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SOIL MOISTURE SENSOR BASE AUTOMATIC IRRIGATION SYSTEM POWERED BY SOLAR ENERGY

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Abstract — nowdays, 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.

Keywords— AVR microcontroller, LED, GSM, DC motor, Water pump

I. INTRODUCTION

Due to increase in population, water demand has been increased and its availability becomes more crucial than ever before. In developing countries, most of the available water is used for agriculture purpose. A source of energy to pump water needed for agriculture is also a big problem. In day to day life there is increasing demand for energy, the continuous reduction in existing sources of fossil fuels and the growing concern regarding environment pollution, have pressed mankind to explore new non-conventional, renewable energy resources such as solar energy for the production of electrical energy. Solar energy is very interested subject flaming all over world in all sectors from space station to agro-irrigation because of unlimited availability of free solar radiation. Concerning to use of solar power in irrigation sector is in primitive stage because of lack of knowledge on design aspects.

In this paper, we are going to study 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. This tracking movement is achieved by coupling a motor to the solar panel such that the panel maintains its face always perpendicular to the sun to generate maximum energy. This is achieved by using a programmed microcontroller to deliver signal to the motor to rotate the mounted panel as desired. The microcontroller used in this system 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 does the above job as it receives the signal from the sensors through the output of the comparator, and these signals operate under the control of software which is 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.

II. PROPOSED METHODOLOGY

The methodology is divided into two parts, hardware development and programming development. The hardware part consists of all the major components required for fabrication of this system. Software part is about writing a program for microcontroller.

2.1 Hardware Part

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

2.1.1 Solar Panel

Solar panel is an assembly of photovoltaic (PV) cells electrically connected and mounted on a supporting structure. Photovoltaic (PV) cells are made of special materials called semiconductors such as silicon. Basically, when light strikes the cell, a certain portion of it is absorbed within the semiconductor material. The electricity produced is called direct current (DC) and can be used immediately or stored in a battery.

2.1.2 AVR Microcontroller

Microcontroller is the heart of this circuit. The microcontroller used is AVR, ATMEGA32 from ATMEL Company. The MOSFET IRF224 will be used as driver for driving DC motor. The sensing of speed for DC motor will be done using optical encoder. The output of sensor will be given as feedback to the microcontroller. For every one rotation of motor one interrupt signal will be send to microcontroller.

2.1.3 Battery

An electrical battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy. In this proposed system, we used battery for storage of electricity produced by solar panels. The stored energy further used for operation of the irrigation system.

2.1.4 Light Dependent Resistor (LDR)

Here, 4 LDR's are used to track the sun. LDR sensor used to get the input data of light, this data is in analog form, on the basis of this data, system track the sun. A photoresistor or light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity. A photo resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron conducts electricity, thereby lowering resistance.

2.1.5 Liquid Crystal Display (LCD)

LCD is used to display the LDR's readings; soil moisture sensor measurement's and pumps working status. LCD we have used is 16x2 i.e. 16 characters in 1 line, total 2 lines are there. This

LCD has 8-bit parallel interface. It acts as an output to microcontroller. It uses ASCII values to display the characters.

2.1.6 LED

LEDs are semiconductor devices made out of silicon, when current passes through the LED; it emits photons as a byproduct. Normal light bulbs produce light by heating a metal filament until its white hot. LEDs present many advantages over traditional light sources including lower energy consumption, longer lifetime, improved robustness, smaller size and faster switching.

2.1.7 DC Motor

A DC motor is an electric motor that runs on direct current (DC) electricity. In any electric motor, operation is based on simple electromagnetism. A simple 2-pole DC electric motor here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization. Every DC motor has six basic parts -- axle, rotor (a.k.a., armature), stator, commutator, field magnet(s), and brushes.

2.1.8 GSM (Global System for Mobile Communication)

We used GSM for sending a SMS about pump status to farmer / user. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. A GSM modem can be an external modem device. Insert a GSM SIM card into this modem, and connect the modem to an available serial port.

2.1.9 Soil Moisture Sensor

Soil moisture sensor is use in proposed system to measure soil moisture. The moisture sensor is buried in the ground at required depth. The moisture sensor just senses the moisture of the soil. The change in moisture is proportional to the amount of current flowing through the soil. The sensor has a low power requirement and very high resolution. This gives the ability to make many measurements (i.e. hourly) over a long period of time with minimal battery usage.

2.1.10 Radio Frequency Trans receiver Module (RF Module)

This High Speed Wireless module is a plug and play replacement for the wired Serial Port (UART). This Wireless module allows engineers of all skill levels to quickly and cost-effectively add wireless capabilities to virtually any product.

2.1.11 Relay

It is electromagnetic switch use to control the electrical devices. In our proposed system, two relays are used for switching. One relay is used for switching between microcontroller and GSM and another relay is used for switching between microcontroller and RF. Relay is acts as transmitter. Most of the relay uses an electromagnet to operate a switching mechanism mechanically.

2.2 Software Part

C language is used for development of source program for the microcontroller which is explain below in the form of flowcharts.

2.2.1 Solar Tracking System

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 are used here to detection of sunlight and to send data to micro controller. 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 which rotates the panel 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.

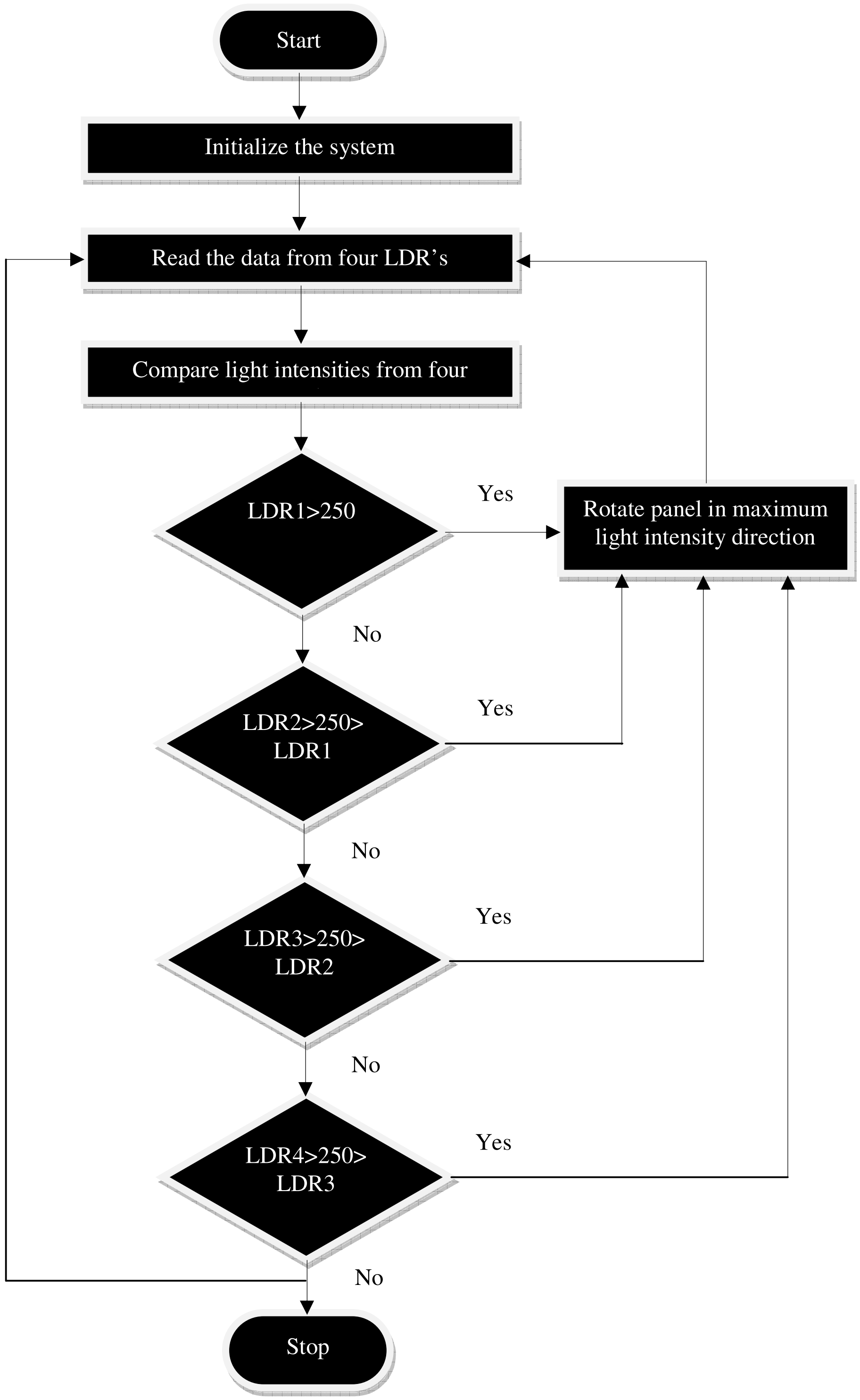

Figure 1. Flowchart of Solar Tracking System

Here we fixed minimum value of LDR to 250 by calibration. Means when LDR value will be more than 250, solar panel will stay in the direction of same LDR. And when this value of LDR will reduce to less than 250, it means sunlight is out of perimeter of this LDR. Again micro controller will read the data of next LDR. If value of next LDR will more than 250 then panel will move to direction of next LDR. Similar procedure will continue for remaining LDR'S.

2.2.2 Automated Irrigation System

Now moving to the second part of the proposed 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 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. Here threshold value of soil moisture content is fixed to 200 by calibration.

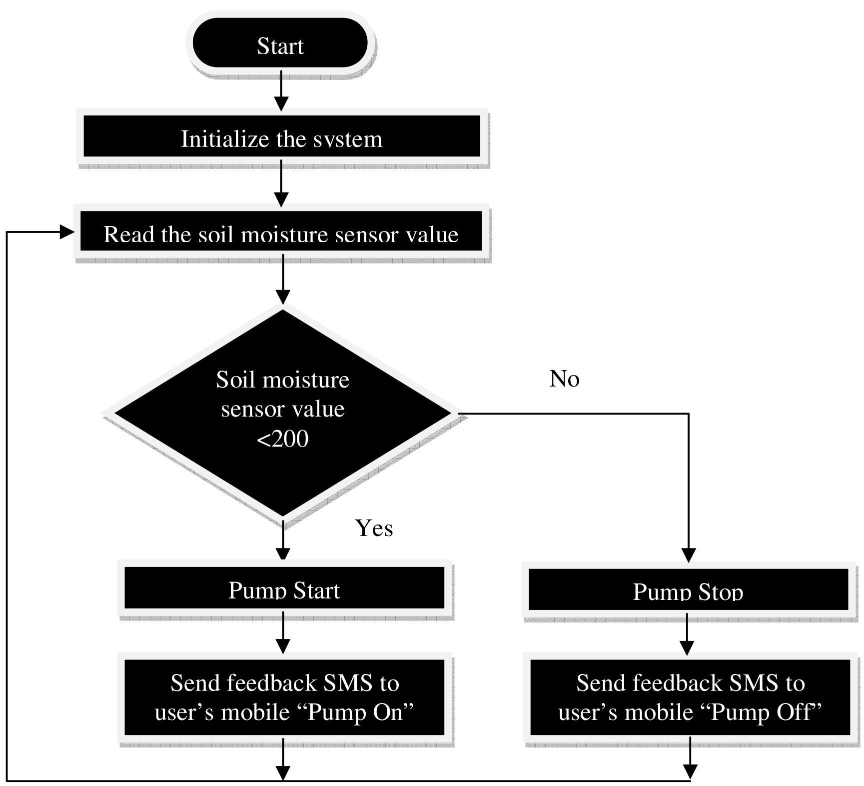

Figure 2. Flowchart of Soil Moisture Sensor Base Automatic Irrigation System

This is how the system will become an automated system also we are using maximum power from the sunlight.

III. CONCLUSION

By implementing above systems there are various benefits.

1. By continuously monitoring the status of the soil, we can control the flow of water and thereby reduce the wastage
2. Conservation of water and labor: Since the systems are automatic, they do not require continuous monitoring by labor.
3. The design is low power, low cost, small size, robust and highly versatile.
4. This system avoids over irrigation, under irrigation, top soil erosion and reduce the wastage of water.
5. The main advantage is that the system's action can be changed according to the situation (crops, weather conditions, soil etc.).
6. By implementing this system, agricultural, horticultural lands, parks, gardens, golf courses can be irrigated.

REFERENCES

[1] Alsayid B, Jallad J, Dradi M and Al-Qasem O, 'Automatic Irrigation System with PV Solar Tracking', International Journal of Latest Trends in Computing, Volume 4, Number 4, December 2013.
[2] Anuraj A and Gandhi R, 'Solar Tracking System Using Stepper Motor', International Journal of Electronic and Electrical Engineering, Volume 7, Number 6: 561-566, 2014.
[3] Fule C and Awachat P, 'Design and Implementation of Real Time Irrigation System using a Wireless Sensor Network', International Journal of Advance Research in Computer Science and Management Studies, Volume 2, Issue 1, January 2014.
[4] Gutiérrez J, Villa-Medina J F, Nieto-Garibay A and Porta-Gándara M A, 'Automated Irrigation System Using a Wireless Sensor Network and GPRS Module', IEEE Transactions on Instrumentation and Measurement, 2013.
[5] 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.
[6] Khan T, Tanzil S M, Rahman R and Alam S M, 'Design and Construction of an Automatic Solar Tracking System', IEEE 6th International Conference on Electrical and Computer Engineering ICECE 18-20, 2010.
[7] Luthra S K, Kaledhonkar M J, Singh O P and Tyagi N K, 'Design and development of an auto irrigation System', Elsevier Science B. V. - Agricultural Water Management, Volume 33: 169-181, 1997.
[8] Mane A, Arif S M, Shaikh S and Shaikh S, 'Solar Panel Tracking System for GSM Based Agriculture System', International Journal of Engineering and Advanced Technology (IJEAT), Volume 2, Issue 5, June 2013.
[9] 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.
[10] 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.
[11] Uddin J, Reza S M, Newaz Q, Uddin J, Islam T, and Kim J M, 'Automated Irrigation System Using Solar Power', IEEE 7th International Conference on Electrical and Computer Engineering 20- 22, 2012.

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