UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF TRAINING MODULE BASED ON REAL INDUSTRIAL AUTOMATION SYSTEM (PALM OIL REFINERY)

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honours.

by

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This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Pada abad ke-21 ini, orang perlu bekerja lebih pintar dan bukannya lebih keras. Pergerakan digitalisasi baru seperti Industri 4.0 menuntut peningkatan kemampuan sistem Pengawasan dan Pemerolehan Data (SCADA) dengan memanfaatkan kemajuan baru-baru ini untuk meningkatkan produktiviti dan industri dengan kos rendah. Kursus kejuruteraan automatik melatih pelajar untuk menyelesaikan masalah, memperbaiki dan menyelenggara peralatan industri automatik seperti kawalan berangka komputer (CNC). Industri penapisan minyak sawit adalah sektor pembuatan terkemuka di dunia dan minyak sawit telah menjadi minyak sayuran yang semakin penting di pasaran dunia. Malaysia, pengeluar minyak sawit mentah dan perniagaan pengeksport terbesar, kini merupakan pengeksport minyak sayuran terbesar di dunia. Malaysia telah mencapai pencapaian ini dengan terus meningkatkan infrastruktur pembuatannya sejajar dengan Revolusi Automasi Industri. Oleh itu, untuk mengikuti perubahan pesat dalam sistem automasi industri, industri kilang minyak sawit dipilih sebagai model pengembangan modul latihan berdasarkan sistem automasi industri yang sebenarnya. Tujuan projek ini adalah untuk mengembangkan modul latihan berdasarkan sistem automasi industri sebenar dengan menggunakan kaedah yang paling murah namun berkesan. Selain itu, untuk menggambarkan sistem automasi industri secara visual. Akhir sekali, untuk meningkatkan kesahan tafsiran eksperimen yang dilakukan semasa sesi makmal. Visual Studio 2019 telah digunakan untuk mengembangkan modul latihan. Gambar rajah tangga dipetakan sesuai dengan proses penapisan minyak sawit menggunakan CX-Programmer. Modul latihan ini merangkumi kawalan mula dan berhenti, kemampuan ulangan, simulasi CX-Programmer masa nyata, video proses yang berkaitan, maklumat pop-up mengenai proses tertentu setelah mengklik mana-mana tangki dan, penjelasan infografik mengenai proses modul latihan dalam bentuk PDF.

ABSTRACT

In this 21st century, people need to work smarter rather than harder. The new digitalization movement like Industry 4.0 demands the enhanced capabilities of Supervisory Control and Data Acquisition (SCADA) systems by leveraging recent advance to improve the productivity of and industry at a low cost. An automation engineering course trains student to troubleshoot, repair and maintain automated industrial equipment's such as computer numerical control (CNC). The palm oil refining industries are the world's leading manufacturing sectors and palm oil has become an increasingly important vegetable oil in the world market. Malaysia, the largest producer of crude palm oil and exporting business, is currently the world's largest palm oil trader. Malaysia has accomplished these achievements by constantly upgrading its manufacturing infrastructure in line with the Industrial Automation Revolution. Therefore, to keep up with the rapid changes in the industrial automation system, the palm oil refinery industry was chosen as a model for the development of a training module based on real industrial automation system. The purpose of this project is to develop a training module based on a real industrial automation system using the cheapest yet effective method. Besides that, to visually describe an industrial automation system. Lastly, to increase the validity of the interpretation of the experiments performed during the laboratory session. Visual Studio 2019 has been used to develop the training module. The ladder diagram is mapped accordingly to the palm oil refinery process using CX-Programmer. This training module includes start, stop, repeat, and back control, real-time CX-Programmer simulation, related process videos ,pop-up information about the specific process upon clicking on any tank and infographic explanation about the training module process in PDF form.

DEDICATION

To my beloved family and honorouble supervisors

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PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
CNC	Computer Numerical Control
DCS	Distributed Control System
VB	Visual Basic
VS	Visual Studio
IDE	Integrated Development Environment
CPU	Central Processing Unit
USA	United States of America
PID	Proportional Integral Derivative
NO	Normally Open
NC	Normally Close
RBDPO	Refined, Bleached and Deodorized Palm Oil
PFAD	Palm Fatty Acid Distillate
SBE	Spent Blasting Earth
DLR	Dynamic Language Runtime
SQL	Structure Query Language
CLR	Common Language Runtime
GUI	Graphical User Interface
ITPO	Introduction to Palm Oil
PC	Personal Computer
H3PO4	Phosphoric Acid

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter includes the background research, problem statements, research objectives, scopes of research and importance of study.

1.2 Background research

Automation is characterized using machinery and technology to make processes operate independently without manpower. Automation helps to increase productivity by modernizing and snowballing job efficiency by making computers implements a fixed series of operation with or without human intervention in the production progression. The key goals of the automation are the merging of production systems. This increases level of protection of the operator as well as the machineries. Also, it maximizes productivity, improve the quality and performance, minimize labour costs and most importantly able to avoid fatal accidents.

The basic specifications for the process automation are for example, the power source, appropriate inputs and outputs, proper feedback, and commands. The current automation consists of a series of transformations from Relay and Communication Logic, Programmable Logic Controller (PLC), Supervisory Control and Data Acquisition (SCADA) as well as Distributed Control System (DCS). PLCs are

increasingly used across all industries and has proven that this modern automation are able to spike productivity and profit.

Figure 1.1 Automation System

Microsoft Visual Basic has changed the way creators build applications for Microsoft Windows since the beginning in 1991. Microsoft has worked hard to keep developers up to date with rapidly developing applications, including statement compliance, Database access and the Native code complier. Visual Studio 2019 was used to enhance the productivity of with cross platform application setting. Such features provide the power and performance required to build applications that run mission critical scenarios.

Factors of using animations, educational psychologist claims that there are essentially two keys factors for using educational animations that are both affective and cognitive. Intent, animation attracts viewers' attention because motion is one of the key characteristics of a graphic that makes it eye catching. Animations also increase the learner's enthusiasm due to their uniqueness. Cognitive, animations with

cognitive functions can promote learning by its presentation of more details than static graphics. It can help learners to create a more reliable mental model of device behaviour compared to graphics alone. Several functions of animation that can be performed are describing a complex process, visualizing objects that cannot be seen with naked eyes, simulating systems, and many more.

1.3 Problem Statements

Animations are not ideal for all situations of learning, but they do have great potential. Animations that are not useful for learning often it is because of the poor design or misinterpretation of topics. Learning medium that can be found in Universiti Teknikal Malaysia Melaka's Programmable Logic Controller laboratory are the programming language software, CX-Programmer, and hardware training module. However, these teaching mediums and equipment are not sufficient to maximize the understanding as CX-Programmer does not clearly define the process of the circuits build. Besides that, the existing hardware training module are faulty and expensive to repair. Through this training module, it will create a more flexible learning environment for students, lecturers, and instructors.

1.4 Objectives

1. To develop a training module based on a real industrial automation system using the cheapest yet effective method.
2. To visually describe an industrial automation system through animation.
3. To increase the validity of the interpretation of the experiments performed during the laboratory session.

1.5 Scope of research

The scope of research of this project is to inform the features and programming languages software used to build this project. Visual Studio 2019 is used to create the training module. The idea is building a graphical user interface which works similarly to SCADA system. The module is designed according to the process of the palm oil refinery. Some settings are included to make the module work as effectively as possible. Such settings are start, stop, repeat, and back control, real-time CX Programmer simulation, pop-up features to display the process information upon double clicking on any tank ,videos selection to help students to understand more about the process and infographic explanation about the training module process in PDF form. The CX-Programmer is used for mapping a ladder diagram according to the plant process and synchronization. This two software can be simulated at the same time on a different screen to ensure learners has maximum understanding of a process working sequence. The most important advantages of this training module are that it is built with the consideration of users. This training module and CX-Programmer can be launched on any laptops or computers if the CX Programmer software are installed in it and has screen resolution of 1920 x 1080. This project is dedicated to the Programmable Logic Controller laboratory for the use of automation engineering students, lecturers, and instructors.

1.6 Importance of study

Visual presentation can be understood better if it is added to an already established schema. Schemas also proved an increase in visual memory and learning. Therefore, to choose an industry that has the potential to set an example for effective learning, the palm oil refinery process has been chosen. The complexity of the process will help students to improve their critical thinking, problem solving skills and become more active in the learning process.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter relates the general findings of the earlier chapters of the literary review. Next, it reviews the broad motivation for this study briefly. It shows methodologies used previously in this field are compared to resolved questions about the findings of previous studies using just one methodology.

2.2 Previous related studies

For automation engineering students, brief PLC education are relevant. The control of automation system is, on the other hand, an important subject and is related to PLC systems, so the students in the field of the automation learn about SCADA, HMI systems and automation education. There are several studies in literature on automation education.

According to [1], the Delta PLC DVP14SS communicates with the Visual Basic 6.0 real time automated control via PLC-VB communication. The DVP14SS and Visual Basic 6.0 communicate through the Modbus Serial Protocol. Delta DVP14SS comes with a serial port and the Modbus serial protocol, an open protocol, is the communication protocol. Visual Basic act as a Modbus Master device for transmitting request or commands in slave received serial bus. PLC acts as a slave Modbus device and answers the Master by sending an answer message. Modbus query and answer includes fields such as device address, function code, data, and error check. Visual

Basic 6.0 makes it easy to integrate software and hardware across a range of vendors [2].

In another study,[3] developed a PLC powered water pumping system that can interact with wireless network. The unit has analogue and digital electric signal inputs, CPU control panels, programming instruments, electrical analogue, digital signals, and relay outputs. Through this development students can learn on how to link PLC and SCADA systems, program these structures, and build new automation projects and test them through a built automation framework. This educational platform also allows students to learn how to process, track, and control digital and analogue PLC signals by SCADA.

Based on [4] , A wireless sensor network structure model is suggested to monitor the key parameters for a site in Karbala, Iraq, in the water field. A PAN coordinator knot was used in this structure to control the data flow between sensor knots to reduce regular network time. The use of the wireless sensor network as the most important technique necessary in different applications, for instance the conditions of water resources for safe living. This is due to the lack of groundwater, fluvial resources, and rain. The project constructs a comprehensive network of wireless sensors to monitor water levels, water quality, depending on the field and power consumption of the installed pump. The sensors used use energy efficiency techniques and the control sensor is assigned to function as a PAN coordinator. The designed structure was implemented and tested with SQL,GUI in the visual studio C# environment. The results obtained from the simulator show that the system monitors well factors efficiently. The designed GUIs of the system are introduced to simulate the real life of the wells and facilitate the use by incompetent users.

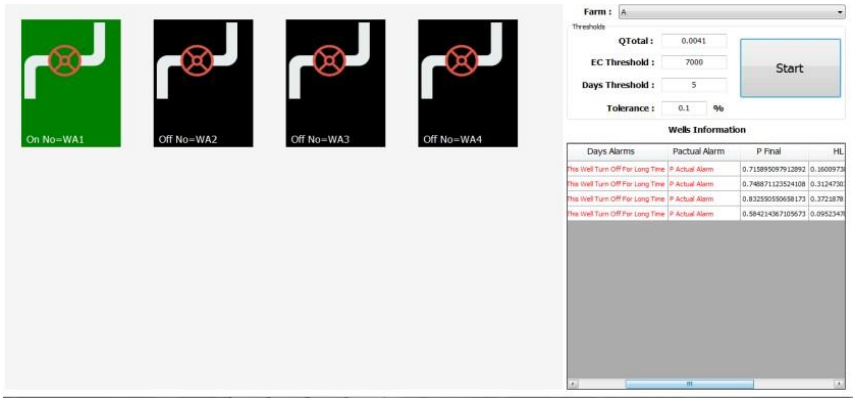

Figure 2.1 GUI of second scenario/Farm A.

On the report of [5], The study uses the Graphical User Interface to operate a remote lab (GUI) display where online interactions are performed by computerdevices. The GUI supports experiments on the PLC and able to provide immediate feedback to prove that an action has been taken. The GUI comprises of colour, image,icon, label, and text navigation to provide users with information when necessary. Thisresearch took place in several phases, specifically the design of the GUI with MicrosoftVisual Studio software, the code testing form and function. The GUI is designed withthe following features of Splash Screen Panel, Program Menu (users can choose which software to use in testing), Camera menu (users can open the attached camera to see the PLC output), Lamp menu (users can turn on and off the lighting menu),Instruction Menu (user can view these steps to carry out experiments), timer and notifications.