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Active Learning of Control Systems

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Abstract: ***Teaching control systems to the under graduate engineering students is a tough job without active learning. The innovation in teaching control systems is simple but quiet interesting. A role play was conducted to make the learners to understand the difference between the open loop and closed loop systems. The analogy of saturation was compared with the saturation of torque speed characteristic of motor. The effect of Positive feedback also demonstrated to the learners. Finally a simple DC motor was constructed by the learners and was successfully rotated by a group of leaners. The author finds easy to teach the control systems with these types of active learning.***

Keywords: Role play, Open loop systems, Closed loop systems, saturation, positive feedback, DC motor construction

1. Introduction to Role-Play

The instructor provides either real or imaginary contexts along with a range of relevant characters/roles; learners are encouraged to research these contexts, characters, and/or roles, and then to improvise dramatic interactions among their characters during class periods. A role play can help learners to understand the difference between open loop systems and closed loop systems. Their observation can then be utilized to extend its meaning in control systems.

1.1 Learners were instructed to watch the role play

Activity 1
There will be a hidden picture of an elephant on the board. One of learners (boy learner)will be asked to come on the stage. His eyes will be blind folded .Now the elephant picture will be displayed. He will be asked to draw the tail of the elephant. He will be given three minutes of time.

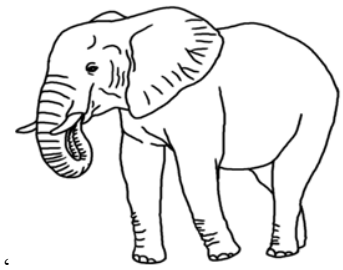

Figure 1: Picture of an elephant

Activity 2
There will be picture of a woman displayed on the board. One of the learner from the girls will be asked to draw the nose ring and tilak on the picture.

Figure 2: picture of a lady.

At the end of this role play the learners will be asked to

- Identify the closed loop system from these two activities?
- What is the feedback signal activity 2?

1.2 The learners response

- Activity 1:open loop system
- Activity 2:closed loop system

Eye vision is the feedback signal in the activity 2.

1.3 Inference

Activity 1 is the example for the open loop system. Here there is no feedback signal. Because of the learner eyes are blind folded there is no feedback signal to the brain. The learner may not be able to draw the tail correct position.

2. Open Loop System

A cellular phone is an open loop. The loop begins when an incoming call causes the phone to ring or when a person dials out using a phone. After the phone has been turned on, it will make a connection with a satellite. The phone will then continue to transmit to that satellite until the connection is broken by a human operator, because the phone is unable to turn itself off after the necessary functions have been performed so it is an open loop.

3. Closed Loop System

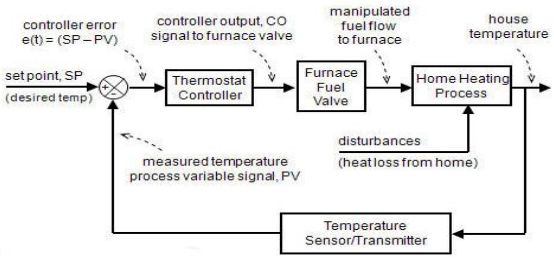

Figure 3: Block diagram of a home heating closed loop system

Starting from the far right in the Figure 3, our process variable of interest is house temperature. A sensor, such as a

thermistor in a modern digital thermostat, measures temperature and transmits a signal to the controller.

The measured temperature PV signal is subtracted from set point to compute controller error, e(t) = SP – PV. The action of the controller is based on this error, e(t).

In our home heating system, the controller output (CO) signal is limited to open/close for the fuel flow solenoid valve . So in this example, if e(t) = SP – PV > 0, the controller signals to open the valve. If e(t) = SP – PV < 0, it signals to close the valve. As an aside, note that there also must be a safety interlock to ensure that the furnace burner switches on and off as the fuel flow valve opens and closes.

3.1 Saturation

Take a bowl of water .A learner was asked to add one tea spoon of salt and rinse it. All the learners were keenly watched. The added salt dissolved in the water .Another learner was called and asked him to do the same. Thirdly some other learner was asked to add two tea spoon of salt and asked to rinse it. Again and again learner was asked to add the salt and rinse it. At one stage the added sugar was as such. This is depicted in the figure shown below. This analogy was compared to the saturation of torque -speed characteristic of motor.

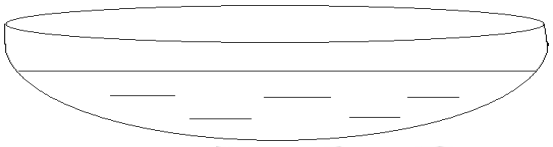

Figure 4: Bowl of water

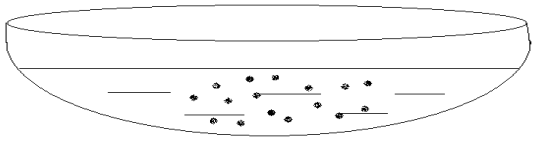

Figure 5: One tea spoon of salt added and rinsed.

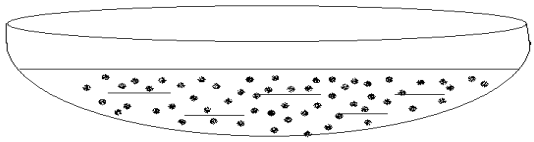

Figure 6: Two tea spoon of salt added and rinsed

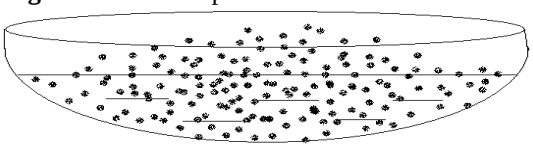

Figure 7: Saturated when more salt is added and rinsed.

3.2 Positive feedback

An audio system was arranged in the seminar hall. The mic was away from the loud speaker .The speakers voice was clear and audible. When the mic was moved closer to the speaker the speakers voice was not audible and not clear. Its because of positive feedback. Positive feedback increases the error as a result the system becomes unstable.

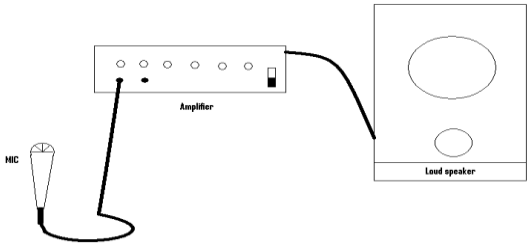

Figure 8: Audio system

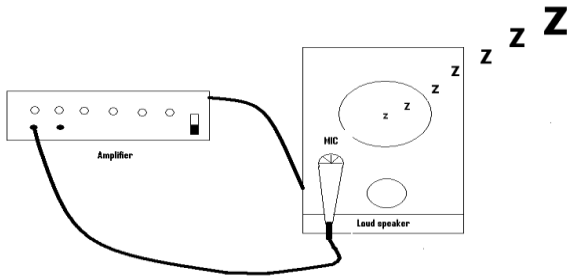

Figure 9: Positive Feedback de stabilizes the audio system

3.3 Construction of a simple DC motor

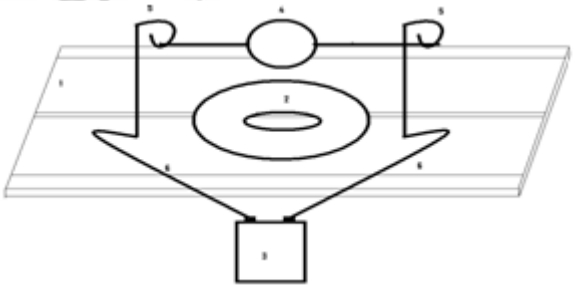

Figure 10.Construction of a simple D.C motor

A dc motor is a device which converts electrical energy into mechanical energy. A current carrying wire in the presence of magnetic field will always have a tendency to move. This effect is known as motor effect. When there is an interaction between electric and magnetic field a mechanical force is produced. Motor works on Fleming's left hand rule. The apparatus required for the construction of motor is given below:

1. Bread board
2. Circular magnet
3. 9V battery
4. Copper coil
5. Paper clips
6. Single strand wires

Learners were asked to bring the apparatus required for the construction of motor. They were asked to assemble the motor as shown in the Figure 10 in the class .Surprisingly one group of learners were successfully rotated the motor. Motor works under the principle of Flemings left hand rule as shown in Figure 11.

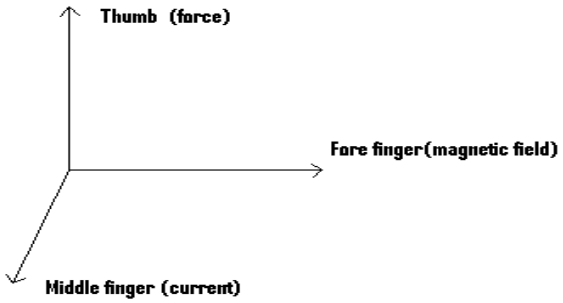

Figure 11: Flemings left hand rule

4. Results

The active learning of open loop and closed loop systems was conducted in the class room. The following learning outcomes were achieved and at the end of the hour learner's feedback were obtained.

4.1 Learning outcomes achieved by learners

At the end of the session learners will be able

1. To Understanding the difference between the open loop and closed loop systems.
2. To understand the various elements of the open loop and closed loop systems
3. To know about the feedback input.

4.2 Learners feedback

1. The class room was so lively, and practical way of teaching was enjoyed to the core.
2. The class was very interesting. It helped many to understand. As per this session we the students also will be alert in the class in spite of sleeping.
3. Very interesting class and also interactive. If done like this then it will be interesting to learn this subject
4. It was really good. We enjoyed the class and we are able to understand the concept clearly by giving practical examples
5. The class was so fun and good. It was interactive and i understand all the concepts easily and we love to have this kind of teaching further.
6. New way of approach towards the student.
7. We really felt a change in your methodology
8. Interesting with PPT and we can also remember it for long time.

5. Conclusion

Active learning brought many benefits. The need to produce forces learners to retrieve information from memory rather than simply recognizing a correct statement. Learners increase their self-confidence and self-reliance[1].For most learners, it is more motivating to be active than passive. The task that i have done as part of a group was more highly valued. Learners conceptions of knowledge change, which in turn has implications for cognitive development. Learners who work together on active learning tasks learn to work with other people of different backgrounds and attitudes. Finally The active learning has made my job quiet easy as an instructor.

References

[1] The role of learning in student affairs outcomes Marilee J Bresciani San Diego state University, California, USA.
[2] Nagrath I.J, &Gopal M, "Control System Engineering", New Age International Publishers Limited, New Delhi, 5th Edition, 2007
[3] Benjamin C. Kuo, "Automatic Control Systems", John Wiley & Sons, Inc., New Jersey, 8th Edition, 2003.
[4] Norman S.Nise, "Control System Engineering", John Wiley & Sons Inc., New Jersey, 8th Edition, 2007

Author Profile

Selvam. G, completed B.E degree from Government College of Engineering, Tirunelveli in 1998,and Received M.Tech degree from College of Engineering, Trivandrum in 2003.He is having 13 years of teaching experience .He passed in CICTT(D) and is obtained through Wipro Mission 10X.His area of interest in control systems.