Sudan University of Science and Technology

College of Graduate Studies

Design and Implementation of an Automated Positioning System of the Ground Station

تصميم وتنفيذ نظام توجيه آلي لمنصة المحطه الأرضية

A Thesis Submitted in Partial fulfillment for the Requirements of the Degree of M.Sc in Mechatronics Engineering

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بسم الله الرحمن الرحيم

الاستهلال

بسم الله الرحمن الرحيم

قال تعالى :"وأعدوا لهم ما استطعتم من قوة ومن رباط الخيل ترهبون به عدو الله وعدوكم وءاخرين من دونهم لا تعلمونهم الله يعلمهم وما تنفقوا من شئ فى سبيل الله يوف اليكم وانتم لا تظلمون"

سورة الانفال الاية (60)

صدق الله العظيم

DEDICATION

Each challenging work needs self efforts as well as

Guidance of elders especially those who were very close to our heart

My humble effort dedicate to my sweet and loving

MOTHER AND FATHER

Whose affection, love, encouragement and pray of days and nights make me to able to get such success and honors

Along with all hard working and respected teachers.

ACKNOWLEDGEMENT

In the accomplishment of this thesis successfully, many people have best owned upon me their blessing and the heart pledged support, this time I am utilizing to thank all the people who have been concerned with thesis.

Primarily I would thank ALLAH for being able to complete this thesis with success. Then I would like to thank my supervisor DR.FATH-ELRAHMAN and all teachers whose valuable guidance has been the ones that helped me patch this thesis and make it full proof success his suggestions and his instruction has served as the major contributor toward the completion the thesis.

Then I would like to thank my brother, sister, family, wife and friend.

Last and not the least I would like to thank my classmates who have helped me a lot.

المستخلص

نتيجة للتطور المضطرد في المجالات الاوتوماتيكية لتقليل الخطأ وزيادة الموثوقية وتقليل جهد اليد العاملة وبدوره يقلل من التكلفة التشغيلية مما يؤدي لربح المعركة الزمنية ,يقدم هذا البحث تصميم وتنفيذ نظام توجية الى لمنصة المحطة الارضية والذى هو الوحدة الرئيسية من اجل تنفيذ السيطرة والاتمتة على الهوائيات. يرتكز على التحكم فى حركة الهوائيات الى اسفل والي اعلى حسب نظام نقل البيانات فى المحطة الارضية.فى العصر الحالي يتم احلال كل الانظمة اليدوية بانظمة يتم التحكم فيها اليا حيث توفر الجهد والزمن والدقة كما تمتاز الانظمة الاوتماتيكية ب تكلفة اقل واعتمادية عالية.هذا البحث عمل على تصميم وتنفيذ نظام توجية الى لمنصة المحطة الارضية با ستخدام جهاز التحكم القابل للبرمجة الذى يقوم بالتحكم فى حركة الهوائيات عبر التحكم فى حركة الموتورات فى اتجاه عقارب الساعة وعكسها .تم تصميم الية ميكانيكية لتحويل حركة الموتورات الدائرية الى حركة خطية كما تقوم بالتحكم فى السرعة عبر التروس وتثبيت الهوائيات فى الوضع الراسى والافقى.تم اختبار المنظومه اولا ببرنامج المحاكاه S7-200 الذى يعمل مع جهازالبرمجة المستخدم فى المشروع وهو المعالج (214). اظهرت النتيجة اداء افضل للمنظومة من الناحية النظرية حيث تم تقليل زمن تشغيل الهوائيات.ام نتائج العملى لها نفس الاداء .الإ ان زمن التشغيل اكثر بقليل من الزمن الذى تم الحصول عليه من برنامج المحاكاة .

ABSTRACT

According to harry development in all automatic filed for reducing total error, increase reliability and maintain the human effort, that lead to reduce the operation cost and win time gain, This Thesis presents Design and implementation of automated positioning system for ground station, which is the key module in order to perform the controlling and automation of antennas. The main area of this thesis focuses on controlling of antennas movement to up and dawn according to ground station operation of communications .recently used automation system because is easy operation, high accuracy and reliability, less effort and time. This thesis presents Design and implementation of automated positioning system for ground station by use Program Logic Control which controlling antennas movement by controlling the motors operation clock wise and counter clock wise. Design and implementation mechanism to change revolution movement to linear movement, decrease motors speed by gears and locked antennas in ideal position. The control system is simulated by powerful software S7-200 program. According to Microprocessor of PLC are CPU 214.Simulation results also show better performance of motor that reduce the time of Antennas movement. Implementation results show same performance and high control of antennas. But the time of simulation is less than actual time.

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LIST OF ABBREVIATION

AC	Alternating Current
amp	Electricity Ampere
BLDC	Brushless Direct Current Servo Motor
CATIA	Computer Aided Three Dimensional Interactive Application
CAD	Computer Aided Design
CPU	Central Processing Unit
DC	Direct Current
DOF	Degree of Freedom
FBD	Function Block Diagram
GM	General Motors
Kg	Kilo Gram
PLCI	Programmable Logic Controller Input
IL	Instruction List
I/O	Input/Output
LD	Ladder Diagram
LED	Light- Emitting Diode
M6,M8	Milli Meter(Size of Screw)
m A	Milli Ampera
M&E	Monitoring and Evaluation
NC	Normal Close
Nm	Newton Meter
NO	Normal Open
PLC	Programmable Logic Controller
PID	Proportional Integral Derivative
PLCO	Programmable Logic Controller Output
rpm	Revolution per Minit
SFC	Sequential Function Chart
SMPS	Switch Mode Power Supply
ST	Structured Text
VDC	Volts Direct Current

LIST OF SYMOBLES

F	Force
g	Acceleration Gravity
M	Marker
w	Angular Velocity
P	Power
T	Torque
V	V0lt
m	mass

CHAPTER ONE

INTRODUCTION

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INTRODUCTION

1.1 Preface

Automation is one of most important factors for development in present industrial world. It helps in the growth of productivity, efficiency of the product and its quality by reducing the human's efforts. Industrial automation includes sophisticated equipment which is used daily such as medical equipment radiography, X-ray machines etc., automobiles, refrigerators and other electronics equipment [1].

Among all of these outcomes, automated positioning system for ground station is one of them. Automated positioning system is used in industrial purposes. Usually, a DC motor is used in positioning systems. These actuators are controlled by a Programmable Logic Controller PLC. This automated positioning system is designed to be used in the industries for fast and reliably picking the object as antennas from one place and placing it in another place. In this thesis PLC is used in control process [1].

There are two modes used in control, automatic and manual mode. As there are many languages to develop a program in the PLC but for this Thesis Ladder logic is used to develop the program.

Setup time is a main factor in the process of preparing ground station antennas. Doing the process manually, we find that the process takes relatively long time and consumes much effort. Automated systems can be utilized to minimize setup time. Automated systems can be found in most systems today. Their tasks are accomplished through actively moving, placing and assembling manufacturing parts.

This movement is facilitated by actuators that apply a torque in response to a command signal [2].

1.2 Problem Statement

Communication efficiency plays an important role in the design process of ground station platforms. There are many factors that affect communication efficiency. The time of preparing process of ground station antennas is one of the most important factors. Long time of preparing process affects communication efficiency.

1.3 Proposed Solution

This study intends to investigate the design, simulation, implementation and control of antenna using DC motors and PLC is a heart of this thesis work to control antennas platform and to minimize the preparing process time, this is designed as automated systems instead of manually preparing.

1.4 Research aims and objectives

- Design and fabrication of actuator for holding the antennas of required size and weight.
- To minimize the setup time of preparing ground station antennas.
- To decrease effort of preparing ground station antennas.
- Ground station antennas are designed as automated systems instead of manually preparing.
- To design mechatronic system for motor guidance and control, that capable moving a load not less than 20 kg.

1.5 Methodology

This Thesis merges different fields of technologies such as mechatronic, embedded systems, and automated systems and a blend of hardware and software engineering. It is divided into two term Mechanical design and Electrical design. In Mechanical design discuss the design, simulation and implementation of the movement arm that can lift an object up to 20 kilo grams the movement it horizontally. The electrical aspect of the thesis is comprised of a circuit that makes it uses three DC motor with gearboxes. The DC motor is capable of doing a 90-degree in addition; it also has LEDs lights to indicated position of antennas and use of PLC, specifically the Siemens model, and a PLC is an open-source online platform based on a combination of hardware and software. Using the PLC enables the actuator movement in one direction; e.g. up and dawn.

1.6 Thesis Outlines

This thesis is composed of five chapters; their outlines are as follows; Chapters One is an introduction to this thesis description consists of an overview, problem statement, the proposed solution, research aims and objectives and finally the methodology is discussed.

Chapter Two represents a general review of work. This chapter contains an explanation of general terms often used in the field of automation. It also contains a literature review e.g. the main tools that are used in this thesis are also mentioned in details beside other components required to accomplish this work and the related work that has a close relationship to the work done. Chapter Three represents the mechanical and an electrical system, this chapter describes in detailed design, simulation and implementation of both term hardware and software.

In chapter Four shows the discussion of the simulation and implementation part of both mechanical and electrical part design. Gained results are also presented in this chapter.

Chapter Five draws a conclusion to my work. It is also suggests a bunch of recommendations that can be thought of.

CHAPTER TWO

LITERATURE REVIEW

CHAPTER TWO

LITERATURE REVIEW

2.1 Background

This chapter contains the background and literature review, Concerning main topics of thesis such automation Tools and review components, Automation Tools e.g. CATIA and S7200 PLC programs. Review components DC motors, limits switch, power supply, relays, indicators, bush bottom and PLC, Which use in thesis.

2.1.1 Concerning of Automation

A Greek word means self dedicated. Automation is the key to modernization and has been conceptually understood as a way to increase efficiently and to improve productivity. The process of having machine follow a predetermined sequence of operation with little or no human labor, using special equipment and devices that perform and control manufacturing processes is known as automation. The goals of automation are Integration of various aspects of manufacturing operations to reduce labor cost. The fundamental constituents of any automated process are a power source, a feedback control mechanism, and a programmable command [1].

2.1.2 Automatic Control Systems

Automation is the technology by which a process or procedure is performed without human assistance Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention. Today a lot of processes have been completely automated.

Automation covers applications ranging from a household thermostat controlling a boiler, to a large industrial control system with tens of thousands of input measurements and output control signals. Control system complexity it can range from simple on-off control to multi-variable high level algorithms [2].

Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, or in combination. Complicated systems, such as modern

factories, airplanes and ships typically use all these combined techniques. The benefits of automation include labor savings, savings in electricity costs, savings in material costs, and improvements to quality, accuracy and precision.
The main advantages of automation are: Reduced direct human labor costs and expenses, Improved quality or increased predictability of quality, Improved robustness (consistency), of processes or product, Increased consistency of output, Installation in operations reduces cycle time, Can complete tasks where a high degree of accuracy is required, Replaces human operators in tasks that involve hard physical or monotonous work (e.g., using one forklift with a single driver instead of a team of multiple workers to lift a heavy object), Replaces humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc.) , Performs tasks that are beyond human capabilities of size, weight, speed, endurance, etc, Reduces operation time and work handling time significantly, Frees up workers to take on other roles, Provides higher level jobs in the development, deployment, maintenance and running of the automated processes [2].
The main disadvantages of automation are:
Possible security threats/vulnerability due to increased relative susceptibility for committing errors, Unpredictable or excessive development costs, High initial cost, Displaces workers due to job replacement, Leads to further environmental damage and could compound climate change[2].

2.1.3 Components of Electrical System

The electrical system and control system composed of many components. It is shown in detail. The components are;

2.1.3.1 Dc motors

A DC motor is rotary electrical machines that convert direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic to periodically change the direction of current flow in part of the motor.
DC motors were the first type widely used A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills.

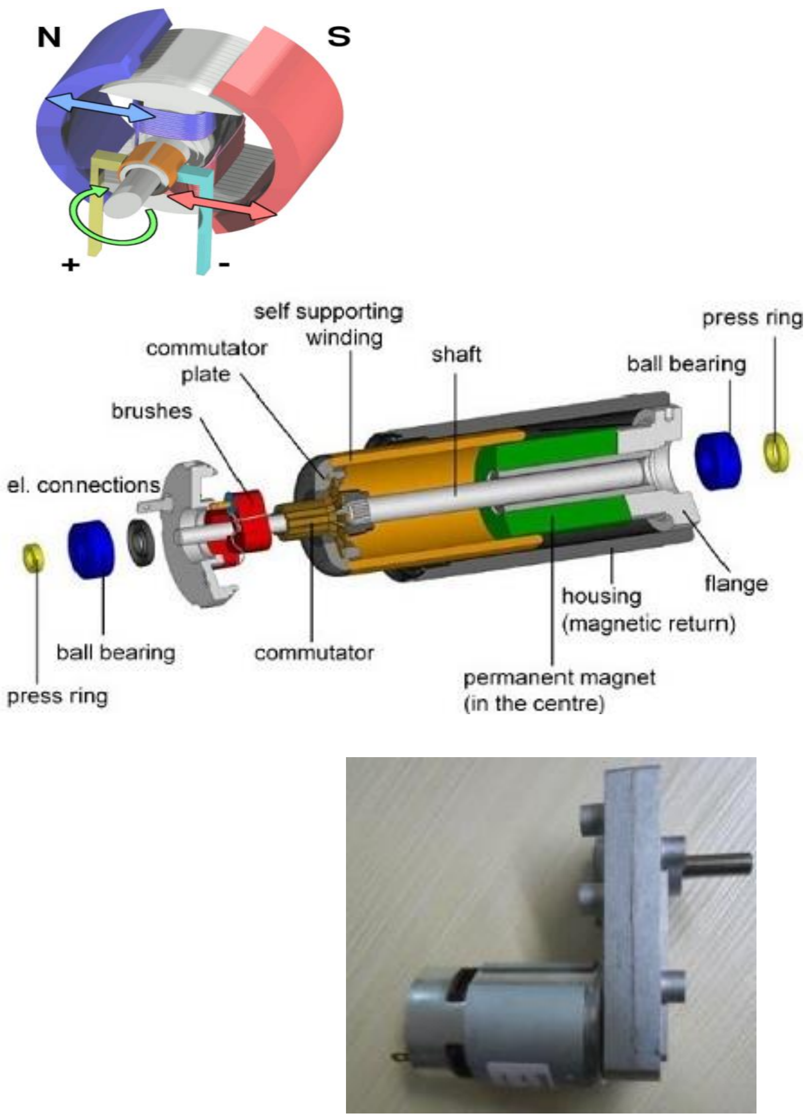

Figure.2.1 DC motors in details[13]

Direct current motor is designed to run on DC electric power. The pure DC designs are Michael Faraday's homo-polar motor (which is uncommon), and the ball bearing motor, which is so far a novelty. The most common DC motor types are; Brushed DC motors and Brushless DC motors.

Brushed DC motors: The classic DC motor design generates an oscillating current in a wound rotor with a split ring commentator, and either a wound or permanent magnet stator. A rotor consists of a coil wound around a rotor which is then powered by any type of battery .Many of the limitations of the classic commentator DC motor are due to the need for brushes to press against the commentator. This creates friction. At higher speeds, brushes have increasing difficulty in maintaining contact. Brushes may bounce off the irregularities in the commentator surface, creating sparks. This limits the maximum speed of the machine. The current density per unit area of the brushes limits the output of the motor. The imperfect electric contact also causes electrical noise. Brushes eventually wear out and require replacement, and the commentator itself is subject to wear and maintenance.

Brushless DC motors: Some of the problems of the brushed DC motor are eliminated in the brushless design. In this motor, the mechanical "rotating switch" or commentator / brush gear assembly is replaced by an external electronic switch synchronized to the rotor's position [13]. Brushless motors are typically 85-90% efficient, whereas DC motors with brush gear are typically 75-80% efficient [13]. Midway between ordinary DC motors and stepper motors lays the realm of the brushless DC motor. Built in a fashion very similar to stepper motors, these often use a permanent magnet external rotor, three phases of driving coils, one or more Hall Effect sensors to sense the position of the rotor, and the associated drive electronics. The coils are activated, one phase after the other, by the drive electronics as cued by the signals from the Hall Effect sensors [5].

Principle of DC Motor Operation In any electric motor is operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware that opposite polarities attract, while like polarities repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion shown in figure 2.1 above. A DC Motor is an electrical motor that runs on direct current electricity [5].

2.1.3.2 A Programmable Logic Controller

A programmable logic controller or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or automated manual system, or any activity that requires high reliability control and ease of programming and process fault diagnosis.

In 1968 the automatic transmission division of General Motors (GM) sought to replace hard wired relay systems and control panels with a software based control system. GM was using thousands of relays, cam timers, drum sequencers and dedicated closed loop controllers. Whenever engineers wanted to update the manufacturing process, usually once a year, they had to rewire the relays and components consuming a lot of time and money. GM sought a system that could change the logic rather than rewiring relays.

Dick Morley of Bedford Associates, Bedford, Massachusetts, now known as the “father of the PLC”, designed the Modular Digital Controller or “Modicon” which used “ladder logic” and replaced relay logic with schematic diagrams, in the process reducing wiring by 80 percent. As they were originally designed as a replacement for hard-wired relay and timer logic control systems. PLCs have the great advantage that it is possible to modify a control system without having to rewrite the connections to the input and output devices, the only requirement being that an operator has key in a different set of instruction. The result is a flexible system which can be used to control systems which vary quite widely in their nature and complexity. PLC Definition by digitally operating electronic apparatus which uses a programming memory for the internal storage of instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic to control through digital or analogue modules, various types of machines or process shown figure 2.2. General definitions of PLC size are given in terms of program memory size and the maximum number of input/output points the system can support.

Table 2.1 Type of Programmable Logic Controllers

PLC Size Defined	Max I/O points	User memory size (No. of instructions
Small (mini)	40/40	1K
Medium (micro)	128/128	4K
Large (modular)	>128/>128	>4K

However, to evaluate properly any programmable logic controller we must consider many additional features such as its processor, cycle time, language facilities, functions, expansion capability, etc. Advantages of PLC are more flexible, Increased Reliability, Lower Costs, Communications Capability, Faster Response Time, and Easier to Troubleshoot. The structure of a PLC can be divided into four parts. They are input/output modules, central processing unit (CPU) and power supply.

Figure 2.2 Programmable Logic Controller Instructions[4].

Programmable logic controllers are purpose-built computers consisting of three functional areas: processing, memory and input/output. Input conditions to the PLC are sensed and then stored in memory, where the PLC performs the programmed logic instructions on these input states. Output conditions are then generated to drive associated equipment. The action taken depends totally on the control program held in memory showing in Figure 2.2. The CPU controls and supervises all operations within the PLC, carrying out programmed instructions stored in the memory. An internal communications highway, or bus system, carries information to and from the CPU, memory and I/O units, under control of the CPU. Virtually all modern PLCs are microprocessor-based, using a 'micro' as the system CPU. Some larger PLCs also employ additional microprocessors to control complex, time consuming functions such as mathematical processing, three-term PID control, etc. The input/output unit of PLCs can handle the job of interfacing high power industrial devices to the low-power electronic circuitry that stores and executes the control program.

Most PLCs operate internally at between 5 and 15V DC, whilst signal from input devices can be much greater, typically 24V dc to 240V ac at several amperes. The I/O module units form the interface between the microelectronics of the programmable controller and the real world outside, and must therefore provide all necessary signal conditioning and isolation functions. This often allows an Inside A PLC figure 2.3.

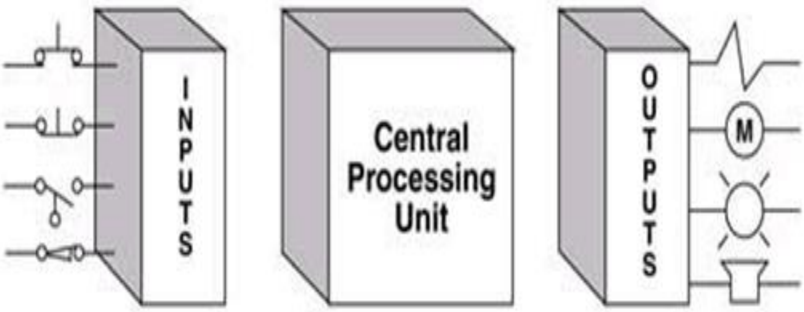

Figure 2.3 Input/Output Unit of PLC[4].

There are four basic steps in the operation of all PLCs; Input Scan, Program Scan, Output Scan, and Housekeeping. These steps continually take place in a repeating loop. Programming Language Is Used To Programs A PLC is:

Ladder Logic is the most commonly used PLC programming language, it is not the only one. The following table lists of some of languages that are used to program a PLC.

Ladder Diagram LD Traditional ladder logic is graphical programming language. Initially programmed with simple contacts that simulated the opening and closing of relays, Ladder Logic programming has been expanded to include such functions as counters, timers, shift registers, and math operations and shown figure 2.4.

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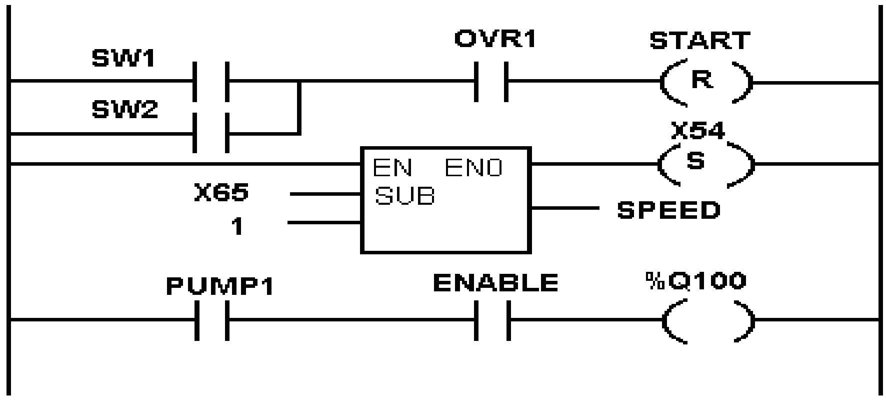


Figure2.4 Ladder Diagram[4].

Function Block Diagram (FBD) - A graphical language for depicting signal and data flows through re-usable function blocks. FBD is very useful for expressing the interconnection of control system algorithms and logic. Shown figure 2.5.

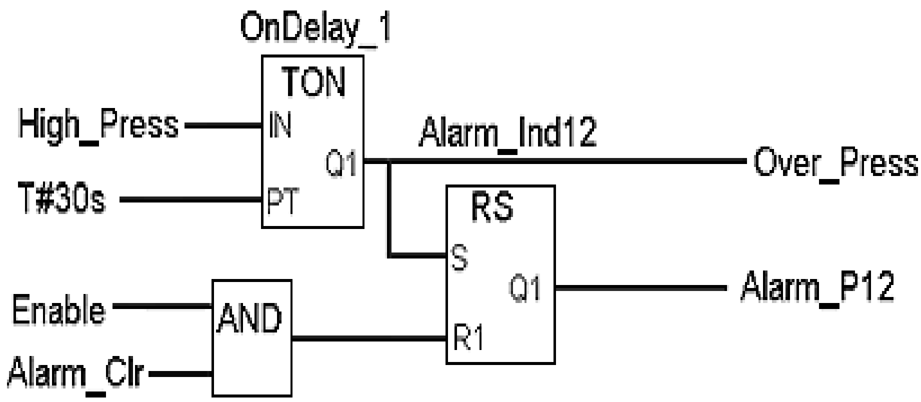


Figure 2.5. Function Block Diagram[4].

Structured Text (ST): A high level text language that encourages structured programming. It has a language structure (syntax) that strongly resembles PASCAL and supports a wide range of standard functions and operators. For example;

```
If      Speed1      >100.0      then
   Flow Rate: = 50.0 + Offset_A1;
Else
   Flow Rate: = 100.0; Steam: = ON
End If;
```

Instruction List IL: A low level “assembler like” language that is based on similar instructions list languages found in a wide range of today’s PLCs .such as

```
LD          R1
MPC         RESET
LD          PRESS_1
ST          MAX_PRESS
RESET:      LD    0
ST          A_X4
```

Sequential Function Chart SFC a method of programming complex control systems at a more highly structured level. A SFC program is an overview of the control system, in which the basic building blocks are entire program files. Each program file is created using one of the other types of programming languages. The SFC approach coordinates large, complicated programming tasks into smaller, more manageable tasks.PLC to be directly connected to process actuators and input devices without the need for intermediate circuitry or relays. To provide this signal conversion, programmable controllers are available with a choice of input/output units to suit different requirements [4].

2.1.3.3 Relay System

The relay, which operates much like a solenoid, is an electromagnetic device that consists of a coil with a soft iron core and electric contacts mounted on, but insulated from, the moving armature or plunger. The relay allows one circuit to control another. Shown figure 2.6[1].

The primary functions of a relay are**:** The galvanic separation of the primary or actuating circuit and the load, circuit's Single input/multiple output capability**,** Separation of different load circuits for multi-pole relays, Separation of AC and DC circuits**,** Interface between electronic and power circuits and Multiple switching functions, e.g. delay, signal conditioning Amplifier.

Applications of a Relay are: Typical applications for relays include laboratory instruments, telecommunication systems, computer interfaces, domestic appliances, air conditioning and heating, automotive electrics, traffic control, lighting control, building control, electric power control, business machines, control of motor sand solenoids, tooling machines, production and test equipment [3].

Figure 2.6 Relay Consists[3].

2.1.3.4 Limit Switch

In electronics, a switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another. The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts. Each set of contacts can be in one of two states: either 'closed' meaning the contacts are touching and electricity can flow between them, or 'open', meaning the contacts are separated and non-conducting [6].

Limit switches are a type of sensor that detects presence and absence. Specifically, mechanical limit switches are switches that are mechanically activated, meaning that they have some sort of arm, lever, knob, plunger, etc., which is physically or mechanically activated by making contact with another object. As the object makes contact with the actuator of the switch, it eventually moves the actuator to its “limit” where the contacts change state. Other varieties of sensors/switches exist, including proximity sensors, light sensors, electric switches, among others shown figure 2.7.

In its simplest form, a limit switch is a “switch” that can be mounted into remote locations so that it is actuated by an object other than a human operator. Some basic functions of limit switches are: Detecting presence/absence, Counting, Detecting range of movement, Detecting positioning & travel limit, Breaking a live circuit when unsafe conditions arise, Detecting speed and hundreds of other applications [6].

The Features and Benefits of Limit Switches are Can be used in almost any industrial environment, Very precise in terms of accuracy and repeatability, Consume little electrical energy, Can switch loads with high inductance and Can control multiple loads [6].

Limit switches are very commonly used devices [6].

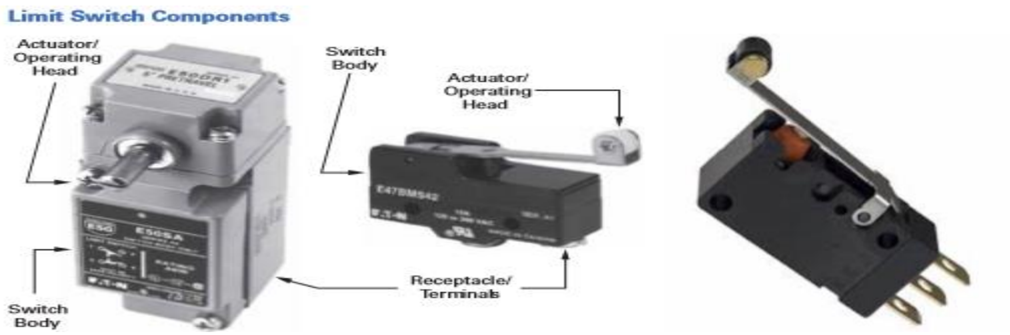


Figure 2.7 Type of Limit switch[6].

2.1.3.5 Power supply

A power supply is a device that supplies power to another device, at a specific voltage level, voltage type and current level. For example, when we talk about a 9 VDC 500mA power supply can provide as much as 500mA of current and the voltage will be at least 9V DC up to that maximum current level. While it sounds simple, power supplies have a lot of little hang-ups that can be very tricky for the uninitiated. For example, unregulated supplies say they can provide 9V but really may be outputting 15V! The very common 7805 regulator datasheet claims it can regulate up to 1000 m A of current, but when you put a 15V supply on one side, it overheats and shuts down! This point will try to help explain about power supplies. Shown figure 2.8.
So to generalize here is what the power supplies for electronics do: They Convert AC power to DC, They regulate the high voltage 120-220V down to around 5V the common voltages range from 3.3V to 15V, they may have fuses or other overcorrect overheat protection [7].

Figure 2.8 Power supply**[7].**

2.1.3.6 Indicators

Indicators are an essential component of any effective M&E (monitoring and evaluation) system. For example, at the national level,

indicators provide technical experts and decision-makers with the data required to effectively manage a country’s response to the epidemic.
Indicator consisting of a light to indicate whether power is on or off eg motor is in operation or stop.
My dashboard is designed to keep you informed about the health of my antennas. Dashboard indicator light decoder to give me the insight the need to understand what is going on with my antennas.
For example, a antenna intending to perform a move uses the indicator as that used for either a dawn or a upturn depending on operation in the region in which it is moving. The same indicator is also used for indicating start and stop. Some thoughts are presented in this article to overcome these and other limitations by using colored LEDs to display the intended moves.
How to select indicators: Indicators should be selected carefully and systematically. It is important to consider the context or the environment in which they will be deployed. It is equally important to take into account any existing or applicable indicator frameworks that are relevant to the context. In addition, all potential indicators should be evaluated using the international indicator standards to ensure that they can and will provide useful data. They should be drawn from harmonized and/ or widely used indicator sets that have a successful track record. Proven indicators and indicator sets are available through the Indicator Registry which is shown in figure 2.9.
A good indicator should meet the following five standards: The indicator is needed and useful, the indicator has technical merit, the indicator is fully defined, it is feasible to measure the indicator, and the indicator has been field-tested or used operationally.
In addition, where indicators are presented as part of a set, this set should meet a sixth standard: The overall set is coherent and balanced [8].

Fig 2.9 Indicators[8].

2.1.3.7 Push buttom

Push buttons also referred to as push button switches are switches that typically consist of a plunger that the user pushes down in order to open and close the switch. There is a wide variety of different push buttons available which can be used in a lot of different applications. Each switch is defined by the number of its contact sets which is also referred to as the number of poles and the number of throws which is basically the number of conducting positions. These throws can be either single or double.

Push buttons are simple single pole switches. They contain a set of contact plates that make or break when activated by someone. All push buttons are made the same way, what gives them their special characteristics or function is the legend plate and sometimes the operator or button head. The legend plate surrounding the push button lets the user know the purpose of the control device, whether it is to turn something on or off or move something up or down, it all depends on what the label is telling the user of the push button to do. In some instances, the shape of the push button indicates its function. For example, a push button in the shape of a mushroom and red in color informs the user that the intention of the push button is to serve as an emergency stop, unlike a push button that is simply red to indicate stop and/or green to indicate start, which is shown figure 2.10.

They are many types of push bottom; Micro Switch Push Button, Mini Push Button Switch, Momentary Push Button Switch, Push Button on Off Switch, Push Button Starter Switch, Push Button Toggle Switch, Waterproof Push Button Switch, pushbutton switches are designed to perform, instrumentation front panels on/off, reset, mode select, eject buttons, communications volume controls, menu scrolling, control keys, consumer remote controls, car radios, joy sticks, computers, peripherals, transportation remote keyless entry, AC controls, window/door locks, heavy industrial machinery construction, agricultural, off-road, aerospace and avionics panels, medical, marine and military equipment and telecom and enterprise network equipment.

Figure 2.10 Push Buttom[8].

2.1.4 Automation Tools

Many automation tools. But in thesis used CATIA Program and Micro/win Programmable logic controllers;

2.1.4.1 CATIA Program

CATIA V5 is the software that covers a large part of today often used areas as the product life cycle, i.e. which includes the design from the start to product construction, it can perform a variety of analysis, simulation and optimization, creates drawings and NC programs for the production itself. It can be implemented and applied in a wide area of industries, such as automotive or aerospace industry, production of consumer goods, production of machine tools and capital equipment for heavy engineering. All CATIA V5 is based on three different platforms: P1, P2 and P3, which focus on specific levels according to customer's needs, but the data created in one platform, can be used in the product from of the other platform. CATIA V5 is modular and consists of several areas that the users can choose according to their needs. They are Mechanical Design, Shape Design and Styling, Product Synthesis, Equipment and System Engineering, Analysis, Machining and Infrastructure [9]. CATIA is mechanical design software. It is a feature based, parametric solid modeling design that takes advantage of the easy to learn windows graphical user interface. You can create fully associative 3-D solid models with or without constraints while utilizing automatic or user-defined relations to design intent.

2.1.4.2 Micro/win Programmable Logic Controllers (S7-200)

Simatic Controllers form the core of the automation system and help in controlling production machines, manufacturing plants or industrial processes. There are three main families of controllers in the simatic Automation System, viz. simatic S7 controllers, simatic M7 controllers and the simatic C7 controllers simatic S7 programmable logic controllers form the basis of the automation system. There are three types of PLCs in this family, S7-200 Micro PLC, S7-300 modular mini PLC, for low-end an mid-range applications S7-400 for high-end top-level performance requirements PLCs consist of the central processing unit and the I/O modules. The CPU stores the user program written in one of the PLC programming languages. The I/O modules provide the connection to the machine or the plant to be controlled [10].

The S7-200 series is a line of micro-programmable logic controllers that can control a variety of automation applications. Developed by Siemens Company. The S7-200 series of micro-programmable logic controllers are Micro PLCs can control a wide variety of devices to support automation needs. It monitors inputs and changes outputs as controlled by the user program, which can include Boolean logic, counting, timing, complex math operations, and communications with other intelligent devices. The compact design, flexible configuration, and powerful instruction set combine to make the S7-200 a perfect solution for controlling a wide variety of applications, Which shown in figure 2.11 [4].

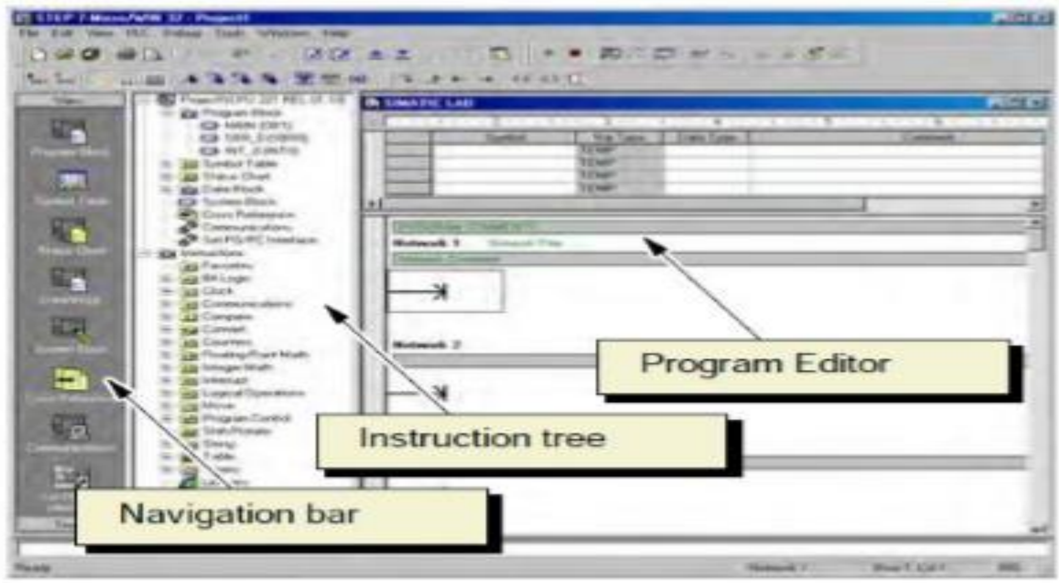


Figure 2.11 Micro/win Programmable logic controllers (S7-200)

2.2 Related Works

SREE and other [11] did a design and fabrication an attempt to design efficient mechanism for picking and placing by automating them by constructing the three directional robotic arm using Pneumatic cylinders which are controlled by the PLC. The system consists of a PLC which controls the movements of the pneumatic cylinders based on the inputs coming from the sensors placed on the conveyor belt. The robotic arm is having the capability to move along the three axes X, Y and Z. A mechanical gripper is placed at the end of the robotic arm which is used for holding the objects on the conveyor belt. Their differs from my in the actuator is Pneumatic cylinders and I use motors. Their method is similar to my method in using PLC in control.

STELIOS and other [12] did design of a novel two degree of freedom (DOF) reaction less pointing mechanism for satellite antennas that requires only the minimum number of actuators i.e. two is presented. At first, the basic concept and the theory of dynamic balancing are addressed. The balancing equations are derived by requiring that the mechanism centre of mass will remain fixed at a pivot point and that any reaction moments are internally cancelled. A typical example of a 20 kg antenna composed of the shelf parts is used to study the mechanism properties. Simulation tests via the dynamic simulation software Adams are performed to verify the reaction less nature of the mechanism for arbitrary trajectories. The advantages and disadvantages of the pointing mechanism are discussed as well as the ability of extending the concept ideas to other satellite subsystems or even terrestrial applications. There is similar to my in the design mechanism for controlling satellite antennas.

NORBERT [13] did control of motion by Limit Switches, Proximity Sensors, Relay and Electric motors. The current shift from mechanical control systems towards electronic servo control systems promises to increase process speeds by 50% or more, depending on application. The transfer and assembly lines have had a powerful impact in automating our factories with the primary goal of reduction of labor content while holding on to the financial justification labeled as economy of scale. Motion controllers are components that range from ON/OFF devices with simple linear controllers to complex, user programmable modules that act as controllers within complex integrated multi-axis motion systems. Applications include all types of industrial processing, packaging, and machining forming operations. This thesis will focus on analysis of basic motion control theory, sensors and actuators used in motion control, adapting field bus technology in motion control systems, and developments, trends and application of motion control technology in different engineering disciplines. His method has advantages The current shift from mechanical control systems towards electronic servo control systems promises to increase process speeds by 50% or more, depending on application .There is similar to my in the control of motion by Limit Switches, Relay and Electric motors.

WILLIAM and other [14] did design, constructed, and tested a robotic arm for the Aerobat (Aerial Robot). The main purpose of the Arm is to enable the Aerobat to retrieve objects. Design of the Arm involved synthesizing the characteristics of simplicity, weight, strength, and size. The result was a three-degree-of-freedom manipulator that uses electric motors, cable linkages, and telescoping tubes to access a work space below the Aerobat. Forward and inverse kinematics was investigated to enable automation of the Arm. Data was collected from infrared sensors to validate the model. Manipulation of the ARM is presently under open loop control (joy stick) which demonstrates the use of tale-robotics and its capabilities The problems that were noted did not have a profound significance in the performance of the Arm. They were merely presented to allow the design to be improved upon. There is similar to my in use Electric motors.

R. JAGAN and other [15] did control the Robotic Arm manually and automatically by using Programmable Logic Control (PLC) to pick the moving object on a conveyor belt. In industries highly advanced robots are used, but still the controlling is done by manually or processors like Aurdino, microprocessors etc. There are several disadvantages by using these processors like micro controllers cannot work in the environments with the high levels of vibrations, corrosion, humidity, and other environmental factors. All these problems are overcome by using Programmable Logic Controller (PLC) which acts as a brain to control the robotic arm. This project focuses to create and build more compact, useful and cheaper robotic arm to perform various functions where human is proven too dangerous to perform a specific task and also to eliminate human errors to get more precise work A control system is made for controlling the robotic arm by using PLC. After a detailed study a best possible solution for designing and constructing a robotic arm which includes PLC, and its components, DC motors, power supply unit and many other components. There is similar to my in use DC motors to move and controlled by using Programmable Logic Controller (PLC). Their differs from my in the pick the moving object on a conveyor belt.

DWOMOH [16] the project demonstrates a possible way to maneuver a robotic arm through Bluetooth communication between an Android application and an Arduino circuit. For this specific project, he make use of an OWI robotic arm from the OWI Arm Edge Kit, as it is an affordable option which makes it perfect for small-scale projects and it uses simple DC motors on each joint to enable its movement. He replaces the embedded circuit that the OWI kit includes with a custom one designed with the use of an ARDUINO board and H-Bridge Chips. To control the movement of the arm he built an Android app that allows an android phone that has an inbuilt Bluetooth functionality to communicate with the Bluetooth module that exists on custom circuit, thus allowing him to perform targeted movements. Is get motor responding to the signal received by the wireless Bluetooth communication protocol, the same method is applicable to all the other motors available on the arm. Their method differs from my method in demonstrates a possible way to maneuver a robotic arm through Bluetooth communication between an Android application and an ARDUINO circuit .There is similar to my in use DC motors to move.

BALAZS [17] did presents a dual drive actuator design that is capable of physically line arising friction and hence eliminating the need for complex compensation algorithms. A number of mathematical models are derived that allow for the simulation of the actuator dynamics. The actuator may be constructed using geared dc motors, in which case the benefits of torque magnification is retained whilst the increased nonlinear friction effects are also line arise. An additional benefit of the actuator is the high quality, low latency output position signal provided by the differencing of the two drive positions. Due to this and the line arise nature of friction; the actuator is well suited for low velocity, stop-start applications and micro-manipulation and even in hard-contact tasks. There are, however, disadvantages to its design. When idle, the device uses power whilst many other, single drive actuators do not. Also the complexity of the models means that parameterization is difficult. Management of start-up conditions still poses a challenge. There is similar to my in the actuator may be constructed using geared DC motors to move.

TOMAS [18] the research describes the basic design concepts for the PLC controlled motion systems. This is done through the building a model of an automated warehouse. The main goal was not to introduce a scalable solution for the industrial use but to build the system that would serve educational purposes. The work includes a wide range of problems starting with mechanical design, integrating the electrical design as well as introducing the concepts of the software design for the PLC motion control. Was similar in PLC.

GAVALI and PATIL [1] the paper describes how the present automation system comes in to existence through its various stages. In the past, automation is done through relays and contactor logics. Since the human intervention is more, the scope of errors was also more. But with the advent of microprocessors & microcontrollers several new tools as PLCs (Programmable Logic controllers) come in to use. These have reduced human intervention. This in turn has increased accuracy, precision and efficient. There is similar to my in automation system.

PARVIZ and MAHSA [19] said PLC is proposed as the essential tool in many different applications. In them paper, the PID controller is designed to control Motor Speed based on incoming information of system and Auto tuning. The control system is simulated by powerful software MATLAB and SIMULINK. Simulation results also show better performance of motor that reduce the rise time, steady state error and overshoot and increase system stability. His method has used the PID controller is designed to control Motor Speed based on incoming information of system and Auto tuning. There is similar to my in use PLC to control Motor Speed.

SNEHA [20] they present the architecture and implementation of a low-cost, small, mobile and easily deployable ground station to track and receive signals from satellites that operate on the VHF-band (144 MHz to 147 MHz). The ground station uses a handheld 5-dB gain YAGI-UDA antenna, a low noise amplifier with 23 dB gain and a software defined radio (FUN cube Dongle) to receive the signals. The analog front end's software-defined nature gives it the flexibility to target satellites with diverse power, modulation and error-correcting schemes. Software for satellite tracking, signal decoding and processing is freely-available. The low cost of the ground station makes its affordable for classroom and laboratory activities in a research or educational institution that involve satellite signal processing in wireless communication courses. The small size and portability of the proposed ground station means it can be adopted in locations with limited access to fixed outdoor antennas, whether because of financial, regulatory or other restrictions. Examples of ground station-tracked and received signals include satellites such as FUN cube (AO-73), International Space Station (ISS) and NOAA satellites. Specifically, the National Oceanographic and Atmospheric Administration (NOAA) series of satellites (NOAA 15, 18, 19) were tracked. The signals received were processed to recover images of the earth using various software. This thesis also presents the details of decoding the image using MATLAB. There is similar to my in ground station-tracked Antennas.

JAMES [21] as part of its research program in spacecraft operations SSDL had developed a ground station control system, Mercury that centralizes station equipment control into a single interface, provides Internet access to the interface, and automates ground segment tasks. This system allows SSDL to explore ground station automation issues. It also enables direct human console control, remote human tale operation, and script/program based autonomous control of station equipment. A low-cost prototype of Mercury has been implemented in the SSDL OSCAR-class ground station. Preliminary Mercury results demonstrate an increase in operator efficiency. Centralization of control has decreased the multiplexing of operator time between control panels of equipment. Automation of ground tasks has freed operated to focus on satellite contacts rather than operating support equipment such as antenna tracking and transceiver tuning. Mercury has also decreased the dependence of ground station location on operator location. The operators are now able to control the ground station via the Internet, thereby providing virtual global access to the station. There is similar to my in ground station-tracked Antennas. And His method has advantages is control the ground station via the Internet.

PHILIPP [22] describes the development and implementation of a new digital antenna controller. It is called Antenna Control Interface. During the design the main objectives have been to realize a safe and reliable operation protecting the antenna's structure and existing analog control electronics. First task was to determine suitable interfaces to the existing motion electronics. Based on the interfaces a modular concept for the system has been designed and the single modules interacting with the motion electronics have been developed. The communication between the modules has been defined and a Main Processing Unit has been set up which manages all modules and provides all control algorithms. The Main Processing Unit can be accessed remotely by client software developed for this purpose. This client software is intended to be run at the mission control center of the European Student Moon Orbiter mission. The installed Antenna Control System has been tested and first remote control activities outside the original antenna control room could be performed. The system provides all necessary control modes like manual remote steering and NASA/NORAD Two Line Elements Format file tracking. As soon as the Antenna System Interface and Antenna Monitoring System, which control and monitor all peripheral subsystems of the antenna, are ready Raising he can be entirely remotely controlled. There is similar to my in ground station-tracked Antennas. Their method differs from my method in digital antenna controller.

AUSTIN [23] the purpose of thesis is to discuss the design and development of a platform used to automate a stock 2013 Ford Focus EV. The platform is low-cost and open-source to encourage collaboration and provide a starting point for fellow researchers to advance the work in the field of automated vehicle control. The thesis starts by discussing the process of obtaining control of the vehicle by taking advantage of internal communication protocols. The controller design process is detailed and a description of the components and software used to control the vehicle is provided. The automated system is tested and the results of fully autonomous driving are discussed. There is similar to my in automation system. Their method differs from my method in I controlled to antenna and he controlled work in the field of automated vehicle control.

Mir Sajjad Hussain [5] this thesis is use robotics in food industry. This paper is design and implements a microcontroller based on reliable and high performance robotic system for food / biscuit manufacturing line. We propose a design of a vehicle. The robot is capable of picking unbaked biscuits tray and places them into furnace and then after baking it picks the biscuits tray from the furnace. A special gripper is designed to pick and place the biscuits tray with flexibility. Is similar to my in automation system. And both used DC motor. But he is used to controlling Microcontroller and I used PLC to control.

Adwait Palsule [10] the primary focus of this applied research work is to develop a Manufacturing Execution System to control a flexible manufacturing system using Siemens PC-based automation technology. This technology is implemented in a Flexible Manufacturing cell named the CAMCELL. The CAMCELL consists of two CNC machining centers, assembly robots, and a vision system, all of which are interlinked by a material handling system. The software architecture of the

CAMCELL is based on NIST's five level hierarchy, discussed briefly in the report. Specifically it contains functional modules for order entry, scheduling and routing. In addition to these functional modules, there is various support modules such as order entry module, scheduler, router etc, two of which named the Inquire and the Pallet Controller that are implemented in this study. Siemens' Step 7 and WTNCC software are used for the control and monitoring of the cell. There is similar to my in use Siemens' Software Installation
Hardware and Step7 with WTNCC.

CHAPTER THREE

DESIGN, SIMULATION AND IMPLEMENTATION

CHAPTER THREE

DESIGN, SIMULATION AND IMPLEMENTATION

FIRST; DESIGN

3.1 Introduction

In this chapter the design and implementation of the automation system is presented to control four antennas. The design is dividing into two systems; mechanical and electrical system. To minimize cost in mechanical implementation only one antenna is applied. but in electrical term programming and indicator for four antennas has been done.

3.2 Proposed System

The system content of control circuit is PLC, interface circuit relays, input switches, output motors and indicators feedback sensors . The Mechanical part are main body and antennas mechanism are shown in figure 3.1.

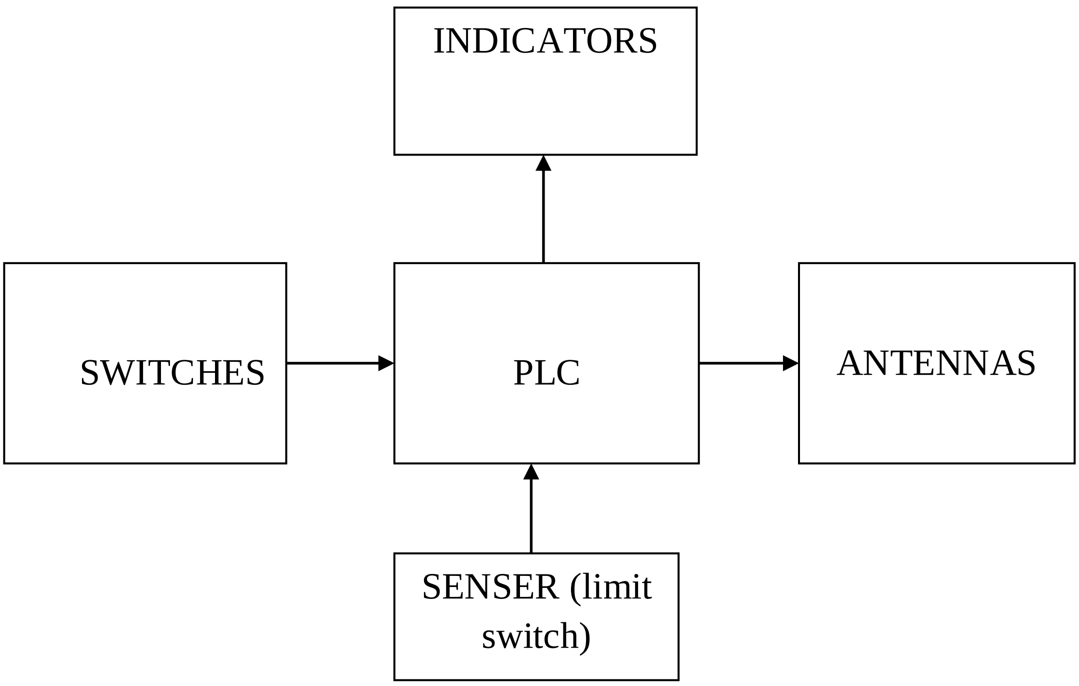


Figure 3.1: General Block Diagram of the Proposed System

3.3 The Operation steps of the System

From Figure 3.2 , when start Ground Station and put main switch in the auto mode the PLC send signal after twenty second to the relays to activate motors. The motors move the antennas to up. During this moves the three red lights are on to indicate the antennas are move to up position. When antennas arrived to idle position the limit switch energized to stop the motor and send signal indicator green to be on, to indicate that four antennas are in up position. It is locked by gearbox.

To shut dawn Ground Station the main switch is in the auto mode the control system PLC send signal after twenty second to relays to activate motors. The motors move antennas to down position. during this moves the three green lights are on to indicate the antennas are move to dawn position, When antennas arrived to idle position the limit switch energized which stop motors and send signal to green indicator to be on, to indicate that the four antennas in down position. It is locked by gearbox.

When start Ground Station and select the manual mode, the antennas steel in down position. When press push bottom no 1 manual switches the control system PLC send signal to relay is move antenna no 1 to up position.

When press push button no 2 manual switches the control system PLC send signal to relay is move antenna no 2 to up position.

When press push button no 3 manual switches the control system PLC send signal to relay is move antenna no 3, 4 to up position.

When antennas arrived to idle position the limit switch is send feedback signal to control system PLC .its send signal to relays to stop antennas in up position and send signal to red indicator to be on, to indicate the any four antennas are up position. Then, it is locked by gearbox.

In manual mode must be move antennas to down position before shut down grown station.

It's found third manual push bottoms no 4, 5, and 6 to move antennas to dawn position. First to move antenna no 1 to down position, second to move antenna no 2 to down position and third to move antennas no 3, 4 to down position. When turn on switches of antennas and main switch of manual mode and ground station is on the control system PLC sends signal to relays are move antennas to down position. When antennas arrived to idle position the limit switch is send feedback signal to control system PLC .its send signal to relays to stop antennas in down position and send signal to green indicator to be on, to indicate the any four antennas are dawn position,. Then, it is locked by gearbox.

3.4 Flow Chart of System

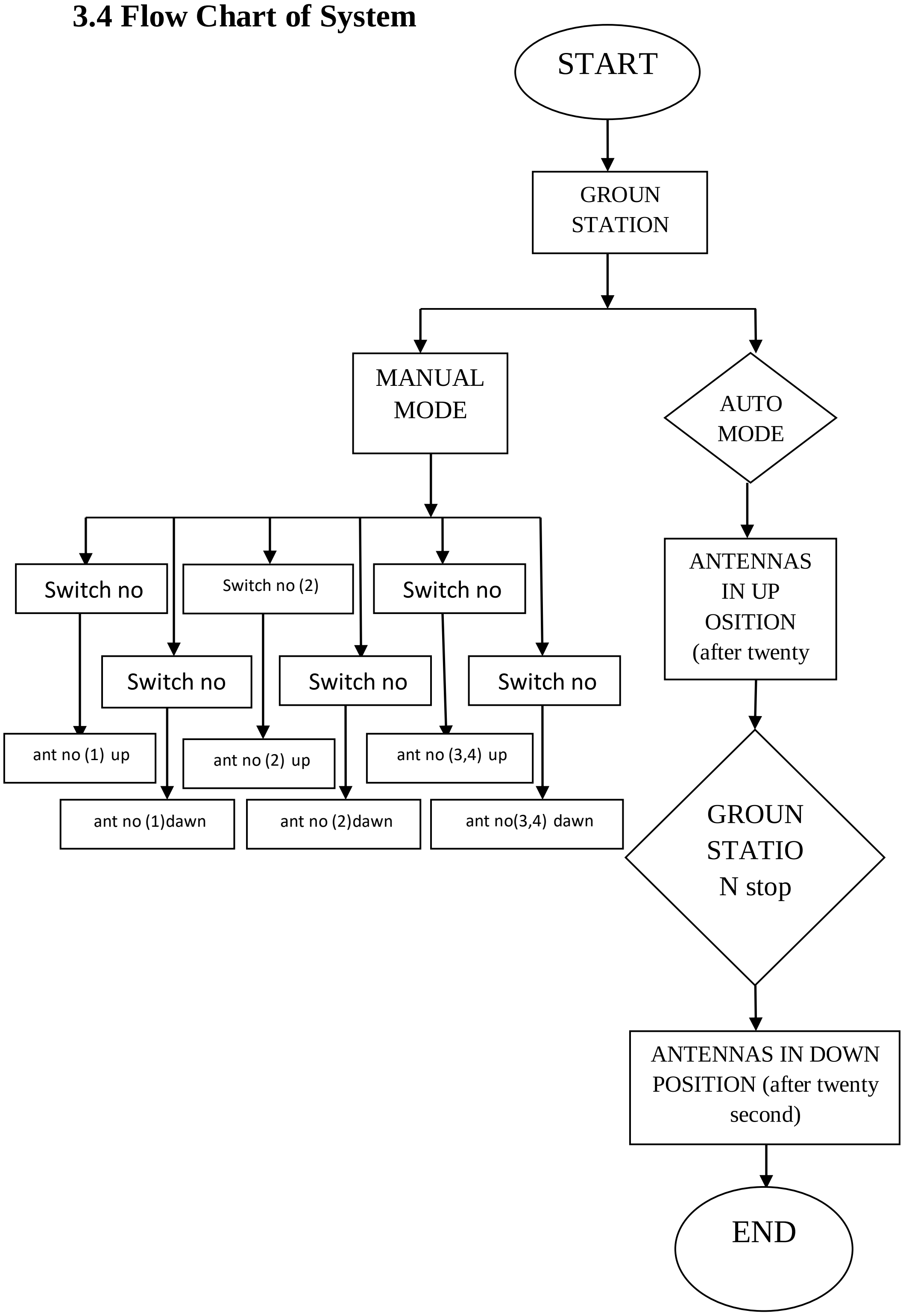


Figure 3.2: Flow Chart of System

3.5 Mechanical Design

In this thesis CATIA program is used to design and implementation mechanical part. Mechanical design is two parts the main support structure of the body basic of mechanical system and mechanism of antennas to move the antennas. CATIA is CAD tool and can be used for different design stages. Draw my concepts on it, modify them, identify problems and finally detail them to go the production. Many programs are used in design Aerospace and Automotive industry but recently these sectors are shifting to CATIA because of its cost being less than that of other programs.

3.5.1 Layout of Piece

The body is the main support structure of the mechanism. It holds all the components and the antennas load. In the following designs, various options of the body will be presented and analyzed. Upon the sketch, the structuring of the pieces and their layout was built. The dimensions were added, and thus the size of the design got its overall parameters Layout of pieces one of the key elements of the designs is that the pieces should fit onto the body, so that the overall size would not exceed the specified dimensions. All the components of the system have to be fitted so that they would have enough space and air flow in order to keep them from overheating. Also, avoiding damage to the components in case of a collision should be considered in this design, since one motor cannot run the antennas up and down position. Another, a three motors will be working the moving antennas the power will be supplied by a power line. The antennas will move backwards and forwards by using the PLC which connected relays, to change the direction of the current going to the motors, thus changing the rotation direction of the motors.

Motors will be connected to the Mechanism which connected directly of end of antennas. The input of PLC will be connected directly to switches the output of PLC will be connected directly to relays which connected to Motors.

All the components motors, Limit switch and antennas will be in the main body. The electrical components will be fit separately. Materials needed for the mechanical part of the mechanism were supplied, and then the materials were drawn on CATIA in mill metric form. The mechanical part was assembled with these materials. Drawings of the mechanical part of the project are given in Figures from3.3 to 3.10 Mechanical Part Mounting.

3.5.2 Design Step

The mechanical design began by designing basic body and used CATIA program to design. First it draws in two dimensions. The dimensions is1m*2m according to antennas required and surface dimensions of ground station. Is shown in figure 3.3

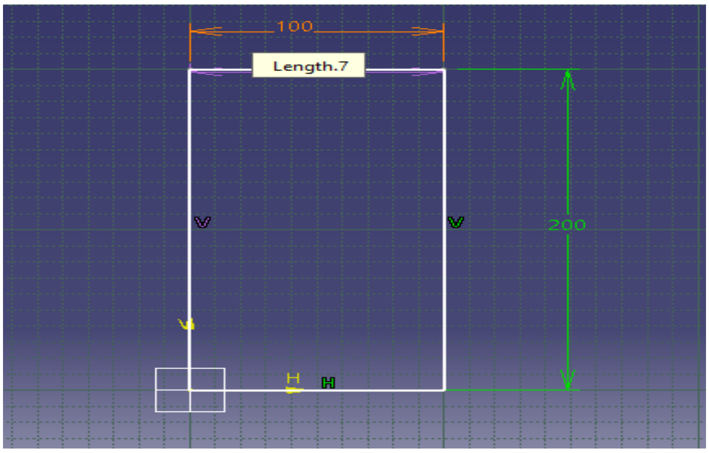


Figure 3.3: Basic Body in Two Dimensions

After that it draws third dimension which is 20 cm according to bending, which caused by weight of antennas and other part of system. It is implemented from steel les steel, because anti corrosion, stiffness and cheaper. Figure 3.4 bellow

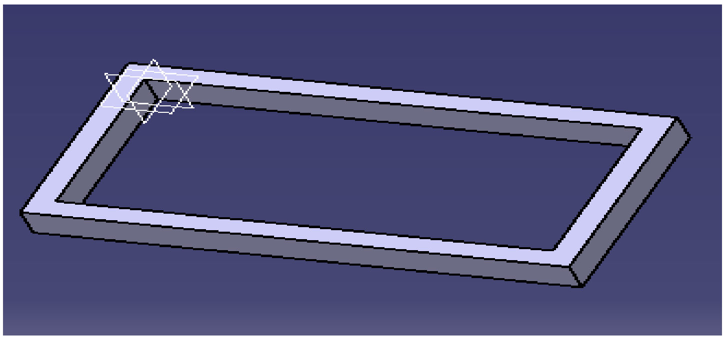


Figure 3.4: Basic Body in Three Dimensions

3.5.2.1 Antennas Stand Arm Design

Antennas stand arm designed to carry the antennas, mechanism and fitted Limit switch.and design antennas rest beam to support antennas in down position and carry damper.

The function of damper is damping the shock which cased when antennas move to down position, Shown in figure3.5 bellow.

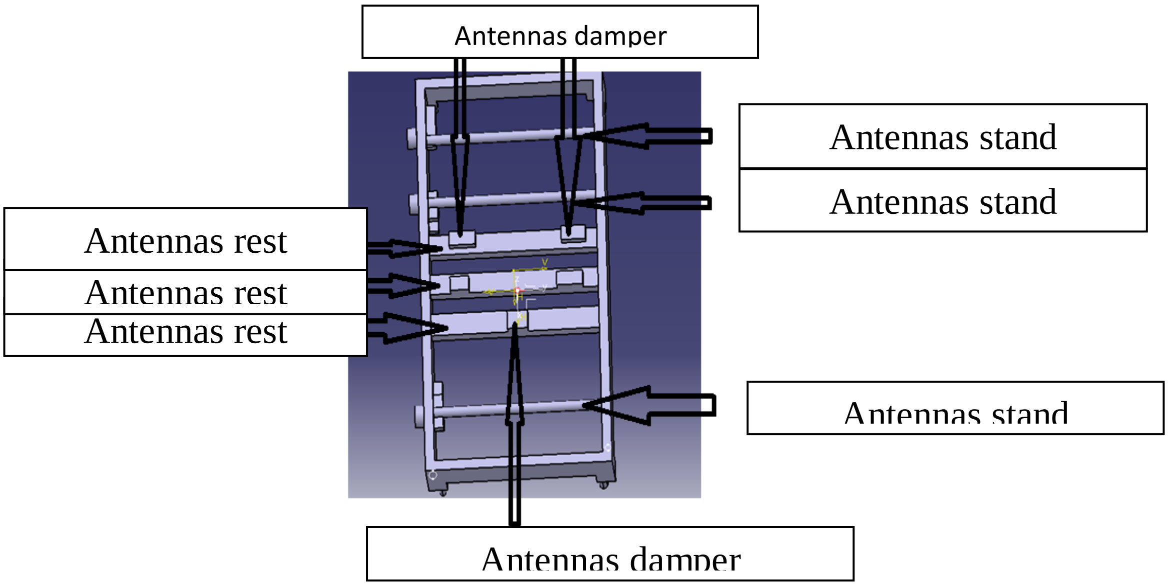


Figure 3.5: Antennas Stand Arm

3.5.2.2 Damper and Limit Switch Design

I put the damper in case with limit switch, this case designed to protected antennas from damage. Is shown in figure 3.6 bellow.

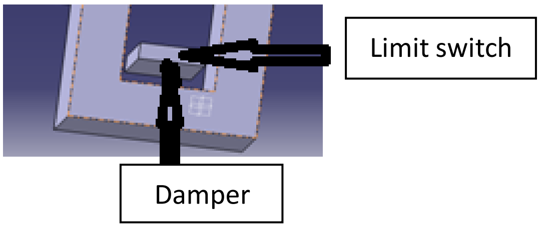
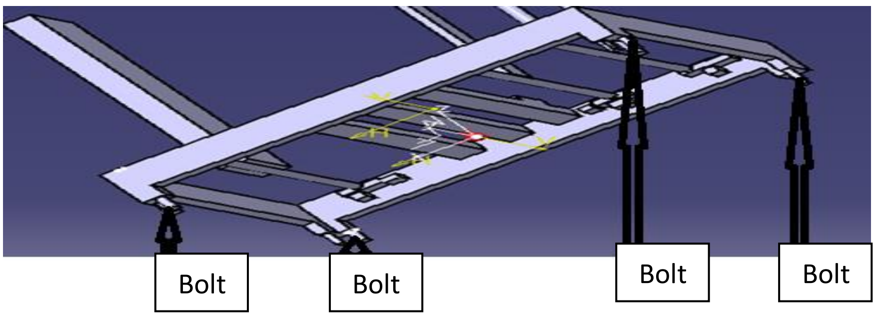


Figure 3.6: Damper and Limit Switch Design

3.5.2.3 Body Connect Design

To connect mechanical part with surface of ground station I used eight Bolts. Their size 24mm. Is shown in figure 3.7 bellow. To protect component from environment affect the Body covered by sheet.



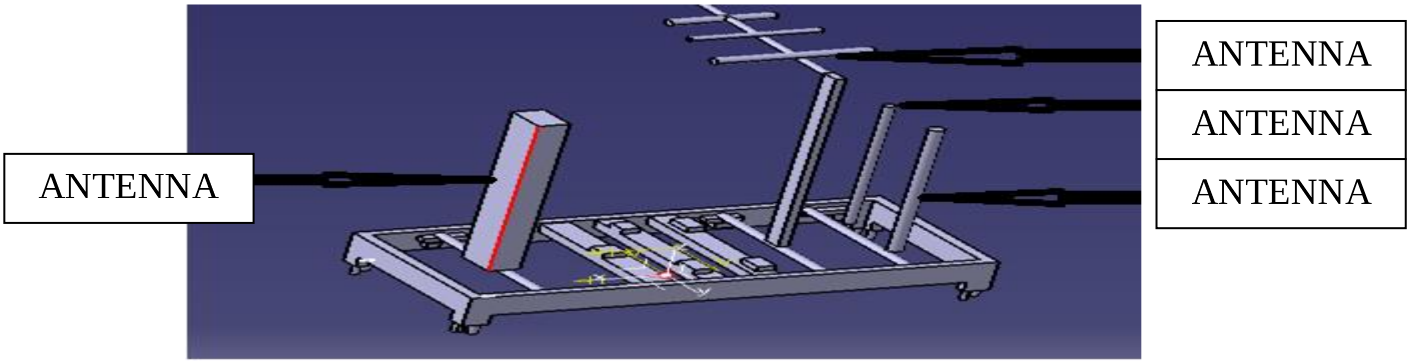


Figure 3.7: Body Connect with Ground Station

3.5.3 Movement Arm of Antennas

CATIA is used program to design the mechanism of antennas which creates extention the antennas up and down posion. the mechanism is engage with motor by gear 1:70. The mechanism content of two nute ,bearing,outer tube, inner tube and rod.Is shown in figure 3.8 bellow. Operation Mechanism ; When motor is rotate in clockwise ,the motor gear is rotate and rotate another gear whitch fixed on rotated rod.when rotated rod is rotate the inner tube is moving,this move generated extention of mechanism and the result of extention is antenna move to up position. When motor is rotate in unterclockwise ,the motor gear is rotate and rotate another gear whitch fixed on rotated rod.when rotated rod is rotate the inner tube is move,this move generated inxtention of mechanism and the result of extention is antenna move to down position.

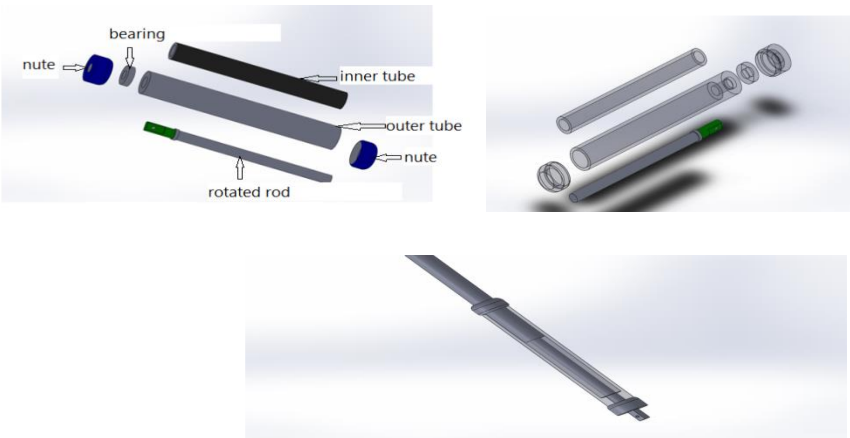


Figure 3.8: Movement Arm of antenna

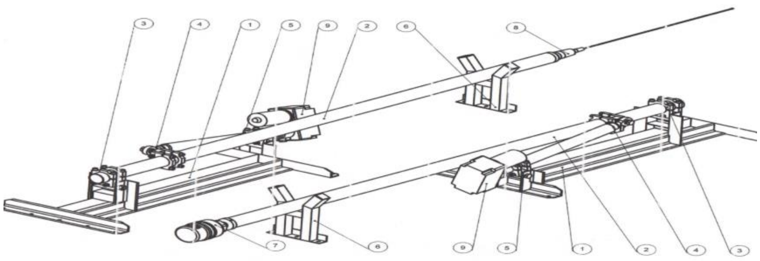


Figure 3.9: Movement Arm of Antenna in Ground Station

Table 3.1 Mechanism and Antenna

NO	Description	No in ground station
1	Base	4
2	Pipe	4
3	Pole bracket	4
4	Transitional bracket	4
5	Actuator bracket	4
6	Holder	4
7,8	Antenna	4
9	Actuator	4

3.6 Electrical Design

In this chapter all the main components are chosen of the electrical circuits according to design. The components will be shown and their main work principles explained.

3.6.1Circuit Components

The electrical circuits composed of seven components. Shown in table3.2

Table 3.2 Circuit Components

NO	Component	Function	No in circuit
1	PLC	control system	1
2	Relay	Interfacing	14
3	WIRE	Connection	
4	Motors	move antennas	3
5	Indicator	Indicate	10
6	Power Supply	Supply power	1
7	Switch	Open circuit	8

3.6.2Motors and Gearbox

The choice of motors and gearboxes depended on the torque required to move the antennas to up and down position. Two types of motors were considered, the stepper motor has the advantage of not needing an external position sensor as each step can be counted. However, it is prone to missing steps when heavily loaded as well as requiring high amount of power which results in a lot of heat The other option was a brushless DC servo motor BLDC. The basic construction is the same as for a three phase AC motor. It is highly accurate if used with positional sensors and a motor controller of high quality. It also consumes less power than a stepper motor and has a higher torque output at low speeds. A disadvantage with these motors is that they require a high quality motor controller which results in a high total cost. Despite the high cost the brushless DC motor was chosen as high torque at low speeds was necessary.

As described above virtually all torque required moving and change the position of the antennas is due to gravitational pull. Therefore the torque was calculated only considering the force applied by gravity. On the first antenna the torque is generated by the weight of the motor, gearbox and antenna. These where considered to be placed 0.6 m out with a total weight of 2 kg.

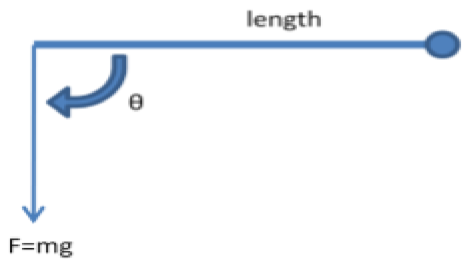


Figure: 3.10: Motor Torque Calculation Description

$$M = rF\sin\theta \qquad (3.1)$$

$$F = mg \qquad (3.2)$$

ϴ is angle between antennas and ground station and here equal 90

g is gravity constant =9.8

Table 3.3 Torque of Motor Calculate

NO of Motor	r (m)	F=mg	Sin ɵ	Torque(Nm)
1	0.6	2*9.8=19.6	1	11.76
2	0.5	13*9.8=127.4	1	63.7
3	0.5	(1.5+2)*9.8=34.3	1	17.15

Above equation 3.1 gives a moving torque for the first motor of approximately 11.76Nm. For the second motor the weight is 13 kg and the length is 0.5 m which means a moving torque of more than 63.7 Nm. For the third motor the weight of first antenna is 1.5 kg and second antenna is 2 kg and the length of two antennas is 0.5m which means a moving torque of more than 17.15 Nm.

Results After consultation with a professional in motors and gearboxes a setup of three motors and gearboxes was chosen. The first antenna uses a 20Nm motor with a 1:70 gearbox. Backlash on the gearbox is up to 0.133°. It is capable of nominal torque output of 18.8Nm after mechanical losses 6% in the gearbox.

The second antenna uses 80Nm motor with a 1:70gearbox. Backlash is below 0.083°. It is capable of nominal torque output of 75.2 Nm after mechanical losses 6% in the gearbox. For specifications of the motors.
The third and fourth antenna uses 20Nm motor with a 1:70 gearbox. Backlash is below 0.083°. It is capable of nominal torque output of 18.8 Nm after mechanical losses 6% in the gearbox.

Specifications of the motors; is

Place of Origin: Jiangxi, China Mainland
Model Number: ZRD1348
Supply voltage: 48V
Nominal torque: 18.8Nm
Rated power: 1584W at 33amp 528 at 11amp

The motors used in this thesis are the entire same model, the attachment holes on the motor accept M6 bolts. The screw on the revolving part accepts M8nuts

Figure 3.11: DC Motor

3.6.3 Wires of the Electrical Circuit

All cables are fitted with quick connectors to simplify assembly and disassembly. The wiring to the motor power supply as well as to the motor controllers uses standard three wires 1.5 mm, 2mm and 4mm cables. A cable with three 1.5 mm 2 wires connects the motors to the motor controllers.

3.6.4 Power Calculation

The Motors consumption power calculated by using equation of power 3.3 and equation3.4, which related torque (T) in table 3.3 and angular velocity (W) is given 3000rpm, the result of calculated put in table3.4.

$$P = \frac{T*W}{1000} \quad (3.3)$$

$$P = T*\left(\frac{2\pi N/60}{1000}\right) \quad (3.4)$$

Table 3.4 Power of motor calculate

NO	MOTOR	T(nm)	N(rpm)	POWER
1	1	11.76	3000	3.69
2	2	63.7	3000	20.01
3	3and4	17.15	3000	5.39

3.6.5 Programmable Logic Controller Preface

The power supply used is 24V DC supply by the relays and switch mode power supply (SMPS) because PLC has only two states of switching 0V and 24V low and high and it is given to the PLC. When the 24V of DC voltage is applied to the PLC, the input module receives input signal from push buttons and limit switch. A program from external PC is dumped into the PLC then CPU of the PLC performs the task based on the requirement of the user. The output is obtained from the output module and the output is movement of the antennas.220 AC power supply to start and over load indicators and 5 DC to another indicators.

Choosing PLC according to: size, number of I/O put maximum temperature
, scan time, PLC supply volt 220 or 24 and type of PLC compact modular. PLC Siemens CPU 214 is selected.

3.2.6 Programmable logic controller Programing

There are many language to develop a program in PLC like functional block diagram, structural text and other languages but here ladder diagram is used is develop the program because it is very to understand and does not required any software knowledge like C+, C++, and java to implement the program. There are simple logic's like normally open switch, normally close switch and many other functions like timers, window and many other functions. Normally open is a switch which is open in normal condition and the output is 0V or Low once the switch is activated it is a closed switch and the output is 24V or High. Even the normally close switch working is also same but it is reverse operation. In normal condition, the switch is closed and output is 24V once the switch is activated it is open switch and the output is 0V. Let us take the example of this antennas program for better understanding of the logic's involved in the program.

Input Programmable Logic Controller Table 3.5

NO	Address	Comment	Function	Status

1	I0.0	switch	Auto mode	NO
2	I0.1	Push bottom	Up of antenna (no 1)	NO
3	I0.2	Push bottom	Down of antenna (no 1)	NO
4	I0.3	Limit switch	Stop antennas in up	NC
5	I0.4	Limit switch	Stop antennas in down	NC
6	I0.5	Start signal	Start antennas system	NO
7	I0.6	Over load	Protect system	NC
8	I0.7	Push bottom	Up of antenna (no 2)	NO
9	I1.0	Push bottom	Down of antenna (no 2)	NO
10	I1.1	Push bottom	Up of antenna (no 3and4)	NO
11	I1.2	Push bottom	Down of antenna (no 3and4)	NO

Output Programmable Logic Controller Table 3.6

NO	Address	Comment	Function
1	Q0.0	Indicator	Start indicator
2	Q0.1	Indicator and signal	Motor(no 1)forward
3	Q0.2	indicator and signal	Motor (no 1) reverse
4	Q0.3	Indicator	Overload indicator
5	Q0.4	Indicator	Stop indicator antennas in up
6	Q0.5	Indicator	Stop indicator antennas in down
7	Q0.6	indicator and signal	Motor(no 2)forward
8	Q0.7	indicator and signal	Motor (no 2) reverse
9	Q1.0	indicator and signal	Motor(no 3,4)forward
10	Q1.1	indicator and signal	Motor (no 3,4) reverse

3.6.7 Operation of Network

From figure 3.12 shows the program is write by ladder language, the company is Siemens and write program is STEP 7-MicroWIN V4.0.

At the network 1 The first switch is for start signal came when ground station start with address I0.5 is normally opened switch, The second switch is for over load with address I0.6 normally closed switches, The third switch is for auto/manual select switch with address I0.0, the output is connected manual with address M0.1 and another output auto with address M0.0.

At the network 2 one input auto with address M0.0 and one output auto with address Q0.0.

At the network 3 one normally closed switch is for over load with address I0.6, and the output with address Q0.3.

At the network 4 The first switch is for start signal came when ground station start with address I0.5 is normally opened switch, The second switch is for over load with address I0.6 normally closed switches, The third input auto with address M0.0 normally opened switch, The fourth push bottom is for up of antenna no 1 with address I0.1 normally opened switches, The fifth is limit switch is for Stop antennas in up with address I0.3 normally closed switches, sixth input is for protect circuit of motor no 1 from short with address M0.3 the output is connected manual with address M0.2 .

At the network 5 one limit switch is for stop antennas in up with address I0.3 is normally closed switch and the output with address Q0.3.

At the network 6 The first switch is for start signal came when ground station start with address I0.5 is normally opened switch, The second switch is for over load with address I0.6 normally closed switches, The third input auto with address M0.0 normally opened switch, The fourth push bottom is for down of antenna no 1 with address I0.2 normally opened switches, The fifth is limit switch is for Stop antennas in down with address I0.4 normally closed switches, the sixth input is for protect circuit of motor no 1 from short with address M0.3 , the output is connected manual with address M0.2

At the network 7 one limit switch is for stop antennas in down with address I0.4, is normally closed switch and the output with address Q0.5.

At the network 8 is one input auto with address M0.0 normally opened switch and the output is connected with timer on delay with address T37. twenty second, The second is limit switch is for Stop antennas in up with address I0.3 normally closed switches, third input is for protect circuit of all motors from short with address M1.2 and the output with address Q0.5.

At the network 9 is one input auto with address M0.0 normally opened switch and the output is connected with timer on delay with address T38. twenty second, The second is limit switch is for Stop antennas in up with address I0.4 normally closed switches, third input is for protect circuit of all motors from short with address M1.1 and the output with address M1.1 .

At the network 10 is one input manual with address M0.2 normally opened switch and second input auto with address M1.1 normally opened switch and the output with address Q0.1.

At the network 11 is one input manual with address M0.3 normally opened switch and second input auto with address M1.2 normally opened switch and the output with address Q0.2.

At the network 12 The first switch is for start signal came when ground station start with address I0.5 is normally opened switch, The second switch is for over load with address I0.6 normally closed switches, The third input auto with address M0.0 normally opened switch, The fourth push bottom is for up of antenna no 2 with address I0.7 normally opened switches, The fifth is limit switch is for Stop antennas in up with address I0.3 normally closed switches, sixth input is for protect circuit of motor no 2 from short with address M3.1 ,the output is connected manual with address M3.0.

At the network 13 The first switch is for start signal came when ground station start with address I0.5 is normally opened switch, The second switch is for over load with address I0.6 normally closed switches, The third input auto with address M0.0 normally opened switch, The fourth push bottom is for down of antenna no 2 with address I1.0 normally opened switches, The fifth is limit switch is for Stop antennas in up with address I0.4 normally closed switches, sixth input is for protect circuit of motor no 2 from short with address M3.0 , the output is connected manual with address M3.1.

At the network 14 is one input manual with address M1.1 normally opened switch and second input auto with address M3.0 normally opened switch and the output with address Q0.6.

At the network 15 is one input manual with address M1.2 normally opened switch and second input auto with address M3.1 normally opened switch and the output with address Q0.7.

At the network 16 The first switch is for start signal came when ground station start with address I0.5 is normally opened switch, The second switch is for over load with address I0.6 normally closed switches, The third input auto with address M0.0 normally opened switch, The fourth push bottom is for up of antenna no 3 with address I1.1 normally opened switches, The fifth is limit switch is for Stop antennas in up with address I0.3 normally closed switches, sixth input is for protect circuit of motor no 3 from short with address M3.3 , the output is connected manual with address M3.2.

At the network 17 The first switch is for start signal came when ground station start with address I0.5 is normally opened switch, The second switch is for over load with address I0.6 normally closed switches, The third input auto with address M0.0 normally opened switch, The fourth push bottom is for up of antenna no 3 with address I1.2 normally opened switches, The fifth is limit switch is for Stop antennas in up with address I0.4 normally closed switches, sixth input is for protect circuit of motor no 3 from short with address M3.2 , the output is connected manual with address M3.3.

At the network 18 is one input manual with address M1.1 normally opened switch and second input auto with address M3.2 normally opened switch and the output with address Q1.0.

At the network 19 is one input manual with address M1.2 normally opened switch and second input auto with address M3.3 normally opened switch and the output with address Q1.1.

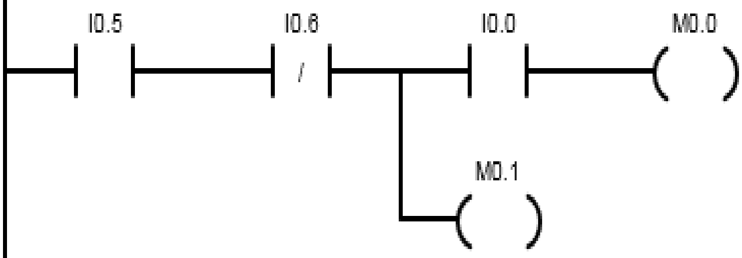
Block: MAIN
Author:
Created: 05/03/2019 07:08:32 am
Last Modified: 06/25/2019 02:34:18 pm

Symbol	Var Type	Data Type	Comment
	TEMP		
	TEMP		
	TEMP		
	TEMP		

PROGRAM COMMENTS

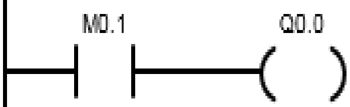
Network 1 Network Title

manual / automatic - selection



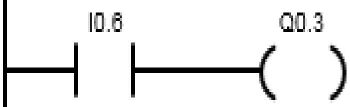
Network 2

run siganl



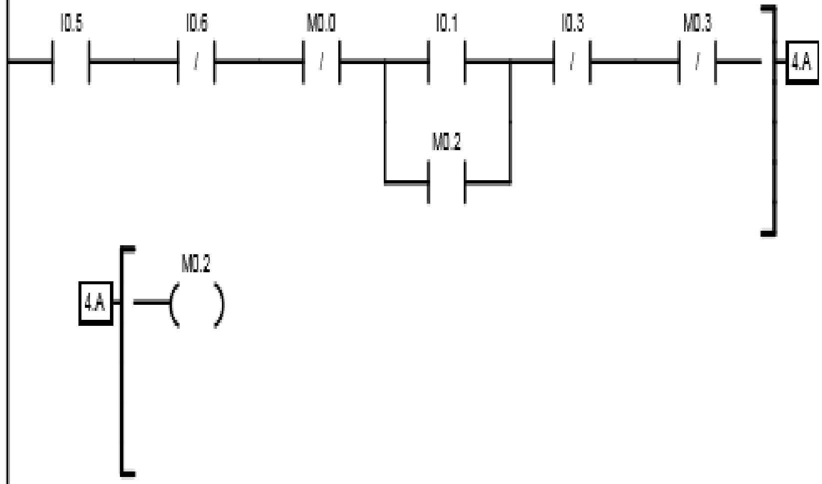
Network 3

over load



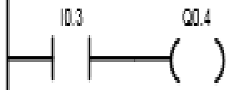
Network 4

antenna 1 fw



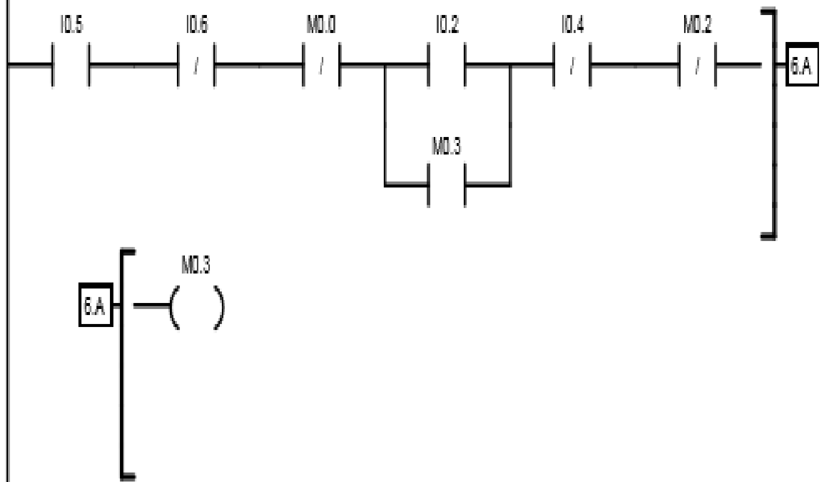
Network 5

stop signal fwd



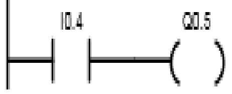
Network 6

antenna 1 ref

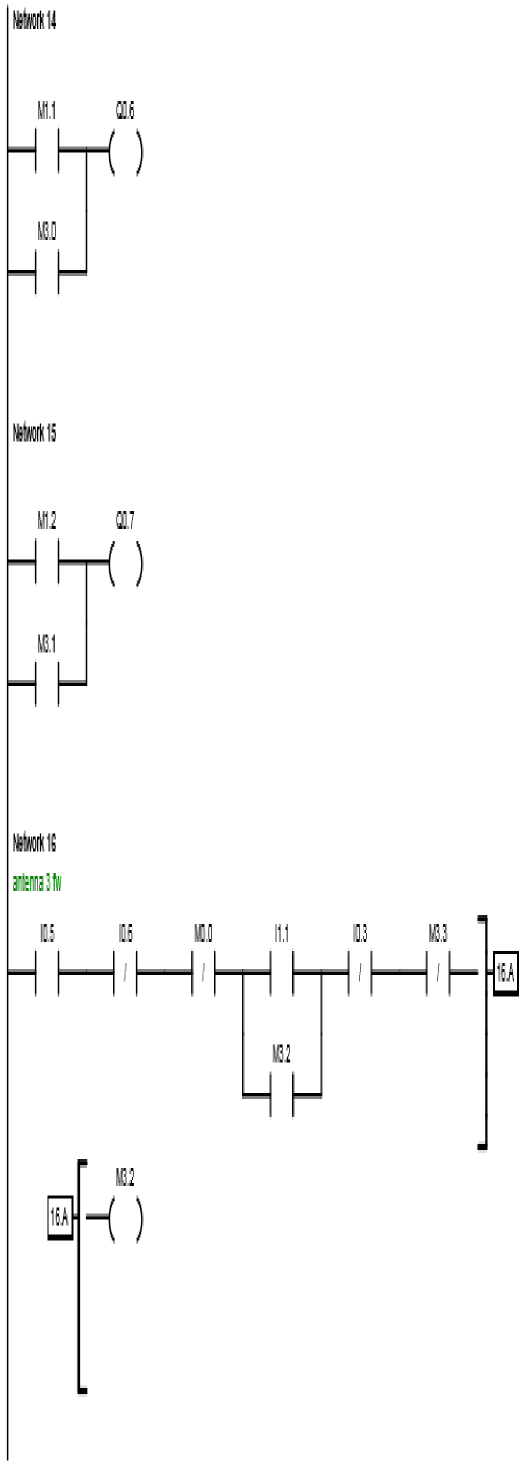


Network 7

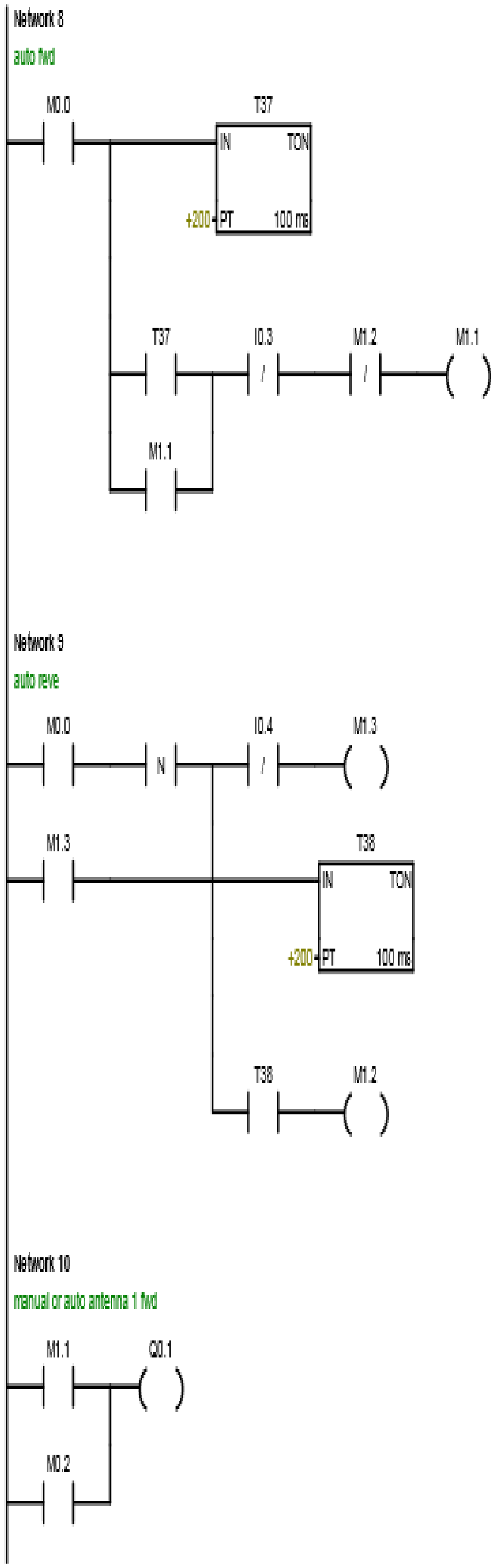
stop signal rev

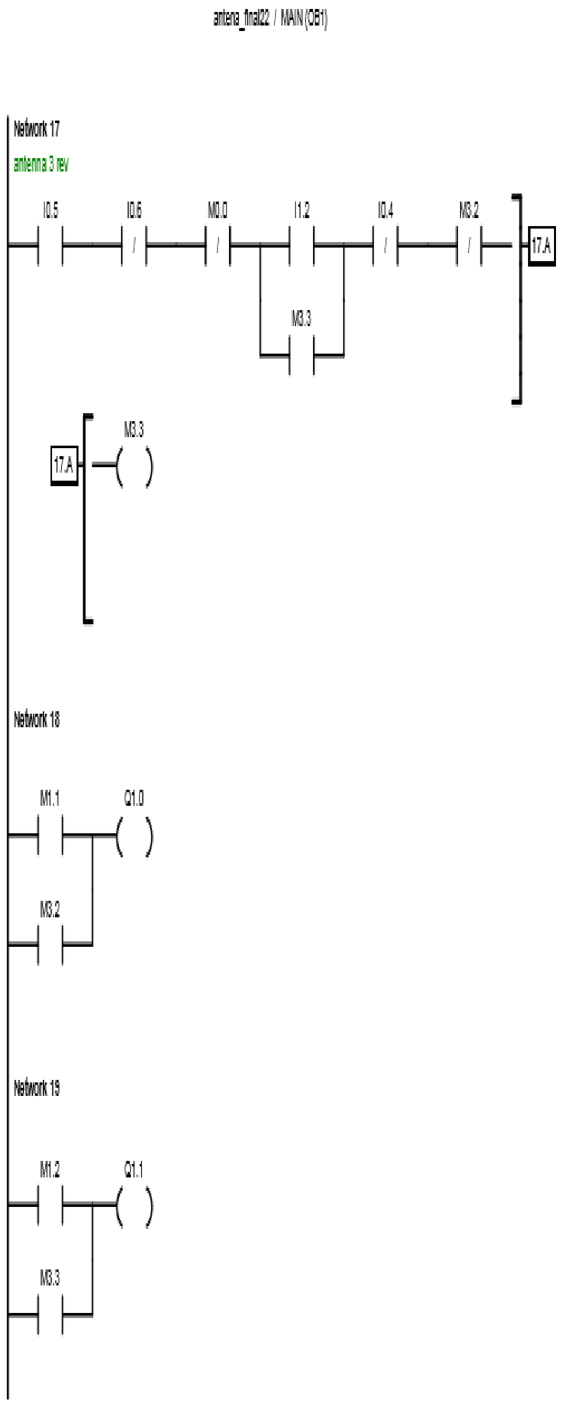


antena_final22 / MAIN (OB1)



antena_final22 / MAIN (OB1)




antena_final22 / MAIN (OB1)
Network 17
antenna 3 rev
I0.5
I0.6
M0.0
I1.2
I0.4
M3.2
M3.3
17.A
Network 18
M1.1
Q1.0
M3.2
Network 19
M1.2
Q1.1
M3.3

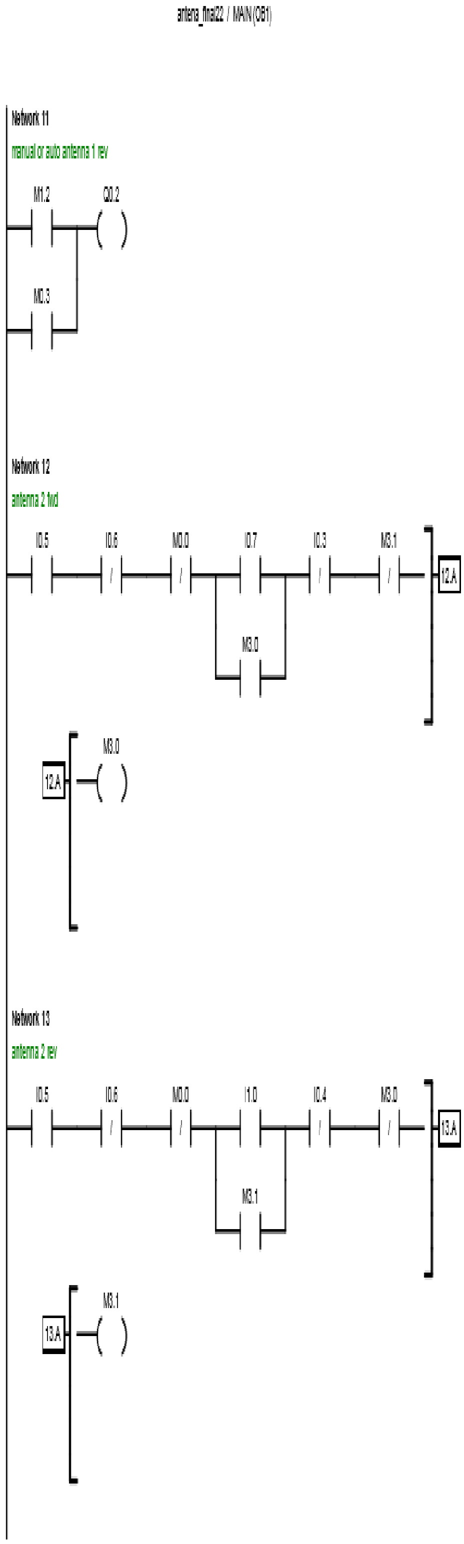

antena_final22 / MAIN (OB1)
Network 11
manual or auto antenna 1 rev
M1.2
Q0.2
M0.3
Network 12
antenna 2 fwd
I0.5
I0.6
M0.0
I0.7
I0.3
M3.1
M3.0
12.A
Network 13
antenna 2 rev
I0.5
I0.6
M0.0
I1.0
I0.4
M3.0
M3.1
13.A

Figure 3.12: Ladder Diagrams

3.6.8 The Relays

The relay used in this system is JQC-3FC -T73- DC 24V relay the working of this relay is same as other relays. It has the capacity to supply excess of 1.5A current. It has output AC and DC. It is very easy to handle during the operation. Are two limit switches they are antennas up and antennas down. These switches are used in order to limit the position of the antennas. There are ten relays; two relays will operate motion motor and indicators for up and down of antenna no1. There are eight LEDs and two 220 indicator to indicate whether the antennas are operated shown in fig. 3.15. In auto mode the arm is controlled automatically according to the program dumped and the input given to the PLC. But in manual mode the user should operate for the position of the arm by push buttons. Here limit switches are provided for arm up/down in order to avoid the breakage of the antennas mechanism shown in figure3.13.

Figure 3.13: Relays

3.6.9 Limit Switches

Limit switch choosing according will be use, different opinions how you would pick either NC or NO. What brand or where people recommend get for the limit switch. It is many types of limit switch: Button, Lever, Roller and they come into different price and specification. Roller allows the axis to over travel without crushing the limit switch or bending brackets. The AAP2T51Z11 mini switches from Automation Direct. It is used in electrical circuit according to the needs. Are rated at and accuracy of "0.01mm on the operating points at million operations" shown in figure 3.14.

Figure 3.14: Limit Switch

3.6.10 Indicators

The following criteria were used to select indicators included in this thesis

Good Indicators and The design should meet the following criteria: Simple Indicators should not be more complex than they need to be clearly defined the measures used must be clearly and precisely defined. It is not sufficient, for instance, to use, Variable to be useful, indicators must show variation between subjects and over time. If the indicator does not vary, then even if it is valid, Valid is important that an indicator be valid, that it accurately reflect the concept it is supposed to measure, Reliable Indicators must be reliable so that regardless of who collects the data, the results will be nearly identical, Quantifiable finally, indicators should be quantifiable, and where appropriate, presented as ratios. Actual numbers are often meaningless unless they are converted into some type of proportion, Accuracy: The indicator measures what it purports to measure, Feasibility: Data can be obtained with reasonable and affordable effort, Credibility: The indicator has been recommended - and is being used, Distinctiveness.

High light 220v indicator for start and over load are chooses because is very important to observe. Shown in figure 3.15, other indicators are DC volt. Shown in figure 3.16

Figure 3.15: Indicators 220V

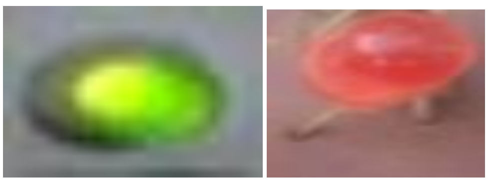


Figure 3.16: Indicators DC

3.6.11 Push BottomS

Switches don't require any fancy equations to evaluate. All they do is select between an open circuit and a short circuit. Select Bush bottom according to loads that not exceed the rated switching capacity or other contact ratings, actual conditions, number of switching operations is within the permissible range, voltages and size. Shown in figure 3.17.

Figure 3.17: Push Bottoms

3.6.12 Control Box

It is function carries relays, PLC, wire, indicators, switches and power supply. Top Solid program is used to design a control box. The dimensions are 25*25*25 mm3 according to size of component. Six faces. One face is door. Shown in figure 3.17.

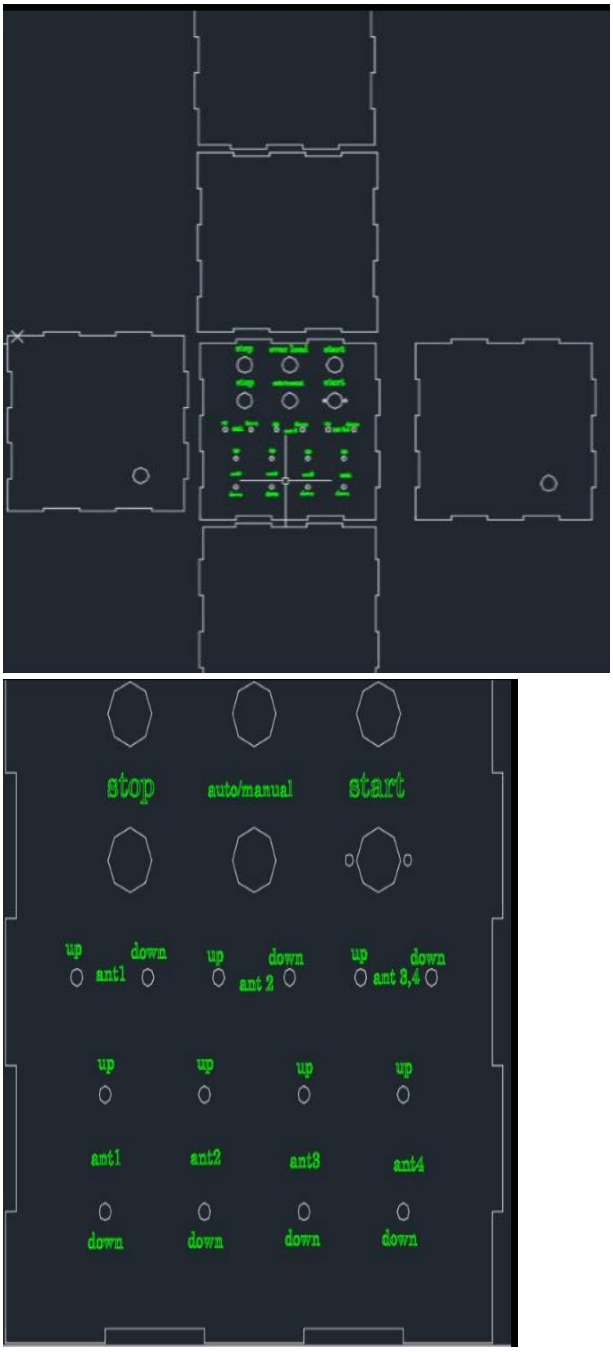


Figure 3.18: control box

SECOND; SIMULATION

The S7-200 series is a line of micro-programmable logic controllers Micro PLCs that can control a variety of automation applications. Compact design, low cost, and a powerful instruction set make the S7-200 a perfect solution for controlling small applications. The wide variety of S7-200 models and the Windows-based programming tool give you the flexibility you need to solve your automation problems. To useful from this program, it is necessary to have a general knowledge of automation and programmable logic controllers. The program is STEP 7--Micro/WIN, version 4.0 and the S7-200 CPU product family. After downloaded program, the S7-200 contains the logic required to monitor and control the input and output devices in your application. Siemens provides different S7-200 CPU models with a diversity of features and capabilities that help user to create effective solutions for varied applications.

The S7 200 simulator program is used to simulate CPU which helps me add and modify in program. First write program in PLC Language o and save it by select option file then export to save file at AWL. Second open simulator and enter code 6596 .the program open the simulator window. Third loading program and chooses CPU type. Fourth run PLC and work state program. Fifth moves switch according to input status and saw result according to input moves. Shown in figure 3.19 and figure 3.20.

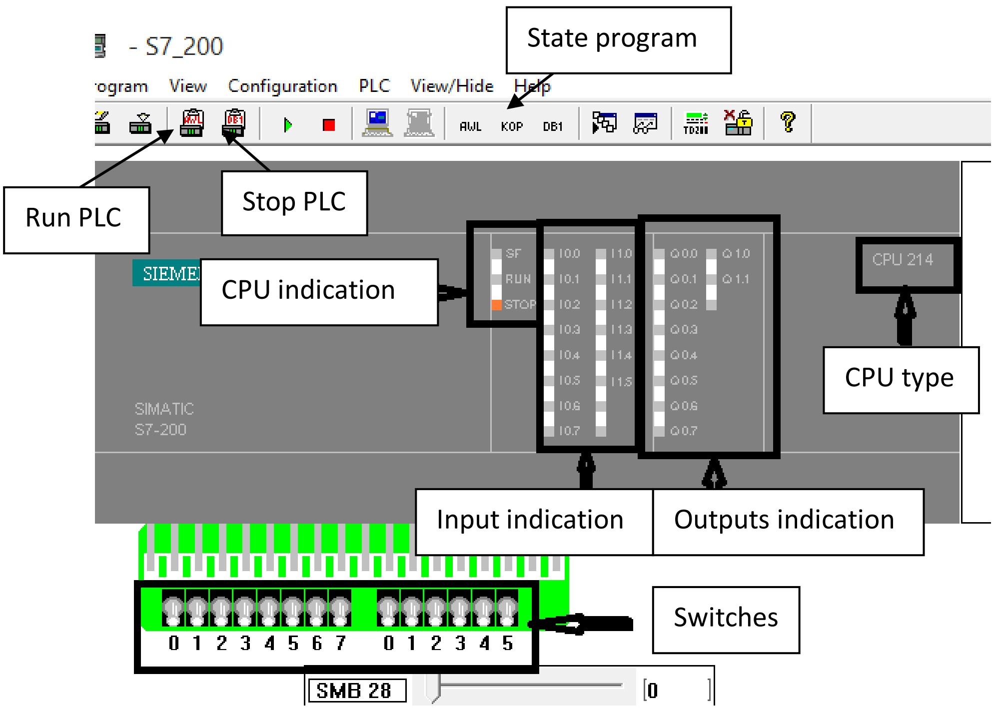


Figure3.19: Simulation Program

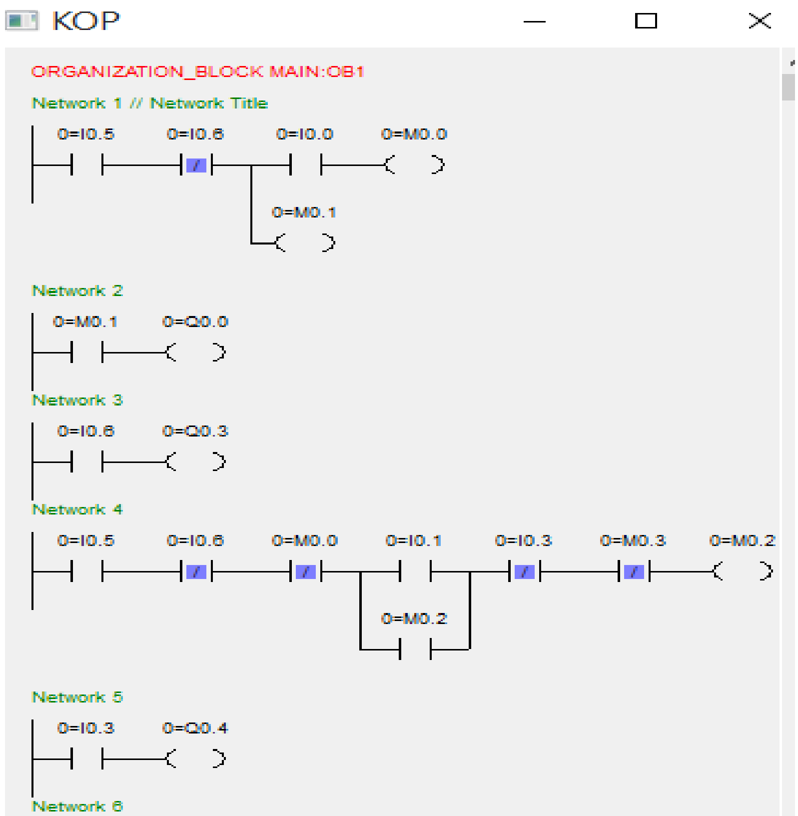


Figure3.20: Network Simulation Program

THIRD; IMPLEMENTATION

After finish design and used simulation to solve design problems. The third steps is implementation .It's began by welding Relays on port, welding LEDs with relays and LED protect items, welding wires, collects positive wires and connected with positive line of power supply, collects negative wires and connected with negative line of power supply, connected input pin of PLC with push bottom, switches and limit switch, connected output pin of PLC with relays, connected relays with indicators and motors and implementation control box by CNC machine. In last put it in control box. CNC machine is used to cut edges and write. Used to types of material .ablakash and placid. Shown in figure. 3.21.

Figure 3.21: Control Box

CHAPTER FOUR

RESULTS AND DISCUSSION

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1Software Simulations

S7 200 simulators are used to simulate CPU which helps me add and modify in program. After write program above and save it by select option file then export to save file at AWL. When open simulator and enter code 6596 .the program open the simulator window.

4.1.1 Start Indicator ; when start Ground Station address I0.5 and run PLC, The start indicator being on address Q0.0 shown in figure4.1

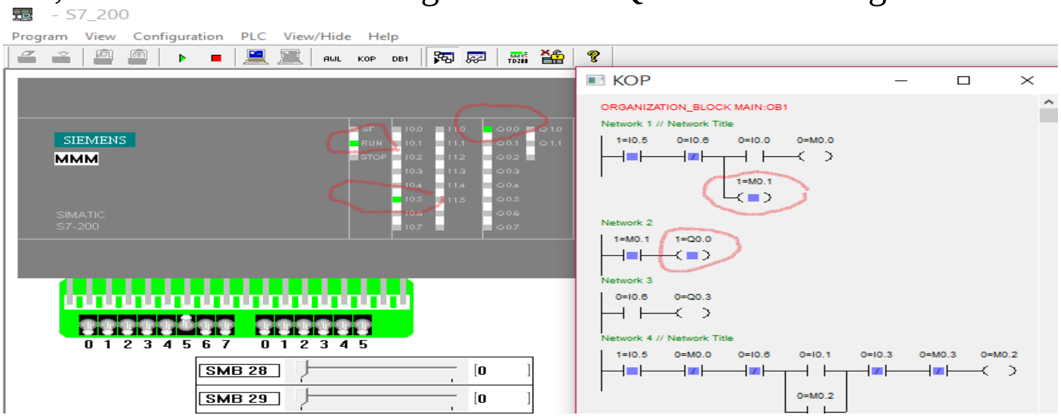


Figure 4.1 Start Indicator

4.1.2 Moves Antennas to up Position; when put main switch in the auto mode address I0.0 and grown station is start address I0.5. The control system PLC sends signal after twenty seconds to relays. Relays will activate motors. The motors move antennas to up position address Q0.1 shown in figure 4.2. During antennas go to up position red indicators are on, to indicate the four antennas is up position addressQ0.4 shown in figure 4.3.

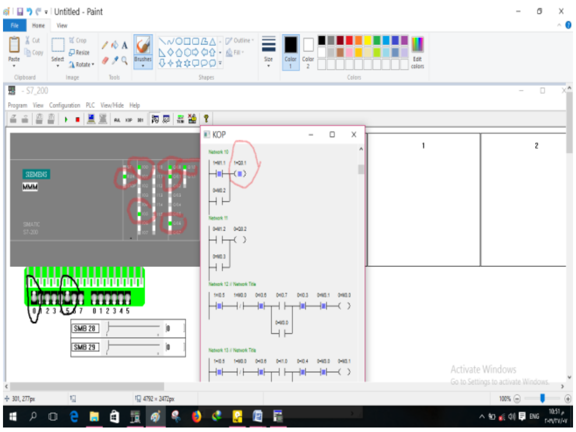


Figure4.2 Motors Move Antennas to Up Position

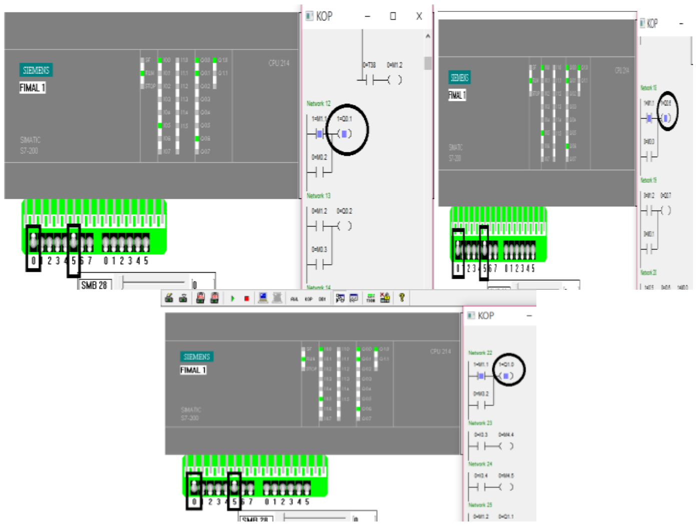
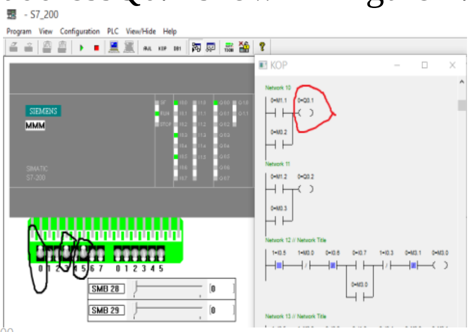


Fig. 4.3a Move Antenna no1 to Up   Fig. 4.3b Move Antenna no2 to Up   Fig. 4.3c Move Antenna no1 to Up

4.1.3 Antennas in Up Position; when antennas arrived to idle position the limit switch addressI0.3. Is send feedback signal to the PLC the motors stops and antennas in up position addressQ0.1 shown in figure 4.4.It is sends signal to red the indicator to be on, to indicate the any four antennas are up position addressQ0.4 shown in figure 4.5.



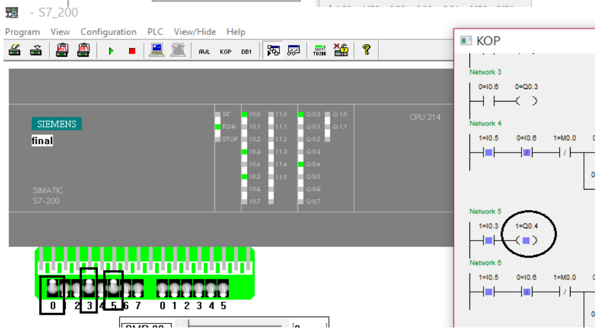


Figure4.4 Motors are Stopping   Figure 4.5 Antennas in Up Position

4.1.4 Antennas Moves to Down Position; when main switch in the auto mode addressI0.5 and ground station is shut down addressI0.0 the control system PLC sends signal after twenty seconds to relays. Relays will activate motors. The motors move antennas to down position addressQ0.1. During antennas go to dawn position green indicators to be on, to indicate the any four antennas is dawn position addressQ0.4 shown in figure 4.6.

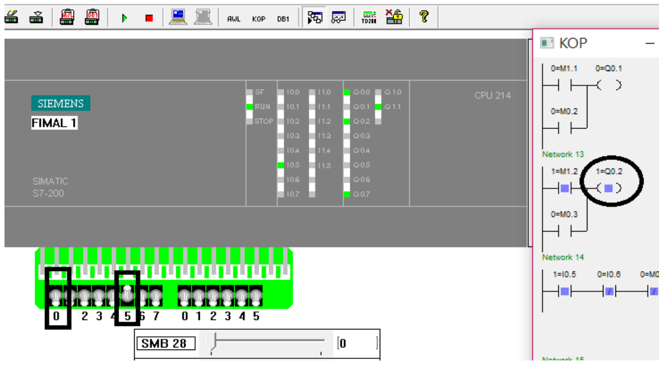
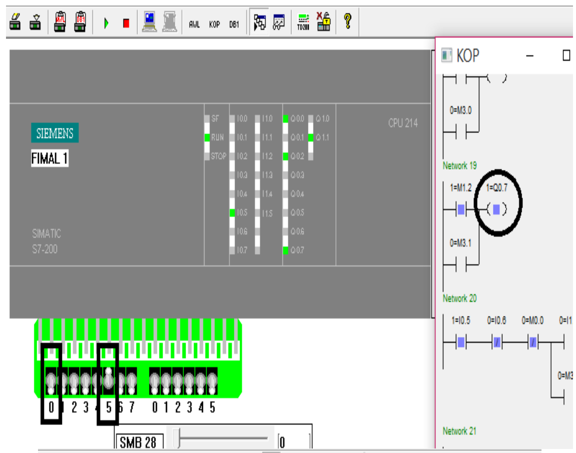


Figure 4.6a Antenna1 Moves to Down Position



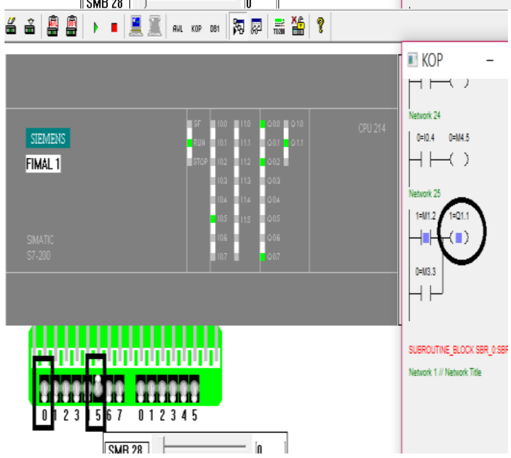
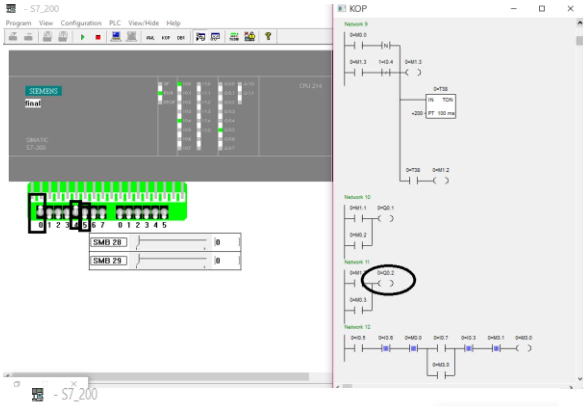


Figure4.6b Antenna2 Moves to Position
Down Position

Figure4.6c Antenna3,4 Moves to Down

4.1.5 Antennas in Down Position; when antennas arrived to idle position the limit switch addressI0.4 are sends feedback signal to control system PLC which stops motor and antennas in dawn position addressQ0.2. It is locked by gearbox shown in figure 4.7. It is sends signal to green indicator to be on, to indicate the any four antennas is down position address Q0.5 shown in figure 4.8.



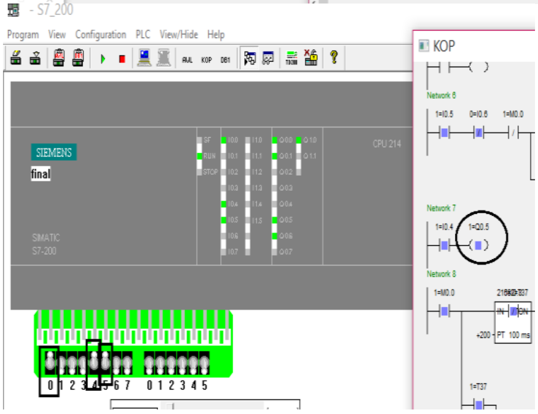


Figure 4.7 Motors Stop in Dawn Position Figure 4.8 Up Indication is on

4.1.6 Manual Mode; when select the manual mode addressI0.0 and ground station is starts the antennasaddressI0.5 steel in down position addressQ0.1 shown in figure 4.9.

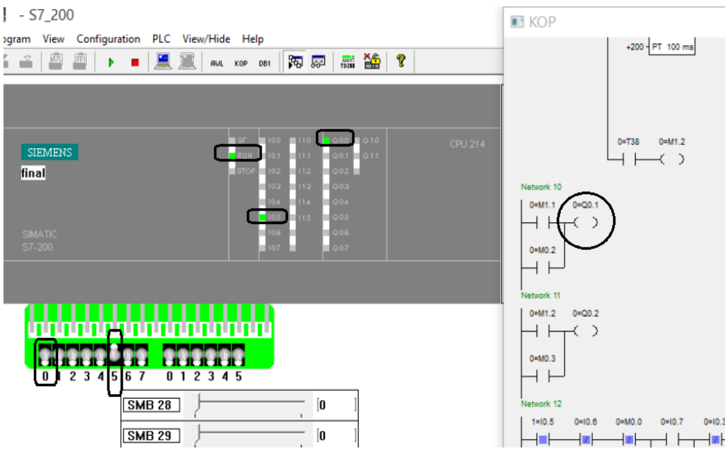


Figure 4.9 Manual Mode

4.1.7 Antenna1 Moves to Up Position; when pressed push button antenna no 1 addressI0.1 to up position, select the manual mode addressI0.0 and ground station is start addressI0.5 antenna go to up position addressQ0.1.During antenna go to up position red indicator to be on, to indicate the antenna no 1 is move to up position addressQ0.1 shown in figure 4.10.

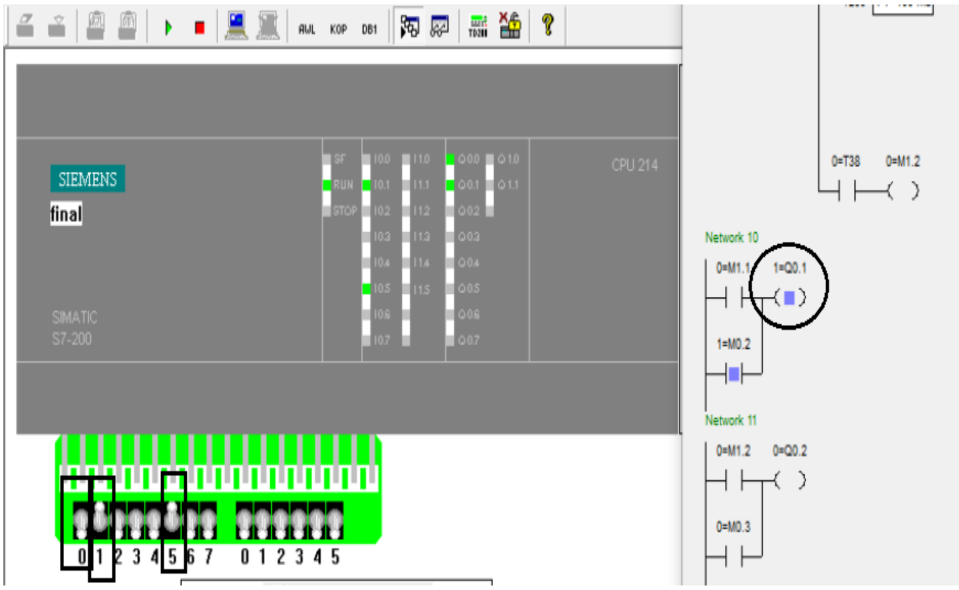
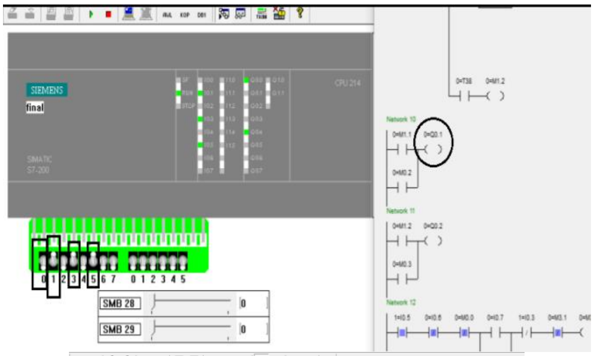


Figure 4.10 Antenna1 go to Up Position

4.1.8 Antenna 1 in Up Position; when antenna no 1 arrives to idle position the limit switch addressI0.3 sends feedback signal to control system PLC to stop antenna no 1 addressQ0.1 in up position shown in figure 4.11. The red indicator of up position to be on, to indicate the antenna no 1 in up position shown in figure 4.12.



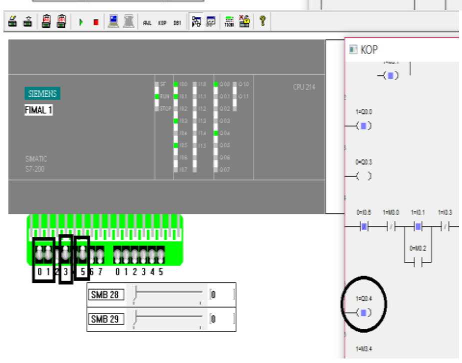


Figure4.11 motor1 stop in up position Figure 4.12 up indication is on

4.1.9 Antenna2 Moves to Up Position; when pressed push button antenna no 2 addressI0.7 to up position, select the manual mode addressI0.0 and ground station is start addressI0.5 antenna go to up position address Q0.6 during antenna go to up position red indicator to be on, to indicate the antenna no 2 is move to up position addressQ0.6 shown in figure 4.13.

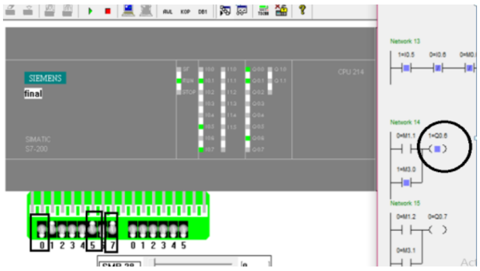
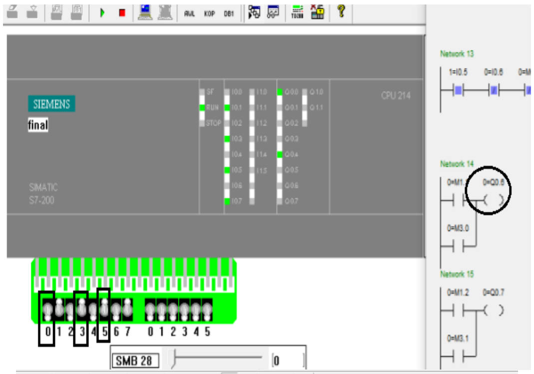


Figure 4.13 Antenna2 go to Up Position

4.1.10 Antenna2 in Up Position; when antenna no 2 arrived to idle position the limit switch addressI0.3 is send feedback signal to control system PLC to stop antenna no 2 addressQ0.6 in up position shown in figure 4.14 red indicator to be on, to indicate the antenna no 2 in up position shown in figure 4.15.



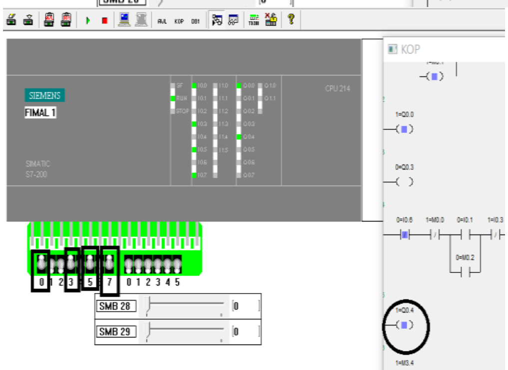


Figure4.14 Motor1 Stop in Up Position

Figure4.15 Up Indication is On

4.1.11 Antenna3,4 Moves to Up Position; when pressed push button antennas no 3, 4 addressI1.1 to up position, select the manual mode addressI0.0 and ground station is start addressI0.5 antennas go to up position addressQ1.0. During antennas go to up position. Red indicator to be on, to indicate the antennas no 3, 4 is move to up position addressQ1.0 shown in figure 4.16.

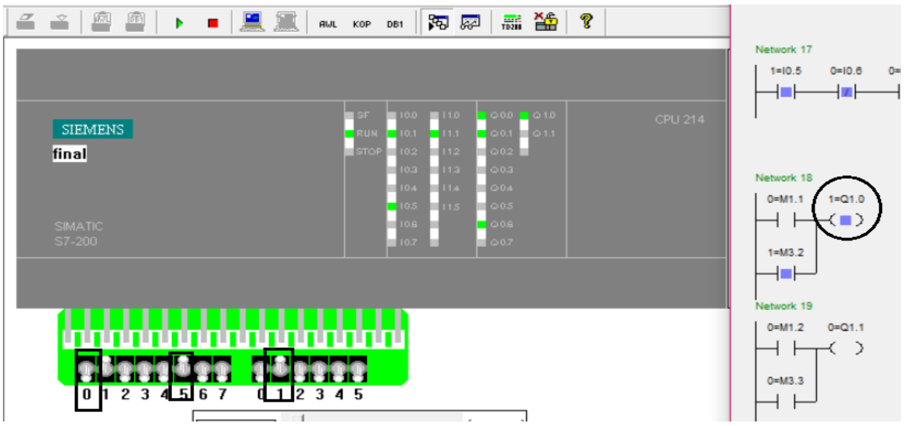


Figure 4.16 Antenna3, 4 go to Up Position

4.1.12 Antenna3,4 in Up Position; when antennas no 3, 4 arrived to idle position the limit switch addressI0.3 sends feedback signal to control system PLC to stop antennas no 3,4 addressQ1.0 in up position shown in figure 317. Red indicator to be on, to indicate the antennas no 3, 4 in up position shown in figure 4.18.

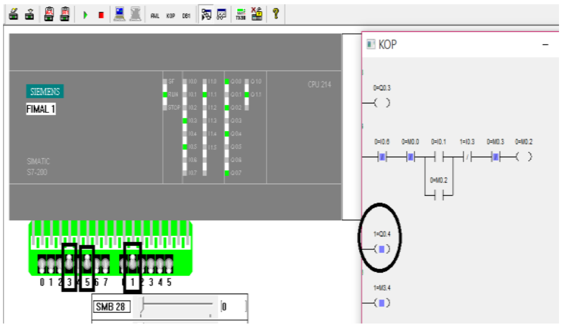


Figure4.17 Motor1 Stop in Up Position is On

Figure4.18 Up Indication

4.1.13 Antenna1 Moves to Dawn Position; when pressed push button down antenna no 1 addressI0.2, select the manual mode addressI0.0 and ground station is start addressI0.5 antenna go to down position address Q0.2. During antenna go to dawn position green indicator to be on, to indicate the antenna no 1 is move to dawn position addressQ0.2 shown in figure 4.19.

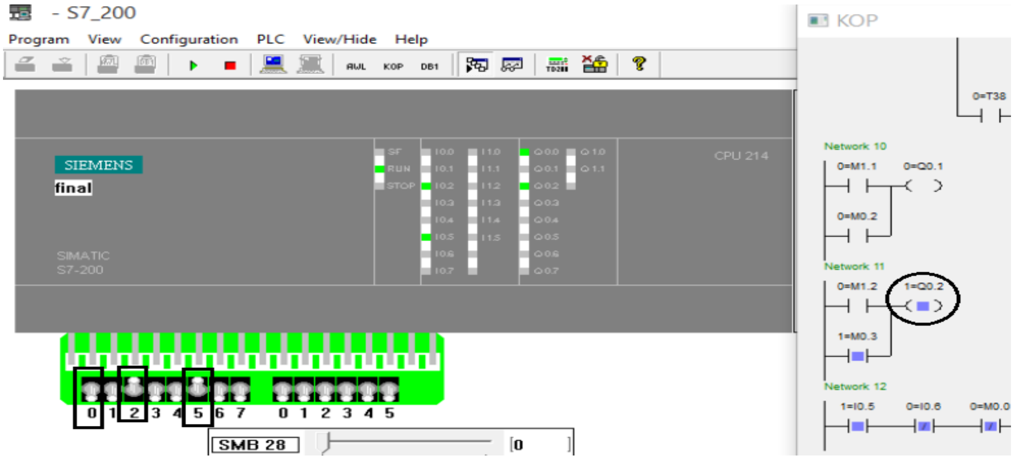
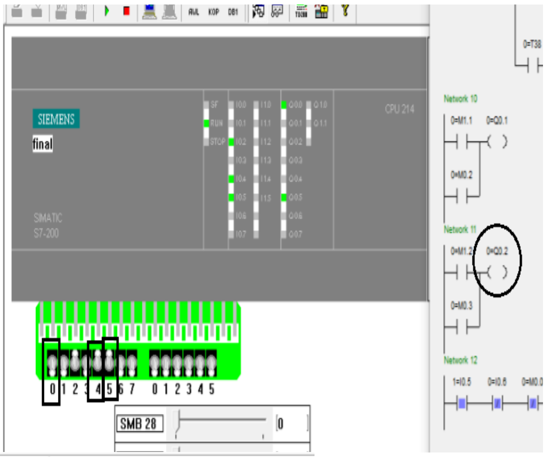


Figure 4.19 Antenna1 go to Dawn Position

4.1.14 Antenna1in dawn Position; when antenna no 1 arrives to idle position the limit switch addressI0.4 sends feedback signal to control system PLC to stop antenna no 1 addressQ0.2 in down position shown in fig. 4.20 green indicator to be on, to indicate the antenna no 1 in dawn position shown in figure 4.21.



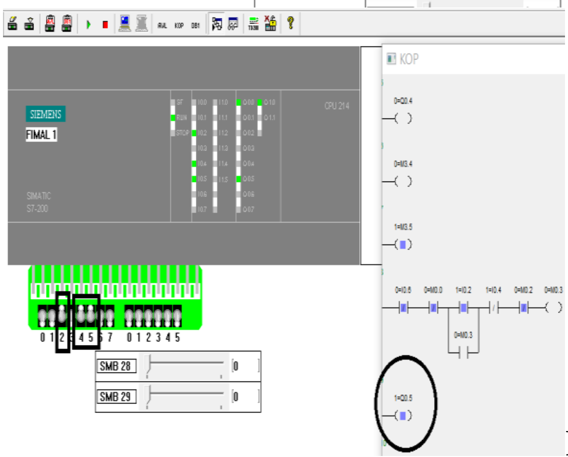


Figure4.20 Motor Stop in Dawn Position Figure4.21 Dawn Indication is On

4.1.15 Antenna2 Moves to Dawn Position; when I press push button down antenna no 2 addressI1.0, select the manual mode addressI0.0 and ground station starts addressI0.5 antenna go to down position address Q0.7. During antenna go to dawn position green indicator to be on, to indicate the antenna no2 is move to dawn position addressQ0.7 shown in figure 4.22.

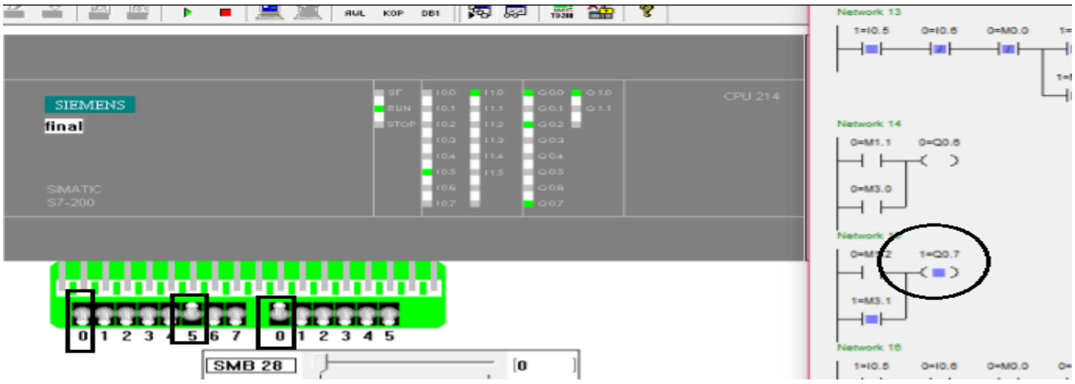
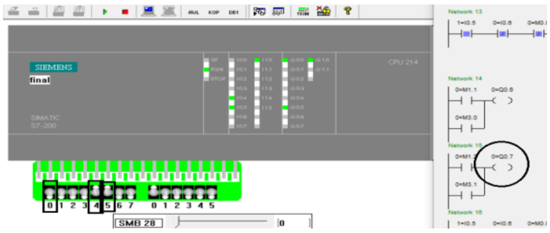


Figure 4.22 Antenna1 go to Dawn Position

4.1.16 Antenna2in Dawn Position; when antenna no 2 arrives to idle position the limit switch addressI0.4 sends feedback signal to control system PLC to stop antenna no2 addressQ0.7 in down position shown in figure4.23 green indicator to be on, indicate the antenna no 2 in dawn position shown in fig. 4.24.



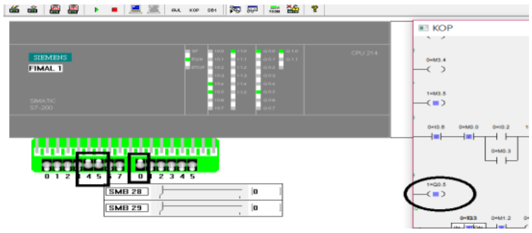


Figure 4.23 Motor Stop in Dawn Position Figure 4.24 Dawn Indication is on

4.1.17 Antenna3,4 Moves to Dawn Position; when I press push button down antennas no 3, 4 addressI1.2, select the manual mode addressI0.0 and ground station starts addressI0.5 antennas go to down position address Q1.1. During antennas go to dawn position green indicator to be on, to indicate the antennas no 3, 4 is move to dawn position addressQ1.1 shown in figure 4.25.

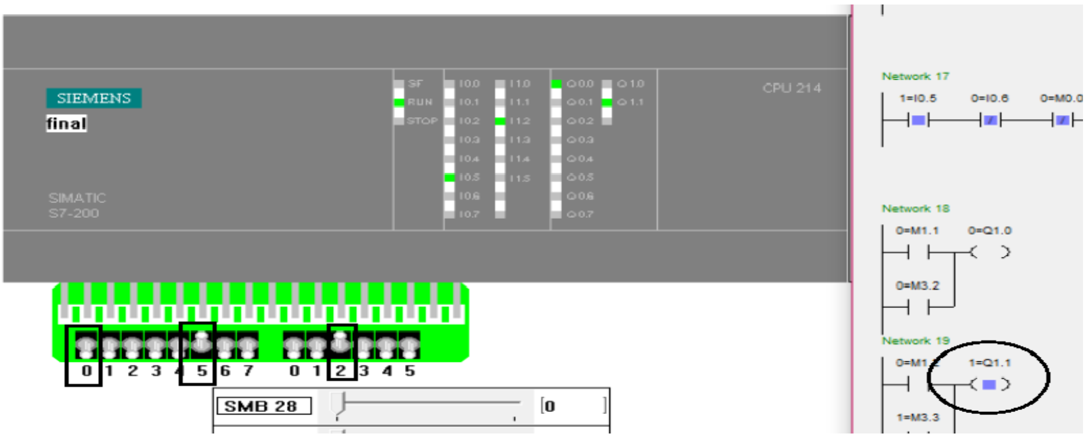
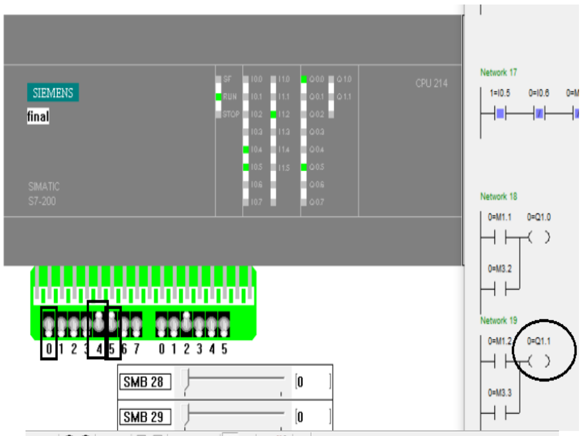


Figure 4.25 Antenna1 go to Dawn Position

4.1.18 Antenna3,4 in Dawn Position; when antennas no 3, 4 arrived to idle position the limit switch addressI0.4 is send feedback signal to control system PLC to stop antennas no 3,4 addressQ1.0 in dawn position shown in figure 4.26 green indicator to be on, to indicate the antennas no 3,4 in dawn position shown in figure 4.27.



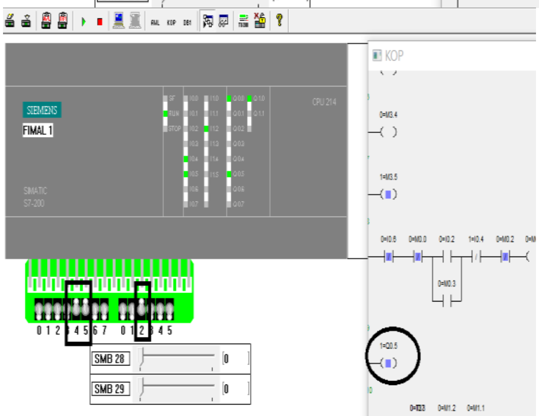


Figure4.26 Motor Stop in Dawn Position is On

Figure4.27 Dawn Indication

4.1.19 Over Load; when over load in circuit address I0.6 and start signal run PLC addressQ0.5, the over load indicator being on address Q0.3 shown in figure 4.28.

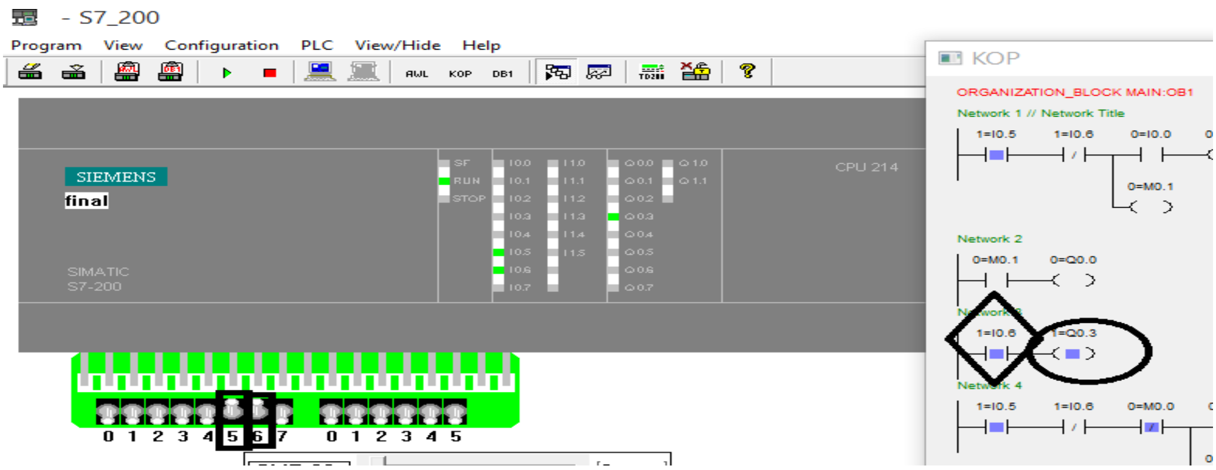


Figure 4.28Over Load Indicator

4.2 Hardware Implementations

Here I showing and explain how hardware and software work.

4.2.1 Start Indicator; when start ground station 24volt and run PLC, the start indicator being on 220volt shown in figure 4.29.

Figure 4.29 Start Indicator

4.2.2 Movement Antennas to Up Position; when put main switch in the auto mode 24 volt and grown station is start 24 volt. The control system PLC sends signal after twenty seconds to relays. Relays will activate motors. The motors move antennas to up position 90deg shown in figure 4.30 and sends signal to red indicators to be on, to indicate the any four antennas is move to up position 24 volt shown in figure 4.31.

Figure 4.30 Antennas Moves to Up Position

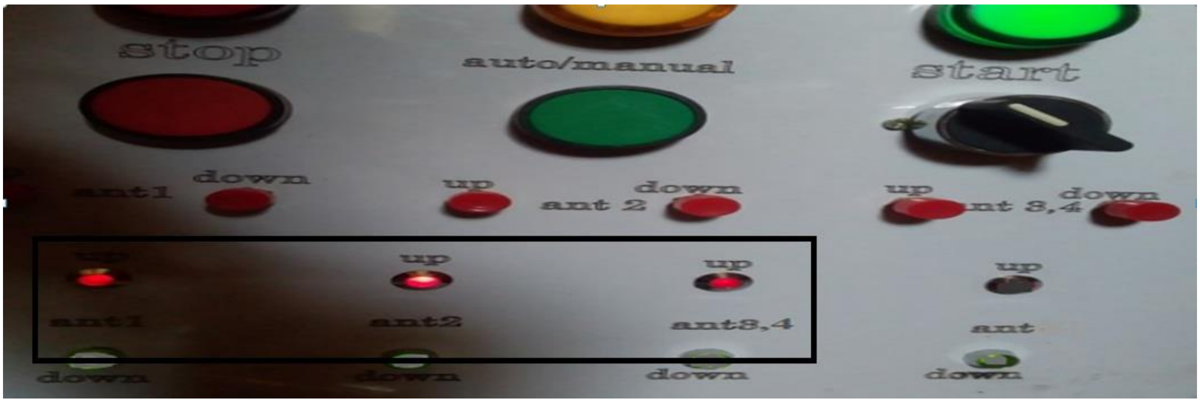


Figure 4.31 Indicate the Antennas is Move to Up Position

4.1.3 Antennas in Up Position; when antennas arrived to idle position the limit switch 24 volt. Is send feedback signal to control system PLC the motors stops and antennas in up position 90deg shown in figure 4.32 and sends signal to red indicator to be on, to indicate the any four antennas arrives up position 24 volt shown in figure 4.33.

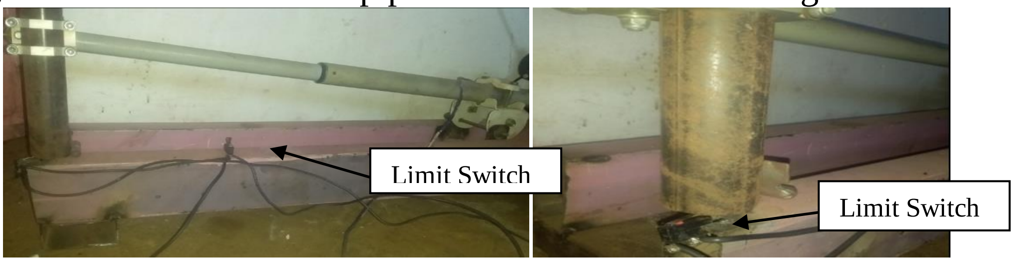


Figure 4.32 Antennas in Up Position

Figure 4.33Indicator of Antennas in Up Position

4.1.4 Antennas Moves to Down Position; when main switch in the auto mode 24 volt and ground station is shut down 0 volt the control system PLC sends signal after twenty seconds to relays. Relays will activate motors. The motors move antennas to down position 0deg. Shown in figure 4.34 and sends signal to green indicators to be on, to indicate the any four antennas is move to dawn position 24 volt shown in figure 4.35.

Figure 4.34 Antennas Moves to Down Position

Figure 4.35 Indicators of Antennas Moves to Down Position

4.1.5 Antennas in Down Position; when antennas arrived to idle position the limit switch 24 volt are sends feedback signal to control system PLC which stops motor and antennas in dawn position 0deg. It is locked by gearbox. Shown in figure 4.36 and sends signal to green indicator to be on, to indicate the any four antennas are arrive dawn position 24 volt shown in figure 4.37.

Figure 4.36 Antennas in Down Position

Figure 4.37 Indicating Antennas in Down Position

4.1.6 Manual Mode; when select the manual mode 0 volt and ground station is start the antennas 24 volt steel in down position 0 volt shown in figure 4.38 and signal of indicator is off, to indicate the any four antennas isn't move to up position 24 volt shown in figure 4.39.

Figure 4.38 Manual Mode Motors Off

Figure 4.39 Manual Mode Indicators Off

4.1.7 Antenna1 Moves to Up Position; when pressed push button antenna no 1 24 volt to up position, select the manual mode 0 volt and ground station is starts 24 volt antenna go to up position 24 volt shown in figure 4.40. During this red indicator to be on, to indicate the antenna no 1 is moves to up position 24 volt shown in figure 4.41.

Figure 4.40 Antenna1 Moves to Up Position

Figure 4.41Indicating Antenna1 Moves to Up Position

4.1.8 Antenna 1 in Up Position; when antenna no 1 arrives to idle position the limit switch 24 volt sends feedback signal to control system PLC to stop antenna no 1, 0volt in up position shown in figure 4.42 and red indicator of up position to be on , to indicate the antenna no 1 in up position shown in figure 4.43.

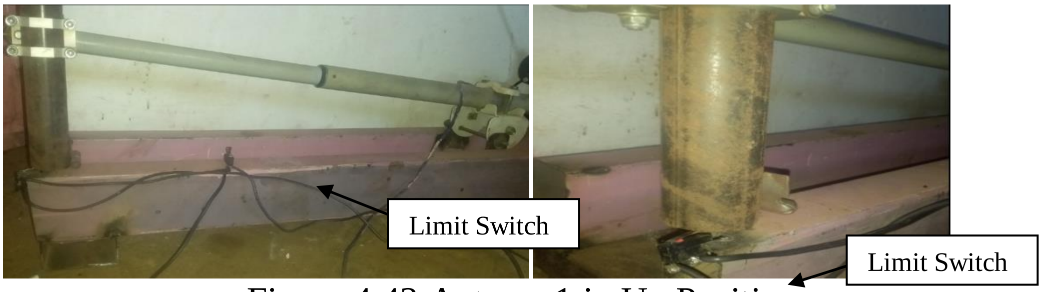


Figure 4.42 Antenna1 in Up Position

Figure 4.43Indicating Antenna1 in Position

4.2.9 Over Load; when over load in circuit 24 volt and start signal run PLC 24 volt, the over load indicator being on220 volt shown in figure 4.44.

Figure 4.44 Over Load Indicator

4.2.10 Antenna2 Moves to Up Position; when pressed push button antenna no 2, 24 volt to up position, select the manual mode 0 volt and ground station is starts 24 volt antenna goes to up position during this red indicator to be on, to indicate the antenna no 2 is moves to up position 24 volt shown in figure 4.45.

Figure 4.45 Antenna2 Moves to Up Position

4.2.11 Antenna 2 in Up Position; when antenna no 2 arrives to idle position the limit switch 24 volt sends feedback signal to control system PLC to red indicator to be on, to indicate the antenna no 2 in up position shown in figure 4.46.

Figure 4.46 Antenna2 in Up Position

4.2.12 Antennas3,4 Moves to Up Position; when pressed push button antennas no 3,4,24 volt to up position, select the manual mode 0 volt and ground station is start 24 volt antennas go to up position during this red indicator to be on, to indicate the antennas no 3,4 are move to up position 24 volt)shown in figure 4.47.

Figure 4.47 Indicators of Antennas 3, 4 Moves to Up Position

4.2.13 Antennas 3,4 in Up Position; when antennas no 3,4 arrive to idle position the limit switch 24 volt sends feedback signal to control system PLC to red indicator to be on, to indicate the antennas no 3,4 in up position shown in figure 4.48.

Figure 4.48 Antenna3, 4 in Up Position

4.2.14 Antenna1 Moves to Dawn Position; when pressed push button down antenna no 1, 24 volt, select the manual mode0 volt and ground station is start 24 volt antennas go to down position24 volt shown in figure 4.49 and during this green indicator to be on, to indicate the antennas no 1 is move to dawn position 24 volt shown in figure 4.50.


Figure 4.49 Antenna1 Moves to Dawn Position

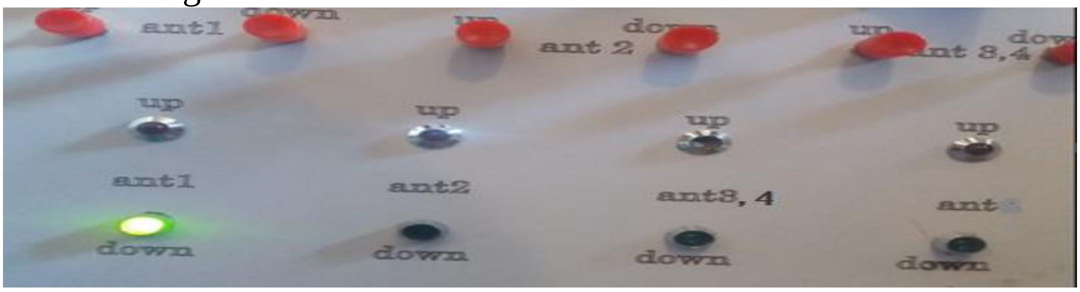


Figure 4.50 Indicator of Antenna1 Moves to Dawn Position

4.2.15 Antenna1 in Dawn Position; when antenna no 1 arrives to idle position the limit switch 24 volt sends feedback signal to control system PLC to stop antenna no 1, 0 volt in down position shown in figure 4.51 and green indicator of dawn position to be on, to indicate the antenna no 1 in dawn position shown in figure 4.52.

Figure 4.51 Antenna1 in Position

Figure 4.52indicator of Antenna1 in Dawn Position

4.2.16 Antenna2 Moves to Dawn Position; when pressed push button antenna no 2, 24 volt to dawn position, select the manual mode 0 volt and ground station is starts 24 volt antenna go to dawn position during this green indicator to be on, to indicate the antenna no 2 is move to dawn position 24 volt shown in figure 4.53.

Figure 4.53 Indicator of Antenna 2 Moves to Dawn Position

4.2.17Antenna 2 in Dawn Position; when antenna no 2 arrives to idle position the limit switch addressI0.4 sends feedback signal to control system PLC to green indicator to be on, to indicate the antenna no 2 in dawn position shown in figure 4.54.

Figure 4.54 indicator of Antenna2 in Dawn Position

4.2.18 Antennas 3, 4 Moves to Dawn Position; when pressed push button antennas no 3,4is 24 volt to dawn position, select the manual mode 24 volt and ground station is start 24 volt antennas go to dawn position during this green indicator to be on, to indicate the antennas no 3, 4 is move to dawn position 24 volt shown in figure 4.55.

Figure 4.55 Indicator of Antenna 3, 4 Moves to Dawn Position

4.2.19 Antenna3,4 in Dawn Position; when antennas no 3,4 arrive to idle position the limit switch 24 volt send feedback signal to control system PLC to green indicator to be on, to indicate the antennas no 3,4 in dawn position shown in figure 4.56.

Figure 4.56 Indicator of Antenna3, 4 in Dawn Position

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

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5.1 Conclusion

Working on the project has been a very satisfactory experience. It has also brought some challenges. Combining concepts of mechanical, electrical and software design into one application requires constant considerations of the impacts the change in one concept would mean for the rest of the system. The wide range of the problems to be solved made the work very time consuming but also more interesting. The selection of actuator components also provided some valuable lessons. In finding a motors and combination that satisfied the strength requirements, the movement arm of antennas, Choosing PLC, Relays, wire ,Motors move a load not less than 20kg ,gears, Indicators ,Power Supply and Switches. When first the decision came to design and implementation of automated positioning system for ground station, the design process seemed very easy. But as the process progressed and as the design became more and more clear, the level of detail started mattering more and more.

The CATIA program used to design and fabrication of actuator for holding the antennas, required size and weight. Minimize the setup time of preparing ground station antennas. From three hours to one minute and six second.

Now the antennas not need to assembly and disassembly .this is decrease effort of preparing ground station antennas.

It can be concluded that the most of the goals were achieved with satisfactory results. The mechanical design introduced some challenges because of the time limitation. Many parts of the construction are heavier than expected due to the limited choice of material available at the time. The electrical design has been implemented with slight changes because of the delivery problems. The biggest challenge of the electrical design was getting to know the hardware and the software used in the project and interfacing outputs and inputs. Testing of

The designed control system (PLC) can control the motor speed very quickly. The motor speed (current value) reaches to set value in a short time and it is very useful for controlling speed in industrial to avoid damage to the parts. The results of simulation and hardware implementation show the good performance of the system. . PLC plays an important role in formulation of any embedded system; various software implementations can be done. PLC can be implemented with various communication modules. After the study of this thesis we come to know that as antennas can be designed as wants.

5.2 Recommendations

The first recommendation that should be made is to have all of the previously

Developed improvements installed. These include the connections between mechanical parts.

The second recommendations some electrical components need more searching and power calculate not enough.

The third recommendation that should be changes PLC or add PLC module. To add inputs and outputs.

The fifth recommendation that should be study and used pneumatic system because is more controllability of antennas speed than motors.

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