GPS Module Programming of Sun Position Algorithm for 2-Axis Sun Tracking System

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Abstract
The overall objective of this study is to design and develop a program for controlling A Dual axis sun tracking system with astronomical equation program on Arduino via GPS module. This paper discusses about mechanical structure, concept of program and algorithm base on the astronomical equation in Thailand. The concept of this tracking system is to collect GPS location and real-time data of date and time to calculate Azimuth and Elevation angle without another sensors, which is usually have problem of sun tracking. The dual axis sun tracking controller system develops by using an 8 bits Arduino MEGA via GPS module. This paper also compares the efficiency of the dual axis sun tracking system and a non-tracking system under the same location and environment.

Keywords: Dual Solar Tracking System, Arduino, GPS Module

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Introduction

In Thailand, Alternative Energy Development Plan (AEDP : 2015-2036) have Solar is the most proportion number about 6,000 MW shown in Figure 1. Now Solar Plant in Thailand about 1,420 MW, almost of them is fixed type can be percent about 98%. In Solar Roof top (fixed type) is about 20% , Solar Power Plant (fixed type) is about 78% and the tracking System just have in solar power plant only. It's about 2 %. For capacity factor of solar roof top (fixed type), there is 20 units in Metropolitan Electricity Authority Area, that is about 12% shown in Figure 2.

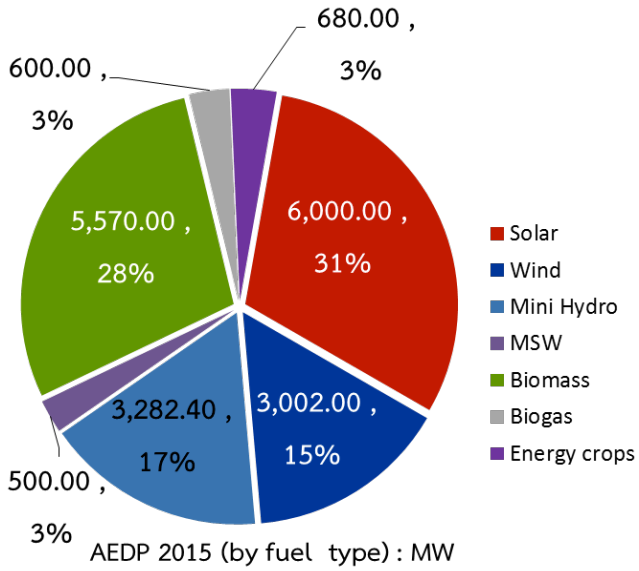

Figure 1 : PDP2015 Proportion

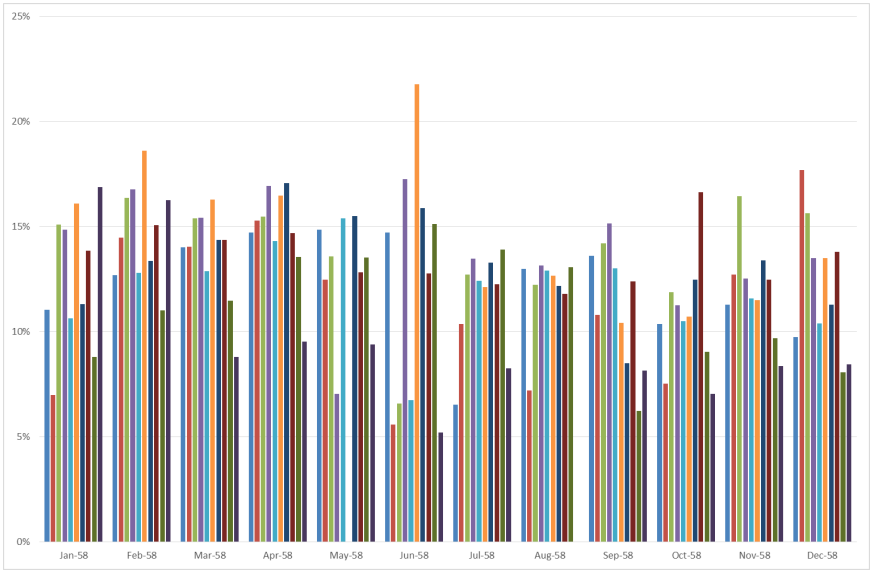

Figure 2 : Capacity Factor Solar Rooftop

The problem of loss factors of solar plant fixed type consist of first , a season problem with the direction of motion of the sun, the energy value is not maximum efficiency. And second, sun path problems with path moving of the sun in each day, the sun always moving, not stop shown in Figure 3. So increasing efficiency of solar plant is moving PV module, which always track the sun.

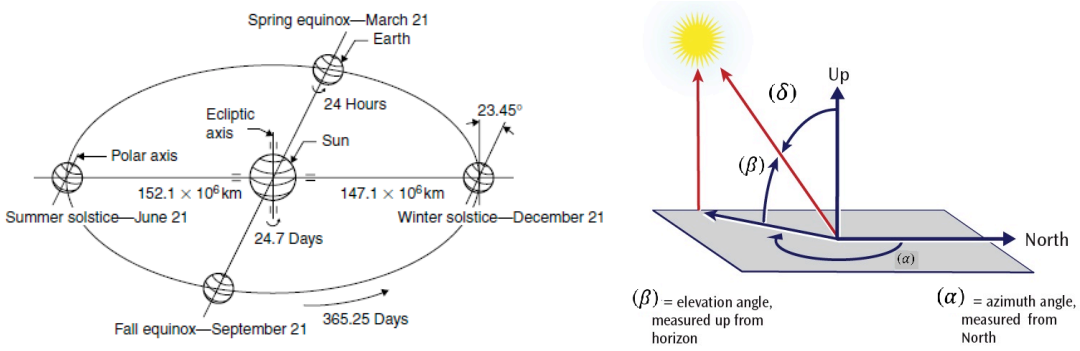

Figure 3 : Problem of the statement

The solar tracking systems have 3 types, which include of one axis Tracking, one axis tracking with tiled angle and dual axis tracking system shown in Table 1.

Table 1 : Type of Solar Tracking

Solar Tracking Type	% efficiency more than fixed type
One Axis	13 %
One Axis with tiled angle	17%
Dual Axis	20%

Idea and Concept

For the idea for dual tracking program can consist of 3 main parts shown in

Figure 1. First Data Time and Location (Latitude and Longitude), in red block, that can get the data from GPS Module We choose the EM506 from Sparkfun. Second Astronomical Parameter it's consist of the basic parameter, in blue block, that can calculate by Microcontroller we choose the Arduino MEGA 2560 as, develop by C# programming. The last is the sun angle parameter, in orange block, Angle after calculated from arduino, that command the motor drive for Sun tracking.

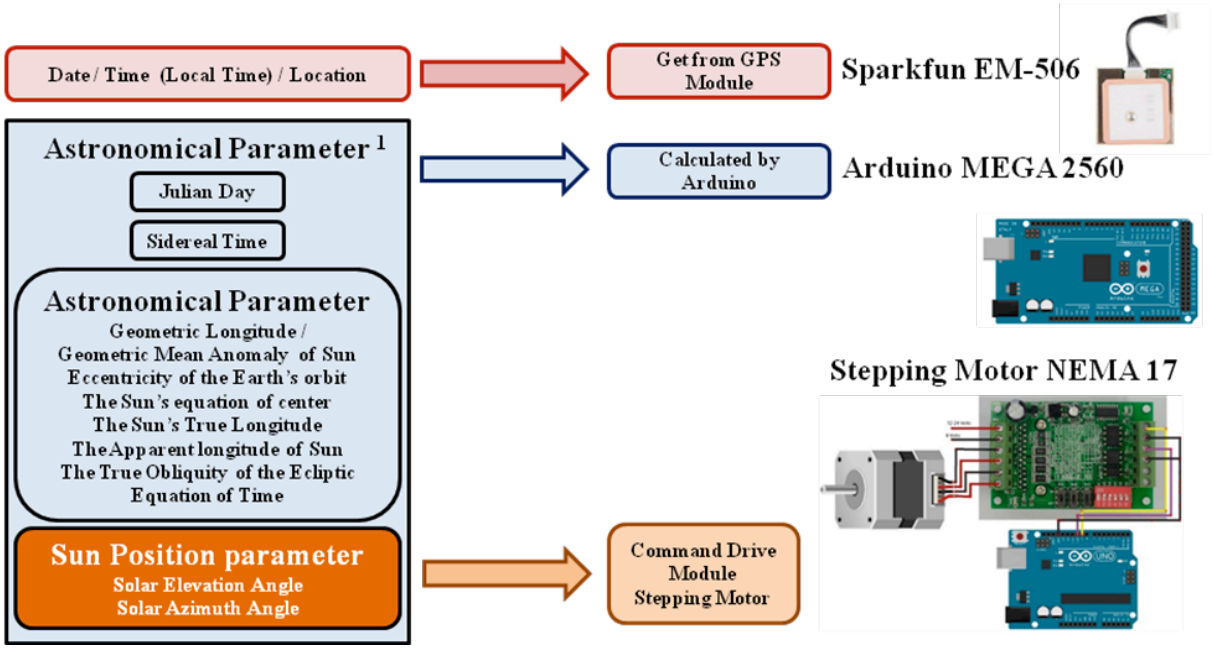

Figure 4 : Idea and Concept

For structure of dual axis tracking module can shown in Figure 5, that consist of 5 point. Position A is rotation point of Elevation / Zenith angle. Position B is rotation point of Azimuth angle. Path C is rotated direction of Elevation / Zenith angle. Path D is rotated direction of Azimuth angle. Position E is dish for install Pyranometer or PV Module.

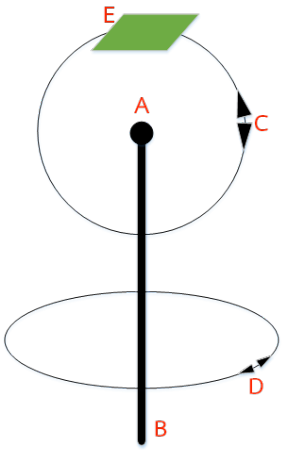

Figure 5 : structure of dual axis tracking module

For collect of data and analysis, use comparing result (Azimuth and Elevation Angle) during a year between general calculation with result from calculation of Arduino and General calculation with actual tracking feedback from potentiometer following Figure 6.

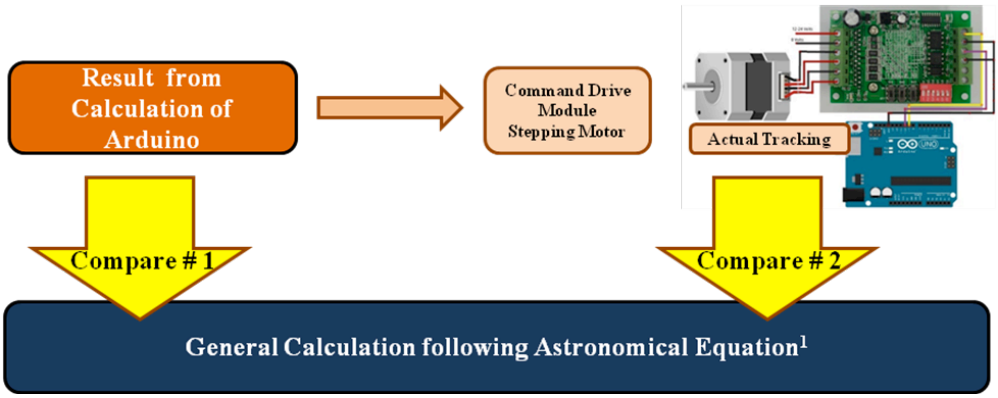

Figure 6 : Data Collection and Analysis

Result

First, the result data collection with simulation during in year 2017 for checking error of the program and system, which have error about 5%. In month May have error highest in year, that is about 40-50 %

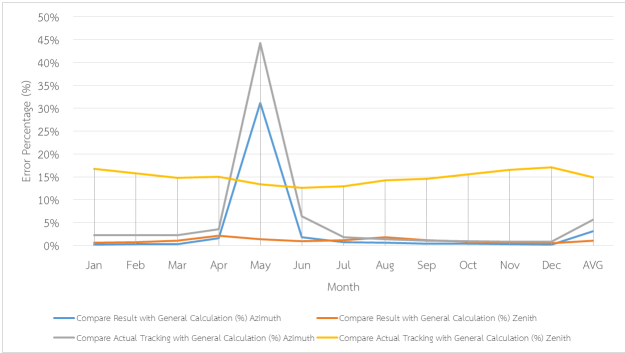

Figure 7 : Error of the program and system

Second, the compare solar radiation between dual solar tacking with fixed tiled south 15 degree. The Dual solar tracking system can increase efficiency more than fixed type about 15% shown in Figure 8.

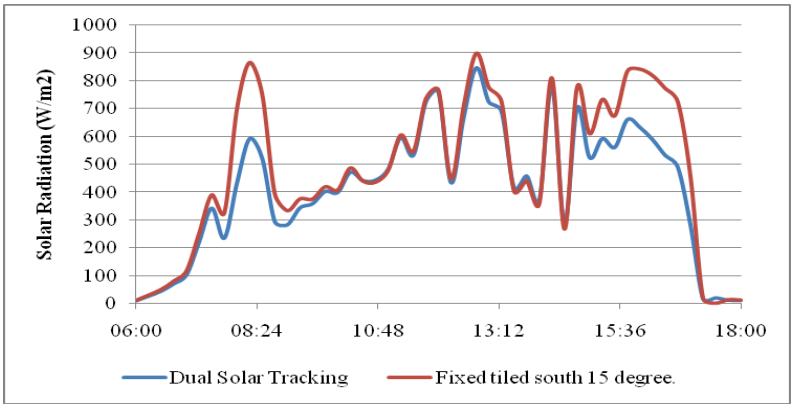

Figure 8 : solar radiation between dual solar tacking with fixed tiled south 15 degree

Conclusion

In conclusion, it is clear that the dual solar tracking system can receive radiation from the sun more than the fixed type south 15 degree is about 15%. And the program has the error average 5 % for simulation in year 2017. But this module and system is a model of pilot for studying the concept of program and create the simple and basic module, which cannot protect water and dust.

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