| **Class Notes:** |
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| **C1- Buzzer, AD/DA Converter, LDR Sensor, Accelerometer, Gyroscope**  Buzzer   * It is an electronic device used to produce sound. * usable in various applications like car reversing indicator, computers, call bells etc. * It is based on the inverse principle of piezo electricity. * principle of piezo electricity : It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and vice versa. Such materials are called piezo electric materials.   AD/DA Converter   * Microcontroller processes digital signals. * When the output of the sensor is analog in nature, we need to convert it in digital form. * Then, ADC (Analog to Digital Converter) is used in between sensor and microcontroller. * ADC converts an analog signal into digital and gives it to the microcontroller. * There are many applications of ADC like in a biometric application, environment monitoring, Gas leakage detection etc. * Arduino Uno has 6 on-board ADC channels which can be used to read analog signal in the range 0-5 V i.e. A0-A5.   LDR Sensor   * An LDR or light dependent resistor is also known as photo resistor, photocell, photoconductor. * It is a one type of resistor whose resistance varies depending on the amount of light falling on its surface. * When the light falls on the resistor, then the resistance changes. * These resistors are used in many circuits where it is required to sense the presence of light.   Accelerometer  Accelerometers are electromechanical devices that measure acceleration, the rate of change in velocity of an object.  Devices based on Accelerometer are used to respond to any vibrations associated with movement.  Measuring acceleration is a bit more tricky than measuring speed because it involves figuring out how speed *changes* over a period of time.  1. Static acceleration: the device is mainly used to find the degrees at which an object is tilted with respect to the ground.  2. Dynamic acceleration**:** the movement of the object can be foreseen.  Gyroscope  Gyro sensors, also known as angular rate sensors or angular velocity sensors, are devices that sense angular velocity. Angular velocity. In simple terms, angular velocity is the change in rotational angle per unit of time. Angular velocity is generally expressed in deg/s (degrees per second).  **C2-PIR Sensor, Ultrasonic Sensor, Gas Sensors, Proximity, Heart rate**  PIR Sensor  1. PIR Sensor (passive infrared sensor)     * used to detect human or particle movement in a certain range, and it can also be referred to as PIR(motion) sensor, or IR sensor. * commonly used in security alarms and automatic lighting applications. * The module actually consists of a Pyroelectric sensor which generates energy when exposed to heat. * when a human or animal body will get in the range of the sensor it will detect a movement because the human or animal body emits heat energy in a form of infrared radiation. * That’s where the name of the sensor comes from, a Passive Infra-Red sensor. And the term “passive” means that sensor is not using any energy for detecting purposes, it just works by detecting the energy given off by the other objects. * PIR sensors sense general movement, but don't have information on who moved or what. An active IR sensor is necessary for this purpose. * It does not emit the referred IR signals itself, rather passively detects the infrared radiations coming from the human body in the surrounding area. * The detected radiations are converted into an electrical charge, which is proportional to the detected level of the radiation. * Used in dark and light time.   Ultrasonic Sensor   * An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. * Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target). * In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is **D = ½ T x C** (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second).      * It emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module.   Gas sensor  The smoke sensor has a built-in potentiometer that allows you to adjust the sensor sensitivity according to how accurate you want to detect gas.  Working   * The voltage that the sensor outputs changes accordingly to the smoke/gas level that exists in the atmosphere. * In other words, the relationship between voltage and gas concentration is the following: * The greater the gas concentration, the greater the output voltage * The lower the gas concentration, the lower the output voltage   Proximity  It is used to detect movement/presence of objects without physical contact and relay that information captured into an electrical signal.   * Contactless sensing * Unaffected by surface conditions * Suitability for wide range of applications * Longer service life * High speed response rate   Heart Rate   * Heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. It works on the principle of light modulation by blood flow through finger at each pulse.   Working of Heart beat sensor  The module uses an infrared led (IR) and a photo transistor to detect the pulse of the finger and whenever a pulse is detected, red led flashes.  **C3-Actuators-Pneumatic , Hydraulic, Thermal, Electric, motors**  Actuators   * An actuator is a device that converts electrical, air or hydraulic energy into mechanical force or motion. * An actuator is the mechanism by which a control system acts upon an environment. * Examples: Light Bulb, LED, Buzzer, Water pump, electric motors, stepper motors, jackscrews, electric muscular stimulators in robots, etc.   Types of Actuators   * Hydraulic * pneumatic actuators * Electrical actuators * Thermal Actuators * Mechanical actuators   Types of Motors   * Hydraulic motors * Pneumatic motors * Clutch/Brake motor * Stepper motors (DC motor) * AC Motors * Servo motors (DC motor)   Reference – Presentations provided as Study Material |
| Week 5 SH   1. How LDR sensor is useful in Health Monitoring?   Six light dependant resistors (LDR) sensors embedded in a printed circuited board are habituated to receive the vibration signal by studying the change in the intensity of the laser beam. The [printed circuit board](https://www.sciencedirect.com/topics/engineering/printed-circuit-boards) includes a sensing element and a resistor interface able to carry information from the sensing element and send an [analog signal](https://www.sciencedirect.com/topics/engineering/analog-signal) to the [microcontroller](https://www.sciencedirect.com/topics/engineering/microcontroller). The figure below shows two-dimensional cross-shaped five sensors, i.e., PIN 0, PIN 1, PIN 2, PIN 4, and PIN 5 are placed together to receive the variation in intensity of laser light due to vibrations, whilst the sixth sensor, i.e., PIN 3 is placed at some distance to receive the surrounding light. The PIN 3 is positioned separately as to remove the noise (in the form of light) interferences that come from the surroundings during operation. PIN 1 acts as a reference pin, change in the intensity of light between PIN 0 and PIN 2 are used to measure the X-axis vibrations, while between PIN 4 and PIN 5 are used to measure Y-axis vibrations.     1. Name some applications where accelerometer and Gyroscope are used together? Explain how and why?  * Indoor Navigation. Acceleration is the rate of change of velocity. * Optical Image Stabilization. Human hands shake at a very low frequency (10Hz to 20Hz). ... * Gesture-Based Control.   Microelectromechanical systems (MEMS) combine mechanical and electrical components into small structures in the micrometer scale. They are formed by a combination of semiconductor and microfabrication technologies using micro machine processing to integrate all the electronics, sensors, and mechanical elements onto a common silicon substrate. Major components in any MEMS system are the mechanical elements, sensing mechanism, and the ASIC or a microcontroller. This article presents an overview of MEMS accelerometer sensors and gyroscopes. We discuss the principles of their operation, their sensing mechanism, the growing variety of applications for them, and the profound impact they are already having on our daily lives.   1. Explain those scenarios where we need to use PIR sensor and ultrasonic sensors together?   Both PIR and ultrasonic detection can be used in standalone systems and ‘connected’ (IoT) systems, principally to detect the presence of humans – but there are other applications as well.  Lighting control is a key part of many BEM systems that sense the presence of people and control lighting so that it is only on when needed. PIR sensors can be used for this, but they do require the person to be moving. On the other hand, ultrasonic sensors can scan an empty room and then know when one or more people are present. As part of a more sophisticated BEM, this information can be used to control and automate heating, ventilation and air conditioning (HVAC) systems to save energy and minimise environmental impact.  PIR sensors are very commonly used in security or intrusion detection systems in both domestic and commercial applications. As they are placed away from the potential point of entry (door or window) they will detect any intruder before they are able to reach the sensor and tamper with it.  Connected robots are becoming more popular in both domestic and commercial applications. In the home, simple robots can vacuum rooms unattended while similar technology is increasingly being used for robotic lawn mowers. Objects in the path of these robots are an issue and ultrasonic transducers are commonly used to detect these obstructions and change the direction of travel.   1. Which type of motors are used in Drones. Explain.   Brushed motors are used in the smallest drones, whereas larger drones and UAVs will use brushless motors, as they can carry the extra weight of the additional electronics. Brushless drone motors also require an electronic speed controller (ESC) to operate. |

| **Deliverable Status** | | | | |
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| **Deliverables** | **What did you plan to accomplish** | **What did you actually accomplish** | **Size** | **Effort** |
| ENB | * To take notes from class * To complete study halls * To write deliverable status, plan for next week * To write lessons I learned this week | * Notes with references are given * Plan for next week and deliverable status are added * Lessons learned are stated * All the answers to study hall are provided | 7 Pages | 1 hour |

| **Lessons Learned Reflection** | |
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| **Context** | **Lesson** |
| Plan: to read and understand basic IOT concepts and sensors in real world  Implementation: read a little about IOT and its features | To read more about IOT and to study its sensors in real life. Also, try to perform some on my own |

| **Plan for the Next Week:** | |
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| **Deliverable** | **What do you intend to accomplish and why** |
| ENB | * Make the document short and write notes in an effective manner * Complete before deadline * To take doubts if any occur |
| Study Halls | * To understand and perform study halls * To answer the questions provided * To take screenshots |