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SOLAR POWERED SENSOR BASE IRRIGATION SYSTEM

KAVITA BHOLE [1] DIMPLE CHAUDHARI[2]

[1] *Master Student, Department of Electronics and Telecommunication Engineering, SESGOIFE College*

Mumbai University

[2] *Assistance Professors, Department of Electronics and Telecommunication Engineering, YTIET College*

Mumbai University

Abstract - This paper throws light on development procedure of an embedded system for solar based Off-Grid irrigation system. Solar power is absolutely perfect for use with irrigation systems. Using Solar Panel, the sun energy will converted to electrical power and saves in to batteries. When the sun is rising and shining, the solar panel will absorb the energy of the sun and the energy will keep in the battery. Light Detecting Resistors (LDR's) are placed on the solar panel which helps in tracking maximum intensity of sunlight. For generation of maximum energy, it is important to maintain solar panels face always perpendicular to the sun. This tracking movement of the panel is achieved by mounting the solar panel on the stepped motor. This stepped motor rotates the mounted panel as per signal received from the programmed microcontroller. The microcontroller used in this project is from AVR family.

Soil moisture sensor is placed inside soil to sense the moisture conditions of the soil. Based on moisture sensor values, the water pump is switched on and off automatically. When moisture level of the soil is reaches to low, the soil moisture sensor is sending the signal to microcontroller to start the pump by using stored solar energy. Same time, using GSM technique microcontroller is sending message on farmers mobile about pump status. The microcontroller completes the above job as it receives signals from the soil moisture sensors, and these signals functions as per program stored in ROM of the microcontroller. The LDR's values, soil moisture values, condition of the pump i.e., on/off are displayed on a 16x2 LCD which is interfaced to the microcontroller.

***Key Words*: Solar panel, Light Dependent Resistors (LDR's), Soil moisture sensor, AVR microcontroller.**

1. INTRODUCTION

In India, agriculture plays a very important role to development of country as our economy mainly based on it. India ranks second worldwide in farm output. The most important factor for the agriculture is timely and ample supply of water. But due to uncertain rainfall and water scarcity in land reservoirs, we are not able to make proper use of agricultural resources. Also unplanned used of water results in to wasting of water on large proportion. With the increase in agricultural activity and competitive demand from different sectors, it has become important to economize on the use of water. We can optimize use of water by adopting sensor base irrigation system.

There is different irrigation systems are used nowadays to reduce dependency of rain. Due to the lack of electricity and mismanagement, in the manual control irrigation system many times crops are dry or flooded with water. So to avoid this problem sensor base irrigation system is used. In manual system, farmers usually control the electric motors observing the soil, crop and weather conditions by visiting the sites. Soil moisture sensor base irrigation system ensures proper moisture level in the soil for growing plants in all season. In this system, sensor is sensing the moisture content of soil and accordingly switches the pump motor on or off. Soil moisture sensor is find the soil condition whether the soil is wet or dry. If soil is dry the pump motor will pump the water till the field is wet which is continuously monitored by the microcontroller. The main advantage of soil moisture sensor is to ensure accurate measurements and farmer doesn't have to visit his farm to operate the pump. Same time, using GSM technique microcontroller is sending message on farmers mobile about pump status.

For operation of sensor base irrigation system, pump motor requires energy for pumping. In day to day life there is increasing demand for energy but there is continuous reduction in existing sources of fossils and fuels. According to the survey conducted by the Bureau of Electrical Energy in India in 2011, there are around 18 million agricultural pump sets and around 0.5 million new connections per year are installed with average capacity 5HP. Total annual consumption in agriculture sector is 131.96 billion KWh (19% of total electricity consumption). So, solar power is only an answer to today's energy crisis. It is perfect source of

energy in the world as it is environment friendly and its unlimited availability. In fact the amount of the Sun's energy that reaches the Earth every minute is greater than the energy that the world's population

2. OBJECTIVES OF STUDY

1. To develop solar panel tracking system.
2. To develop sensor base irrigation system based on soil moisture.

3. PROBLEM DEFINITION

Nowadays, even though irrigation systems are used in agricultural field to reduce dependency of rain, most of them are either regulated manually or having time based automation. In these types of system water is applied to field on the basis of fixed intervals which required high manpower for monitoring and also it reduces the field efficiency. In addition, this fixed interval operation leads to over irrigation than the actual plant requirement and under irrigation when plants required more water in their peak periods. Retardation of crop growth rate, late flowering and reduction of the yield are the major events caused due to water deficiency. Moreover, over irrigation in the root zones leads to ill health of the root zones and vegetation, additional cost for farmer, wasting of water and time wastage. Also salinity of the soil can be increased by continuous supply of excess water.

For operation of irrigation system, electricity is required. So use of solar energy for power generation is essential to tackle current energy crisis. One of the major weaknesses of the fixed panel solar system is that due to rotation of the sun, it is not able to extract maximum energy from the sun.

4. PROPOSED METHODOLOGY

In the proposed system single axis solar tracking system is used for the irrigation along with GSM. Four LDR's are placed on solar panels helps to track maximum intensity of sunlight and thus helps to collect more electricity. Produced electricity is stored in DC battery which is used to pump the water for irrigation system. The analog values from LDR sensors and soil moisture sensor are converted in to digital values by using ADC Converter. The digital values then provided to AVR Microcontroller as an input. Microcontroller is interfaced with DC Pump, LCD, and GSM Module. When moisture content of soil will low, pump will start automatically and farmers can get the information on his mobile through GSM module.

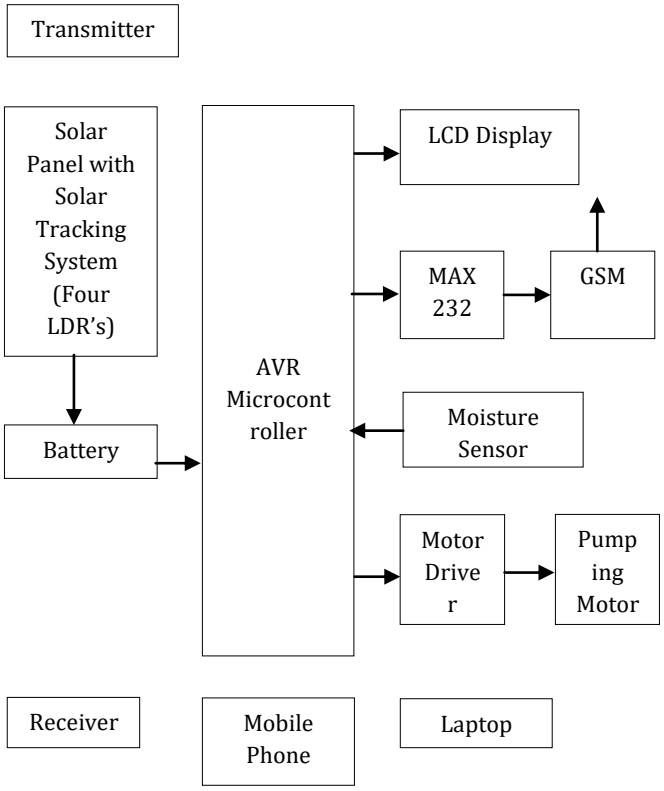

Figure 4.1 Block Diagram of Solar Powered Sensor Base Irrigation System

Following are the major components from which proposed system is fabricated.

1. AVR Microcontroller
2. Solar panel
3. Soil Moisture Sensor
4. GSM
5. Liquid Crystal Display (LCD)
6. Light Dependent Resistor (LDR)
7. Battery
8. DC Motor
9. LED
10. RF Radio Frequency Wireless Communication
11. Relay

4.1 Solar Tracking System

The basic idea of developing solar tracking system in this project is to get maximum sunlight from the sun throughout the day, by tracking the movement of the sun. Here the solar cell panel is moved according to the position of the sun. By tracking the movement of the sun, maximum sunlight is obtained; further this energy will be stored in a 12 V DC battery. The solar cell panel will be mounting on a rotating structure. This structure

will have DC motors that will help the structure to rotate.

Here we are going to implement the LDR for detection of the sunlight. The LDR will be detecting the sunlight and send the data to the microcontroller. We are going to use four LDRs in the project. One at each direction from East to West.

As long as the sunlight is in the perimeter of the LDR the solar panel will remain in the same direction. Once the sunlight is out of the perimeter of the LDR, it will stop sending data to the microcontroller. But at the same time the sunlight will be in the perimeter of the next LDR, as we have installed the LDRs in such a pattern. Now the next LDR will start sending the data to the microcontroller. Upon getting the data from the next LDR the microcontroller will send a command to the DC motor. After receiving the command from the microcontroller now the DC motor will get started and the panel will move to the corresponding direction of the next LDR. Again similar procedure will continue for remaining LDRS. This is how we are going to track the sunlight and adjust the solar panel in a position where it will receive maximum sunlight.

4.2 Automated Irrigation System

Now moving to the second part of the project, the energy generated through the solar panel will be sent to a DC battery. The battery will store the energy for further applications. Now we are connecting a water pump to the battery so that the motor should run on the power generated by the solar panel. In this system the water supply will be an automated one that means the pump will supply the water only when the land needs it.

In order to achieve this task we are making use of soil moisture sensor and a GSM module. The soil moisture sensors will be placed inside the field, and it will be connected to the microcontroller. The moisture sensor will be continuously sensing the moisture content of the soil and sending it to the microcontroller, where moisture content value will be compared with predefine level. Now whenever the moisture level becomes less than the predefined level, microcontroller will send a command to activate the water pump. Same time microcontroller will activate GSM module, which will send a feedback message to user, stating that the "Pump on". After the motor gets started and starts supplying water to the field; simultaneously the moisture sensor will be sensing the moisture content and sending the data to the microcontroller. Since the field is getting water supply now the moisture level of the field will start increasing, this increase in the moisture content will again will be compared with a predefined moisture level. When it will reach the predefined moisture level, pump will automatically off. Again GSM module will send feedback message stating that "Pump off". This water pump also works manually by pressing the key.

This is how the system will become an automated system also we are using maximum power from the sunlight. The source program for the microcontroller is written in "C" language.

5. ADVANTAGES

The main advantages of this proposed system are as follows.

1. By using soil moisture sensors in the field, this system provides water for plants according to the crop water requirement and operates according to the soil moisture condition of the root zone of the plant. This leads to saving of water by avoiding excess irrigation.
2. The system has designed to operate using solar energy; hence it could be used for the areas where the electricity is not available. Further, use of this renewable energy does not affected by the energy crisis. This renewable energy produces little or no waste products such as carbon dioxide or other chemical pollutants, so it has minimum impact on environment.
3. The proposed system controls amount of water use for irrigation in the agricultural fields. Thus it reduces excessive pressure on farmers to pay additional water tariff on water. In addition to this controlled irrigation also save additional cost for water pumping, reduces the conveyance and distribution losses in the field level. Moreover, energy consumption on water pumps could be reduced by efficient water allocation based on the crop water requirement.
4. This solar powered automated irrigation system does not require man power for operation. This intelligent system can detect the soil moisture conditions and perform automatically based on pre-defined moisture conditions.
5. This system reduces run off from over watering saturated soils, avoid irrigating at the wrong time of the day, which will improve crop performance by ensuring adequate water and nutrient balancing. Further, it prevents Salinity of agricultural lands which cause for poor productivity and land degradation.

6. In addition, this system helps in time saving, removal of human error in adjusting available soil moisture level and to maximize their net profit.
7. By using solar tracking system as compared to fixed panels, energy output is increased.
8. Proposed system makes easy to adopt advanced crop systems and technologies, those are complex and are difficult to operate manually.

6. APPLICATIONS

By implementing proposed system, there are various benefits to both government as well as farmers. For the government solution to energy crisis and water shortage is proposed.

Main application of the proposed system is for irrigation of agriculture fields. Even we can apply this system in agriculture research stations, greenhouses where high precision soil moisture control is required. Use of solar energy in the proposed system allows us to use this system in remote areas where electricity is not available.

7. CONCLUSIONS

In this paper, a solar powered sensor base automated irrigation model is proposed. We designed this model considering low cost, reliability, alternate source of electric power and automatic control. As the proposed model is automatically controlled, it will help the farmers to properly irrigate their fields. The model always ensures the sufficient level of water in the soil. Thus, this system avoids over irrigation, under irrigation, top soil erosion and reduce the wastage of water. Solar power provides sufficient amount of power to drive the system. To overcome the necessity of electricity and ease the irrigation system for our farmers, the propose model can be a suitable alternative.

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