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2016 International Conference on Smart Green Technology in Electrical and Information Systems (ICSGTEIS)

CONFERENCE PROCEEDINGS

Advancing Smart and Green Technology to Build Smart Society

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Department of Electrical and Computer Engineering
Postgraduate Study in Electrical and Computer Engineering
Udayana University

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WELCOME MESSAGE

It is my privilege and pleasure to welcome to the beautiful island of Bali all the distinguished participants to the International Conference on Smart-Green Technology in Electrical and Information Systems (ICSGTEIS 2016) which is held on 6 – 8 October 2016, in Sanur, Bali. The ICSGTEIS 2016 is organized by Department of Electrical and Computer Engineering together with Magister of Electrical and Computer Engineering, Udayana University, for international researchers, experts, students to share, exchange ideas, innovation, experience and the latest research in the field of Smart-Green Technologies. The conference is conducted in conjunction with 54th Anniversary of Udayana University and 51st Anniversary of Faculty of Engineering.

The conference includes a wide range of topics, that is not limited to Energy and Power Engineering, Electronic Devices and Systems, Multimedia Telecommunications, and Software Engineering and Information Systems. The conference has received 95 submissions. All submissions then have been reviewed through peer revieweng process. There are 38 selected papers for presentation.

Additionaly, the conference run three programs that are international workshop on 'e-Government toward Smart City Implementation', Udayana University IEEE Student Branch Workshop with topic of 'Internet of Thing for Smart City', International Student Conference conducted by Udayana University IEEE Student Branch, and social events. Totally eight keynote speakers are pleased to present and share their latest reseach in the plenary sessions and in the workshops.

For this good opportunity, I would like to express my great gratitude to all keynote speakers for their kind support to make this conference a great success. I would like to thank the IEEE Indonesia Section for their continuous support. My high appreciation goes to the President of Udayana University and Dean of Engineering Faculty of Udayana University for their encouragement and funding. Many thanks go to Primakara, PT. Telkom, and all technical sponsors for their kind assistance. In addition, I am grateful for great support of all technical program and organizing committees for their hard work for more than one year. Finally many thanks go to all participants. With all of your supports, the conference could be run now.

I wish you all have a successful conference and pleasant experience of Bali.

Dr. Linawati
ICSGTEIS 2016 General Chair

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INVITED TALKS

Inkjet-/3D-/4D- Printed Paper/Polymer-Based "Green" mmW Modules: The Final Step to Bridge Cognitive Intelligence, Nanotechnology and RF for IoT and 5G Applications

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Abstract. In this talk, inkjet-/3D-printed flexible antennas, RF electronics and sensors fabricated on paper and other polymer (e.g. LCP) substrates are introduced as a system-level solution for ultra-low-cost mass production of Millimeter-Wave Modules for Communication, Energy Harvesting and Sensing applications. Prof. Tentzeris will briefly touch up the state-of-the-art area of fully-integrated wireless sensor modules on paper or flexible LCP and show the first ever 2D sensor integration with an RFID tag module on paper, as well as numerous 3D and 4D multilayer paper-based and LCP-based RF/microwave structures, that could potentially set the foundation for the truly convergent wireless sensor ad-hoc networks of the future with enhanced cognitive intelligence and "rugged" packaging. Prof. Tentzeris will discuss issues concerning the power sources of "near-perpetual" RF modules, including flexible miniaturized batteries as well as power-scavenging approaches involving thermal, EM, vibration and solar energy forms. The final step of the presentation will involve examples from mmW wearable (e.g. biomonitoring) antennas and RF modules, as well as the first examples of the integration of inkjet-printed nanotechnology-based (e.g. CNT) sensors on paper and organic substrates for Internet of Things (IoT), 5G and autonomous vehicles applications. It has to be noted that the talk will review and present challenges for inkjet-printed organic active and nonlinear devices as well as future directions in the area of environmentally-friendly ("green") RF electronics and "smart-skin' conformal sensors.

Learning Design and Digital Resources for STEM Education

Professor Daniel Churchill

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Abstract. STEM (curriculum integration of Science, Technology, Engineering and Mathematics) is being strongly recognized as critical for development of contemporary societies in the atmosphere of increasing economic, scientific and technological globalization. STEM related reforms emphasize that the teaching practices must (a) focus across the curriculum of the STEM disciplines, (b) be inquiry-, problem- and activity-based, and (c) incorporate digital literacies. In this paper we explore learning design framework and suitable digital resources for development of concept knowledge in STEM education. Further attention in this paper is given to an appropriate curriculum design that can serve needs and requirements of STEM education. Such curriculum must clearly emphasize importance of concept learning in STEM, in addition to that, promote knowledge uses and development of digital literacies.

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Design of a GPS-Based Solar Tracker System for a Vertical Solar Still

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***Abstract*—Compared with horizontal solar still, vertical solar still has better condensation but lower evaporation. To increase the evaporation, it needs a control system that moves a vertical solar still to follow the azimuth angle of the sun. This paper presents a design of a GPS-based solar tracker system, that can moves the vertical solar still follow the azimuth angle of the sun. Furthermore, to determine the effect of this solar tracker system, research was done by comparing the power of 2 solar cells placed in different positions. The first solar cell was placed upright and rotated with the solar tracker system. The second solar cell was placed horizontally. The result showed that the power generated by the first solar cell is greater than the second solar cell.**

Keywords—GPS-based; solar tracker system; azimuth angle; vertical solar still; solar cell

I. INTRODUCTION

Solar still is a prominent method to produce clean and healthy water from polluted water using solar energy. As a country with abundant solar energy resources, and also because most of the remote areas in Indonesia have not been reached with the electricity supply, it becomes a powerful reeason to implement and develop solar still. The weakness of solar still is the low productivity of resulting water. Many researches are proposed to increase the productivity which can be classified to two main approaches.

The first one and the most conducted approach is enhancement of condensation process. Among these approaches are addition of condenser and reduction of the cover temperature [3,7,8]. The second common method is pre-heating approach. The methods are focused on enhancing the evaporation process. The problem of evaporation is the energy supply. To increase evaporation, the methods exploit approaches which increase energy supply.

A vertical solar still is naturally good in condensation due to the position of its cover. Vertical surface has better convection than horizontal [5]. Wind is also important in reducing the temperature of the cover which enhancing the condensation process. But it is lack in evaporation due to path of the solar rays especially in tropical areas. Therefore it is reasonable to increase the vertical solar still productivity through increasing the energy supply. The simplest approach of increasing energy supply is facing the solar still to the path of solar rays.

To be always faced the solar path, the solar apparatus need solar tracker system. Some mechanisms have been proposed. Most of them are designed for PV, photovoltaic [2,4,6,9,10]. The other are proposed for horizontal solar still. On the other hand discussion of such mechanisms for vertical solar still is very rare. The solar tracker for PV does not consider fluid surface and flow while the solar tracker for solar still consider both. The other situation that should be taken into account is the weight of the apparatus. The solar still naturally is heavier than PV [1].

The vertical solar still has different characteristic operation than horizontal solar still. The most differing threats which are greater than the horizontal solar still are wind and solar path effect. For tropical area, the horizontal solar still gets its abundant energy during middle of the day. The vertical solar still gets its abundant solar rays in the morning and afternoon, when the sun is near the horizon.

A half-sphere coordinate with the apparatus as the center is exploited to define the position of the sun, where the rays arrive from. In such coordinate, a point above the observer (O) is defined as top. The point will be used to define zenith as the angle from the top to horizon. A horizon is boundary of a surface where the center (O) is located and perpendicular to the line from the top to the center. The horizon is circular shape through North, East, South and West position. The azimuth is defined as the angle around the horizon which is counted from the north. The description of the zenith and azimuth is figured on Fig. 1 below.

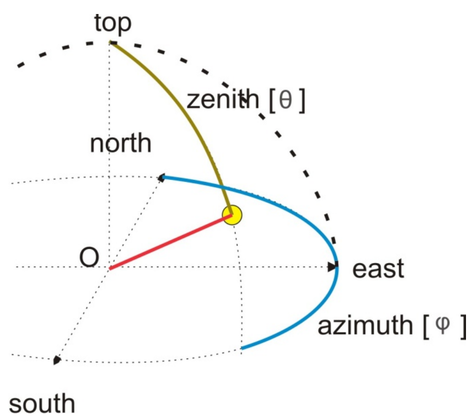

Fig. 1. A half-sphere coordinate for describing zenith and azimuth

Because the solar still here is vertical and it can not be rotated along zenith line, the adjustable position is only azimuth. Therefore, it need to determine the azimuth angle of the sun. The following equation presented herein are taken from NOAA Sunrise/Sunset and Solar Position Calculators, that are based on equations from Astronomical Algorithms by Jean Meeus.

$$\gamma = \frac{2\pi}{365} * (day\_of\_year - 1 + \frac{hour - 12}{24}) \tag{1}$$

$$\begin{aligned} eqtime = {} & 229.18 * (0.000075 + 0.001868\cos\gamma - 0.032077\sin\gamma \\ & - 0.014615\cos 2\gamma - 0.040849\sin 2\gamma) \end{aligned} \tag{2}$$

$$\begin{aligned} decl = {} & 0.006918 - 0.399912\cos\gamma + 0.070257\sin\gamma - 0.006758\cos 2\gamma \\ & + 0.000907\sin 2\gamma - 0.002697\cos 3\gamma + 0.00148\sin 3\gamma \end{aligned} \tag{3}$$

$$time\_offset = eqtime - 4 * \text{longitude} + 60 * \text{timezone} \tag{4}$$

$$tst = hr * 60 + mn + sc / 60 + time\_offset \tag{5}$$

$$ha = (tst / 4) - 180 \tag{6}$$

$$\cos\phi = \sin(lat)\sin(decl) + \cos(lat)\cos(decl)\cos(ha) \tag{7}$$

$$\cos(180 - \theta) = -\frac{\sin(lat)\cos\phi - \sin(decl)}{\cos(lat)\sin\phi} \tag{8}$$

Here the parameters list of the above equation:

γ = fractional year (radians),
eqtime = equation of time (minutes),
decl = solar declination angle (radians),
tst = true solar time (minutes),
ha = solar hour angle (degrees),
ϕ = solar zenith angle (radians),
θ = solar azimuth angle (radians).

The azimuth angle of the sun is derived from Equation (8), that is measured clockwise from North. After knowing how to calculate the azimuth angle, then the following is presented the design of a GPS-based solar tracking system for vertical Solar Still.

II. Design and Implementation Process

A. Hardware Layout

As described above, since the Vertical Solar Still can only be rotated along the azimuth line, it requires one actuator only. This condition is favorable, because the control becomes simpler and energy efficient, making it possible to eliminate an additional power supply in the future, and simply relying on the energy supply from the solar cell. The Vertical Solar Still that has been made is shown on Fig. 2 below.

Fig. 2. The Vertical Solar Still with Gearbox to ease rotating the Basin

The Vertical Solar Still is equipped with a gearbox to ease rotating the basin along the azimuth line. The following figure shows a prototype of the solar tracker system.

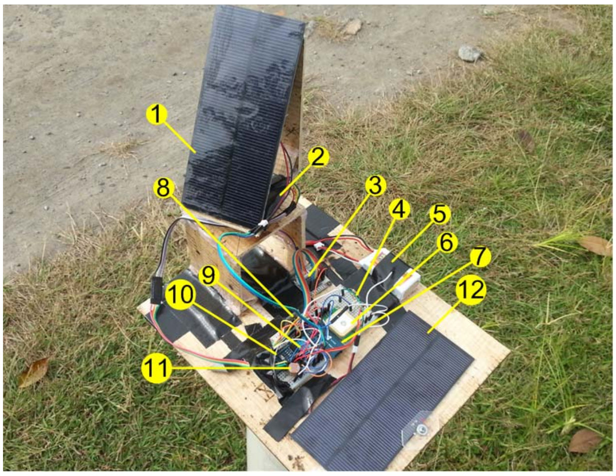

Fig. 3. Prototype of the Solar Tracker System

1	*Solar Cell-1*		*7*	*SD Card Breakout*
2	*Compass Sensor*		*8*	*Bluetooth HC-05*
3	*Stepper Motor + Driver*		*9*	*DHT11*
4	*Voltage Divider*		*10*	*Arduino Nano*
5	*Battery*		*11*	*LDR*
6	*GPS module*		*12*	*Solar Cell-2*

The prototype figure above shows two pieces of solar cells. Both solar cells are used to measure the efficiency of solar energy. The first solar cell was placed in an upright position, slightly tilted, on top of a stepper motor , which will rotate the Solar Cells following the azimuth angle of the sun. The second solar cell was placed on a fixed horizontal position facing up.

B. Control System

The following figure shows the block diagram of the circuit in the prototype of solar tracker system above.

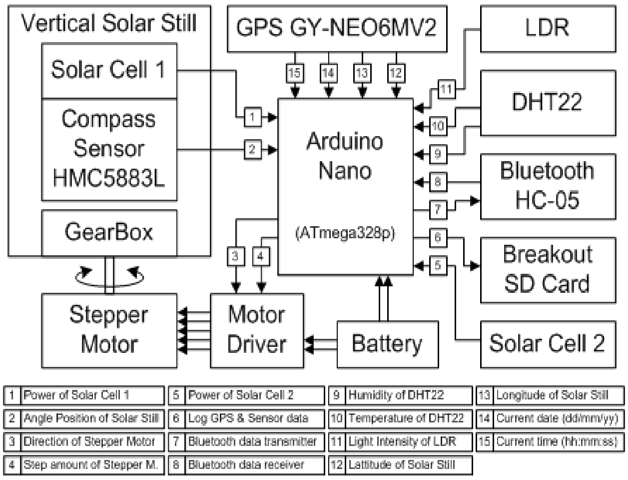

Fig. 4. Block Diagram of the Solar Tracker System

Working principle of the prototype circuit above is as follows: vertical solar still, which is simulated by a solar cell 1, rotated by a stepper motor, which is controlled by Arduino Nano. Arduino Nano was chosen because it is economical, with free programming software. Positioning control of Vertical solar still by Arduino Nano is based on equation of Astronomical Algorithms by Jean Meeus. The equation entering data of lattitude, longitude, date and time that provided by the GPS GY-NEO6MV2. By inserting these values into the equation, the value of azimuth angle of the sun will be obtained. Then the azimuth angle value was compared with the angle value of the compass sensor, which reads the face position of the vertical solar still. When the azimuth angle value is different from the angle value of the compass sensor, the stepper motor will be rotated automatically to minimize this differences.

To determine the effect of control by the solar tracker system, shown in the picture above, we use solar cell 2, which is placed in a fixed position facing upwards. Then Arduino Nano will measure the power generated by the solar cell 1 and solar cell 2, by adding a voltage divider resistor circuit in order to protect Arduino Nano from overvoltage. To determine the environmental conditions, light intensity sensor (LDR), temperature and humidity sensor (DHT22) has been added. Then the data of date, time, lattitude, longitude GPS, azimuth angle, compass sensor angle, power of solar cell 1, power of solar cell 2, light intensity, temperature and humidity, periodically stored in the memory card (8GB micro sd card).

A Bluetooth HC - 05 was added for the purpose of wireless communication with the computer, which will be used for controlling and monitoring solar tracker system from computer using LabVIEW software. The following figure shows control and monitoring whole system from computer wirelessly using LabVIEW software and Bluetooth communication.

Fig. 5. Control and monitoring whole system from computer wirelessly using LabVIEW software and Bluetooth communication

C. Solar Tracker Control and Monitoring System Algorithm

To facilitate the controlling, monitoring and testing of the solar tracker system, a program created using Labview software is used. The program can control the stepper motor, to rotate solar cell 1, manually or automatically based on the calculated azimuth angle and the compass sensor angle.

The following figure shows the display of solar tracker control program using LabVIEW software.

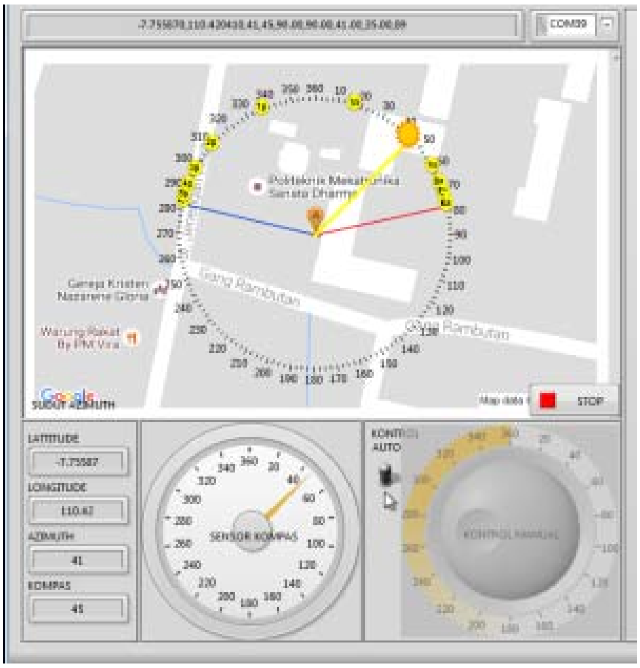

Fig. 6. The display of solar tracker control program using LabVIEW software

The program can also monitor and display the following data in graphical form: data of solar cell 1 power, solar cell 2 power, light intensity, temperature and humidity. The following figure shows the display of sensor data monitoring program using LabVIEW software.

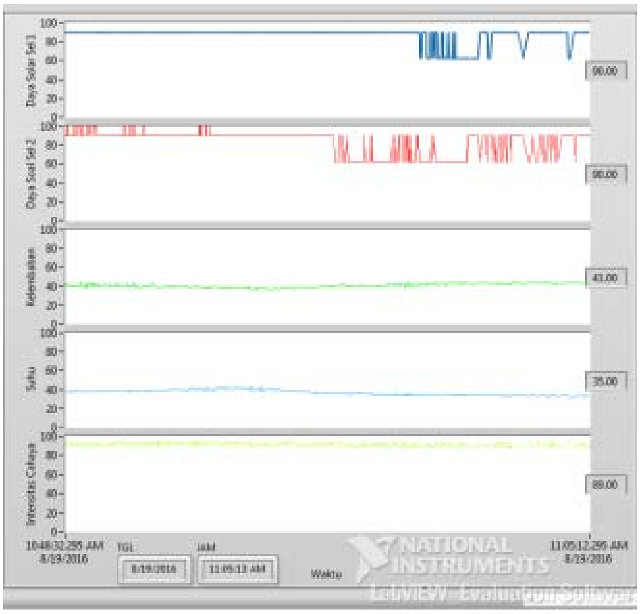

Fig. 7. The display of sensor data monitoring program using LabVIEW

The following figure shows the flowchart of the solar tracker control system using Arduino and control and monitoring whole system using LabVIEW software.

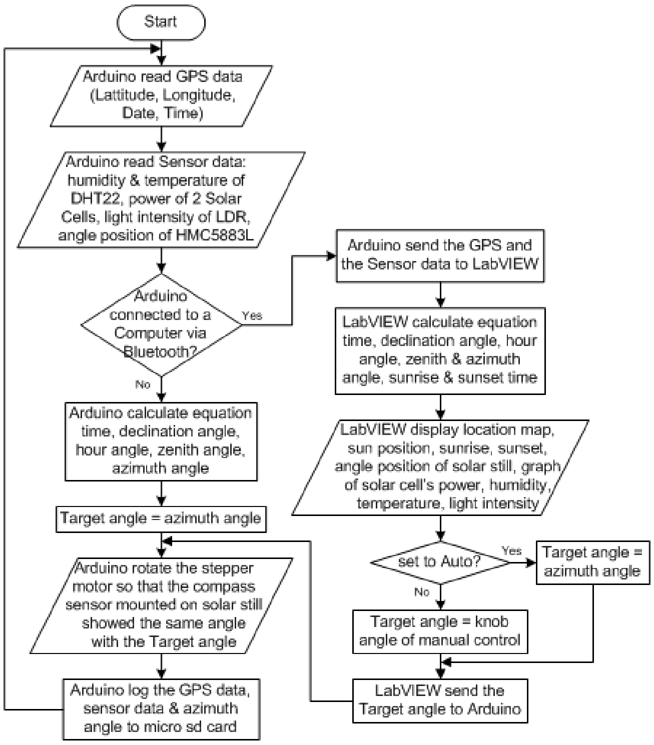

Fig. 8. Flowchart of solar tracker control and monitoring system using Arduino and LabVIEW software

III. Experimental Results and Data Analysis

The performance of the solar tracker system is measured by comparing the power generated by solar cell that controlled by solar tracker system (solar cell 1) with a solar cell placed at a fixed position facing up (solar cell 2). The power generated from both solar cell is recorded in memory card simultaneously for every minute from 6:00 am to 6:00 pm. The following figure shows the graph of recorded data of the power generated by solar cell 1 and solar cell 2.

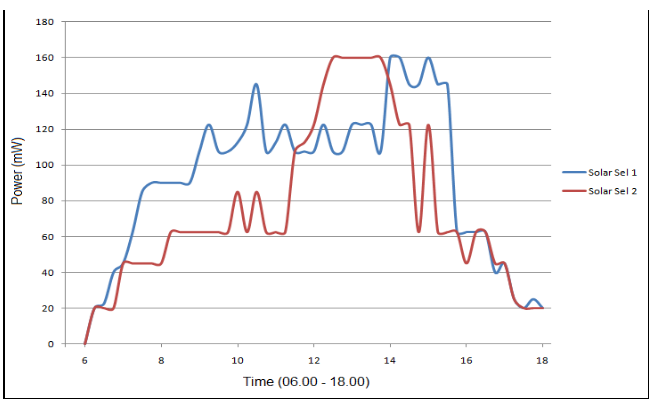

Fig. 9. The graph of the power generated by solar cell 1 and solar cell 2

From the experimental results shown in the graph above, the average power generated by the solar cell 1 is equal to 92.09 mW, while the average power generated by the solar cell 2 is equal to 75.46 mW. From this, it can be stated that the average power generated by solar cell 1 is larger than solar cell 2, which is about 22%.

Based on this experiment, it can be said that the first solar cell, which was controlled by solar tracker system, captures more solar energy than the second solar cell. Furthermore , it can be expected that the evaporation rate on vertical solar still with solar tracker system will be higher than vertical solar still without solar tracker system. Another interesting thing is, with the use of GPS and astronomical calculations, solar tracking systems become faster, because it avoids the scanning and reading of conditions repeatedly, as happens in the solar tracking system using LDR

IV. Conclusion

A prototype of a GPS-based solar tracker system has been proposed and designed to harvest solar energy for vertical solar still as much as possible. Research has been conducted by simulating the vertical solar still with a solar cell, which is mounted upright at a slight angle, which is then compared with another solar cell that placed in a fixed horizontally facing up. The result showed that the first solar cell, that is controlled by solar tracker system can capture more solar energy than the second solar cell, that placed in a fixed horisontally facing up.

Acknowledgment

The authors express gratitude for the research which is supported by the Higher Education Ministry.

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Evaluation of Transmission Line Parameter for Non Horizontal Earth Contour

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***Abstract*—Calculation of transmission line parameter such as capacitance and inductance had been done by several researchers. However, it's common that in calculation, the earth surface under the transmission line is assumed to be horizontal. In fact, the earth surface is not horizontal but has an uneven contour. This paper explained a method to determine the parameter value of transmission line which passing through non horizontal earth contour, by entering the conductor height as a function of x axis for every segment of calculation. The total transmission line parameter values are the total sum of transmission line values of each segment. Calculation and simulation results show that the value of parameter is influenced by earth contour. The precision of the parameter value depend on the width of the segment that being used. However, the maximum voltage in switching transient has smaller relative error than the relative error obtained for transmission line parameter.**

Keywords—transmission line; capacitance; inductance; earth contour

I. INTRODUCTION

Transmission line parameters consist of capacitance, inductance, and resistance. Its value is very essential to be known accurately. Because it will influences the transient condition. Nowadays, calculation method of transmission capacitance had been given by several researchers. Estimated value of transmission line using finite element method is described in [1]. Finite element method was able to calculate the capacitance value for conductor that has diverse cross section shape. Besides that, calculation of capacitance value using tower geometric and mirroring effect of earth surface is explained in [2]. Calculation of line impedance using supervisory control and data acquisition (SCADA) data has been conducted in [3], while estimated capacitance value is also can be determined with fault data record [4]. In the other side, determination of transmission line parameter using phasor measurement data is given in [5-12]. The references show that the result using measurement method is influenced by error in measuring process, so it is necessary to do some estimation method to predict the actual value.

In determining the value of transmission line parameter, generally there is an assumption that the distance between conductor and ground is always constant. In fact, the path of transmission line is not horizontal. Therefore, there is a possibility of error in determining the transmission line parameter.

In this paper, a method to calculate the parameter value of transmission line through non horizontal path has been discussed. This method is the modification of method described in [2], with an addition of conductor height as a function of horizontal spacing along the transmission line. Therefore, the result of capacitance value is expected to be closer to the actual value. The result from this method then compared with the previous methods, so it can be known the difference between the results.

II. CALCULATING CAPACITANCE AND INDUCTANCE

Based on method in [2], calculation of capacitance value uses matrix which describe the relationship between phase conductor and ground wire geometry, and it has been considered with the effect of earth on the assumption that the earth contour is horizontal. The matrix form is given in (1).

$$\begin{bmatrix} V_{an} \\ V_{bn} \\ V_{cn} \\ \hline 0 \\ \vdots \\ 0 \end{bmatrix} = \left[\begin{array}{ccc|ccc} P_{aa} & P_{ab} & P_{ac} & P_{an1} & \cdots & P_{anN} \\ P_{ba} & P_{bb} & P_{bc} & P_{bn1} & \cdots & P_{bnN} \\ P_{ca} & P_{cb} & P_{cc} & P_{cn1} & \cdots & P_{cnN} \\ \hline P_{n1a} & P_{n1b} & P_{n1c} & P_{n1n1} & \cdots & P_{n1nN} \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ P_{nNa} & P_{nNb} & P_{nNc} & P_{nNn1} & \cdots & P_{nNnN} \end{array}\right] \begin{bmatrix} q_a \\ q_b \\ q_c \\ \hline q_{n1} \\ \vdots \\ q_{nN} \end{bmatrix} \tag{1}$$

V_{an}, V_{bn}, V_{cn} represent the phase to neutral voltage of phase a, b, and c, respectively. While, q_a, q_b, q_c, q_{ni} represent the charge in phase a, b, c, and earth wire, respectively. For more compact form, (1) can be modified into (2).

$$\begin{bmatrix} V_{in} \\ 0 \end{bmatrix} = \begin{bmatrix} PA & PB \\ PC & PD \end{bmatrix} \begin{bmatrix} q_i \\ q_{ni} \end{bmatrix} \tag{2}$$

PA matrix states the relationship of capacitance between each phase in transmission line, while PB and PC matrix state the relationship of capacitance between phase conductor and ground wire. PD matrix is a matrix that states the relationship of capacitance between each ground wire. Each element of PA, PB, PC, and PD is obtained from (3).

$$P_{km} = \frac{1}{2\pi\varepsilon} \sum_{m=a}^{nN} ln \frac{H_{km}}{D_{km}} \tag{3}$$

H_{km} is the distance between conductor k and the image of conductor m. D_{km} is distance between conductor k and