of the labour to turn valves or motor ON OFF. This reduces runoff over watering saturated soils avoid irrigating at the wrong time of the day. It improves crop performances and help in time saving in all the aspects [5]. The management of this kind of farms requires data acquisition in each greenhouse and their transfer to a control unit which is usually located in a control room, separated from the production area. At present, the data transfer between the greenhouses and the control system is mainly provided by a suitable wired communication system, such as a field bus. In such contexts, even though the replacement of the wired system with a fully wireless one can appear very attractive, a fully wireless system can introduce some disadvantages. A solution based on a hybrid wired/wireless network, where Controller Area Network and ZigBee protocols are used. In particular, in order to integrate at the Data Link Layer the wireless section with the wired one, a suitable multi-protocol bridge has been implemented. Moreover, at the Application Layer, porting of Smart Distributed System services on ZigBee, called ZSDS, allows one to access the network resources independently from the network segment [6]. The some system highlights the development of temperature and soil moisture sensor that can be placed on suitable locations on field for monitoring of temperature and moisture of soil, the two parameters to which the crops are susceptible. The sensing system is based on a feedback control mechanism with a centralized control unit which regulates the flow of water on to the field in the real time based on the instantaneous temperature and moisture values [7]. Some system presents Artificial Neural Network (ANN) based intelligent control system for effective irrigation scheduling. The proposed Artificial Neural Network (ANN) based controller was prototyped using MATLAB. The input parameters like air temperature, soil moisture, radiations and humidity are modeled. Then using appropriate method, ecological conditions, evapotranspiration and type of crop, the amount of water needed for irrigation was estimated and then associated results are simulated [8].

II. AUTOMATED IRRIGATION SYSTEM

The Automated Irrigation system has two main units one is wireless sensor unit (WSU) and another is Wireless information unit (WIU). Wireless sensor unit is nothing but transmission section which Transmit the sensor data to the wireless information unit. Wireless information unit is nothing but section which receives sensor data from wireless sensor unit. [11]

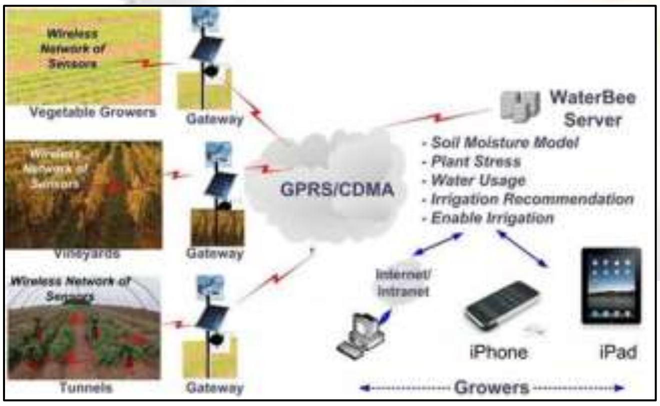

Fig. 3.1: Overview of the irrigation system

A. *Wireless Sensor Unit*

A WSU is comprised of a RF transceiver, different sensors, a micro-controller, ZigBee and power sources. Several WSUs can be deployed in-field to configure a distributed sensor network for the automated irrigation system. Each unit is based on the micro-controller that controls the radio modem ZigBee and processes information from the soil-moisture sensor, temperature sensor and water level sensor.

In this wireless sensor unit or transmission unit the sensor data from different sensors (Soil moisture, temperature, humidity and water level) are collected in the main controller. This data is displayed on transmission section LCD. ARM controller is programmed to some threshold values of temperature and soil moisture. Sensed values are compared with the threshold values and according to comparison automation is takes place.

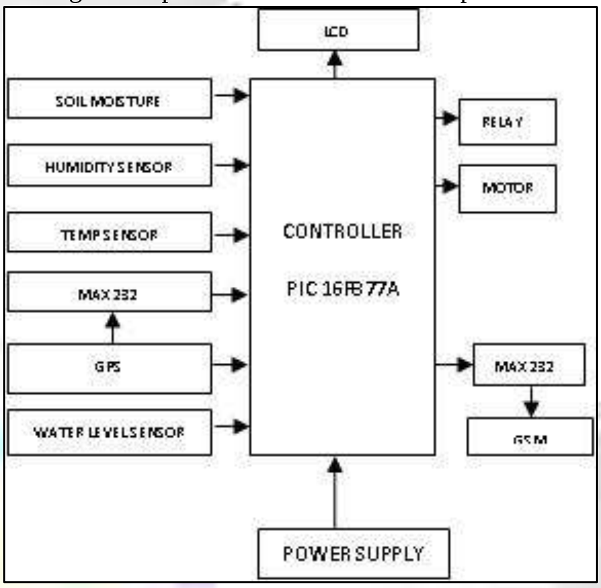

Fig. 3.2: Wireless Sensor Unit

B. *Temperature Sensor*

The temperature sensor used to measure the temperature at the field is LM 35. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade).

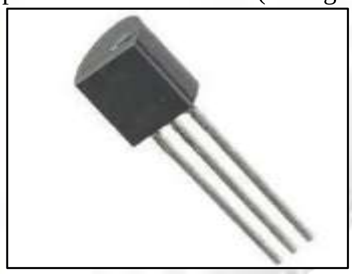

Fig. 3.3: Temperature Sensor

C. *Humidity Sensor*

A humidity sensor also called a hygrometer, measures and regularly reports the relative humidity in the air. A humidity sensor senses relative humidity as shown in Fig. 6. This means that it measures both air temperature and moisture.

Fig. 3.4: Humidity Sensor

D. Soil Sensor

Soil sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a frequency domain sensor such as a capacitance sensor. Measuring soil moisture is important in agriculture to help farmers manage their irrigation systems more efficiently.

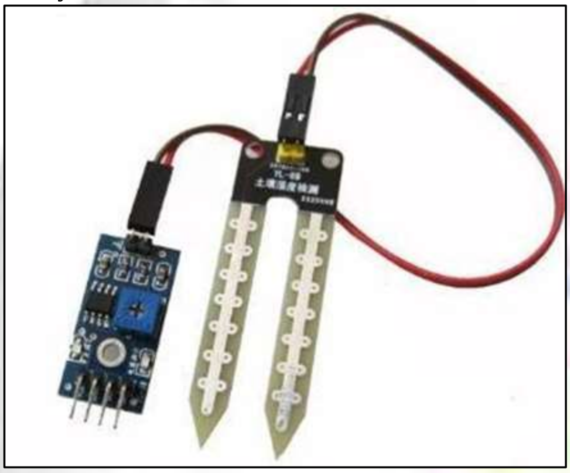

Fig. 3.5: Soil Sensor

E. Water Level Sensor

Water level sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor.

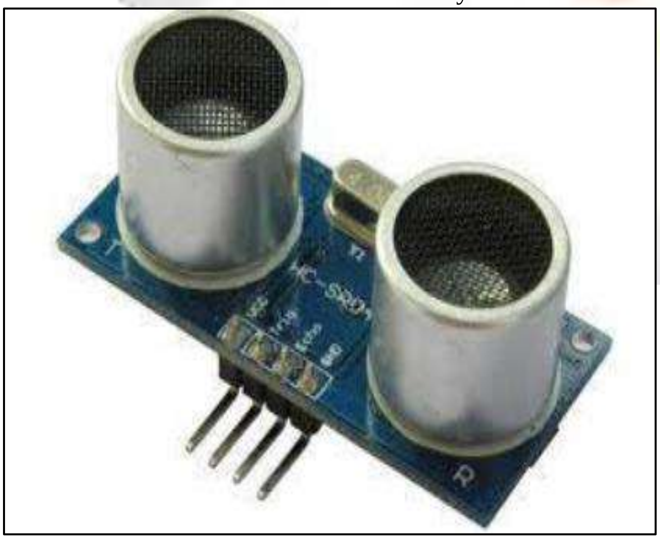

Fig. 3.6: Water Level Sensor

F. GPRS

GPRS stands for General Packet Radio Service. GPRS is one of the technologies to improve 2G phones (second Smart Irrigation System Using a Wireless Sensor Network and GPRS Module to enable them for transferring data at higher speed. GPRS allows mobile phones to remain--connected to network and transfer requested or sent data instantly, e. g. if you receive MMS from other mobile phone, you do not need to press a button to check if you have any new MMS, instead mobile handset notifies you when new MMS is downloaded to your mobile. GPRS technology can provide you up to 32 kbps to 48 kbps.

G. PIC Micro Controller

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller" Peripheral interface controller is the most powerful microcontroller which is a 40pin device which is used as RISC architecture. One advantage of reduced instruction set computers is that they can execute their instructions very fast because the instructions are so simple. Another, perhaps more important advantage, is that RISC chips require fewer transistors, which makes them cheaper to design and produce.

H. LCD Display

The LCD Display is used to provide the user with the digital values converted by the PIC microcontroller. LCD driver is a link between the microcontroller and LCD. It is necessary to interface the LCD according to the driver specification. To understand the algorithm of LCD interfacing user must have Data sheet of both LCD and LCD driver. In LCD initialization you have to send command bytes to LCD.

I. RS 232

The RS 232 cable is used for the purpose of serial communication. The output signal of PIC16F877A is in TTL level from 0V to +5V. But for COM port on PC, it needs both positive and negative voltage levels. Therefore, a RS 232 Level Converter is necessary to perform +15V and-15V.

III. WIRELESS INFORMATION UNIT

The soil moisture, temperature and water level sensor data from each WSU are received, identified, recorded, and analyzed in the WIU. The WIU consists of a master microcontroller, an ZigBee radio modem, a GPRS module This processed information is send to web page where status of all these sensors are display graphically using graphical user interface using the GPRS module.

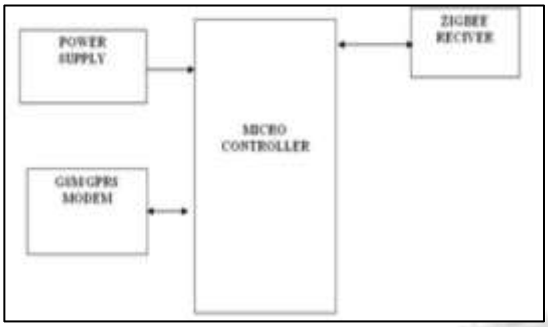

Fig. 3.7: Wireless Information Unit

IV. SIMULATION RESULT

The greenhouse had 56 blossoming beds covered with plastic. Each bed was 14m long and had two black polyethylene tubes with drip hole spacing of 0. 2m. The automated irrigation system was used to irrigate only 600m, which corresponded to 14 beds, whereas, the tarring 42 beds were irrigated by human supervision to compare water consumption with the traditional irrigation practices in this blossoming place. Four WSUs labeled by the last significant byte of the unique 64-bit address were located in the greenhouse at arbitrary points The WSU-57 unit was used to measure the soil moisture and temperature in the area where the historic irrigation practices were employed. The other three units were located in beds to operate the automated irrigation system with their corresponding soil humidity and temperature sensors situated at a depth of 10 cm Gathered data of the WSUs, in the web application of the automated irrigation system: soil temperatures, soil humidity, and water supplied (vertical bars indicate automated and scheduled irrigation) in the soul zone of the plants. These three units allowed data redundancy to ensure irrigation control. The algorithm considered the values from the WSU-54, 55, and 56, if one attained the threshold values the automated irrigation was performed.

The pumping rate awarded 10 ml/min/drip hole, which was measured in the automated irrigation zone in six different drip holes. In accordance with the biological producer's experience, a minimum value of 5% VWC for the soil was established as the sweat threshold level and 30 °C as the temperature threshold level for the automated irrigation modes. Initially, the scheduled irrigation of 35 min/week was used during the first six weeks. After that, the scheduled irrigation was set at 35 min three times per week. Sage farming finalized after 136 days. During the farming, several automated irrigation periods were borne out by the system because of the soil moisture.

Water misuse with the biological producers' traditional irrigation procedure consisted of watering with a 2" electrical pump during 5 h three times per week for the whole farming period. Under this scheme the volume flow rate measured on site was 10 ml/min/per sprinkle hole, giving a total of 174 l/drip hole, whilst the automated irrigation system used 14 l/drip hole. In the entire plant house, the sage plants presented similar fresh biomass regardless of the irrigation procedure during the whole blossoming period. The average biomass per cut was 110 pounds for the traditional irrigation system corresponding to 42 blossoming beds and 30 pounds for the automated irrigation system corresponding to 14 beds. The automated stem was tested in the planthouse for 136 days. Daily mean soil moisture and temperature are shown, as well as the accrued water used for both systems. Both mean temperatures presented similar behaviour for the production period.

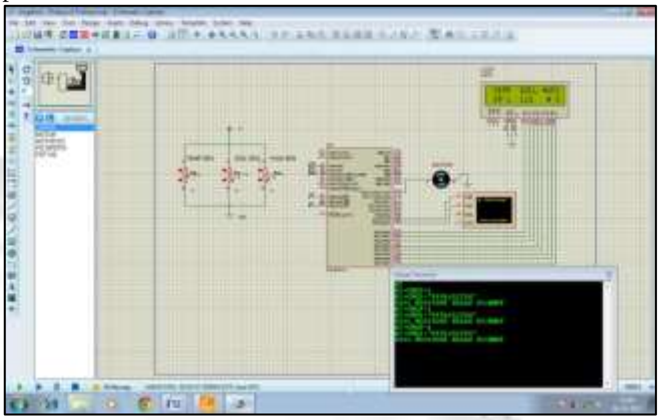

Fig. 4.1: Simulation output for automated irrigation system

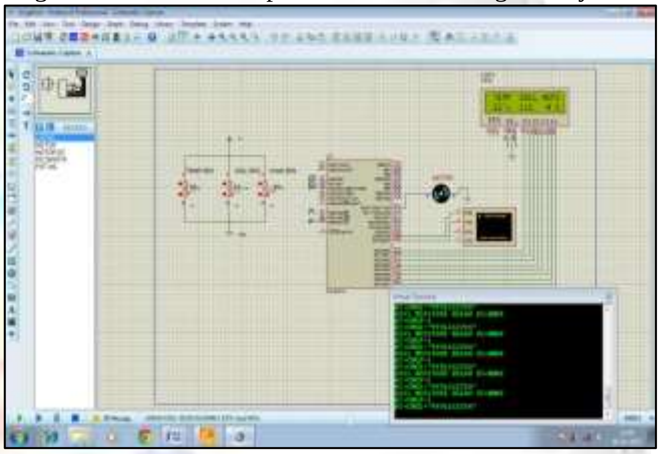

Fig. 4.2: Simulation output for automated irrigation system when motor in "on" condition

Fig. 4.3: Greenhouse irrigation System [1]

Fig. 4.4: Hardware Kit for Automatic irrigation System

V. CONCLUSION

The automated irrigation system was found to be forcible and cost adequate for optimizing water assets for agricultural blossoming. The automated irrigation system proves that the use of water can be diminished for a given amount of fresh biomass blossoming. The use of solar power in this irrigation system is related and significantly important for biological yield and other agricultural products that are geographically confined, where the investment in electric power supply would be wide ranging. The irrigation system can be adjusted to a variety of specific crop needs and requires minimum maintenance. The standard contour of the automated irrigation system allows it to be scaled up for larger plant houses or open fields. In addition, other utilization such as temperature monitoring in compost production can be easily implemented. In future, the Internet controlled duplex communication system provides a powerful decision making device concept for transformation to several foaming scheme. Furthermore, the Internet link allows the supervision through telecommunication devices, such as a smart phone. Besides the financial savings in water use, the importance of the safeguarding of this natural resource favors the use of this kind of irrigation systems.

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