# Solar Power Based Water Pumping System with Automatic Irrigation Using Wireless Technology

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**ABSTRACT:** Solar energy has emerged as viable source of renewable energy over the past few decades and is now used for various applications such as emergency lighting, water heaters and industrial application. This project proposes a solar based automatic irrigation system. The main objective is to design a low cost and time based irrigation system with the help of microcontroller. Irrigation scheduler measures various parameters such as humidity, temperature and soil moisture. This automatic irrigation system uses alternative energy that drives water pump to pump water from bore well to a tank and therefore the outlet valve of tank is automatically regulated exploitation controller. In this irrigation system the irrigation pump controlled in two modes: Automatic mode and WIFI mode.

**KEYWORDS:** Solar photovoltaic, water pumping system, irrigation, photovoltaic (PV) pumping

## I.   INTRODUCTION

Solar energy is the most abundant source of energy in the world. Solar power is not only an answer to today's energy crisis but also an environmental friendly form of energy. Photovoltaic (PV) generation is an efficient approach for using the solar energy. Solar panels (an array of photovoltaic cells) are now extensively used for running street lights, for powering water heaters and to meet domestic loads. The cost of solar panels has been constantly decreasing which encourages its usage in various sectors. One of the applications of this technology is used in irrigation systems for farming. Solar powered irrigation system can be a suitable alternative for farmers in the present state of energy crisis in India. Today the generation is heading towards ultra technologies. Water pumping has a long history; so many methods have been developed to pump water. People have used a variety of power sources, namely human energy, animal power, hydro power, wind, solar and fuels such a diesel for small generators.

## II. EASE OF USE

### A.  *Photovoltaic cell*

A photovoltaic cell is a stack of thin layers of semiconductor materials which exhibit the photoelectric effect, such as silicon or cadmium telluride. The layers contain small amounts of doping agents (intentional impurities), such as the element germanium. The dopants give the semiconductor the ability to produce a current when exposed to light. Typical cells convert about five to fifteen percent of the solar energy they receive into electricity, depending on the type. Solar cells are mounted into groups called modules since each cell produces only a small amount of electricity, typically 0.5 Volts. The module provides the combined current from all the cells. Modules power lights and appliances.

Photovoltaic systems sometimes have two additional components to complement the solar modules: an inverter and a storage device. Since solar cells produce direct current (DC) and most conventional equipments operates on alternating current (AC), an inverter is used to change the DC current to AC current. The energy is stored for use during overcast periods and at night. The energy can be stored as chemical energy in batteries, or as potential energy in pumped water or compressed air. As an alternative to on-site storage, a photovoltaic system can be made *utility interactive*. Interactive systems are connected to the power company's lines so the utility can provide "make-up" power when solar radiation is low. Conversely, when the PV modules produce more power than is needed at the site, the excess is fed back to the utility grid. This causes the electric meter to run backwards, offsetting the cost of the "make-up" electricity.

### B. System components

The whole system of solar pumping includes the panels, support structure with tracking mechanism, electronic parts for regulation, cables, pipes and the pump itself.

**i) Solar panels or modules:** Solar panels are the main components used for driving the solar pump. Several solar panels connected together in arrays produce DC electricity, interconnections are made using series or parallel combinations to achieve desired voltage and power for the pump.

**ii) Solar pump:** Centrifugal or submersible pumps are connected directly to the solar array using DC power produced by the solar panels. Solar pumps are available in several capacities depending upon the requirement of water.

**iii) Support structure and tracking mechanism:** Support structure provides stability to the mounted solar panels and protects them from theft or natural calamities. To obtain maximum output of water, a manual tracking device is fixed to the support structure. Tracking increases the output of water by allowing the panels to face the sun as it moves across the sky.

**iv) Foundations (array and pump):** Foundations are provided for support structures and pump.

**v) Electrical interconnections:** A set of cables of appropriate size, junction boxes, connectors and switches are provided along with the installation.

**vi) Earthing kit:** Earthing kit is provided for safety in case of lightning or short circuit.

### III. DESCRIPTION OF COMPONENTS

### C. Photo voltaic cells

The photovoltaic (PV) effect is the basis of the conversion of light to electricity in photovoltaic, or solar, cells. Described simply, the PV effect is as follows: Light, which is pure energy, enters a PV cell and imparts enough energy to some electrons (negatively charged atomic particles) to free them. A built-in-potential barrier in the cell acts on these electrons to produce a voltage (the so-called photo voltage), which can be used to drive a current through a circuit.
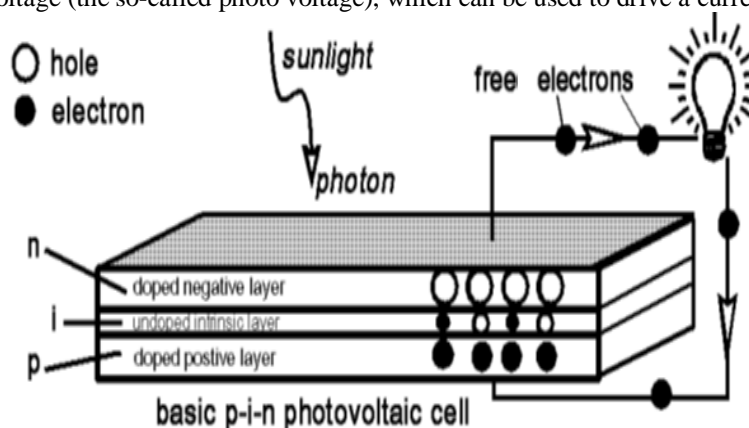


**Fig 1: Principle of Photovoltaic cells**

### D. Solar Battery Charger Circuit Principle

Solar battery charger operated on the principle that the charge control circuit will produce the constant voltage. Thecharging current passes to LM317 voltage regulator through the diode D1. The output voltage and current areregulated by adjusting the adjust pin of LM317 voltage regulator. Battery is charged using the same current.
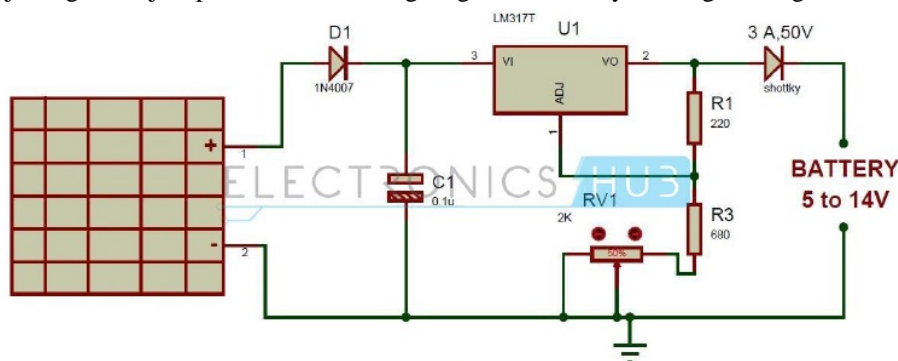


**Fig 2: Solar energy to storage energy**

### E. Voltage Regulator

An input (5V) from the battery is given to the 7805 Voltage Regulator IC. 7805 IC then converts this to a regulated 5V DC and the output can be obtained at its output terminals.

### F. Arduino Uno Board

Arduino is an open source physical processing hardware, which is based on a microcontroller board and an incorporated development environment for the board to be programmed. Arduino is simple and can be easily learned by beginners. Arduino can runs on any platform that includes Windows, Linux Operating System, and Macintosh, unlike other microcontrollers, which run only in the Windows operating system.

The Arduino can be used to develop an interactive interface, get inputs from a diverse collection of switches as well as sensors, and simultaneously control the output from various physical devices including lights and other appliances. Arduino is focused on an environment, which needs to be programmed with a language that is executed via wiring: a physical computing platform.

### G. BLDC Motor

A motor converts supplied electrical energy into mechanical energy. Various types of motors are in common use. Among these, brushless DC motors (BLDC) feature high efficiency and excellent controllability, and are widely used in many applications. The BLDC motor has power-saving advantages relative to other motor types.

### F. ESP8266

1. Processor: L106 32-bit RISC microprocessor core based on the Tensilica Xtensa Diamond Standard 106Micro running at 80 MHz
2. Memory:

   – 32 KiB instruction RAM

   – 32 KiB instruction cache RAM

   – 80 KiB user-data RAM

   – 16 KiB system-data RAM

3. External QSPI flash: up to 16 MiB is supported (512 KiB to 4 MiB typically included)

4. The **mebibyte** is a multiple of the unit byte for digital information. The binary prefix mebi means $2^{20}$; therefore one mebibyte is equal to 1048576 bytes = 1024 kibibytes. The unit symbol for the mebibyte is **MiB**.

5. 16 Bits GPIO pins and SPI.

6. I²C (software implementation) and 10-bit ADC (successive approximation ADC)

### G. Battery

Batteries used in home energy storage typically are made with one of three chemical compositions: lead acid, lithium ion, and saltwater. In most cases, lithium ion batteries are the best option for a solar panel system, though other battery types can be more affordable. Lithium ion,

- The majority of new home energy storage technologies, such as the , use some form of lithium ion chemical composition.

- Lithium ion batteries are lighter and more compact than lead acid batteries. They also have a higher DoD and longer lifespan when compared to lead acid batteries.

- However, lithium ion batteries are more expensive than their lead acid counterparts.

### H. Soil Moisture Sensor

The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.

When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower. This sensor can be connected in two modes; Analog mode and digital mode. First, we will connect it in Analog mode and then we will use it in Digital mode.
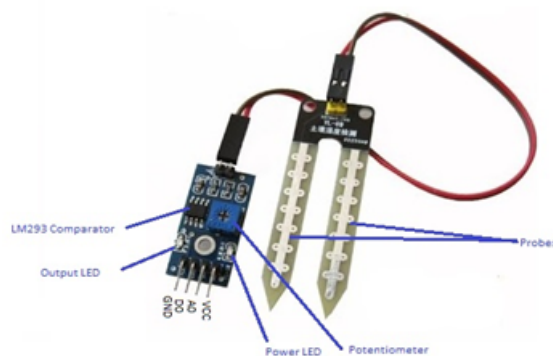


**Fig 3: Soil Moisture sensor**

### I. Water Level Sensor

A water level indicator is a sensor that relays information back to a control panel to indicate whether a body of water has a high or low water level. Some water level indicators use a combination of probe sensors to sense water levels. Most water level indicators are used to manage water levels in a water tank. The control panel can also be programmed to automatically turn on a water pump once levels get too low and refill the water back to the adequate level.

## J.  Solenoid Valve

A **solenoid  valve** is  an electromechanical device  in  which  the solenoid uses  an electric  current to  generate a magnetic field and thereby operate a mechanism which regulates the opening of fluid flow in a valve.

Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control.

The mechanism  varies  from  linear  action,  plunger-type  actuators  to  pivoted-armature  actuators  and  rocker actuators. The valve can use a two-port design to regulate a flow or use a three or more port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

## K.  LCD Display

A **liquid-crystal  display** (**LCD**) is a flat-panel  display  or other electronically  modulated optical device that uses  the  light-modulating  properties  of liquid crystals. Liquid crystals  do  not  emit  light  directly,  instead  using a backlight or reflector to produce images in color or monochrome.[1] LCDs are available to display arbitrary images (as in  a general-purpose computer display) or fixed images with low information content, which can be  displayed or hidden,  such  as  preset  words,  digits,  and  seven-segment  displays,  as  in  a  digital clock. They use  the  same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement.
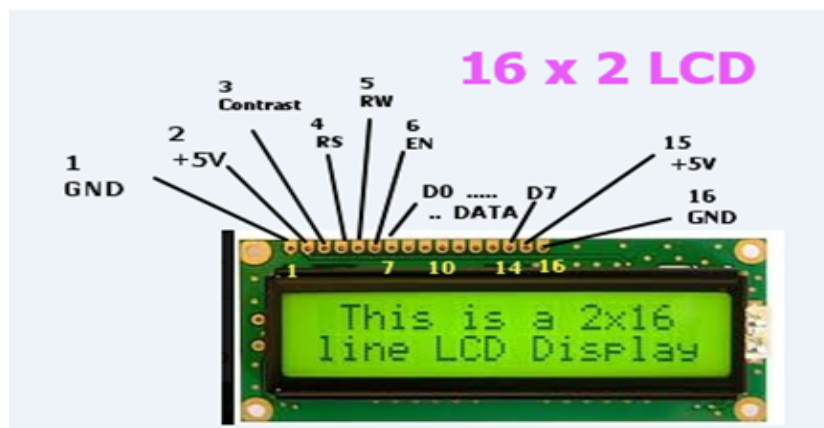


**Fig 4: Liquid Crystal Display Pin Configuration**

LCDs are used in  a wide range of  applications,  including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage.

## L.  Motor Driver Circuit

L293D  is  a typical Motor driver or Motor Driver IC which allows DC motor to drive on either  direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC.
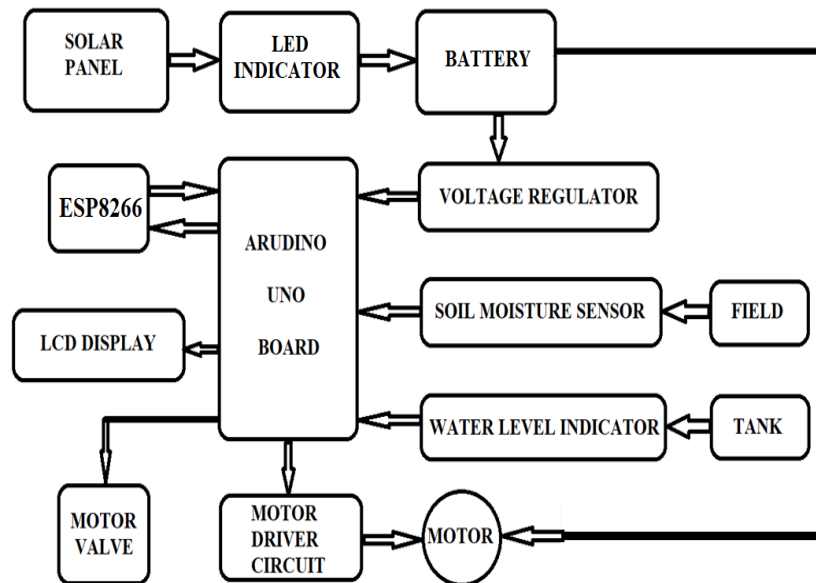
## IV. BLOCK DIAGRAM



**Fig 5: Block Diagram of system**

## V. ADVANTAGES

- It helps in saving Energy.

- There is no fuel cost - as it uses available free sun light.

- No electricity required.

- Can be operated lifelong.

- It works everywhere.

- It is also useful for clean, drinking water sanitation and also irrigation.

- The dependence on rain is reduced.

- It creates wealth for farmers by increasing no of crops.

## VI. APPLICATIONS

- Agriculture livestock watering / crop irrigation, home gardens and drip irrigation systems.
- Domestic portable water for remote homes, campgrounds.

- Pond water management and water transfer.

- Water supply for villages in developing world.

- 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.

## VII. CONCLUSION

By using the automatic irrigation system it optimizes the usage of water by reducing wastage and reduce 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. Minimal maintenance, manual interaction and attention as they are self-starting. In long run this system is economical.

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