INTEGRATED CONCURRENT PROGRAMMABLE LOGIC CONTROLLER (PLC) BASED IR 4.0 TRAINING KIT

Firdaus bin Sukarman[1], Muhammad Amir Bin Mat Shah[1], Mazleenda Binti Mazni[1], Norjasween Binti Abdul Malik[1] and Mohd Ghazali Bin Mohd Hamami[2]

[1]*Faculty of Mechanical Engineering, Universiti Teknologi MARA, MALAYSIA*

E-mail: firdaus@uitm.edu.my

[2]*Malaysia Japan Institute of Technology, Universiti Teknologi Malaysia, MALAYSIA*

ABSTRACT

Programmable Logic Controller (PLC) is an industry standard equipment for integrated automation and vastly used in automotive, manufacturing and heavy industries. Reliable, robust and flexible to industries' environment make it the best solution for the current industrial control applications and monitoring of the robots and equipment in the plant. However, since it is an advanced application in industry, students have problems to understand the concept and see the whole objective why a certain process and correct sequence is required in the designated industry's system. Thus, the integrated system that includes Programmable Logic Control hardware, physical input output modules, and also visualization environment is developed as a training kit to improve the hands-on skills and holistic understanding of the system as whole. This combination of physical and software system brings new experience to students in learning ecosystem since they can operate using the input modules in laboratory, see the output feedback in real time and monitoring the whole process in visualization software.

Keywords: programmable logic controller (PLC), PowerBI, automation, IR 4.0

1. INTRODUCTION

Our country is pursuing the development of technologies in Industry 4.0. Rapid development in cyber-physical system and automation playing an importance part to accelerate the readiness of utilizing this technology in the future [1]. Programmable Logic Controller (PLC) is very synonym to the automation in the industry as it can control the connected machines and robots in sequence manner and provide feedback with helps of sensors and control algorithm in computer. As in industrial application, if the process is relatively simple, it only requires several input and output modules [2]. However, for automation system that consists of multiple input, various intermittent delays and ambient output control, complexity of manoeuvring signal in PLC are increased. Thus, to achieve better understanding for each complex module, physical senses of the object must be included during learning environment. Furthermore, with the help of visualization software, result of the designated sequence for each process can be debugged and improved by allocating delay timer and proper workflow as the output of the pre-complete results can be shown.

2. EQUIPMENT

Integrated Concurrent Programmable Logic Controller (PLC) based IR4.0 practical educational training device is developed based on the existing PLC Trainer for teaching and learning. The objective is to achieve a conducive ecosystem in enhancing the hands-on skill aspect through circuit designing, installation and troubleshooting. The system is divided into several main sub-systems as shown in Fig. 1. The main system consists of Programmable Logic Controller (PLC) by Siemens and programmable Ladder diagram software (Siemens TIA Portal) [3]. The additional kit included in this system is physical I/O module and Cloud Virtualization tools.

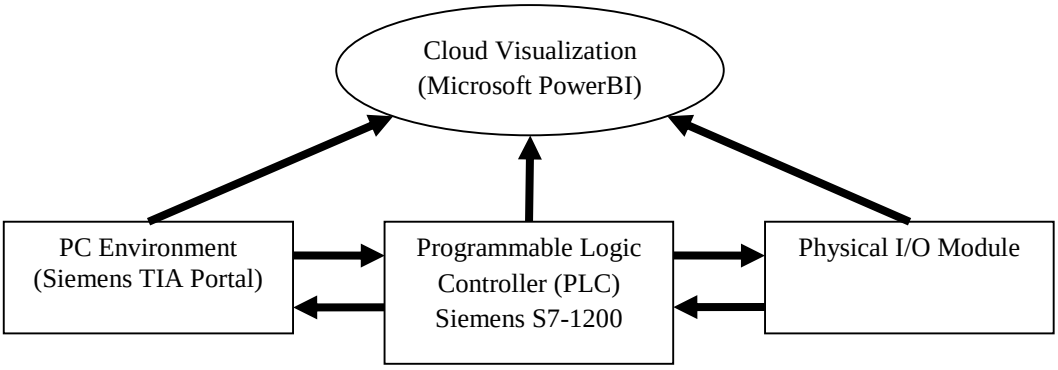

Figure 1. Integrated Concurrent PLC Training Kit System

PLC is the main device to save the program that initially set in PC Environment. It controls how the process will occur by giving the instructions in orderly manner to output such as motor and solenoid and accept input from physical sensor or any input from user. This practice is common in industry to automate the task for acquired process [4].

2.1. Physical I/O module

The existing PLC trainer board comes with a casing where students have the difficulty in observing and understanding the connection between the input module, PLC controller and output modules. The development of PLC Kit has been designed and improved by increasing the number of input and output components, cost reduction and it is also user friendly and portable. This PLC Kit is embedded with Input Output (I/O) module such as normally open push buttons, Toggle switch, 24VDC motor, 24VDC relay, 24VDC solenoid cylinder, 24VDC lamp, LEDs and fan.

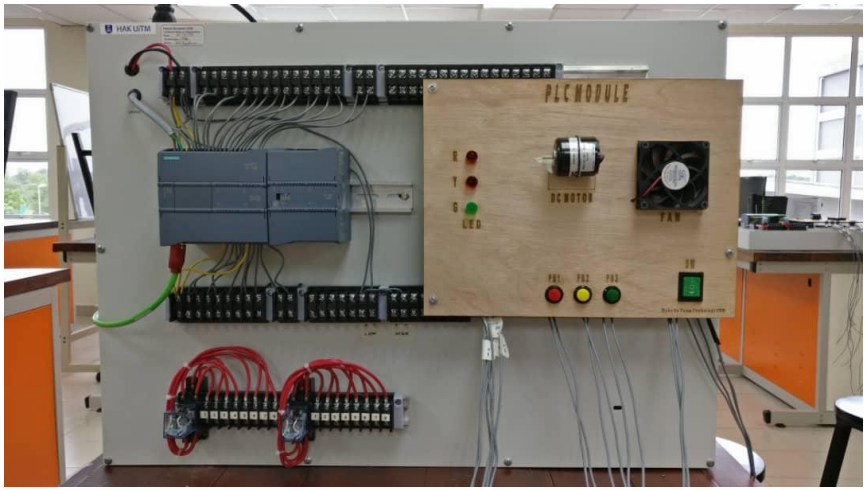

Figure 2. Physical I/O Module

2.2. Visualization software

The overall system counts, delay time and determined variables for each process can be shown in real time by using cloud centred software called Power BI Desktop by Microsoft [5]. Input/output data is registered to the input of Power BI datasets so it can concurrently send the data to the configured input. This data can be synced to the cloud and several settings to the report is required to show the actual condition of the physical system (Figure 3).

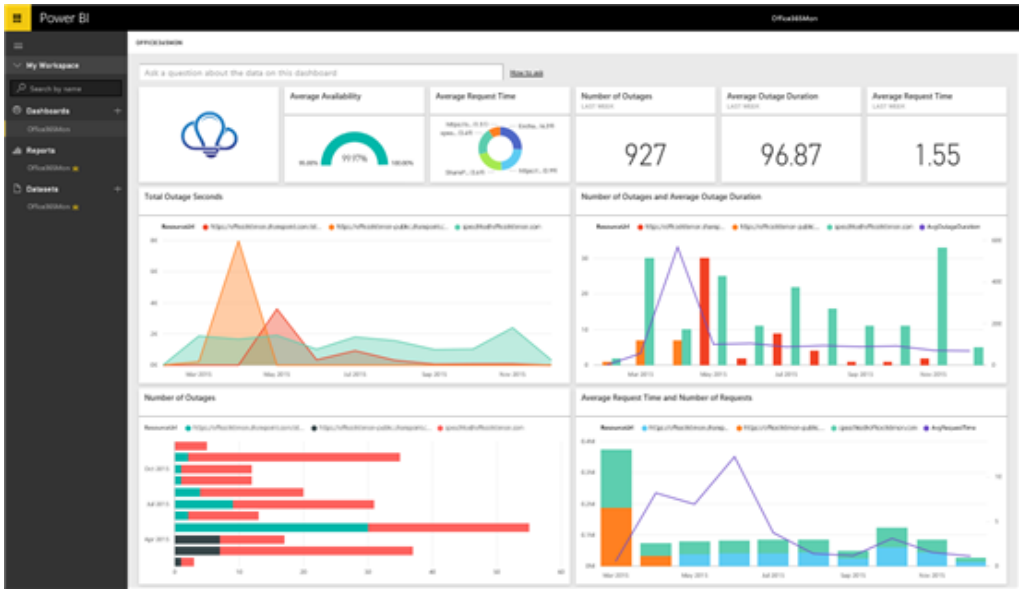

Figure 3. Power BI Desktop

3. RESULTS

Based on students Lab Practical Assessment record, it is found that there is an improvement of knowledge and hands-on skill when students use the PLC Kit. One of the feedbacks is the overall system output is shown in the virtualization software and how the overall systems work can be determined and improved in term of work cycles and parameter setting.

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