Mechatronics:

Mechatronics can be defined as the integration of electronic engineering, the computer technology and control engineering with mechanical engineering in designing and manufacturing of engineering products.

Systems of mechatronics:

The system is considered as a device which has an input and a output as shown. For example an electric motor can be considered as an electric system which receives the electrical energy and transforms into a mechanical energy of rotation as output. Similarly a water pump which pumps the water from a source can be considered as a mechanical system. A valve which regulates the flow of a fluid may be considered as a control system. A number of such systems which helps in functioning of devices are called system of mechatronics. The two important systems employed in mechatronics are-

- Measurement system and
- Control system.

Measurement system:

It may be defined as a system used for making measurements. A measuring system receives the input and gives out the output in the form of measured quantity as shown. In practice we use number of measurement systems, such as mercury thermometer, digital thermometer, pressure gauge, speedometer, voltmeter, dynamometer, etc.

Elements of measuring system:

A measuring system mainly consists of the following three basic elements.

1. Sensor
2. Signal conditioner
3. Display.

In a measuring system, these elements are arranged in sequence as shown.

Sensor:

It is a device which detects and responds to the variation in the physical quantity and gives out the output as a signal proportionally related to the quantity to be measured. For e.g. a thermocouple is used as a temperature sensor.

Signal conditioner:

It is placed next to the sensor as shown. It receives the signal from the sensor, modifies it to the condition suitable either for the direct display, or sends modified signal to a control system for actual control. In case of thermocouple it generates very small emf which is difficult to show precisely the variations. Hence these signals are fed to an amplifier to obtain the amplified signal. Hence it serves as a signal conditioner.

Display system:

It is placed next to the signal conditioner as shown. It receives the modified signal from signal conditioner and displays as a measured quantity. For e.g. in thermocouple, the display system indicates the temperature in C.

Control systems:

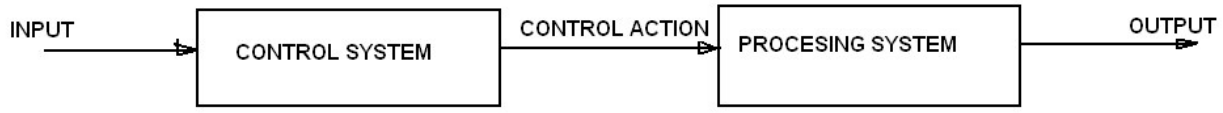
A control system regulates or controls the output from a device so as to maintain it constant at a predetermined level. For e.g. a water level controller installed with a pumping system, switches the pump on and off as and when the water level in the discharge tank either falls or rises. The control systems are broadly classified as-

- Open loop control system
- Closed loop control system.

Open loop control system:

In open loop control system only the input is controlled without any reference to the output. Thus the output is independent of the control action at the input.

For e.g. in the working of water pump the switching on and off the pump motor is quite independent of whether the discharge tank is completely filled or not. The schematic diagram of an open loop system is as shown.



OPEN LOOP CONTROL SYSTEM

Advantages:

- Since it comprises of only control system and process system, it is relatively simpler.
- Because of the absence of the sophisticated measuring and comparison system the cost is less.
- Reliability is very high.
- Requires less maintenance because of absence of less number of systems in the loop.

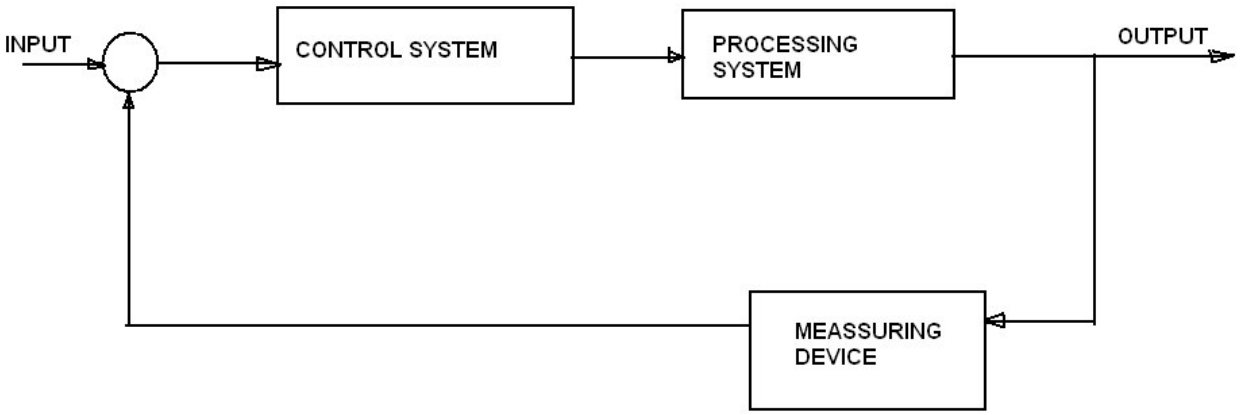
Disadvantages:

- No control over the output.
- Inaccurate system.

Closed loop control system:

In a Closed loop control system, the control action at the input is governed by the output conditions. Thus the input action in a closed loop system obiviously depends on the output. To effect the changes at the input depending on the output conditions, two more systems, viz, a measuring system and a comparing system are included in the loop as shown. The measuring system senses the variations in the output and sends the feed back signals to the comparison system which suitably controls the input.

Incase of pumping water to make it closed loop system, an electric water level control system is connected at the input side to serve as comparison system, and the water level sensors immersed in the discharge tank serve as measuring system. There will be two water level sensors, one for the minimum level and the other for the maximum level. Whenever the water levels reaches maximum or the minimum point the corresponding sensor sends the feedback signal to the electronic water level controller.



CLOSED LOO P CONTROL SYSTEM

Advantages:

- The input conditions can be changed to match the output conditions hence more accurate.
- Response time between the output and the input is very less, hence works economically.
- Needs no manual operation.
- Highly accurate.

Disadvantages:

- Design is highly complex.
- Breakdown frequency is high.
- More expensive because of additional sophisticated elements.

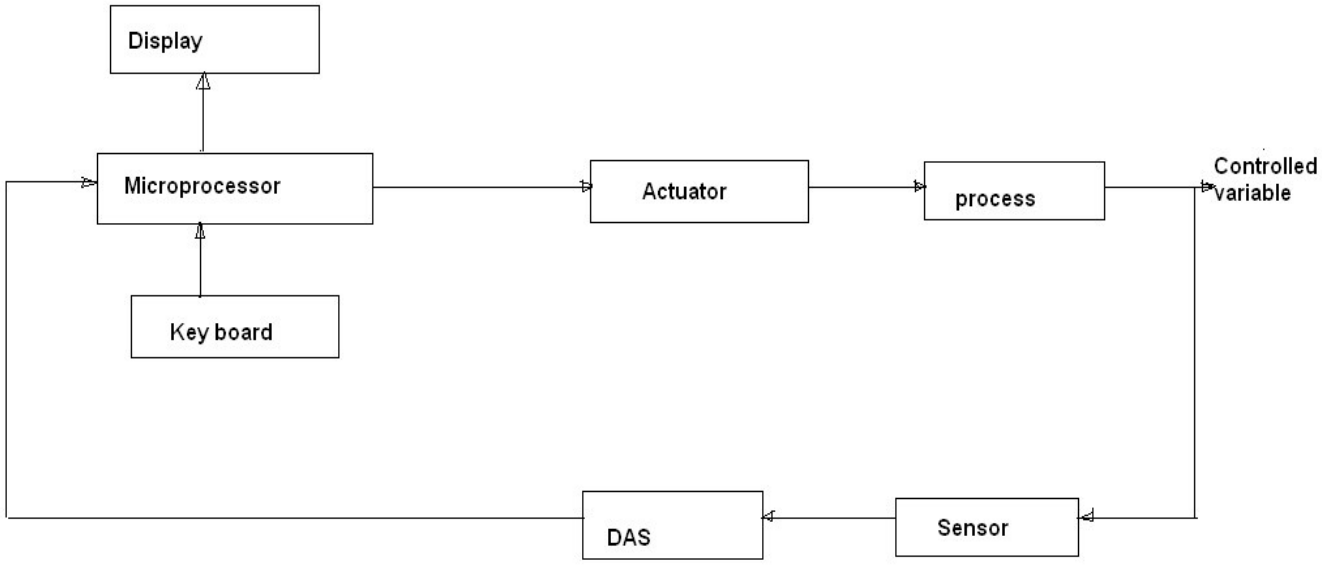
Microprocessor:

It is a programmable logic device that is usually implemented on the IC package. It receives the information in digital form, process the information according to the stored program and output the information in the form of digital signal. When it is combined with the memory, input and the output devices, a micro computer is formed.

The memory stores binary information as instructions and data, and provides that information to the microprocessor whenever necessary. It usually consists of a mixture of random access memory (RAM) and read only memory (ROM). RAM is a storage device for words whose contents can be read and also altered at specific address. It is used for storing temporary data. ROM is a storage device whose contents cannot be altered. It is used to store the information required for the microprocessor to work properly.

Microprocessor based controller:

Fig shows a block diagram of a microprocessor based control system. The data acquisition system (DAS) converts the analog signals from the sensor to digital values that can be read in and processed by the microprocessor. A key board and display in the system allow the user to enter the desired value and to read the values of process variables. Actuators such as relays, D/A converter, solenoid values are used to control process variables under program direction.



Applications of Microprocessor based controllers:

Microprocessor based controllers are found in domestic washing machines, dish washers, microwave ovens, cameras, watches, video recorders, etc. Computer numerical control machines, robots, I.C engines, wind mills, etc. are also being controlled by the microprocessor.