Week-3-Day-1-Afternoon Session

3.1.1 Role of sensors in automation & Robotics

The role of a sensor in a control and automation system is to detect and measure some physical effect, providing this information to the control system. Sensors play a crucial role in factory automation in making the system intellectual. Different types of sensors are available as per the suitability and applications some of them are produced in mass and available in the market at affordable costs.

In Industrial Automation, sensors play a very important role in making the products intelligent and highly automatic. Machines can detect, process, analyze, and measure different position, height, appearance, length, and any displacement in production sites.

These sensors also cater to the needs of multiple sensing applications. For automated and embedded control systems, sensors are as important for device safety and performance as the five senses are for humans. An array of sensors can be designed and combined to improve your business, organization, or company's efficiency at any level.

Sensors can be utilized for parking management, inventory/stock measuring, manufacturing, energy efficiency, and virtually any other aspect. Efficiency, is one way sensors can improve your business. Sensors have the ability to count, measure, and assess quantities and qualities at higher speeds and in greater detail than that of a manual process.

Another area of improvement from sensors is safety. With sensors, you have the ability to automate and inform minute and large-scale aspects of your manufacturing with the result of reducing workplace hazards.

A sensor is a device that detects, measures and converts a physical quantity into a signal that can be read by an observer or an instrument. For example, a thermocouple is a sensor that converts a temperature difference into an electrical output. Sensors that give digital or discrete, that is, on/off, outputs can be easily connected to the input ports of PLCs. An analog sensor gives an output proportional to the measured variable. Such analog signals have to be converted to digital signals before they can be input to PLC ports.

In industrial automation, sensors play a very important role to make the products intelligent and highly automatic. These allow one to detect, analyze, measure and process various changes like change in position, length, height, appearance and displacement that occurs in the production sites. These sensors also play an important role in predicting and preventing many future events, thus, catering to the needs of many sensing applications.

3.1.2 Selection of sensors in industrial automation system based on applications

The successful application of sensors depends on selecting the right technology for the application, the variables of the product being sensed and the conditions in the operating environment. Following are factors to be considered for selection of sensors.

1. Measuring range

While selecting a sensor (temperature sensor, proximity sensor, accelerometer sensor, etc), the range of measuring should directly correspond with the physical measuring range so that we can obtain the most precise reading and optimal sensor lifespan.

2. Environment

We must be aware of environmental conditions while installing a product. Numerous sensors can be affected by the environmental conditions (such as temperature variation, gas, humidity, chemicals, etc.)

3.Flexibility

While selecting a sensor, we need to check if it can provide flexibility, like features that can adapt to changing the products.

4. Digital lowers costs.

It is always better to use a sensor which gave gives a digital output. It is better to avoid using the analog field devices, even though they minimize the cost because while converting from analog to digital that can produce errors. A digital output equivalent sensors are more worth.

5. Intelligent sensors

It is better to adopt intelligent sensors that can be scaled, calibrated or configured remotely. Smart sensors are those which take up data from the environment and use the predefined function to perform some actions.

6. Accuracy and Precision

Precision and Accuracy does not mean the same thing, though they are often related. Accuracy is the quality or state of being correct or while the precision ability of the devices to notice small changes (As an example, a temperature sensor that measures the normal body as 35.999°C has high precision but low accuracy.) The Accuracy and precision and one of a given product should be appropriate. Too high precision can give a wrong indication that the value is too accurate. Similarly, a sensor with good accuracy will be expensive. The error can affect both precision and accuracy.

7. Excitation

We must provide power to most of the devices. The power which is provided must not introduce any error.

8. Signal Conditioning

Electrical noise is present everywhere, mainly on the production floor which can produce huge errors in reading. So, protection circuits and Signal conditioners can provide some protection. In mobile manufacturing industry ESD safety is a must because electronic products are very sensitive to electrostatic charges so we use a wrist strap, grounded floor mat, heel strap, air ionizer, etc.

9. Sudden temperature changes

The sensor must be in such a situation that it can overcome the sudden temperature changes and work properly without producing errors.

3.1.3 Desirable features of Sensors

1. Accuracy

- Accuracy should be high. How close output to the true value is the accuracy of the device.

2. Precision

- There should not be any variations in the sensed output over a period of time precision of the sensor should be high.

3. Operating Range

- Sensor should have wide range of operation and should be accurate and precise over this entire range.

4. Speed of Response

- Should be capable of responding to the changes in the sensed variable in minimum time.

5. Calibration

- Sensor should be easy to calibrate time and trouble required to calibrate should be minimum. It should not require frequent recalibration.

6. Reliability

- It should have high reliability. Frequent failure should not happen.

7. Cost and Ease of operation

- Cost should be as low as possible, installation, operation and maintenance should be easy and should not require skilled or highly trained persons.

3.1.5 Practice Session

Aim: Build a circuit for sensing any object using proximity sensor and indicating with LED

Components Required

• IC : LM358

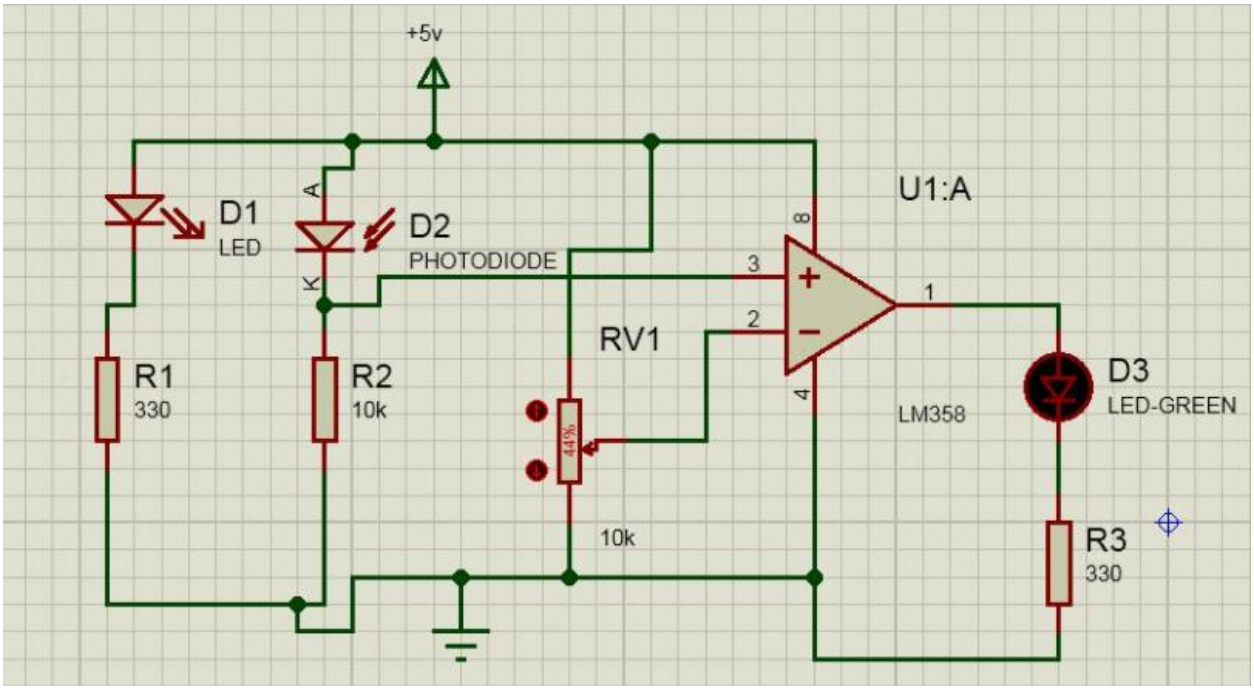
• IR LED

• Photo Diode

• Resistors 330 Ohms -2No.s, 10K ohm,10K POT

• LED

Circuit Diagram for IR Proximity Sensor :



Circuit Operation:

Case1: When IR rays fall on the Photo diode, the resistance of the photo diode decreases and current flows through the photodiode. Now the Voltage develops at 10Kohm resistor and this voltage is fed to the pin No.3 of the comparator. With the help of Variable resistor a reference voltage is fed to the pin No.2(Whose Voltage must be less than the Pin No.3).Now the Comparator o/p becomes high and Led turns ON with the help of current limiting resistor.

Case2: When IR rays doesn't fall on Photo diode,the resistance of photo diode becomes high. less current flows through photo diode and there will be less voltage drop across 10Kohm resistor. Now the Voltage at Pin No.3 is less than the pin No.2 Now the Comparator o/p becomes is Zero and the LED turns off

Procedure:

- Construct the circuit as per the circuit diagram.

- Make Circuit connections such a way that, the IR LED and Photo Diode must be side by side.
- When IR LED turns on IR rays fall on the photo diode, it turns the output LED on.
- When IR LED turns off IR rays doesn't fall on the photo diode and observe the output, it turns off.

Conclusion:

When the obstacle is placed on the IR LED and Photo diode ,the LED is ON and no obstacle, the LED is OFF.