Middle-East Journal of Scientific Research 24 (S2): 01-05, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.S2.101

Design of Single Axis Solar Tracking System Using PLC

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Abstract: Due to rapid increase in globalization, the power requirement is also increasing day by day. To compensate the power needs various renewable energy sources are been employed because of its abundant supply. The objective of this paper is to develop an automatic solar tracking system where solar panels will keep aligned with the Sunlight in order to maximize in harvesting solar power. The system focuses on the alternative design of control system which will keep the system to track the maximum intensity of sunlight hit on the solar panel. When the intensity of sunlight is decreasing, this system changes its direction accordingly to get brightest intensity of Sunlight. LDR light detector acts as a sensor is used to trace the sunlight by detecting the level of sunlight. While to rotate the appropriate position of the panel, a geared DC motor is used. The system is controlled by two relays as a DC-geared motor driver and a PLC(programmable logic controller) as a main processor. This project is covered for a single axis, five positions in LDR sensor and is designed for low power and residential usage applications. The motor is also rotated using PLC controller, using H-bridge

Key words: LDR · Solar tracking · Intensity · PLC · DC motor

INTRODUCTION

Solar tracker system [1] is an automated rotation of solar panel that actually follows the intensity of light to increase the power requirement. The sun's position in the sky varies both with equipment over any fixed position. The heliostat, a movable mirror that reflects the moving sun to a fixed location. Active trackers uses motors and gear trains to direct the tracker as commanded by a controller responding to the solar direction. To develop the sun tracking, solar system model which is a device that traces the movements of the sunlight regardless speed of motor. Beside that, it is to improve the overall electricity generation using solar tracking system and also to provide the design for residential use. Light dependent resistor (LDR) has been chosen as the sensor because LDR is commonly used in sun tracking system. This is because LDR is sensitive to the light. The resistance of LDR will decreases with increasing incident light intensity. In existing solar tracking system, the 555 timer has been used and the intensity of sun light is assumed with the real time clock system to adjust the solar panel based on the clock time. The conceptual idea of the existing system is to move the panel one hour once from morning 6 o'clock to evening 6 o'clock for a period of 12 hours in 12 different angles. At noon 12 the panel will be horizontally placed so that the maximum intensity to be received. The intensity of the sun light varies from environmental conditions and seasonal changes so there will not be an efficient output from the panel. So the power production due to this will be much lesser. In proposed system, the 555 timer has been replaced with LDR sensor to measure the intensity of the sun light. With the use of the sensor, we can track the intensity of the sun light and make the movements in the direction of the solar panel with the implementation of DC Motor. The signals from the LDR are received to the PLC controller and the motor is operated with the help of the PLC programming. The LDR keeps on tracking sunlight and solar panel turns to the direction of higher intensity in order to produce the high power production.

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Methodology

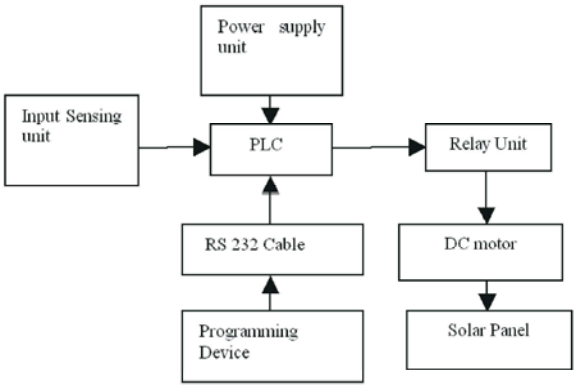

Fig. 1: Block diagram of proposed system

Sensing Unit: In this sensing unit five light dependent resistor sensors [2] are used for tracking the maximum sunlight intensity. Each of the sensors are equally spaced among them at an angle of 36 degrees covering a total of 180 degree of angle. The common wire from all LDR sensor are grounded inorder to use it for feedback system. All the five LDR sensors are compared by receiving the input signals that are processed to the PLC. Two sensors LDR A & LDR B are compared initially, depending upon the input signal which is receiving the higher sunlight intensity, then the solar panel rotates in forward direction towards higher sunlight intensity. Suppose if both LDR A & LDR B receive same amount of sunlight then the DC motor is stopped & kept in sleep mode of action. Again the sequence follows as LDR B & LDR C are compared, if the sunlight intensity received in direction of LDR C is higher, then the solar panel rotates in forward direction of LDR C.

D.C Motor: A motor in the solar tracking system is used to rotate the solar panel according to the inputs received from the PLC directed from the input sensing device. The motor is used to rotate the solar panel in forward direction and reverse direction.

Power Supply Unit: The 24v AC power supply is converted into 12v AC using step down transformer. By using bridge rectifier the AC to DC power supply is obtained for rotating of DC motor. By using filters the signal noise is removed. In this 12v filter & 5v filter are used for developing H-bridge circuit for DC motor. Finally the 12v DC power supply is obtained & connected in the DC motor.

Limit Switch: When the fifth LDR sensor is activated then solar panel rotates forward direction and at the end of the 180 degrees there is an limit switch placed for stopping of the DC motor, when the limit switch is hit by solar panel, then it is taken as input signal in the PLC programming, by PLC programming and H-bridge circuit the rotation of DC motor is reversed and so the solar panel is rotated in backward position for next day process.

Interfacing: The LDR sensor is taken as an input signal is send to the PLC controller were the programming is stored and read from the input signals such as LDR sensor, limit switch. The AB brand of PLC is chosen as the main controller for operating single axis [3] solar tracking system.

When its Cloudy in Early Hours: When the early hours is cloudy were no input signal are read from the LDR sensor and then during noon the sun is out then the solar [4] panel rotates according to the intensity of sun light. If first two sensors were not active during early hours then the third LDR sensor gets sunlight then the input is activated and the motor starts to rotate in forward direction.

When its Cloudy in Evening: When sun is out in early morning and then when it becomes cloudy in the evening the LDR 3 and LDR 4 position of input sensor may b inactive, in which early morning sunlight hits the first position of LDR 1 in which the limit switch is been hit and so the solar panel rotates in reverse direction.

Programming

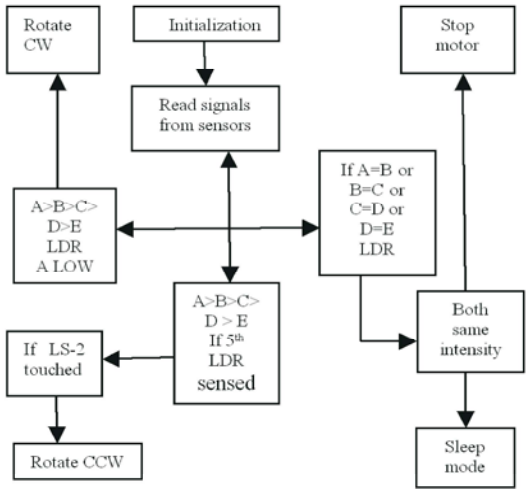

Fig. 2: Algorthim for PLC programming

A Programmable logic controller(PLC) is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices.

There are various types of PLC ranging from small usage to large capacity usage based upon the type of control system. However,the biggest benefit in using PLC is the ability to change and replicate the operation or process while collecting and communicating vital information.

RESULT AND SIMULATION

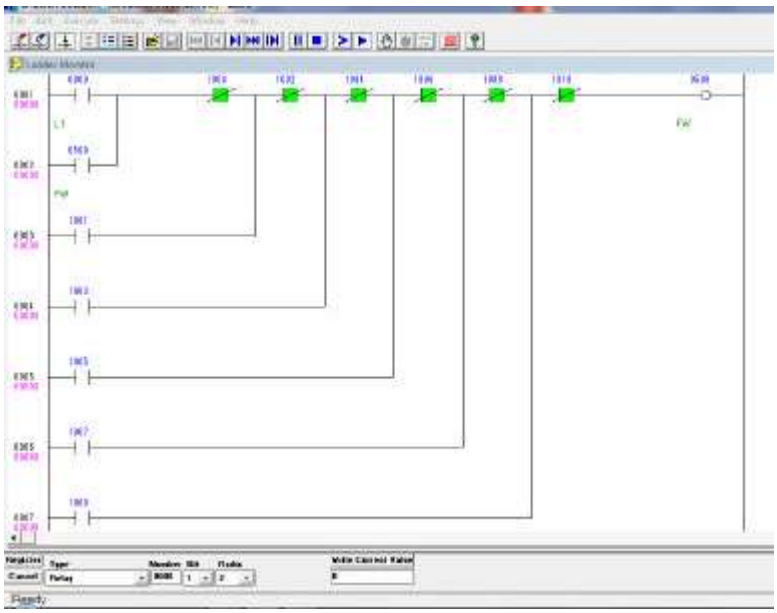

Fig. 3: Input switchs in PLC program

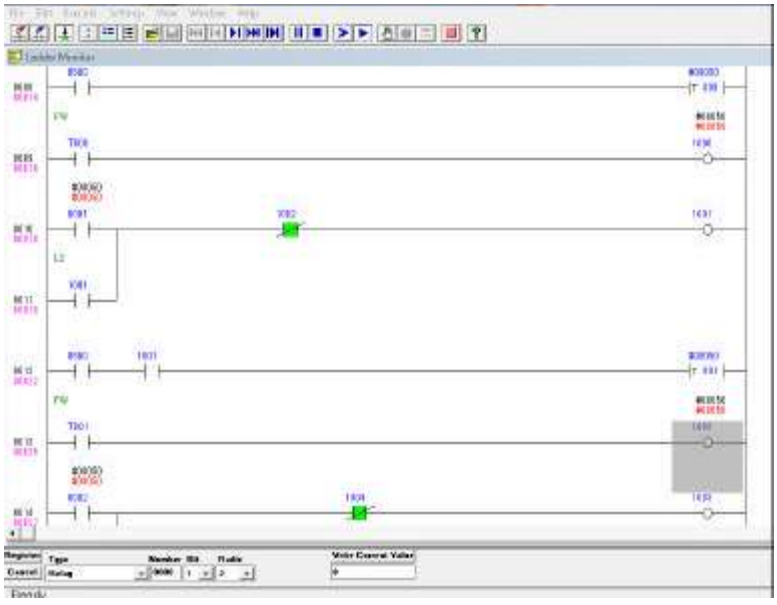

Fig. 4: Five position LDR as input switchs

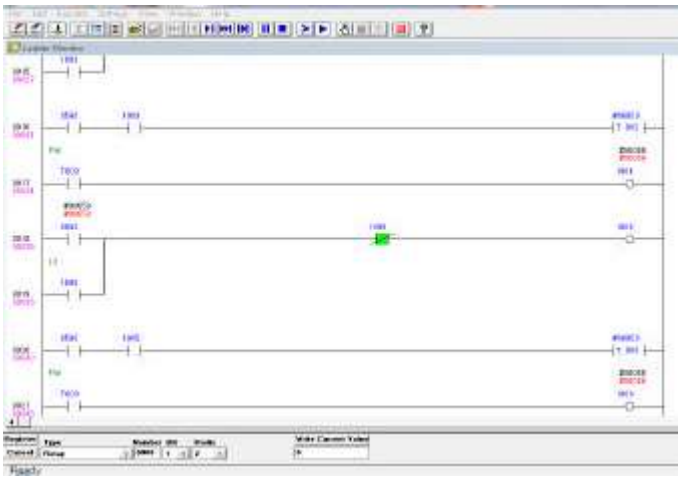

Fig. 5: Clockwise rotation of motor

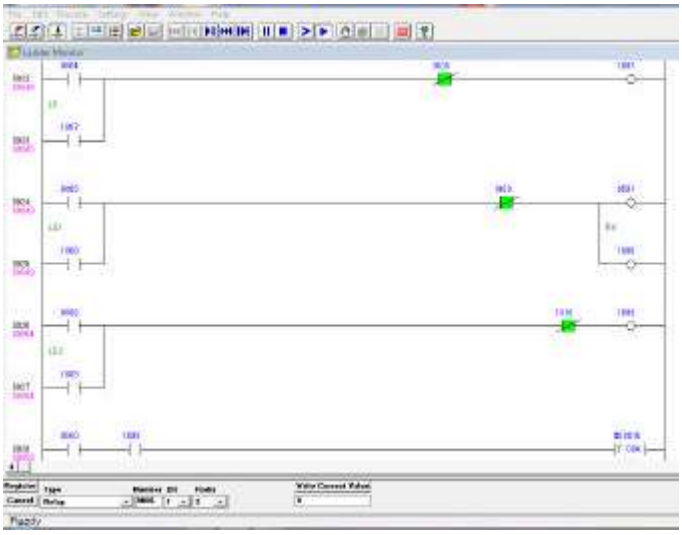

Fig. 6: Counter clockwise rotation of motor

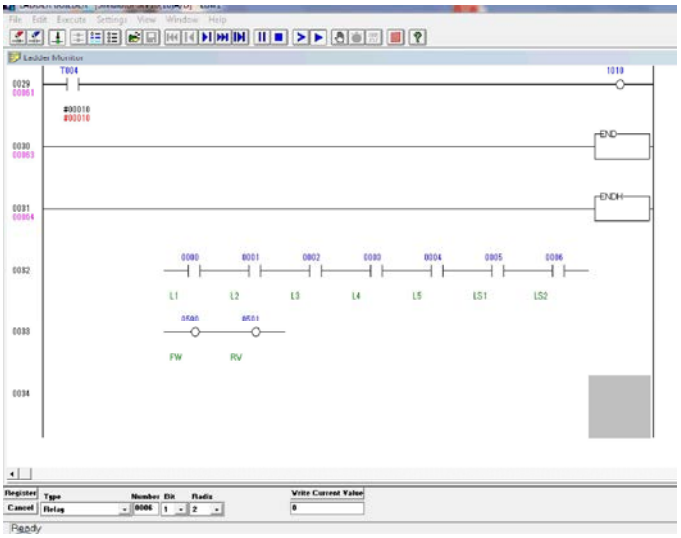

Fig. 7: Output of five position LDR sensor

The PLC program for single axis solar tracking system has five inputs. The ouput of DC Motor is utilised for rotation of solar panel. The H-bridge circuit with relays are used for forward and reverse direction of motor according to touch of limit switches. The step down transformer is used for operating the motor at 12v power supply.

Future Scope: Single axis solar tracking system prototype model for automatic tracking needed to be implemented in future work. Interfacing between computer & prototype model with help of PLC programming needed to be done.

CONCLUSION

This paper is proposed for a sun tracking system based on LDR sensor using PLC for rotating motor. The paper shows how to develop and implement a single axis solar tracking system with minimum cost. The PLC programming for five position LDR sensor is successfully simulated [5] using KV builder software.

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