Dual Axis Solar Tracker With Fuzzy Logic Method

Yustinus Bagus Arisoya
Sanata Dharma University
Yogyakarta, Indonesia
bagusarisoya@gmail.com

A. Bayu Primawan
Sanata Dharma University
Yogyakarta, Indonesia
bayu@dosen.usd.ac.id

Djoko Untoro Suwarno.
Sanata Dharma University
Yogyakarta, Indonesia
djk_untoro@usd.ac.id

Abstract—The aim of the research is to fix the solar trackers that use LDR as input were losing tracking due to bad weather. In addition, solar trackers that use the calculation of the sun's movement cannot adapt to the environment when the weather is bad. As a solution to these problems, a two-axis solar tracker was made using fuzzy logic. The north south axis is moved once per day. The tilt angle of this axis is determined by the fuzzy logic output. The first input of this fuzzy logic is the difference between the west LDR and the east LDR. The second input of this fuzzy logic is the difference between the calculated east-west angle and the actual east-west axis angle. The output of fuzzy logic is the speed of the actuator and the direction. The actuator is two stepper motors. This project uses Arduino Mega as a data processing center and ESP-12E to send data to Blynk. The ESP-12E acts as the master while the Arduino Mega acts as the slave. These two modules communicate with the I2C protocol. In conclusion, this solar tracker can follow the movement of the sun and adapt to the environment or weather at that time.

Keywords—solar tracker, dual axis, fuzzy logic, LDR, motor stepper, arduino mega, ESP-12E, solar panel

I. INTRODUCTION

Global warming issue has been discussed recently. The use of fossil fuels is one of the causes of global warming. To prevent the worsening of global warming, many researchers are developing renewable energy as a substitute for energy made from fossil fuels. Various kinds of renewable energy sources have been found, including energy sources from wind, water, sun, geothermal, and biomass.

Renewable energy sourced from the sun is one of technologies that is quite popular compared to other renewable energy sources. The popularity of this technology is because it can be applied on a small scale. However, to be able to optimize the output of the solar panel, it must be perpendicular to the angle of the sun.

The sun has two types of angles in its motion: declination angle and the hourly angle. To be perpendicular to the sun, a tool is needed that can move the position of the solar panels. A device to adjust the position of the solar panel to the angle of the sun is called a solar tracker. Solar trackers are usually equipped with light sensors such as LDR (Light Dependent Resistance) to detect the presence of the sun. There are two types of solar trackers that can be applied: single-axis and dual-axis. According to a journal, it is said that two axis can produce 12% more energy than one axis [1].

Solar trackers that use LDR usually will lose the track when the weather is cloudy. To overcome these weaknesses, this system is equipped with inputs derived from the calculation of hourly angles and LDR. The purpose of this additional input is to make sure the system does not lose its tracking and can approach the most optimal angle even though the weather is bad. The data processing method of this system uses fuzzy logic. With this method, the design will be easier because we do not need a mathematical model of the system, but it is enough with several sets of rules for decision making [2]. To monitor the input and the output, Blynk application will be used. It is easier to display input, output data, and create graphs with this application [3].

II. DUAL AXIS SOLAR TRACKER DESIGN

The solar tracker in this project has two axis. The first axis is the north south axis. This axis is used to adjust the declination angle. The movement of this axis is only done once per day. Determination of the tilt angle on this axis is based on the calculation. The result of this calculation becomes the set point of motor movement. The second axis is the east west axis. This axis is used to adjust the movement of the sun from west to east. Tracking on this axis will be performed every 10 minutes using fuzzy logic.

The system will receive input from the west LDR, east LDR, and RTC (Real Time Clock) during the tracking process. LDR is used to determine the difference in the intensity of sunlight on the west and east sides. RTC is used to inform the current time. Sun tracking will only be done if it is between 8 am and 4 pm. To determine the mechanical 0 point, this project uses limit switches as stoppers. Mechanical 0 point only determined in the first running of the machine.

Input processing, formula calculation, and fuzzy logic processing are performed by Arduino Mega. Arduino Mega acts as slave and ESP-12E as master. This configuration was chosen because the GPIO ESP-12E has a working voltage of 3.3V. If Arduino Uno is used as the master, it will potentially damage the GPIO ESP12-E when sending SDA or SCK signals with a value of 5V. The input and output data will be sent to the ESP-12E via I2C so that it can be displayed on Blynk. The result of the fuzzy logic is used to determine the speed and direction of the stepper motor. The data acquisition process will be carried out every 10 minutes.

The data that will be monitored with the Blynk application are: West and east sensor readings, angle of declination according to the formula, hourly angle according to the formula, the actual angle of the north south motor and east west motor, the last is the defuzzification value. Summary of this project can be seen in figure 1.