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IMPLEMENTATION OF MAXIMUM POWER POINT TRACKING TWO AXIS ON PHOTOVOLTAIC BASED ON ARDUINO UNO

Widodo*, Luky Ardiansyah
Departemen of Electrical Engineering,
Faculty of Engineering, University of PGRI Adi Buana Surabaya
**Corresponding Email addres: widodo@unipasby.ac.id*

Abstrak - The photovoltaic system is a renewable energy source that utilizes solar energy and converts it into direct current (DC) electrical energy as an alternative energy to replace fossil fuels which will run out over time because it cannot be renewed quickly. In the design of the Maximum Power Point Tracking Two Axis On Photovoltaic Based on Arduino Uno intends to get a solar panel system that can work automatically following the maximum point of sunlight. The LDR (Light Dependent Resisitor) sensor functions to provide analog signals to Arduino Uno which Arduino Uno then processed as a basis for decision making to move the steper motor in changing the position of the solar panel so that it can get maximum sun exposure.

***Keywords**: Photovoltaic, LDR Sensor, and Arduino Uno*

1. INTRODUCTION

In this era of globalization, the earth's condition is getting warmer day by day, so there is a lot of discourse to minimize the use of fossil fuels which can strengthen the greenhouse effect caused by the residual gases from combustion of fossil fuels. In addition to the greenhouse effect, fossil fuels It will also run out if it is continuously used because it cannot be renewed quickly, which encourages the use of renewable energy which can replace the role of fossil fuels which have been the main energy source in human life in general. Photovoltaic systems have nonlinear output characteristics influenced by irradiation, temperature, and load impedance. The maximum power of the solar panel is obtained when it is at a certain operating point called the Maximum Power Point (MPP). So, MPPT is needed to find MPP when temperature and / or irradiation changes [2]. Seeing the great opportunity that exists in the presence of renewable energy from the sun, a photovoltaic system will be created that can move according to the movement of the sun. This photovoltaic system works based on the LDR sensor as an identifier for the intensity of sunlight, 2 stepper motors as an actuator to change the direction of the solar panel. This solar solar panel system works automatically with instructions that have been programmed.

2. METHOD

To support this research, the authors make an arrangement of product research designs that will assist in the process of making, testing and retrieving the required data..

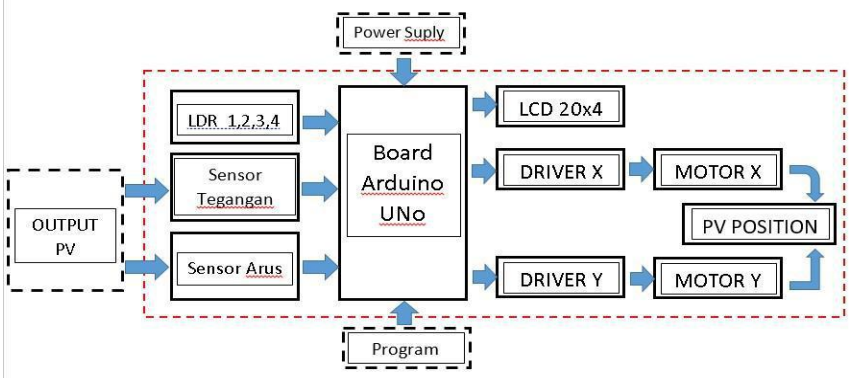

Figure 1. Block Diagram of Product Design

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How the block diagram above works is as follows:

- LDR Sensor

As a tool used to detect light intensity and forward the signal to the Arduino to be processed as an output to be used to control the stepper motor driver.

- Voltage Sensor and Current Sensor

As a tool used to detect the output voltage and current from the solar panel which will then be processed by Arduino to be displayed on the LCD display.

- Arduino Uno

Serves as the main brain of the automatic work system. Arduino Uno contains programs that have been uploaded by the programmer as desired. Arduino requires an input voltage supply of 3-5 volts DC

- LCD (Liquid Crystal Display)

LCD (Liquid Crystal Display) is a type of display media that uses liquid crystals as the main display. LCD has been used in various fields, such as electronic devices such as televisions, calculators, or computer screens. In the post, the LCD application used is a dot matrix LCD with a 20x4 character number. LCD is very functional as a viewer which will be used to display the working status of the tool.

- Power Supply

The power supply is used as a voltage source for the Arduino Uno boar, the voltage from the power supply must be adjustable from the range 3 - 5 volts DC.

- Driver Motor Stepper

Serves as a signal successor from Arduino to the stepper motor so that it can move according to the program.

- Motor Stepper

Serves to drive the mechanical system in determining the position of the solar panel against the optimal exposure to the sun's syncs according to the LDR sensor readings.

a. Product Test

- Test the voltage sensor and current sensor to read the output voltage and current from the solar panel and it will be displayed on the LCD.
- Sensitivity test of the ldr sensor in light intensity readings.
- Test drivers and stepper motors to drive mechanical systems.

b. Operational Definition of Variables

1) The independent variables, namely: Light Intensity.
   Variable operational definition: Light intensity is the input that the LDR (Light Dependent Resistor) sensor will read. In principle, the LDR sensor functions when exposed to sunlight, this sensor will send an analog signal to the Arduino Uno. Then it is processed into Arduino Uno input for decision making on the position of the steper motor according to the movement of the sun's position.
2) The dependent variable, namely: Motor Movement.
   Variable operational definition: Motor movement is the movement generated from the stepper motor which will determine the position of the solar panels against the position of the sun.

3. RESULTS AND DISCUSSION

3.1 Results of Software Research

The results of the implementation of two-axis maximum power point tracking on an Arduino microcontroller-based photovoltaic using 4 ldr sensors which are useful for giving analog signals which are then converted into digital signals to instruct stepper motor drivers to move the stepper motor to move the panel solar signal exposure to the sun optimally.

3.2 Hardware Research Results

The results of the implementation of the hardware design need to be tested for the function of all circuits. Circuit testing is carried out separately and data and evidence are obtained that the system that has been created can work properly.

a. Power supply circuit testing

Based on the design of the power supply used, it is necessary to test the voltage output using a device called a multimeter. The test is carried out by providing a voltage input to the power supply of 220Volt AC and the output is checked whether it matches the required voltage, namely 5VDC.

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Figure 2 Testing the 5VDC power supply output

b. Arduino board testing

Arduino as the system control center, has an important role so that all hardware works properly according to orders. Arduino testing is done by giving a voltage of 5VDC and entering a simple program (upload program) from the laptop via a USB cable. Programs created with the Arduino IDE program are then compiled and uploaded.

c. 20 x 4 LCD testing

LCD (Liquid Crystal Display) is a type of display media that uses liquid crystals as the main display. LCD has been used to display current and voltage sensor readings.

Figure 3. Testing the LCD circuit

d. LDR sensor sensitivity testing

The test was carried out by exposing the four ldr sensors to the hot sun and data on what the maximum and minimum values were from the ldr sensor readings.

Figure 4. Testing the LDR sensor

e. Testing stepper motor drivers and stepper motors.

Testing of the driver and stepper motor is carried out to determine the performance of the stepper motor in making step changes to the program instruction of Arduino Uno.

Figure 5. Testing the driver and steper motor

3.3 Data analysis

Based on the results of the research that has been carried out, the results of the study are presented in the form of data presentation that is in accordance with the results of previous measurements. This research was carried out.

a. Static solar panel data presentation (without tracking)

Data obtained from direct measurements on a static solar panel system every 30 minutes from 7 am to 4 pm shown in Figure 6 so that the voltage and current output from the solar panel are obtained.

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Figure 6. Measurement of the voltage and current of a static solar panel system

Table 1.Sample of voltage and current measurement results for a static solar panel system

Waktu(WIB)	Vout (Volt)	Iout(mA)
07:00	18.60	232
07:30	18.90	245
08:00	19.10	340
08:30	19.12	364
09:00	19.45	386

b. Presentation of dynamic solar panel data (tracked)

Data obtained from direct measurements on a dynamic solar panel system every 30 minutes from 7 am to 4 pm shown in Figure 7 so that the voltage and current output from the solar panel are obtained.

Figure 7. Voltage and current measurements for dynamic solar panel systems

Table 2.Samples of measurement results for dynamic solar panel system voltages and currents

Waktu(WIB)	Vout (Volt)	Iout(mA)
07:00	19.33	223
07:30	19.34	303
08:00	19.43	320
08:30	19.48	363
09:00	19.99	486

3.4 Discussion of Data Analysis

Based on the results of data analysis that has been carried out as in Tables 1 and 2, researchers can discuss the results of research on automation systems that have been made. The results of testing the controller device can work well but have slightly less accuracy due to the weight of the mechanical frame which is too heavy, resulting in a slow response of the stepper motor movement for about 2-3 seconds on each axis shift execution.

4. CONCLUSION

From the results of the discussion on the research implementation of maximum power point tracking on phothovoltaics based on Arduino Uno, it can run and function properly and achieve the expected goals. However, with some of the limitations that the researcher has, there are also some obstacles that are experienced by the researcher. The results of the researchers' observations can be concluded, namely:

1. The solar panel system using 2 axis tracking of the sun based on Arduino Uno can increase the current efficiency and the output voltage of the solar panel.
2. The pirating system runs 2-3 seconds slower by using a solar panel frame that has excess weight.

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