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Designing Solar Tracker System under Fuzzy Logic Controller

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Abstract **– In this paper, we proposed a wireless communication technology to assist local government, society and waste officer to monitoring waste level in the container. To applied this system, a sensor was required to detect the level of waste in the container. A control system send a massages direct to a mobile phone and website to inform regarding of the level of waste in the container. There are two kind of information from the monitoring centre, such as: full or not full. All information status was updated automatically through the system. The result indicated the real time processing to control the level of waste in the bin have been displayed in the monitoring system.**

Keywords **– Container, Detect, Level, Monitoring, Waste.**

I. INTRODUCTION

Today, fossil fuel as a finite resources have become a big problem in the world. Even though burning fossil fuel, such as: gas, coal and oil are considered most economic ways to generate electricity. However, the cost of which increases sharply as the availability decreases. According to [1] the problem of shortage of fossil fuel sources and global warming effects have become more and more severe.

Based on [1, 2] one of solution to solve the problem is applied energy sun as an a potential option, which not only as an alternative energy but also decreased environmental pollution. According to [3] photovoltaic solar system is considered to be as a renewable energy solution for most of energy crises and environmental pollution. In order to increase the solar system efficiency, it is required to maximize the output power by keeping the solar panel aligned to the sun. Consequently, a tracking of the sun position with high degree of accuracy is required [3].

According to [3] the main purpose of solar tracking system is to track the movement of the sun during the aunshine in order to orientate the solar panel to the maximum radiation in all time. A solar tracker is a device that orients a payload towards the sun. The use of solar tracker can increase electricity production by around a third, and some claim by as much as 40% in some regions, compared with modules at a fixed angle. In any solar application, the conversion efficiency is improved when the modules are continually adjusted to the optimum angle as the sun traverses the sky. As improved efficiency means improved yield, use of trackers can make quite a difference to the income from a large plant [4].

According to [4] the commercial purpose of solar tracking system are:

1. Increase solar panel output
2. Maximum efficiency of the panel
3. Maximum power per unit are
4. Able to grab the energy throughout the day.

The application of solar tracking system in recent years are increased rapidly. However, still need to improve the materials and methods to optimize this system. In Taiwan, solar panel have been applied to produce electricity, where many power-generating products operate in open by using solar cell. However, as the solar panel are exposed to the elements, blemishes and deposits accumulate on the surface, reducing the efficiency of the output current. The particle create shadows on the solar cells, substantially reducing the energy conversion efficiency [5].

Based on the technical report that, in USA have shown solar tracking to be particularly effective in summer, when the increases in output energy may reach over 50%, while in autumn they may be higher than 20%, its depending on the technology used [6].

II. SOLAR TRACKING AND FUZZY CONTROLLER DESIGN

According to [6] solar tracking can be classified to several criteria, such as:

1. Solar tracking system with a rotation axis
2. Solar tracking system with two rotation axis

Based on [7] the for one axis sun tracker, the tracking system drives the collector about an axis of rotation until the sun central ray and the aperture normal are coplanar. Single axis solar trackers can either have a horizontal or vertical axis. The horizontal type is used in region near the equator where the sun gets very high at noon, thus not having to adjust to vertical changes so much as horizontal changes [8]. There are three types of one axis sun tracker, such as [7]:

1. Horizontal -axis tracker- the tracking axis is to remain parallel to the surface of the earth and it is always oriented along East-West or North-South direction.
2. Titled axis Tracker-the tracking axis is titled from the horizon by an angle oriented along North-South direction, e.g. latitude-tilted-axis sun tracker.
3. Vertical-Axis Tracker-the tracking axis is collinear with the zenith axis and it is known as azimuth sun tracker.

In contrast, the two axis sun tracker, such as azimuth elevation and tilt roll sun tracker. Azimuth-elevation and till-roll sun tracker are the most popular two-axis sun tracker employed in various solar energy application. This type is most costly and most complicated design. Dual axis solar tracker have both a horizontal and a vertical axis and thus they can track the sun apparent motion virtually anywhere in the sky no matter where it is positioned on earth [8].

The following Figure 1 indicated classified of solar tracking :

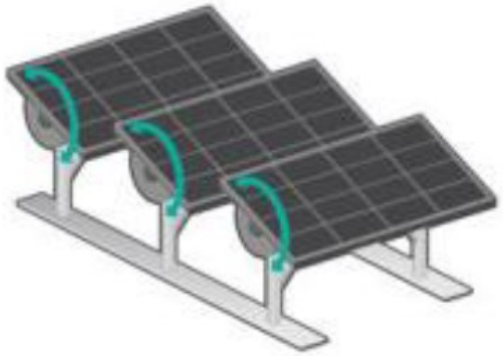

Fig. 1. Horizontal axis tracker [9]

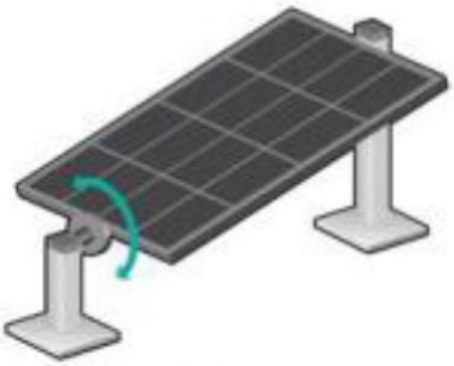

Fig. 2. Tilted Axis tracker [9]

Fig. 3. Vertical Axis tracker [9]

In the previously research, Fuzzy controller was applied to track the movement of the sun. According to [5] fuzzy logic controller to determine the solar intensity based on the CdS circuit values was 0.25 , a level indicated the CdS has detected a light source, as well as to determine whether the energy conversion efficiency was too law for the solar panel. The most popular method of implementing fuzzy controller is using a general purpose microprocessor or microcontroller. Microprocessor based controller are more economical, but often face difficulties in dealing with control system that required high processing and input/output handling speed. Rapid advance in digital technologies have given designer the option of implementing a controller on a variety of programmable Logic Device (PLD), Field Programmable Gate array (FPGA) and etc. FPGA is suitable for past implementation controller and can be programmed to do any type of digital function [10].

III. Research Methodology

The following Figure 4 indicate the block diagram of solar tracker

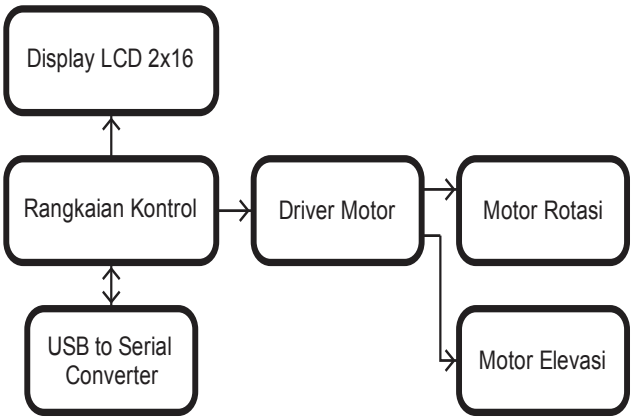

Fig. 4. Block diagram of solar tracker

Figure 4 illustrated that the block diagram of solar tracker. In this research, there are some equipment or tools were required ro design of solar tracker, such as: LCD layer, control circuit, USB, driver motor, rotation motor and elevation motor. In this research, microcontroller ATMega16 is used for main component in this system.

For the first step, mechanical design was developed to setup photovoltaic, as illustrated in the following Figure 5.

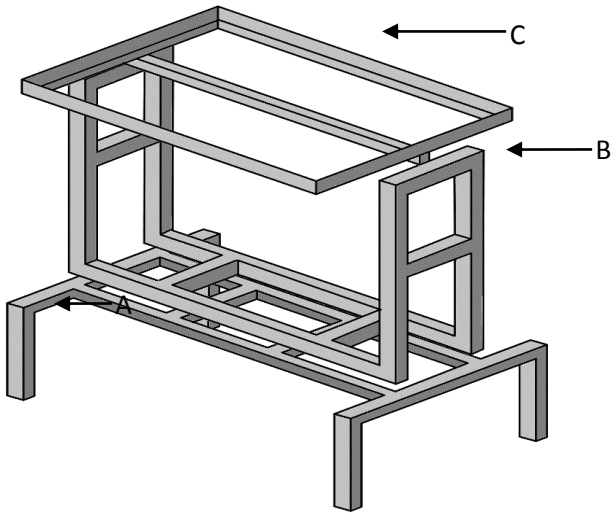

Fig. 5. Mechanical Design

Figur 5 illustrated that there are three part as a componen in this model was developed, such as:

A. Main componen, this part to support all componnent in this system
B. Elevation componen, this part is needed to install electricity motor for elevation system.
C. Rotation componen, this part is used to put photovoltaic and to install electricity motor for rotation system.

The following Figure 6 indicated control box system that has been designed:

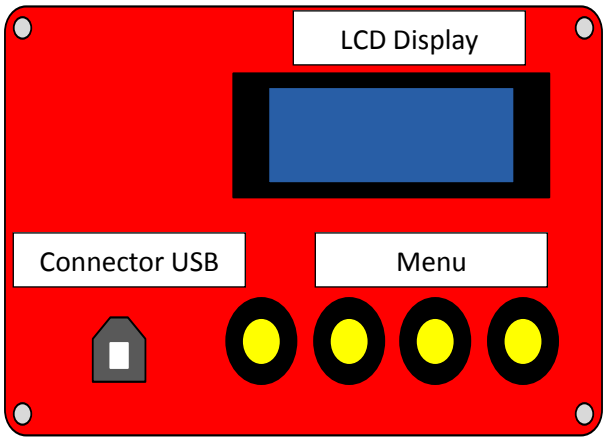

Fig. 6. Control box system

The design of the control box serves as a testing tool used for setting up the rotation angle and the desired elevation.

The following figure, 7 and 8 indicated the solar tracker design is used to take some data's for rotation and elevation system.

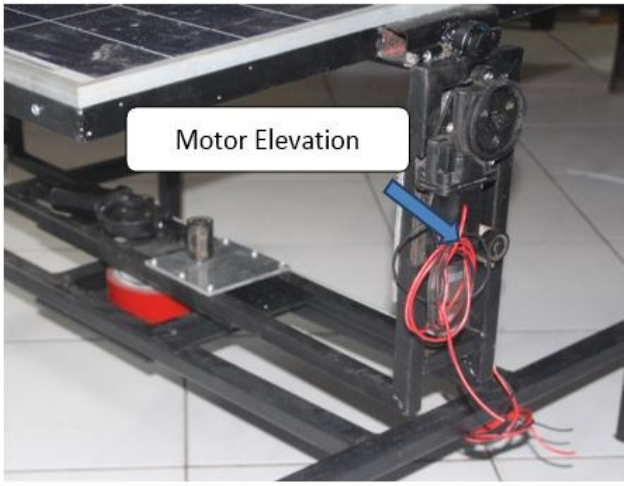

Fig. 7. Motor elevation

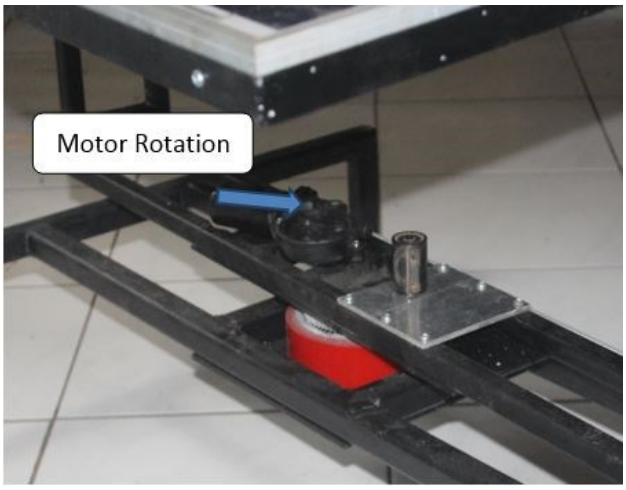

Fig. 8. Motor rotation

IV. Result and Discussion

The following Figure 9 illustrated solar tracker interface which can be used to control and monitoring system.

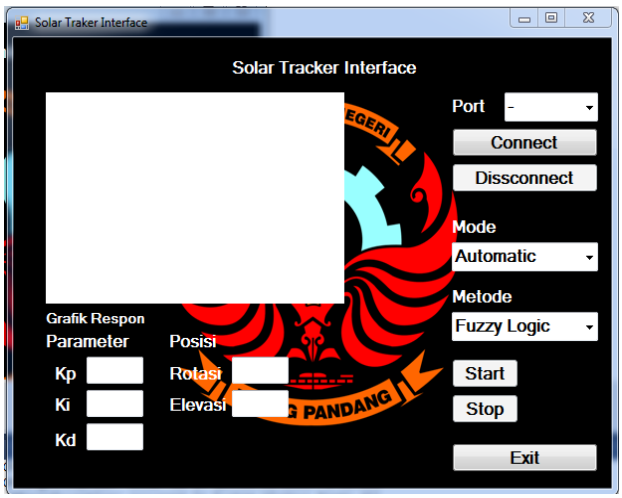

Fig. 9. Solar tracker interface

In the operation of this software interface, there are several settings provided that is mode and method. In the mode settings, there are two types of options provided are manual and automatic. Likewise with the type of method settings. The use of fuzzy logic method can be used as an option. Rotation and elevation position values can be entered to direct the solar tracker manually. The parameter button will work if the user is using a Fuzzy Logic control. While the position button will work if the user using the control manually. To start the operation, user only used the start button, in contrast stop button to stop the system. Connect button was applied if consumer want make connection with control box and Disconnect to end connection. The following Figure 10 and 11 illustrate some example as a response to the given parameters.

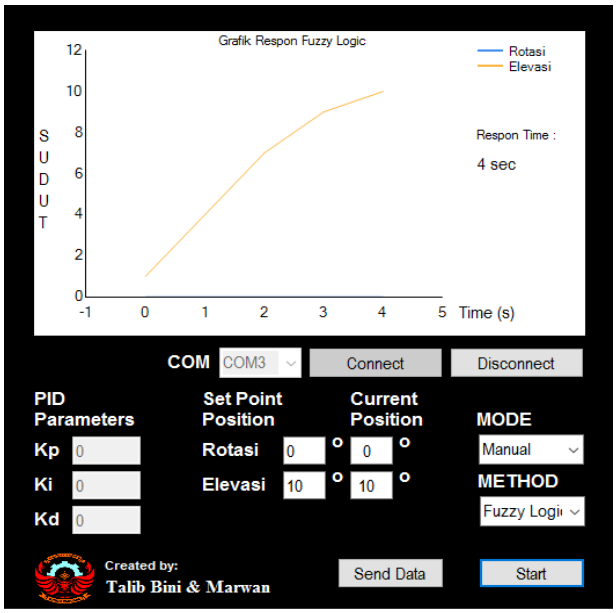

Fig. 10. Response Fuzzy Logic for Set Point 10º, Present Value 0º

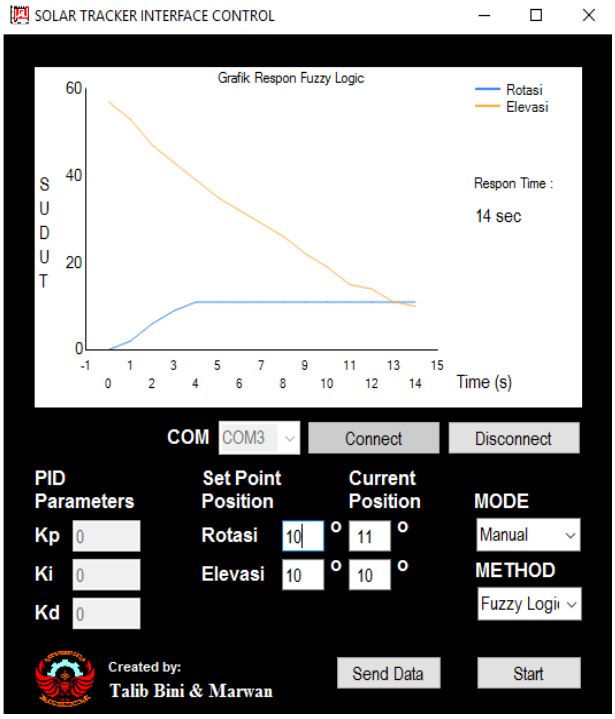

Fig. 11. Response Fuzzy Logic for Set Point 10º, Present Value 0º

Figure 11 above indicated that the tool response to the given fuzzy logic control, the y axis is the position, and the x-axis is the time. In the set point graph of 10º, the time needed to reach the set point tool is 4 seconds. Similarly, on rotation and elevation testing, the time required in set point 10º requires 14 seconds to reach the set point value.

V. Conclusion

Based on the results of tests performed indicate that this tool responds to the given Fuzzy Logic parameters, where y axis is the position, and the x axis is the time. Response time obtained in the use of Fuzzy Logic method can function well both at the time of use of rotation and elevation on the solar tracker system.

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