Development New Press Machine using Programmable Logic Controller

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Abstract: *The Press Machine is a project that is designing a new way to improve the previous press machines in industries which has a few weaknesses in safety while operating processes. This will create a lot of problem to the operators which have the higher risk to have an accident. The new press machine is a project to improve previous press machine which have weakness in safety while operating it. This matter creates a lot of problem and at the same time the operators and technician have the higher risk to have an accident in industries. The solution for this problem is a development of a new program of machine which running same operation but the machine is more safety and easy to setup when machine pressing the radio panel using external timer. This machine controlled by the Programmable Logic Controller (PLC). It consists of 5 pneumatic cylinders which each cylinder have their own function. This project contains in 2 states of operations which in automatic and manual mode. In automation mode, all the operation will begin automatically after the operators pressed the 2 switch simultaneously. In manual mode, the operator need to press (switch on) in every state condition to complete the operation. That mean, every state operation has its own switch for the operation. The result showed press machine is able to press the component and device, push it to pick up unit then it will be hold by the pickup unit before it placed on the target place. For the future work, this system should be building with a larger machine as the press components. It will give more power to press the device. The suggestion that can carry out from this research is to use a circuit that can make the Direct Current (DC) current more stable and linear. This project uses the DC current from the motorcycle battery because it more safety for this project.*

Keywords: Programmable Logic Controller (PLC), Pneumatic Cylinder, Automatic and Manual Mode

1.0 Introduction

New Press Machine is a project that is designing a new way to improve the previous press machines in industries which has a few weaknesses in safety while operating it. This matter creates a lot of problem to the operators which have the higher risk to have an accident. This development is the solution for the problem that contain a new program of the machine which running the same operation but the machine is more safety to the operators. Besides that, it will make easier to setup the timer for the operation because this development uses the external timer.

This machine controlled by the PLC. It consists of 5 pneumatic cylinders which each cylinder have a specific function. For example, this machine is used to press the board of circuit to the casing. Here, this cylinder has its own function for this operation which is to press the board towards casing (e.g. production of a television) and then carry the finished television to the pickup and place section. The last cylinder used to grip and pickup the television.

This project contains two states of operations which are in the automatic and manual mode. In automation mode, all the operation will begin automatically after the operators pressed the two switches simultaneously. However in manual mode, the operator need to press (switch on) in every state condition to complete the operation. Hence, every state operation has its switch for the operation.

The programmable logic controller may be the best example ever of taking an existing technology and applying it to meet a need. In the 1960s and 1970s, industry was beginning to see the need for automation. For this reason, industry saw the need to improve quality and increase productivity. Flexibility had also become a major concern. Industry needed to be able to change processes quickly to meet the needs of the consumer [1].

Programmable logic controllers were first created to serve the automobile industry, and the first programmable logic

controller project was developed in 1968 for General Motors to replace hard-wired relay systems with an electronic controller. There was always a huge wiring panel to control the system. The wiring panel could cover an entire wall.

One of the problems with old type of control is that it is based on mechanical relays. Mechanical devices are usually weak link in systems. Mechanical devices have moving part that can wear out. If one relay failed, the electrician might have to troubleshoot the whole system again. The system will be down until the problem was found and corrected.

Another problem with hardwired logic is that if a change had been made, the system must be shut down and the panel should be rewired. Here if a company decided to change the sequence of operations (even a minor change), it will be a major expense and loss of productions time whiles the system do not produce parts.

As the result, the PLC has been used as the flexibility aspect with one single controller can easily run many machines [2], [3]. It also can correct all the errors happened with wired relay-type panels, any program alterations required time for rewiring of panels and devices [4]. PLC also allows controlling any change in circuit design or sequencing simple as retyping the logic. Correcting errors in PLC is extremely short and cost effective.

It also has space efficient. Today's PLS's memory is getting bigger and this means the user can generate more and more contacts, coils, timers, sequencers, counters and etc. Thousands of contact timers and counters are allowed in a single PLC. The PLC has low cost that varies from few hundreds to few thousands. The price is less compared to the prices of the contact and coils and timers. Furthermore the installation cost, the shipping cost also cost the user less. PLC also known as a testing device as it can be programmed and evaluated the availability by ourselves in a laboratory [5]. It also has visual observation, as visual operation can be seen on the screen during the running time. Hence troubleshooting a circuit is really quick, easy and simple [6], [7], [8].

The objectives of this project are to identify the input and output component like pneumatic, sensor, switch external timer and solenoid valve. The second objective is to learn more about the types of pneumatic and its system to be function. The third is to build a new press machine model that more safety and effective. The fourth is to create the press machine that need only one worker to handle the machine process until send it to the set not like other machine that need two workers.

2.0 Methodology

2.1. System Overview
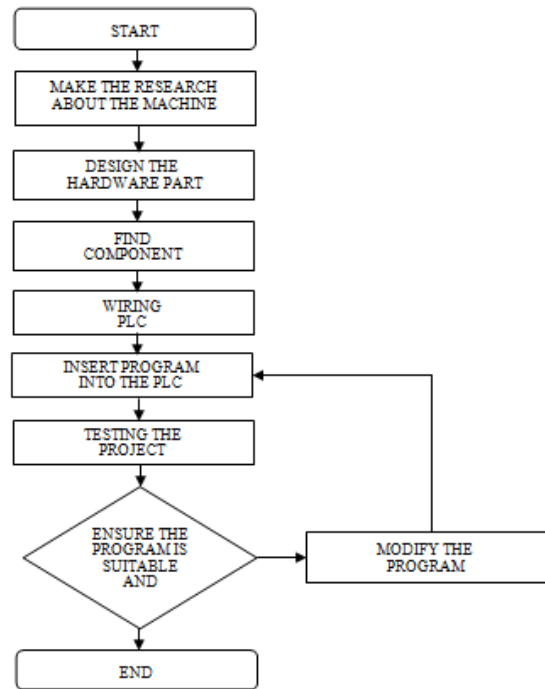
The Figure 1 shows the flow of the entire project.

Figure 1: The Flowchart of Designing the Press Machine

2.2. Interfacing and Troubleshooting

Individual ladder programming symbols are represented as instruction in the CPU section. When programming the PLC, these instructions are entered one by one and stored sequentially in the user program portion of the processor's memory.

When the PLC is in run mode, these instructions are combined to attain at the resulting ON or OFF state of each rung's output. In the sorting device to be interfaced with the PLC, the development of the program used the CX-Programmer. It will apply to the model. Then, the PLC will execute the instruction stored in its memory. The PLC is an industrial computer in which the hardware and software have been specifically adapted to the industrial environment and the electrical technician.
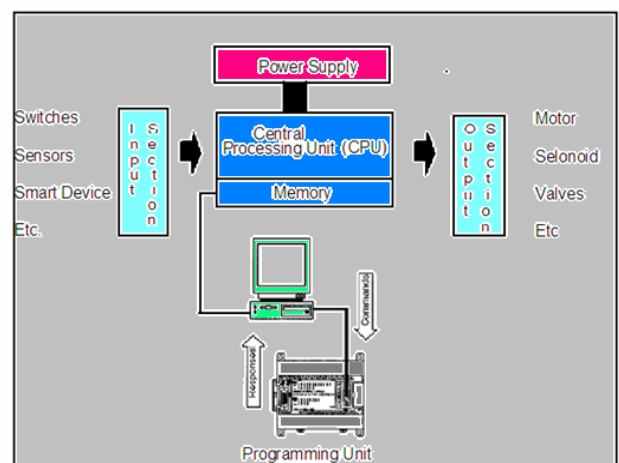

**Figure 2:** The Block Diagram of Typical Component of a PLC

The Figure 2 shows the Block Diagram of the input section, the output section and the central processing unit of PLC. The arrows from input section to the CPU and from the CPU to the output section represent protection that necessary to isolate the CPU from the real world input and outputs. The programming unit is used to write the control program (ladder logic) for the

CPU. It also used for documentation of the programmer's logic and troubleshooting the system. For sorting device, the input section contain switch, magnetic sensor, photoelectric sensor and the output section contain solenoid valve, lamp, buzzer and relay to connect power supply 12 V to DC motor [9], [10], [11].

2.3. Interfacing

There is no need to use external circuit for interfacing model with PLC. All the connection and wiring for sorting device are directly connected to the output and input at PLC port. In this sorting device, there are 12 volt power supply is used to move the direct current motor. However, the external added power supply is used if there is direct current motor been involved in the process. The external relay is used to connect power supply 12 volt and direct the current motor.

Figure below shows the wiring connection configuration between hardware (model) and PLC. After all wiring has been in place, and then the PLC will be connected to with Personal Computer (PC) or laptop [12], [13], [14].
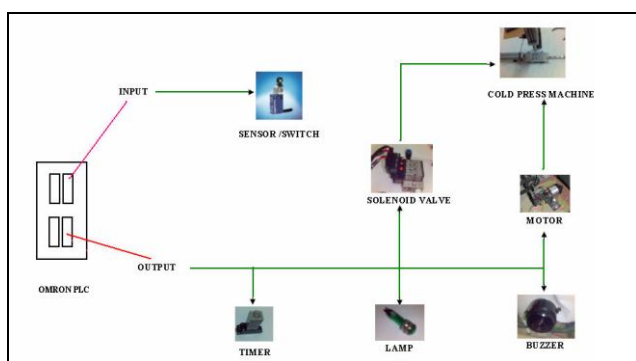
**Figure 3:** The Wiring Configuration for Sorting Device for PLC

2.4. Troubleshooting

Troubleshooting is the process of analyzing the operation to determine the error that happened in the circuit. It will involve identifying the defective components and repairing the circuit. Troubleshooting can be major or minor and it is depends on the types of equipment been used. Troubleshooting is a form of problem solving. It is the systematic search for the source of a problem so that it can be solved systematically. Troubleshooting is a process of elimination - eliminating potential causes of a problem. Troubleshooting is used in many fields such as system administration and electronics. Troubleshooting is applied to something that has suddenly stopped working, so the first focus, or concentration of attention, should be on what has changed. A basic principle in troubleshooting is to start from the simplest and most probable possible problems first. Further steps in troubleshooting are to check each component in a system one by one, and to substitute known good components for any suspect ones.

Troubleshooting can also take the form of a systematic checklist, troubleshooting procedure or table that is made before a problem occurs. Developing troubleshooting procedures in advance allows sufficient thought about the steps to take in troubleshooting and organizing the troubleshooting into the most efficient troubleshooting process. Troubleshooting tables can be computerized to make them more efficient for users.

3.0 Results/ Findings and Discussion

At the end of the project, this press machine completed and functioned as the desired result. Press machine was able to push the object to the place which will be press by the pneumatic. Then it will push to a gripper machine that will grip the object and place it to nearest place. This gripper will turn about 90 degree from its initial state. This machine functioned well in both automatic and manual mode.
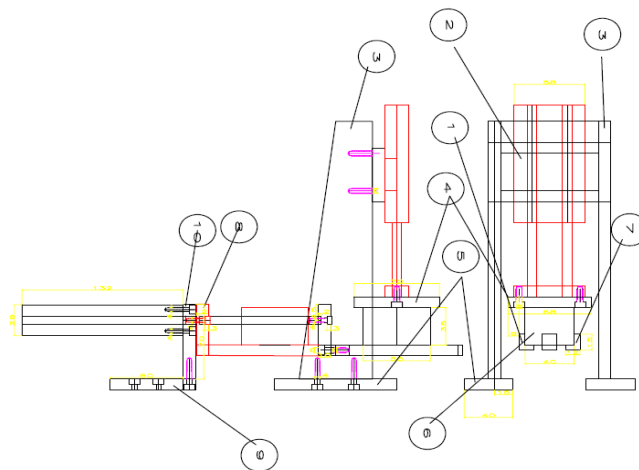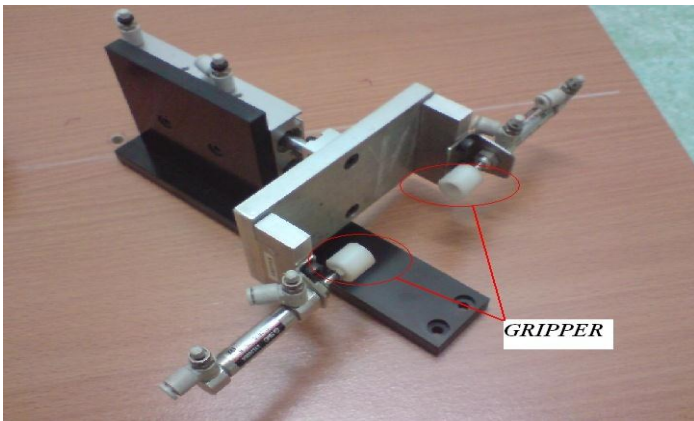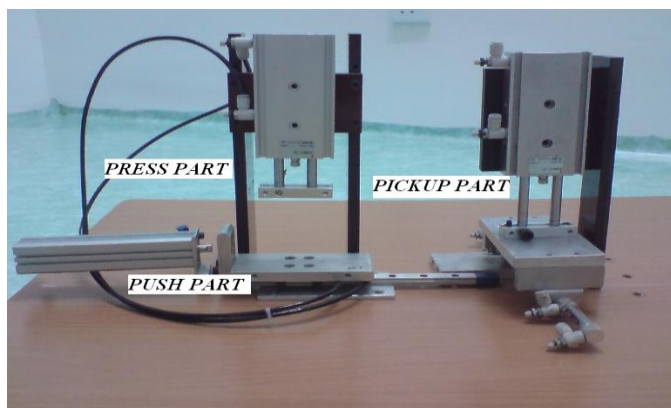

Figure 4: The Model (1) of Press Machine
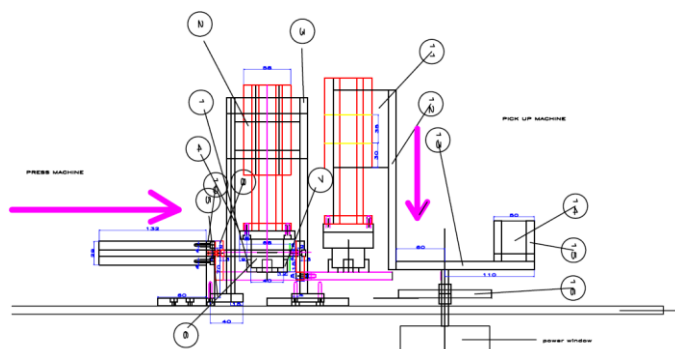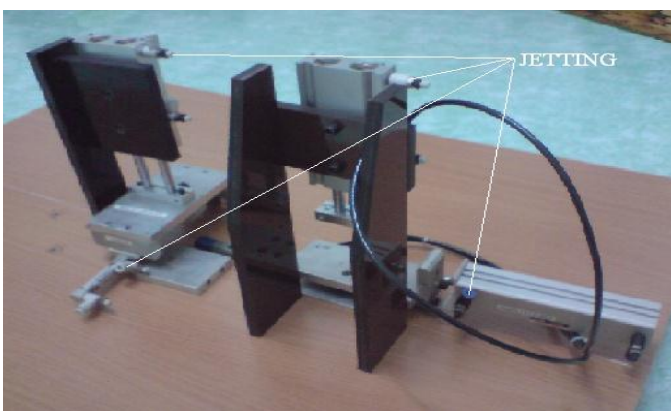

Figure 5: The Model (2) of Press Machine
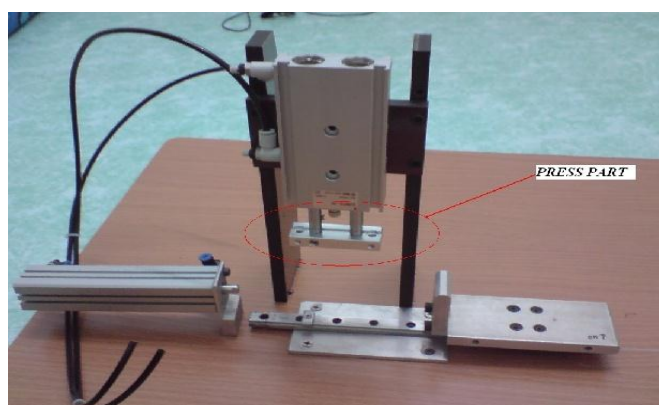
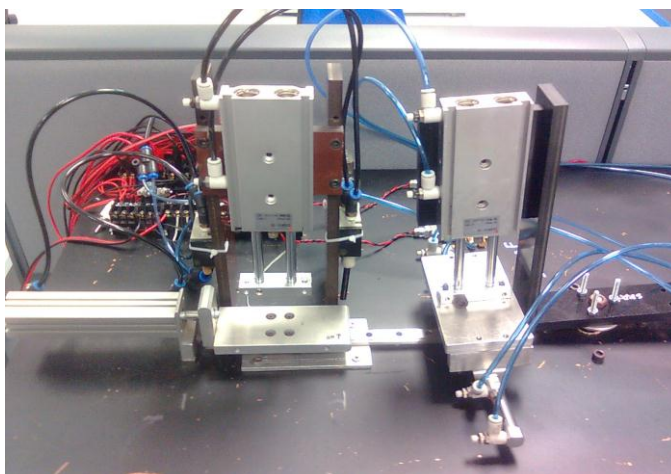**Figure 6:** The Press Part of Press Machine

Figure 7: The Gripper of Pickup Part

Figure 8: The Main Part Position of Press Machine

Figure 9: The Position of Jetting Tube

Figure 10: The Completed Press Machines

During the development of the project, there are many types of PLC found that can be used to complete this project such as OMRON, SIEMEN, NAiS and etc. For this project, the OMRON type was chosen.Besides that, there are many software that can be use to program PLC. All the software has same principal to write the program to PLC, which is the need to develop ladder diagram. For this project, CX-Programmer 6.0's software has been choose because the programs are the latest program for PLC. This CX-Programmer is the ladder diagram that only used symbol to write the program. Besides that, the address for every symbol must meet the correct for clearly functioning program.

The main problems appear when developing the project is to get the component or device that will be used such as the area sensor, pneumatic cylinder and the jetting. This problem finally solved since the components and devices can be borrowed from or faculty laboratory which is Electronic Laboratory 2. This project functioned smoothly on manual mode for press part and push part. The improvement is still needed in the gripper part because it cannot operate like expected due to the cylinder for the part was blocked. Then the auto mode operated not well because of the sensor was damages.

4.0 Conclusions

From the research and findings made in this project, it showed that this press machine is able to press the component and device, push it to pickup unit then it will be hold by the pickup unit before it placed on the target place. There are few suggestion and improvements that can be carried out for this press machine. The system is suggested to be built with larger size of machine as the Press components. It will give more power to press the devices. Secondly, usage of the cylinder of electric type or hydraulic type is recommended to be as the future study. Another suggestion is to use the digital timer for the machine as the digital timer can show the user about the timer of the operation more clearly than analogue timer.

5.0 Acknowledgement

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