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RESEARCH ARTICLE

RENEWABLE ENERGY AGRICULTURE MONITORING SYSTEM USING FUZZY BASED PID CONTROLLER

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A B S T R A C T

Agricultural operations are constantly becoming technology-driven mainly due to labor shortages, increase in labor cost, and trends in new and advanced technology applications. Solar energy is one of the renewable energy sources, which is significantly contributing to the sustainable energy supply. The objective of this paper is to propose a novel environment information monitoring and controlling system operating under less controlled environment conditions. A major concept related to solar energy and PV systems is remote monitoring. Remote monitoring is on-line real-time monitoring and controlling of the field equipment, transmitting the real time testing data to the terminal to forecast. PV which generate electricity from solar radiation. The novelty of our approach relies on the fact that it is operational even in the case of a huge spread deployment of PV system. Our solution aims to be a good replacement of manual module checking which is not recommended because of time-consuming, less accuracy and potentially dangerous to the operator. Simulation is carried out using proteus software.Hardware implementation of Automatic agricultural monitoring can also be done in fuzzy based PID controller using labview.

INTRODUCTION

Monitoring of environmental factor is significant over the last few decades[1]. In particular, monitoring agricultural environments for various factors such as temperature, moisture, humidity along with other factors can be of more significance. A traditional approach to measure these factors in an agricultural environmental meant individuals manually taking measurements and checking them at various times. To avoid this, it is necessary to document the detail changes in environmental parameters by the use of technologies helping for both that is to improve the yield as well as to reduce the man efforts. Crop farming in India is labor 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. The current work aims to develop a 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. Traditional or old-type farming involved much more manual labor 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 paper 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. 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[2].

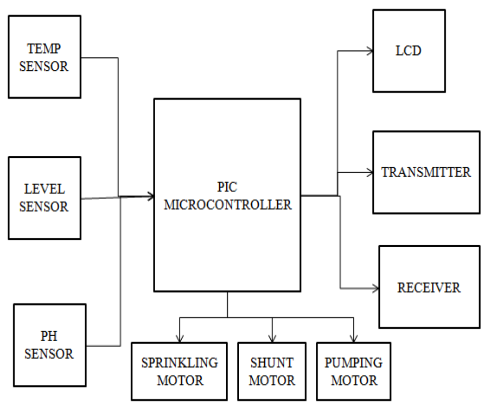

Figure 1 Block Diagram for Agricultural Monitoring System

It is very important for the farmer to maintain the content in the field. The benefits for automatic agricultural monitoring system are increased productivity, enhanced safety, easier agriculture procedures, instant interventions around the clock, advanced lifestyle, increased throughput.

System Model

PIC Microcontroller

PIC16F873A/876A devices are available only in 28-pin packages, while PIC16F874A/877A devices are available in 40-pin and 44-pin packages. All devices in the PIC16F87XA family share common architecture with the following differences:

1. The PIC16F873A and PIC16F874A have one-half of the total on-chip memory of the PIC16F876A and PIC16F877A.
2. The 28-pin devices have three I/O ports, while the 40/44-pin devices have five.
3. The 28-pin devices have fourteen interrupts, while the 40/44-pin devices have fifteen.
4. The 28-pin devices have five A/D input channels, while the 40/44-pin devices have eight.
5. The Parallel Slave Port is implemented only on the 40/44-pin devices.

Features

High-Performance RISC CPU, Self-reprogrammable under software control, ICSP via two pins, Power saving Sleep mode, Selectable oscillator options, ICD via two pins.

Temperature Sensor

The measurement of temperature is one of the fundamental requirements for environmental control, as well as certain chemical, electrical and mechanical controls. Many different types of temperature sensors are commercially available, and the type of temperature sensor that will be used in any particular application will depend on several factors. For example, cost, space constraints, durability, and accuracy of the temperature sensor are all considerations that typically need to be taken into account.

Various types of temperature sensors are known including bimetallic thermometers, resistance thermometers, thermocouples, and radiometers. Depending upon the temperature to be measured, the required accuracy of the measurement, and other factors such as durability or cost, one type of temperature sensor may be preferable over another. There are many types of devices that can be employed as temperature sensors. They include integrated circuits, pyrometers, resistance temperature detectors, thermistors, thermocouples, electromechanical & volume. LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ^{o}C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. LM35 temperature can be measured more accurately than with a thermistor. It also possess low self-heating and does not cause more than 0.1^{o}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 ^{o}C rise/fall in ambient temperature, *i.e.,* its scale factor is 0.01V/^{o}C.

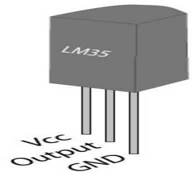

Figure 2 Schematic diagram of LM35

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

Table 1 Electrical Rating of LM35

Level Sensor

Level sensors detect the level of substances that flow, including liquids, slurries, granular materials, and powders. All such substances flow to become essentially level in their containers (or other physical boundaries) because of gravity. The substance to be measured can be inside a container or can be in its natural form (e.g. a river or a lake). The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. Generally the latter detect levels that are excessively high or low.

Features

Easy to wire, Connections between controller and sensor are made through MS connectors, excellent sensitivity. The shaft supporting the pendulous mass and the rotor is mounted on ball bearings for smooth, low-friction rotation, DC input and output voltages designed for analog and microcontroller interface.

PH Sensor

The most common pH sensor is the glass electrode. It's used in many industry applications and in a wide variety of fields. The glass-electrode method has high reproducibility, and it can measure pH of various solutions. A pH electrode is a potentiometric or electrochemical sensor that has a voltage output.

A potentiometric sensor consists of two electrochemical cells or electrodes: the glass electrode, sometimes called the measuring electrode or active electrode and the reference electrode.

Motor Unit

Shunt motor

The shunt wound DC motor falls under the category of self excited DC motors, where the field windings are shunted to, or are connected in parallel to the armature winding of the motor, as its name is suggestive of. And for this reason both the armature winding and the field winding are exposed to the same supply voltage, though there are separate branches for the flow of armature current and the field current as shown in the figure of DC shunt motor below.

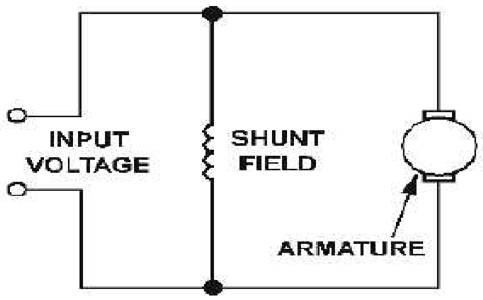

Figure 3 Shunt Motor

Sprinkler Motor

Water is a key factor in increasing agricultural production. About 78% of India's water resources are used for agriculture out of this only 50% is actually used by plants and the remaining water resources are wasted either as deep percolation or as evaporation. Excess irrigation not only reduces crop production and damages soil fertility but also causes ecological hazards like water logging and salinity. With competitive use of water and its increasing scarcity, it has become imperative to economise water use for optimum productivity. This is possible only through improved water management and adopting advanced techniques of irrigation. One such method of modern irrigation is sprinkler irrigation system which is becoming more and more popular among the farmers across the country.Sprinkler irrigation system saves upto 50% of water compared to surface irrigation method and increases productivity by about 15-25%.

Sprinkler irrigation method distributes water to crops by spraying it over the crop area like a natural rainfall. The water under pressure flows through perforations or nozzles and sprays over the area. The pressure is provided by a pump of suitable capacity and horsepower. With careful selection of nozzle sizes, operating pressure and spacing, the actual water required for maintaining the soil moisture at field capacity is applied uniformly at a rate to suit the infiltration rate of soil thereby obtaining efficient water application. It is estimated that the sprinkler irrigation system substantially reduces the use of water and the crop productivity also increases.

Pumping Unit

A pump is required to carry water from the source through the main line and laterals upto the sprinkler or nozzle from where it is sprayed and applied to the crops. In areas where the land topography allows to develop enough pressure at nozzle or sprinkler head under gravity a separate pump may not be necessary. But in most cases it is necessary to pump water and carry it under pressure through the system.

The pump is normally a centrifugal pump or a submersible pump fitted with usual accessories. If the water is pumped from a well or a tube well, and the capacity and horse power of the existing pump is sufficient to provide the desired pressure at the nozzle or sprinkler head, a separate pump may not be necessary for the system. But, in case the existing pump is not sufficient to provide the required pressure for the sprinkler system, a separate booster pump has to be provided depending upon the field situation after taking into account frictional losses in the main, laterals and risers and nozzles.

UART

A universal asynchronous receiver/transmitter is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. UARTs are commonly used in conjunction with other communication standards such as EIA RS-232. A UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers. A dual UART or DUART combines two UARTs into a single chip. Many modern ICs now come with a UART that can also communicate synchronously; these devices are called USARTs.

LCD

A LCD is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consist of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystal between them, light passing through one would be blocked by the other. LCD plays an important role in displayed the parameter making the system user friendly.

Modes for Agricultural Monitoring System

There are two modes for agricultural monitoring system and they are: 1. Manual mode 2. Automatic mode

Manual Mode

This is the manual mode of agricultural monitoring system. In this mode agricultural monitoring takes place only by means of manual comments. No specific conditions for various sensors will be checked only the output is executed for manual comments. The type of mode under operation is displayed in LCD. Outputs are verified according to the motor rotation.

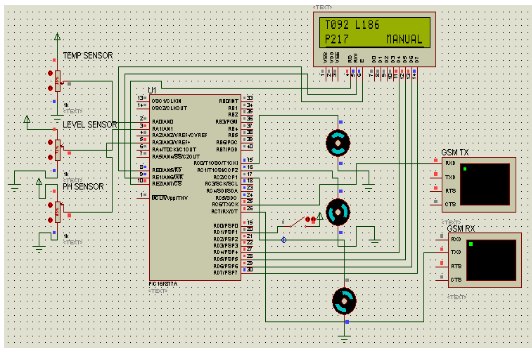

Figure 4 Design for Manual Mode

Automatic Mode

This is the automatic mode of agricultural monitoring system. In this mode agricultural monitoring takes place without any manual comments. All the conditions with respect to various sensors are executed and the motors rotate with respect to conditions.

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.

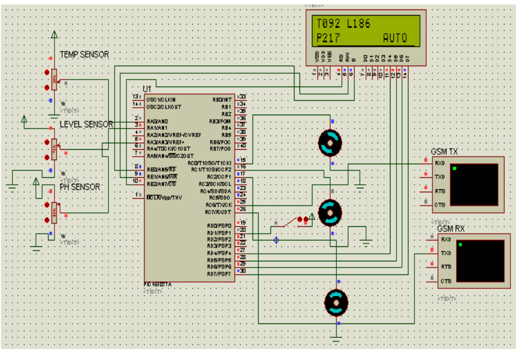

Figure 5 Design for Automatic Mode

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. The software and hardware combine together provide a very advanced control over the currently implemented manual system.

Comparison of Modes

Table 2 Comparison of Modes

Parameters	Manual Mode	Automatic Mode
1.Usability	Complicated	Flexible and user friendly
2.Maintenance	Difficult	Easy of system components replacement
3.Portability	Not portable	Portable
4.User Interface	No web interface	Web interface

RESULTS AND DISCUSSION

Agricultural monitoring system is done by using proteus software in ISIS platform. Two modes of operations are involved:

1. Manual mode
2. Automatic mode.

Manual Mode

The figure 6 shows the agricultural monitoring system in manual mode. Here the operations are performed for agricultural monitoring system only after receiving comments.

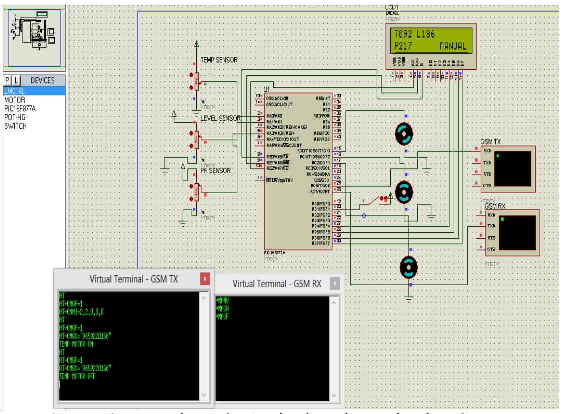

Figure 6 Manual Mode Agricultural Monitoring System

Automatic Mode

The figure 7 shows the agricultural monitoring system in automatic mode. The operations in these modes are done automatically with the help of sensors without receiving any manual comments and vast operations can be performed using this mode.

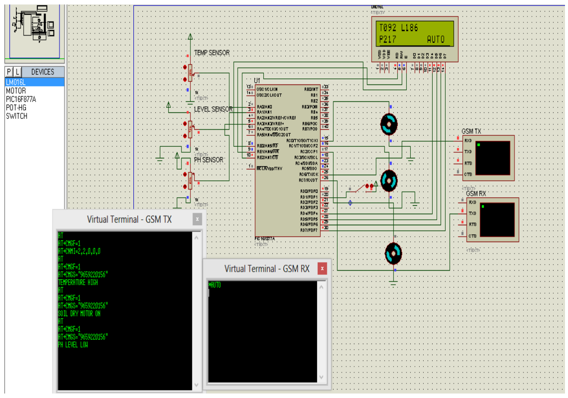

Figure 8 Automatic Mode Agricultural Monitoring System

CONCLUSION

In this paper simulation for agricultural monitoring system is carried out using PROTEUS software. Simulation is performed for both manual and automatic modes and the outputs were noted. This system reduces the water use because it provides irrigation as per the requirement of the crop. This system is automated irrigation system so it reduces the human resources. This irrigation system was found to be feasible and cost effective for optimizing water resources for agricultural production. 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 (PH, Temperature, Water level) and also the ON/OFF status of the motor.

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