

Importance and Scope of Control Systems

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Abstract: This paper is to answer the most basic questions asked about the Control Systems (CS) that is "What is a control system, what is its importance in our daily life, and scope of control systems". The CS can in a way reduce the human interference in the daily work of household and industry and many other domains of human life and thus reducing the human error. Here the authors have tried to give an insight of the topics broadly under the CS. Authors have tried to explain the control theories and use of Control Systems in main six categories that are household, agriculture, transportation, medical and defense which are major domains of the human life.

Keywords: Control Systems, Definition

I. INTRODUCTION

We humans have always wanted things to be done for us, but now instead of making other humans do it for us we make machines and systems who do work for us and have the least amount of error as possible and for this purpose we the most important technology is that which comes from the term control systems, Control system can be defined as the means which is used to maintain or alter any quantity of interest in any domain in a desired manner. The different names given to the systems to be controlled are plant or a process or a controlled system. Earlier there was process control which was added on to by servomechanism and then came the theory of cybernetics, this all is collectively called as unified control theory. Control systems are broadly classified as open loop systems and closed loop systems [1-8].

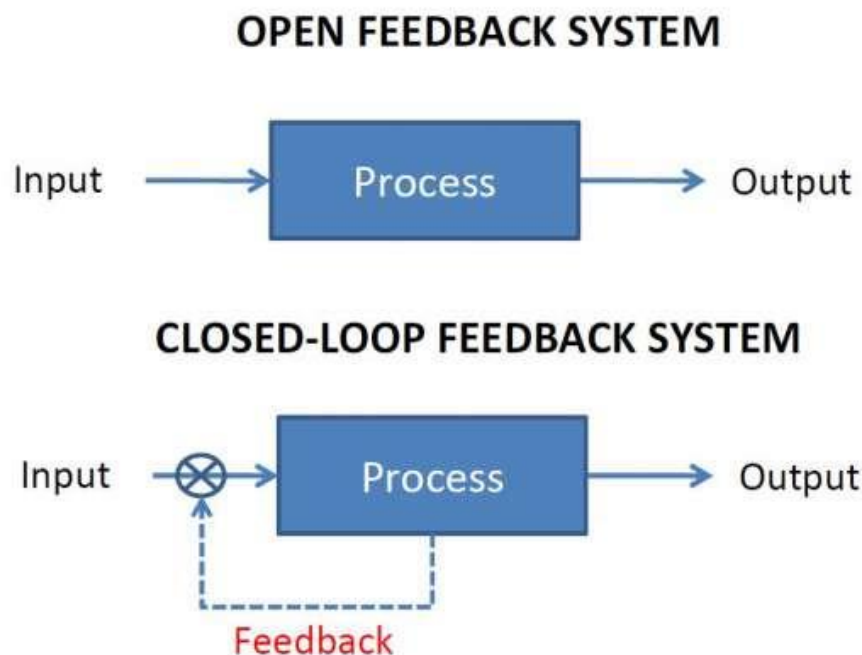


Figure: 1. Open loop and Closed loop systems

There are three principles of design aspect in the control systems which are 1.) Experimental approach 2.) Analytical method (modelling based method) 3.) Knowledge based method (tools are fuzzy logic and neural networks). The methods developed in between 1940 to 1960 are termed as classical methods of design which includes Bode plot and Nyquist Plot (for frequency domain) and Root Locus (for time domain). Near about 75% industries still use the classical methods. 1960 onwards the methods are termed as Modern Control Systems which includes state variable method which is mostly used to solve problems in aerodynamic tracking [1-8].

II. CONTROL THEORIES

As mentioned in the introduction, there are two control theories namely classical and modern. First, about the classical theory, it is only applicable to the single input and single output systems only. The analysis of the system can be carried out in time domain or in frequency domain with specifications of their own for measure of stability and for speed of response. Mostly the responses for the second order equations are done as the higher orders can be reduced to second order equations. The systems designed with the classical theories are preferred over the designs of modern theories because of the ease of physical implementation. The most designed controller is the PID controller. The characteristics such as damping ratio, peak overshoot, resonance peak(in case of time domain) and rise time, bandwidth, gain and phase margins(in case of frequency domain) can be evaluated through simulation.

Now, about the modern theories of control systems, can also be used to design system with multiple input and multiple output thus removing the limitation of the classical theory though the evaluation of the specifications is very complex task but the results are reliable with the design problems to be more sophisticated. There is no frequency domain analysis in modern theory. Because of its reliable designs, it is mostly used in design of aircrafts control. The areas of the modern theory are yet to be explored [1-8].

Control systems in Household

Control system in household or more often referred to as home automation is control and automation of home appliances using sensors and switches which are further connected to a gateway and is controlled by the user using a smartphone or tablet or a terminal which might or might not be connected to a web server. It can be used to remotely access any device and its applications are varied. It can be used to turn on the air conditioner before reaching home or turn off the washing machine when at work. It is mostly used in the security systems for leak, smoke and theft detection. At present the industry is in its infancy and the concern for the consumer according to a survey is that the wifi network is vulnerable to hacking. The home automation market is a fast-growing market and is estimated to reach a market value over 10 billion us dollars [1-8].

Control Systems in Agriculture

Control systems can also be used in the field of agriculture to make smart farms. There are many organizations working in this direction, the most prominent one is International Federation of Automatic Control (IFAC). The main work of this federation in the field of agriculture is on the energy issues, precision farming, post-harvest operations and many more. There are conferences organized by the IFAC names as AGRICONTROL and a workshop named as BIOROBOTICS. Japanese universities and industries are also working in the same field and their main motive of work is monitoring of crop and data acquisition that is status, yield and quality using robotics, developing navigation systems, design of automated farms and they are also trying to automate the fruit picking by making robotic arm which can detect the size, shape and quality and color of the fruit and will also help in pollination. There is one more organization working in this direction named as the Control

Systems Society of the International Institute of Electrical and Electronics (IEEE) on the future of farming [1-8].

Control systems in Transportation

Nowadays control systems are used to provide services in the transportation department as traffic management and making the users aware about safe and smart use of transportation network. The application can vary from as simple as car navigation to the latest technologies. These use a combination of control systems and communication systems such as use of antenna to make the monitoring of the traffic wireless. The control systems can have used for safety using a ecall system which could be activated in case of an accident either manually or by the car sensors detecting an accident. The control systems are also used nowadays to automate the road enforcement by detecting the vehicles breaking the speed limit or other road laws automatically. Variable speed limit indicator detects the road congestions and automatically displays a speed limit according to the values detected. Companies are trying to make cars which will not require a driver, this like an autopilot in flight is also based on feedback loop systems [1-8].

Control Systems in Medical

In medical sciences, new discoveries are going on and some are depended on the feedback loop systems one such example is nanorobots. These artificially intelligent robots will enter the human body and will repair the damaged tissues, clean the blood vessels. The research is going on the nano-level control systems. Assist devices are also under development which will help the disabled person to return to a normal life and these devices are based on the biofeedback mechanism. A closed loop system is designed for the blood sugar level for insulin injection for diabetic patients. The anesthesiologists take the help of controllers for a giving adequate anesthesia as it is a difficult task to determine the quantity nut with feedback controller the difficult part of the decision can be worked out. The body parameters like heart rate, skin humidity, heart rate and body temperature depend on the external conditions of the temperature and humidity, in critical conditions like in ICUs it is very crucial to control the environmental parameters for the patient's good health and for this purpose control systems are used [1-8].

Control Systems in Industry

control systems in industry also sometimes referred to as industrial control systems uses several of the devices and systems for production in the industry such as PID controllers and supervisory control and data acquisition(SCADA) and many more. The data is received from the remote stations, then automated commands are used to control actuators or field devices. The collected data is used for altering the commands and also for safety reasons in alarming conditions. Feedback and feedforward control loops are developed for the process control where desired set points are maintained automatically and for this purpose specified programmable controllers are used. There are different devices used such as DCs which stands for Distributed Control system used as a supervisory controller, seeing subsystems which are responsible for controlling localized processes. PLCs are also used which stands for Programmable logic controller. They are computer based hardware devices that are used to control processes and devices in industries [1-8].

Control Systems in Defense

Defense is one field where the development is rapid and nowadays to reduce the human casualties the organizations are developing more of the automated systems. Sensors are used to detect unwanted objects and weapon auto loading and fires the payload on the target with accuracy and precision. The reloading of the artillery and tanks is made automatic to reduce time. It has also improved man machine

interface in battlefields. Ballistic fire control systems are also integrated in the defense of many countries [1-8].

III. CONCLUSION

As we have seen that control systems are used in almost every domain of our life and it is a developing concept which will play crucial role in the future of automated and smart society. There is a lot of scope for research and development in the feedback loop system so the study of the control systems is essential in terms of technological growth.

Conflict of Interest: The authors declare that they have no conflict of interest.

Ethical Statement: The authors declare that they have followed ethical responsibilities

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