International Journal on Future Revolution in Computer Science & Communication Engineering
Volume: 4 Issue: 12
ISSN: 2454-4248
27 – 31

Automatic Solar Tracking System and Fault Detection Using Wireless Technology

A. Senthilkumar
Asst Proff (SG),
Department of ECE,
Sri Shakthi Institute of Engineering and Technology,
Coimbatore, Tamil Nadu, India.
Email: a.senthilkumar@siet.ac.in

S. Raja
Asst Proff,
Department of ECE,
Sri Shakthi Institute of Engineering and Technology,
Coimbatore, Tamil Nadu, India.
Email: raja.s@siet.ac.in

Abstract: Renewable energy solutions are becoming increasingly popular. Photovoltaic (solar) systems are but one example. Maximizing power output from a solar system is desirable to increase efficiency. In order to maximize power output from the solar panels, one needs to keep the panels aligned with the sun. As such, a means of tracking the sun is required. This is a far more cost effective solution than purchasing additional solar panels. It has been estimated that the yield from solar panels can be increased by 30 to 60 percent by utilizing a tracking system instead of a stationary array [1]. This project develops an automatic tracking system which will keep the solar panels aligned with the sun in order to maximize efficiency. In this paper we proposed automatic solar tracking system and fault detection using wireless technology as a key to the new era.

Keywords *– Renewable Energy, Solar panel, Tracking, Array of solar system, wireless technology.*

*****

I. INTRODUCTION

The main objective of this project is to do automatic solar tracking and to detect the fault. Here Voltage, current and temperature are transmitted and received. Solar panel tracks the sun rays and it starts to rotate in step by step. It is done by viper motor. Spar gear is used to control the speed of rotation of solar panel. Photo voltaic cell is used to observe the solar energy to electrical energy. PIC controller is used in this fault detection system. RF module is implemented to compute the output. LDR is used to measure the light intensity in the solar panel. Opto coupler is used to prevent damage of relays.

II. LITERATURE SURVEY

Bhavesh pandey and Anita Agrawal proposed that Vast amount of energy is available within the core of sun. The energy that is received from sun in an hour is more than that is consumed by us in a year [1]. If human race is able to capture even 1% of the total energy which sun delivers then we can cater the need of our race for decades. Efforts are continuously being made to capture as much energy as we can in order to store most of the energy which se are getting. In this paper a device called solar tracker has been discussed. Solar panels give maximum output when the plane of the solar collector is normal to incident radiations [2]. The system discussed in this paper uses a PSoC device to control a small model of solar tracker. Voltage across the solar panel and a photo resistor is fed as an input to the PSoC to be processed and the output is fed to the geared DC motor.

Ravi Tejwani and Chetan S Solanki proposed that the solar PV modules are generally employed in dusty environments which are the case in tropical countries like India. The dust gets accumulated on the front surface of the module and blocks the incident light from the sun. It reduces the power generation capacity of the module. The power output reduces as much as by 50% if the module is not cleaned for a month. In order to regularly clean the dust, a sun tracking- cum-cleaning system has been designed, which not only tracks the sun but also cleans the modules automatically. This automated system is implemented using 8051 microcontroller which controls the stepper motor coupled with the gear box (40:1 ratio).This mechanism does not require any sensor or synchronization for tracking the sun. While for cleaning the PV modules, a mechanism consists of a sliding brushes has been developed. In this mechanism, the solar panels make a rotation of 360o in a day, which results in sliding of cleaning brushes twice over the PV modules. In terms of daily energy generation, the presented tracking cum cleaning scheme provides about 30% more energy output as compared to the flat PV module (module kept stationary on ground) and about 15% more energy output as compared to PV module with single axis tracking. The implementation and working of 360o sun tracking system with automatic cleaning is described in this paper.

Sushma.V and Sneha.V implemented a Conventional solar panel, fixed with a certain angle, limits there area of exposure from sun due to rotation of Earth. In pursuing to get the maximum energy converted from the sun, an automatic system is required which should be capable to constantly

 ISSN: 2454-4248
27 – 31

rotate the solar panel. The automatic solar tracking system solves this problem. There are single axis trackers and dual axis trackers. In this paper we will discuss PLC based dual axis tracker. Stepper motor arrangement is used to rotate the panel to the desired position. The system tracks by comparing the intensity of light falling on the sensors. Based on the sensors output the motor can rotate the solar panel to meet the sun's maximum position. Thus, solar panel can be driven by the motor which in turn gets the input signals from the PLC. Precise control of the stepper motors is possible by using the PLC. By giving a suitable delay between each step, the time for rotation of the solar panel to a particular position can also be controlled.

Mostefa Ghassoul presents the design of a solar tracking system driven by a microchip PIC 18F452 micro controller. The system is based on two mechanisms. The first one is the search mechanism (PILOT) which locates the position of the sun. The second mechanism (intelligent PANELS) aligns itself with the PILOT only if maximum energy possible could be extracted. On top of that the main advantage of the technique is that the rotation only takes place, if the energy obtained in the new position is higher than that consumed by the panels during the transition. So there are two mechanisms, one for the search which is mounted on a miniature motor and consumes only small amount of energy. Its role is to locate the best position for maximum energy extraction. The second one is the panel mechanism which rotates to the position when energy extraction is optimal.

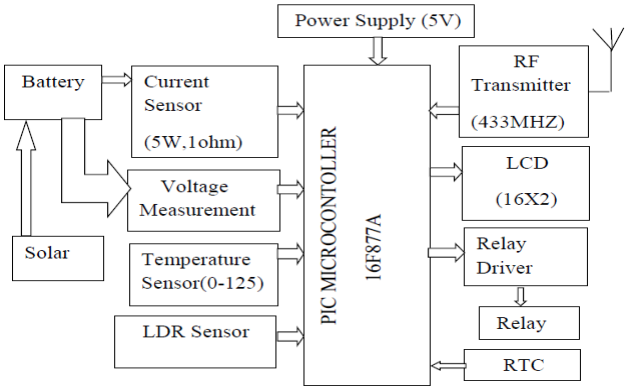

Figure 1: Transmitter block diagram

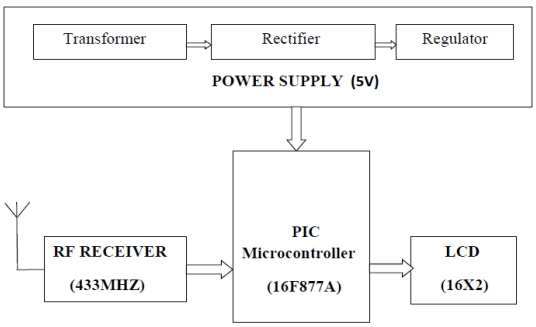

Figure 2: Receiver block diagram

III. WORKING METHODOLOGY

When sufficient voltage is applied to the electrodes the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating/highlighting the desired characters. The power supply should be of +5v, with maximum allowable transients of 10mv. To achieve a better/suitable contrast for the display the voltage (VL) at pin 3 should be adjusted properly. The ground terminal of the power supply must be isolated properly so that voltage is induced in it. The module should be isolated properly so that stray voltages are not induced, which could cause a flicking display. When a row line is activated, all of the Column lines are connected to a row of pixels and the correct voltage is driven onto all of the column lines. The row line is then deactivated and the next row line is activated. Active-matrix addressed displays look "brighter" and "sharper" than passive-matrix addressed displays of the same size, and generally have quicker response times, producing much better images. An alphanumeric LCD, with two lines of 16 characters. So the type of LCD used in this project is16 characters * 2 lines with 5*7 dots with cursor, built in controller, +5v power supply, 1/16 duty cycle.

RF Module (Transmitter & Receiver)

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK). Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4.

 ISSN: 2454-4248
27 – 31

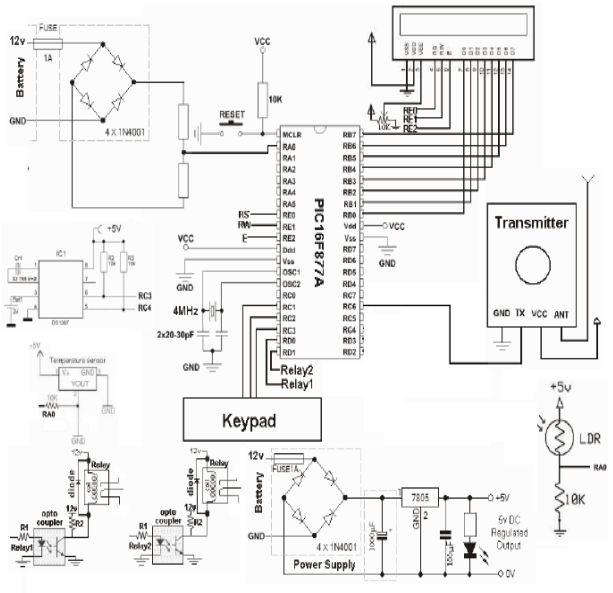

Figure 3: Circuit Diagram of Transmitter

Temperature Sensors

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level.

Light Dependent Resistor

A Light Dependent Resistor (LDR) is also called a photo-resistor or a cadmium sulfide (CdS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases. This optoelectronic device is mostly used in light varying sensor circuit, and light and dark activated switching circuits. Some of its applications include camera light meters, street lights, clock radios, light beam alarms, reflective smoke alarms, and outdoor clocks. The basic structure of an LDR is shown below

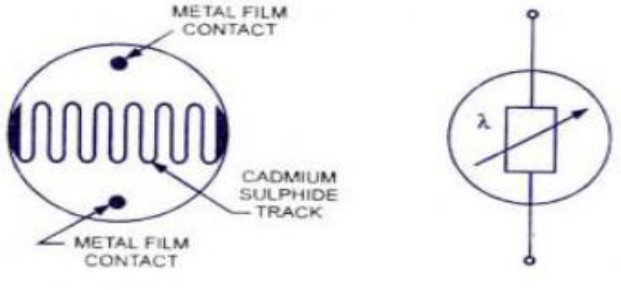

Figure 4: Structure and Symbol of LDR

Voltage Divider

The voltage division rule (voltage divider) is a simple rule which can be used in solving circuits to simplify the solution. Applying the voltage division rule can also solve simple circuits thoroughly. The voltage division rule can be used solve simple circuits or to simplify solving complicated circuits. One of the common mistakes in using the voltage division rule is to use the formula for resistors which are in parallel with other elements. The voltage division rule can be used to ease solving problems.

Solar Panel

A solar panel is a collection of solar cells. Lots of small solar cells spread over a large area can work together to provide enough energy to be useful. Solar panels are devices that convert light into electricity. They are called “solar” panels because most of the time, the most powerful source of light available is the Sun, called Sol by astronomers. Some scientists call them photovoltaic which means, basically, “light-electricity. Going to battery. The more light that hits a cell, the more electricity it produces. Solar PV system includes different components that should be selected according to your system type, site location and applications. DC electricity. Solar charge controller – regulates the voltage and current coming from the PV panels The major components for solar PV system are solar charge controller, inverter, battery.
bank, auxiliary energy sources and loads (appliances).PV module – converts sunlight into Battery – stores energy for supplying to electrical appliances when there is a demand. Load – is electrical appliances that connected to solar PV system such as lights, radio, TV, computer, refrigerator, etc. Auxiliary energy sources – is diesel generator or other renewable energy sources.

 ISSN: 2454-4248
27 – 31

Figure 5: Structure solar cell

Power Supply

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection'). The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and current. Many of the fixed voltage regulator ICs has 3 leads and look like power transistors, such as the 7805 +5V 1A regulator shown on the right. They include a hole for attaching a heat sink if necessary. Positive regulator regulates the positive voltage. Negative regulator, regulates the negative voltage. The regulated DC output is very smooth with no ripple.

Opto Coupler

In other words, transformers isolate the primary input voltage from the secondary output voltage using electromagnetic coupling by means of a magnetic flux circulating within the iron laminated core. But we can also provide electrical isolation between an input source and an output load using just light by using a very common and valuable electronic component called an Optocoupler. An Optocoupler, also known as an Opto-isolator or Photo-coupler, is an electronic component that interconnects two separate electrical circuits by means of a light sensitive optical interface. The basic design of an Optocoupler consists of an LED that produces infra-red light and a semiconductor photo-sensitive device that is used to detect the emitted infra-red beam. Both the LED and photo-sensitive device are enclosed in a light-tight body or package with metal legs for the electrical connections as shown. An Optocoupler or opto-isolator consists of a light emitter, the LED and a light sensitive receiver which can be a single photo-diode, photo-transistor, photo-resistor, photo-SCR, or a photo-TRIAC and the basic operation of an Optocoupler is very simple to understand.

Real time clock

The DS1307 serial real-time clock (RTC) is a low power, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. Address and data are transferred serially through an I^2C, bidirectional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with AM/PM indicator. The DS1307 has a built-in power-sense circuit that detects power failures and automatically switches to the backup supply. Time keeping operation continues while the part operates from the backup supply. The DS1307 uses an external 32.768 kHz crystal. The oscillator circuit does not require any external resistors or capacitors to operate. Table 1 specifies several crystal parameters for the external crystal. Figure 1 shows a functional schematic of the oscillator circuit. If using a crystal with the specified characteristics, the startup time is usually less than one second. The accuracy of the clock is dependent upon the accuracy of the crystal and the accuracy of the match between the capacitive load of the oscillator circuit and the capacitive load for which the crystal was trimmed. Additional error will be added by crystal frequency drift caused by temperature shifts. External circuit noise coupled into the oscillator circuit may result in the clock running fast. The DS1307 supports the I2C protocol.

IV. RESULTS AND DISCUSSIONS

The experimental setup of solar fault detection and automatic tracking system is as given above. Renewable energy solutions are becoming increasingly popular. Photovoltaic (solar) systems are but one example. Maximizing power output from a solar system is desirable to increase efficiency. In order to maximize power output from the solar panels, one needs to keep the panels aligned with the sun. As such, a means of tracking the sun is required. The Automatic solar tracking system has been implemented for transmitting and receiving the voltage, current and temperature using RF transmitter and receiver. Also in this project if any fault occurred in the above said parameters it can be easily detected. This project implements the transmission and reception of the parameters through wireless system that generates more electricity than the stationary counterparts due to increased exposure to solar rays. The wireless RF transmission and

 ISSN: 2454-4248
27 – 31

reception can be implemented for short distance communication for about maximum of 10 meters range. For displaying the parameters such as voltage, current and temperature in multiple areas wireless RF transmission and reception has been implemented. Hence cost wise more effective compared to wired transmission. Also it can able to overcome from the transmission losses.

Figure 6: Circuitry setup for implementation

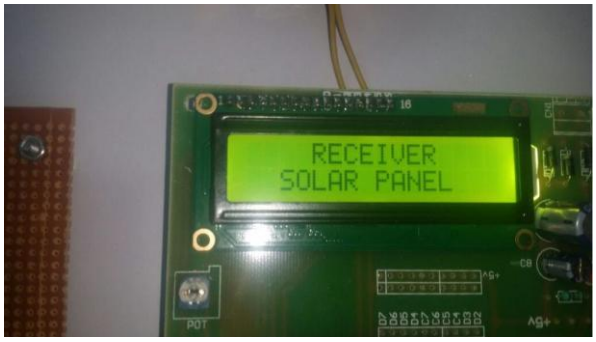

Figure 7: Receiver solar panel output

Figure 8: Identification of fault in system

V. CONCLUSION

Automatic solar tracking system has been implemented for transmitting and receiving the voltage, current and temperature using RF transmitter and receiver. Also in this project if any fault occurred in the above said parameters it can be easily detected. The Automatic solar tracking system has been implemented such that it can able to track the direction of the sun such that maximum electrical energy can be produced. For displaying the parameters such as voltage, current and temperature in multiple areas wireless RF transmission and reception has been implemented. Hence cost wise more effective compared to wired transmission. Also it can able to overcome from the transmission losses. The wireless RF transmission and reception can be implemented for short distance communication for about maximum of 10 meters range. This project can be further enhanced for long distance communication by using ZIGBEE module. Which can able to cover more than 2 Km circumference.

REFERENCES

[1]. Bhavesh Pandey, Anita Agrawal,(2012) "Automatic Sun Tracking System Using PSOC". International Journal of Innovative Research in Science, Engineering and Technology

[2]. Sushma.V , Sneha.V(2014) " PLC Based Solar Tracking Panel Assembly" International Journal of Engineering Trends and Technology (IJETT)

[3]. Huifeng Jiao, Jianzhong Fu, Yuchun Li, Jintao Lai, "Design of automatic two-axis sun-tracking system", IEEE International Conference on Mechanic. Automation and Control Engineering (MACE) 2010, Dept. of Mech. Eng.,Zhejiang Univ., China, 26-28 June 2010, 2323–2326.

[4]. A.W.M. Smeulders, M. Worring, S. Santini, A. Gupta, and R. Jain, "Content-Based Image Retrieval at the End of the Early Years," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 22, no. 12, pp. 1349-1380, Dec. 2000.

[5]. S.C.H. Hoi, R. Jin, J. Zhu, and M.R. Lyu, "Semi Supervised SVM Batch Mode Active Learning with Applications to Image Retrieval,"ACM Trans.Information systems, vol. 27, pp. 1-29, 2009.

[6]. D. Wang, S.C.H. Hoi, Y. He, and J. Zhu, "Retrieval-Based Face Annotation by Weak Label Regularized Local Coordinate Coding," Proc. 19th ACM Int'l Conf. Multimedia (Multimedia), pp.353362, 2011.

[7]. D. Wang, S.C.H. Hoi, and Y. He, "A Unified Learning Framework for Auto Face Annotation by Mining Web Facial Images," Proc. 21st ACM Int'l Conf. Information and Knowledge Management (CIKM), pp. 1392-1401, 2012.

[8]. Dayong Wang, Steven C.H. Hoi, Ying He, and Jianke Zhu," Mining Weakly Labeled Web Facial Images for Search-Based Face Annotation" IEEE Transactions on Knowledge and Data Engineering, vol. 26, no. 1, January 2014

[9]. W. Dong, Z. Wang, W. Josephson, M. Charikar, and K. Li, "Modeling LSH for Performance Tuning," Proc. 17th ACM Conf. Information and Knowledge Management (CIKM), pp. 669-678, 2008.

[10]. J.Y.Choi, W.D.Neve, K.N.Plataniotis, and Y.M.Ro,"Collaborative Face Recognition for improved Face Annotation in Personal Photo Collections Shared on Online Social Networks,".