Research Paper Engineering

Automatic Solar Irrigation System

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ABSTRACT

This paper proposes a model of variable rate automatic microcontroller based irrigation system. Solar power is used as only the source of power to control the overall system. Sensors are placed on the paddy field and these sensors continuously sense the water level and give the message to the farmer informing the water level. Without visiting the paddy fields, farmers can get the information about the water level. However, if the water level reaches to the danger level; the motor will automatically start without confirmation of farmer to ensure the proper water level in the site. At the end of this paper, a complete hardware implementation of this proposed automated irrigation system is presented.

KEYWORDS Automatic microcontroller, Irrigation system, Solar power, Sensors, Motors.

1. INTRODUCTION:

The population of India has reached beyond 1.2 billion. If the population goes on increasing with the present rate then after 25-30 years there will be a serious problem of food, so in order to meet the demand of food one has to give more emphasis on the development of agriculture. Today, man has occupied all the suitable land but the land located far away from the human settlement is not developed properly and not utilized fully because it requires more manpower, time and expenditure. But now a days it is possible to pay more attention with the help of modern available controlled devices like computer, microprocessor, sensor, integrated circuits and microcontroller. In the present work a Microcontroller based controlled remote irrigation system is developed for the agricultural plantation. The developed system is placed at the remote location and required water provides for plantation whenever the humidity of the soil goes below the set-point value. Humidity sensor provides proportional amount of output with change in humidity, which is compared, to the set-point and the data is taken through the channel. If the set-point data is high, then after motor is turned ON, which provides water to the plant till the humidity goes above set-point value. After reaching the humidity above set-point value motor is turned OFF and scans the next channel. This provides right amount of water at right time. The required software program is developed in assembly level language.

2. LITERATURE SURVEY AND BACKGROUND STUDY:

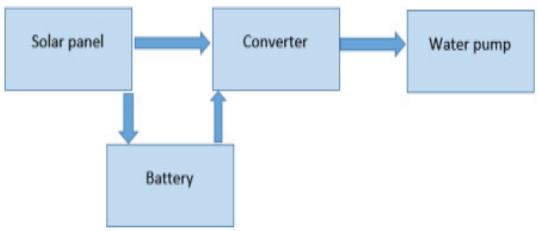
According to the survey conducted by the Bureau of Electrical Energy in India in 2015 there are around 20 million agricultural pump sets and around 0.5 million new connections per year is installed with average capacity 5HP. Total annual consumption in agriculture sector is 131.96 billion KWh (19% of total electricity consumption).

3. THE PROPOSED SOLUTION:

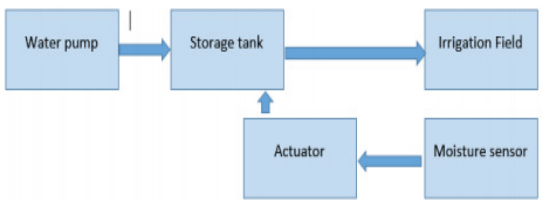
In this proposed system we utilize the solar energy from solar panels to automatically pump water from bore well directly into a ground level storage tank depending on the intensity of sunlight. While conventional methods include pumping of water from bore well into a well and from this well onto field using another pump, our system uses only a single stage energy consumption wherein the water is pumped into a ground level tank from which a simple valve mechanism controls the flow of water into the field. This saves substantial amount of energy and efficient use of renewable energy. A valve is controlled using intelligent algorithm in which it regulates the flow of water into the field depending upon the moisture requirement of the land. In this system we use a soil moisture sensor that detects the amount of moisture present in the soil and depending upon the requirement of level of moisture content required for the crop the water flow is regulated thus, conserving the water by avoiding over flooding of crops.

4. SYSTEM DESCRIPTION:

Proposed irrigation system mainly consists of two modules- Solar pumping module and automatic irrigation module. In solar pumping module a solar panel of required specification is mounted near the pump set. Solar Powered Smart Irrigation System 343 Then using a control circuit it is used to charge a battery. From the battery using a converter circuit it gives power to the water pump which is submerged inside the well. Then the water is pumped into an overhead tank for storing water temporarily before releasing the water into the field. In automatic irrigation module the water outlet valve of the tank is electronically controlled by a soil moisture sensing circuit. The sensor is placed in the field where the crop is being cultivated. The sensor converts the moisture content in the soil into equivalent voltage. This is given to a sensing circuit which has a reference voltage that can be adjusted by the farmer for setting different moisture levels for different crops. The amount of water needed for soil is proportional to the difference of these two voltages. A control signal was given to a stepper motor whose rotational angle is proportional to the difference in voltage. The stepper motor in turns controls the cross sectional area of the valve to be opened controlling flow of water. Therefore the amount of water flowing is proportional to the moisture difference.



Block diagram of solar pumping module.



Block diagram of automatic irrigation module.

5. IMPLEMENTATION:

For the implementation of the proposed system we are using a 2 HP water pump and various modules which are designed and fabricated separately and then finally they are assembled together to implement the proposed system. Solar energy is harnessed using solar panel PVL-68 that generates 53W at Nominal Operating Cell Temperature. It is 24V, amorphous silicon type solar cell. Specification of the solar panel selected: Array capacity --240Wp Irradiance – 580 W/m2 Open circuit voltage – 18.1 V Short circuit current – 3.98 A Load test on a solar panel have been conducted and its maximum and minimum values is tabulated.

Design of converter and battery specification:

An inverter is designed with a DC input of 230V D.C which is generated from 12V D.C using a boost converter. Sine PWM technique is applied to generate 230V A.C. The inverter circuit fabricated is shown in Fig. 4. As far as battery is concerned we are using a battery with 12V, 100Ah capacity for a 2HP pump.

Moisture sensor module:

A moisture sensor is used to sense the level of moisture content present in the irrigation field. It has a level detection module in which we can set a reference value. This circuit can be used with analog probes that produce a voltage proportional to soil moisture.

Automatic valve regulation:

For an automatic valve control we are using a stepper motor as an actuator control of the valve which is connected to the outlet valve of the tank. With the help of moisture sensor signal and a controller, a control pulses is given to the driver circuit that excites the stepper motor. So this way the outlet valve is slowly opened or closed depending upon the amount of moisture present in the soil of the field. When the soil moisture content reaches the required value, the valve is fully closed and power to driver circuit is killed and controller is put into sleep mode for low power consumption. When the moisture in soil is dried and reaches a minimum cut-off value, the controller comes out of sleep mode and flow of water is regulated. This way the whole system works automatically.

6. COST ANALYSIS

With over nine hundred thousand tube wells being used in every state of India, around Rs.18 Million of energy is used for pumping water for irrigation. This amount of money used for electricity can be saved with the help of solar water pump. Annually the cost of nearly five million kilo watt hour of energy can be spared. That is around Rs.27 Million per annum can be redeemed which comes around 40% of the total amount of investment. Even though the initial investment is high, it can be earned back in 2 and a half years' time. If we assume the cost of power is Rs. 1.5 Million per kilo watt hour, Rs.18 Million is used for pumping water alone in a year. By using the solar water pump, we can save up to 4.8 million KWh of energy annually which saves a lot of energy. The excess energy can also be given to the grid with small modifications and investments in the circuit, which can add to the revenue of the farmer.

Component	Unit Cost	Quantity	Total Cost
Solar Panel (3 Watt)	500	1	500
Converter Circuit	2000	1	2000
Battery	1200	1	1200
		Overall cost	3700

7. CONCLUSION:

By implementing the proposed system there are various benefits for the government and the farmers. For the government a solution for energy crisis is proposed. By using the automatic irrigation system it optimizes the usage of water by reducing wastage and reduces the human intervention for farmers. The excess energy produced using solar panels can also be given to the grid with small modifications in the system circuit, which can be a source of the revenue of the farmer, thus encouraging farming in India and same time giving a solution for energy crisis. Proposed system is easy to implement and environment friendly solution for irrigating fields. The system was found to be successful when implemented for bore holes as they pump over the whole day. Solar pumps also offer clean solutions with no danger of borehole contamination. The system requires minimal maintenance and attention as they are self starting. To further enhance the daily pumping rates tracking arrays can be implemented. This system demonstrates the feasibility and application of using solar PV to provide energy for the pumping requirements for sprinkler irrigation. Even though there is a high capital investment required for this system to be implemented, the overall benefits are high and in long run this system is economical.

Problem Encountered:

During soldering, many of the connection become short cktd. So we desolder the connection and did soldering again.

A leg of the crystal oscillator was broken during mounting. So it has to be replaced.

LED`s get damaged when we switched ON the supply so we replace it by the new one.

TROUBLESHOOT

Care should be taken while soldering. There should be no shorting of joints.

Proper power supply should maintain.

Future Improvement:

In my project I am sending messages through GSM network and Control the home devices by utilizing AT (ATTENTION) commands. The same principle can be applied to display the message on electronics display board appliances at a distant location.

Robots can be controlled in a similar fashion by sending the commands to the robots. These commands are read by using AT commands and appropriate action is taken. This can be used for spy robots at distant locations, utilized by the military to monitor movement of enemy troops.

Currently farmers have to manually put on or off pumps, drippers etc by using electric switches. Using the principle of AT commands we can put on or off these appliances remotely.

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