

Investigation on Simulation of Wind and Solar Power Hybrid Systems through Human Machine Interface by InTouch Wonderware Software

Tatang Mulyana

Lab. Sispromasi, Faculty of Industrial
Engineering & System Information
Telkom University
Bandung, Indonesia
tatangmulyana@telkomuniversity.ac.id

Hari Setiawan

Lab. Sispromasi, Faculty of Industrial
Engineering & System Information
Telkom University
Bandung, Indonesia
hri.sispromasi@gmail.com

Rasidi Ibrahim

Precision Machining Research enter
(PREMACH), Faculty of Mechanical
Engineering and Manufacturing
Universiti Tun Hussein Onn Malaysia
Johor Malaysia
rasidi@uthm.edu.my

Abstract—Human Machine Interface (HMI) serves as a bridge for operators to understand the processes that occur in a production system. Without the HMI, operators have difficulty in monitoring and controlling the production system. It serves to facilitate the operator in monitoring the plant, plant control, plant handling, and access historical data either for the whole process or each of the existing equipment in the process. This paper presents an investigation on the simulation of wind and solar power hybrid systems through the human machine interface using software InTouch Wonderware. This simulation features a visualization of the process of charging wind power and solar power in a hybrid and charging process on battery and load. The simulated investigation results show that each power source produces a maximum of 100 KW, the total power charging is the sum of the two power sources, which is a maximum of 200 KW, the charging capacity of the battery is a maximum of 100 KW, and the duration usage at the load is a maximum of 100 KW converted to 10 hours load usage. With this HMI, operators can easily control the hybrid system in the power charging field.

Keywords—*investigation, simulation, wind, solar, hybrid.*

I. INTRODUCTION

Programmable logic controllers (PLC) are built to input various signal types (discrete, analogue), execute control algorithms on those signals, and then output signals in response to control processes. By itself, a PLC generally lacks the capability of displaying those signal values and algorithm variables to human operators. A technician or engineer with access to a personal computer and the requisite software for editing the PLC's program may connect to the PLC and view the program's status "online" to monitor signal values and variable states, but this is not a practical way for operations personnel to monitor what the PLC is doing on a regular basis. In order for operators to monitor and adjust parameters inside the PLC's memory, we need a different sort of interface allowing certain variables to be read and written without compromising the integrity of the PLC by exposing too much information or allowing any unqualified person to alter the program itself. One solution to this problem is a dedicated computer display programmed to provide selective access to certain variables in the PLC's

memory, generally referred to as Human-Machine Interface, or HMI. HMIs may take the form of general-purpose ("personal") computers running special graphic software to interface with a PLC, or as special-purpose computers designed to be mounted in sheet metal panel fronts to perform no task but the operator-PLC interface. It is the interface between the equipment in the field with the operator in the control room. With this HMI, operators can easily control the equipment or machines in the production field. Simply by pressing the animation button on the HMI screen, as well as playing a game. A complex and large system, that is, the production system is only displayed on a regular PC monitor screen size. The rapid development of HMI today, one of the most widely used in the industrial world is the HMI Wonderware manufactured by Invensys, which Schneider currently acquired. It is spread across the Indonesian industry from oil and gas to manage water discharge. Wonderware InTouch has been the world's number one the HMI for over 25 years and offers legendary ease of use, market-leading innovation, unparalleled investment protection, brilliant graphics, unsurpassed connectivity, industry-leading support and the widest partner ecosystem. The award-winning of this software is enables fast and reusable visualization applications, as well as deployment across the company without leaving the office. Used in more than one-third of the world's industrial facilities. The InTouch software continues to deliver business value in the simplicity of engineering, operational agility, and real-time performance mastery. It helps drive maximum performance, improves agility, lowers costs, enhances security, and reduces risk. In SCADA subsystem there is the HMI, which can literally define a computer with a graphical display that is directly related to humans. So it is a computer that displays data from the measurement, control, or describe a process that is happening in real time (Real time). To make this program on a computer there are actually many types and we can create HMI with conventional programming like Visual Basic, Visual C ++, Visual C #, Delphi, Java, and others. But in industry, many engineers and companies prefer using an instant tool to create the software like Wonderware. This is because companies prefer to save time and cost in making it. While from the engineer more facilitated in the

making. Because the tools-tools graphics and animations are widely available in the HMI makers such as Wonderware. Although in terms of price Wonderware much more expensive than the price of conventional programming license even some are free / open source. Some of the most important the features, among them are the Operator can control the process without plunging into the location, this can be very useful when there are security issues. The operator does not need to get closer to the equipment. Viewing an alarm will help the operator to find and react more quickly to any malfunction of any anomaly. Some alarms can be a preventive type, for example to make a warning alarm at the level of the hydraulic oil tank before the oil level really reaches a critical point. History Alarm logging is very useful for tracking problems. This can be used to optimize the process, which in turn increases productivity and reduces lost time. This is a very interesting function. You can message or fax someone when certain events occur. Let's say the level of oil in the hydraulic tank has reached a low level. Then the low oil level will trigger and will advise the person responsible for filling the tank. It can also turn on equipment and instruments based on carrier standards. They say one picture is better than 100 words. With it not even just images but also animations. This will really increase the whole look of the process. Anomalies will be detected much more easily. It can replace hundreds of buttons, lights and so on. Several papers related to the hybrid system simulation and design have been studied by several researchers, including [1], [2], [3], and [4]. The use of InTouch Wonderware Software for remote monitoring and control of a system in the industry can be found in several papers, including [5] – [13].

II. WIND AND SOLAR POWER HYBRID SYSTEMS

A Hybrid energy system usually consists of two or more renewable energy sources used together to provide increased system efficiency as well as greater balance in energy supply. The system is one that again provides electricity from a Wind generator and Solar panels from the sun during the day, and continues to be supported by the Wind energy generator source, coupled with energy stored in batteries at night. Solar panel or photovoltaic (PV) cells has absorbed sun beam by radiation and gives electric energy output. Solar panels are the medium to convert solar power into electrical power. Fig. 1 shows electric power generation from solar radiation, and Fig. 2 shows solar panel diagram. A wind turbine obtains its power input by converting the force of the wind into torque (turning force) acting on the rotor blades. The amount of energy which the wind transfers to the rotor depends on the density of the air, the rotor area, and the wind speed. Fig. 3 shows components of wind turbine, and Fig. 4 shows electric power generation from wind.

Both system (solar and wind turbine) has produced DC power. The both electric power has stored in the battery by battery charger. Both power has controlled by inverter (DC/AC) and supply to the lighting system. Generator is an electrical device that converts mechanical energy received from shaft into electrical energy. It works on electromagnetic induction to produce electrical voltage or electrical current, as shown in Fig. 5.

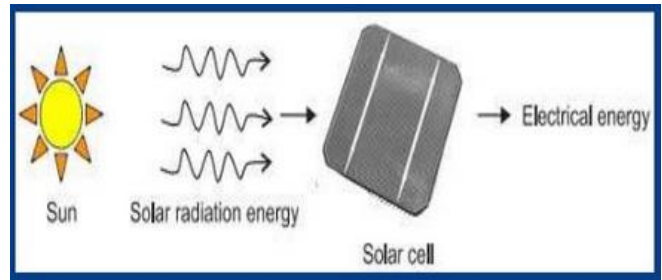


Fig. 1. Electric power generation from solar radiation

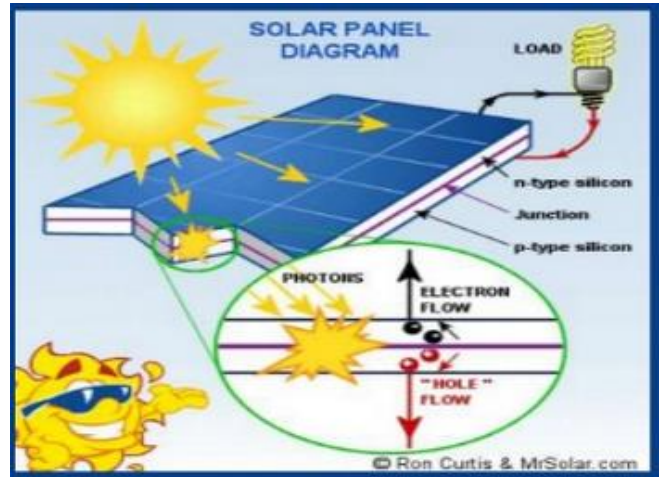


Fig. 2. Solar panel diagram

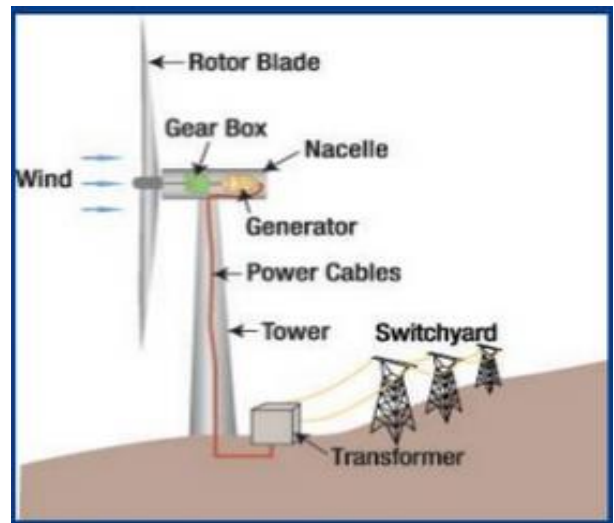


Fig. 3. Components of wind turbine

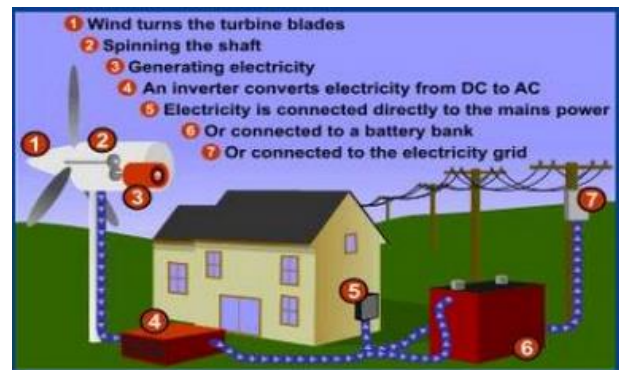


Fig. 4. Electric power generation from wind

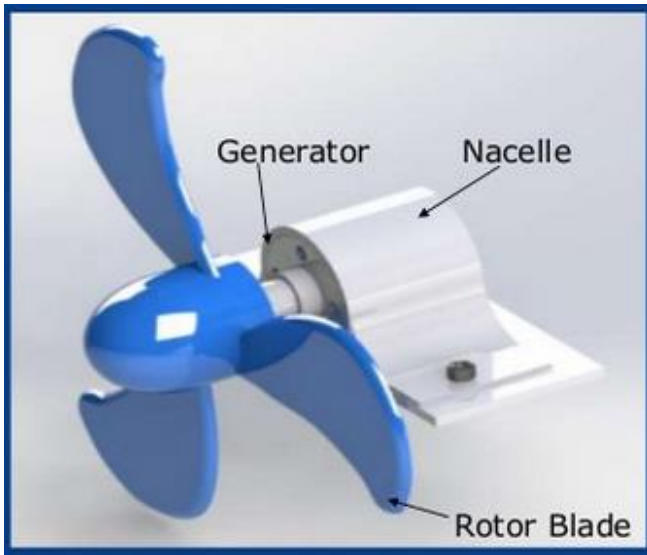


Fig. 5. Wind turbine rotor with generator

The storage battery or secondary battery is such battery where electrical energy can be stored as chemical energy and this chemical energy is then converted to electrical energy as when required, as shown in Fig. 6.



Fig. 6. (a) Battery and (b) Battery Charger

Inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry, as shown in Fig.7.



Fig. 7. Inverter.

In this system is a solar photovoltaic coupled with a wind turbine, as shown in Fig. 8, and Fig. 9 shows block diagram of wind and solar hybrid power generation system.

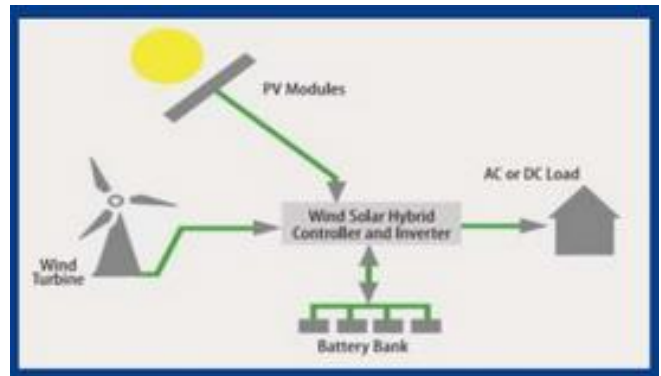


Fig. 8. Hybrid power generation system consist of a solar photovoltaic coupled with a wind turbine.

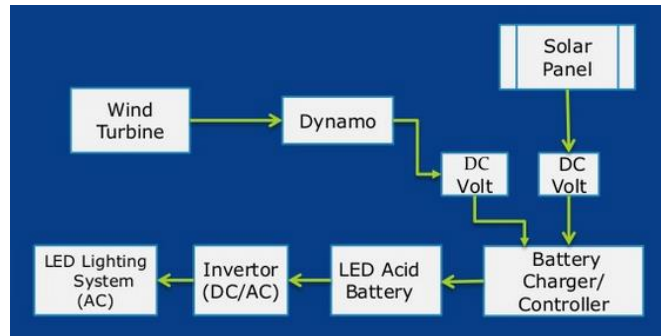


Fig. 9. Block diagram of wind and solar hybrid power generation system

III. SIMULATION DESIGN

This simulation has 7 steps: Click InTouch icon, Select New Application, Click find file simulation in directory, Double Click simulation file, Click Runtime, Click START, and Click STOP. In the form of flowchart shown in Fig. 10.

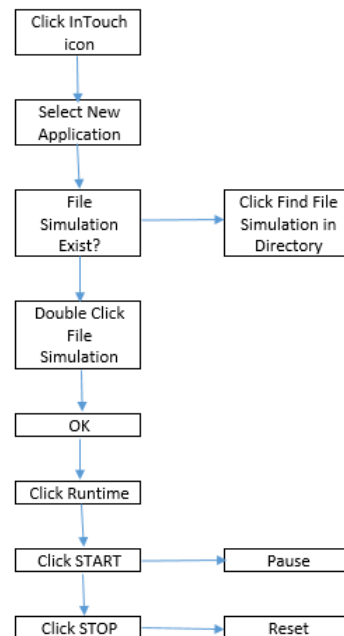


Fig. 10. Flowchart hybrid simulation by InTouch Wonderware Software.

Here are the steps to using Wonderware InTouch software in general. First open InTouch, click InTouch icon. Then select New Application, which is a picture on the top left corner with a blank paper image, i.e. to set where the folder is stored. If the simulation file already exists, but not in Application Manager, click find file in directory until raise the file. Double Click the simulation file, and click OK. Click Runtime will bring up the full simulation. Then click START will bring up a window simulation. Click START during running simulation produces pause, and click STOP generate reset.

IV. RESULT AND DISCUSSION

TABLE I shows the results of the maximum power calculations based on the simulation.

TABLE I. POWER MAX SIMULATION

Parameter	Table Column Head		
	Charging	Charge	Unit
Wind Power	100	0	KW
Solar Power	100	0	KW
Battery Capacity	0	100	KW
Load Capacity	0	100	KW
Total Power	200	200	KW

*Load Capacity (Houses): 100 KW = 10 Hours

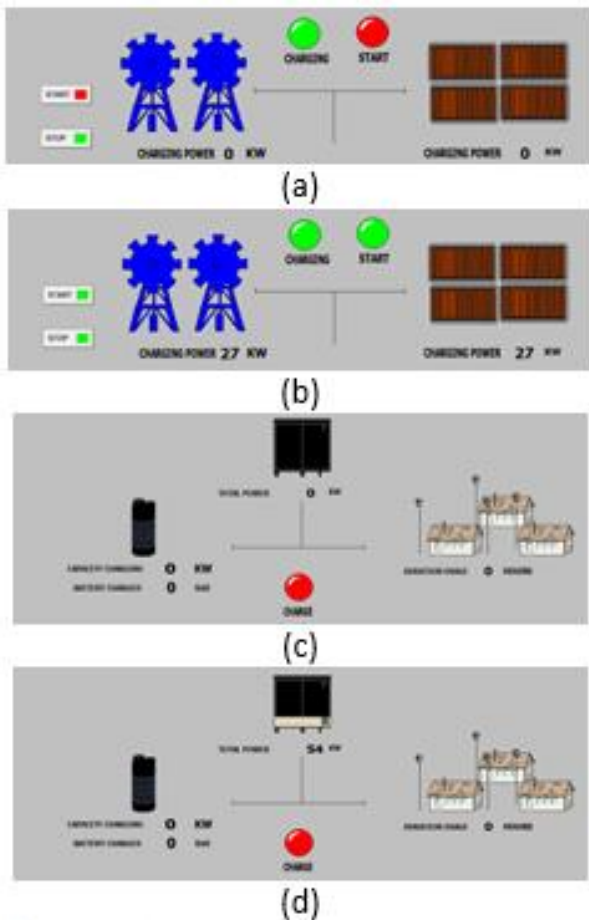


Fig. 11. Example of the simulation results of (a) – (d)

Fig. 11 shows example of the simulation results. Fig. 11 (a) and (b) displaying the simulated charging results for 0 - 27 KW. The power generated by wind and solar is 27 KW each so that the total of the two power sources is 54 KW as shown in Fig. 11 (c) and (d), the total power is 54 KW. From Fig. 11 (c) and (d) it is also seen that the total power charging was originally 0 KW to 54 KW, and capacity charging, battery charged, and duration usage is 0. This indicates the charging process is in progress, but the charge process has not started.

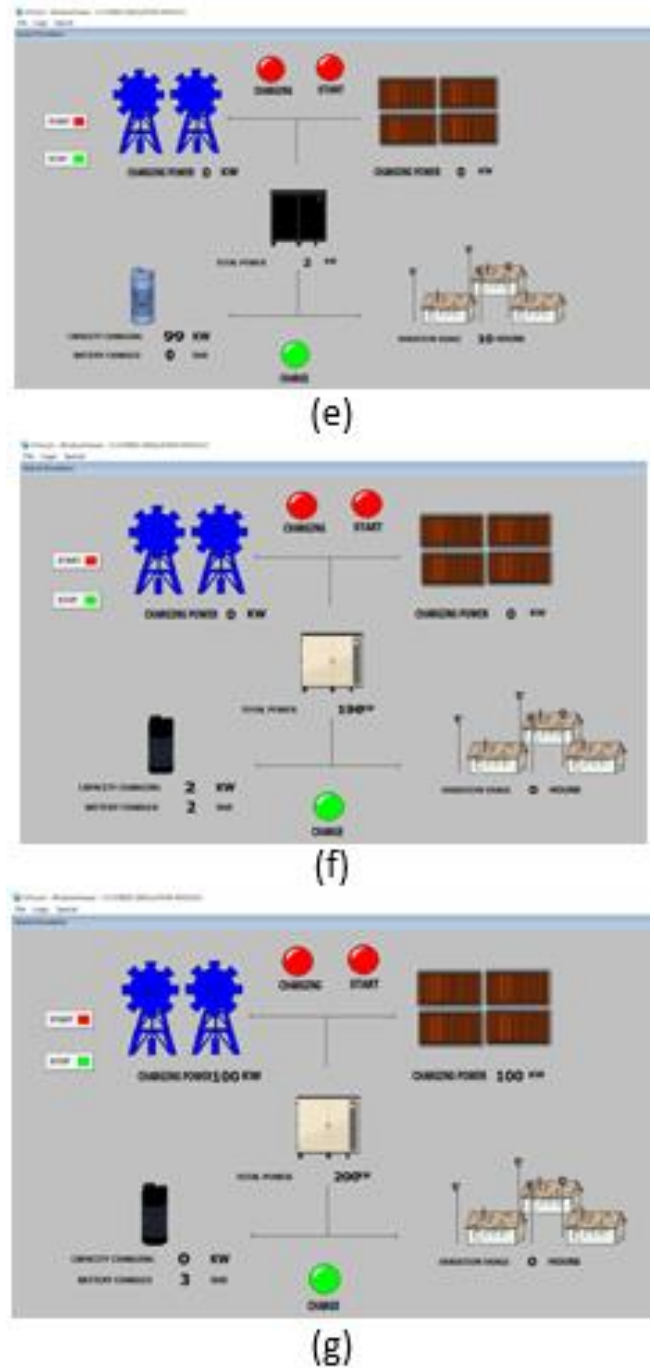
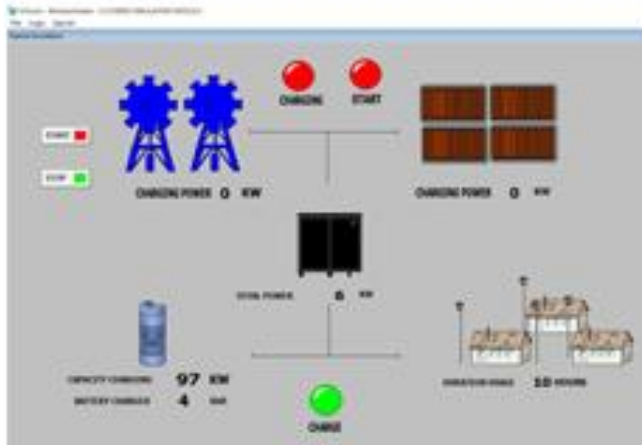


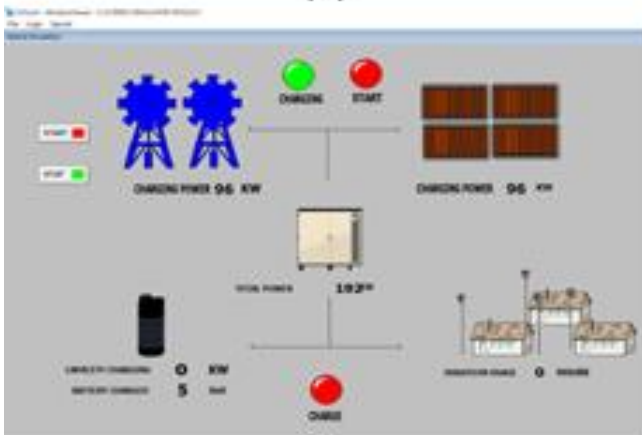
Fig. 12. Example of the simulation results of (e) – (g)

Fig. 12 (e) shows the results of the simulation of charging power for both sources is still minimum, that is 0 KW, the remaining power is 2 KW, the charging capacity of the 1st battery is 99 KW, the battery charged is still missing, and the duration usage on load is 10 hours. Fig. 12 (f) shows the

results of charging power simulation for both sources is still 0 KW, the remaining power is 196 KW, charging capacity on the 1st battery is 2 KW, battery charged is still missing, and duration usage on load still 0 hours. Fig. 12 (g) shows the simulation results of charging power for both sources is maximum, that is 100 KW, total power is maximum, that is 200 KW, capacity charging at 4th battery still 0 KW, battery charged has 3 unit, and duration usage on load is 0 hours.



(h)



(i)

Fig. 13. Example of the simulation results of (h) and (i)

Fig. 13 (h) shows the simulation results of charging power for both sources is 0 KW, total power remaining 6 KW, capacity charging at the 5th battery is 97 KW, battery charged has 4 units, and duration usage at load is 10 hours. Fig. 13 (i) shows the simulation results of charging power for both sources is 96 KW, the total power is 192 KW, the charging capacity of the 6th battery is 0 KW, the battery charged is 5 units, and the duration usage at load is still 0 hours.

V. CONCLUSION

In this paper, investigated the wind and solar power hybrid system through charging power simulation using human wavelength software interface InTouch Wonderware software. The simulated investigation results in a maximum of 200 KW, total power charging is the sum of both power sources, and the duration usage at load is a maximum of 100 KW converted to 10 hours load usage. With the facility of

human machine interface is very helpful for operators to monitor and control the process on the system without plunging into the location. This can be very useful when there are security issues, so the operator simply sees an alarm to find and react more quickly to any multifunctional anomaly.

ACKNOWLEDGMENT

The paper presented is the result of the Joint Publication on the Staff Exchange Program between Telkom University and Universiti Tun Hussein Onn Malaysia which was held in April-October 2018.

REFERENCES

- [1] Z. Nedic and A. Nafalski, "Development of Online Power Laboratory with Renewable Generation," *iJOE –Volume 11, Issue 3, 2015*
- [2] R. Rawat, S. S. Chandel, "Simulation and Optimization of Solar Photovoltaic-Wind standalone Hybrid system in Hilly Terrain of India," *International Journal Of Renewable Energy Research, Vol.3, No. 3*
- [3] M. Tatang, S. Darwin, M.D.R. Akmal, H.D.A. Jauharah, and S.M. Yahya, "Design and Analysis of Windmill Simulation and Pole by Solidwork Program," *IOP Conf. Series: Materials Science and Engineering 343 (2018) 012018, ICEAMM 2017*
- [4] M. Tatang, S. Darwin, F. Fildzah, and M.F. Raihan, "Design and Analysis of Solar Smartflower Simulation by Solidwork Program," *IOP Conf. Series: Materials Science and Engineering 343 (2018) 012019, ICEAMM 2017*
- [5] S. Indar, P. Felix, "Design and Implementation of SCADA Alarm in a Drink Production Process Using Wonderware," *Jurnal Teknik Elektro Vol. 4, No. 2, September 2004: 85 – 91*
- [6] E. Nugraha, A.G. Abdullah and D.L. Hakim, "Designing a SCADA system simulator for fast breeder reactor," *IOP Conf. Series: Materials Science and Engineering 128 (2016) 012006*
- [7] W. Umar, G.A. Ade, L.H. Dadang, "Design of Virtual SCADA Simulation System for Pressurized Water Reactor," *AIP Conf. Proc. 1708 (2016), 050005-1– 050005-6*
- [8] De-Kai Xu, Li-Jie Wang, Wei-Chao Shi, "The Auto control System Based on InTouch Configuration software for High-gravity Oil Railway Tank Feeding," *MATEC Web of Conferences 31, 05004 (2015)*
- [9] M.S. Leena, C.B.S. Swati, " Building a Redundant Data Acquisition System using Ide and PLC Simulation," *International Journal of Industrial Electronics and Electrical Engineering, Volume-4, Issue-9, Sep.-2016*
- [10] D.L. Hakim, A.G. Abdullah, Y. Mulyadi and B. Hasan, "The Development of Dispatcher Training Simulator in a Thermal Energy Generation System," *IOP Conf. Series: Materials Science and Engineering 288 (2017) 012164*
- [11] Neetika, K. Parminder, S. Hardeep, "Simulative Analysis of Various Faults for Protection of Induction Motor using SCADA," *International Journal of Computer Science Trends and Technology (IJCTST) – Volume 4 Issue 4, Jul-Aug 2016*
- [12] D.S. Mohit, Prerna, S. Shubhendu, S. Sumedha, T. Utkarsh, " Smart Traffic Control System using PLC and SCADA," *International Journal of Innovative Research in Science, Engineering and Technology Vol. 1, Issue 2, December 2012*
- [13] Ming-Hung Lin and Li-Chen Fu, "A virtual factory based approach to on-line simulation and scheduling for an FMS and a case study," *Journal of Intelligent Manufacturing 12, 269±279, 2001*