Solar Powered Sensor Base Irrigation System

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***Abstract*— Solar energy is rapidly advancing as an important means of renewable energy resource. Using Solar Panel, the sun energy will converted to electrical power and saves into batteries. During day time, 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 towards the sun. This tracking movement of the panel is achieved by mounting the solar panel on the stepped motor. 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 zigbee technique microcontroller is sending message on farmers mobile about pump status. The microcontroller completes the tasks as it receives signals from the soil moisture sensors, and these signals functions as per program stored in ROM (Read Only Memory) of the microcontroller.**

Keywords—Light detecting resistors, stepped motor, microcontroller, soil moisture sensor, zigbee, ROM.

I. INTRODUCTION

Agriculture is the need of most of the Indians livelihood and it is one of the main sources of livelihood. It also has a major impact on economy of the country. A major quantity of water is used for irrigation system and therefore 85% of available fresh water resources are used for yielding agricultural crops. This resource of water will decrease day by day and consumption of water will dominate and increase more than 85% in upcoming half century. This is due to the high growth in population due to this tremendous growth in population there is huge demand for food. Agriculture is the main source for food production. Using science and technology we need to implement a method by which there can be limited consumption of water.

To provide a sustainable power production and safe world to the future generation, there is a growing demand for energy from renewable sources like solar, wind, geothermal and ocean tidal wave. Solar panels directly convert solar radiation into electrical energy. Solar panel is mainly made from semiconductor materials. Si used as the major component of solar panels, which is maximum 24.5% efficient. Increasing the cell efficiency, maximizing the power output and employing a tracking system with solar panel are three ways to increase the overall efficiency of the solar panel. Improvement of solar cell efficiency is an ongoing research work and people throughout the world are actively doing research on this. Maximizing the output power from solar panel and integrating solar tracking system are the two ways where electronic design methodology can bring success[1]. A parameter to determine crop irrigation needs is estimating plant evapotranspiration (ET). ET is affected by weather parameters, including solar radiation, temperature, relative humidity, wind speed, and crop factors, such as stage of growth, variety and plant density, management elements, soil properties, pest, and disease control. Systems based on ET have been developed that allow water savings of up to 42% on time-based irrigation schedule [2]. The most important factor for the agriculture is timely supply of sufficient 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 use 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. 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 zigbee 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.

II. RELATED WORK

Harishankar S, Kumar R, Sudharsan K P, Vignesh U and Viveknath T, 'Solar Powered Smart Irrigation System', Advance in Electronic and Electric Engineering, Volume 4, Number 4: 341-346, 2014. Cost effective solar power can be the answer for all our energy needs. Solar powered smart irrigation systems are the answer to the Indian farmer. This system consists of solar powered water pump along with an automatic water flow control using a moisture sensor. It is the proposed solution for the present energy crisis for the Indian farmers. This system conserves electricity by reducing the usage of grid power and conserves water by reducing water losses[3].

Fule C and Awachat P, 'Design and Implementation of Real track maximum intensity of sunlight and so as 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 microcontroller as an input. Microcontroller is interfaced with DC Pump, LCD, and zigbee module. When moisture content of soil will low, pump will start automatically and farmers can get the information on his mobile through zigbee and if moisture content of soil is high, pump will automatically switched to off state.

International Journal of Advance Research in Computer Science and Management Studies, Volume 2, Issue 1, January 2014. The purpose 0f this paper to measuring the moisture of agricultural soils by real-time method and to minimize this manual involvement by the farmer, which is why we are using a micro-controller (AVR ATMEGA-16L),RF module. The sensor senses the amount of moisture present in the soil and presents an output in the form of analog voltage ranging between 1.7V to 4.5V respectively[4].

Sanjukumar and Krishnaiah R V, 'Advance Technique for Soil Moisture Content Based Automatic Motor Pumping for Agriculture Land Purpose', International Journal of VLSI and Embedded Systems - IJVES, Volume 4, Article 09149, September 2013 The Soil moisture content based irrigation system was developed and successfully implemented along with flow sensor. User can easily preset the levels of the Moisture and is regularly updated about current value of all parameters on LCD display. The main aim of this paper is to monitor the moisture content in the soil in cultivating field. Based on soil moisture, pumping motor will be automatically switch on or off through relay. This saves the water at the same time and on the other hand the plant can get optimum level of water, so increasing productivity of crop[5].

Seal B, Shirke O, Shewale S, Sirsikar A and Hankare P,'Solar Based Automatic Irrigation System',International Journal of Research in Advent Technology, Volume 2, Number 4, April 2014 The purpose of the paper is to design a model to harness maximum available solar energy by tracking the sun, and modernize the agriculture industries at a mass scale with optimum expenditure. The solar power irrigation system will help to reduce the gap between required and consumed energy by using soil moisture sensors and further conserves the resources thereby reducing the wastage of resource [6].

III. METHODOLOGY

In the proposed system single axis solar tracking system is used for the irrigation along with zigbee. LDR's are placed on solar panels helps to track maximum intensity of sunlight and so as 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 microcontroller as an input. Microcontroller is interfaced with DC Pump, LCD, and zigbee module. When moisture content of soil will low, pump will start automatically and farmers can get the information on his mobile through zigbee and if moisture content of soil is high, pump will automatically switched to off state.

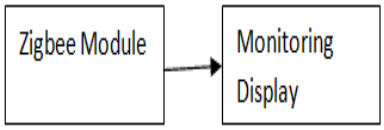

Figure 1 Block diagram of receiver

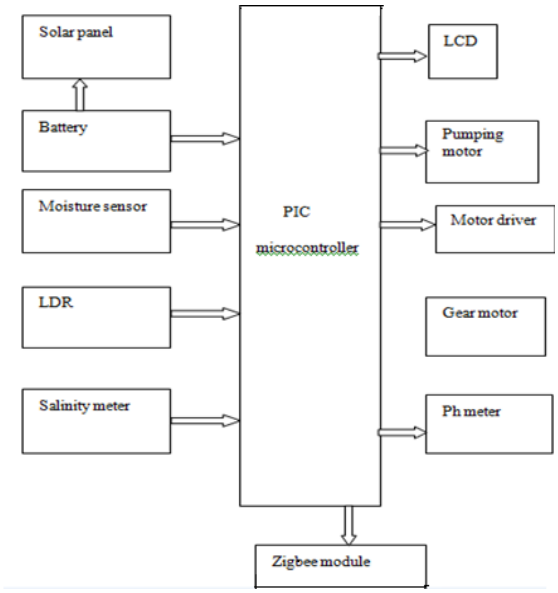

Figure 2.Block diagram of solar powered sensor base irrigation system

IV. WORKING PRINCIPLE

In the proposed system, we are using solar panel, sun energy will converted to electrical energy by photovoltaic cells, that energy is stored in batteries. During day time, solar panel will absorbs the energy obtained by the sun and stored the energy in battery. LDR's, placed on solar panel tracks maximum intensity of sunlight. 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 zigbee technique microcontroller is sending message on farmers mobile about pump status. Salinity meter is used to identify the amount of dissolved salts in water. If the amount of dissolved salts in water is high, which negatively affects plant growth and development therefore we are not going to prefer water with high salinity. Ph of soil also plays a vital role in plants growth. Soil Ph is a measure of the relative acidity or alkalinity of the soil. Soil Ph should be maintained in a neutral to slightly acidic range (6.0-7.0)for grain crops, but closer to neutral(6.8-7.0) for forage legumes. Metal toxicity negatively affects root growth in acidic soils, and is the most important reason for managing soil Ph. We can prevent soil becoming more acidic over time due to natural processes and fertilizer inputs by the application of lime.

A. Overview of Solar Tracking System

The basic idea of developing solar tracking system in this paper 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. But at the 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 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.

B. Overview of Automated Irrigation System

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 zigbee 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 zigbee 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 zigbee 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.

V. RESULT

This section describes about the results obtained, it mainly focuses on the way that the received signal is been processed using software and the way that the obtained signal is been produced by the PIC microcontroller then water pumping is on or off depending on the field moisture condition.

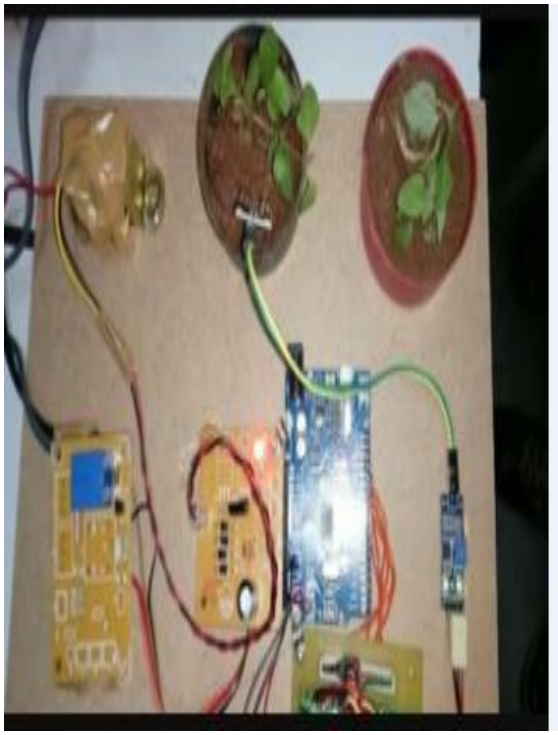

Figure3 Final model of irrigation system

In the above final model of irrigation system, the soil moisture sensor is dipped into the soil, if the soil is dry the indicator light of the sensor is off then the water is pumped up to some potential so that to grow a crop. If there is enough water in the soil the indicator light of sensor is on then the motor is turned off. When the motor is off, the power of the device is 27 volts which contains 5 volts of battery, two 6

volts of solar panel and two 5 volts of LDR and when the motor is on, the 5volts of pumping motor is added to get 32 volts of power.

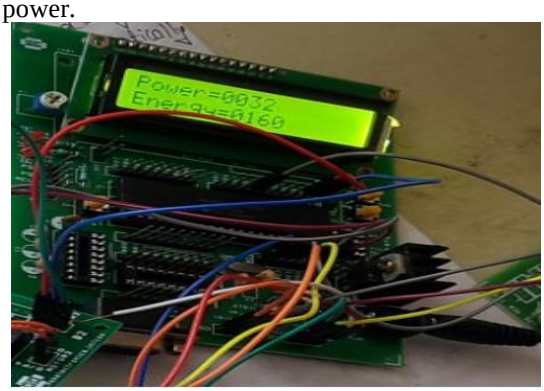

Figure 4 LCD display

Here, the microcontroller sends the message to the farmer's phone or laptop through zigbee transmitter and receiver about the condition of the field in the absence of the farmer.

VI. CONCLUSION

In this proposed system 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.

VII. FUTURE SCOPE

Number of channels can be increased. It can be modified with the use of a data longer and a graphical lcd panel. The speaking voice alarm and normal buzzer can be used to detect unwanted things coming inside the field. Modems, cellular phones or satellite terminals can be used.

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