



Automatic Monitoring System for a Precision Agriculture Based On Wireless Sensor Networks

Manikandan .K, Rajaram. S,

*M.E Embedded System Technologies, M.E(Ph.D) Associate Professor
Dept. Of ECE, PSN College of Engineering and Technology, Tirunelveli, TN*

Abstract - Crop farming in India is labour intensive and obsolete. Farming is still dependent on techniques which were evolved hundreds of years ago and doesn't take care of conservation of resources. The newer scenario of decreasing water tables, drying up of rivers and tanks, unpredictable environment present an urgent need of proper utilization of water. We have the technology to bridge the gap between water usage and water wastage. Technology used in some developed countries is too expensive and complicated for a common farmer to understand. Our project is to give cheap, reliable, cost efficient and easy to use technology which would help in conservation of resources such as water and also in automatizing farms. We proposed use of temperature and moisture sensor at suitable locations for monitoring of crops. 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. The sensor data would be collected in a central processing unit which would take further action. Thus by providing right amount of water we would increase the efficiency of the farm. The farmer can also look at the sensory data and decide course of action himself. We have made the interface of our project keeping in view the educational and financial background of average Indian farmer.

In this paper we are proposed a low cost and efficient wireless sensor network technique to acquire the soil moisture and temperature from various locations of farm and as per the need of crop controller take the decision to make irrigation ON or OFF.

Keywords: Soil moisture sensor, temperature sensor, wireless sensor network, Microcontroller

I.INTRODUCTION

Irrigation is one of the fundamental problems of agriculture in developing countries. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains and level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste. In the modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have intervals. This process sometimes consume sometimes the water reaches late due to which the crops get dried. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water

deficiency. This problem can be perfectly rectified if we use automatic drip irrigation system in which the irrigation will take place only when there will be intense requirement of water. Irrigation system uses solenoid valves to turn irrigation ON and OFF. These valves easily automated by using controllers. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labour to turn valves ON and OFF. In addition, farmers using automation equipment are able to reduce run off from over watering saturated soils, avoid irrigating at the wrong time of day, which will improve crop performance by ensuring adequate water and nutrients when needed. Automatic Drip Irrigation is a valuable tool for accurate soil moisture control in highly specialized production and it is a simple, precise method for irrigation. It also helps in time saving, removal of human error in adjusting available soil moisture levels and to maximize their net profits. The entire automation work can be divided in two sections, the field station and central station.

Temperature sensors that are currently being used are linear with temperature, $0.05 \text{ mV}/^\circ\text{C}$ scale factor, with $0.5 \text{ }^\circ\text{C}$ accuracy guarantee able (at $+25 \text{ }^\circ\text{C}$). Low cost is assured by trimming and calibration at the wafer level. It works on the principal of conductance of electricity. When two electrodes A and B are placed parallel to each other in a medium and electric current is passed, the resistance to the flow of electricity is proportional to the moisture content in the medium. As the moisture level increases, conductivity decreases and the sensor is calibrated to output the moisture level. Since the probes have direct contact with the soil, there is no buffer against salt and fertilizer affects on the measured conductivity.

The current work aims to develop a Wireless Sensor Network based low cost soil temperature and moisture monitoring system that can track the soil temperature and moisture of the field in real time and thereby allow water to be Dripped on to the field if the soil temperature goes above and/or the soil moisture falls below a prescribed limit depending in the nature of crop grown in the soil. The sensors take the inputs like moisture, temperature and provide these inputs to the microcontroller. The microcontroller converts these inputs into its desired form with the program that is running on it and gives outputs in the mode of regulation of water flow according to the present input conditions. The complete system is implementing for Smart Irrigation Application Using RF 433 MHz modules. The system is designed using a microcontroller and RF 433MHz module. The system can control several valves for irrigation.

BLOCK DIAGRAM

It tells about the design and working of the design with the help of circuit diagram and explanation of circuit diagram in detail. It explains the features, programming and serial communication of ATmega8 microcontroller. It also explains the different modules used in this project.

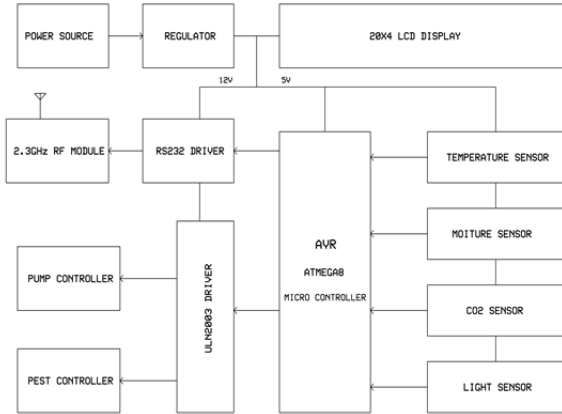


Fig 1: Block diagram

II. HARDWARE DESIGN

2.1 CO₂ Gas Sensor



Fig 2 CO₂ Gas Sensor

The CO₂ Gas Sensor measures gaseous carbon dioxide levels by monitoring the amount of infrared radiation absorbed by carbon dioxide molecules. It is intended only for measuring gaseous, not aqueous, CO₂ concentration. The sensor has two settings: low range (0–10,000 ppm) and high range (0–100,000ppm). With this sensor, we can easily monitor changes in CO₂ levels occurring in respiration of organisms ranging from peas to humans. A 250 mL respiration chamber with probe attachment is included for running controlled experiments with small plants and animals.

2.2 Temperature Sensor

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possesses low

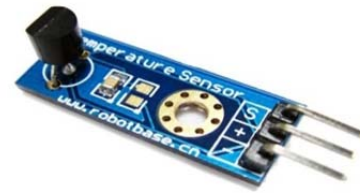


Fig 3 Temperature Sensor

self-heating and does not cause more than 0.1 °C temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature, i.e., its scale factor is 0.01V/°C.

2.3 Moisture Sensor

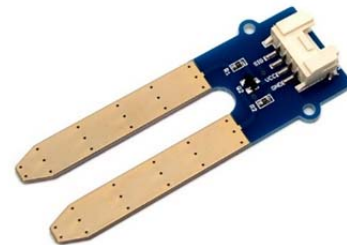


Fig 4 Moisture Sensor

The Soil Moisture Sensor is used to measure the volumetric water content of soil. This makes it ideal for performing experiments in courses such as soil science, agricultural science, environmental science, horticulture, botany, and biology. The Soil Moisture Sensor uses capacitance to measure the water content of soil (by measuring the dielectric permittivity of the soil, which is a function of the water content). Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is reported in percent.

2.4 Light sensor



Fig 5 Light Sensor

A **Light Sensor** generates an output signal indicating the intensity of light by measuring the radiant energy that exists in a very narrow range of frequencies basically called “light”, and which ranges in frequency from “Infra-red” to “Visible” up to “Ultraviolet” light spectrum.

2.5 2.4GHz RF Module

This 2.4Ghz RF data module is useful for two ways half duplex communication between microcontrollers or in between PC. A maximum of 32



Fig 6 2.4GHz RF Module

bytes can be transmitted in a single packet. A CR (Carriage Return) will transmit the packet contents. The default baud rate is 9600. Custom changes can be made on request according to the application. A regulated voltage of DC 5V must be given to the board.

III. RESULTS

The analog output from various sensors is fed to microcontroller based system where it compares it with the reference value and take consequent action. The measured sensor values are displayed in the LCD Display and the Virtual terminal through USART interface.

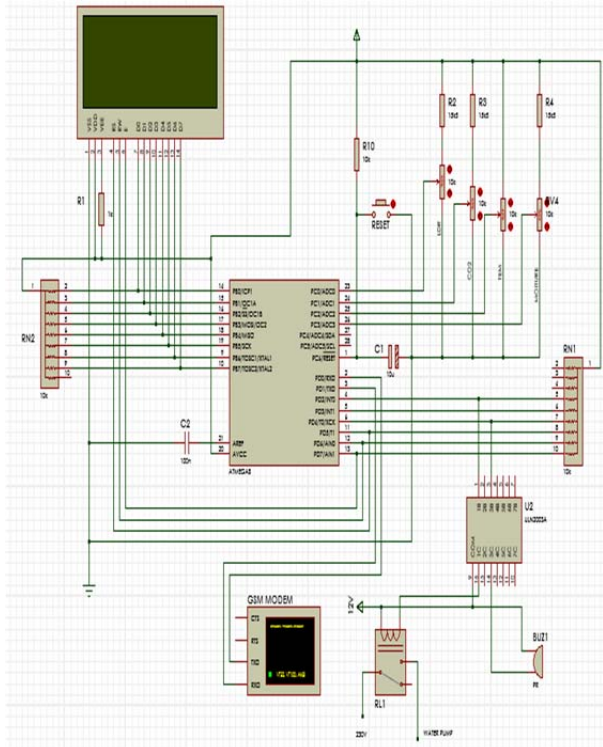


Fig 7 Simulation Result (a)

Using potentiometer, variable sensor output voltages in different phases of simulation that are truly displayed in the LCD. Request through virtual instrumentation has controls the output relays and other output devices. Also it obtains measured sensor quantity through virtual terminals.

The following simulation data are obtained during the operation.

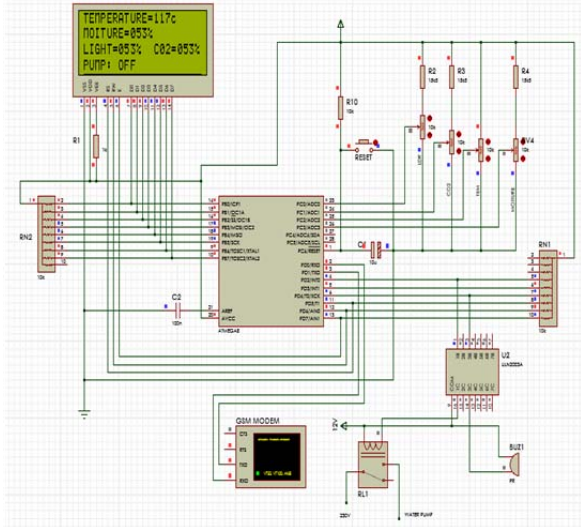


Fig 8 Simulation Result (b)

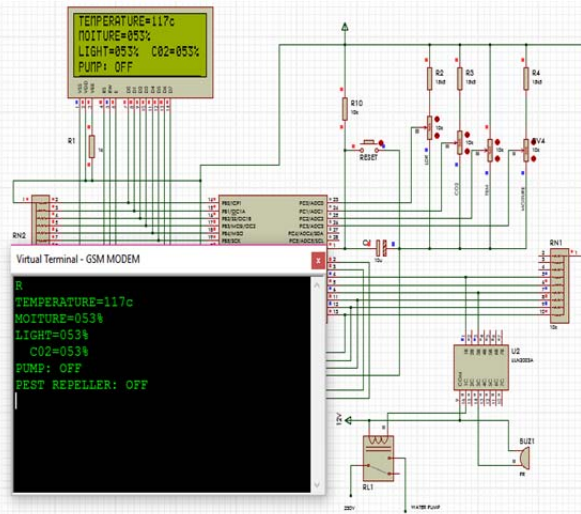


Fig 9 Simulation Result (c)

IV. CONCLUSION

The project is thus carried out using AVR microcontroller with the Wireless Sensor Networks. Traditional or old-type farming involved much more manual labour and for longer hours than the modern methods of today. Farmers were highly dependent on climate and weather. In traditional agricultural system the farmer needs to monitor the field condition every hours or minutes for the control of irrigation. This project finds the application in domestic agricultural field. In civilian domain, this can be used to ensure faithful irrigation of farm field, since it have the option of finding out irrigation data in particular area.

V.FUTURE SCOPE

The future scope of this project is enhanced applications with the addition of the required features. One such application is to detect the soil parameter and suggesting the proper fertilizer and its feed time. Such

Sensors can be incorporated in the design. It can also be designed to detect the particular disease on the plant and suggest the proper curative measures on it. In the same manner one can exactly predict the weather if the system is made to communicate with the nearer weather station through satellite communication.

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