Implementation of Solar Tracking Mechanism Based On Mobile PV Panel

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Abstract: This paper presents the Design of an automated solar tracking system is discussed in this paper. The objectives of the proposed work are to design an automated tracking technique using Light Dependent Resistance (LDR), and solar panel power output to position the solar panel to absorb maximum energy. For positioning the solar panel DC motor is used, each for positioning in a plane. These DC motor was driven by a Programmable Logic Controller (PLC). The controller is designed using wonder ware software considering the inputs from LDR Sensor and solar panel output to drive the DC motor connected to solar panel. The energy saves to the Li-Po battery. The energy applied to the vehicle. Then the whole program is implemented with the help of PLC. The system was tested on a real time and results showed the proposed technique had improved the efficiency of solar panel by an amount of 25%.

Keywords: PLC, photovoltaic, DC motor, Li-Po Battery, LDR sensor.

I. INTRODUCTION

The increasing demand for energy, the continuous reduction in existing sources of fossil fuel and growing concern regarding environment pollution have pushed mankind to explore new technologies for the production of electrical energy using clean, renewable sources, such as solar energy, wind energy. Among the non-conventional, renewable energy sources, solar energy affords great potential for conversion into electric power, able to ensure an important part of the electrical energy needs of the planet. The conversion of solar light into electrical energy represents one of the most promising and challenging energetic technologies, in continuous development, being clean, silent and reliable, with very low maintenance costs and minimal ecological impact. Solar energy is free, practically inexhaustible, and involves no polluting residues or greenhouse gases emissions.

The conversion principle of solar light into electricity called Photo-Voltaic or PV conversion is not very new, but the efficiency improvement of the PV conversion of sunlight into electricity. Photovoltaics are used for the conversion of sunlight into electricity either directly or indirectly with concentrated solar power (CSP), which normally concentrates the sun's energy to boil water which h is then used to generate power. Photovoltaics were initially used to power small and medium sized applications, which are powered by a single solar cell to off-grid homes powered by a photovoltaic array.

II. SOLAR TRACKING MECHANISM

PV panel is continuously changing, reaching a maximum point when the direction of solar radiation is perpendicular to the panel surface. In this context, for maximal energy efficiency of a PV panel, it is necessary to have it equipped with a solar tracking system. The topic proposed in this paper refers to the design of a single axis solar tracker system that automatically searches the optimum PV panel position with respect to the sun by means of a DC motor controlled by an intelligent drive unit that receive input light intensity sensor compared to a fixed panel, a mobile PV panel driven by a solar tracker is kept under the best possible insulation for all positions of the Sun, as the light falls close to the geometric normal incidence angle. Automatic solar tracking systems (using light intensity sensing) may boost consistently the conversion efficiency of a PV panel, thus in this way deriving more energy from the sun.

A measurement system for light intensity applied to the PV panel, representing the sensor that commands the solar panel movement action of the completed device DC motor. The parameters of the DC motor used as the movement execution element are rated voltage 24V, rated current 3A, maximum speed 3000 rpm, gear box with a speed reduction ratio of 1: 20.
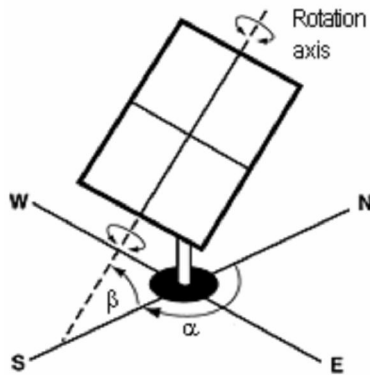
Fig.1 Solar tracking device

Li–Po battery is considered charged to a 75–80%—takes up relatively short time. The conversion of sunlight into electricity is done, either directly using the photovoltaic (PV) or indirectly using concentrated solar power. Photo voltaic convert light into electric current using the photoelectric effect. Concentrated solar power system uses lens or mirrors and tracking system to focus a large area of sunlight into a small beam. The concentrated heat is then used as a source for a conventional power plant. Various techniques are used to track the sun and focus light. In all of these systems a working fluid is heated by the concentrated sunlight and is then used for the power generation of energy.

III. PHOTOVOLTAIC CELL

Solar panels are firmed out of solar cells that are connected in series. When connected in series, in parallel increases the overall current. Each individual solar cell is typically made out of crystalline silicon, although other types such as ribbon and thin film silicon are gaining popularity. A PV cell consists of layered silicon that is doped with different elements to form a PN junction. The p-type side will contain extra holes or positive charges, the n-type side will contain extra electrons or negative chargers. This difference of charge forms a region that is charge neutral and acts as a sort of barrier. When the p-n junction is exposed to light, photons with the correct frequency y will form an extra electron /hole pair. However, since the p-n junction have potential difference, the electrons can't jump to the other side only the holes can. Thus, the electrons must exit through the metal connector and flow through the load, to the connector on the other side of the junction. Since the PV cells generate a current, cells/panels can be modelled as DC current sources. The amount of current a PV panel produces has a direct correlation with the intensity of light the panel is absorbing.

A solar tracking generating power system is designed and implemented. A tracking mechanism is integrated with an expert controller, sensors and input/output interface, that it can increase the energy generation efficiency of solar cells. In order to track the sun, cadmium sulphide light sensitive resistors are used. To achieve optimal solar tracking, a programmable logic controller is implemented. A ladder logic method is performed in controller so that the solar cells always face the sun in most of the day time. The sun tracking sensor is the sensing device, which sense the position of the sun at the time to time continuously and it gives the sensing output to the amplifier based on light density of the sun. Here the sun tracking sensor is LDR (light dependent resistor). The amplifier unit is used to amplify the LDR signals, which makes the low level signal

IV. RELAY MODULE

The relay module is a separate hardware device used for remote device switching. With it you can remotely control devices over a network or the Internet. Devices can be remotely powered on or off with commands coming from Clock Watch Enterprise delivered over a local or wide area network. You can control computers, peripherals or other powered devices from across the office or across the world. The Relay module can be used to sense external On/Off conditions and to control a variety of external devices. The PC interface connection is made through the serial port. The Relay module houses two SPDT relays and one wide voltage range, optically isolated input. These monitor the input and two relay lines. The module is powered with an AC adapter.
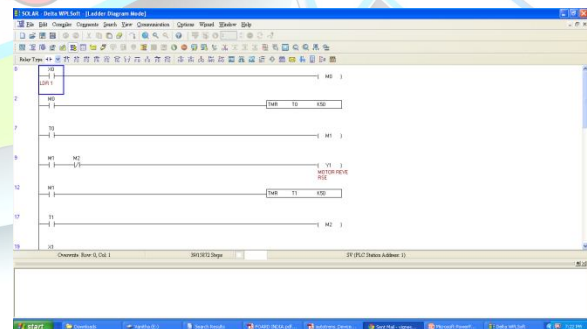

Fig 2. Simulation Output

The operator interface provides a means for an operator to start and stop the motor and adjust the operating speed. Additional operator control functions might include reversing, and switching between manual speed adjustment and automatic control from an external process control signal. The operator interface often includes an alphanumeric display and/or indication lights and meters to provide information about the operation of the drive. An

operator interface keypad and display unit is often provided on the front of the VFD controller as shown in the photograph above. The keypad display can often be cable-connected and mount a short distance from the VFD controller. Most are also provided with input and output (I/O) terminals for connecting pushbuttons, switches and other operator interface devices or control signals. A serial communications port is also often available to allow the VFD to be configured, adjusted, monitored and controlled using a computer gain currents versus base-emitter voltage, with the emitter length as parameter, are shown in the Fig. 6. The DC gain current decreases when emitter length goes down for base-emitter voltages lower than 0.9 V. If the base-emitter voltage is higher than 0.9 V, DC gain current

Fig 3. DC Motor

The Automatic Solar Tracking is done by using PLC. Power supply to the PLC and the Proximity sensors is given by the AC-DC Convertor whose input voltage is 230V AC and the output is 24V DC. The PLC is programmed in Computer. Output of the PLC is given to 8-Channel Relay Module. The Speed and Direction Control of the motor is done by the VFD. The Drive is connected to the motor input. The speed of the motor is preset and the direction is controlled by the input switches provided to the drive. The drive is controlled by the PLC by overriding the switches through Relay Module. The input of the PLC is the proximity sensor which provides feedback to the PLC. The sensor is made to sense the teeth of the Cog Wheel. The power supply for the sensor as well is provided by the converter. The output of the panel is checked with the help of a multi meter. In Advance Solar or photovoltaic (PV) cells are made up of materials that turn sunlight into electricity. Photovoltaic (PV) technologies including solar thermal hot water are renewable energy technologies and are clean energy alternatives compared to non renewable energy technologies that burn fossil fuels. PV cell are composed of layers of semiconductor such as silicon. Energy is created when photons of light from the sun strike a solar cell and are absorbed with the semi conductor material. This excites the semiconductor electrons, causing the electrons to flow, and creating a usable electric current. The current flows in one direction and thus the electricity

is termed direct current (DC). One PV cell produces only one or two watts which isn't much power for most uses. In order to increase power, photovoltaic or solar cells are bundled together into what is termed a module and packaged into a frame which is more commonly known as a solar panel.

A solar cell (also called a photovoltaic cell) is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. It is a form of photoelectric cell which, when exposed to light, can generate and support an electric current without being to any attached external voltage source. A solar panel (also solar module, photovoltaic module or photo voltaic panel) is a packaged, connected assembly of photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each panel is rated by its DC output power under standard test condition, and typically ranges from 100 to 320 watts. The efficiency of a panel determines the area of a panel given the same rated output - an 8% efficient 230 watt panel will have twice the area of a 16% efficient230 watt panel. Because a single solar panel can produce only a limited amount of power, most installations contain multiple panels. A photovoltaic system typically includes an array of solar panels, an inverter, and sometimes a battery and or solar tracker and interconnection wiring.
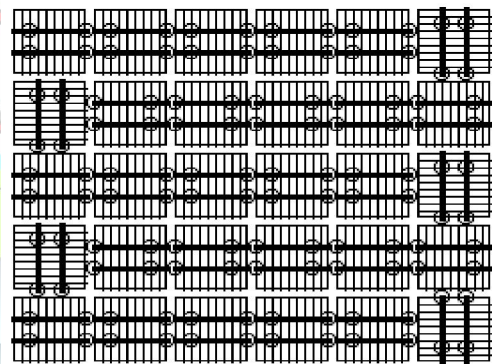

Fig 4. Inner view solar panel

V. PLC AND SCADA

A Programmable Logic Controller (PLC) is a digital operating electronic apparatus which uses a programmable memory for internal storage of instruction for implementing specific function such as logic, sequencing, timing, counting and arithmetic to control through analog or digital input/output modules various types of machines or process. In the past humans was the main method for controlling a system. More recently electricity has been used

for control and early electrical control was based on relays. These relays allow power to be switched on and off without a mechanical switch. It is common to use relays to make simple logical control decisions. The development of low cost computer has brought the most recent revolution, the Programmable Logic Controller (PLC).

Supervisory Control and Data Acquisition (SCADA) System. SCADA is used to monitor and control all the process in the tracking mechanism. Using SCADA able to control tracking mechanism from remote area. SCADA is a graphical representation it interfaces with PLC.The control system shall be designed to use 4 to 20 DC analog signals, unless otherwise specified. 2. Provide signal converters and repeaters where required. Analog inputs to the distributed control system shall be through appropriate repeaters to provide signal isolation where series looped with other devices and to allow the loop to maintain integrity even if the SCADA system is out of service. Power supplies shall be sized adequately for signal converter and repeater loads. 3. Signals shall be isolated from ground. 4. Signals shall not have a transient DC voltage exceeding 300 volts over one millisecond nor a DC component over 300 volts. 5. The system and associated input/output wiring will be used in a plant environment where there can be high energy AC fields, DC control pulses, and varying ground potentials between the sensors/transducers or input contact locations and the system components. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

VI. Conclusion

The Automatic Solar Tracker thus, is able to trace the sun in discrete steps from morning to evening without any manual intervention. This automation is achieved by the PLC thus rendering the setup more accurate and reliable. The PLC programming is User-Friendly and easier to program as it is Block Programming. The V/f drive has made it easy to use the DC Motor speed Control and the direction control. Different preset speeds could also be achieved by this drive.

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