Scientific Journal of Impact Factor (SJIF): 5.71
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 04, April -2018

SOLAR WATER PUMP CONTROL WITH DIFFERENT TIME SLOTS

Pingale A.R.[1*], Jamdhade K.N. [2], Satalkar A.N. [3]

[1,2,3]*Department of Electrical Engineering, Savitribai Phule Pune University,Maharashtra, India*

Abstract - *Solar energy is converted into electrical energy by using photovoltaic cells. During the daytime, the energy stored in the batteries can be utilized to run water pump for agriculture. This project aims at developing a controlled charging mechanism providing protections for overcharge condition, deep discharge condition and under voltage state of the battery. This proposed system will be comprised of a DC pump which reduces the use of inverters etc, therefore reducing the cost of the project. Using the charge-controlled mechanism; the water pump can be operated at four different time slots. Difficulties like switching the pump ON/OFF manually can be overcome using this project. There exists an inbuilt real time clock (RTC) which keeps tracking the time and thus switches ON/OFF the pump accordingly. MOSFET's are also used by the charge controller as power semiconductor switches to ensure cutting of the load (DC Pump) in conditions like low battery or overload, while, the transistor is used to bypass the solar energy to a dummy load while the battery gets fully charged. Thus the battery is protected from getting overcharged.*

Keywords: *Solar Energy, Solar Water Pump Control*

INTRODUCTION

A solar-powered pumping system method needs to take proper account of the fact that demand for irrigation system water varies throughout the year. Solar-powered systems are being preferred for use in developing countries instead of other forms of alternative energy because they are extremely durable and can also exhibit long-term economic benefits. Solar powered water pumping systems can be the most appropriate solution for grid-isolated rural locations in poor countries where the levels of solar radiation are extremely high. Solar powered water pumping systems (SPPS) can cater to basic needs of the public like provide drinking water, water for irrigation etc without the need for any kind of fuel or extensive maintenance. A large-scale SPPS can serve well over 240 people at a time. The solar PV panels have proven time and time again their ability to reliably produce sufficient electricity directly from solar radiation to power livestock and solar irrigation systems. Solar water pumps find their use mainly in small scale or community-based irrigation fields, as large-scale irrigation requires large volumes of water which in turn requires a solar PV array extremely large in size. As the water may be required only during some parts of the year, a large PV array would provide excess energy which isn't necessarily required, thus making the system inefficient. Solar PV water pumping systems are mainly used for irrigation and drinking water purposes in India. Larger SPPS can deliver around 140,000litres of water/day from a total head of 10 m.

LITERATURE SURVEY

From olden days we are using non-renewable sources of energy in excess mount for our needs. As this type of minerals like coal etc are exhausting so we have to depend on the renewable sources of energy like solar, wind, etc. For a smaller application, it is better to use renewable energy. As this project is based on streetlight automation and required AC supply, So for this particular application, we are using solar panels to charge the DC battery and the power from the battery can be used for this application. This project is an innovative solution to operate a machine/motor/liquid pumps for a small duration. If a machine is to be operated for 10 minutes and should be switched off after the duration, it is too difficult and many times we forget to switch it off the system after the prescribed time. This project provides the facility of automatic switch off after the required time duration. This is achieved by using the MCU. Four push-to-on switches are connected to one port of the microcontroller. These four switches are to provide four different fixed time constants. A 16X2 LCD is connected to the microcontroller to display the status of the pump. The contrast of the LCD can adjust by using a preset which is connected to it. A transistor is used to drive the relay during the active time period. 5V double pole-double through the relay is used to control the AC liquid pump. The LED indication is provided for visual identification of the relay/load status. A switching diode is connected across the relay to neutralize the reverse EMF

BLOCK DIAGRAM AND EXPLANATION

The Solar panel serves as the main power source that provides the energy to charge a battery. A separate circuitry is also added to control the charging and current transmission constant. In the proposed system, when the battery is charged long enough, it drives the water pump, i.e. the load, for a proper timing. As it can be clearly seen from the block diagram that the load is connected to a relay in-between which actually triggers the load. There is one additional feature in the setup. This additional feature allows us to set the timing in order to control the ON/OFF time of the water pump. In this way, the solar energy can be harnessed more efficiently. This can be done by interfacing an RTC (Real-time Clock) to the microcontroller in order to control the timing

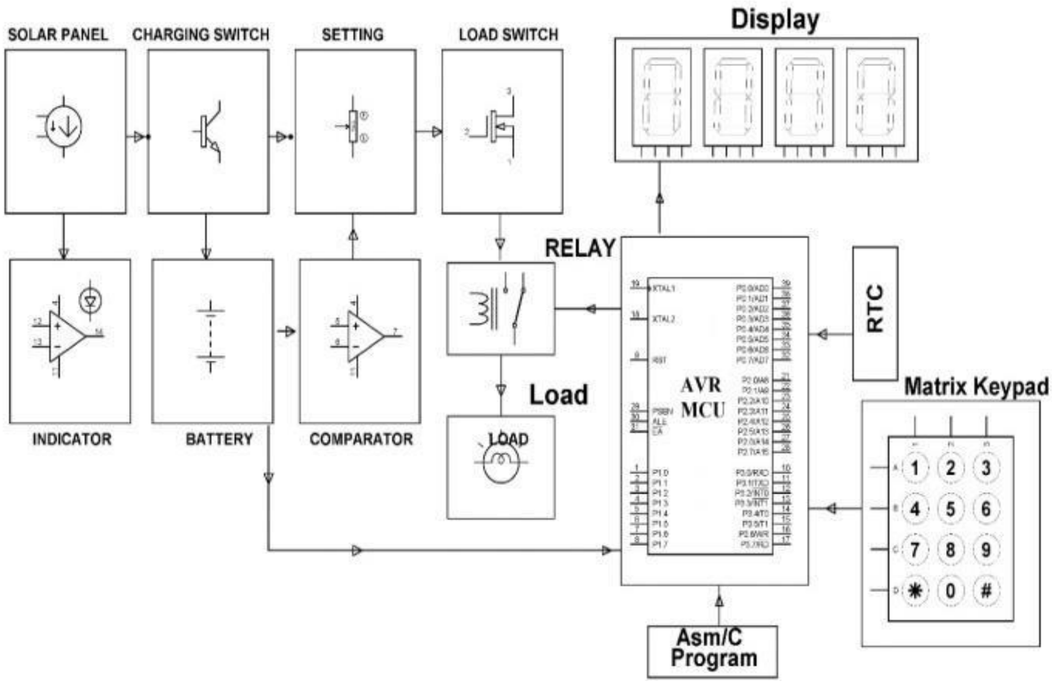

Fig. 1: Block Diagram and Explanation

A. Pin-Diagram

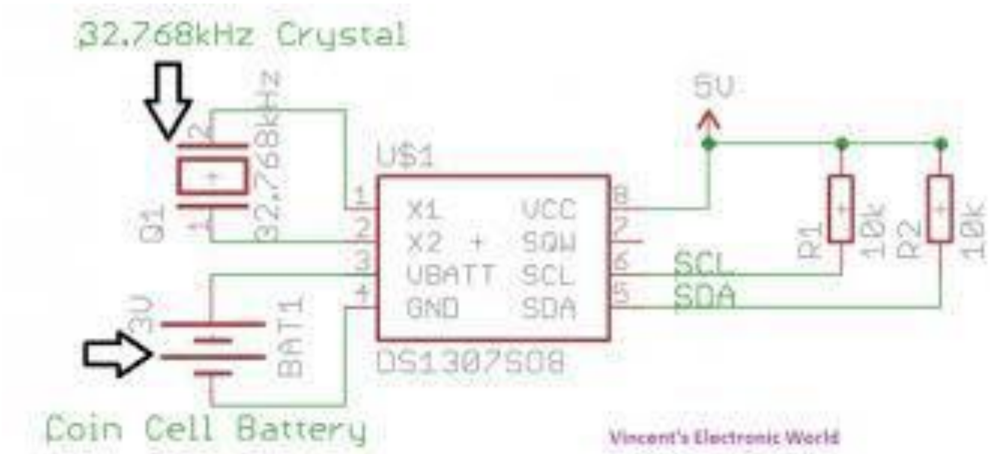

Fig. 2: Diagram

1) Pin Description of DS1307

Pin 1, 2: The internal oscillator circuitry which is intended for operation using quartz crystal of standard 32.768 with a specified load capacitance of 12.5pF having X1 as the input to the oscillator and can alternatively be connected to an external 32.768 kHz oscillator whereas The output of the internal oscillator X2 is drifted if X1 is in connection with external oscillator.

- Pin 3: Serves as the battery input having a voltage between 2V and 3.5V for suitable operation for a standard 3V lithium cell. The nominal write protect trip point voltage at which access to the RTC and user RAM is denied is set by the internal circuitry as 1.25 x VBAT nominal. DS1307 will be ensured a backup by using 48mAhr in the absence of power at 25ºC for more than 10years. Perhaps used for protection against reverse charging current
- Pin 4: Ground.
- Pin 5: This serves as the input/output for the I2C serial interface is the SDA, which is an open drain and requires a pull-up resistor, allowing a pull-up voltage up to 5.5V.
- Pin 6: Serial clock input. It is the I2C interface clock input and is used in data synchronization.

- Pin 7: Square wave/output driver. When enabled, the SQWE bit set to 1, the SQW/OUT having frequencies (1Hz, 4 kHz, 8 kHz, and 32 kHz). Since open drain, it requires an external pull-up resistor. It requires the application of either Vcc or Vb at to operate SQW/OUT, with an allowable pull up the voltage of 5.5V
- Pin 8: Primary power supply. When the applied voltage is within normal limits, the device is fully accessible and data can be written and read. However, at low voltages, the timekeeping function still functions.
- Start data transfer: A change in the state of the data line from high to low, while the clock line is high, defines a START condition.
- Stop data transfer: A change in the state of the data line from low to high, while the clock line is high, defines the STOP condition.
- Data valid: The state of the data line represents valid data when, after a START condition, the data line is stable for the duration of the high period of the clock signal. The data on the line must be changed during the low period of the clock signal.
- The number of data bytes transferred between them is determined by the master device. The information is transferred byte-wise and each receiver acknowledges with a ninth bit.

B. Relay

The relay is nothing but an electrical switch which uses an electromagnet to automatically move the switch from the OFF position to the ON position instead of a person manually moving the switch. A relay switch can be divided into two parts: input and output. The input section consists of a coil which generates a magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is known as the operating voltage. The output section contains contactors which can connect or disconnect mechanically. A relay comprises of three contractors: normally open (NO), normally closed (NC) and common (COM). When at no input state, the COM is 3connected to NC. On applying the operating voltage, the relay coil gets energized and the contact gets changed from COM to NO. The contractors help in switching ON/OFF the circuit.

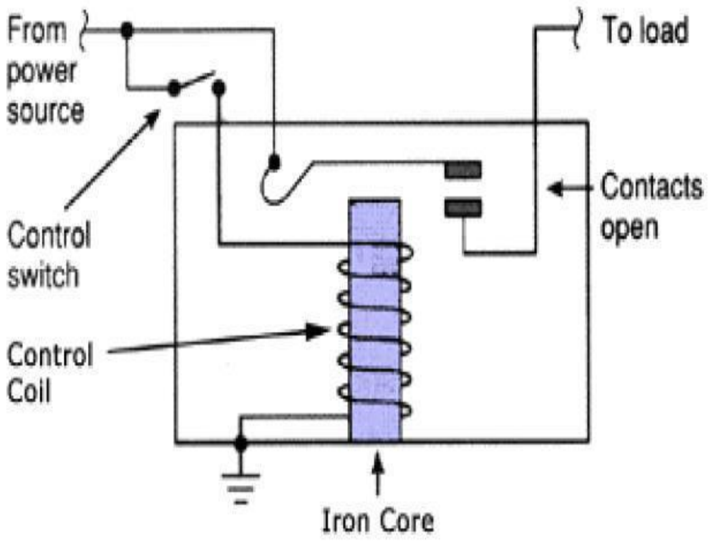

Fig. 3: Switching ON/OFF the circuit

C. Matrix-Keypad

Keypads are perhaps a part of Human Machine Interface (HMI) and play a major role in a small embedded system where there is a requirement of human interaction or where human input is needed. They are also known for their simple architecture and the ease with which they can interface with any microcontroller.

D. Seven Segment Display

A seven segment display is the most basic electronic display device that can display digits from 0-9. They are widely used in devices that display numeric information like digital clocks, electronic meters etc. The most common configuration has an array of 8LEDs arranged in a special manner to display the digits.

Seven segment displays are most commonly available in 10 pin package in which 8 pins correspond to the 8 LEDs, while the remaining 2 pins in the middle are common and shorted internally. Seven Segment Displays are available in two configurations; a Common cathode (CC) and Common anode (CA).

In the CC arrangement, the negative terminals of all LEDs are connected to the common pins while the common is connected to ground. The LED glows when the corresponding pin is given a “High”, or logic “1” signal. The signal can be given out via a current limiting resistor to forward bias the anode terminals.

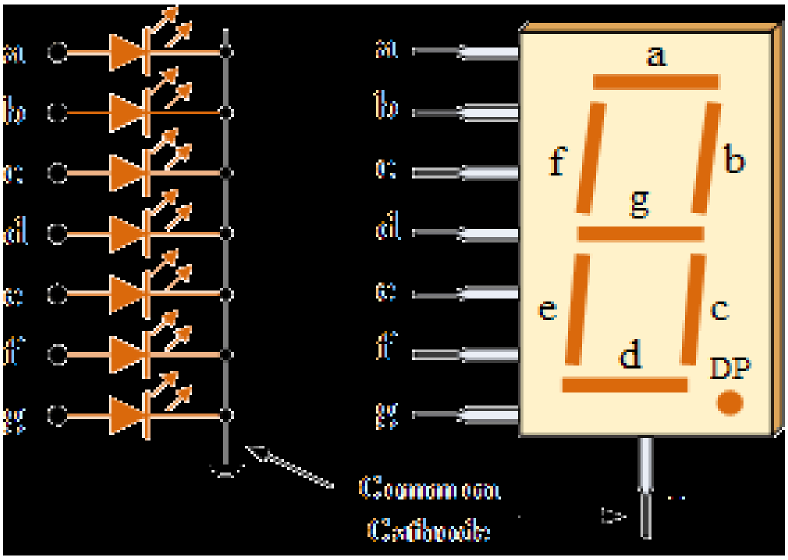

Fig. 4: SSD

PROBLEM STATEMENT

From olden days we're using non-renewable sources of energy in excess amount for our needs. As these type of minerals like coal etc are exhausting, so we have to depend on the renewable sources of energy like solar, wind, etc. For a smaller application, it is better to use renewable energy. Most of the existing systems are the manual system. The manual system needs labor for monitoring the productivity and healthy crop. Considering labor's salary, the system will cost much more than the automatic system, in which there is no assistance to the system. The farmer himself has to check the moisture level of the soil and has to make a judgment whether the field requires water or not. This way of inspecting the moisture level is not accurate and this drawback can be eliminated by using soil moisture sensor which is been used in our architecture. Moreover, the temperature required for the crops to sustain differs from crops to crops. If the temperature increases or decreases then the expected temperature, it may affect the quality of the crops. This problem can be overcome by using the shielding mechanism, thereby maintaining the desired temperature.

FLOW OF WORKING

A very major part of this project is the Real-Time Clock (RTC) which is interfaced to a microcontroller of the AVR family. When the time set by the user is equal to the real-time, then the microcontroller gives the command to the corresponding relay, which in turn turns ON the load, and then another command to turn OFF the load as entered by the user. The biggest advantage of this project is that multiple ON/OFF time values can be entered (this can be done using the matrix keypad).To display time, a 7-segment display can be used. In this project, a solar panel is used to charge a battery. A set of op-amps are used as comparators to continuously monitor panel voltage, load current, etc. Indications are also provided by a green LED for fully charged battery while a set of red LEDs indicate undercharged, overloaded and deep discharge condition. Charge controller also uses MOSFET as power semiconductor switch to ensure cutting off the load in low battery or overload condition. A transistor is used to bypass the solar energy to a dummy load while the battery gets fully charged. This protects the battery from getting overcharged

V. ADVANTAGES

- Energy is saved
- Reliable and long life
- Produces water when it's needed most
- Low labor and maintenance costs
- No fuel costs
- Easy to remove, transport and store
- Non-polluting

FUTURE SCOPE

With advancements in technology, the systems can be made more user-friendly. The proposed system can be further enhanced by deploying a GSM model. The user can control the motor pump from a remote location using his mobile phone. The user can also get the water level indication of the reservoir and overhead storage tank on his mobile phone. These technologies are already available in the market, though presently they are not so popular. Furthermore, to check the appropriateness of the soil, the system can be fitted with sensors like; Humidity sensor, pH sensor, Temperature sensors etc which can provide the user with information about the soil conditions via an SMS on his mobile phone.

CONCLUSION

It can be concluded that Photovoltaic systems are designed to supply water and irrigation in areas where there is a scarcity of electricity. Their main advantages over hand pumps are their practically zero maintenance, long useful life, no fuel requirement, no contamination, and comparatively easier installation. Also since the sun is used as the energy source output coincides with the amount of solar radiation. Thus compared to diesel powered pumping systems, the cost turns out to be 64.2% in case of solar PV pumping system for the duration of 10years. Solar pumps are available to pump from anywhere in the range of up to 200m head and with outputs of u to 250m³/day. Such high is the solar PV water pumping for irrigation (9 to 70 million solar PV pump sets), that at least 255 billion lit/year of diesel can be saved. The Peak demand is around twice the average demand during the irrigation system seasons. Thus this indicates that the solar pumps for irrigation remain under-utilized for the most part of the year. The selected irrigation system should be such that it minimizes the water losses without putting additional pressure on the water head.

REFERENCES

[1] Abdallah S., The effect of using sun tracking systems on the voltage-current characteristics and power generation of flat plate photovoltaics, Energy Conversion and Management, Vol. 45, pp. 1671-1979, 2004.
[2] Aliyu A.G. and Sambo A.S., Study of photovoltaic solar water pumping system in various climate conditions, Journal of Solar Energy, Vol.8 (1), pp. 345-354, 1989.
[3] Ghoneim A.A., Design optimization of photovoltaic powered water pumping systems. Energy Conversion and Management, Vol. 47, pp 1449-1463, 2006.
[4] Glasnovic Z. and Margeta J., Maximum area that can be economically irrigated by solar photovoltaic pumping system. Journal of Irrigation and Drainage Engineering, Vol.135(1), pp. 44-49, 2009.
[5] Hammad M.A., Characteristics of solar water pumping in Jordan. Energy, Vol. 24, pp. 85-92, 1999. pp. 341-346, 2014.
[6] Khatib T., Design of photovoltaic water pumping system at minimum cost for Palestine: a review. Journal of applied sciences, Vol.10 (22), pp. 2773-2784, 2010.
[7] Kolhe M., Joshi J.C. and Kothari D.P., Performance analysis of a directly coupled photovoltaic water-pumping system. IEEE Trans. On Energy Conv., Vol. 19, pp. 613-618, 2004.
[8] Meah K., Ula S. and Barrett S., Solar photovoltaic water pumping: opportunities and challenges. Renewable and Sustainable Energy Reviews, Vol.12, pp. 1162-1175, 2008.
[9] Van Dyk E.E., Gxasheka A.R. and Meyer E.L., Monitoring current voltage characteristics and energy output of silicon photovoltaic modules. Renewable Energy, Vol. 30, pp. 399- 411, 2015.
[10] Vick B.D. and Clark R.N., Effect of panel temperature on a solar-PV AC water pumping system. ASES Solar 2004: A Solar Harvest Growing Opportunities. July 11-14, 2015. Portland.