Solar Panel Based Lead Acid Battery Charging System using LabVIEW

S. V. Padma
UG Student
Department of Instrumentation & Control Engineering
Saranathan College of Engineering, Panjappur, Trichy, Tamil Nadu, India

R. Sathya
UG Student
Department of Instrumentation & Control Engineering
Saranathan College of Engineering, Panjappur, Trichy, Tamil Nadu, India

T. N. Sindhu
UG Student
Department of Instrumentation & Control Engineering
Saranathan College of Engineering, Panjappur, Trichy, Tamil Nadu, India

A. Krithiga
UG Student
Department of Instrumentation & Control Engineering
Saranathan College of Engineering, Panjappur, Trichy, Tamil Nadu, India

M. EazhisaiVallabi
Assistant Professor
Department of Instrumentation & Control Engineering
Saranathan College of Engineering, Panjappur, Trichy, Tamil Nadu, India

Abstract

In order to meet the power demands, an alternative source of energy is essential to produce power. Sun being renewable energy, it is used. Photons from the sun light are incident on the solar panel and LDRs which are fixed near the panel. The solar tracking is done using arduino which is interfaced with LDRs. When the light falls on LDRs the intensity changes, based on the higher intensity side the solar panel is titled with the help of DC motor using relay circuits to move in forward and backward directions. Thus the lead acid battery is charged by the energy from the panel. In addition to that, different loads are connected to the battery and they were operated at their operating voltage. If voltage in the battery goes beyond operating voltage, it will be charged and when the battery is overcharged, the load is disconnected from the battery. Thus, the battery was charged for various voltages so that it can be used for various purposes. For monitoring the panel and controlling the batteries the real values from the panel and the batteries are given to arduino and it is interfaced with LabVIEW.

Keywords: Arduino, LabVIEW, LDR, DC motor, Relay Driver circuit, Lead acid battery, Solar panel

I. INTRODUCTION

Now-a-days power consumption is exponentially increasing. To meet the demands, we are using non-renewable and renewable energy. Fossil fuels are non-renewable energy, they are too expensive to use and may lead to environmental damage. So we are moving towards renewable energy like sun, which is pollution free and easily available in most of the season. Solar energy can be used directly for driving home appliances like water heating, lighting homes for generating electricity and for various purposes. Its advantages are not reached because of its installation cost. Once it is installed then it can be used lifelong and it needs no maintenance. A photovoltaic cell is a semiconductor diode which converts light energy absorbed by sun radiation into direct current. A Light Dependent Resistor or photo resistor gives output voltage by changing the resistance depending upon the intensity of light. Solar panel is rotated depending upon the maximum intensity obtained from LDR. Motor converts electrical energy to mechanical energy. Brushed DC motor is one which provides speed control precisely. Driver circuit governs the rotation of DC motor. Driver circuit is designed by Darlington amplifier. Two back to back transistors are connected. Direct current obtained from solar panel is stored in the battery. Lead acid battery or secondary battery is used instead of primary battery. It is portable, rechargeable.

II. HARDWARE ARCHITECTURE

A. Solar Panel:

Solar panel is an array of solar cells and has P-N junction. They convert light energy into direct current by photovoltaic effect. They are made up of semiconductor material like silicon. The photons of solar energy are absorbed by the solar cells. The
electrons in the N-region are excited to higher energy state and they are moved to N region the holes enter P region. These excited electrons when flows in a circuit hence constitute electric current.

### B. DC Motor

Motor converts electrical energy to mechanical energy. Brushed DC motor is one which provides speed control precisely. It has ability to supply 3 to 4 times more torque than its rated value and has 6 major components axle, armature/ rotor, stator, commutator, magnets, brushes. Electricity flows into the coil when they are positioned to face the magnets, magnetic field is generated which pushes coil away from magnet and cause the rotor to run. DC motor is rotated Via Arduino programming. It is used to tilt the solar panel according to light intensity. Motor is made to rotate in both directions with the help of relay circuit.

### C. Light Dependent Resistor

Light dependent resistor is used for measuring the intensity of light. Based on the higher intensity side the solar panel is tilted. They can be described by a variety of names from light dependent resistor, LDR, photo resistor, or even photo cell (photocell) or photoconductor. There are other devices such as photodiodes or photo-transistor but LDRs are a particularly convenient to use. For small change in light they provide large change in resistance. LDRs are made from semiconductor materials such as cadmium sulphide (CdS).

### D. Relay Driver Circuit

A relay is an electronically operated switch which is used to turn on and off the appliances which is connected to high voltage AC supply by consuming low currents. Driver circuit governs the rotation of DC motor. Driver circuit is designed by darlington amplifier. Two back to back transistors are connected. ULN2803 is an darlington IC which is used to drive the motor. Motor will start to rotate when it gets +12V, 0V respectively from the driver which is operated using relay.

### E. Lead Acid Battery

Lead acid battery is used as storage battery or secondary battery. The energy from the solar panel is stored as the power in the battery. These batteries are commonly used in car. These batteries do not discharge quickly and can be used for many days according to the capacity of the battery and the load connected. Charging the batteries using solar panel can be chosen based on the capacity of the panel used. If the panel specification is 10W, 16-17V, 0.58A the battery specification may be 12V but the minimum current or initial current to the battery should be 0.39A

### III. GENERAL DESCRIPTION

#### A. Block Diagram

Solar energy, which is renewable source of energy, is incident on solar panel. Due to photoelectric effect, the excited electrons will flow to N region and the photons of sun rays will flow to P region and hence electricity is produced due to movement of electrons. The solar panel is tracked according to the light intensity which falls on light depending resistor. It is achieved by DC motor. DC motor is made to rotate and panel is tilted, placed in a position that has higher intensity. The motor is driven by arduino programming.

---

All rights reserved by www.ijste.org
The voltage from solar panel which is direct current (DC) is stored in a lead acid battery. Voltage from the solar panel is acquired by arduino and it is monitored in LabVIEW by interfacing arduino with LabVIEW by using VISA tool. The Direct Current stored in the battery cannot be used directly. So an inverter is employed to convert Direct Current into Alternating Current which can be used to drive appliances and can be used in many industrial applications.

SOFTWARE ARCHITECTURE

B. Front Panel:

The baud rate, data bit, parity, stop bits flow control, serial are the necessary input to the visa resource which interfaces arduino and LabVIEW. The voltage of solar panel and the battery is monitored in the front panel.

![Fig. 2: Front Panel of monitoring system](image)

C. Block Diagram

One of the object oriented software is LabVIEW. It is possible to design any real time problems virtually. Here programming is done by connecting the blocks instead of writing codes. Each function is stored. The block diagram is designed to control the experimental set and acquire the experimental data used. Front panels are the user interfaces containing data input and control components. Block diagrams are the panes where the functions are defined graphically.

![Fig. 3: Block Diagram of monitoring system](image)
IV. CONCLUSION

Power can be generated even in amidst of forest where electricity is absent. To meet the electricity demands, solar energy will be the best alternative. Instead of using AC supply for charging lead acid battery, solar power is used here. The position of panel is controlled according to sun rays with the help of DC motor which is operated using arduino. The solar panel shows pulsating inputs which varies with time. The voltage changes are shown for few inputs with respect to time.

![Solar Panel Variation](image1)

**Fig. 4:** Variation in voltage in solar panel with respect to time

<table>
<thead>
<tr>
<th>S.NO</th>
<th>TIME</th>
<th>VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>1.5</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>2.5</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>3.5</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

**Table – 1**

Variation in voltage in solar panel with respect to time

The charge in the battery changes according to the load used. It is observed that the lead acid battery does not discharge easily and it takes time to discharge. Thus it reduces with time and charged continuously with the help of the solar panel energy.

![Battery Variation](image2)

**Fig. 5:** Variation in voltage in battery with respect to time
Table – 2
Variation in voltage in battery with respect to time

<table>
<thead>
<tr>
<th>S.NO</th>
<th>TIME</th>
<th>VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

REFERENCE


