Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF TRAINING MODULES FOR INDUSTRIAL AUTOMATION SYSTEMS BASED ON REAL INDUSTRIAL AUTOMATION SYSTEM (ICE CREAM INDUSTRY)

MOHD SUAIDIE BIN SAIFUANUAR

Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

2021

DEVELOPMENT OF TRAINING MODULES FOR INDUSTRIAL AUTOMATION SYSTEMS BASED ON REAL INDUSTRIAL AUTOMATION SYSTEM (ICE CREAM INDUSTRY)

MOHD SUAIDIE BIN SAIFUANUAR

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics)
with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek: DEVELOPMENT OF TRAINING MODULES FOR INDUSTRIAL AUTOMATION SYSTEMS BASED ON REAL INDUSTRIAL AUTOMATION SYSTEM (ICE CREAM INDUSTRY)

Sesi Pengajian: 2020/2021

Saya MOHD SUAIDIE BIN SAIFUANUAR mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐ **SULIT*** (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

☐ **TERHAD*** (Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

☑ **TIDAK TERHAD**

Disahkan oleh:

(TANDATANGAN PENULIS)
Alamat Tetap:
No. 11, jln 1/2D Prima Saujana
Seksyen 1, Kajang 43000,
Selangor

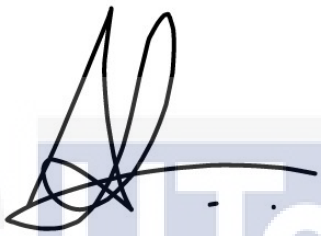
(COP DAN TANDATANGAN PENYELIA)

Tarikh: Tarikh:

*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this project report entitled "Development Of Training Modules For Industrial Automation Systems Based On Real Industrial Automation System (Ice Cream Industry) is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Student Name : MOHD SUAIDIE BIN SAIFUANUAR

Date : 5/1/2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

Signature : 

Supervisor Name : Ts. Shahrudin Bin Zakaria

Date : 11/1/2022

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

This thesis is dedicated to:

The sake of Allah, my Creator, and my Master,

My great teacher and messenger, Mohammed (May Allah bless and grant him), who taught us the purpose of life,

My great parents, who never stop giving of themselves in countless ways,

My friends who encourage and support me,

All the people in my life who touch my heart, I dedicate this research.

ABSTRACT

In today's society, individuals may pursue any fascinating topic they want and have the luxury of tackling them at their leisure in the comfort of their own homes. Although certain segments of society have pupils who are unable to acquire a single grain of knowledge about the curriculum they are studying as a result of the shift from face-to-face to online courses. As a result, this training session focuses on leading students toward a better understanding of how to program PLC ladder diagrams using an industrial automation system as an example. Each module will be evaluated, and 90% of students who enroll are anticipated to get an 80 percent or above. This training module may be enhanced further by integrating it with CX-Programmer and enabling students and instructors to immediately sync their progress.

ABSTRAK

Dalam masyarakat masa kini, individu boleh mengejar topik menarik yang mereka mahukan dan mempunyai kemewahan untuk menangani mereka pada waktu lapang dalam keselesaan rumah mereka sendiri. Walaupun segmen masyarakat tertentu mempunyai murid yang tidak dapat memperoleh pengetahuan tentang kurikulum yang mereka pelajari sebagai hasil daripada peralihan dari kursus tatap muka ke dalam talian. Hasilnya, sesi latihan ini memfokuskan kepada memimpin pelajar ke arah pemahaman yang lebih baik tentang cara memprogram diagram tangga PLC menggunakan sistem automasi industri sebagai contoh. Setiap modul akan dinilai, dan 90% pelajar yang mendaftar dijangka mendapat 80 peratus atau lebih. Modul latihan ini dapat dipertingkatkan dengan menggabungkannya dengan CX-Programmer dan membolehkan pelajar dan tenaga pengajar untuk segera menyegerakkan kemajuan mereka.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Ts. Shahrudin bin Zakaria for their precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and my parents for the financial and educational support which enables me to accomplish the project. Not forgetting my fellow colleague, Prakash for the willingness of sharing his thoughts and ideas regarding the project.

My highest appreciation goes to my parents, and family members for their love and prayer during the period of my study. An honourable mention also goes to Nazri and Hana for all the motivation and understanding.

Finally, I would like to thank all my fellow colleagues and classmates, the faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

TABLE OF CONTENTS

LIST OF TABLES

TABLE **TITLE** **PAGE**

No table of figures entries found.

LIST OF FIGURES

LIST OF SYMBOLS

LIST OF ABBREVIATIONS

API	-	Application Programming Interface
CALC	-	Computer Assisted Learning Centre
CPU	-	Central Processing Unit
GUI	-	graphical user interface
HMI	-	Human Machine Interface
IDE	-	integrated development environment
IR 4.0	-	Industrial Revolution 4.0
PLC	-	Programmable Logic Controller
RAM	-	Random Access Memory
UMP	-	Universiti Malaysia Pahang
UTeM	-	Universiti Teknikal Malaysia Melaka
VB	-	Visual Basic
WPF	-	Windows Presentation Foundation

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

In labor tasks, automation exists only to reduce effort and enhance accuracy, regardless of whether or not human interaction is necessary. At its essence, automation refers to the development and deployment of technology in the creation of goods and services with little or no human involvement during the manufacturing process. A wide range of businesses, including manufacturing, transportation, operations, and more recently the information technology sector have all benefited from its widespread use. Because of this, the current IR4.0 boom has occurred, with automated assembly lines now being used by the vast majority of industrial companies. Human interaction with these devices is required at a restricted number of locations, mostly for the purpose of monitoring and supervising certain components of the manufacturing line. Using a human-machine interface (HMI), which acts as a means of communication between the machine and the outside world, this was done.

HMI products were initially developed to address the requirement for simple-to-operate machinery that produced optimal output. The Batch Interface (1945–1968), the Command-Line User Interface (1969–Present), and the Graphical User Interface (1969–Present) are all examples of HMI predecessors (1981-Present)[1].In industries, the most apparent application of HMI is in conjunction with PLCs. Construction and maintenance of human-machine interfaces (HMIs) have never been easier than they are now, thanks to tools such as CX-Designer and CX-Supervisor, but both require a solid understanding of the subject matter to function properly.

1.2 Problem Statement

While human machine interfaces (HMIs) are perfect for overseeing a single step on an assembly line, they pose a hurdle when it comes to interpreting the assembly line's flow without adequate training. Aside from that, most human machine interfaces (HMIs) currently utilize technology that is more focused on functionality than on visuals. While animations are not ideal in an industrial setting, they may be an excellent tool for self-directed learning in some situations. At the moment, the vast majority of instructional media, including those accessible through the UTeM's Lab, are CX-One package software, which does not have a step-by-step visual tutorial. Furthermore, the current hardware components are both expensive and difficult to maintain on a long-term basis. In conjunction with the current pandemic, a more adaptive training program is necessary now more than ever before.

1.3 Project Objective

The overall goal of this project is to provide a proven approach for developing a training module for PLCs using an actual industrial automation system in VB. Specifically, the objectives are as follows:

a) Creating a training module guiding students to understand ladder diagrams.

b) To visually describe an industrial automation system through animation.

1.4 Scope of Project

The following describes the nature of this project:

a) Targeted to students who are interested in the industrial automation system field.

b) Creating an interactive module with fixed ladder diagram based on real industry.

c) Investigates the effectiveness of the module through trials in a given group of students and trainees.

d) This module is unable to communicate to PLC.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is a systematic examination of academic materials on a particular subject. It summarizes existing knowledge, enabling you to find pertinent ideas, methodologies, and gaps in existing literature. This chapter will analyze the subject at hand and will undertake past investigations and research on the dissected keywords or phrases based on current academic publications and highlight any linkages or disagreements across research in order to strengthen the case for this project.

2.2 Review on Current Situation

The Online learning or blended learning has been around even before the existence of the internet. In early 1986, CALC's first Tutoring Center went live on the Q-Link network. In those days, the teachers were known as QTutors. CALC also developed a community college that offered non-credit courses through live online group instruction [2]. Following the progress, online learning continued to bloom within major institutions such as UTeM and UMP. Student-centered learning and collaborative learning will be the focus of new learning environments created by engagement technology in education [3]. This paves a new method replacing traditional learning method where studying is student centered. This came with their own problems as listed by Susan Pedersen, teachers should provide support for students with special needs; promote the acquisition of factual information; and concentrate on the multimedia capabilities of computer technology [4]. Not only that, but a study that was conducted by K Overby demonstrates the critical nature of embracing technology,

inviting it into the classroom, guiding and coaching students in learning the proper method to use online technology, as well as teaching them dependable and safe networking and research processes [5].

2.3 Visual Studio 2017

Microsoft created Visual Studio in 1997 [6] as an integrated development environment (IDE) for developing graphical user interfaces (GUIs), console programs, internet applications, online services, mobile applications, and cloud applications. This integrated development environment was utilized to create managed and native code. It is developed using Microsoft software development platforms such as the Windows Store, Microsoft Silverlight, and the Windows API. It is not a language-specific integrated development environment; you may use it to develop code in a number of languages, including C#, C++, Visual Basic, Python, and JavaScript. It is capable of supporting a total of 36 distinct programming languages. It is compatible with both Windows and Mac OS X. Additionally, it supports the.NET framework, which will be discussed in greater detail in the subtopics.

2.3.1 VB and VB.Net

First introduced in in the year 1991 [7], Visual Basic (VB) was designed to combine visual design tools and BASIC programming language to ease the creation Microsoft Windows forms. Later, Visual Basic 6.0 was originally made available for download in the middle of 1998. Additionally, this edition included many new features, one of which was the ability to construct web-based applications. Extended support for VB 6.0 ceased in March 2003. Windows 8.1 does not support VB 6, although it does support some of its fundamental components, including the programming environment and debugger [8].

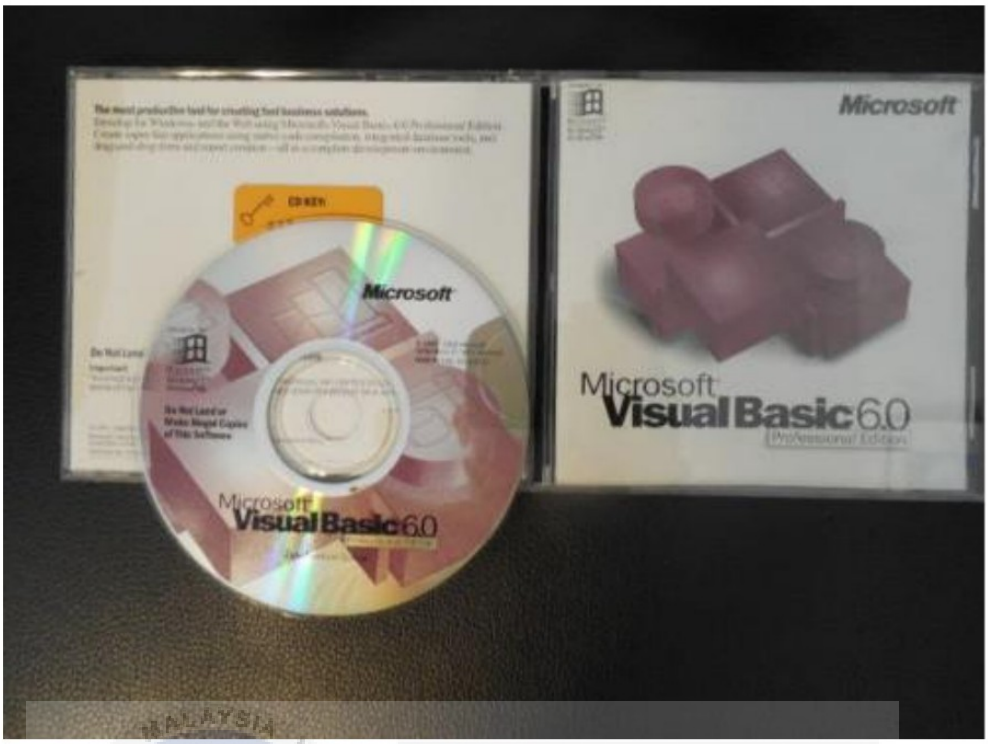


Figure 2-1 : Installation disk for VB 6.0

Not long after that, VB is upgraded with the ability to VB.NET, which was in-line with the .NET framework during its time [9]. Before the discontinuation of VB 6, VB.NET was integrated into Visual Studio.

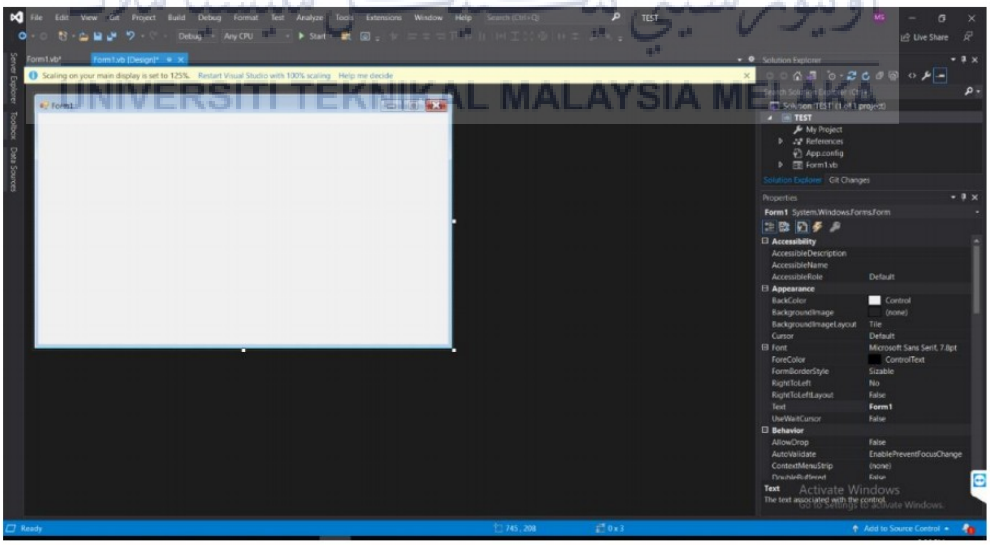


Figure 2-2 : An Example of VB in Visual Studio 2019

2.4 Programmable Logic Controller

The PLC is a robust and adaptable industrial digital computer that operates production operations such as assembly lines, robotic devices or other activities that need a high level of dependability, programming, and diagnostics of faults. It is made possible with the application of microprocessors in the PLC. Microprocessors are integrated circuits that are capable of processing data and executing programs. While PLCs include microprocessors, they are much less powerful than those found in desktop computers. The PLC software is run by a microcontroller and all input and output signals are processed. It may be used to connect the PLC's connection terminals to the microprocessor's inputs, so establishing an electrical circuit. While the inputs and outputs of a microprocessor are both present, they typically operate at a voltage of approximately 12 volts. Most PLCs need one or more power sources to run the CPU and, in certain cases, the inputs and outputs. You will require a power supply for your PLC due to the fact that some PLCs demand direct current electricity. It is important to connect the PLC properly and carefully since an incorrect connection may cause the PLC to be destroyed [10].

PLC programming is often done using ladder diagrams. Starting with the check of the conditions of all inputs, the PLC captures an image and saves the image as binary data in the RAM. After checking the state of all of the PLC's inputs, the PLC will run the program. This means that the logic program that we used to program the PLC will now be executed, and the software will collect and temporarily store some data while it is running. Upon completion of the program, the PLC will automatically update the state of the outputs. The same thing occurs now with the inputs, but in the opposite order. The output status will now be stored in the PLC as the number reflecting the output status, and the status of all outputs will be changed as a result of this change. A scan cycle is made up of these three procedures

that are carried out in succession. The time duration for the input check, running the program and updating the output status is the scan cycle specified by the PLC [11].

2.5 OMRON CX-Programmer

As aforementioned above, PLC is a crucial CPU when it comes to automation and industrial fields. To program PLC controllers and other programmable devices made by Omron, a company pack of software called CX-One is used. One of its elements is a program called CX-Programmer shown in Figure 2.1, which currently is a standard PLC programmer for the Omron company.

Figure 2-3 : Example of New File in CX-Programmer

This software uses ladder logic to program an OMRON PLC by using simple drag and drop function of standardized ladder language

2.6 Ice Cream Industry

In China in 200 BC, a frozen mixture of milk and rice was used [12]. The Chinese may have created a sorbet and ice cream machine. They sprayed a mixture of snow and