Solar Powered Smart 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. Based on the water level, a farmer can control the motor by sending a message from his cellular phone even from a remote place. 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*

I. INTRODUCTION

The project is aimed at developing Solar Powered Irrigation System in order to solve today's energy crisis with environment friendly forms of energy.Solar powered irrigation system can be a suitable alternative for farmers in the present State of energy crisis in India.We propose an automatic irrigation system using solar power which drives water pumps to pump water from bore well to a tank and the outlet valve of tank is automatically regulated using controller and moisture sensor to control the flow rate of water from the tank to the irrigation field which optimizes the use of water.The use of renewable energy source such as Solar Energy makes this project eco-friendly and also cost effective as Government is providing subsidies to the projects that are making use of renewable energy sources.

According to a survey which was done by the bureau of electrical energy in India in 2011 it has been observed that the number of agricultural pumps installed is 18 million and new connections for each year was approximately 0.5 million with an average capacity of 5 hp. If the total annual consumption is calculated then it can be seen in agriculture sector 131.96 billion kWh is in use which is cited in paper solar power smart irrigation technique [2]. Due to such big amount of energy consumption, in future for the agriculture sector electricity may not be available to use. So the proposed system is solarpowered system we are using techniques analyzed. In the research paper during the operation of inverters PWM technique has been that results in a very less harmonics which promotes the augmentation of the overall efficiency of the system, the rating of the system was calculated corresponding to the pump specifications referred.

In [1] a system of rain gun irrigation which is automated by microcontroller is shown. Irrigation is required only when it becomes necessary to water the fields, which in real meaning saves a large quantity of water.

Many researchers are working on the topic, viz. smart irrigation system, which includes autonomous monitoring and controlling of water pump by using photovoltaic energy [4].

II. DEFINATION OF IRRIGATION

Irrigation is defined as applying sufficient amount of water to the plants at regular interval, or the water which is supplied to land or crops that helps the crop growth, typically using separate channels. Irrigation and cultivation are related to each other and can be used for the agricultural crops during the span of inadequate rainfall and for maintaining landscapes. In India, smart irrigation systems are not widely used.

III. MODEL DISCRIPTION

In this proposed design of solar energy based AIS, photo voltaic cells are generating electricity, the excess amount of generated energy may be stored, for the storing rechargeable batteries may be used. In case of stored energy which is produced from the battery cells can be used during the system operation. A water pump may be used to pump the water from a bore well or natural water resources like river, pond, and lake to a water storage tank. Here a proposal has been given for the automatic irrigation using a PV cell that can drive water from various natural resources to the tank. The outlet valve of the tank is automatically regulated by the controller, to control the level of moisture a moisture sensor may be attached to keep the record of flow rate of water to the irrigation field. The sensor and actuator optimizes the required amount of water.

A solar powered automated irrigation system refers to the operation of the system with no or just a minimum of manual involvement beside the surveillance. An automatic irrigation system does the operation of a system with minimum requirement of manual involvement of labor with the help of electronic devices. It makes the irrigation system more efficient and workers can concentrate more on other farming task.

Irrigation system such as drip irrigation, sprinkler system and surface irrigation gets automated with the help of electronic appliances and detectors such as computers, timers, sensors and other mechanical devices. Almost every irrigation system can be automated. A well controlled irrigation system is the one which adjusts the special and time based distribution of water to maximize the efficiency of crop production. It makes in every region of the world as it times and water.

The main intention of this project is to develop a solar powered automatic irrigation system. The entire system is controlled by a programmable microcontroller. A wireless application of irrigation in automation is supported by soil moisture sensors. Intelligent automatic plant irrigation concentrates watering plants regularly without human monitoring using a moisture sensor. The system hardware components that are used may be replaced with the availability and environmental conditions.

The newly added feature in this work is water level sensor module. The water level sensor YL-69 manufactured by Sun Robotics is used to check the level of water of surrounding. For water level increment or decrement from the reference value is required for good growth of a crop, the arrangement is done with the help of which will maintain the water supply to the paddy field, which results in controlled irrigation that may provide healthy growth to the crops. The use of solar panel makes the whole system less costly in long run. Using power supply from solar energy the total power consumption of the circuit is reduced. The renewable energy source is acting as a major resource for the AIS. This system has an additional arrangement of power supply from regular domestic mains too.

A solar photovoltaic panel contains the following components of Fig. 1 which converts solar energy to electrical energy with the help of semiconducting material properties. In this Fig. 1 the equivalent circuit of PV panel is presented, where a current source of Iph, diode of D, shunt resistance Rsh, series resistance Rs is shown.

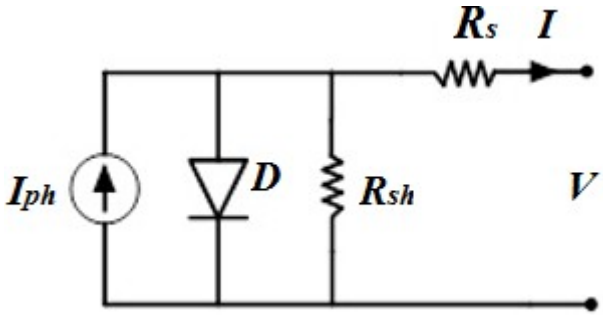

Fig. 1: Equivalent circuit diagram for Solar Photo Voltaic System

The specification of solar panel used in this paper is given; the name of the manufacturer is Soltek.

Table 1: Specifications of Solar Panel

Parameters	
Maximum power	10 w
Product tolerance	± 10 %
Maximum voltage for power	18 V
Maximum current for power	0.56 A
Voltage at open circuit	21.6 V
Current at short circuit	0.59 A
Number of cells	36
Temperature coefficient for Power Pm	-(0.5+/-0.05)%℃
Temperature coefficient for Current Im	+0.1 %/ č
Temperature coefficient for Voltage Vm	0.38%/ č
Temperature at which Operates	-40 č to 80 č

IV. METHODOLOGY

The solar powered AIS is sustainable and draws attention to utilization to the renewable sources. This approaches the AIS more efficient and techno-economical also. The circuits are mostly classified by two parts one is (a) solar power supply to the water pump and the other is (b) monitoring the automation. The motor pump arrangement requires a specific or exact rated solar panel which will be mounted nearby the pump and should face the sunlight directly.

The operation of solar panel and water pump are required for 5-6 hrs of day time, except the operation of pump solar energy may be stored in some batteries for the alternate power supply resources. Charging circuit of battery using diode and resistor of proper rating is required which may provide power in absence of sunlight. The essential part of the

circuit is to operate the water pump and constructing an automated circuit for that. Now-a-days using electronic chip many high rated appliances also can be controlled. In this paper such type of controller is designed using ARDIUNO UNO. The main circuit diagram is shown in Fig 2 and a prototype of the proposed design is shown in Fig. 3. Microcontrollers may work parallel and store several commands in its memory. Here using ARDUINO the automation is done where four level performances is analyzed. LM 383 is used to control the analog output of the main microcontroller circuit.

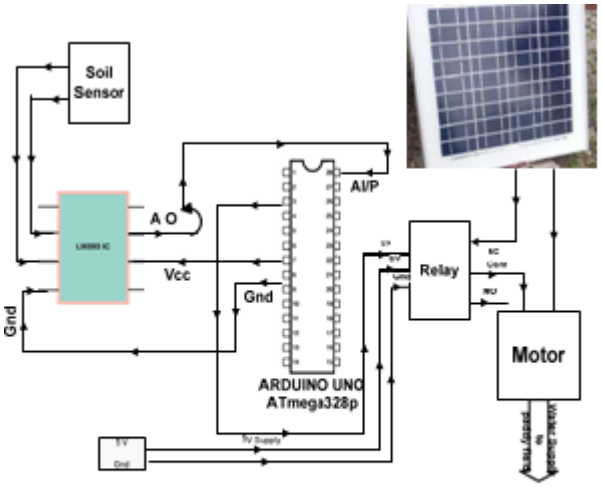

Fig. 2: Basic circuit diagram of the model

Table 2: Description of Components

Sl. No	Item Name	Working hour	Capacity	Total Power
1	PV Plate	Direct Sunlight/day, 5 hrs	10 Watt	500 watt-hr
2	Motor	4-5 hrs	12V, 0.4 A	24 kW
3	Soil Moisture	4-5 hrs	2.5-3 V	
	YL-69			
4	Arduino UNO	4-5 hrs	3.3-5 V, 0.05 mA	1 W <
5	LM 393	4-5 hrs	02-10V, 0.4 mA	1 W <

Table 2 consists of the basic rated components which is used to design the solar power AIS for agricultural applications. The total power consumption of the circuit is very less which is designed for the prototype.

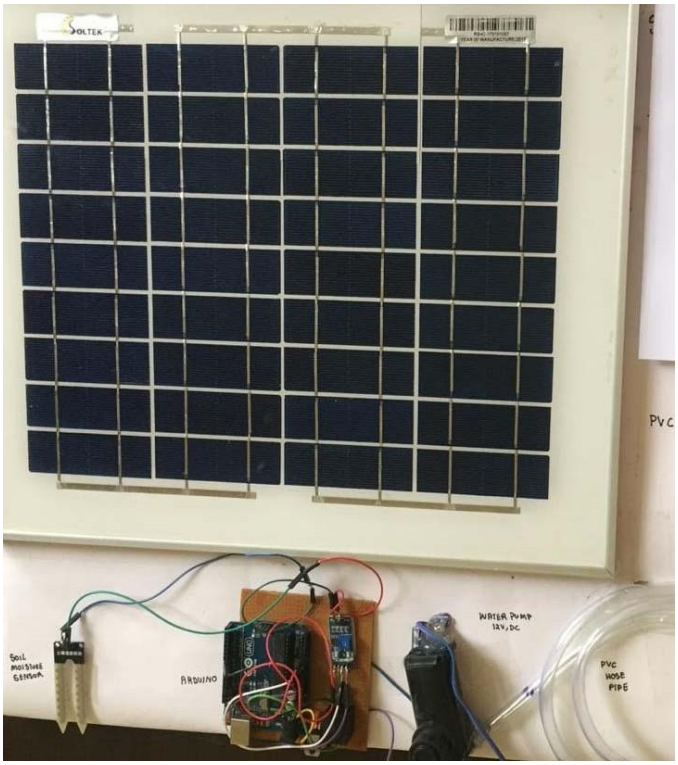

Fig. 3: Prototype of the System

V. OPERATION OF THE CIRCUIT

The YL-69 sensor can observe the level of water present in the soil. With the help of probes current is passed to the circuit of the sensor and it activates the resistance to measure the water level from the working area. When the water level is higher it comes in contact with higher soil conductivity which helps the soil current to resist from the flow of higher current to the receiver of the relay. Now due to the higher level of water the motor current becomes zero and water will not flow through the hosepipe.

The optimum moisture level is kept at 45%, if the soil moisture level shows more than 45% the pump is off hence no water will be supplied to the soil and if the moisture level is 45%, the pump is automatically ON as it is below the threshold level and water will be supplied till it reaches the moisture level of more than 45%.

VI. COST ANALYSIS

A massive number of water sources are used every year in for irrigation and crop production in all over the world, the number of figures is very high and the amount used for water supply is also very high. The renewable source may reduce this gigantic amount of energy and that energy may be preserved for other electrical applications.

After installing this solar powered AIS the payback period of the total project will be very less, almost 2 and a half year. The initial cost may be high to the lower economical county people, but installing such project where the payback period is less is profitable only. Now the excess amount of solar powered AIS may be used for domestic lighting purpose too. Low wattage lights may be used in domestic area, or streetlights to illuminate streets at night time. The major investment will be provided in water pump only, but this kind of automation circuits can be used for parallel controlling of water pumps. So using only one AIS circuit more than two water pumps can be controlled.

Table 3: Bill of Materials

Equipment	Quantity	Cost (Rs)
Solar panel	1	1500
6v Battery	1	500
Soil moisture sensor	1	250
Dc 12 v water pump	1	400
LM7805 ,LM7812	1	180
	Total	2830

VII. CONCLUSION

This uncontrolled fund may be used for electricity generation for the cause of electrifying in un-electrified villages. A huge amount of energy may be spared using renewable energy source. Investment also may be systematic and controlled using non conventional resources. Using non-conventional energy for automation of AIS gives a huge liberty to save energy per year. The excess energy from solar may be fed back to the grid after modification and may cause advantage while payback cost assumption. Automation of the solar powered AIS may be a better solution for the farmers of different regions of India. In any climatic condition this model may be installed and can be making operational. Like the cost effectiveness power consumption of the circuit is also very less.

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REFERENCES

[1] Liserre, M., Sauter, T., Hung, J.Y.,"Future energy systems: integrating renewable energy sources into the smart power grid through industrial electronics", IEEE Industrial Electronics Magazine, Vol. 4, No.1, pp. 18-37, 2010

[2] Saad Motahhir, Abdelilah Chalh, Abdelaziz Ghzizal, Souad Sebti, Aziz Derouich, " Modeling of Photovoltaic Panel by using Proteus". Journal of Engineering Science and Technology Review, Eastern Macedonia and Thrace Institute of Technology, 2017, 10, pp.8 - 13. Doi:10.25103/jestr.102.02.

[3] Chua Hock-Chuan "Getting Started with Arduino" (2016, October 30), retrieve from, https://www.ntu.edu.sg/home/ehchua/programming/arduino/Arduino.html

[4] SparkFun "Voltage Divider" (2016, November 6) retrieves from https://learn.sparkfun.com/tutorials/voltagedividers

[5] Arduino "Overview of the Arduino", (2016, November 21) retrieve from https://www.arduino.cc/en/Main/ArduinoBoard Uno

[6] Mohd Rashid B. Mohd Kamlon, "Solar Power Measurement System", Universiti Teknikal Melaka Malaysia, (2007).