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Experiment - 4

Aim :- To study CNC machine and M-code and G-code.

2) Objectives :-

- i) An objective of the CNC machine is to enhance lean manufacturing by significantly reducing the cycle time of processes and increasing flexibility, thereby improving the overall quality of work.
- ii) M-codes deals with the configuration of machine tools such as on/off commands and bringing back the machine to the origin or cutting point.
- iii) G-code deals with geometry of hardware.

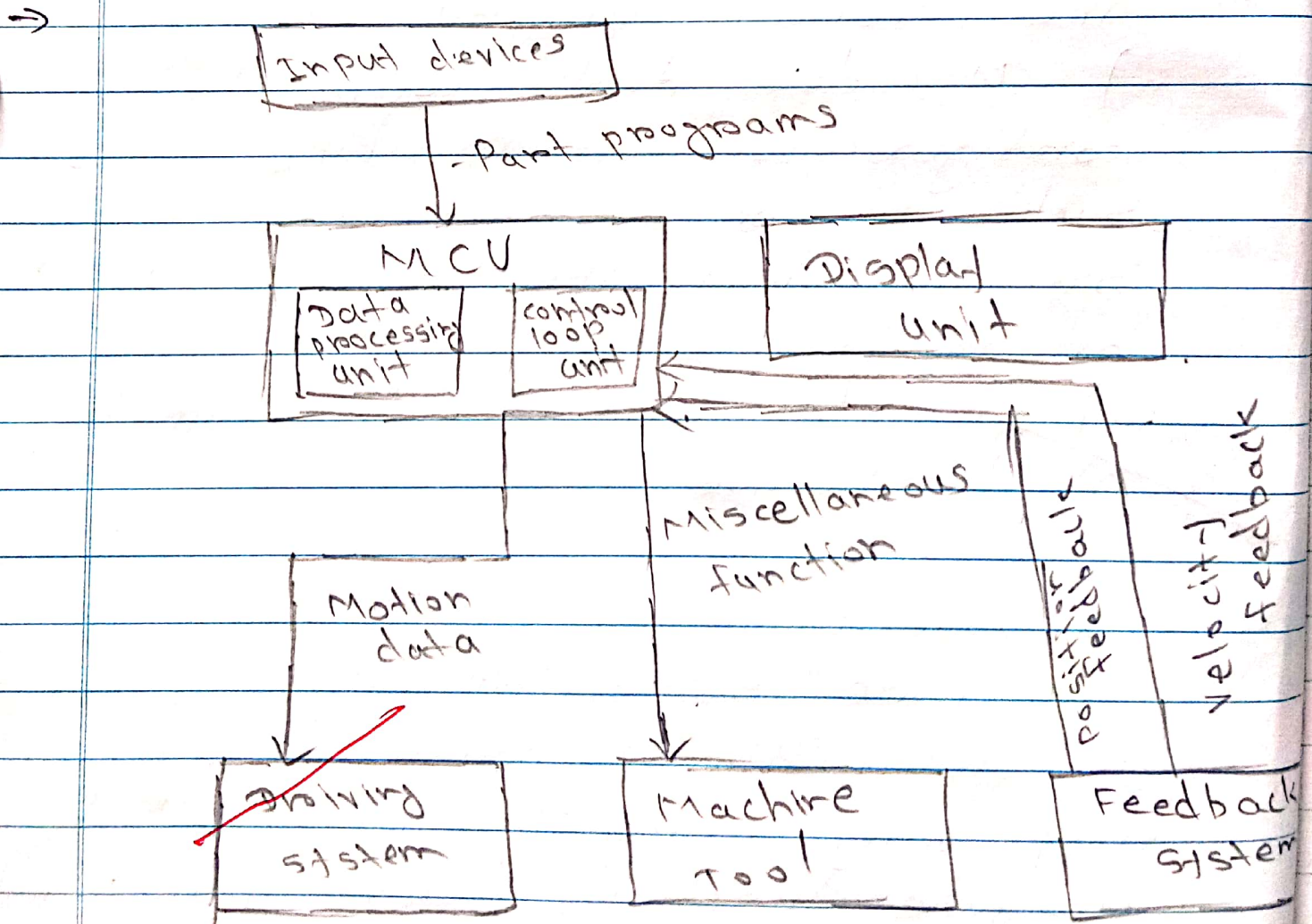
3) Introduction :-

- i) M-code is for miscellaneous function is an auxiliary command; descriptions may vary. Many M-codes call for machine functions like open workstat on doors M-stands for machine.
- ii) G-code deals with the geometry of hardware, for example, straight

cutting, developments, penetrating tasks and determining the unit of estimator.

iii) A CNC machine processes a piece of material to meet specification by following a coded programme instruction and without a manual operator.

1] Block diagram of CNC machine work and detail information of CNC



I] Detailed information :-

1) Input devices :- i) These are the devices which are used to input the part program in CNC machine.

ii) There are three commonly used input devices and these are punch tape reader magnetic tape readers and computers.

2) Machine control unit (MCU) :-

It is the heart of CNC machine.

It performs all the controlling action of CNC machine various functions performed by MCU are-

i) It reads the coded instructions fed into it.

ii) It decodes the coded instruction.

~~iii) It implements interpolation (linear, circular and helical) to generate axis motion commands.~~

iv) It feeds the axis motion commands to the amplifier circuits for driving the axis mechanisms.

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

vi) It implements the auxiliary control

Functions such as coolant on spindle on/off and tool change

3) Machine Tool :-

- i) A CNC machine tool always has a slide table and a spindle to control of the position and speed.
- ii) The machine table is controlled in X and Y-axis direction and the spindle is controlled in the Z-axis direction.

4) Driving system :- i) Driving system of a CNC machine consists of amplifier circuits, drive motors and ball lead screw.

- ii) The MCU feeds the signals each axis to the amplifier circuits. The control signals then are augmented (increased) to actuate the drive motors. The actuated drive motors rotate the ball lead screw to position the machine.

5) Feedback system :- i) This sys



consists of transducers that act like sensors. It is also called as measuring system.

ii) It contains position and speed transducers that continuously monitor the position and speed of cutting tool located at any instant.

iii) 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.

e) Display unit :- A monitor is used to display the programs, commands and other useful data of CNC machine.

• Working :-

1) First, the part program is inserted into the MCU on the CNC

2) In MCU all the data process takes place and according to the program prepared it prepares all the motion commands and

sends it to the driving system
3) The drive system works as the motion commands are sent by MCU. The drive system controls the motion and velocity of the machine tool.

4) The feedback system records the position and velocity measurement of the machine tool and sends a feedback signal to the MCU.

5) In MCU, the feedback signals are compared with the reference signals and if there are errors, it corrects it and sends new signals to the machine tool for right operation to happen.

6) A display unit is used to see all the commands, programs and other important data. It acts as the eye of machine.

Applications :-

i) Almost every manufacturing industry uses CNC machines. With an increase in competitive environment and demands, the demand for CNC usage has increased, to a



greater extent.

2) The machine tools that come with the CNC are lathe, mills, shapers, welding, etc.

3) The industries that are using CNC machines are automotive industry, metal removing industries, industries of fabricating metals, electrical discharge machining industries, wood industries, etc.

• Advantages :-

1) It can produce jobs with highest accuracy and precision than other machine.

2) It can be run for 24 hours a day.

3) The parts produced by it have the same accuracy. There is no variation in the part manufactured by CNC machine.

4) A highly skilled operator is not required to operate a CNC machine. A semi-skilled operator can also operate accurately and precisely.

5) Operators can easily make changes

and improvements and reduces the delay time.

• Disadvantages :-

- 1) The cost of CNC machine is very high as compared with a manually operated machine.
- 2) The parts of CNC machines are expensive.
- 3) The maintenance cost in the case of CNC is quite high.
- 4) It does not eliminate the need for costly tools.

2] What is M-code and G-code.

→ i) M-code:- i) M code is an auxiliary command; descriptions vary. Many M-codes call for machine functions like the 'open workstation door' which is why some say 'M' stands for machine.

ii) M-codes deals with the configuration of machine tools such as on/off commands and bringing back the machine to the origin and cutting point

iii) M-codes are :-

M01 = Program stop.

M02 = End of program.

M03 = Spindle on clockwise.

M04 = Device on counter clockwise.

M05 = Device stop.

M06 = Tool change.

M08 = Coolant / Air / Vacuum on.

M09 = Coolant / Air / Vacuum off.

M10 = Reserved for tool height offset.

M13 = Spindle on, coolant on.

M30 = End of program with rewind.

M91 = Readout Display Absolute.

M97 = Go to or jump to line number

M98 = Jump to macro or subroutine.

M99 = Return from macro or subroutine.

M100 = Machine zero Reset.

M199 = Mid program start.



2) G-code :-

→ i) G-code deals with the geometry of hardware, for example, straight cutting developments, penetrating, tasks and determining the units of estimation.

ii) G-code is a type of function used in Numerical control programming language that contains the information to position a tool to do the actual work.

iii) G-code is separate from M-code and T-code, codes that control the machine and tooling.

iv) G-code is the name of the most prevalent programming language for computer numerical control (CNC) in computer-aided design and manufacturing (CAD / CAM).

v) G-codes provides metric-based numeric control of CAM-controlled equipment such as CNC milling machines. Some G-codes are-

a) G00 - Rapid move

G01 - Feed rate move.

G02 - 3D clockwise or helical move.



G03 - 3D counter clockwise on helical.

G04 - Dwell time.

G09 - Exact stop check.

G10 - Decelerated stop.

G11 - Controlled Decel stop.

G17 - XY plane.

G20 - Inch mode.

G21 - Millimeters mode.

G90 - Absolute mode.

★ Conclusion :-

In this experiment, we learnt CNC machine, its applications, advantages, disadvantages, and M-code and G-code in the CNC machine.

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