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Tarikh : 27 APRIL 2007

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FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : CONTROL DESIGN FOR BALL SORTER MACHINE USING GRAFCET (SOFTWARE PROGRAMMING)

Sesi Pengajian : 2006/2007

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SITI HUZAIMAH BT HUSIN
Pensyarah
Fakulti Kej Elektronik dan Kej Komputer (FKEKK),
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh, 75450 Melaka

Tarikh: 25 April 2007

Tarikh: 25 April 2007

CONTROL DESIGN FOR BALL SORTER MACHINE USING GRAFCET (SOFTWARE PROGRAMMING)

MUHAMMAD FIRDAUS BIN ADNAN

This Report Is Submitted In Partial Fulfillment Of Requirements For Bachelor Degree Of Electronic Engineering (Industrial Electronic)

Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Tenikal Malaysia Melaka

April 2007

"Saya akui laporan ini adalah hasil kerja saya sendiri kecuali ringkasan dan petikan yang tiap-tiap satunya telah saya jelaskan sumbernya."

Tandatangan : .....

Nama Penulis : Muhammad Firdaus Bin Adnan

Tarikh : 27/4/2007

I dedicate this to both of my parents, my family,
friends and electronic engineering education

ACKNOWLEDGMENT

Bismillahirohmanirohim...Syukur and thanks to Allah swt, make this PSM project finished successful. As introducing, I would like to wish my thankful to all people especially to my parents and my family that sacrifice and pray for me trough making this PSM project successful. Secondly to my supervisor Siti Huzaimah, that had been guide and gives her point of view to make this project successful and to all my friends that help me trough making this project finished successfully. Finally I would to thanks to all who help me and spend their times and knowledge to make my project success. Thanks again to all. May God bless their kindness. . .

ABSTRACT

The target of this project is to control design ball sorter machine. The ball sorter machine will sort the ball from every aspect for example colour and material. The ball sorter machine is control by using software programming. For the software programming the PLC and GRAFCET method is used as a programming tool. A complete ball sorter machine system involves a combination of accessories and controls of the movement of the material through the operation process. The Programmable logic controller (PLC) was becoming more power fool and high technologies that extensively used in the automation works. Thus, an efficiency approach which can represent the control process by using graphical representation perhaps a good solution to helps the designer in order to programming the PLC's. There has been a growing interest in programming languages for PLC's. In order, the sequential function chart (SFC), an international standard based on the GRAFCET languages was introduced in 1977 at France. The Grafcet language has been used as one of the most important means for designing, programming and describing logic sequential control system. These powerful graphical languages dedicated to the specification of the behavior of sequential logic systems. It is standardized by CEI and its semantic is defined for this of application. The Grafcet is a very good tool for logic controller specification and the graphical nature of the language makes Grafcet easy and simply can learn or use in automation works especially in company site. In this ball sorter machine, the suitable sensors and other accessories can makes this system sort the ball using the program that had been made.

ABSTRAK

Projek ini bertujuan untuk mengawal sebuah mesin pengagihan bola. Bola dapat diasingkan dari pelbagai aspek seperti warna dan material. Mesin pengagih bola ini akan dikawal melalui atucara. Disini kaedah aturcara yang digunakan adalah dari kaedah GRAFCET. Dalam projek ini iaitu menggerakan mesin pengagih bola, ia meliputi pengetahuan dan pembelajaran mengenai PLC dan GRATCET sebagai alat untuk mengaturcara. Grafcet meerupakan satu cara pengaturcaan dengan menggunakan PLC. Sistem pengaturcaraan ini adalah satu system pengaturcaraan berpiawai antarabangsa dan telah diperkenalkan pada tahun 1977 di Prancis. Dalam Grafcet, pengaturcaraan bergantung pada carta aliran yang dilukis berdasarkan kaedah Grafcet. Dengan menggunakan kaedah ini pengaturcaraan atau penyelesaian masalah dalam suatu system automasi mudah untuk difahami. Dalam projek ini, ia mudah digunakan untuk mengagihkan bola kerana dengan pemilihan pengesan yang sesuai, system ini dapat mengagihkan bola mengikut aturcara yang telah dibuat.

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PLC	Programmable Logic Controller
CPU	Central Processing Unit
I/O	Input/Output
DC	Direct Current
ET	Ecomomique Technique
AFCET	Association Francaise de Cybernetique Ecomomique ET Technique
LED	Light Emitting Diode
AC	Alternate Current

CHAPTER 1

INTRODUCTION

1.1 Introduction

Balls are a part of our everyday life. They span major toy and sports markets. For example, in just one year, Slazenger supplies 52,200 tennis balls for Wimbledon. Numerous golf balls are being lost in ponds, ditches and forests across the world. It's no surprise that many companies are making their way into the lucrative industry. This forces the competitors to streamline processes and broaden their range of products. A factory once made solely for producing tennis balls can now produce golf and ping-pong balls as well.

Human centered sorting is greatly inefficient and costly. On the other end of the spectrum, recycling of balls is also emerging. As previously mentioned, balls are being bought, used, lost and re-sold everyday. Recycling companies take advantage of this cycle to bring in profits. Used balls are rarely ever brought in sorted. The machine outlined in this report is much different.

The main features of the machine are aligned with the request for the proposal outlined by Puan Siti Huzaimah bt Husin, our supervisor for final year project. This Project aim is to design and develop both hardware and programming for PLC (software) using the GRAFCET as a design tool. The Ball Sorter Machine must be able to

differentiate several aspects (colour, material and etc) of the Ball. The Ball Sorter Machine will lend the Ball to the dedicated box based on the early specifications. The counter should be able to count the balls inside the box.

1.2 Objective

For this project, the objectives are:

1. To design and create the Ball Sorter Machine using software (programming) and hardware.
2. To design and create machine that can differentiate the ball in several aspects (colour material and etc).
3. Study how to link the software (programming) and the hardware.
4. Study how to design the PLC programming using the GRAFCET method.

1.3 Scope of work

For this project there are 4 steps to be developed.

1. Research about the ball sorter machine:
    - Find information from books, internet and the supervisor point of view.
    - Do analysis about the project.
    - Study about PLC programming, GRAFCET, pneumatic and etc.
2. Design software programming:
    - Design PLC programming using the GRAFCET.
    - Test run and troubleshoot the program.
    - Request the components for this project.

3. Design and build the hardware part:
    - Start building the ball sorter machine.
    - Construct BDC 7-segmen circuit for counter.
    - Make some adjustment and troubleshoot the device if needed.
4. Test run and troubleshoot:
    - Link the hardware and the software.
    - Tests run the project and troubleshoot if needed.

1.4 Problem statement

1.4.1 Advantages of Grafcet

Sequence of Operation software undergoes a rigorous development process. Graphic flow charts and detailed memory maps are created before any actual coding is done on the PLC or control computer. Many newer PLCs refer to this coding style as SFC and can be directly programmed using an SFC or Graph type language. Regardless whether the PLC directly supports an SFC language, development of GRAFCET prior to coding provides significant advantages:

- Reduced startup time, rigorous up-front design ensures fewer bugs.
- Quicker troubleshooting.
- Obvious program state, allows a problem to be quickly isolated to a small section of code.
- Complete documentation of causes of alarm and fault conditions.
- Easier program modifications, no unexpected side effects from code changes.

1.4.1.1 Design method

A graphic sequence of operation is developed for each logical sequence of the application. We call this a GRAFCET. This is a French acronym for a structured flow chart of this type. After the GRAFCETs are reviewed and approved by the customer, additional detail is added to show memory references and faults.The GRAFCET is then coded into PLC ladder logic or other form as required by the PLC or the control computer.

1.4.1.2 Benefit

GRAFCET flowcharts can be used by maintenance or engineers for troubleshooting. The need to refer to a paper listing is reduced. Current sequence step numbers as well as display of HTML versions of the GRAFCET documentation on the Operator interface allow rapid troubleshooting of common problems such as failed sensors. With some training Operators can learn to recognize fault situations and can assist or replace maintenance in resolving minor problems. Modification of the application is straightforward. No mysterious side effects occur as a result of a software modification. Training new Operators and Maintenance technicians is simplified since good documentation is available.

1.4.2 Boolean Model

Advantages

- Complete expressiveness for any identifiable subset of collection
- Exact and simple to program
- The whole panoply of Boolean algebra available

Disadvantages

- Complex query syntax is often misunderstood (if understood at all)
- Problems of Null output and Information Overload
- Output is not ordered in any useful fashion

1.4.3 PLC: Advantages and Disadvantages

1. **Flexibility**: One single Programmable Logic Controller can easily run many machines.
2. **Correcting Errors**: In old days, with wired relay-type panels, any program alterations required time for rewiring of panels and devices. With PLC control any change in circuit design or sequence is as simple as retyping the logic. Correcting errors in PLC is extremely short and cost effective.
3. **Space Efficient:** Today's Programmable Logic Control memory is getting bigger and bigger this means that we can generate more and more contacts, coils, timers, sequencers, counters and so on. We can have thousands of contact timers and counters in a single PLC. Imagine what it would be like to have so many things in one panel.
4. **Low Cost:** Prices of Programmable Logic Controllers vary from few hundreds to few thousands. This is nothing compared to the prices of the contact and coils and timers that you would pay to match the same things. Add to that the installation cost, the shipping cost and so on.

5. **Testing:** A Programmable Logic Control program can be tested and evaluated in a lab. The program can be tested, validated and corrected saving very valuable time.
6. **Visual observation:** When running a PLC program a visual operation can be seen on the screen. Hence troubleshooting a circuit is really quick, easy and simple.

CHAPTER 2

LITRETURE REVIEW

2.1 Programmable Logic Control (PLC)

A programmable logic controller is a computer design for used in machines. Unlike computer, it has been design to operate in the industrial environment and is equipped with special input/output and control programming language. The common abbreviation used in the industry for the devices, PC, can be confusing because it also the abbreviation for personal computer. Therefore some manufacturers refer to their programmable controller as PLC, which is an abbreviation for programmable logic controller.

Initially the PLC was used to replace relay logic, but its ever-increasing range of functions means that it is found in many and more complex application. As the structure of the PLC is based on the same principles as those employed in the computer architecture, it is capable of performing not only relay switching tasks, but also other application such as counting, calculating, comparing and processing of the analog signal'

Programmable controller offer several advantages over a conventional relay type of control. Relays have to be hard-wired to perform a specific function. When the system requirements change, the relay wiring has to be changed or modified, which requires time. In extreme case, such as in automaton industry, complete control panels had to be

replaced since it is not economically feasible to rewire the old panels with each model changeover. The programmable controller has eliminated much of hand wiring associated with conventional relay control circuits. It is small and in expensive in compared to equivalent relay-based process control systems. Programmable controller also offers solid-state reliability, lower power consumption and ease of expandability. If an application has more than a half dozen relays, it is probably will be less expensive to install a PLC-Simulating a hundred relay, timers and counters is not a problem even on small PLCs.

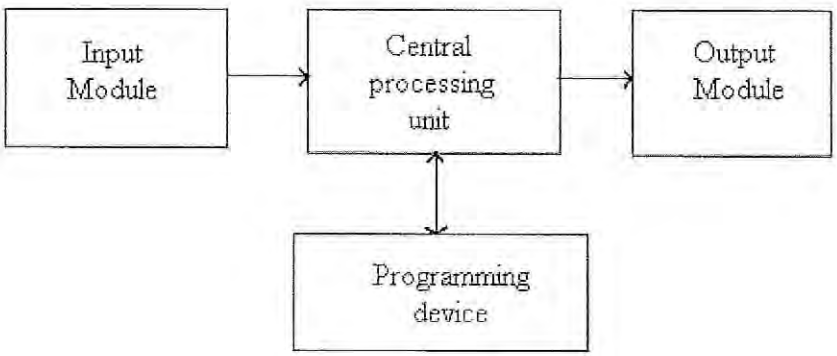

Figure 2.1: PLC Block diagram

A personal computer can be made into a programmable controller if you provide some way for the computer to receive information from device such as pushbuttons or switches. You also need a program to process the input and decide the mean of turning off and on load devices. A typical PLC can be divided into three parts, as illustrated in the block diagram. These three components are the central processing unit (CPU) the input/output (I/O) section and the program device. The programmable controller is an event-driven device which that is event taking places in the field will result in an operation or output taking place.

The central processing unit (CPU) is the heart of the PLC system. The CPU is a microcontroller-based system that replaced control relays counter timers and sequencers.