INTERNSHIP REPORT ON

STUDY OF FIELD INSTRUMENTS IN CNC AND PLC SYSTEM

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BY:

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बी एच ई एल
BHEL

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
रामचंद्रापुरम, हैदराबाद
मानव संसाधन विकास केंद्र

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Human Resource Development Centre

Ref No: 19ENGG0337 **Date :** 06/06/2019

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr./~~Ms.~~/~~Mrs.~~ B.K. Hemcharan with college id no: 17BEC0189 studying in Vellore Institute of Technology (VIT, Vellore) pursuing ~~B.~~E/B.Tech/~~MBA~~ in ECE discipline had undergone project training from 08/05/2019 to 06/06/2019. The title of the project as per our records is STUDY OF FIELD INSTRUMENTS IN PROCESS CONTROL IN CNC

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We would like to take this opportunity and express our heartfelt thanks to all those who helped us in the course of this project work.

We are very much grateful to BHARAT HEAVY ELECTRICLAS LIMITED for providing with real data regarding the functioning of organization and we take this opportunity to express our
heartfelt gratitude to B.H.E.L., for having permitted us to undertake the project in the organization and encouraging in completing this project successfully.

We would like to convey our thanks to other staff members, who also guided us in our endeavors and also extending their helping hands.

BHEL is the largest engineering and manufacturing enterprisein INDIA in the energy related / infrastructure sector today. BHEL was established more than 40 years ago, when its first plant was set up in BHOPAL ushering in the indigenous. Heavy electrical equipment in INDIA, a dream which has been more than realized with a recognized track record of performance. It has been earning profits continuously since 1971 1972.

BHEL as it is known today, as come a long way from being a mere heavy electrical generation equipment company to the position of leadership that it enjoys today with major presence not only in the field of power, but in the other co sectors of industry. Transportation, Transmission, Oil & Gas, Telecommunication, Defense & Civil Aviation.

The wide network of BHEL consists of 14 manufacturing divisions , 4 power sector regional centers, and 18 regional offices, enables the company to promptly serve its customers and provide them with suitable products ,systems and services-efficiently and it competitive prices.

Today , BHEL has a major presence in the domestic power market and accounts for 65% of the nations installed power generating capacity. Thus making a significant contribution to the growth and development of the country's economy over the years.

It has had a consistent track record of growth ,performance and profitability and has been reported by the world bank as being " One of the most efficient enterprise in the industrial sector at par with international standards of efficiency."

Having achieved the international quality certification(ISO-9000), the organization is now moving towards a culture of total management(TQM) for achieving business excellence.

Having technology and business tie-ups with some of the leading world giants in the field ,BHEL has demonstrated its international competitiveness time and again which is evident by the fact that over 86% of domestic power plant orders floated for competitiveness bidding since 1978 have been bagged by BHEL. The organization has been exploiting market opportunities in India and abroad by competing , collaborating and coexisting with leaders and enjoys a market presence in over 50 countries.

Through its 'vision 2001' exercise, the company has already set its sight on becoming a world - class, innovative , competitive and profitable engineering enterprise that would provide total business solutions and has also articulated a set of values which would provide the guiding light to the organization on its journey to realizing this vision.

Control & Instrumentation Group is involved in engineering, procurement, inspection of various field instruments, safety & control valves, cables, etc. for the power plants. Also involved in providing overall plant control system using various makes of Distributed Control Systems (DCS) and Programmable Logic Controllers (PLCs).

WHAT IS A POWER PLANT?

A power plant is an industrial facility for the generation of electric power. At the center of nearly all power stations is a generator, a rotating machine that converts mechanical power into electrical power by creating relative motion between a magnetic field and a conductor. The energy source

harnessed to turn the generator varies widely. It depends chiefly on which fuels are easily available, cheap enough and on the types of technology that the power company has access to. Most power stations in the world burn fossil fuels such as coal, oil, and natural gas to generate electricity, and some use nuclear power, but there is an increasing use of cleaner renewable sources such as solar, wind, and hydroelectric. Central power stations produce AC power, after a brief Battle of Currents in the 19th century demonstrated the advantages of AC distribution.

DISTRIBUTIVE CONTROL SYSTEM

A type of automated control system that is distributed throughout a machine to provideinstructionsto different parts of the machine. Instead of having a centrally located device controlling all machines, each section of a machine has its own computer that controls the operation. For instance, there may be one machine with a section that controls dry elements of cake frosting and another section controlling the liquid elements, but each section is individually managed by a DCS. A DCS is commonly used in manufacturing equipment and utilizes input and output protocols to control the machine.

A design approach in which factory or machine control is divided into several sub-systems, each managed independently by a unique programmable controller or other control system, yet all interconnected to form a single entity. Individual subsystems may be interconnected via communications networks.

STUFY OF FIELD INSTRUMENTS IN PLC AND CNC

PLC

INTRODUCTION :Programmable Logic Controllers (PLCs), also referred to as programmable controllers, are in the computer family. They are used in commercial and industrial applications. A PLC monitors inputs, makes decisions based on its program, and controls outputs to automate a process or machine. This course is meant to supply you with basic information on the functions and configurations of PLCs.

PLCs consist of input modules or points, a Central Processing Unit (CPU), and output modules or points. An input accepts a variety of digital or analog signals from various field devices (sensors) and converts them into a logic signal that can be used by the CPU. The CPU makes decisions and executes control instructions based on program instructions in memory. Output modules convert control instructions from the CPU into a digital or analog signal that can be used to control various instructions determine what the PLC will do for a specific input. An operator interface device allows process information to be displayed and new control parameters to be entered.

A device-level network system connects devices, while eliminating the hassles of traditional I/O wiring.

Figure 4: Traditionally hardwired control cabinet

Figure 5: Networked control cabinet using Eaton's SmartWire-DT

COMPONENTS OF PLC

Programmable controllers have grown throughout industrial control applications because of the ease they bring to creating a controller: ease of programming, ease of wiring, ease of installation, and ease of changing. PLCs span a wide range of sizes, but all contain these basic components:

1. Processor
2. Memory Unit
3. Power Supply
4. I/O Modules
5. Programming Device

Processor (CPU):

The processor, central processing unit, or CPU is the "brain" of the PLC. The size and type of CPU will determine things like: the programming functions available, size of the application logic available, amount of memory available, and processing speed.

Memory Unit:

It is connected to the cpu which contains the programs of logic, sequencing and i/o operations.

Power Supply:

The power supply provides power for the PLC system. The power supply provides internal DC current to operate the processor logic circuitry and input/output assemblies. Common power levels used are 24V DC or 120 VAC.

I/O Modules:

Inputs carry signals from the process into the controller, they can be input switches, pressure sensors, operator inputs, etc. These are like the senses and sensors of the PLC.

Outputs are the devices that the PLC uses to send changes out to the world. These are the actuator the PLC can change to adjust or control the process _ motors, lights, relays, pumps, etc.

Programming Device:

The PLC is programmed using a specialty programmer or software on a computer that can load and change the logic inside. Most modern PLCs are programmed using software on a PC or laptop computer. Older systems used a custom programming device.

Electronic Control System

Electronic control systems are of hardwired or programmable control systems.

Programmable Control

In programmable control systems, the construction of the controller and the wiring are independent of program definition. Sensor contacts and operating coils on machine tool, for instance, are connected directly to the controller.

The program defining the control operation is written directly into the memory of the controller with the aid of a programmer. This program determines the sequence in which sensor contacts are to be scanned, according to which logic function (AND, OR) they are to be gated and which outputs the result are to be assigned to i.e. in which order the operating coils are to be energized or de-energized.

The control program can be modified by changing the contents of the controller's memory. The circuit wiring is not affected.

Hard wired Control

In hardwired control, it is the wiring between the individual elements such as sensor contacts, valve solenoids etc. which defines the control "program ". Any modification to the program involves rewiring the circuit. As a consequence, a hard-wired control system may only be constructed after its "program" has been defined.

Bus System

A bus system is a path for the transmission of signals. In the programmable controller, it is responsible for the signal exchange between processor and input/output modules. The bus comprises of several parallel signal lines:

- The address bus, which selects the address on the individual modules.
- The data bus, which carries data e.g. from input or to output modules.
- The control bus, which transfers control and timing signals for the synchronization of the CPU's activities within the programmable controller.

The power supply module generates internal voltages from the main supply for powering the electronic modules of the programmable controller. The magnitude of this supply voltage is 5V. The voltage require for sensors, actuators and annunciators is much higher than

5V(24V to 220V) and is obtained from external power supplies or control transformers installed specially for this purpose.

The processor of the programmable controller scans the inputs for "voltage present "and "voltage not present" and depending on the stored program and result of the scanning operation, the actuators are switched "ON" or "OFF".

Requirements of a Reliable Industrial Control

Following are the requirements, which a control system should fulfill in order to qualify as a reliable and efficient industrial process controller:

1. They should be designed to survive in an industrial environment with all that this implies for temperature, dirt and poor quality mains supply.
2. They should be capable of dealing with bit – form digital input / output signals at the usual voltages encountered in industry (24V DC to 240 V AC) plus analog input/output signals. The expansion of the input/output should be simple and straightforward.
3. The programming language should be understandable by maintenance staff (such as electricians) who no computer training. Programming changes should be easy to perform in a constantly changing plant.
4. It must be possible to monitor the plant operation whilst it is running to assist fault finding. It should be appreciated that most faults will be in external equipment such as plant-mounted limit switches, actuators

and sensors and it should be possible to observe the action of these from the control computer.

5. The system should operate sufficiently fast for real time control. In practice ‘sufficiently fast’ means a response time of around. 1s, but this can vary depending on the applications and the controller used.
6. The user should be protected from the computer jargon.
7. Safety must be a prime consideration

Suitability of PLC as Industrial Process Controller

Any industrial control system goes through four stages from conception to a working plant. A PLC controlled system brings advantages at each stage.

1. The first stage is design: the required plant is studied and the control strategies decided. With conventional systems design must be complete before construction can start. With a PLC system all that is needed is a possibly a vague ideal of the size of the machine and the I/O requirements (i.e. many inputs and outputs). The input and output cards are cheap at this stage, so a healthy store capacity can be built in to allow for the inevitable omissions and future developments.
2. Next comes construction: with conventional schemes, every job is a ‘one-off’ with inevitable delays and cost. A PLC system is simply bolted together from standard parts. During this time the writing of the

PLC program is started (or at least the detailed program specification is written).

3. The next stage is installation: a tedious and expensive business as sensors, actuators, limit switches and operator controls are cabled. A distributed PLC system using serial links and pre-built and tested desks can simplify installation and bring huge cost benefits. The majority of the PLC program is written at this stage.
4. Finally comes commissioning: and this is where the real advantages are found. No plant ever works first time. Human nature being what it is, there will be some over sites. Changes to conventional systems are time consuming and expensive. Provided the designer of the PLC system has built in spare memory capacity, spare I/O and a few spare cores in multicore cables, most changes can be made quickly and relatively cheaply. An added bonus is that all changes are recorded in the PLC's program and commissioning modification does not go unrecorded, as these often the case in conventional systems.
5. There is an additional fifth stage, maintenance, which starts once the plant is working and is handed over to production. All plants have faults, and most tend to spend the majority of their time in some of failure mode. A PLC system provides a very powerful tool for assisting with fault diagnosis. A plant is also subject to many changes during its life to speed production, to case breakdowns or because of changes in its requirements. A PLC system can be changed so easily

that modifications are simple and the PLC program will automatically document the changes that have made.

Characteristic Functions of a PLC

A PLC is defined “a digital electronic device that uses a programmable memory to store instructions and implement specific functions such as logic sequence, timing, counting and arithmetic to control machines and processor”.

As this is a very broad definition it is more useful to examine the essential characteristics of the PLC that portray its unique aspects.

Some of the most important characteristics include the following:

1. It is field programmable by the user. This characteristic allows the user to write and change programs in the field without rewiring or sending the unit back to the manufacturer for this purpose. It contains pre-programmed functions.

PLC’s contain least logic, timing, counting and memory function that the user can access through some type of control oriented programming language.

2. It scans memory and I/O in a deterministic manner. This critical feature allows the control engineer to determine precisely how the machine or process will respond to the program.

3. It provides error checking and diagnostics. A PLC will periodically run internal tests of its memory, processor and the I/O system to ensure that what it is doing to the machine or process in what it was programmed to do.

4. It can be monitored. A PLC will provide some form of monitoring capability either to indicating lights that show the I/O status or by an external device that can display program execution status.

Selecting the Right PLC

To select or size a PLC to meet with your requirements, the producers should be as follows.

- Determine the number of inputs and outputs.
- Establish the types of inputs and outputs required.
- As certain the types and complexities of function needs.
- Consider what type memory needs.
- Determine the size of memory needs.
- Evaluate the effect of scan times.
- Consider remote input and output capability is needed, and if so, over what distances.
- Outlines the system requirements in terms of peripherals and special features.
- Establish the physical constraints.
- Define the type of program panel.

PLC OPERATION SEQUENCE

1. SELF TEST- Testing of its own hardware and software for faults.
2. INPUT SCAN- If there are no problems PLC will copy the inputs and copy there values into memory.
3. LOGIC SOLVE /SCAN- Using inputs the ladder logic program is solved once and outputs are updated.
4. OUTPUT SCAN- While solving logic the output values are updated only in memory when ladder scan is done, the outputs will be updated using temporary values in memory.

ADVANTAGES OF PLC

The same, as well as more complex tasks, can be done with a PLC. Wiring between devices and relay contacts is done in the PLC program. Hard-wiring, though still required to connect field devices, is less intensive. Modifying the application and correcting errors are easier to handle. It is easier to create and change a program in a PLC than it is to wired one.

Following are just a few of the advantages of PLCs:

- Smaller physical size than hard-wire solutions.
- Easier and faster to make changes.
- PLCs have integrated diagnostics and override functions.
- Diagnostics are centrally available.
- Applications can be immediately documented.
- Applications can be duplicated faster and less expensively.

DISADVANTAGS OF PLC

There's too much work required in connecting wires.

It is difficult to find errors.

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- Skillful workers are required.
- There's difficulty with replacements.
- PLC devices are proprietary, which means that parts and software from one manufacturer can't easily be used in combination with parts of another manufacturer, which limits the design and cost options.

PLC APPLICATIONS

Proper application of a PLC begins with an economical justification analysis. The batch process in chemical, cement, food and paper industries are sequential in nature, requiring time or event based decisions. PLCs are being used more and more as total solutions to a batch problem in these industries rather than just a tool.

In batch process savings are developed principally from reduced cycle time and scheduling. Cycle automation provides rigid control enforcement to eliminate human errors and to minimize manual interventions. Increased efficiency in scheduling is to be expected with maximum utilization of equipment and reduction of fluctuating demands on critical equipment.

In large process plants PLCs are being increasingly used for automatic start up and shutdown of critical equipments. A PLC ensures that an equipment can not be started unless all the permissive conditions for safe start have been established.

It also monitors the conditions necessary for safe running of the equipment and trip the equipment whenever any abnormality in the system is detected.

The PLC can be programmed to function as an energy management system for boiler control for maximum efficiency and safety. In the burner management system it can be used to control the process of purging, pilot light off, flame safety checks, main burner light off and valve switching for changeover of fuels.

CNC

Controlling a machine tool by means of prepared program, which consists of blocks, or series of commands/numbers, is known as numerical control. Numerical Control [NC] for machine tools was introduced in 1950 by Prof. John T Parsons. The first CNC machine was built at the Massachusetts institute of technology [MIT] in 1953 by joint efforts of US Air force, MIT and the Parsons Corporation.

NC is nothing but position control of machine tools by recorded information called part program, which is a set of coded instructions given as numbers for automatic control of machine tool in a predetermined sequence. Numerical control can be defined as a technique of controlling the position of a machine tool by the direct insertion of numerical data at some point (command point) of the control system. The functions that are controlled on the machine tool are position of slide members, spindle speed, tool selection etc. At first the numerical control was used to produce geometrically complex parts, but later used for added efficiency in medium batch production. Presently numerical controls are employed in all sections of production.

Rapid developments in the field of electronics such as integrated circuits, large scale-integrated circuits and development of minicomputer lead to the development of minicomputer based CNC

systems. Further development and the electronic “chip” revolution have used in the current generation “compact and powerful” microprocessor based CNC systems.

HISTORY OF CNC MACHINE

The history of numerical control (NC) began when the automation of machine tools first incorporated concepts of abstractly programmable logic, and it continues today with the ongoing evolution of computer numerical control (CNC) technology.

The first NC machines were built in the 1940s and 1950s, based on existing tools that were modified with motors that moved the controls to follow points fed into the system on punched tape. These early servomechanisms were rapidly augmented with analog and digital computers, creating the modern CNC machine tools that have revolutionized the machining processes.

ELEMENTS OF CNC MACHINE

The CNC system consist of the following elements:

1. Input Device
2. Machine Control Unit
3. Machine Tool
4. Driving System
5. Feedback Devices
6. Display unit

(i) Input Devices: These are the devices which are used to input the part program in the CNC machine. There are three commonly used input devices and these are punch tape reader, magnetic tape reader and computer via RS-232-C communication.

(ii) Machine Control Unit (MCU):It is the heart of the CNC machine. It performs all the controlling action of the CNC machine, the various functions performed by the MCU are

- It reads the coded instructions fed into it.
- It decodes the coded instruction.
- It implements interpolation (linear, circular and helical) to generate axis motion commands.
- It feeds the axis motion commands to the amplifier circuits for driving the axis mechanisms.

It receives the feedback signals of position and speed for each drive axis.

It implements the auxiliary control functions such as coolant or spindle on/off and tool change.

(iii) Machine Tool: A CNC machine tool always has a slide table and a spindle to control of the position and speed. The machine table is controlled in X and Y axis direction and the spindle is controlled in the Z axis direction.

(iv) Driving System: The driving system of a CNC machine consists of amplifier circuits, drive motors and ball lead screw. The MCU feeds the signals (i.e. of position and speed) of each axis to the amplifier circuits. The control signals are than augmented (increased) to actuate the drive motors. And the actuated drive motors rotate the ball lead screw to position the machine table.

(v) Feedback System:This system consists of transducers that acts like sensors. It is also called as measuring system. It contains position and speed transducers that continuously monitor the position and speed of the cutting tool located at any instant. The

MCU receives the signals from these transducers and it uses the difference between the reference signals and feedback signals to generate the control signals for correcting the position and speed errors.

(vi) Display Unit: A monitor is used to display the programs, commands and other useful data of CNC machine.

Input Elements

Some of the commonly employed input elements are push-button, foot switch, proximity switch, float switch, relay contact, photo transistor switch, selector switch, pressure switch, limit switch and flow switch.

Output Elements

Output Elements that are commonly used are:

- Indicating Lamps
- DC control relays (electromagnetic)
- Power contractors
- DC and AC solenoids
- Electromagnetic clutch and brake
- Solid state relay

A control relay (CR) is an electromagnetic device excited through an ac or dc electric coil. The dc relays are used as interface between the CNC-PLC and the ac or dc power switching devices.

Contractors (C) are also electromagnetic devices which are excited with ac voltages (110 V or 220 V used for ON/OFF functions of induction motors, induction coils, drive power circuits, etc. Power contractors are designed to switch currents up to several hundreds of amperes at 440 V ac three-phase.

Overload (OL) Relays

Bi-metallic thermal overload relays are very commonly used as overload protection devices for various ac motors such as hydraulic pump motor, coolant pump motor, lubrication motor, blower induction motor, or any other power ac circuit. The overload (OL) relay, when connected in series with the power circuit, will open out when the current increases beyond a preset value.

Miniature Circuit Breaker (MCB)

An MCB is a protective device, which will provide both overload and short circuit protection when connected in a circuit. Hence an MCB will replace a fuse and a bi-metallic overload relay. When an MCB trips, it has to be reset manually. Compact MCBs with auxiliary trip contact are used in the electrical control panel for CNC machines.

Configuration of a CNC System

A schematic diagram of the working principle of an NC axis of a CNC Machine and the interface of a CNC control.

A CNC system basically consists of the following:

- Central processing unit (CPU)
- Servo-control unit
- Operator control panel
- Machine control panel
- Other peripheral devices
- Programmable logic controller

Central Processing Unit (CPU)

The CPU is the heart and brain of a CNC system. It accepts the information stored in the memory as part program. This data is decoded

and transformed into specific position control and velocity control signals. It also oversees the movement of the control axis or spindle and whenever this does not match with the programmed values, a corrective action is taken.

Speed Control Unit

This unit acts in unison with the CPU for the movement of the machine axes. The CPU sends the control signals generated for the movement of the axis to the servo-control unit and the servo-control unit converts these signals into a suitable digital or analog signal to be fed to a servo-driver for machine tool axis movement. This also checks whether machine tool axis movement is at the same speed as directed by the CPU.

Servo Control Unit

The decoded position and velocity control signals, generated by the CPU for the axis movement forms the input to the servo-control unit. This unit in turn generates suitable signals as command values. The command values are converted by the servo-drive unit which are interfaced with the axes and the spindle motors.

The servo-control unit receives the position feedback signals for the actual movement of the machine tool axes from the feedback devices (like linear scales, rotary encoders, resolvers, etc.). The velocity feedback are generally obtained through tacho generators. The feedback signals are passed on to the CPU for further processing. Thus, the servo-control unit performs the data communication between the machine tool and the CPU.

The amount of movement and the rate of movement are controlled by the CNC system.

Closed Loop System

The closed loop system is characterized by the presence of feedback. In this system, the CNC system sends out commands for movement and the result is continuously monitored by the system through various feedback devices. There are generally two types of feedback to a CNC system-position feedback and velocity feedback.

Open Loop System

The open loop system lacks feedback. In this system, the CNC system sends out signals for movement but does not check whether actual

movement is taking place or not. Stepper motors are used for actual movement and the electronics of these stepper motors is run on digital pulses from the CNC system.

Operator Control Panel

The operator control panel provides the user interface to facilitate a two-way communication between the user, CNC system and the machine tool. The consists of two parts:

- Video display unit
- Keyboard

Video Display Unit (VDU)

The VDU displays the status of the various parameters of the CNC system and the machine tool. It displays all current information such as:

- Complete information on the block currently being executed actual position values, set or actual difference, current feed rate, spindle speed
- Actual position value, set or actual difference, current feed rate, spindle speed.
- Active G functions, miscellaneous functions
- Main program number, subroutine number
- Display of all entered data, user programs, user data, machine data, etc.

- Alarm messages in plain text
- Soft key designations.

Keyboard

A keyboard is provided for the following purposes:

- Editing of part programs, tool data, machine parameters.
- Selection of different pages for viewing.
- Selection of operating modes, e.g., manual data input, jog, etc.
- Selection of feed rate override and spindle speed override
- Execution of part programs
- Execution of other tool functions

Machine Control Panel (MCP)

It is the direct interface between the operator and the NC system, enabling the operation of the machine through the CNC system.

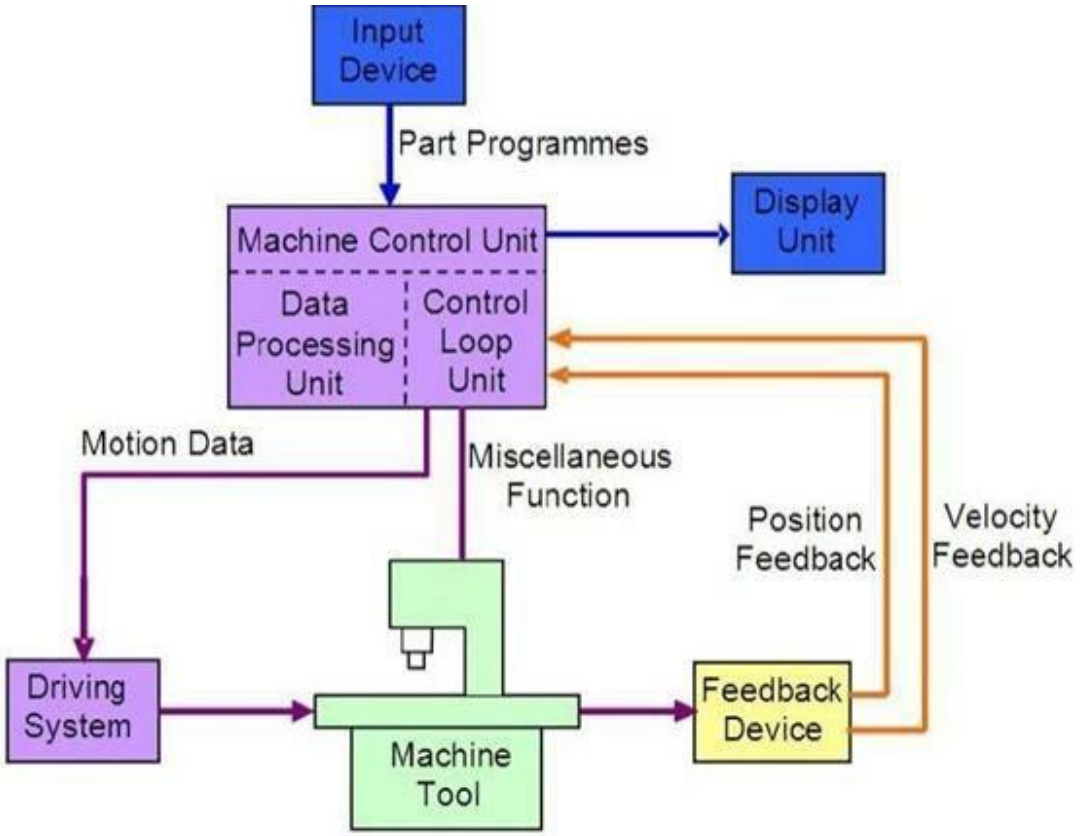
During program execution, the CNC controls the axis motion, spindle function or tool function on a machine tool, depending upon the part program stored in the memory. Prior to the starting of the machining process, machine should first be prepared with some specific tasks like,

- Establishing a correct reference point

- Loading the system memory with the required part program
- Loading and checking of tool offsets, zero offsets, etc.

Modes of Operation

- Preset mode
- Manual data input (MDI) mode
- Automatic mode
- Reference point mode
- Jog mode
- Incremental mode


Input Device
Part Programmes
Machine Control Unit
Display Unit
Data Processing Unit
Control Loop Unit
Motion Data
Miscellaneous Function
Position Feedback
Velocity Feedback
Driving System
Machine Tool
Feedback Device

MODES OF OPERATION OF CNC MACHINE

Every CNC machine has couple of Modes or I call it Standard Working Modes , such as Auto Mode, Single Block Mode, MDI (Manual Data Input) and Jog Mode and there will be more modes but those mostly will be CNC machine or CNC control specific modes.

CNC Machine Jog:

CNC machine Jog mode is one of the most used CNC mode. Jog mode is mostly used to travel the CNC machine carriage (or CNC machine Slide) such as CNC machine's axis movement e.g. x-axis z-axis. These axis movement can be via axis specific keys or through the CNC machine *hand wheel*.

CNC Machine MDI Mode or MDA Mode:

The CNC machine *MDI* (Manual Data Input) mode or *MDA* (Manual Data Automatic) mode can be called a semi automatic mode. The CNC MDI or MDA mode is mostly used to index tools, or to execute one block of CNC code (on some models of CNC such as sinumerik 840D you can execute multi block CNC program in MDA mode). The CNC M-Codes can be executed in MDI or MDA mode. You can even rotate the CNC machine spindle to a specific RPM in MDI or MDA mode.

CNC Machine Single Block Mode:

The CNC program consists of *CNC program blocks*. The CNC program blocks are numbered such as N10, N20, N30 and so on. In CNC machine single block mode when you press the *cycle start button* on the *CNC machine control panel* only one block of the CNC program will be executed and the machine slide or CNC machine carriage will stop or you might say that the CNC machine

cutting tool feed will be at hold but remember that this does not mean that CNC machine fully stops, only CNC machine axis movement will be at hold and all the other functions like coolent will continue to flow and the spindle will continue to rotate. In short the CNC machine single block mode will not affect the machine spindle rotation but it will only hold the tool feed after the CNC program block is executed. And if you press the cycle start button again the next program block of the CNC program will be executed and the machine will again be at hold after that block completion.

CNC Machine Auto Mode or Automatic Mode:

You will rarely see a *production shop CNC machine* out of *CNC machine auto mode*. The most used mode on a CNC machine (on some controls like Sinumerik 840D the *machine control panel* has a setting key which when switched off the machine will only be in auto mode and you can't change the modes). In CNC machine auto mode when you press the *cycle start button* on the *machine control panel* the whole CNC program will be executed. To run the CNC machine in auto mode there are some conditions on some CNC machine such as the CNC machine safety guard door must be closed.

ADVANTAGES OF CNC

1. It can produce jobs with highest accuracy and precision than any other manual machine.
2. It can be run for 24 hours of a day.
3. The parts produced by it have same accuracy. There is no variation in the parts manufactured by a CNC machine.
4. Highly skilled operator is not required to operate a CNC machine. A semi-skilled operator can also operate accurately and more precisely.
5. Operators can easily make changes and improvements and reduces the delay time. 6. It has the capability to produce complex design with high accuracy in minimum possible time.
7. The modern design software, allows the designer to simulate the manufacturer of his/her idea. And this removes the need of making a prototype or model and saves time and money.
8. Fewer workers are required to operate a CNC machine and saves labour cost.

APPLICATION OF CNC MACHINES:

Almost every manufacturing industry uses CNC machines. With increase in the competitive environment and demands, the demand of CNC usage has increased to a greater extent. The machine tools that comes with the CNC are late, mills, shaper, welding etc. The industries that are using CNC machines are automotive industry, metal removing industries, industries of fabricating metals, electrical discharge machining industries, wood industries etc.