Automatic Solar Tracking System with AVR Microcontroller based Street Light

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Abstract— This paper presents the design of a solar tracking system driven by an AVR microcontroller. This project is done by two ways of tracking system, manual and auto tracking. This project is very useful for street light in the campus and villages. The solar panel converts the sun light into the electrical energy, because sun is a very good source of different energies. And the solar energy is the best technique for renewable energy. Basically the energy sources are two types such as conventional energy sources and non-conventional energy sources. Coal, petroleum, natural gas etc. are example of conventional energy sources and solar cell, fuel cells, thermo-electric generator, thermionic converter, solar power generation, wind power generation, geo-thermal energy generation etc. are example of non-conventional energy sources. In developing countries where electricity supplies are inadequate, renewable energy can offer an alternative to expensive extensions of the grid to sparsely populated or rural areas, or a contribution to the grid-based energy mix to meet rapidly expanding electricity demand in urban areas. This work presents an autonomous street lighting system based on solar energy as primary source, batteries as secondary source, and light emitting diodes as lighting source. This system is being presented as an alternative for remote localities, like roads and crossroads.

***Keywords*—Solar Panel, AVR Microcontroller, Temperature Sensors, LDR, renewable energy.**

I. INTRODUCTION

Today we want to save energy and environment. The modern society is extremely dependent on electricity generated by oil and coal, which both add to green house gasses which build up in the environment. Solar energy is clean, renewable and sustainable, helping to protect our environment. The World Energy Council's Technical Work Programme 2014-15 a new committee to solve the energy problem and established renewable energy. Photovoltaic solar energy is the use for direct conversion sunlight into electricity. This can be done by flat panel but we can use tracking panel for absorbing more energy from the sunlight. Tracking panel moves according to the sun temperature and absorb more energy. The system is provided with automatic ON or OFF time switch for dusk operation and overcharge or deep discharge prevention cut-off with LED indication. The sun does not deliver that much energy to any one place at any one time. How much solar energy a place receives depends on several conditions. These include the time of day, the season of the year, the latitude of the area, and the clearness or cloudiness of the sky. This project has two ways of tracking 1st auto tracking and 2nd manual tracking. Manual tracking system is working by the sun tracking software. Auto tracking system is working by the LDR sensor. Photovoltaic cells consist of a semiconductor PN junction, in which electron-hole pairs produced by absorbed radiation are separated by the internal electric field in the junction to generate a current, a voltage, or both, at the device terminals.

II. BLOCK DIAGRAM FOR THE TRACKING SYSTEM

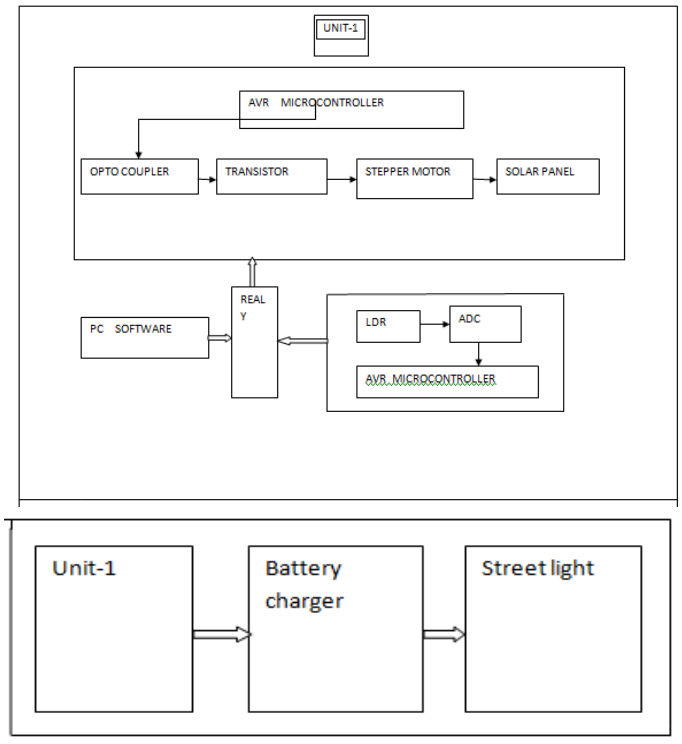


Fig.1:Block diagram of tracking system

III.DESCRIPTION OF BLOCK DIAGRAM

Microcontroller is used for to get the instructions to the stepper motor and sensors.AVR microcontroller required 5 volt power supply. AVR microcontroller has some features such as analog comparator, analog to digital convertor and universal synchronous asynchronous receiver transmitter.

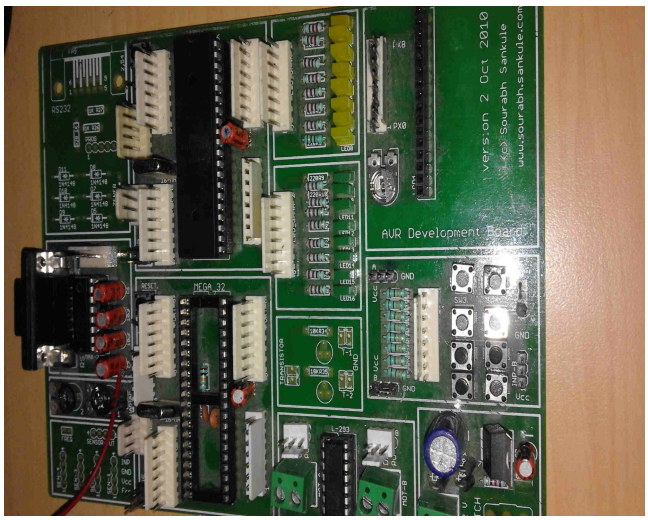


Fig.2:AVR microcontroller kit

ADC is used for converting analog data into digital data. Because microcontroller used this digital data for tracking system. Code Vision AVR software is used for the microcontroller. Programming process for AVR microcontroller is done with the help of this software. A stepper motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. Solar panel have Photovoltaic cell consists of a semiconductor PN junction, in which electron-hole pairs produced by absorbed radiation are separated by the internal electric field in the junction to generate a current. Relays are using as a switch in this tracking system. Relays are simple switches which are operated both electrically and mechanically. Relays consist of a electromagnet and also a set of contacts. The main operation of a relay comes in place where only a low power signal can be used to control a circuit. This sensor is used for auto tracking system. When sun is rises the sensor is work it gets input data of light, this data is in the analog form, on the basis of this data, sun tracking system track the sun and sun light convert into the electricity with the help of photovoltaic cell. In this project we use TIP41 transistor for the stepper motor and opto-coupler is using to safe the AVR microcontroller. For rotation of panel we use Real Time Clock by using interrupt pins in ATMEGA16 microcontroller.

1) BATTERY CHARGER

Battery charger is used for controlling over charging and under charging of battery from the solar panel. Given this circuit we use a regulator IC LM317 for the controlling charging voltage. Connect the circuit to the solar panel and measure the input voltage. In this TIP 122 transistor is used for controlling the output current.

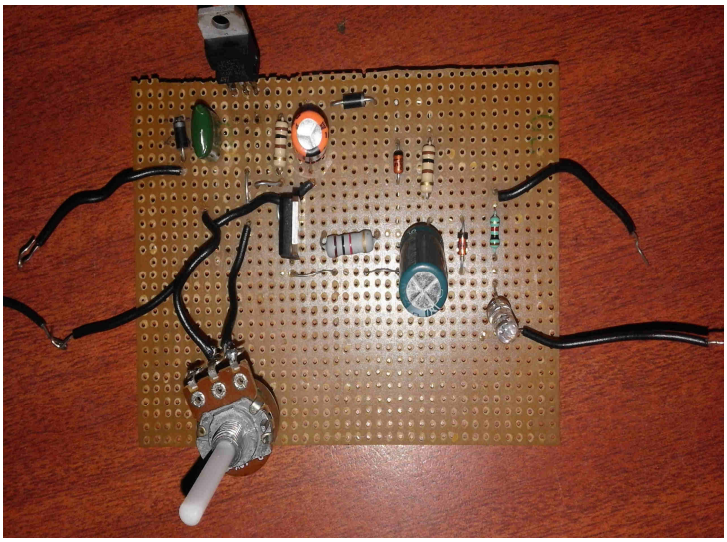


Fig.3: Battery Charger Circuit

Street light is the final output of this tracking system. Due to LDR street Light automatic ON or OFF in night and day. Solar Street lights sources which are powered by photovoltaic panels.

A. WORKING OF SOLAR TRACKING SYSTEM

The photovoltaic panels charge a rechargeable battery, which powers a fluorescent or LED lamp during the night. When sun light fall on solar panel the photovoltaic cell convert the sun light directly into electricity. Photovoltaic cell can also convert infrared or ultraviolet radiation DC electricity. A microcontroller or stepper motor controller can be used to activate the drive solar panel in the right order. Temperature sensor sense high temperature of sun and gives instruction to the microcontroller. Through the microcontroller stepper motor drive solar panel according to the high temperature of sun light and panels get more energy from the sun. The efficiency of tracking panel is more than flat panel because it moves according to the sun and absorb more energy from the sun but flat panels are fixed at the one place and not absorb energy of sun in different angle of sun.

B. WORKING OF BATTERY CHARGER CIRCUIT

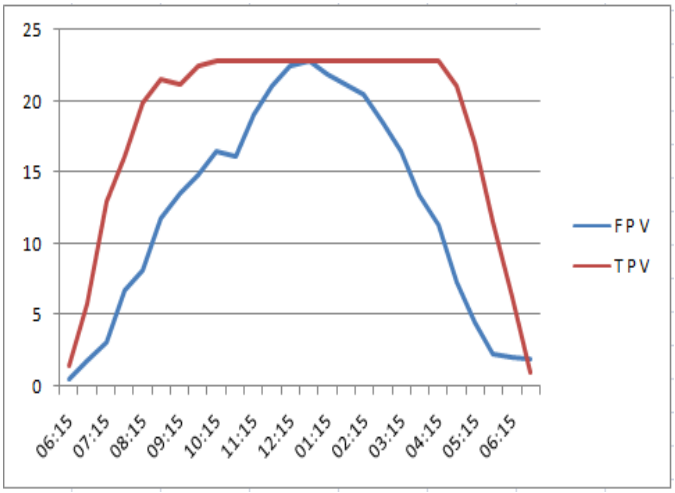
In this circuit variable voltage regulator IC LM317 use to set the output voltage steady around 16 volts. When the solar panel generates current, forward bias diode and regulator IC gets input current. When the output voltage is above 16 volts, zener diode conducts and gives stable 15 volts for charging. Charging current depends on resistor. Around 250 to 300 mA current will be available for charging. LED indicates charging status. When the battery attains full voltage around 13 volts, zener diode conducts and transistor worked in the forward

bias condition. This drains the output current from the regulator IC through transistor and charging process stops. When the battery voltage reduces below 12 volts, zener turns off and battery charging starts again.

TABLE .I: VOLTAGE AND TIME

Time	Flat Panel Voltage	Tracking Voltage	Time	Flat Panel Voltage	Tracking Voltage
6:15	0.56	1.5	12:45	22.8	22.8
6:45	1.9	5.8	1:15	21.9	22.8
7:15	3.12	12.0	1:45	21.2	22.8
7:45	6.8	16.12	2:15	20.5	22.8
8:15	8.11	19.9	2:45	18.5	22.8
8:45	11.8	21.5	3:15	16.5	22.8
9:15	13.5	21.11	3:45	13.4	22.8
9:45	14.8	22.5	4:15	11.3	21.0
10:15	16.5	22.8	4:45	07.3	17.0
10:45	16.11	22.8	5:15	04.5	11.5
11:15	19.10	22.8	5:45	02.3	06.3
11:45	21.10	22.8	6:15	02.1	01.5
12:15	22.5	22.8	6:45	02.0	01.0

C. GRAPHICAL REPRESENTAION



F P V- Flat Panel Voltage

T P V-Tracking Panel Voltage

Fig.4: Graphical Representation

D. OUTPUT OF THIS PROJECT

We can see above this diagram tracking panel voltages are more than flat panel voltages so, for getting more energy from the sun use of sun tracking system is the best choice. These outputs obtained during the 6:15 AM to 6:45 PM and at the night time street light ON automatically due to LDR.

IV. CONCLUSIONS

In this project, we can use different types of microcontroller such as 8051, PIC, AVR microcontroller etc. But this project is based on AVR microcontroller for sun tracking system. Sun tracking system collects more energy from the sun and converts into electricity. The battery charger control the charging and discharging of battery and street light automatic ON in the night through the battery with the help of LDR sensors. An LDR sensor is used as a auto tracking system for converting solar energy into electricity.

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