Solar Water Pumping System with Automation

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***Abstract*: Electricity is one of the major parameters for making growth and development of a country. The increasing demand for energy, the continuous reduction in existing sources of fuels and the growing concern regarding environment pollution, have pushed mankind to explore new non-conventional energy, renewable energy resources such as solar energy. Solar energy is mostly available and it is a clean source of energy in the whole world. In India, most of our agriculture water requirement is fulfilled from rainwater. As per land is concerned, India has the second largest available agricultural ground in the whole world. Still the problem of electricity not resolved. Most of the users (farmers) are not getting electricity for their agriculture field. The transportation and condition of roads is also hurdling in the development of agriculture. In this paper, we are discussing about the irrigation techniques available for the users (farmers). The main objective of this paper is to provide solar operated water pump which is controlled by GSM module with solar tracking to maximize efficiency. This minimizes the human effort of users (farmers) in the remote places. Users (farmers) can control all irrigation operations through mobile device.**

***Keywords*: Solar Energy, Water Pump, Agriculture, Automation, Irrigation**

Introduction

Population wise India stands 2nd in the world. The primary source of income for most of the population is still farming in India. Current agriculture systems are operated manually which consumes huge amount of time, money and energy. In India there is huge difference between total power supply & demand to the farming. In many areas power cut down continues for more than 8hrs. The current technology uses fossil fuel in many parts of India, which creates air pollution. So, it better to use renewable source of energy government also encourages its use in various sectors, including automation irrigation system for the farming. The main objective of paper is to design GSM module based Solar operated water pump use for the farming which uses Solar panel to the drive water pump. For the maximum efficiency of solar panel we use solar tracking technology The pump is control by DOL (Direct On Line) starter and it is operated through GSM module or we can use automatic starter. So this irrigation system can be operated from anywhere. The whole irrigation system is operated by the GSM and electricity is supplied to water pump by solar energy.

Literature Review

[1] A review of current status of solar photovoltaic water pumping system technology research and applications is presented. The study focuses on update on solar water pumping technology, economic evaluation, environmental aspects and recent advances in materials and efficiency improvement of photovoltaic technology and experience of using solar PV pumps worldwide. Agricultural techniques are changing speedily because of current advancement in renewable energy technology. The current advancements in renewable energy can be successfully applied in the agriculture sector to minimize dependency on conventional crops irrigation techniques. Fields and crops irrigation are usually performed by water pumps (runs on fossil fuels) which can lead to environmental damage and high agricultural costs. The humidity sensors and global system for mobile (GSM) module are installed for automation and wireless control of irrigation to reduce manpower needs.

[2] The paper has discussed about the possibility of implementing a solar based smart irrigation system which has been tested in lab and is to be taken to a village in Coimbatore, India. A system with a solar panel, moisture sensor, Arduino Microcontroller Unit and battery is implemented and tested in the lab. The power requirements for the area of the irrigation field we are covering is calculated and accordingly number of solar panels, battery, microcontroller units, wireless interface modules and moisture sensors are decided. Because of the variable atmospheric situation these conditions sometimes may vary from place to place in the huge farmhouse that makes very difficult to maintain the uniformity at whole places in the farmhouse manually. It is observed that for the first time an android phone-control the Irrigation system, which could give the facilities of maintaining uniform environmental conditions are proposed.

[3] In this proposed system we utilize the solar energy from solar panels to pump water from bore well directly into a ground level storage tank based on the intensity of sun rays. The water is pumped into a ground level tank from which a simple valve mechanism govern the flow of water into the ground. This saves enormous 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 ground depending upon the moisture fulfillment of the ground. In this system we use a soil moisture sensor that detects the amount of moisture content in the soil. Transportation of renewable energy system such as photovoltaic (PV) pumps, is much easier than the other types because they can be transported in pieces. The life cycle cost analysis that covered both the systems proves that the PV water pumping system is more economical prior over the diesel water pumping system. This method was suitable for determining the size and thus applicable for these solar powered irrigation systems since the cost of photovoltaic (PV) systems is fairly high.

[4] In this project we developed Solar Tracking for an automated water pump in this project water pump automatically get operated by using soil moisture sensor, here the solar panel is auto tracking which rotate as per the direction of sun. This solar tracking

system uses the sunlight for pumping the water to agricultural grounds and farm, when pumping operation not taking place the energy can be stored in battery for other application.

[5] This paper presents a low cost automated solar water pumping system for irrigation in developing countries. The programmed sensor module recognize the temperature, humidity, soil moisture content and sends the information to ESP32 microcontroller. A water level sensor also detect the water level and sends the data to the microcontroller unit. Based on the information and boundary conditions, the microcontroller decides either to start or to stop the pump motor. This paper also describes how to decide soil moisture limits for a particular type of soil. The ESP32 microcontroller also sends information to the web server so that the user can see. The user can operate the irrigation system far from the field by a simple click on a cell phone. A manual switch ON/OFF system is also include into the proposed design.

[6] As we know that agriculture technology is changing rapidly so applications suitable are numerous. Basically these applications have mix of individual installations and system installed by utility. Each solar cell has prepared layers of semiconductor material produces DC.

[8] Scarcity of electricity with that high cost of diesel affects the water supplies and irrigation. So, Solar energy for water pumping is promising options in terms of conventional energy. Using PV technology we can save water as without proper technique we waste lots of water. Along with that various socio-economic aspects of surroundings commodities are taken care of.

[9] This paper is designed for low cost irrigation pumping system. The programmed sensor module detects the temperature, humidity, soil moisture level and sends the information to ESP32 microcontroller. This paper also describes how to decides oil moisture limits for a particular type of soil.

[10] The problem of manually operating the water pump is also resolved with the help of the RTC (Real Time Clock) and Microcontroller circuit. We can control the pump by predefined time slots. that makes the controlling very easy and reliable than the existing system. This system can be improved through implementing GSM and soil moisture sensor into the prevailing system.

Components
This project has to be done both on software and hardware. The required components are as follows:
Solar Panel, LDR sensors Battery, Arduino, Relay, Motor driver, Stepper motor, GSM Module, Soil moisture sensor, LCD Display

Solar Panel:
It is the device which changes the photon energy into electrical energy. The energy by the panel get stored in battery.


Fig. 1

Charger Circuit:
As we know the energy provided by the panel is variable, so the charger circuit provided in the system protects battery from fluctuating potential difference and hence, improves life of battery.

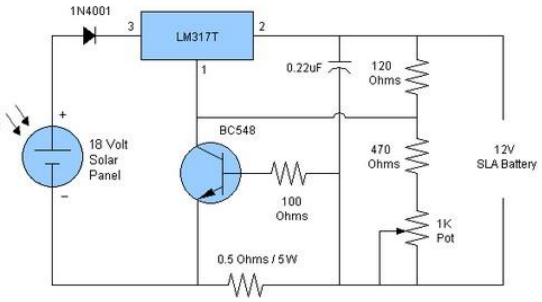


Fig. 2

LDR (Light Dependent Resistor):
It is the photo sensor which senses the intensity of light and according to that the panel rotates in maximum intensity of light direction. It is placed on panel in east-west direction. It is controlled by microcontroller.

Fig. 3

Arduino:
It is a microcontroller board based on ATmega328. It reads the input signal and according to the input value it controls the various operation such as starting motor, sending message through GSM.

Fig. 4

Motor Driver:
It basically controls the direction of motor as per the instruction given by microcontroller based on the information provided by light sensors.

Fig. 5

Stepper Motor:
It is fitted on solar panel so that it moves in the direction of maximum luminous intensity as per information provided through light sensors.

Fig. 6

Relay:
It is a programmable switch which can be controlled by Arduino. It works on low voltage.

Fig. 7

Water Pump:
It is a submersible pump which is controlled by Arduino through relay.

Fig. 8

GSM Module:

It is a chip that helps to communicate between the system and mobile device. Here, it takes the information from Arduino and sends the information to the users mobile device.

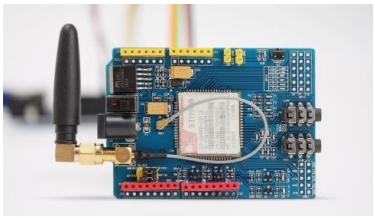


Fig. 9

Moisture Sensor:

Moisture sensor measures the moisture content in the soil and sends the information to microcontroller according to which ON and OFF operation of system.

Fig. 10

LCD (Liquid Crystal Display):

It display all the values provided by sensors present in the system.

Fig.11

Working & Principle

The fundamental structure of the system is divided into two basic circuit. The first one is the circuit that supply the required power to the system by the use of solar tracking. Another circuit is related to sensory network required in the system. Initially, as soon as the photovoltaic panel exposed to sunlight the two LDR sensors use in the circuit becomes active through microcontroller. Both LDR senses the luminous intensity and decides which sensor receives maximum luminous intensity. The panel starts moving according to the maximum intensity receiving sensor through stepper motor driven by motor driver which is connected through microcontroller. The maximum power received by the photovoltaic panel is stored in battery. But for the protection of battery, the variable electrical energy received through panel passes through the charger circuit. The energy stored in battery is used for running submersible pump. In the second part we are completely focused on making irrigation system automated. For this we have used GSM module and Soil Moisture Sensor. For the automation, the soil moisture sensor is placed in farming land and is connected through microcontroller. Sensor senses the moisture in the soil and sends the data to microcontroller. Microcontroller activates the GSM module which sends the SMS to the user for turning ON or turning OFF according to the moisture value. Here user have the option for OFF and ON of pump by just sending an SMS to the module from any location.

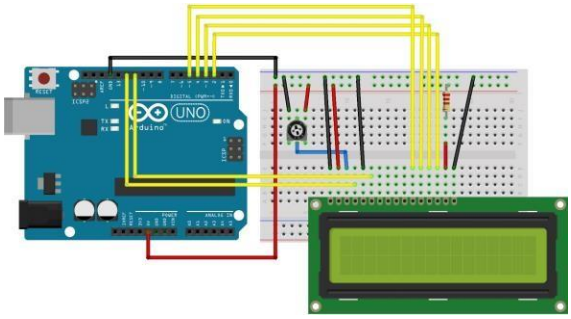


Fig. 12 - Connection of LCD with Arduino

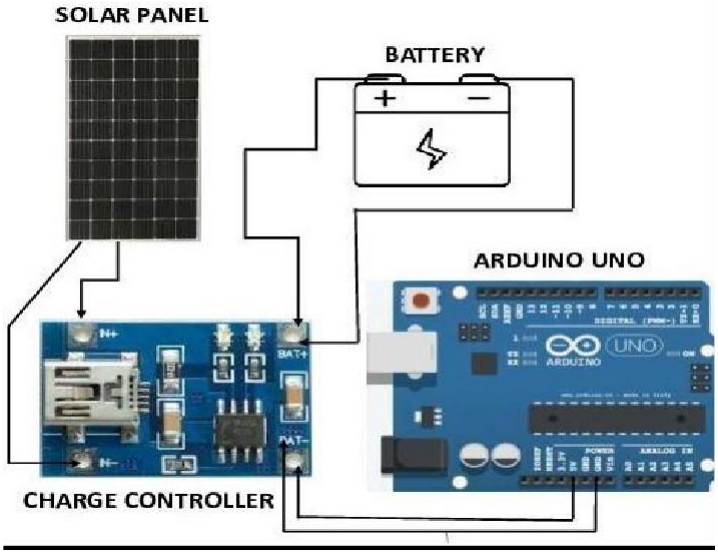


Fig. 13 - Charge Controller Connection

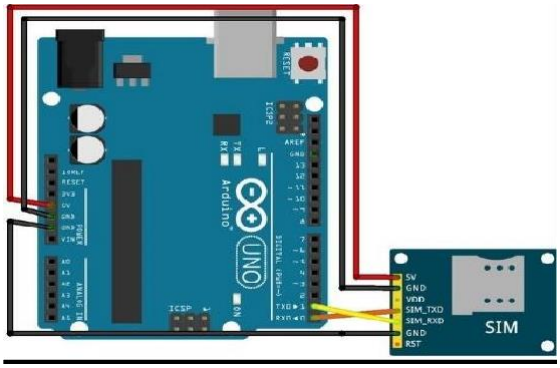
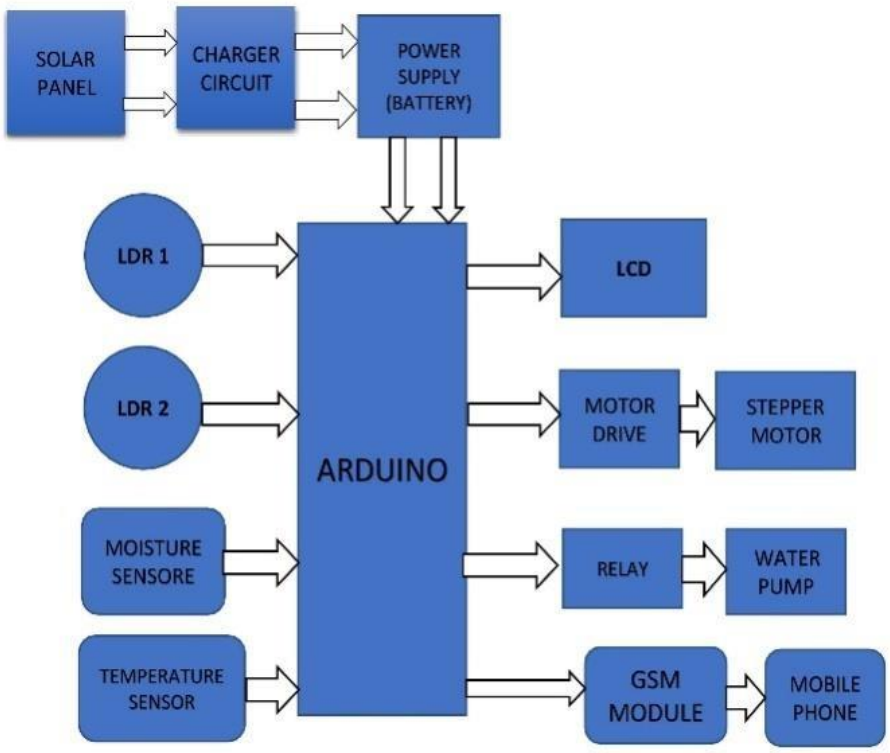


Fig. 14 - Connection with GSM

Block Diagram



Objective

- To design a water pumping system for irrigation that uses solar energy for its operation.
- To design a pumping system that minimizes human interventions.
- To design a water supply system that makes irrigation more efficient.

Merits

- Zero fuel costs
- Less labour & maintenance
- Environmental friendly
- Saves time & water
- Adaptable
- Convenient & Efficient

Applications

- Useful Irrigation in Fields
- Useful Irrigation in Gardens, Parks
- This Irrigation System is very efficient for Paddy Fields
- Household purpose

Future Scope

The above system can be further enhanced by the technology which predicts the weather and irrigate the plants crops accordingly. On raining forecast, lower amount of water is supplied for the agriculture land. Automatic carrying of plants will be done. Plantation will be successful in less water quantities. Surrounding balancing like tree plantation & saving trees category of activities will become come easy once applied. This is possible to pumping the water through solar energy.

Conclusion

As we know in India there is large part of population living in village which are totally dependent on agriculture for their earning. So for the betterment of crop water irrigation process is important, but in some areas due to lack of electricity farmers are not able to irrigate their fields timely. Also in some areas farmers does not know the amount of water needed to the crop. So the above automated system of irrigation helps farmer to control the irrigation process from any remote location. This technology also helps in proper management of water and time. There is huge reduction in burden of farming work. Farmers are less dependent on grid for electricity. This system improves growth of crops and increase crop yield which helps in economic growth of country.

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