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Automated Irrigation System Based on Wireless Sensor Network and GPRS Module

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Abstract - *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. 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 and soil moisture that was programmed into a microcontroller-based gateway to control water quantity.*

Key Words: Temperature sensor, Soil moisture sensor, ARM7 microcontroller, GSM, LPC2148 16X2 LCD display.

1. 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 labor 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 [1].

1.1 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 labor to turn valves. 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 [2]. For this GSM is used to report the detailed about irrigation. The report from the GSM is send through the android mobile. 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. 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 labor 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. 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 . 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. 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 [1].

2. AN OVERVIEW ON IRRIGATION SYSTEM USING WIRELESS SENSOR NETWORK AND GPRS

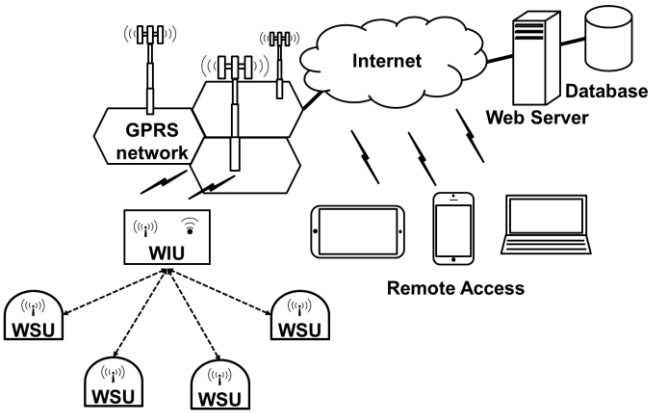

Fig1: Configuration of the automated irrigation system. WSUs and a WIU based on microcontroller, ZigBee, and GPRS technologies.

The automated irrigation system hereby reported, consisted of two components (Fig. 1) wireless sensor units (WSUs) and a wireless information unit (WIU), linked by radio transceivers that allowed the transfer of soil moisture and temperature data, implementing a WSN that uses ZigBee technology. The WIU has also a GPRS module to transmit the data to a web server via the public mobile network. The information can be remotely monitored online through a graphical application through Internet access devices [1].

A. WIRELESS SENSOR UNIT

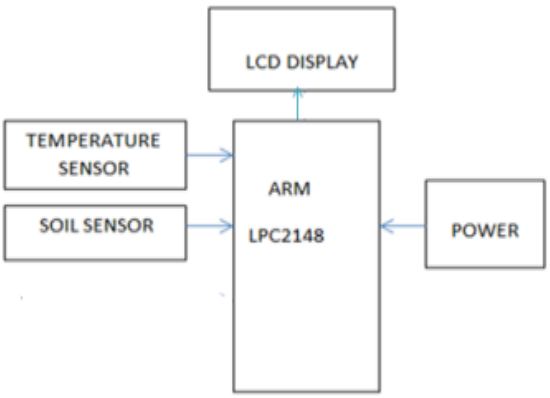

Fig 2. Wireless Sensor Unit

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 [2].

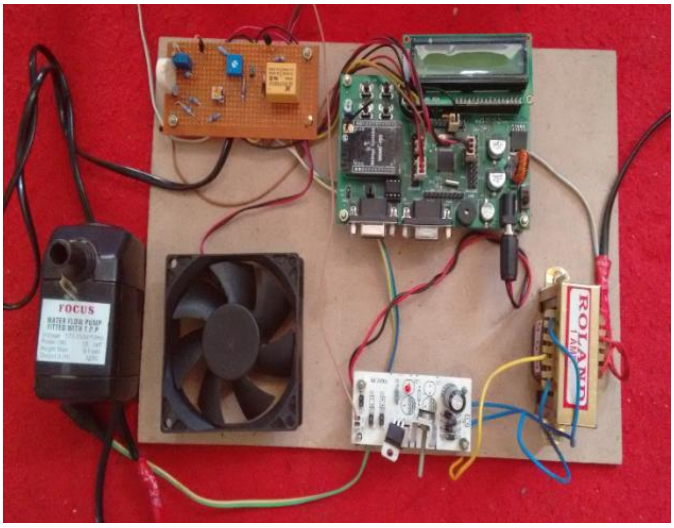

Fig 3. Transmission Section

B. WIRELESS INFORMATION UNIT

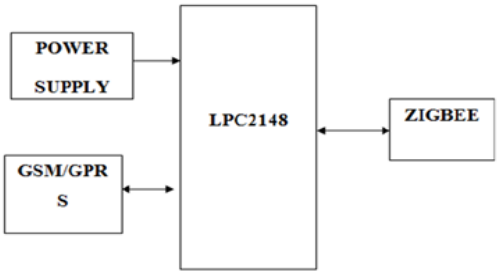

Fig 4. Wireless Information Unit

The soil moisture, temperature and water level sensor data from each WSU are received, identified, recorded, and analyses 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. The data from the transmission section is received by ZigBee communication modem [2].

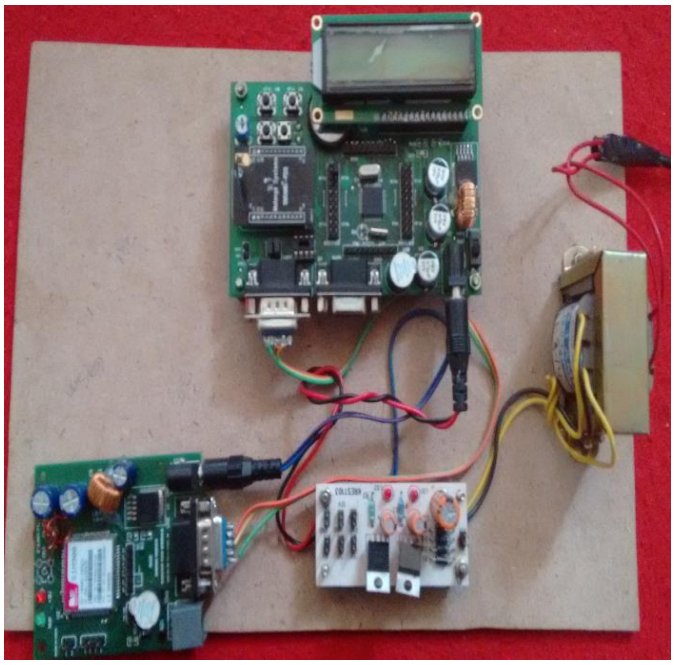

Fig 5. Receiver Section

3. EXPERIMENTATION AND RESULTS

TABLE1:

	THRESHOLD LEVEL	MOTOR	THRESHOLD LEVEL	MOTOR
TEMPERATURE SENSOR	<33	OFF	>33	ON
SOIL MOISTURE SENSOR	<723	OFF	>723	ON

TABLE 2:

Different conditions for irrigation system operation

CONDITION	TEMPERATURE SENSOR	SOIL MOISTURE SENSOR	MOTOR
1	29.35	1023	OFF
2	31.93	1023	OFF
3	32.90	1023	OFF
4	38.70	1023	ON
5	39.03	1023	ON
6	31.80	523	OFF

Status of Field on Web Page:

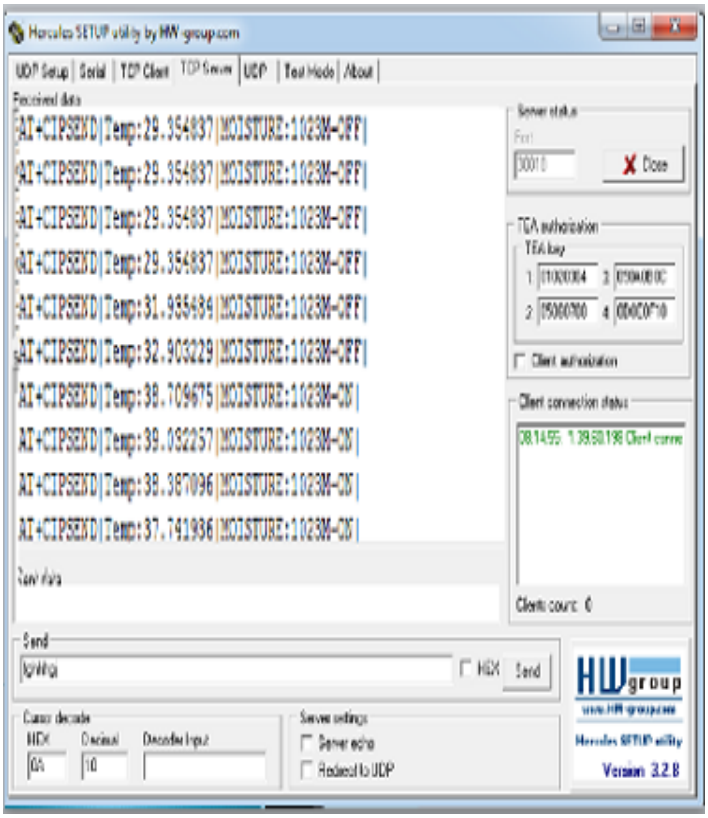

Fig 6. Output of Condition irrigation system

4. CONCLUSIONS

1. This system is reduces the water use because it Provide irrigation as per the requirement of the crop.
2. This system is automated irrigation system so it reduces the human resources.
3. This irrigation system was found to be feasible and cost effective for optimizing water resources for agricultural production.
4. The irrigation system can be adjusted to a variety of specific crop needs and requires minimum maintenance.

Using this system we can monitor the status of all the sensors (Soil-moisture, Temperature, Water level) and also the ON/OFF status of the motor.

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