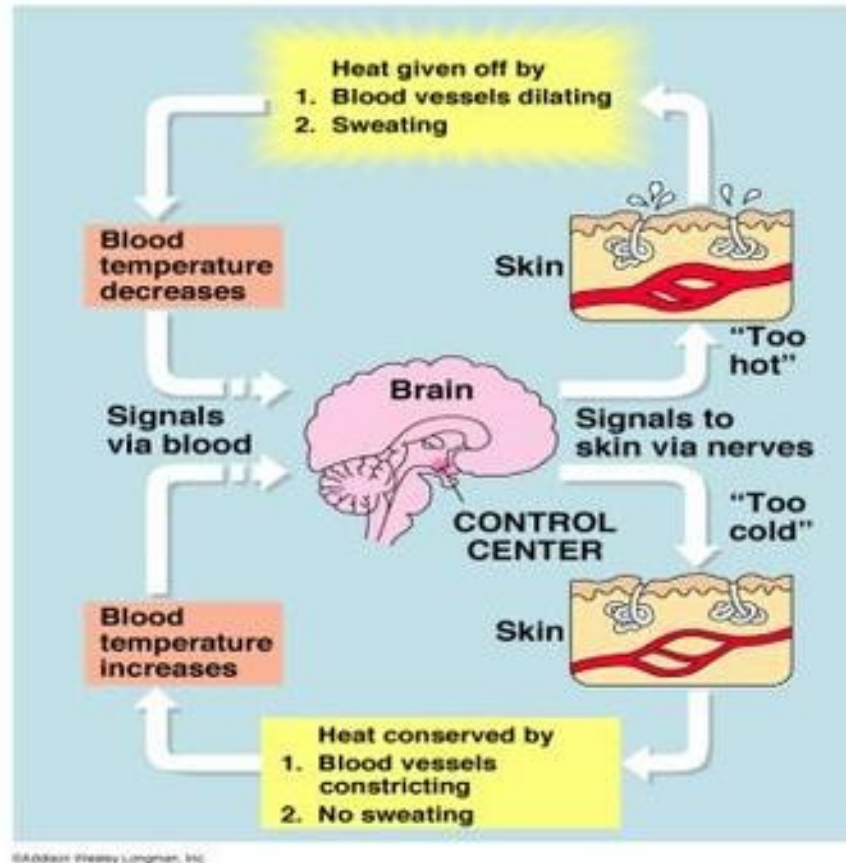


INTRODUCTION TO CONTROL SYSTEMS

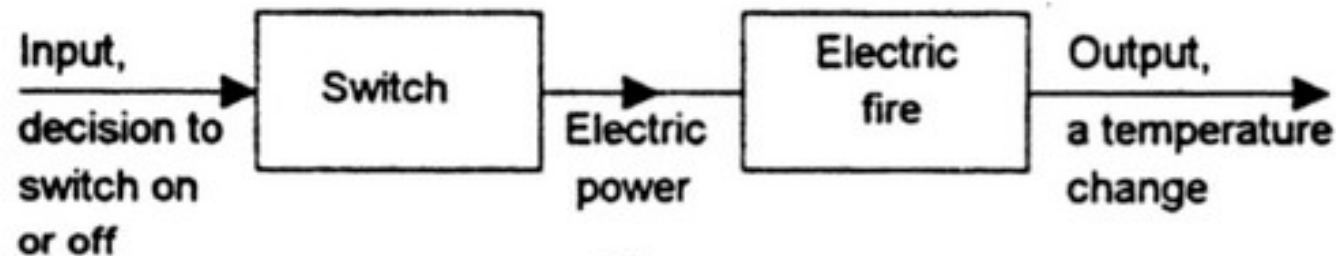
- *The control system is that means by which any quantity of interest in a machine, mechanism or other equipment is maintained or altered in accordance with a desired manner.*



Your body temperature remains almost constant regardless of whether you are in a cold or hot environment. To maintain this constancy your body has a temperature control system. If your temperature begins to increase above the normal you sweat, if it decreases you shiver. Both these are mechanisms which are used to restore the body temperature back to its normal value. The control system is maintaining constancy of body temperature.

OPEN AND CLOSED LOOP CONTROL SYSTEMS

- There are two basic forms of control system, one being called *open loop and the other closed loop*.
- Consider an electric fire which has a selection switch which allows a 1 kW or a 2kW element to heat a room, he or she might just switch on the 1 kW element if the room is not required to be at too high a temperature.
- The room will heat up and reach a temperature which is only determined by the fact the 1 kW element was switched on and not the 2 kW element. If there are changes in conditions, perhaps someone opening a window, there is no way the heat output is adjusted to compensate. This is an example of open loop control in that there is no information fed back to the element to adjust it and maintain constant temperature.



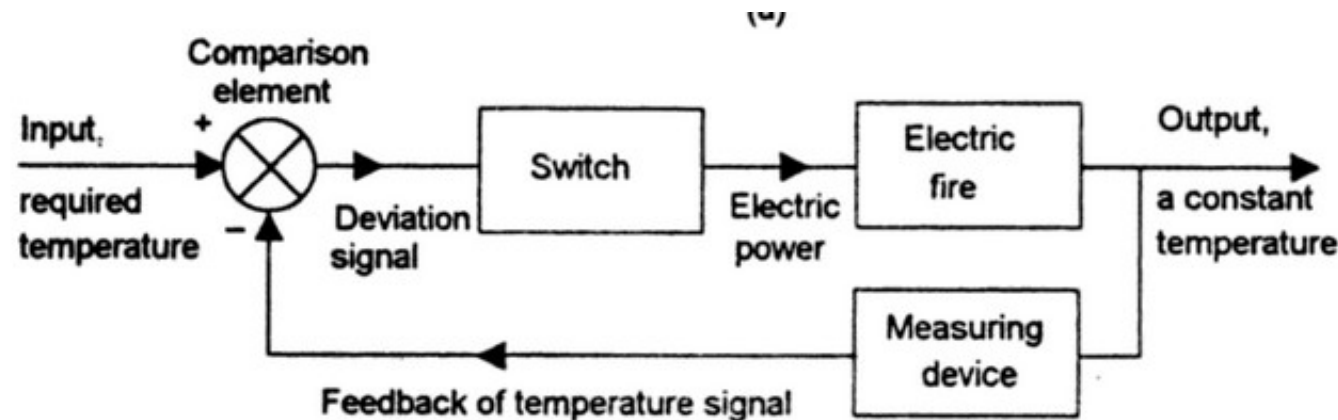
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INTRODUCTION TO MECHATRONICS AND ROBOTICS

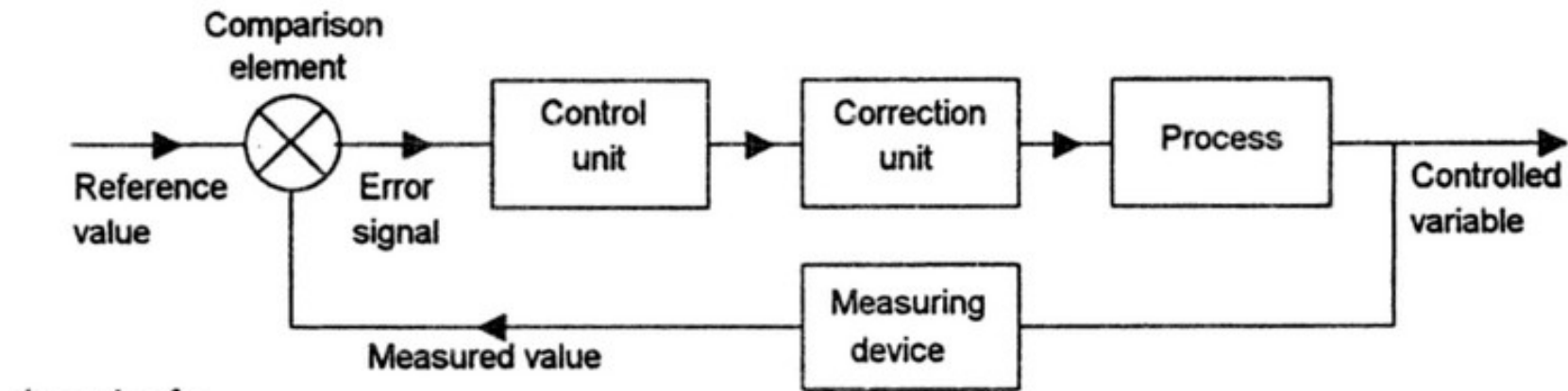


OPEN AND CLOSED LOOP CONTROL SYSTEMS

- The heating system with the heating element could be made a closed loop system if the person has a thermometer and switches the 1 kW and 2kW elements on or off, according to the difference between the actual temperature and the required temperature, to maintain the temperature of the room constant.
- In this situation, there is feedback, the input to the system being adjusted according to whether its output is the required temperature. This means that the input to the switch depends on the deviation of the actual temperature from the required temperature., the difference between them determined by a comparison element – the person in this case.



BASIC ELEMENTS OF A CONTROL SYSTEM



- **Comparison element** – This compares the required or reference value of the variable condition being controlled with the measured value of what is being achieved and produces an error signal.

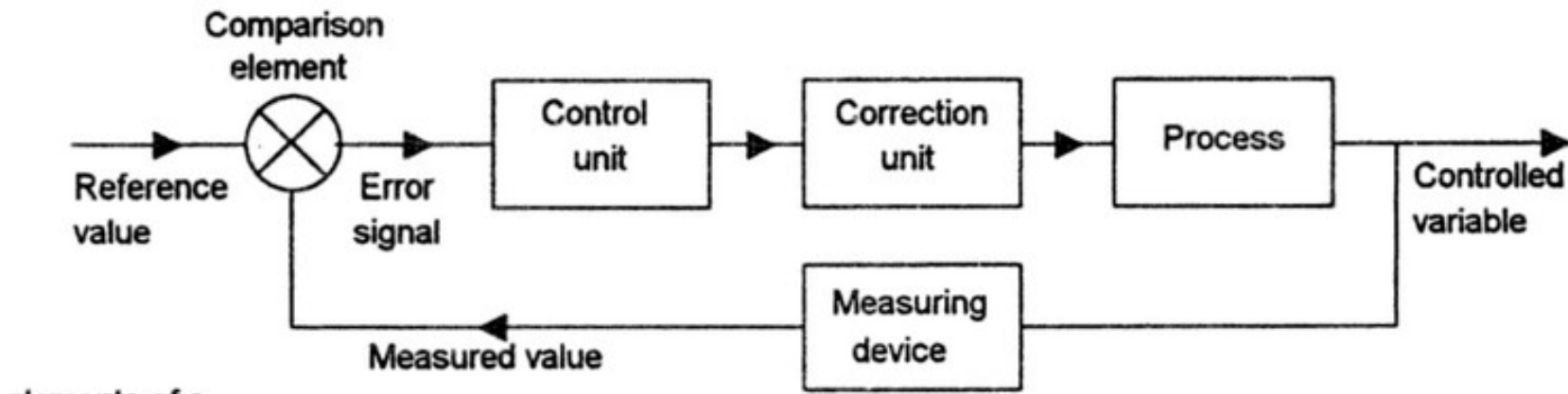
$$\text{Error signal} = \text{reference value signal} - \text{measured value signal}$$

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BASIC ELEMENTS OF A CONTROL SYSTEM



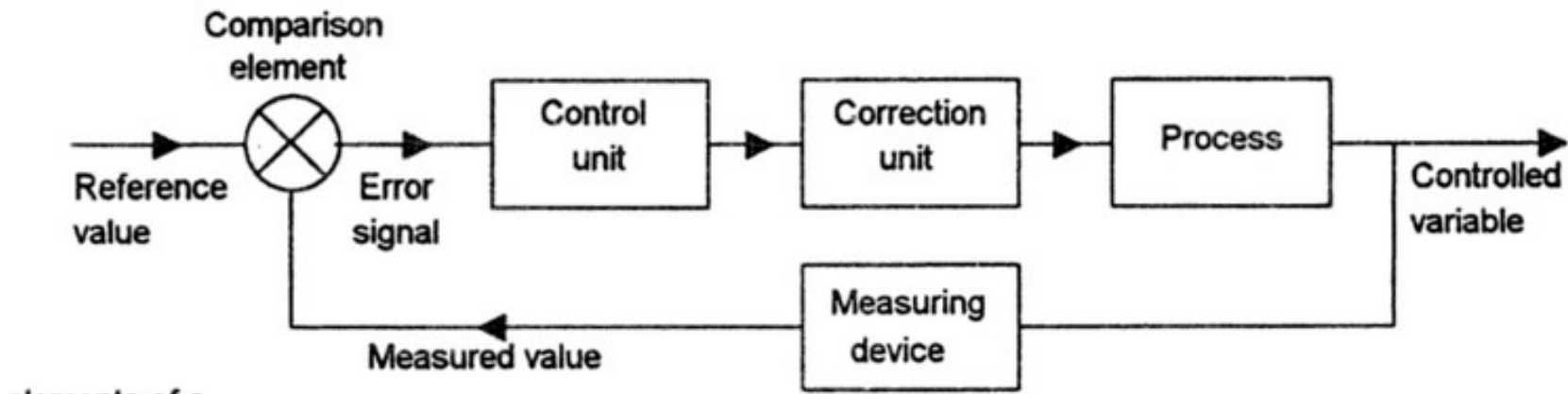
- **Feedback loop** – A feed back loop is a means whereby a signal related to the actual condition being achieved is fed back to modify the input signal to a process.
- **Control unit** – This decides what action to take when it receives an error signal.
- **Correction unit** – The correction unit produces a change in the process to correct or change the controlled condition.

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BASIC ELEMENTS OF A CONTROL SYSTEM

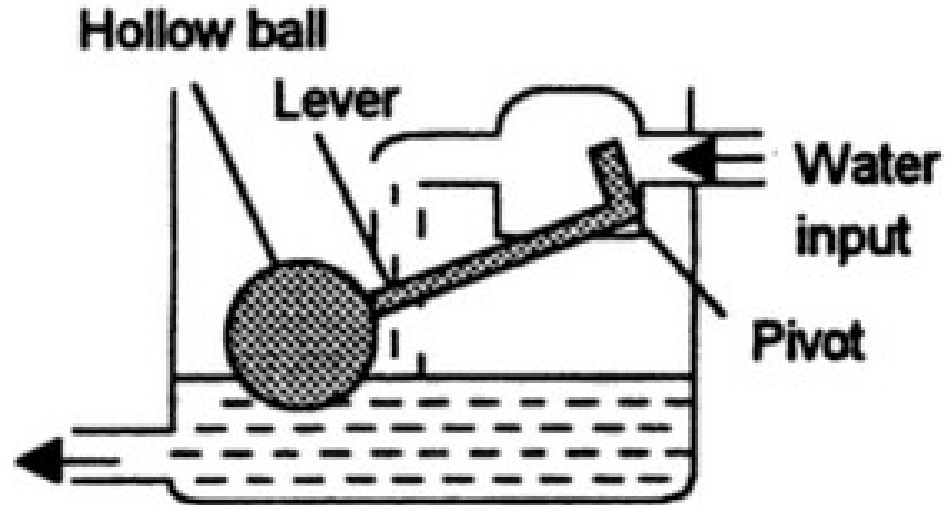


- **Process unit** – The process which is being controlled.
- **Measurement unit** – The measurement element produces a signal related to the variable condition of the process that is being controlled.

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BASIC ELEMENTS OF A CONTROL SYSTEM

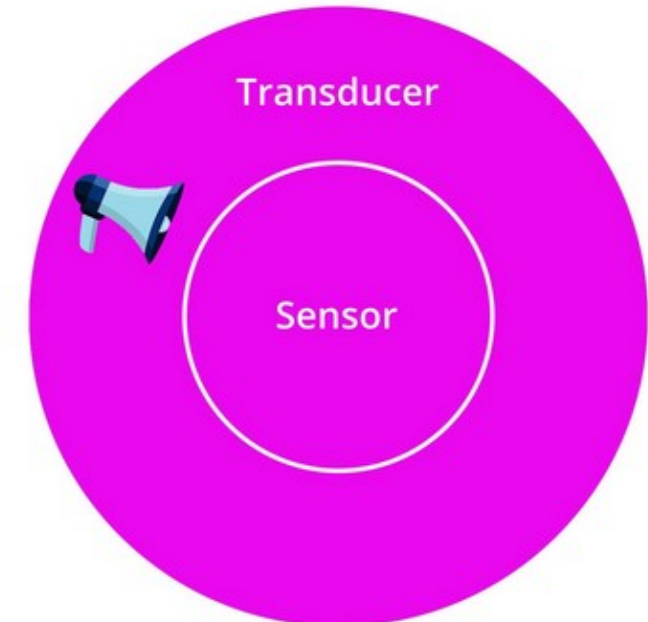
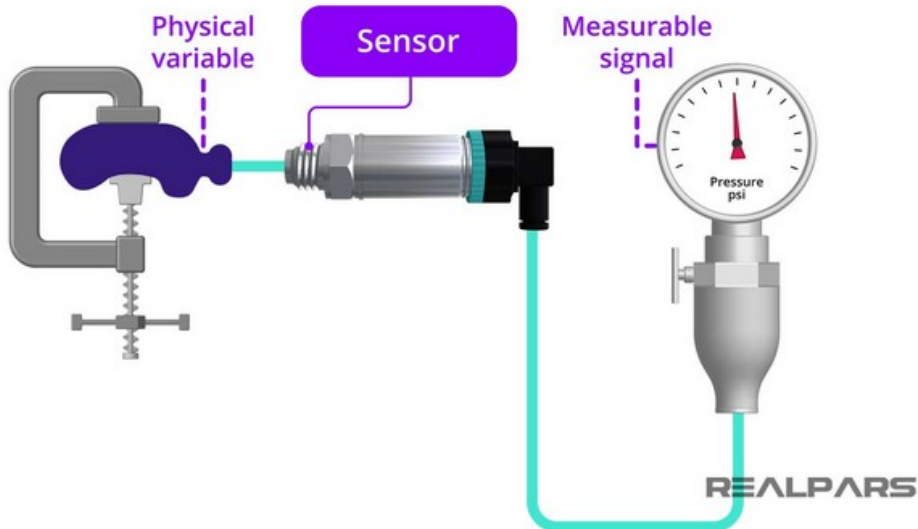


AUTOMATIC WATER LEVEL CONTROL

Identify controlled variable, reference value, comparison element, error signal, control unit, Correction unit, process and measuring unit???

SENSORS AND TRANSDUCERS

- The term **sensor** is used for an element which produces a signal relating to the quantity being measured.
- The term **transducer** is defined as an element that when subject to some physical change experience a related change.

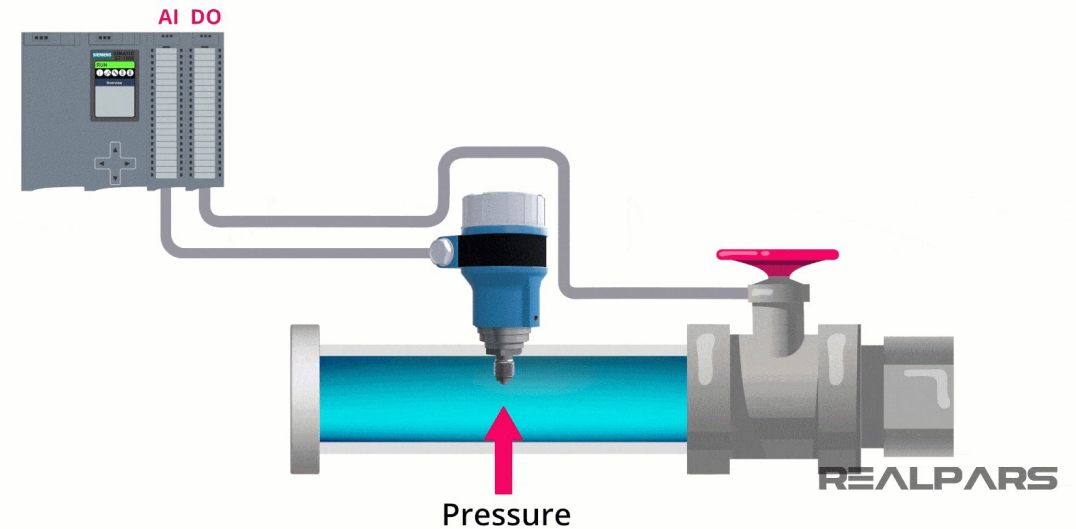
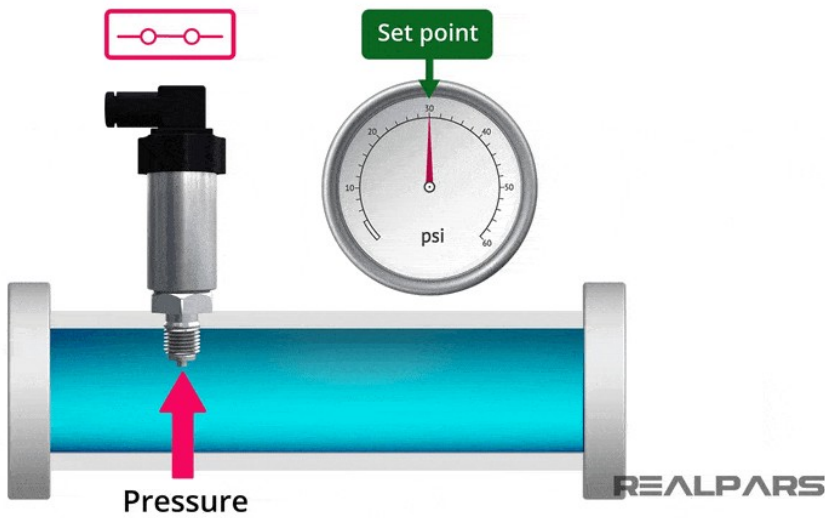


All sensors are transducers, but not all transducers are sensors.

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INTRODUCTION TO MECHATRONICS AND ROBOTICS

SENSORS AND TRANSDUCERS



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INTRODUCTION TO MECHATRONICS AND ROBOTICS



MICROPROCESSOR BASED CONTROLLERS

- Microprocessors are used in general to carry out control functions.
- In many simple systems there might be just an embedded microcontroller, this being a microprocessor with memory all integrated on one chip, which has been specifically programmed for the task concerned.
- A more adaptable form is the programmable logic controller. This is a microprocessor based controller which uses programmable memory to store instructions and to implement functions such as logic, sequence, timing counting, and arithmetic to control events and can be readily programmed for different tasks.



MECHANICAL ENGINEERING SCIENCE

INTRODUCTION TO MECHATRONICS AND ROBOTICS

ACTUATION SYSTEMS

- *Actuation systems are elements of control systems which are responsible for transforming the output of a microprocessor or control system into a controlling action on a machine or device.*
- Examples – an electrical output from the controller may have to be transformed into a linear motion to move a load, an electrical output from the controller may have to be transformed into an action which controls the amount of liquid passing along a pipe etc.

