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Solar Based Automatic Irrigation Using Soil Moisture Sensor

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Abstract - *This paper gives the embedded system for automatic irrigation using the soil moisture sensor based on solar power with GSM module. Solar energy is best way for the irrigation purpose to overcome energy crisis problem. The solar panel will extract energy from the sun and convert into electrical energy which is stored in the battery. Automatic irrigation using solar power can be efficiently used for the proper management of irrigation. Proper irrigation increases fertility rate of field and can get maximum production of crops by increasing yields and the quality of the crop by improved management of water during critical plant growth stages. The benefit of solar based automatic irrigation using soil moisture is, the field gets continuous or proper water and plant grows fast. The proper management of water helps to rid of from problem of water scarcity. The GSM (Global System of Mobile Communication) module used sends the message for the status of pump ON and OFF on registered SIM. If the automated system is not working than pump can be also operated manually. The manually operation can be done through the manual switching system. Another benefit of the manual operation is we can also use the pump to supply the water for other purpose besides irrigating field. The soil moisture sensor measures the soil resistivity or volumetric moisture contain of soil in terms of voltage.*

***Key Words*: Soil Moisture Sensor, LCD, Microcontroller, and GSM module, Pump, Solar Panel, Manual switch and Battery.**

1. INTRODUCTION

For the development of country agriculture plays vital role. Most of the land in world are cultivated land but they are not able to utilize properly due lack of proper knowledge or due to scarcity of water. Lots of lands have to depend on monsoon rain and due to untimely rain crops are late grown or dried. If not depend on rain then farmers have to pay heavy amount for water supply or irrigation purpose, which ultimately increase the cost of production. As we know there is lack of proper market for agricultural products, high investment during production is not able to get during the selling time in market or in harvesting time. Or else have to increase the price of crops. In some places there is no problem for scarcity of water but due to mismanagement of water crops are dying and over flooded which ultimately decreases the production rate of the crops or fertility of lands. Solar based automatic irrigation using soil moisture sensor helps to maintain proper water supply at equal interval of time which will rid of the problem of scarcity of water and over use of water through automatic system. For the fulfillment of water problem many technologies have made lots of methods and types of irrigation systems. But in today's world the demand of fossil fuel is increasing day by day and it going to finish near to decay. And also there is lack of electricity. These technologies are not giving their benefits to the farmers. For the problem of energy crisis and load shedding solar energy is best way hence, solar based irrigation system is used.

In this solar based automatic irrigation is done by sensing the soil moisture placed in field. Here moisture sensor measures the volumetric moisture contain or soil resistivity present in the soil. If the moisture content in soil is less or soil is dry than again pump will run and supply the water. These all controlling is done by microcontroller and hence microcontroller is heart of this system [1]. The GSM placed sends the message about the motor status and field status to the register number [2]. In case of failure in automatic system there also pump can be operated manually through switch which will not stop the irrigation system but only thing is farmer has to go for checking the field. Beside that pump can be also use to supply the water for other purpose through manual operation.

Here, we have made model for the operation of solar based automatic irrigation using soil moisture sensor.

2. PROBLEM DEFINITION

Now day lots of technologies are working on automatic irrigation system but there is also a chance for failure on the system. Hence along with automatic system manual operation also should be there. Manual system will supply the water if any short circuit occurs in automation system. Irrigation system should not disturb to get target productivity so, by switching the manual switch we can irrigate the field. The pump installed for the irrigation, only can irrigate the field where sensor is placed. Rather than no use, also by installing manual switch we can use pump to supply water for other purpose. If the battery is down and also solar system is not charging the battery, then system will not work, for smooth working of system adopter or main supply is needed. Hence multiple sources for power supply are proposed.

3. PURPOSED MODEL

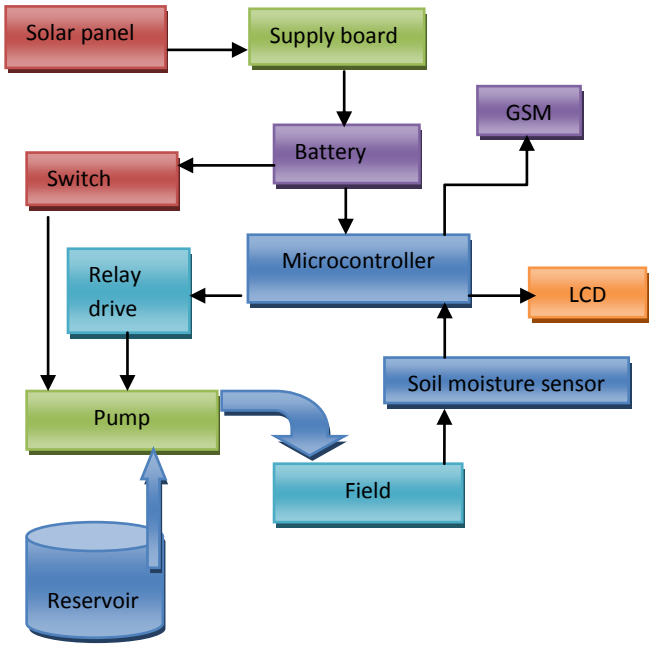

Fig 3.1 Block Diagram

The whole system can be understood by looking at the block diagram. The solar panel will convert the solar energy into electrical energy and charging unit stores the electrical energy in the battery. The whole system, automation system as well as irrigation system is connected to the battery. The microcontroller controls and regulates all the parts of automation system. The LCD display, GSM module, relay drive and soil moisture sensor placed in the field are connected to microcontroller through microcontroller board. The relay drive after the microcontroller is connected with power supply and pump. And also connection is made in between power supply and pump through a switch for manual operation.

4. MODEL DESCRIPTIONS

The model consists of following components which are explained below:

4.1 Power supply

4.1.1 Solar panel (PV-cell):

Solar panels harness the sun's energy in the form of light and convert the energy into electricity. Although the average consumer might associate solar panels with residential rooftop assemblies, solar panels are available for a wide range of applications, including powering individual gadgets, electronic devices and vehicle batteries. The smallest unit of a solar panel is the solar cell, also called a photovoltaic, or PV cell; it's the individual PV cell that turns sunlight into electricity. Individual cells arranged in a group are called a "module" or panel; a collection of two or more panels is called an array. According to the National Renewable Energy Laboratory, the typical residential or business solar panel holds approximately 40 cells and the average residential array consists of 10 to 20 panels.

4.1.2 Power supply board:

It is used for connection of negative and positive terminal of system where power supply is connected with three suppliers; solar panel, battery and main supply (adopter). Here solar panel is also connected with battery for charging purpose but while working with adaptor batter will not charge. For that connections are done through diode which prevents from back flow of charge and also switch the system.

4.1.3 Battery:

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved additionally to include devices composed of a single cell. The battery used is 12v dc batter which stores the charge and operates the system when required.

4.2 Micro-controller:

Microcontroller is used as the heart of automation system to control the all actions required. The status of soil read by sensor is send to the microcontroller in the form of 0 &1. If soil is dry it will send 1 and if wet then 0, depending on the sensor used. According to the soil status the controller will send signal to the relay drive along with LCD display and GSM module. The microcontroller here used is W78E052, under the family of 8051. The microcontroller is placed in the controller board where power supply and other connections can be done.

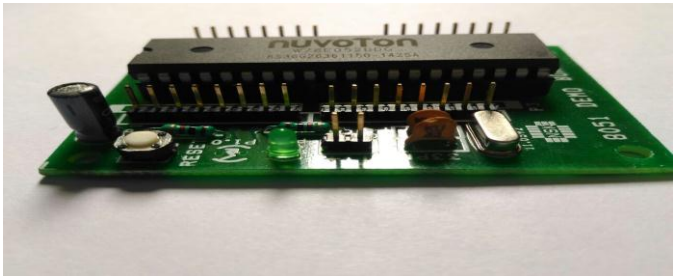

Fig 4.1 Microcontroller 8051

4.3 Soil Moisture Sensor

Soil moisture sensor is used to measure the soil resistivity or volumetric water contain of soil in terms of threshold. When sensor is placed in field, it measures the moisture or water level content in it. It gives a digital output of 5V when moisture level is high and 0V when the moisture level is low in the soil.

The sensor includes a potentiometer to set the desired moisture threshold. When the sensor measures moisture, it is compared by comparator LM393 with the set threshold if compared value is more than the set value then, the digital output goes high and an LED indicates the glows. When the moisture in the soil is less than the set threshold, the output remains low and LED remains off. The digital output is send to connected micro controller to sense status of field. The sensor also outputs an analog output which can be connected to the ADC of a micro controller to get the exact moisture level in the soil. This types of soil moisture sensor are easy available in market and easy to use and also low cost.

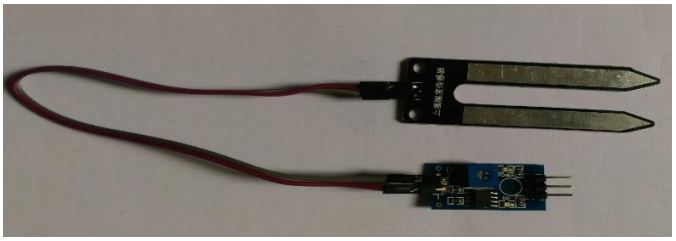

Fig 4.2 Soil moisture sensor

4.4 GSM Module

GSM is a mobile communication modem; it stands for global system for mobile communication (GSM). It is a wireless communication between server and nodes. That means GSM helps to make communication between two systems in certain range. The one can know the status of operation without visiting the place. The GSM module used here is GSM SIM800c which works under the frequencies of 900/1800 MHz the module is connected with 5V microcontroller where commands are instructed and information's are share between the systems. The system is capable enough to instruct the automatic system via SMS from the registered cell number. Here, in this project the GSM sends the SMS about the status of pump operation.

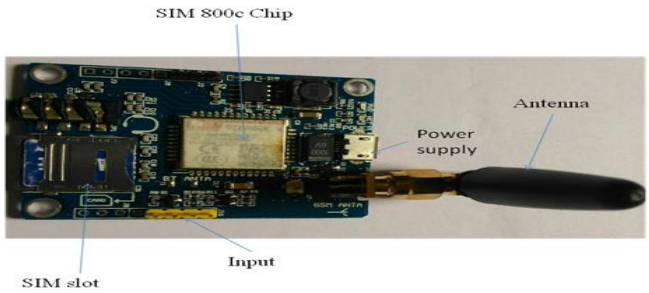

Fig 4.3 GSM module SIM 800c

4.5 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. Here display is used to indicate the condition of soil either it is dry or wet and also the status of pump when it is OFF or ON.

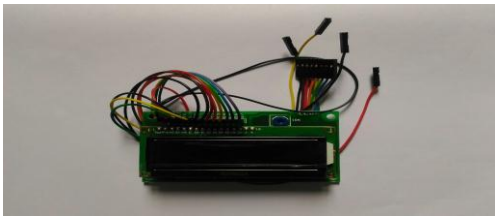

Fig4.4 (16x2) LCD display

4.6 Relay Driver:

A relay is an electro-magnetic switch which is useful to use a low voltage circuit to switch on and off a load connected to the mains supply. Here relay driver is used to switch ON and OFF the pump on the demand of field. The relay driver is controlled by microcontroller.

Fig 4.5 Relay Drive

4.7 Pump:

Pump is a device which moves the fluids by means of mechanical action. Pumps operate by some mechanism and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines or wind turbine, and come in many sizes, from microscopic for use in medical applications to large industrial pumps. Mechanical pumps serve in a wide range of applications such as pumping water from well, irrigations, pumping fuel, operating cooling tower.

The pump used in irrigation is self priming centrifugal electrical pump. This type of pump is completely dipped into reservoir or bore well for pumping purpose. The pump moves the fluid from the reservoir and supply to the desire field. The distance of pumping depends on the head of pump used.

The pump used in this model is 5V Dc pump with head of 0.5 m.

Fig 4.6 DC pump (5V)

5. OPERATIONS:

The working principle of this system is simple. When the soil moisture sensor is placed in field it senses the condition and the comparator will compare with set value of potentiometer. If the value is less, than it will read as soil is dry and send signal to the microcontroller. The microcontroller commands the relay drive to close the circuit and switch ON the pump for supply of water. At the same time microcontroller will display the status in the LCD display as well as it will command to GSM model to send the SMS to the register SIM about the pump status. If the value cross the set value of potentiometer, the microcontroller again sends signal to relay driver to open the circuit to switch OFF the pump. And again GSM module sends SMS to the SIM about the pump status. At the same time LCD will display the soil status. Hence, the automatic system works. In the case of any failure in automatic system the pump also can be operate by switch but for that one have to visit in the field and ON the switch. After the irrigation is done again have to OFF the switch. Besides irrigating the field, pump also can be used during the cultivating land and other purpose through manual switching.

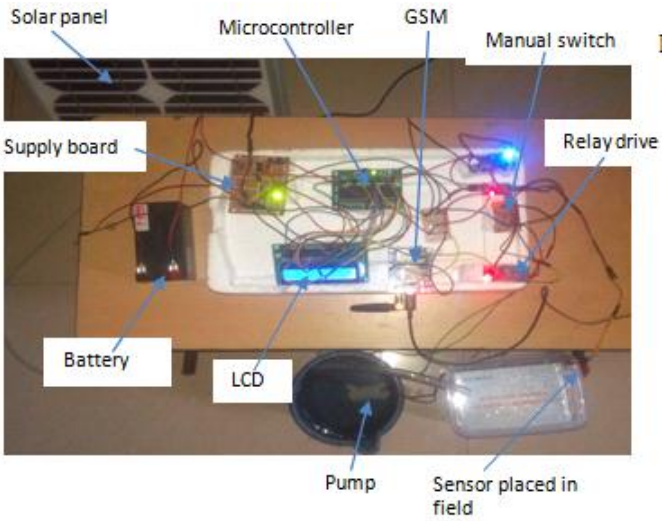

Fig 5.1 Model

6. CONCLUSION

Hence by implementing the automatic irrigation system proper irrigation is done which maximizes the productivity of crops. The scarcity or deficiency of water in field is controlled and regular irrigation is done. By implementing manual switching we use the pump to supply water for other purpose also. The pump is also used for filling the tank and used during cultivation of land. Beside that it helps to operate the irrigation system if any short circuit or failure in automation system. The solar panel used helps to overcome the energy crisis problem, and adopter used is for alternative used to subsidy for damage of battery or for cloudy days when solar will not get enough charge for charging the battery. Hence our idea works successfully.

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