

Development of Inverter Trainer With Frequency Regulator on Power Plant Subject

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Abstract— In the course of subject Power Plants in the Department of Electrical Engineering, State University of Malang, there is a description of competence, namely : examining operating procedures and scheduling of power generation: power settings, settings capacitive power, voltage regulation, and the frequency setting. Based from interviews with the lecturer in the Power Plant obtained information that facilitates of the trainer about the competence of the inverter frequency setting not accomodated yet. Model development of regulating the frequency inverter is adapting the ADDIE development model. ADDIE development model consists of five phases: (1) Analysis; (2) Design; (3) Development; (4) Implementation; (5) Evaluation. The validation process carried out by materials experts, media experts, and implement on a small group of test and test large groups. Validation aims to measure the feasibility of the products developed The resulting product are Trainer, handout , and jobsheet. The first phase of the validation conducted by experts of material and media experts continued to test the trainer piloted in learning. Target sample test is a student majoring in electrical engineering as many as 75 people. The percentage of 87% material validation experts, media specialists 89.2%. And the results of the validation and testing on small groups 84.40%, 89.2% and large groups.

Keywords— *Development; Trainer Inverter; Frequency Regulator; Learning*

I. INTRODUCTION

The advance of technology, people's lifestyles and the number of population. Therefore we need alternative energy sources that can be used as a power plant such as, the use of renewable energy. Renewable energy is a renewable energy that comes from natural elements in the earth's available in large quantities. The Government also launched the increased use of renewable energy to the electrical power supply[1].

The use of renewable energy will not be separated from the need for an inverter, usually because the electrical energy generated by renewable energy is electricity with DC current, while for the needs of household electricity is electricity with AC current. Then the inverter is essential to improve the quality of the AC voltage required. Specification and other types of inverters need to be studied to encourage the use of renewable energy[2].

Education Electrical Engineering, State University of Malang is one institution that accommodates learning the use of renewable energy on a course that is a powerhouse

Learning courses Power Plant in the Department of Electrical Engineering, State University of Malang, there are descriptions of competence, namely: examining operating procedures and scheduling of power generation: power settings, settings capacitive power, voltage regulation, and the frequency setting. Energy Conversion Laboratory at the Department of Electrical Engineering, State University of Malang, there are 2 inverters trainer: trainer inverter on-grid and H-bridge inverter 1 phase. Both trainer inverter on-grid and H-bridge inverter 1 phase not facilitate descriptions of competence in the subject frequency setting Power Plant[3].

Based on these problems, will be developed in the form of learning media trainer frequency inverter regulator. At trainer, there are two series of AC inverters with different waveforms, wherein each - each inverter is equipped with a frequency regulator. The addition of a frequency regulator aims to explain the effects of changes in the frequency of the second inverter circuit, especially on the switching mosfet. So that students can understand the usefulness of the frequency setting terhadap tool - a tool that comes from alternating current (AC)[4].

Development is expected trainer Inverter timer frequency (modified sine wave and square wave) can facilitate the learning of the practice in the subject of the Power Plant in particular on the description of competence, namely: examining operating procedures generation and scheduling of power: power settings, settings capacitive power, voltage regulation, and the frequency setting. Trainer was developed in the title of the thesis "Development Trainer at the Frequency Inverters Power Plant Courses Department of Electrical Engineering, State University of Malang"

II. METHODS

Products developed in this study is a regulator of frequency inverter trainer Development of instructional media trainers on subjects inverter Power for S1 students of Electrical Engineering Education Department of Electrical Engineering, State University of Malang using ADDIE

development model. This development model consists of five steps: (1) analysis (analyze), (2) design (design), (3) the development of (development) (4) implementation (implement), and (5) evaluation (Evaluate).

A. Analysis of needs

In analyzing the first step needs to be taken is the observation and direct consultation with the lecturer lab power generation State University of Malang. The purpose of this observation to find and get information, a picture and media feedback on what has been used in the learning process. So that the media can know what is appropriate for use in the lab, especially in the subject of Power at the State University of Malang. From the description of competence subject Power Plants in the Department of Electrical Engineering, State University of Malang. Students who take a course that is expected to practice some props or trainer related to power management competence, capacitive power, voltage regulation, and the frequency setting[5][6]. However, some props such an arrangement, in the Energy Conversion Laboratory in the Department of Electrical Engineering, State University of Malang is still not too discussed especially regarding the frequency setting using the inverter. At trainer, there are two series of AC inverters with different waveforms, wherein each - each inverter is equipped with a frequency regulator. The addition of a frequency regulator aims to explain the effects of changes in the frequency of the second inverter circuit, especially on the switching mosfet. So that students can understand the usefulness of the frequency setting terhadapat tool - a tool that comes from alternating current (AC). The development of trainers expected frequency regulator Inverter (modified sine wave and square wave) can help students to develop the abilities and skills of Energy Conversion Inverter particular material[7][8].

B. Design of Inverter Trainer

Inverter Trainer design is done as limiting development. After the process of making inverter design to be evaluated by the supervisor as an evaluator. The purpose of the evaluation that the trainer made in accordance with needs. Results of the evaluation are shown in Figure 1.

Blog design diagram, shown in Figure 2, aims to provide a picture of the working principle of the trainer inverter. The working principle regulator of frequency inverters that convert the DC current into AC current input so that it can be used to turn on the lights AC. In the inverter there is also a frequency regulator that can be used as a light controller.

This driver has a function as a regulator of frequency that is controlled by a variable resistor. Driver aims to explain the effect of changing the frequency of the load and also explains the difference in the second inverter switching frequency range that can be set range from 0 Hz - 50 Hz. The following equation was used to determine the frequency according to the equation below

$$f = \frac{1,44}{(R_a + 2R_b)c} \tag{1}$$

The percentage of each resistance can be set with a potentiometer. The series total resistance equal to the value indicated on the potentiometer resistance.

C. Inverter Switching Mosfet Circuits

In making process that determines the inverter changes the DC electricity into AC is the process of switching. Switching itself is a process of switching between ON and OFF, or vice versa. Enumeration of DC current with a switching process is intended to form the AC waveform that can be accepted by the equipment / load AC power.

In making Inverter Square Wave Inverter power mosfet used is IRF950 and IRF44N, shown in Figure 3-5. The second mosfet work interchangeably with the same input. Both of mosfet work interchangeably with the same input. At the time of the mosfet input is positive then the mosfet IRFZ44N working as switching while the input current negative bernila the IRF950 mosfet working as switching

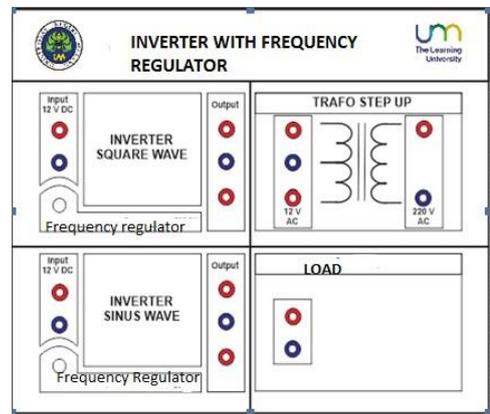


Fig. 1. Design of Inverter Trainer

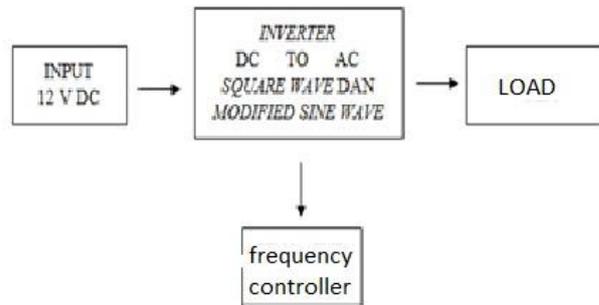


Fig. 2. Block Diagram Inverter with Frequency Regulator

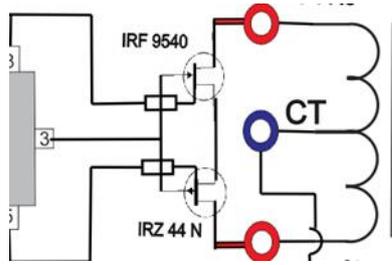


Fig. 3. Switching Modified Square Wave Inverter Circuit

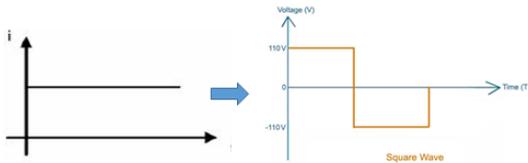


Fig. 4. Modified Square Wave In making Inverter Sine Wave Inverter

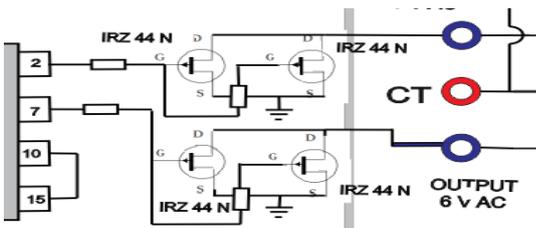


Fig. 5. Switching Modified Sine Wave Inverter Circuit

Both of these works alternately mosfet continuously causing movement of oscillation that causes alternating current.

Output of mosfet is directly connected to the transformer as a voltage riser, while switching successful then mosfet will cause the movement of oscillation that causes alternating current and formed the AC power.

At modified sine inverter mosfet used only IRFZ44N. So switching is used only on the negative side because this mosfet including N-type channels, while the positive side directly connected to the source.

The switching circuit having different input so that the output is in the form of wave inverter modified sine or square wave is modified so as to resemble a sine. Output of mosfet is directly connected to the transformer as a voltage riser. When switching is successful then the mosfet will cause the movement of oscillation that causes alternating current and formed the AC power.

For the course "Power" in the UM Department of Electrical Engineering FT. The following description of the results of development trainer inverter frequency regulator, see Figure 7.

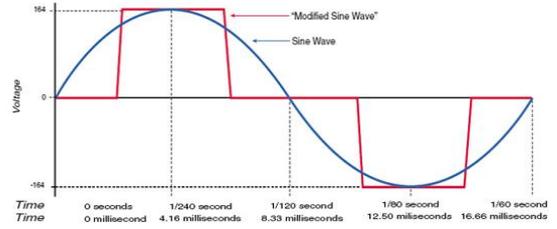


Fig. 6. Modified Sine Wave



Fig. 7. Display Inverter with Frequency Regulator

1) Inverter Trainer

Trainer which was developed in the research is a trainer inverter with two series where square-shaped wave inverter output wave and modified sine wave and equipped with a frequency regulator. Trainer inverter frequency regulator explains the process of change in DC electric current into AC current.

2) Handout and Jobsheet

Jobsheet handouts and instructional materials to support learning is the practice of using trainer inverter with frequency regulation on the subject Power Plants in the Department of Electrical Engineering. Handout developed contains materials that support learning. In the handout there are also examples of questions as a reflection of students' knowledge in the following study. Jobsheet developed consisting of jobsheet students and faculty, the difference in the two jobsheet this jobsheet there is an answer key lecturers and lab assessment rubric.

III. IMPLEMENTATION OF PRODUCT TEST

ADDIE development model is based on trials carried out with the prototype implementation, so that data collection techniques on the development of validation is done with materials experts, media experts as well as tests on student class of 2011 and 2012 using questionnaire instrument or questionnaire. Developing products validated by one (1) media expert and one (1) material experts as well as small

group trial 13 students and testing of large groups of 75 students.

IV. EVALUATION

A. Testing Trainer Perform

Trials conducted with the use of trainer by testing trainer has been developed that includes the testing of changes in value against both the frequency inverter as well as differences in the frequency of the lights if the inverter is reduced to near 0%.

The data is in the form of data voltage difference, the shape of the signal on the oscilloscope, and lights if the frequency of the both of inverter (*inverter square wave* and *inverter modified sine wave*) is reduced to near 0% . It can be concluded that the inverter has a different switching circuit and look at the lights when the frequency is reduced to 0 Hz.

B. Testing Products Result

Testing product is shown in Figure 8.

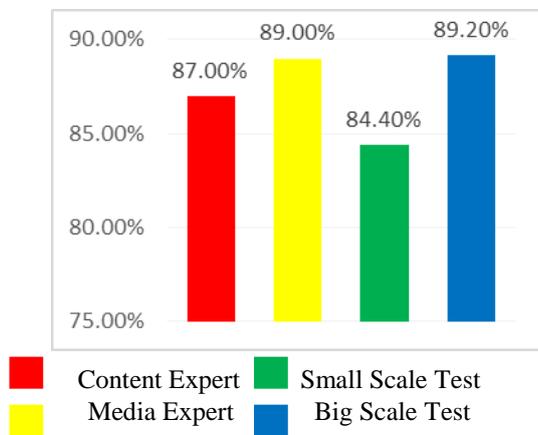


Fig. 8. Result of Products Testing

V. CONCLUSIONS AND SUGGESTIONS

Products trainer regulator frequency inverter has been developed using ADDIE development model has been through the production process and testing are then revised by the experts of material and media experts. From some of these steps, the resulting trainer inverter frequency regulator in the Department of Electrical Engineering, State University of Malang in the form of handouts, jobsheet, dan.trainer guide books. Trainer developed a teaching media when used at Department of Electrical Engineering , Engineering faculty, State University of Malang that can support learning course "Power Plant". Recommendations Product Utilization

In order to use this product trainer as expected, it is advisable to pay attention to the following: (a) Before using the trainer for the lab is expected to read the handout in advance to avoid mistakes in the installation on the trainer, (b) So that practical activities run well and truly obtain maximum results, it is expected to read measures contained in jobsheet trial, dan (c) Health and safety procedure must be considered and done well so that trainers used are not damaged. So the trainer is expected to function well within a display.

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