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REPORT:

DEVELOPMENT OF SMART PLC TRAINING KIT

DMP5A

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**Laporan ini dikemukakan kepada Jabatan Kejuruteraan Mekanikal
sebagai memenuhi sebahagian syarat penganugerahan Diploma
Kejuruteraan Mekanikal**

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APPRECIATION

First of all, we are grateful to Allah Subannallah Taala for His bounty bestowed on us to complete the course work assignments successfully. guidance from him has opened the space for us to succeed in the task. In addition, I would also like to thank our parents who gave us facilitators to complete our course work. they have indeed given us all the facilities and moral support that infinite to us to succeed in our task.

Last , we thank those who are directly or indirectly involved in the success of our course work. Thank you very much.

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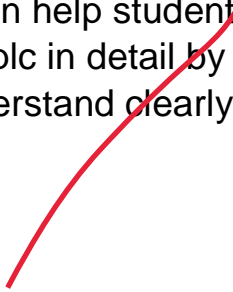
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ABSTRACT

Our group has chosen the title Development Smart PLC Training Kit for our final year project. Development Smart PLC Training Kit is a training kit that can help and share to students to find out information about PLC and IOT that we have improved. Based on this training kit, target users consisting of students are expected to improve their knowledge of programmer logic controller (PLC). Students can add knowledge with training kits easily without using many other components. The problem faced by students about this plc training kit is that the first is the difficulty in understanding the basic concepts of lessons taught by teachers. Secondly, the existing training kits cannot meet the needs of course content and misunderstandings among students due to limited training kits. The last is the Lack of training kits in the laboratory. The results obtained from the methodology used are from feedback from users collected through qualitative and quantitative methods such as questionnaires, interviews, and so on. The result is that more than 90% agreed to create this Smart PLC Training Kit in their place of study. The PLC Training Kit that we have improved can attract students to learn plc because it does not require any wires to connect the input and output of the plc and we have provided a module for the use of this PLC training kit compared to the existing plc training kit before which has non -detailed modules. In conclusion, this PLC training kit can help students and instructors to more easily understand the basic concepts of plc in detail by using the concept of the Internet of Things (IoT) so that they better understand clearly.



ABSTRACT

Kumpulan kami telah memilih tajuk Kit Latihan PLC Pintar Pembangunan untuk projek tahun akhir kami. Kit Latihan PLC Pintar Pembangunan adalah kit latihan yang boleh membantu dan berkongsi kepada pelajar untuk mengetahui maklumat tentang PLC dan IOT yang telah kami perbaiki. Berdasarkan kit latihan ini, pengguna sasaran yang terdiri daripada pelajar diharapkan dapat meningkatkan pengetahuan mereka tentang pengawal logik pengaturcara (PLC). Pelajar boleh menambah pengetahuan dengan kit latihan dengan mudah tanpa menggunakan banyak komponen lain. Masalah yang dihadapi oleh pelajar tentang kit latihan plc ini ialah yang pertama ialah kesukaran untuk memahami konsep asas pelajaran yang diajar oleh guru. Kedua, kit latihan sedia ada tidak dapat memenuhi keperluan kandungan kursus dan salah faham dalam kalangan pelajar kerana kit latihan yang terhad. Yang terakhir ialah Kekurangan kit latihan di makmal. Keputusan yang diperolehi daripada metodologi yang digunakan adalah daripada maklum balas daripada pengguna yang dikumpul melalui kaedah kualitatif dan kuantitatif seperti soal selidik, temu bual, dan sebagainya. Hasilnya ialah lebih daripada 90% bersetuju untuk mencipta Kit Latihan PLC Pintar ini di tempat pengajian mereka. Kit Latihan PLC yang telah kami perbaiki dapat menarik minat pelajar untuk mempelajari plc kerana ia tidak memerlukan sebarang wayar untuk menyambung input dan output plc dan kami telah menyediakan modul penggunaan kit latihan PLC ini berbanding latihan plc sedia ada. kit sebelum ini mempunyai modul tidak terperinci. Kesimpulannya, kit latihan PLC ini dapat membantu pelajar dan tenaga pengajar untuk lebih mudah memahami konsep asas plc secara terperinci dengan menggunakan konsep Internet of Things (IoT) supaya mereka lebih faham dengan jelas.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The internet of things or IOT is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. In short, the internet of things refers to the rapidly growing network of connected objects that are able to collect and exchange data in real time using embedded sensors. Thermostats, cars, lights, refrigerators and more appliances can all be connected to the IOT.

Next, we added this IOT to be used in the training kit to make it easier for students to use this system more easily and on par with the development of today's IOT. This training kit does not need to use a switch to turn on the program, in fact, it only uses the application in the smartphone remotely with the help of WiFi. This smart PLC training kit can also prevent many injuries to students while using the training kit and so on.

1.2 RESEARCH BACKGROUND

Programmable logic controllers (PLCs) have become an essential device for automating manufacturing processes. Developed in the 1960s, PLCs started out the size of suitcases and required logic programs to be drawn out on a drafting board before being loaded onto the device with a numeric keypad. Since then, PLCs have evolved to be smaller, faster, and more powerful to keep up with the increasing demands and sophistication of modern manufacturing.

The first plc

The first programmable logic controllers were developed as a solution to replace large banks of hardwired relays and timers. At the time, using relays and timers for applications that are now handled by PLCs posed numerous challenges. Most of these challenges stemmed from the need to use several relays to control just one machine, which took up large amounts of space. Additionally, the relays had to be wired in a specific order for the machine to operate properly. If just one relay malfunctioned, the entire system would stop working, and troubleshooting could, at times, take hours to complete. Furthermore, implementing changes posed another set of challenges as they often required reconfiguring the entire system.

Today, PLCs maintain the same core functionality and simplicity that originally made them so popular with manufacturers. However, thanks to continued advancement in processor and memory technology, PLCs continue to shrink in size while growing in power and speed. These technological advancements have led to new capabilities, such as vision system integration, motion control, and support for multiple communication protocols. Modern PLCs also seamlessly integrate with ERP and MES systems, as well as powerful machine monitoring software and SCADA, providing new ways for manufacturers to drive improvements to their operations' efficiency and performance through machine data analysis.

1.3 PROBLEM STATEMENT

Through a survey we have done, 68.2 % of students have never used training kits while in the classroom and laboratory, therefore we have designed training kits that will facilitate their learning. A training kit has been developed to overcome the three main problems of students, understand the basic concepts of lessons taught by teachers. further,the lack of learning kits in the laboratory, this will cause many students to be unskilled in using them. existing learning kits are unable to meet the course content requirements and misunderstandings among students due to limited learning kits. Finally, 100% of students support to increase the number of training kits in the study and to facilitate their learning.

1.4 OBJECTIVE

This study was conducted to achieve the following objectives :

- i) To study the problem of learning methods on smart plc training kit.
- ii) To develop a PLC training module towards Student Centred Learning (SCL) approach for teaching and learning of the setup and configure the iot.
- iii) To develop hardware and software toward SCL approach for teaching and learning of the PLC logic programming.

1.4 RESEARCH LIMITATION AND SCOPE

PLCs are continuously growing and evolving to be the best option for a variety of industrial automation applications. Scope of plc programming is increasing rapidly because of greater programming flexibility and ease, scalability, more memory, smaller sizes, very high-speed (gigabit) Ethernet, and built-in wireless features. PLCs are getting benefits from USB technology and thus make it easier than ever before to get online, program, and monitor your control systems. PLC programming will evolve, and with the availability of smaller micro and mini USB connectors, you can expect to see this option on more of the smaller PLCs. In the future, PLCs will continuously evolve while adapting technology enhancements in communications, hardware, and software.

- Designed to make it easy for students to carry everywhere.
- The PLC trainer kit has many contacts and is low cost and safe.
- It has a very fast scan time, it has a fast operation time.
- Various control applications.
- It has the ability to communicate with computers.
- It requires a shorter training time.
- It has a small physical size.
- It has the project cost can be calculated accurately.
- It has supervisory control capability

1.5 CHAPTER SUMMARY

In this chapter we have explained and elaborated on the things that form the basis and direction of why this project was produced by us. In this chapter the project background, problem statement, project objectives are also described one by one. Project objectives are also determined based on the problems that have been discussed together. This project is expected to be successful and it is also given limitations so that this project is reasonable to do.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Training kit is very important in teaching and learning process. The use of training kit is can facilitate the process of information sharing among students with respect to subject taught more clearly (Abdul Samad et al., 2016). The learning kit aims to help students understand the subject more easily and systematically (Nur Elyani Musa et al., 2014). In fact, it also serves as tool Mechanical Design topics and helping them learn Mechanical Design through a misleading experience. The learning kit is aims to make it easier for students to learn and understand the subject matter. The approach of using the learning kit is a learning strategy that can be applied by teachers to help improve student performance. The achievement of the students will be more effective through the use of learning kits. This is because students can understand and master a concept as well as improve the results of the test in the classroom. Teachers can also fulfill the expected learning objectives in each subject matter at the end of the teaching and learning process. In the study of Jasmi et al. (2011) states that kit aid serves as a facilitator for teachers to improve the effectiveness of student-centered learning. In their study also stated that teachers involvement in the classroom was 25 percent only. In addition, using the learning kit the abstract content can be explained. This makes it easier for students to understand the subject matter (Mohsin & Hassan, 2011). Indirectly the use of correct and multifaceted learning kits can overcome passive behavior among students as it can raise the interest of the students to continuously participate in the learning session and to stimulate the students motivation and desire to learn more about teaching (Nurhanim Saadah et al., 2013). Therefore, learning is no longer dependent on traditional equipment such as chalk, blackboard, and textbooks as a teaching medium (Ahmad Zanzali & Daud, 2010; Haizum Hanim Ab. Halim & Lai, 2011). Therefore, learning kits play an important role not only to attract students, but also for students to easily understand a concept in their teaching and learning. The use of teaching kits in teaching and learning process is an alternative in the success of teaching and learning. The role of teachers is important to create creativity in the classroom

2.2 CONCEPT / THEORY

This learning kit is developed based on the ADDIE Model (E. Forest, 2014) adaptation. Based on the ADDIE model, the development of this learning kit consists of five (5) phases i.e. needs analysis phase, design phase, phase development phase, implementation phase and assessment phase. This learning kit method involves mechanical components of the product. The learning kit is to explain the use of plc connected with iot. Pre -tests were used to determine the performance between the group used the learning kit and the control group was taught using conventional methods. Development smart training kit plc is conceptualized plc towards iot. iot is an abbreviation for Internet of Things. This topic is becoming increasingly popular in today's fast -paced technology. Here and there people talk about IoT. It is a concept where equipment, machines, sensors and devices are connected to the internet and there is data collection and transfer through a network. If it can be connected to an internet network or be part of a machine connected to the internet, and there is data transfer, it is categorized as IoT. These include cameras, lights, coffee makers, washing machines, pulse readers, telephones, smartwatches, light and sound sensors, bars and fences, chains around cat necks and more. Basically the early function of the Internet was a computer network used by scientists and researchers around the world to share information which later expanded its role to become an important medium for communication in this century. In addition, the Internet was initially only used by the military - the military of major powers such as Russia and the United States as a communication role. After that, the University of California (UCLA) used the internet on the grounds that the world of education also felt the use of the internet was very important to learn and develop computer networks.

Kevin Ashton was the individual who came up with the idea to introduce the term Internet of Things or better known by the acronym IoT in one of his presentations around 1999 at the Auto-ID Center. In addition, the Auto- ID Center also discovered RFID (Radio Frequency Identification) based equipment in the same year and this discovery is considered a big leap in commercializing the IoT. In general, IoT can be interpreted as a communication network between things around / around through an internet network. Although according to Sarma (2000), there are different opinions in the IoT from the original concept proposed by Kevin Ashton but it does not inhibit the development of IoT. Just look at the big technology companies, each racing to produce the latest technology based on IoT concepts such as Amazon Web Services, AT&T, Cisco, Huawei, Microsoft, Intel and Oracle. These companies are among the largest pioneers of IoT today.

2.3 MECHANICAL DESIGN

For our development smart training kit plc some of the component that we use for our project Arduino,wires,vbox,plc and lamp.what is Arduino? The Arduino is, in fact, just a CIP MicroController (Micro- Controller) that can be programmed and has RAM and Program-Memory. The blue Arduino board only has support circuits such as Voltage-Regulator and Serial-USB Programming Chip. The use of Arduino does not need to use a blue Board, and can also only use the AtMEGA328P MicroController Chip and can build its own Application Board.meanwhile, VirtualBox is an open source application related to Virtualization . Virtualization is meant to create a virtual PC machine that can run independently on top of the main operating system. All forms of hardware related to virtual machines are all simulated by the host pc. So that all hardware resources cannot exceed the original resources.finally,The PLC receives information from connected sensors or input devices, processes the data, and triggers outputs based on pre-programmed parameters.Depending on the inputs and outputs, a PLC can monitor and record run-time data such as machine productivity or operating temperature, automatically start and stop processes, generate alarms if a machine malfunctions, and more. Programmable Logic Controllers are a flexible and robust control solution, adaptable to almost any application.

2.4 PREVIOUS RESEARCH TRAINING KIT

Learning Kit is defined as a complete teaching material for learning topics and materials are concrete material (Dewan Bahasa & Pustaka 2016). Teaching kit is also one example of Teaching Aids (ABM).

Various teaching aids can be built and prepared for a subject. Instructional tools stored in a container (plastic, boxes, wood, etc.) are named as teaching and learning kits (Norzainariah Abu Hassan, 2004). This storage is intended to facilitate management, and more systematic storage. Usually learning kits contain non-electronic visual tools and materials such as alphabet cards, storyboards, pictures, plastic blocks, story cassettes (Norzainariah, 2004) and boxes containing tools used in practical training or other activities throughout the learning process (Prihatiningtyas et.al, 2012). The learning kit is aims to make it easier for students to learn and understand the subject matter.The approach of using the learning kit is a learning strategy that can be applied by teachers to help improve student performance. The achievement of the students will be more effective through the use of learning kits. This is because students can understand and master a concept as well as improve the results of the test in the classroom. Teachers can also fulfill the expected learning objectives in each subject matter at the end of the teaching and learning process. In the study of Jasmi et al. (2011) states that kit aid serves as a

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2.5 PROS AND CONS PLC

PROS OF PLC

The first advantage of migration is that it's less of an upfront cost. Between less downtime, less new hardware, and less hours spent writing code and designing infrastructure, a migration requires less capital to pull off successfully. Second, migrations bring less short-term risk. The truth is that there's no such thing as bug free software, especially in complex control systems. Whenever we write new code, we inevitably take on some risk. For risk-adverse organizations, especially in facilities that run 24 hours a day or have strict production uptime requirements, this can tip the scales in favor of migration. The final advantage of migration is that it keeps things familiar for operators and technicians. Even though there will inevitably be some learning curve for using, troubleshooting, and repairing the new PLC, this transition is smaller than having to learn an entirely new system. Simply put, migrations offer shorter training periods and reduce the chances of operator error if someone goes into "autopilot".

CONS OF PLC

However, there are some real disadvantages to migration as well. One of the main factors that we have to consider is that newer PLCs have a different architecture than older ones, and there's no such thing as a true 1:1 port from old to new. Rockwell explains that "the PLC-5 and SLC 500s are based on their 16-bit architecture and can have different time bases. A Logix controller is based on its 32-bit architecture and only supports a 1 msec time base." These discrepancies can lead to unforeseen runtime errors and pose a major challenge when trying to translate old logic into new code. Migration is rarely a straightforward process, and, for some applications, it's actually unfeasible.

Migration's other main detraction is an increase in long-term risk. This becomes especially problematic when we want to integrate new machines onto the plant floor because automatic code conversion tools don't output clean code that's easy to modify. In fact, the resulting code is often messy, difficult to read, and an ongoing struggle for maintenance teams. On top of that, both the new tag names and data are left as nonsense since they're based on old PLC-5 conventions that simply don't work for new PLCs.

As a result, if we want to revisit the code later to make improvements or to add logic for something like a new robot, it's going to be much harder. The bottom line is that migrations are less future-proof than upgrades.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

A PLC is defined by the National Electrical Manufacturers Association of America (NEMA) as an electronic system/ digital operating apparatus used in an industrial environment, which uses programmable memory to store instructions used to perform a function such as logic, sequence, timers, calculations, and arithmetic to control a process or machine based on inputs and outputs connected to a module whether digital or analog.

In other words it is a digital computer designed specifically to control a tool or machine or process and is widely used in industry

3.2 BACKGROUND OF PLC

The former control system is difficult to modify. Every time a new product wants to be released, its control system needs to be modified a lot. Among the initial factors that led to the design and development of programmable control systems are as follows:

- . Low cost requirements
- . Smart use
- . Easy to control controller

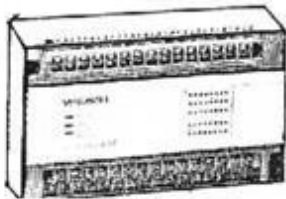
The first PLC was designed by a group of engineers at General Motor Company (GM), USA in 1968 when the company was looking for other methods to replace complicated relay control systems. They have also stipulated that the specifications of this new control system must meet the following requirements:

- . Easy to program
- . No need to rewire the control system if there is a change to the program
- . Smaller, cheaper and high reliability
- . The construction is simple and the maintenance is cheap
- . Competitive cost
- . Flexible

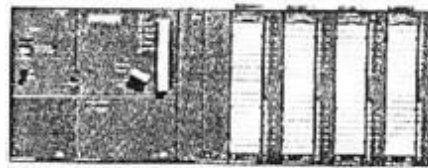
3.3 TYPES OF PLC

There are several types of PLC builds available today. Among the major PLC manufacturers are OMRON, Allen Bradley, Mitsubishi, NAIS, Siemens, Toshiba, and so on. Here are the types of PLCs that are commonly used in industry.

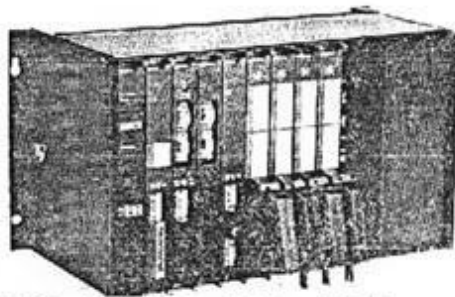
- i. Compact PLC
- ii. Modular PLC
- iii. PLC Plug-in Card



PLB[Compact PLC] - Mitsubishi FX0



PLB Modular(Modular PLC) - Siemens S7 - 300







PLB Kad Pasak(PLC plug - in cards) - Festo FPC 405



3.4 INPUT AND OUTPUT UNITS

The next component is the IO Unit. It connects the PLC to the outside world. It is used for the connection of various input and output signals for control. It converts the received signal so that it can be understood by the PLC CPU using an AD converter. In addition, it can also change the PLC CPU signal so that it can drive output components such as motors.

An Input Unit is a unit to which an input device (switch, sensor) is connected to it. While the Output Unit is a unit for output devices (lights, motors) connected to it.

Component input and output	
Led light	
Lamp	
Fan	
PLC	

3.5 PROGRAMMING UNIT

The programming unit of a PLC consists of two devices, namely :

- 1) COMPUTER
- 2) SMART PHONE
- 3) PROGRAMMING CONSOLE

PROGRAMMER LOGIC CONTROLLER (PLC)

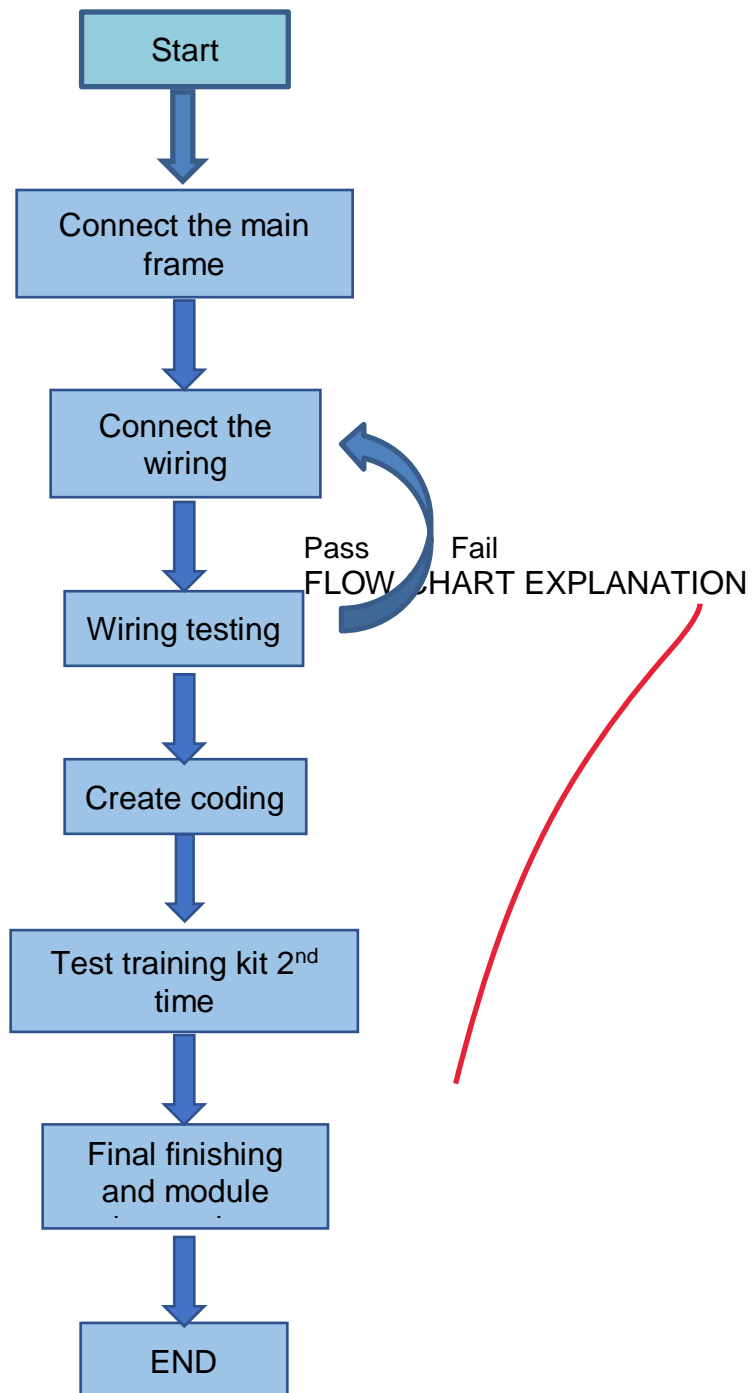
Programmable Controllers are predominately laboratory based subjects as they require “hands on” electrical wiring, interface to industrial electrical components, to Human Machine Interfaces (HMI) and may be networked.

As PLC courses evolve to incorporate the IEC 6-1131 defined programming languages with the resultant extra software theory learning requirement and an increasing demand for in-company courses requirement arises for a PLC system which is portable and can be accommodated in a training or class room.

INTERNET OF THINGS (IOT)

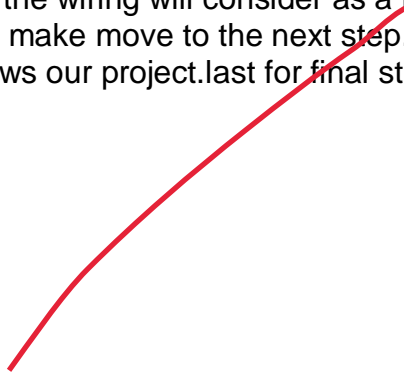
This paper addresses the Internet of Things. Main enabling factor of this promising paradigm is the integration of several technologies and communications solutions. Identification and tracking technologies, wired and wireless sensor and actuator networks, enhanced communication protocols (shared with the Next Generation Internet), and distributed intelligence for smart objects are just the most relevant.

3.6 PROJECT FLOW CHART



FLOW CHART EXPLANATION

At the start of our project we simply make a connection to the main frame which then connect the wiring to the main frame. after that, we do wiring testing to make sure that wire is perfectly good and safe. if the wiring has a problem, then the wiring will consider as a fail to connect to the main frame but if the wiring is going well then we make move to the next step. The next step is to test the training kit for the second before shows our project. last for final step is to make a finishing on the project and module for the project.



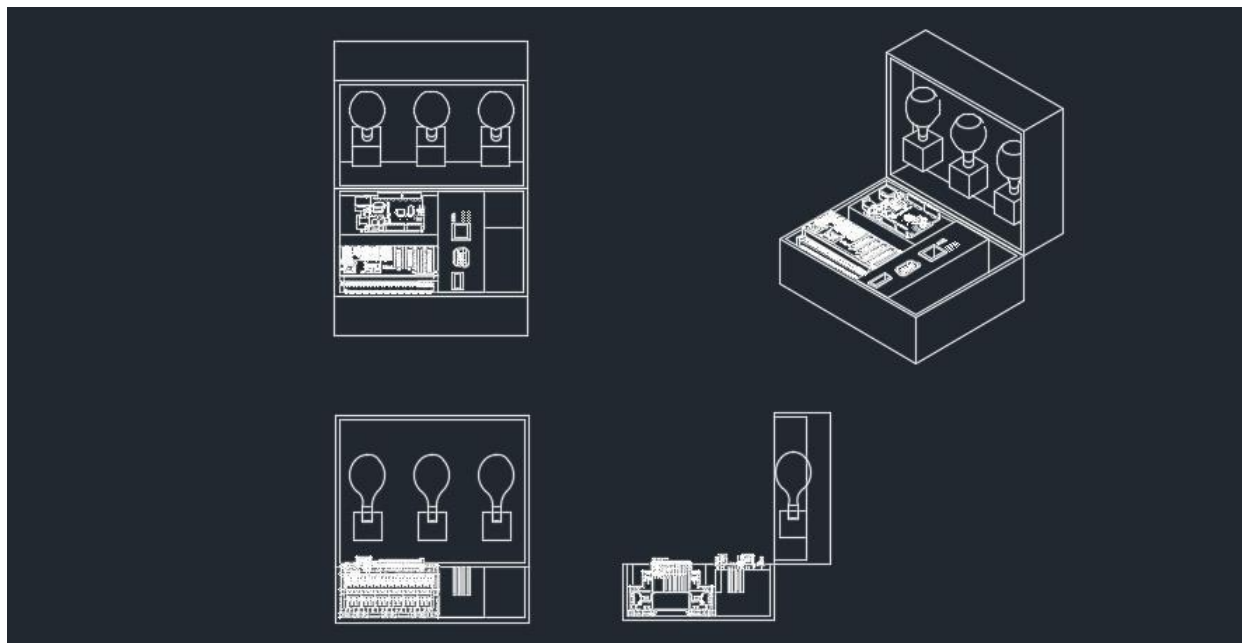
3.7 PICTURE OF OUR PROJECT

1. Example of an initial description of the project (model)

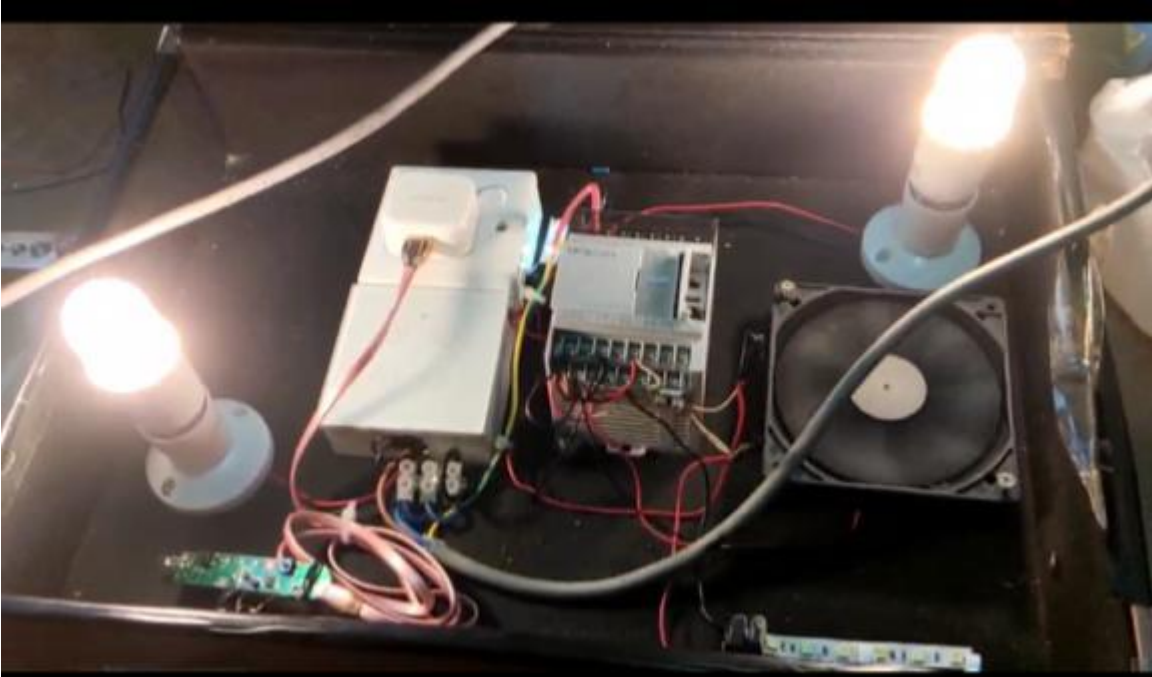


This is an initial overview of our project which uses paper to replace the actual components.

2. This is a 2D illustration of our project generated using autocad.



Result of our project



3.8 MODULES

In the final years of project we have provided 3 modules to facilitate learning. With that they can refer to the module if there is any problem or confusion.

MODULE 1

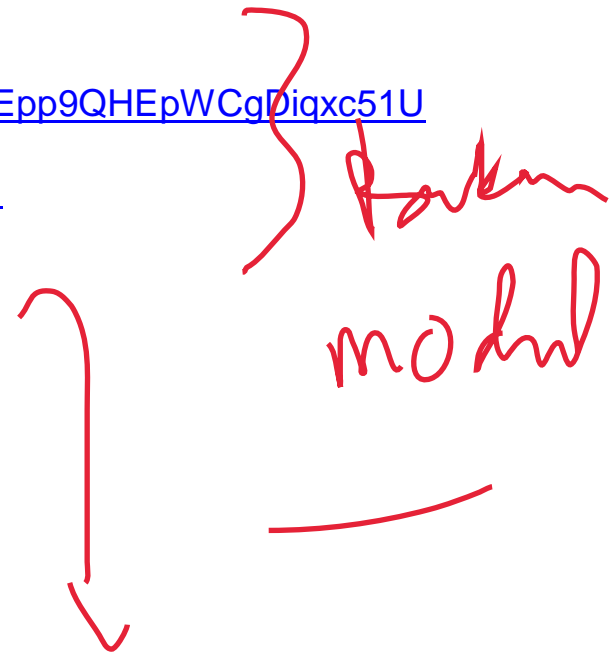
- 1) Explain basic system pneumatic.
- 2) <https://drive.google.com/file/d/1PuAHXzXFEpp9QHEpWCgDiqxc51U/uxIM0/view?usp=sharing>
- 3) <https://www.we-con.com.cn/en/service.html>
- 4) How to install wiring.

MODULE 2

- 1) How to connect components.
- 2) How to arrange components .

MODULE 3

- 1) Programming.
- 2) How to launch the training kit.
- 3) Explain about the function of training kit.



3.9 Gantt chart

WEEK/ PROJECT ACTIVITY	WEEK	8/3	15/3	22/3	29/3	5/4	12/4	19/4	26/4	10/5	17/5	24/5	31/5	7/6	14/6
Attended a briefing to resume the final project report	P														
	A	█													
Attend a briefing on how to calculate project 2 marks	P														
	A	█													
Prepare components	P		█	█											
	A		█	█											
Study and make revision	P		█	█	█	█	█	█	█	█	█	█			
	A		█	█	█	█	█	█	█	█	█				
Research literature review, methodology and update report	P	█	█	█	█	█	█	█	█	█	█	█	█	█	
	A			█	█	█	█	█	█	█	█				
Process of assembling parts of the project framework	P			█	█										
	A									█	█				
Internal component assembly process and also wiring.	P					█	█								
	A										█	█	█	█	
Making coding	P								█	█					
	A												█	█	

Final test on the training kit	P												■	■						
	A														■	■	■			
Analyze and improve project	P													■	■					
	A															■	■			
Make module instruction a	P													■	■					
	A															■	■			
Uptade logbook	P	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	A	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Final presentation of final years project 2 to the evaluator	P																		■	■
	A																			■

3.10 COST

Below is a rough calculation for our final years project :

Bil.	Components	Quantity	Price per unit	Total
1.	1 set v-box & Plc	1	RM 765	RM765
2.	Plug	2	RM 5	RM10
3.	Light	3	RM 3.78	RM 11.34
4.	Box	1	-	-
5.	Big fan	1	RM16	RM16
6.	Led light	2	RM 10	RM 10
7.	Small fan	1	RM 4	RM 4
8.	Usb	1	RM 6	RM 6
9.	Smart switch	1	RM 46	RM 46
Total :				RM 868. 34

3.11 CHAPTER'S SUMMARY

As a conclusion for this study found that this product will helping people by teaching and learning about training kits by using the concept of INTERNET OF THINGS (IOT). In addition to the design that is easy to carry and easy to use anywhere, it also meets the needs of users who is weight much lighter than existing PLCs. This product is useful and safe to use for all ages. The pre-designed shape simplifies the arrangement process as well as saves space. Finally, it can be reinforced through the research that has been done this product is a good product and should be introduced to everyone to use it.

CHAPTER 4 FINDINGS AND ANALYSIS

4.1 RESPONSES FROM GOOGLE FORM

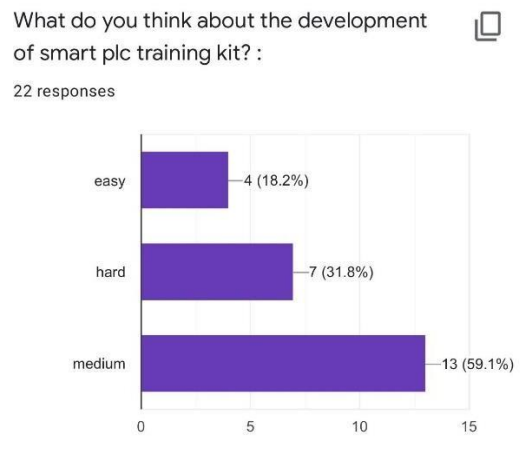
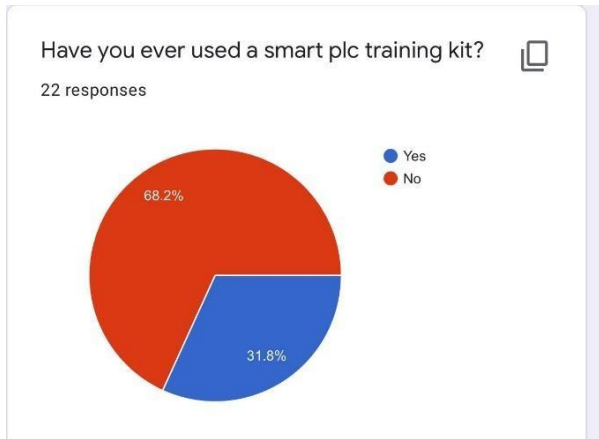


Diagram 1.1 the above results show 59% say that the training kit is medium and 30% show that the training kit is hard because it requires a lot of components



From your point of view, does this smart plc training kit help in your learning?

22 responses



Diagram 1.3 the above results show 100% say that the training kit is help in your learning and and facilitate the learning and teaching process.

Does IOT 4.0 make it easier for you to use this training kit?

22 responses



Diagram 1.4 the above results show 100% say that the training kit the addition of iot to this training kit they understand more clearly.

CONCLUSION

In conclusion, Based on the results of the study, objective research has been answered developing learning kits. Smart plc training kits are used to improve skills, increase efficiency in learning about programmer logic controllers and internet of things. When there is a learning kit, teachers have the opportunity to apply this learning kit during the teaching and learning process. Through this learning kit, it can encourage teachers to carry out 21st century learning activities, namely student-centered learning and learning kits. This research through the findings and analysis of this study the data will help students to better understand their subjects and to improve their performance by using teaching kits as a teaching tool. Overall, the researchers were able to prove the effectiveness of the use programmer logic controller learning kits to improve student performance for their subjects.

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