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Solar Powered Irrigation System

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Abstract: India is the country where most of the population depends on agriculture. The proper irrigation system is necessary as to save water wastage. The solar powered irrigation system enables user to monitor the level of moisture in the soil at the different areas of the field and according to measured moisture the water pump is switched on or off automatically. In these system PV cells are used to produce electricity.
Keywords: sensors; GSM module; microcontroller; solar panels

I. INTRODUCTION

Solar energy is the most abundant source of energy in the world. It is a friendly form of energy as well as an answer to energy crisis. In today's world due to technology advancement the cost of the PV panels have decreased. One of the sector where the use of solar energy is increasing is the irrigation sector. This is the reliable way of production of electricity which provide energy for free once an initial investment is made. The decrease of water level from earth can be seen in last few decades due to continuously extraction of water from earth and due to this reason lot of land is shifted towards un-irrigated zone, another reason of this is due to lack of knowledge and unplanned irrigation practices. Population is one of the major problem in today's world, which is increasing rapidly and due to these demand of food is increasing. To maintain these production of food should increase.

II. LITERATURE REVIEW

A. Perception of Smart Irrigation System

This system uses solar power that drives the water from well to tank via water pump. The controller automatically regulates the output valve of the water tank. It also controls the flow amount of water and enhances it for the use of water using moisture sensor. Thus, it needs to be used with available telecommunication technology. Plant growth and their produce are to govern or increased directly or indirectly by automating the agricultural field that monitors and controls climatic parameters

According to National Energy Efficient Agricultures Pump Programme, in India there are around 21 million agriculture pump sets connected to power grid in India. The sector constitutes around 18.5% of India's total energy consumption. This power consumption is expected to rise by an estimated 54% between 2015 and 2022 which must be matched by energy efficiency. Locally made pump sets used for irrigation are both inefficient and unreliable, causing massive water waste and higher energy consumption.

B. The Approached Solution

System Description- Proposed irrigation system consists of two parts, solar pumping and automatic irrigation part. The solar panel are used as a power source. Solar panels are used to charge battery through charge controllers. The power from the battery is then given to motor to run the pump which is submerged inside the bore well.

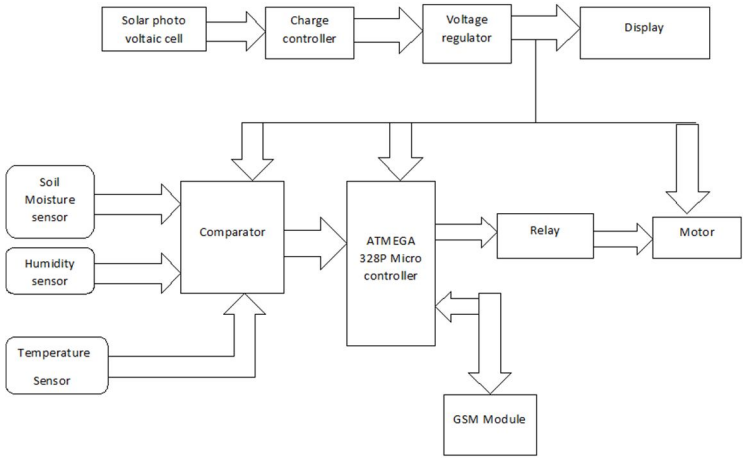

Fig. 1 Block diagram of solar powered irrigation system

Figure 1 shows the block diagram shows the main components used for solar powered irrigation system. The sensors used are soil moisture sensor, temperature sensor, humidity sensor at different location of field where crop is cultivated. The sensor converts moisture content in the soil into equivalent voltage. This is given to sensing circuit which has reference voltage that can be adjusted by farmer according to different moisture level for different crops. The amount of water required depends on the difference of these two voltages, then according to these motor turn ON/OFF is controlled. The GSM module is used so as to provide information of ongoing process on field to the registered user that means temperature, humidity, and timing for which pump was ON.

III. COMPONENT USED

The required electrical and electronic components of this proposed system are

A. Solar Panel

Solar panels are designed with solar cells collected of semiconductor materials. The main function of solar panel is to convert solar energy into DC electrical energy. The required number of cells and also their size depends on the rating of the load. The group of solar cells can generate maximum electricity. But, the solar panel must place closely at accurate angles to the sun rays.

For the implementation of the proposed system we used solar panel PVL-68 that generate 68W rated power.

Specification of solar panel selected:

Short circuit current- 5.1 A

Open circuit voltage -23.1V

Irradiance-580W/m^2

Array capacity-240WP

Load test on a solar panel have been conducted and as shown in table

S. No	Voltage(in volts)	Current (in Ampere)	Irradiance(W/m^2)
1.	5.3	1.48	310
2.	18	3.0	750

B. Charge Controller

In any solar power system, a charge controller is an essential device, used to uphold correct charging voltages of the batteries. The charge controller function is to control the voltage and current from the solar panel. It charges the battery and also halts the battery charging from over voltage and under voltage situations. In these system Sine PWM technique is used to generate 230V A.C.

C. Battery

The Battery is an electric device, used to store solar energy and supplied to the equivalent loads. As far battery is concerned we are using a battery with 12V, 100Ah capacity for a 2HP pump.

D. Moisture Sensor

Moisture sensor measure the volumetric water content in the soil. Soil Moisture Sensor uses capacitance to calculate dielectric permittivity of the nearby medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage relative to the dielectric permittivity, and therefore the water content of the soil. The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of effect with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges. The Soil Moisture Sensor is used to measure the loss of moisture over time due to evaporation and plant uptake, evaluate optimum soil moisture contents for various species of plants, monitor soil moisture content to control irrigation in greenhouses and enhance bottle biology experiments.

E. Humidity& Temperature Sensor

The DTH 11 sensor is used, so as to monitor the temperature and humidity at regular intervals. When sensor senses that value has exceed the particular temperature the circuit sends signal to microcontroller. According to the signal send by the sensor circuit, the decision of the whether to turn motor ON/OFF is made.

F. Relays

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit, when a relay contact is normally open (NO), there is an open contact when the relay is not energized. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. In either case, applying electrical current to the contacts will change their state. Relays are generally used to switch smaller currents in a control circuit and do not usually control power consuming devices except for small motors and Solenoids that draw low amps.

G. GSM Module

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

There are various cell sizes in a GSM system such as macro, micro, Pico and umbrella cells. The security strategies standardized for the GSM system make it the most secure telecommunications standard currently accessible. Although the confidentiality of a call and secrecy of the GSM subscriber Is just ensured on the radio channel, this is a major step in achieving end-to- end security.

Here GSM RS232 is used as to send the information of activities like for what duration pump was ON/OFF, about the humidity and temperature. Through GSM the customer can also send the command so as in case is required to turn ON/OFF the motor.

H. Microcontroller (ATMEGA328P)

The high-performance Microchip Pico Power 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

I. LCD Display

The standard liquid display used in the work is HD44780U, it is 16*2 Display i.e. 16 Character per 2 lines. The LCD displays the numeric value of moisture, humidity, temperature and also displays the motor turn OFF/ON state.

IV. FLOW CHART

The flow chart was prepared on basis of programming that is used for these solar powered irrigation system irrigation

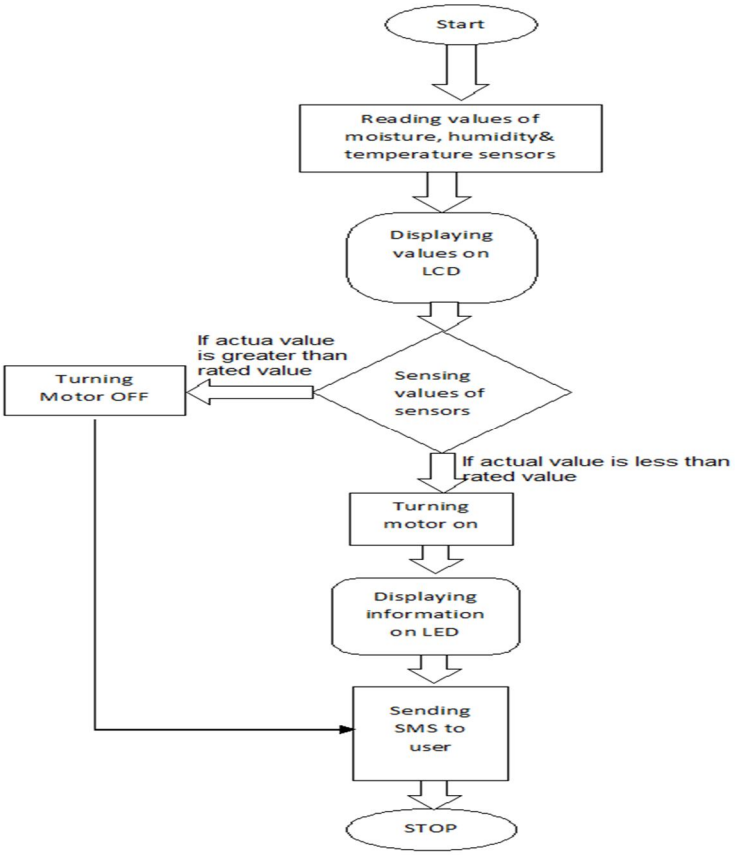

Figure 2 Flow chart of solar powered irrigation system

In the process, there are principally two edge values i.e. upper and lower. The process carries these 2 values and are set by user. The actual value of water content in soil is read by the moisture sensors which are immersed in soil and the temperature and humidity of different part of field is measured by humidity& temperature sensors present. The process compares this value with the two user defined edge values. In the first place the temperature and humidity of soil are taken under note and according to that the process move further. If actual value happens to be below than the lower edge value, the code will generate a signal that will turn motors on. The process will be self-directed and the withered part of soil gets nourished. The values of moisture level are constantly compared with the edge values in process and if actual moisture value crosses the upper edge values then motor will be turned off.Fig.2 represents the basic flowchart diagram of this project. The process starts with sensors reading the value and displaying them on LCD. As the value of moisture falls below the lower rated edge point, the motor starts and if the content climbs the upper edge value the motors shuts off. In either case, user will get a SMS first of undergoing process. The status of motors is also displayed on LCD.

V. RESULT

The system at the time of test was able to function as expected and as observed the sensitivity of sensor was affected by temperature during checking of soil moisture level and the set moisture edge values were able to trigger the pump ON/OFF automatically. The system was however, able to send SMS to the user and LCD system was also displaying the numeric values of humidity& temperature and also indicating the turn ON/OFF of the pump. Similarly, the pump was also responding to the SMS command to turn the irrigation pump ON/OFF when required as per user requirement.

VI. FUTURE SCOPE

A. Rain sensors can be added so that when it rains there won't be floods and this shield the field and evades flood.
B. Smart solar tracker can be used so as utilize the solar power to maximum.
C. IR sensors can be used so that any entity passing into field can be sensed and warned.

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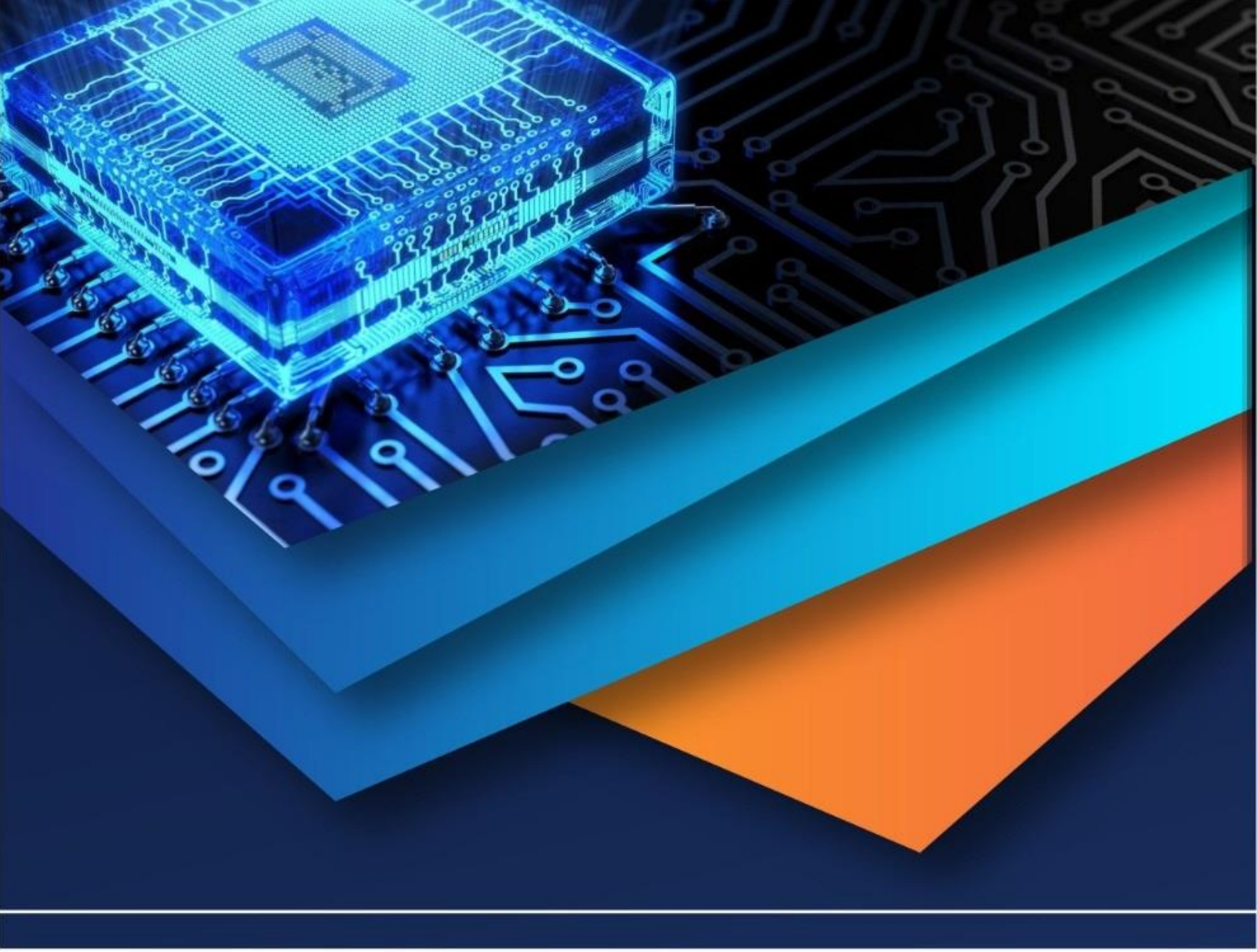

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