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Introduction to CNC Machines

1) Introduction:

Computer Numeric Control (CNC) is the automation of machine tools that are operated by precisely programmed commands encoded on a storage medium (computer command module, usually located on the device) as opposed to controlled manually by hand wheels or levers, or mechanically automated by cams alone. Most NC today is computer (or computerized) numerical control (CNC), in which computers play an integral part of the control.

In modern CNC systems, end-to-end component design are highly automated using computer aided design (CAD) and computer-aided manufacturing (CAM) programs. The programs produce a computer file that is interpreted to extract the commands needed to operate a particular machine by use of a post processor, and then loaded into the CNC machines for production. Since any particular component might require the use of a number of different tools – drills, saws, etc. – modern machines often combine multiple tools into a single "cell". In other installations, a number of different machines are used with an external controller and human or robotic operators that move the component from machine to machine. In either case, the series of steps needed to produce any part is highly automated and produces a part that closely matches the original CAD design.

Computer Numerical Control (CNC) is one in which the functions and motions of a machine tool are controlled by means of a prepared program containing coded alphanumeric data. CNC can control the motions of the work piece or tool, the input parameters such as feed, depth of cut, speed, and the functions such as turning spindle on/off, turning coolant on/off.

2) ELEMENTS OF A CNC MACHINE:

A CNC system consists of three basic components:

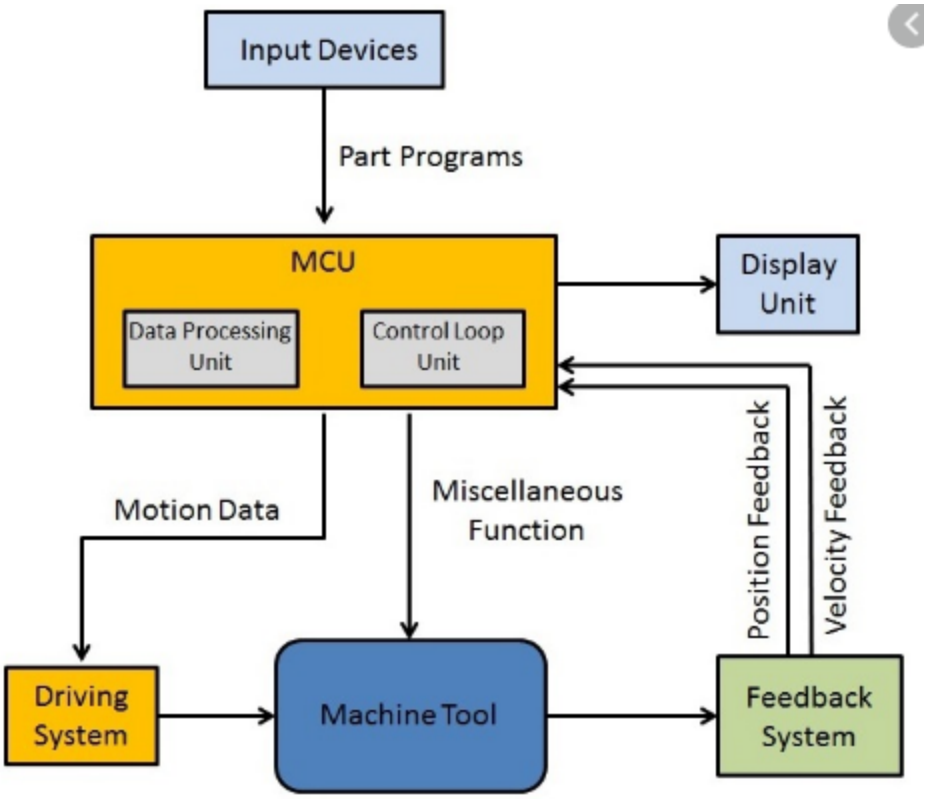
1 . Part program

2 . Machine Control Unit (MCU)

3 . Machine tool (lathe, drill press, milling machine

The part program is a detailed set of commands to be followed by the machine tool. Each command specifies a position in the Cartesian coordinate system (x,y,z) or motion (workpiece

travel or cutting tool travel), machining parameters and on/off function. Part programmers should be well versed with machine tools, machining processes, effects of process variables, and limitations of CNC controls. The part program is written manually or by using computerassisted language such as APT (Automated Programming Tool)



3) FEATURES OF CNC MACHINE:

The following are the main features of CNC machine over other type of machining process,

A. **Part program storage memory**: The CNC machines offer storage for programs and avail facility of portable storage connectivity as well. This gives very much flexibility in machining processes.

B. **Part program editing**: The part programs stored in the memory are editable hence modifications in the existing program is easy. This saves a lot of time when similar components are to be machined little or no modifications

C. **Part program simulation using tool path**: This feature enables the programmer to analyze tool movement and predict the tool path i.e. route travelled by the tool during machining. This also helps the programmer to understand tool movement fouls or constraints of the work envelop.

D. **Tool offset data and tool life management**: This feature enables to predict tool life under given operating conditions and number of components those can be machined successfully by the tool before getting worn out or needing resharpening.

E. **Canned cycles and subroutines**: For repetitive operations and machining cycles this feature is very useful. This saves programmer`s time and restricts length of program as well.

F. **Automatic tool changer:** The tools are contained in a storage unit that is integrated with the machine tool. When a cutter needs to be changed, the tool drum rotates to the proper position and an automatic tool changer (ATC) operating under program control, exchanges the tool in the spindle for the tool in the tool storage unit. Capacities of tool storage unit commonly range from 16 to 80 cutting tools.

G. **Automatic work part positioner:** Many horizontal and vertical machining centers have the capability to orient the work part relative to the spindle. This is accomplished by means of a rotary table on which work part is fixtured. The table can be oriented at any angle about a vertical axis to permit the cutting tool to access almost the entire surface of the part in a single setup.

H. **Automatic pallet changer:** Machining centers are often equipped with two (or more) separate pallets that can be presented to the cutting tool using an automatic pallet changer. While machining is performed with one pallet in position at the machine, the other pallet is in a safe location away from the spindle. In this location, the operator can unload the finished part and then fixture the raw work part for next cycle.

4) Advantage of CNC Machining-

Following are the main advantages of CNC machine over other all conventional machining operations,

A. High accuracy in manufacturing
B. Short production time
C. Greater manufacturing flexibility
D. Simpler fixturing
E. Contour machining (2 to 5 -axis machining)

F. Reduced human error.

5) Disadvantage of CNC Machining-

Following are the main Disadvantage of CNC machine over other all conventional machining operations,

A. Initial Cost of Machine is high
B. Running cost of Machine is high
C. Maintenance Cost of machine is high
D. Skilled part programmer

6) Applications of CNC machine-

Following are the main Applications of CNC machine,

A. Aerospace

The aerospace industry has a long shared history with CNC machining. Metal aircraft components can be machined to a high level of precision, which is essential for safety-critical applications, and the range of engineering metals compatible with CNC provides aerospace engineers with plenty of options.

B. Automotive

The automotive industry regularly uses CNC machining for both prototyping and production. Extruded metal can be machined into cylinder blocks, gear boxes, valves, axels, and various other components, while plastic can be machined into components like dashboard panels and gas gauges.

C. Consumer electronics

CNC machining is widely used for the prototyping and production of consumer electronics such as laptops and smartphones. The chassis of an Apple Macbook, for example, is CNC machined from extruded aluminum and then anodized.

D. Defense

The military sector frequently turns to CNC machining for the prototyping and production of rugged and reliable parts that will withstand wear and tear with minimal upkeep.

E. Medical

Since CNC machining can be used on various medically safe materials, and since the process is suited to one-off custom parts, it has many applications in the medical industry. The tight tolerances afforded by CNC machining are essential to the high performance of machined medical components.

F. Oil & gas

Another industry in which tight tolerances are required for safety-critical applications, the oil and gas sector uses CNC machining for precise, reliable parts such as pistons, cylinders, rods, pins, and valves.