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Design and Development of Delta Wye Innovation (DiY) Trainer for Teaching and Learning Purposes

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Abstract

Delta Wye Innovation (DiY) Trainer is a device that is functions as a continuation panel to identify star or delta circuits with the concept of learning by doing for Power System course. This trainer is start to developed when the course lecturer has difficulty in delivering the star delta connection subtopic in the topic of Three Phase System because of insufficient teaching and learning equipment on the related topic. Students will have difficulties if do not master the subtopic and also have problems in the next subtopic which is the configuration of three phase transformers in the topic Transformer. Students also not able to achieve the objective and learning outcome in enhancing the hands on skill aspect. DiY means D for Delta, Y for wye also known as star and i means innovation. However, the term DiY is more synonymous with the meaning of Do it. The objectives of this works is todesign and develope Delta star transformation trainer. The design features of DiY Trainer are portable, small in size, use battery power, easy connection, adjustable position and all in one cable storage. Based on students Lab Practical Assessment record, it is found that there is improvement of knowledge and hands on skill when students use the DiY Trainer Kit.

Key-word: - Trainer, Power system, Delta, Wye

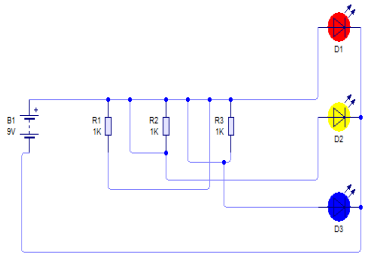
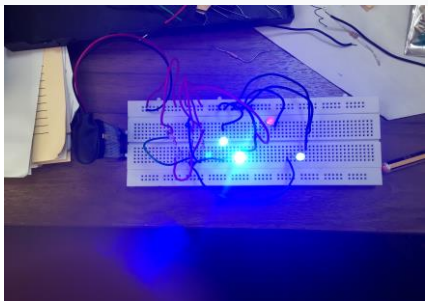
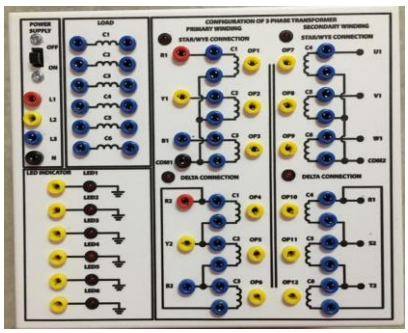
1. Introduction

In the education of scientists and engineers, Laboratory and practical classes play an importance role. The new study in the field of engineering education indicates that laboratory work significantly enhances the comprehension of students. In addition, such practical work develops students towards learning objective (El-rabadi, 2013). The teaching method and practical skills are built in line with the polytechnic objective of creating semi-professional workers in the technical sector, trade and hospitality. It is well founded that by applying learned concepts to real world conditions, this increases student interest and their passion in learning. The design of an instructional kit as an additional aid system must therefore be connected to practicality as a matter of principle (Esteves et al., 2018) (Cornejo et al., 2018).

In accordance to that, equipment and trainers should be able to deliver the practical aspects and they become a necessity. Power System is a second year core subject in Electrical and Instrumentation Engineering at Politeknik Tun Syed Nasir Syed Ismail. It is conducted over the 14 weeks of one semester. The course consists of weekly two-hour lecture and supported by two-hour practical work session. The topics covered three phase system and supported by delta wye sub topic. In each of these delivery modes, (Hosseinzadeh et al., 2011) discusses the role of a power system laboratory and also discusses the evaluation methods of laboratory practice in each mode. According to (Abdullah et al., 2009) practical work will make the learning experience excellent, allowing the student indirectly to grow their knowledge, strengthen analytical, investigative and psychomotor skills.

Existing equipment in the market are very expensive because of three phase application and separated by sub module where it is not suitable in order to complete one learning outcome. Practical session that usually involved with power system is usually utilise only simulation (Shepstone, 2003). However, it's difficult to evaluate the psychomotor assessment.

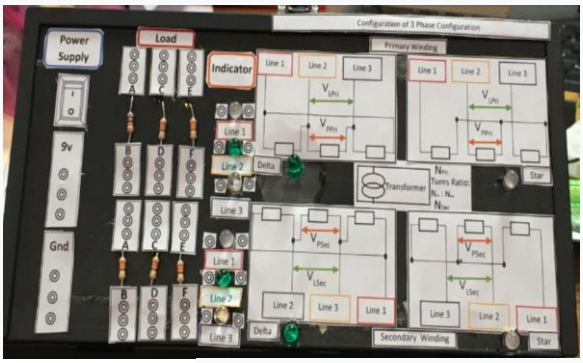
Table 1 History of Diy Trainer Development

Version	Previous	Problem Finding
June 2018	Theoretical lectures with the help of powerpoint slide show.	Conventional methods of learning cause passive students and most students still have difficulty in distinguishing star delta connections and failed to solve the problem in this subtopic.
December 2018	A practical approach using circuit simulation methods in Livewire software. 	This method contributes to active learning but students only implement the instructions given step by step. The output was successfully generated but it is still difficult to identify the star delta connection.
June 2019	Practical session by making circuit connections using testboards (breadboards), batteries, resistors and LEDs of various colors. 	The difficulty of setting the appropriate resistor value affects the brightness of the LED flame. Turn on the LED as an output to prove the connection made is correct. This approach makes it difficult for the lecturer to identify whether the connection made by the student is correct or the LED does not light up due to a faulty circuit connection. It is too difficult for students to make circuit connections and at the same time identify star delta connections.
December 2019	Development of DiY Kit Trainer with the concept of Learning by doing. Students use the kit by making a cable connection on the trainer. 	This trainer focuses students on star delta extensions. This approach makes it easier for students to identify star delta connections.

2. Methodology

A. Early Development

The eruption of ideas in the production of DiY Kit Trainer began when the course lecturer had difficulty in delivering the subtopic star delta connection in the topic of Three Phase System and if students still do not master this subtopic then students also have problems in the next subtopic. Porotypes of a design need to be prepared in advance in order to translate the ideas imagined in material form.



i. Front view

ii. Side view

Figure 1 Prototype trainer

B. Hardware Design

Figure 2 shows the complete setup of this Diy trainer. The proposed trainer is used the concept of portable and easy going trainer. The geometry and dimensions of the trainer are 16.5 cm x 16.5 cm x 10.0 cm and weight 1.6kg. The fabrication of this trainer is set to three segments: the casing that is made of aluminum steel with 350 slanting panel, and 9VDC PowComfort and a conducive surrounding are the main factors in ensuring that the ongoing pdp is effective. Students usually need to bow their heads to make connections on the test board. If the connection is made over a long period of time it will cause pain in the neck and head. Therefore, due to ergonomic factors, the position of the trainer can be adjusted while the circuit connection on the panel is done. The trainer is design with adjustable front panel with several angle according to user need.

Figure 2 Adjustable position due to ergonomic factors

All in one place to store the connection cable for assemble the circuit makes this trainer more attractive. losing of connector cable can be reduced when the concept of all in one is practiced in the design of this trainer. Cable storage space is provided to save time without having to look for connecting cables elsewhere. Therefore, after making the circuit connection, the connecting cable is placed back in the storage space without having to be separated.

i. Front view of cable storage space

ii. Side view of cable storage

Figure 3 Cable storage

II IMPLEMENTATION

This work has been used as a practical work trainer for power system subject in conducting the practical work session for related Delta Wye sub-topic to the Electrical and Instrumentation Engineering students in polytechnic. In order to measure the effectiveness of psychomotor skill by using this trainer, pre-test question was given to the students before using this trainer. Students can scan the QR code of pre-test question beside the trainer and continue using the trainer. To measure the psychomotor skill, students are required to assemble the connection using the connecter cable and doing the experiments based on work sheet that had been distributed by the lectures. After students carried out the practical session, students required to submit a practical report and answer the post-test question to measure the effectiveness of this trainer. From the post-test question, 100% students agreed there is improvement in their knowledge and skill by using the trainer and significant improvement in their marks while doing practical work using the trainer. The results also show their psychomotor skills also increase when using DiY trainer. The findings not be discussed in this paper.

3. Conclusion

In this work, a delta wye innovation trainer practical experiment for power system is successfully fabricated. The trainer is compact in size with 16.5 × 16.5 cm^2 in dimensions. The main objective of this work is to give students knowledge delta wye transformation experiments to improve the learning experience and psychomotor skills of students enrolled in this Power System subject. To meet this, the study had completed the development of a trainer to support the teaching of delta star transformation circuits in Power System course. Based on the DiY kit trainer concept, this trainer is portable, affordable and does not require high cost in maintenance.

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