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Types of Control Systems

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ABSTRACT: The goal of control systems is to adjust the actions of an existing system in order to behave in the desired way. In real life, several instances can be found in which some control actions are necessary to achieve the desired results. The temperature of a room, for example, will change because of external and unwanted disturbances, e.g. someone opens/closes a window, sunlight heats the walls, etc. Despite any external change in the system, an air-conditioned system may be mounted to help maintain a given temperature. The air-conditioning system includes current temperature control elements (also referred to as actuators because they work on the system), current temperature measurement sensors, and some control logic to determine the actuation to be carried out in order to achieve the target temperature. In this chapter we will introduce the basis of the control systems, their influence on real life systems, and their design to modify the behavior of a given plant to fulfill particular specifications.

KEYWORDS: Control systems, Open loop control systems, closed loop control systems, sensitivity, band width.

I. INTRODUCTION

A control system is a system that, by controlling the output, delivers the desired response. The following figure illustrates the basic block diagram of a control system.

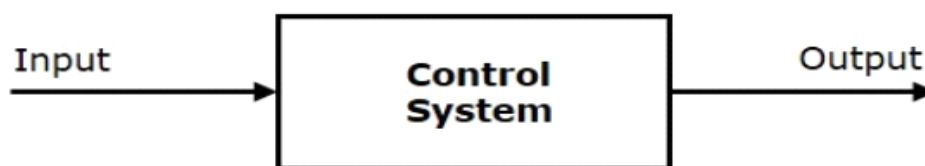


Figure 1: Control Systems

Here, a single block reflects the control structure. Since the output is regulated by varying inputs, this name was given to the control system. With some mechanism, we will vary this input. In the next section on open loop and closed loop control systems, we will research in depth about the blocks within the control system and how to vary this feedback in order to get the desired response.

Examples of control systems for traffic lights, washing machines an example of control systems is the control systems of traffic lights. A series of input signals is added to this control device here, and one of the three lights that will be on for any amount of time is the output. The other two lights are going to be off during this time. The on and off times of the lights can be calculated based on the traffic survey at a specific junction. The input signal, therefore, regulates the output. So, the control system for traffic lights works on a time basis [1].

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Classification of Control Systems:

Based on some parameters, we can classify the control systems into the following ways.

Continuous time and Discrete-time Control Systems

- Control Systems can be classified as continuous time control systems and discrete time control systems based on the type of the signal used.
- In continuous time control systems, all the signals are continuous in time. But, in discrete time control systems, there exists one or more discrete time signals [2].

SISO and MIMO Control Systems

- Control Systems can be classified as SISO control systems and MIMO control systems based on the number of inputs and outputs present.
- SISO (Single Input and Single Output) control systems have one input and one output. Whereas, MIMO (Multiple Inputs and Multiple Outputs) control systems have more than one input and more than one output [3].

Open Loop and Closed Loop Control Systems

Control Systems can be classified as open loop control systems and closed loop control systems based on the feedback path. In open loop control systems, output is not fed-back to the input. So, the control action is independent of the desired output. The following figure shows the block diagram of the open loop control system [4].

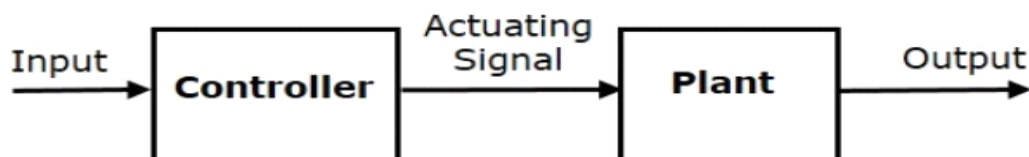


Figure 2: Control Systems

An input is applied to a controller here, and an actuating signal or controlling signal is generated. This signal is given to a plant or process that is to be regulated as an input. So, the plant generates an output that is regulated. The control system for traffic lights that we discussed earlier is an example of an open loop control system as shown in figure 2.

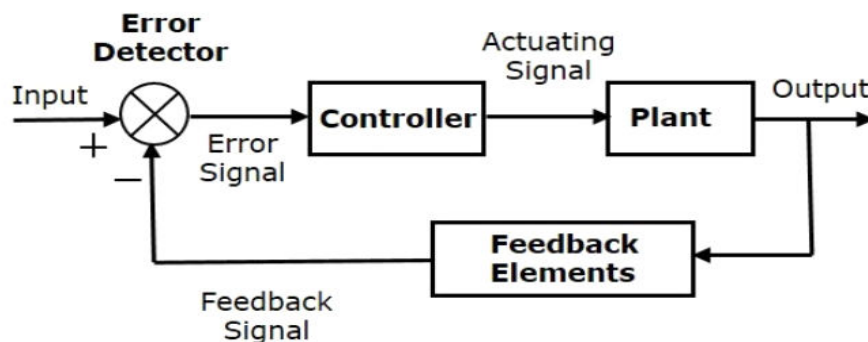


Figure 3: Closed loop control Systems

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An error signal is generated by the error detector, which is the distinction between the input and the feedback signal. By considering the output of the overall system as an input to this block, this feedback signal is obtained from the block (feedback elements). The error signal is implemented as an input to a controller instead of a direct input [5]. The controller creates, thus, an actuating signal that controls the plant. In this combination, the control system's output is automatically modified until we get the desired response. Therefore, the control systems of the closed loop are also called automatic control systems. The sensor control system for traffic lights at the input is an example of a closed loop control system [6].

II. LITERATURE REVIEW

There has been many paper published in the field of control systems among many paper a paper titled “introduction to control systems” by J. Fernandez de Canete and Cipriano Galindo discussed about the various types of control systems such as discrete time control systems, constant time control systems, these types of control systems depends upon the change in parameters of the control system, also give introduction of a software used in controlling the equipments via control systems called MATLAB software, different plots of systems on the basis of systems gain, sensitivity, band width, impedance and transfer function. Different types of controller and their usage in industry. Different types of controllers such as proportional control, integral control, and differential control and PID controller. Also shown different controllers and their output plots on MATLAB softwares. Also explains the Design of Controllers: Ziegler-Nichols Techniques in open loop as well as in closed loop control systems, also give solutions to the problems arising in different controllers [7].

A research paper titled “Mathematical model of differentially steered mobile robot F. Dušek* D. Honc* P. Rozsival discussed the linear and nonlinear systems design of control systems, different case studies various types of control systems such as discrete time control systems, constant time control systems, these types of control systems depends upon the change in parameters of the control system, also give introduction of a software used in controlling the equipments via control systems called MATLAB software, different plots of systems on the basis of systems gain, sensitivity, band width, impedance and transfer function. Different types of controller and their usage in industry. Different types of controllers such as proportional control, integral control and differential control and PID controller. Also shown different controllers and their output plots on MATLAB softwares. Also explains the Design of Controllers: Ziegler-Nichols Techniques in open loop as well as in closed loop control systems, also give solutions to the problems arising in different controllers. Also shown the different mathematical models of control systems [8-10].

III. CONCLUSION

Control systems is the systems whose output can be controlled by changing the input, systems is the combination of different equipment to perform a particular function, in this paper different types of control systems and their usage in industry has been discussed, also controllers are of various types such as proportional controller, integral control, derivative control, proportional derivative integral controller has been discussed in this paper, open loop control systems which is affected by input only also it is stable, while closed loop control systems is sensors based systems which works according to the desired output, also it is comparatively unstable. Time of process is more in closed loop system rather than open loop system also maintenance and design cost is high in closed loop system.

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