Monitoring and Management of Agricultural Environment Using Sensors and GSM

Allan Mary George
Department of ECE, Saveetha School of Engineering, Saveetha University. Thandalam, Chennai,India

M. Sindhubala
Department of ECE, Saveetha School of Engineering, Saveetha University. Thandalam, Chennai,India

Jenifer Emely Thilakavathi
Department of ECE, Jaya EngineeringCollege, Thirunindravur, Chennai, India

Abstract

Real-Time Automation of Agricultural Environment for Social Modernization ofIndian Agricultural System attracts great attention these days. Efficient water management is an important task in various cropping systems in semi-arid and arid areas. Distributed in-field sensor-based irrigation systems give a solution to support site-specific irrigation management. This allows the producers to maximize their productivity and save water. The variable rate irrigation, sensors, real-time in-field sensing software and site-specific precision linear-move irrigation system control are designed and implemented in this paper. The crop field area can be monitored without human interaction. Sensors are the essential device for precision agricultural applications. The main purpose of this project is to monitor the crop field in a wireless manner. Here we sense the temperature and pH values of the field and water level in the well and field using temperature, pH, floating ball type and level sensors respectively. The analog value from the sensors is converted to digital format by the ADC. The micro controller gets the output from the ADC. The sensor values monitored by the controller can be sent wirelessly to the user's cell phone using GSM modem. The pumping motor can be switched ON if the water level is high in the well. Here we use two motors, one is for low rpm that is the sprinkling motor and another is for high rpm that is the shunt motor. The motor control can be done through GSM modem.

1. Introduction

Nowadays agriculture has been a major concern in developing countries like India, China and Brazil. Conventionally, people have been using manual methods to perform the agricultural processes. One of the major problems faced by the farmers is the water scarcity. Farmers are in need of means to monitor their fields and efficiently manage the crops. Technological improvement has paved way for such a tool that can help the farmers to monitor their crops and manage the field. As a result of this the farmers are able to efficiently manage their crops even in shortage of resources and able to increase their productivity and perform site specific irrigation.

2. Sensors

A sensor (also called detector) is a device which measures a physical quantity and then converts it to a signal which can be read by an instrument or an observer. An example for this is a mercury-in-glass thermometer which displays its temperature output through the calibrated glass tube as the result of expansion and contraction of the liquid. Sensors are widely used in very common objects such as touch-sensitive elevator buttons and lamps which are used for adjusting the dim or brightness by touching the object base. Most people are not aware of sensors that are used in numerous applications such as machines, aerospace, medicine manufacturing and robotics. Temperature sensor, pH sensor, floating ball type sensor and level sensor are the four types of sensors used in this project.

2.1. Temperature sensor

The basic necessity for environmental, in conjunction with certain chemical, electrical and mechanical controls is the measurement of temperature. Numerous types of temperature sensors are in demand, according to appropriate applications the type of temperature sensor will be preferred. For example, area, persistence, charge and efficiency of the temperature sensor are

important factors that must be taken in mind.There are varieties of setups that can be used as temperature sensors which includes integrated circuits (ICs), pyrometers, resistance temperature detectors (RTDs), thermistors, thermocouples, electromechanical & volume (EMV).LM35 is an accurate IC temperature sensor with balanced output to its input temperature (in ^{o}C). The sensor setup is not affected to oxidation and other processes since it is bounded. With LM35, the temperature can be calculated exactly than with a thermistor. Self-heating is low and the heat will not increase than 0.1 ^{o}C even in air. The operating temperature of LM35 ranges from 55°C to 150°C. As the result of every ^{o}C rise/fall in ambient temperature the output voltage varies by 10mV i.e., 0.01V/ ^{o}C.

Table 1. Pin configuration

Pin no	Function	Name
1	Supply voltage 5V(+35V to -2V)	Vcc
2	Output voltage (+6V to -1V)	Output
3	Ground(0V)	Output

Figure 1. LM35 pins

2.2. pH Sensor

The amount of acidity or alkalinity of a solution can valuated using the unit pH. Its scale ranges from 0 to 14.The ratio between H+ ion and OH- ion concentrations play a key role in finding the pH value of a substance. The substance is said to be acidic if the H+ concentration is higher than that of OH- and vice versa.7 is neutral, lesser than that is acidic, greater than that is basic. Three parts are there in a pH weighing setup: a pH weighing electrode which is a glass bulb sensitive to H+, a reference electrode which is having constant output, and a meter which is having high input. When the sample is placed in the cup where both the electrodes are kept. The pH weighing electrode measures the acidity of the sample whereas the reference electrode value will be constant. And this difference between the voltages of the two electrodes will be measured by the voltmeter. This meter will display the converted voltage difference to pH.

2.3. Floating ball type sensor

It measures level of any liquid medium using movable arm and air ball. Resistance is measured using speed of movable arm. This setup is a floatable device set out to emplace the Dissolved Oxygen (DO) sensor Model 499ADO.Various application for this sensor are measuring water level and fuel level, can be used to avoid the liquid wastage, wear and tear can be stopped. The input voltage will be 5V, whereas the voltage output will be the resistive output. The range for level detection is from 0 to 1m.

2.4. Level sensor

The level of liquids, slurries, flowing substances, and fine particles can be detected. The MCX104A DC Microsyn Level Sensor is used in this paper and it will measure the fluctuations of it and its placement from reference. The reference is a pendulum which is oil soaked and free to move. Some of distinguishing features of level sensor are its modular design, MS connectors are used for the connection between sensor and the controller, and very reactive, accidental vibrations are ignored since it is oil damped.

3. GSM modem

GSM Modem that is used is a product Sparr Electronics limited (SEL), this provides a very good platform to send data and SMS.GSM modem is very versatile and easily connectable to RS232,this device is excellent for the system users and system merger since it is having a wide voltage range for the power supply and audio perplexing. Python, the most powerful and easiest learning programing language which is license free is present in it. Major characteristics of this modem are its Python interpreter, the Quad GSM GPRS modem, its special design for transmitting voice, data, fax, SMS, GPRS. Modem interfacing is done through RS232 at D-TYPE 9 pin connector; with the help of Molex 4 pin connector the power supply is given. Its input voltage ranges from 5V-30V,in idle mode 8mA will be conducted were as 150 mA during communication through GSM 900 and 110mA during communication through GSM 1800.the operating and storage temperature range is from -30 to +85 ^{o}C .

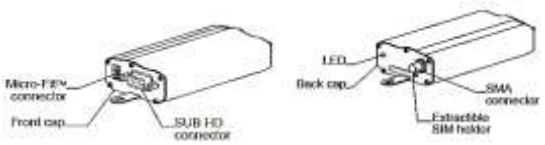

Figure 3. Front and back view of GSM.

4. Block diagram

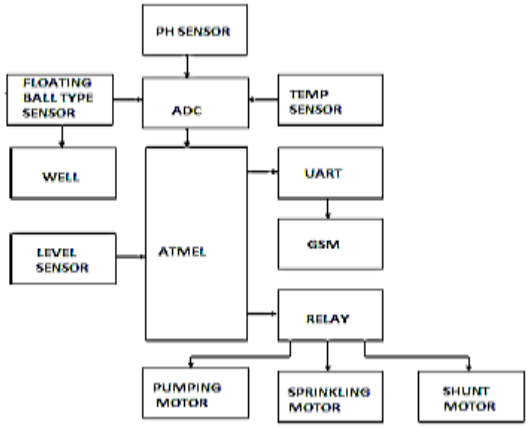

Figure 4..Block diagram

5. Working

The micro controller serves as the central unit of the system. The Sensors measure the value and sends them to the ADC. The ADC receives the analog signals from the sensors and converts them to digital format. The digital data output from the ADC is sent to the micro controller. The micro controller uses the UART to convert the parallel data into serial data and vice versa and then transmits the data to the user through the GSM. The user receives a text message about the parameters of the field conditions and then replies with a command that is sent back to the micro controller. The micro controller receives the message, decodes it into instructions and then executes them with the help of the relay. The relay used to switch on or off the motors.

6. Conclusions

Thus the use of sensors in monitoring and management of the agricultural environment makes the job of the producers easy. It provides an effective way for the monitoring and management of the crop field area and provides remote access to the field conditions. It helps the farmers to improve their site specific irrigation system and thereby increase their productivity and profitability.

7. Future work

The future research on this project can be focused on implementing a range of wireless sensor networks, sensors that determine other parameters like humidity, chemical composition of the soil and speed of the wind etc. A database of the different agricultural sites can be maintained to study and analyze the most effective of the variable rate irrigation.

8. References

[1] Alejandra Jimenez, Santiago Jimenez, Pablo Lozada, Cristhy Jimenez, "*Wireless Sensors Network in the Efficeint Management of Green House Crops*."

[2] C. Castillo, "*Implementation of a prototype wireless sensors network for greenhouses*," Thesis. UPN-Quito, Ecuador, 2007.

[3] M. Siavichay, "*Acclimation of 10 cultivars of tomato (Lycopersicumescululentum Mil*" thesis, ESPOCH, Riobamba,Ecuador, 2011.

[4] N. Wang, N. Zhang and M. Wang, "*Wireless sensors in agriculture and food industry-Recent development and future perspective*" Computers and Electronics in Agriculture, Volume50, Issue1, January 2006, Pages1-14. (Pubitemid 41785356)