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Effective Irrigation Using SOLAR Based Water Pump with Automatic Switching

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ABSTRACT

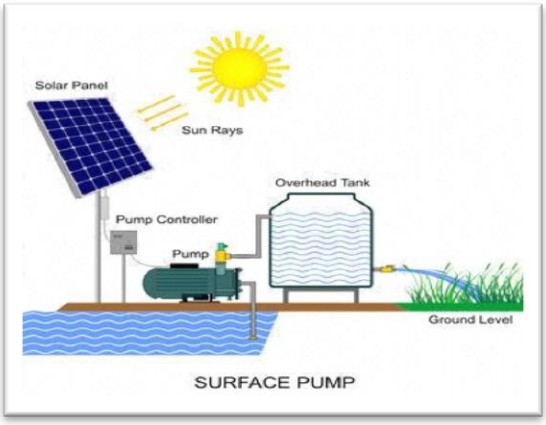
The increasing demand for energy, the continuous reduction in existing sources of fossil fuels and the growing concern regarding environment pollution, have pushed mankind to explore new non-conventional, renewable energy resources such as solar energy. In India most of our agriculture water demand is fulfilled from rainwater. Therefore, efficient water management plays an important role in irrigated agricultural cropping systems. Energy of pumps used for the agricultural irrigation is generally provided from electrical energy or fossil fuels. In this project an automatic system is designed which controls the time of operation of water pump for irrigation in agriculture systems. This system consists of solar powered water pump along with an automatic water flow control using a microcontroller 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.

Keywords: Solar Water Pump, Smart Irrigation, Dc Motor, Pumping

I. INTRODUCTION

In this project we are using solar energy for operating water pump in agricultural area instead of using conventional electricity from state electricity board. This has advantage of saving of energy bills. We also using a microcontroller circuit with an RTC chip which operates the pump in several time zones. Energy generated by solar panel is stored in batteries during the day time for it to be utilized to run water

pump. This project deals with a controlled charging mechanism with protections for over charge, deep



discharge and under voltage of the battery. The project is designed to operate water pump at different time slots.

figure 1.1 proposed system

The Timing control is achieved by a RTC (Real time clock) IC which is initiated with microcontroller. It overcomes the difficulties of switching the pump ON/OFF manually. hence by using Solar power saving of electricity and water both are possible and by control circuit automatic operation can also be possible.

Block Diagram:

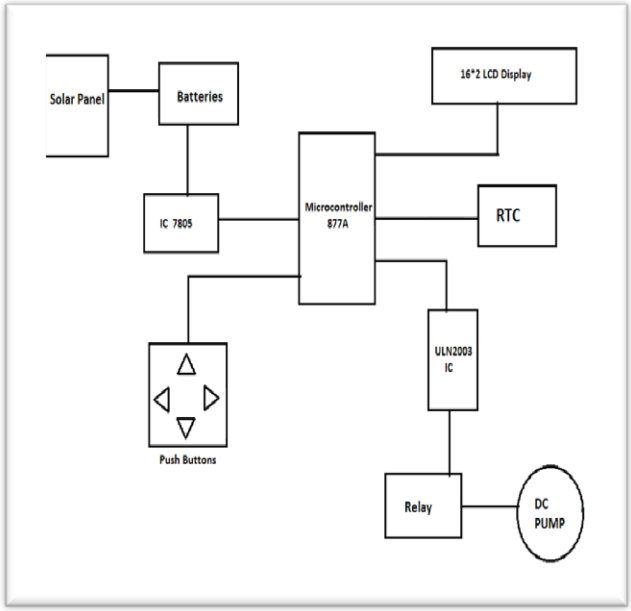


Figure 1.2 Block Diagram

Operation:

Figure.1.2 shows the block diagram of low a effective solar irrigation system. By using this block diagram, we can understand whole process of system step by step.

- First the battery is charged via the output power from a solar module of 15 watts. When sunlight is not sufficient to generate enough power for charging battery, then battery can be charged with an external power supply which is a DC. The charging mechanism for battery is selected by means of a two-way switch.
- The output voltages of battery is stepped down to 5 volts and given to the controller circuit which operates on 5 volt.
- In control circuit includes a PIC controller 87AA interfaced with a RTC chip, a 16*2 LCD Display and a keypad.
- RTC chip generates real time signals like any other clock. This time is indicated on a 16*2 LCD display.
- The operating time for pump is set by using a keypad and display.
- The microcontroller is programmed in such way that it gives the output signal to voltage driver IC for a preset time period entered by the operator.
- Hence the voltage driver IC gives signal to the relay and relay operates pump for the preset time.
- After the preset time limit is over, microcontroller senses the RTC and cuts off the signal from voltage driver.
- Finally, pump is isolated from the supply.

Circuit Diagram:

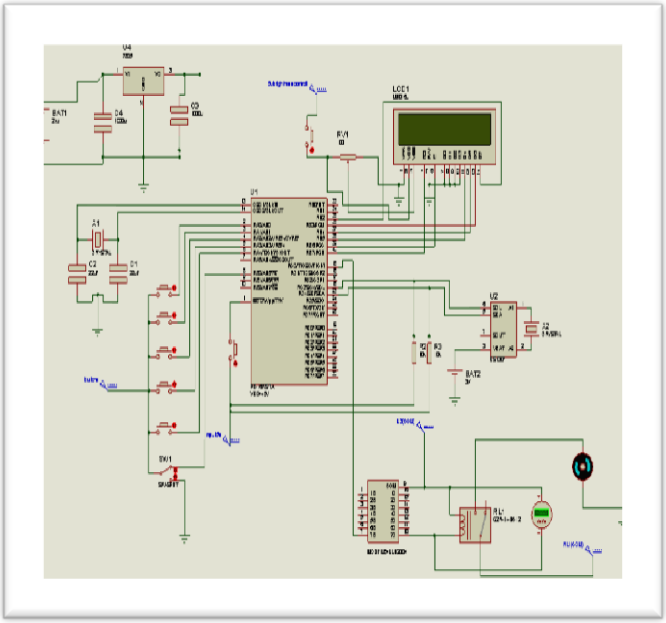


Figure 1.3 Proteous Simulation

The above fig shows the Proteous simulation of the system.

II. METHODS AND MATERIAL

Materials and tools required:-

- Solar Module (15watts)
- Rechargeable DC battery (12volts, 7Ah)
- Charge controller
- Two-way switch
- DC Motor (12Volt)
- Pump section
- Controller Circuit
  - Microcontroller 877A
  - 7805 IC
  - ULN 2003 IC
  - Resistor
  - Capacitors
  - Diode
  - Push button switches
  - Toggle switches
- AC/DC converter
- 16 * 2 LCD Display
- RTC chip (Real Time Clock)
- Battery clamps
- PCB
- Sockets (40 pin,18 pin)
- relay
- Connecting wires
- Fuse
- Metal frame
- Nozzles
- Valve

Actual Implementation:

- We made a metal frame structure for our project with help of a welder.
- To mount the pump and motor a frame is made by joining metal angles.
- The motor and pump set is mounted on structure and welded to the angles. For a stable operation.

Avoiding to mount pump on ground level, this type of arrangement is advantageous and good in appearance.

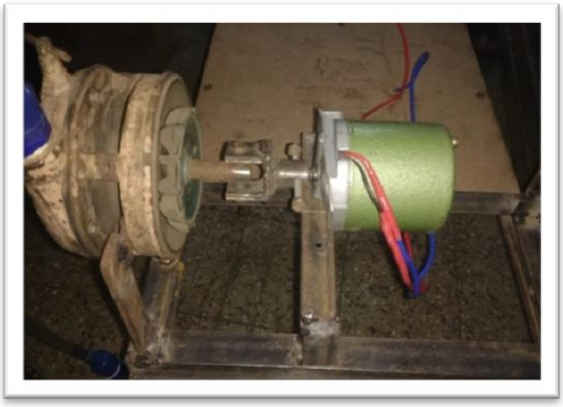


Figure 2.1. structure of Pump mechanism (hardware model)

WHY WE CHOOSE OFF GRID SYSTEM?

This pump controller can be used for both ON Grid and OFF grid irrigation systems.

We choose off grid configuration for hardware model.

The off grid system has following advantages over on grid system:

1. The main advantage of an off grid system is that we can store the generated power, and we can use the stored power for other loads. E.g., when the pump doesn't need the supply, we can use the stored energy for operating the household and appliances like Tube lights, fans, TV etc.
2. With off grid system we can use the DC pumps, DC motors are more efficient and if we use brushless motor then the life of pump is also increased. Also there is no need of inverter circuit for DC pumps.
3. In off grid system, we can also use the stored energy at night time, hence energy is available 24 hours.
4. If the atmosphere is cloudy and solar power is not available, then we can charge the batteries with external power source and run the pump.

5. The solar panels required in OFF grid systems for the same capacity of pump is less than required in ON grid system. Hence the initial cost is decreased.

By considering all above factor we decided to design a hardware model of a low capacity off grid system with a DC Pump of 0.5HP and a Solar module of 15 watts as a model for operating the pump in time zones.

III. RESULTS AND DISCUSSION

Pump:

We bought a 12v DC motor from market and connected it to an old pump section of an AC pump.

Hence we can operate the pump by DC supply.it is economic and efficient.

Figure 3.1. Pump Construction (hardware model)

We connected The shaft of DC motor with the pump shaft by welding it with a coupler mechanism and bolts.

FINAL STUCTURE:

Figure 3.2 Final Structure

- We also constructed an axially rotating structure for solar module.
- All the above components are combined and welded on the metal frame shown in above figure

CIRCUIT:

Figure 3.3 Final Circuit of the system

Benefits of Solar Pump over DG pump set:

- In rural areas where electricity is not available. The other option for irrigation is DG pump set.
- Though the initial cost of a DG pump set is much lower than the initial cost of solar pumping system, there is several disadvantages of DG pump as they make noise and air pollution and rates of diesel is also increased day by day.

TYPE	Capital cost	Net Maintenance	Net Fuel Cost	Total
SPV Pump	2,00,000	3,0,72	Nil	2,03,072
Diesel Pump	25,000	13,000	2,78,993	3,16,282

Table 1. comparison of DG pump set and solar pump

Assumptions	**Cost**
Cost of 1HP diesel pump set	Rs.25,000
Cost of equivalent Solar PV Pump(without subsidy)	Rs.2,00,000
No of operating hour per year(200 days * 5 hours/day)	1000 hours
Cost of diesel per liter	Rs.60
Fuel Consumption per hour for 2 KVA DG set	0.75 liters
Average increases fuel price per annum	5%
Maintenance cost/year for diesel pump	Rs.2000
Maintenance cost/year for solar pump	Rs.500
Life cycle period (in years)	10 years

Table 2 Total expenditure after 10 years of operation

As shown in table 3 and table 4. If we consider a life span of 10 years for both irrigation methods, Solar pumping system is economic and has less maintenance

IV.CONCLUSION

As we know in current days' power supply problems are severe in agriculture areas, hence by using a renewable energy source for agriculture loads and pumps the energy can be saved.

Also the problem of manually operating the water pump is also solved by using the RTC and Microcontroller circuit. We can operate the pump by predefined time slots. Which makes the operation very easy and reliable as compared to the existing system. This system can be improved by implementing GSM module and soil moisture sensor into the existing system.

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