

A brief and basic introduction to sensors

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What is a sensor?

A sensor is an electrical or mechanical device used in the detection of physical quantities. There are many different sensors, but they are all based around the same principle.

The main principle of a sensor is to detect and interpret different things. Firstly, lets look around us and take note of all the different things that a sensor could detect. The most common in the home is temperature, this temperature detection is used to monitor temperature rise and fall in any given environment. If the temperature falls below the set point temperature on the household thermostatic regulator, the sensing device will actively turn 'on' and 'off' what ever it is we need to control. (not taking into account linear control)

As far as sensing devices go there are two types to consider, *Mechanical* and *Electrical*. Because we are using sensors to control robots, then we will concentrate on the latter. As Mechanical sensors are more common in the industrial environment (disregarding normal micro-switches), not for controlling small mobile robots. If this were so, then the mechanical sensor would probably out weigh the physical size and weight of a smaller robot, making it very impractical as a active component of a robot.

Electronic sensing devices could be broken down into four 'Basic' categories.

Resistive

Capacitive

Inductive

Production of an electro-motive force (e.m.f)

The above categories split the different sensing devices by their physical make up. No matter what sensor we are dealing with, each and every one must interpret what it is we are sensing by some electronics, or some electronic principle.

In this article we will not go into each and every type of sensor, but to get a general impression of what sensors are, and why we use them. This may point us in the right direction, in the hope of choosing the correct type of sensor for any given situation.

So, if we were to summarise on what a 'Sensor' could be described as, it could be any of the following.

- i)** A device which switches both 'On' and 'Off', to be used as a control device.

- ii)** A device which detects various conditions, in the outside world.

- iii)** As a Robot sensor, it is used to create a picture of the real world, and used as a tool to perform the tasks in which it is programmed to carry out.

Now we have a general idea of what a sensor is, we can study how they can be used to assist the control of a robot.

We all know it is possible to have fun experimenting with basic (manually controlled) robots, but they have limited practical applications and educational value. With computers controlling the robots, it can be possible to pre-program the robot to perform a multitude of tasks. These tasks are programmed into the computers memory, and accessed only when certain input conditions from the outside world apply. The tasks can be carried out in two ways. One is in 'Real-Time', this is where the human (i.e. you), controls the robot through its given tasks. These tasks could be 'Walking' or 'Moving' instructions. When performed the computer can record what is being executed or another method called 'Step-Time' could be implemented. This is a more conventional means of control, and perhaps the more common in this day in age in the use of controlling robots.

When we say 'Step-Time', we mean a set of instructions programmed into the computer, to be executed if certain conditions apply. An example of this could be, an IF, THEN, ELSE statements, in a command line in 'Basic'. This suggests that if something happens then 'do this', if not then 'do this', if neither of these conditions happen then else 'do this'. What we are achieving here is a computer-controlled robot, operating off a given set of instructions. These instructions are documented into the 'Code' or 'Software program'. The robot is now fully independent, and can perform its tasks all on its own. Where is all this leading and how does it relate to sensors?

In the first example, the robot was being controlled in 'real-time'; the robot was being given a set of instructions from a human. The human was the sensors for the robots. The human can 'see' for the robot, each of the human's senses help navigate the robot. In the second example, the robot was computer controlled. There was no human giving the instructions; it carried out its tasks by programming them into the software, inside the robot's 'brain'. This will probably be a 'micro-controller' or some other form of integrated circuit. So how does the program know which set of instructions in the program to execute? This is all achieved by the use of sensors. Let's take the second example again.

IF, THEN, ELSE. What we didn't detail here was what told the program to perform the IF statement, or the THEN statement, or finally the ELSE statement. Sensors are used to 'sense' the world around the robot, just like the human did in the 'real-time' example. The program executes certain parts of the program if certain input conditions apply. These could be simple things such as a micro-switch fixed to the front bumper skirt. If this is hit then the robot has collided with an object. The program can now execute the part of the program, which tells the robot to back up and correct its path, thus avoiding the object. More sophisticated routines could be programmed, but basically without sensors the robot is 'Blind'.

Sensors are the main component of a robot, without these the robot can not achieve a perception of the outside world, the environment around it and the obstacles in its way. Once we know why sensors are used in the control of robots, we can start to look at all the different types. How sensors can be used to monitor this outside world environment and how to navigate the robot to the best of our ability.