

# Development of Control Mechanism of Robotic Arm for Disabled

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**Abstract:** The motion control of robotic arm is a challenging task due to the precision and accuracy of the work done by humans. The main focus of this study is on motion control.[1] It describes the design and implementation of motion control for robotic system. The system consist of a Programmable logic control (PLC) realized with the PLC Crouzet Millenium 3 Software and 2Degree of Freedom (DoF) robotic arm.[2] In the first part, the robotic arm is designed and analyzed. The robotic arm is developed with the DoF of motion. The main difficulty during the process was the movement of the robotic arm. In the second part, DC gear motor and joystick switches were embedded on the general printed circuit board (PCB) for the movement of arm in forward and backward direction. Problem in this part was the lack of controlled movement of the arm. In the third part, the PLC hardware was introduced to the arm which has its own software Crouzet Millenium 3. The software programming is not much difficult to be learned but requires concentration. It provides highly suitable control of the arm through the program. In this study we have removed the errors upto 100% between the input, output and the logical gates. For future use, the program can be altered according to the degree of freedom of the arm. One disadvantage of the PLC, more the DoF of the arm more complex is the program.

**Keywords:** motion control, PLC, Crouzet Millenium 3 software, degree of freedom

## I. INTRODUCTION

Robot is a machine that collects the information about the environment using some sensors and makes a decision automatically. People prefer it to use in different field, such as industry, some dangerous jobs including radioactive effects. In this point, robots are considered as a server. They can be managed easily and provides many advantages.[3]

A Robotic Arm can be compared to a human hand. It has a free rotating joint (rotation) and a translational joint (displacement) for the movement of the arm. This arm movement is usually driven by an electric driver (motor) or a pneumatic and a hydraulic system (pistons). These actuators are controlled by a microcontroller (CPU), usually programmable and made to perform a set of sequential tasks. Most of these robotic arms are designed to be used in industrial purposes for fast and reliable performance, helping for mass productions.[6]

A robot arm is known manipulator. It is composed of a set of joints separated in space by the arm links. The joints are where the motion in the arm occurs. In basic, a robot arm consists of the parts: base, joints, links, and a grapper. The base is the basic part over the arm, It may be fix or active. The joint is flexible and joins two seperated links. The link is fix and supports the grapper. The last part is a grapper. The grapper is used to hold and move the objects.[4]

In this paper, a robotic arm is designed that is controlled by PLC (programmable logic controller). A PLC is a type of digital computer that has an input and an output interface, controlled by a simulated program designed in a computer and it is used for automation for electromechanical process, typically for industrial use. A PLC is designed for multiple input and output arrangements and these inputs and outputs are logically programmed in different forms, such as a ladder diagram, a structural text and a functional block diagram and stored in the PLC's memory.[9] Conclusively, this project for designing the control system software has given a lot about the learning approach and helps to do more about subject in the future.

## II. OBJECTIVE

Robotic arms are designed and very much used in the industries, particularly in Automobile, Healthcare and Pharmaceutical Industries, for picking and placing objects according to operators' desire. This prototype of mobile robotic arm is a single step towards achieving the similar objective.

The robotic arm is driven on DC motor. The DC motor is driven on two DC gear motor in which one is moving in X

direction & other is moving in Y direction. PLC software based. The program made in the software will help in the movement of the arm in the X and Y direction. This application is in the area of embedded systems and automation. An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular function.

Since the embedded system is dedicated to specific tasks, design engineers can optimize it reducing the size and cost of the product and increasing the reliability and performance. Embedded systems are controlled by one or more main processing cores that is typically either a microcontroller or a digital signal processor (DSP). Embedded systems control many devices in common use today. Robot is a system that contains sensors, control systems, manipulators, power supplies and software all working together to perform a task. Designing, building, programming and testing a robot is a combination of physics, mechanical engineering, electrical engineering, structural engineering, mathematics and computing. In some cases biology, medicine, chemistry might also be involved.

## III. METHODOLOGY

*A Systematic Approach Of Control System Design Using A Programming Logic Controller:[8]*

### 1. Determine the machine sequence of operation

Firstly decide what equipment or system you want to control. The ultimate purpose of the programmable controller is to control the external system. This system to be controlled can be machine equipment, or process and is generically called controlled system.

The movement of the controlled system is constantly monitored by the input devices that give specified condition and send a signal to programmable controller. In response programmable controller outputs a signal to external output devices which actually controls the movement of the controlled system as specified and thus achieves the extended control action. In simplicity you need to determine the sequence of the operation by drawing the flowchart.

### 2. Assignments of Inputs and Outputs

Secondly, all the external inputs and outputs to be connected to the programmable controller must be determined. The input devices are various switches, senses etc. The output devices are solenoids, electromagnetic valves, motor, inductors etc. After identifying all the various INPUT and OUTPUT devices, assigned the numbers corresponding to the INPUT and OUTPUT number of the particular programmable controller you will be using, the actual wiring will follow the number of programmable controller.

### 3. Writing of the Program

Next, design the free body diagram program by following the control system sequence of operation as determined but the step one.

### 4. Programming into Memory

Now, you can apply the program to the programmable controller. Depending on the type of programmable controller, you may have to do I/O generation to prepare the system configuration. After that you can enter your program in the memory by computer aided FBD software tool. After completion of the programming check for errors and simulate the whole operation to see that its right.

### 5. Running the System

Before the push button is pressed, thoroughly ensure that the input and output wiring are correctly connected according to the I/O assignment. Once confirmed, the actual operation of the PLC can now be started. Test run thoroughly until it is safe to operate by anyone.

The above mentioned steps are explained in a flowchart form for better understanding in figure 1

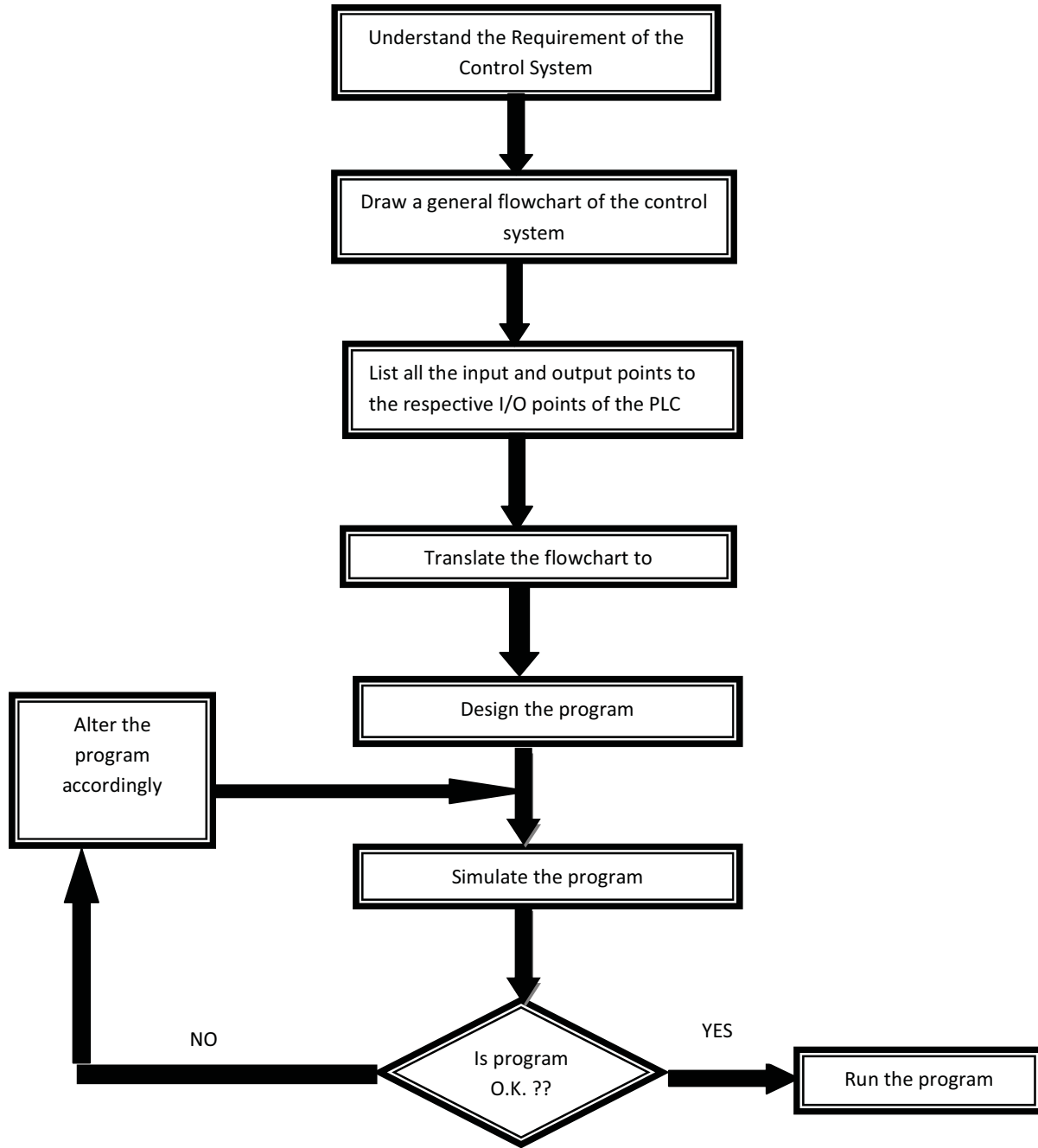


Figure 1 Flowchart

#### IV. PROGRAM

The below shown figure 2 i.e the program window shows the designed program for the control motion of the arm.

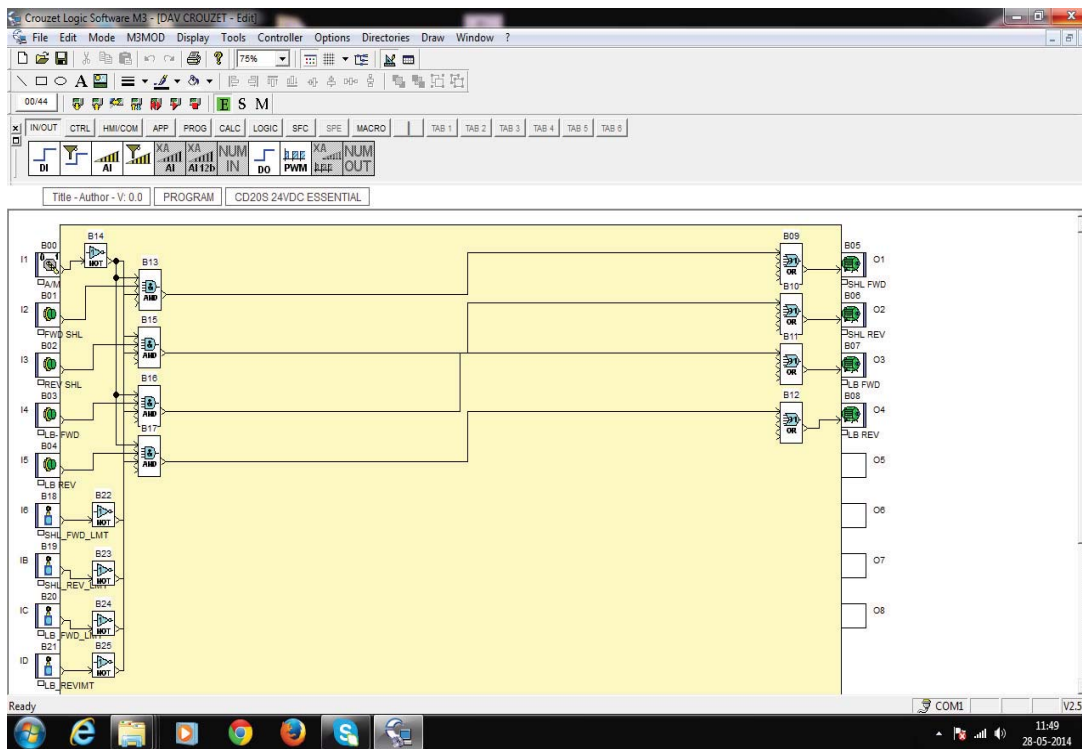


Figure 2 Program

Our program includes 9 inputs and 4 outputs. Input device includes emergency switch, push buttons and limit switches whereas the output devices are motors. The movement of the motor depends upon the logical gating. The tables shown explain the inputs and the outputs of the program.

INPUT: In the program five pushbuttons and four limit switches are used as inputs which are described as follows in table 1.

Table 1 Input

Control Pendent		Description
Name	Type	
A/M	Pushbutton-1	Automatic/manual
FWD SHL	Pushbutton-2	Pushbutton controlling the forward movement of the shoulder
REV SHL	Pushbutton-3	Pushbutton controlling the reverse movement of the shoulder
LB FWD	Pushbutton-4	Pushbutton controlling the forward movement of

		the elbow
LB_REV	Pushbutton-5	Pushbutton controlling the reverse movement of the elbow.
SHL_FWD_LMT	Limit Switch-1	Limit switch to limit the forward movement of the shoulder.
SHL_REV_LMT	Limit Switch-2	Limit switch to limit the reverse movement of the shoulder.
LB_FWD_LMT	Limit Switch-3	Limit switch to limit the forward movement of the elbow.
LB_REV_LMT	Limit Switch-4	Limit switch to limit the reverse movement of the elbow.

OUTPUT: The output is the motion of the motor 1 & 2 in the forward and the reverse direction as explained in the table 2.

Table 2 Output

<b>Name</b>	<b>Type</b>	<b>Description</b>
SHL FWD	Motor no. 1	Motor moving the shoulder in the forward direction.
SHL REV	Motor no. 1	Motor moving the shoulder in the reverse direction.
LB FWD	Motor no. 2	Motor moving the elbow in the forward direction.

LB REV	Motor no. 2	Motor moving the elbow in the reverse direction.
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## V. CONCLUSION

A control system for controlling the robotic arm was accomplished with successful testing. The wiring and software programming was done in the guidance of the supervisor.

The programming was done according to the operating principle which was decided in the thesis i.e manual operating modes and automatic operating modes. The manual operating modes programmed in the PLC to control the positive and the negative movement of the axes was successfully simulated.[12]

Conclusively, the project was worthful with positive result. During this project, it encounters a number of problems due to lack of understanding. The wiring and the installation has a lot of work to be done in this project , which makes the project more skilfull. The other thing, this project has completely different programming software “CROUZET MILLENIUM 3”, which itself is a task to learn.[13] This project for designing the control system software has given a lot about the learning approach and helps to do more about subject in the future.

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