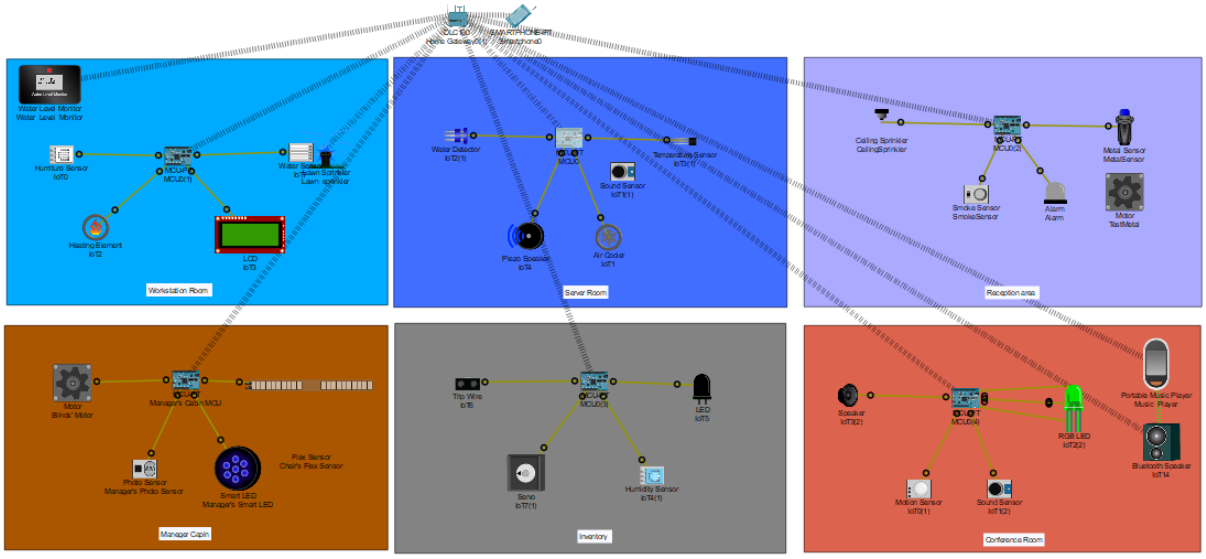
IoT project report

The Smart Office project shows how IoT technology can improve workplaces by making them safer, more comfortable, and more efficient. The project uses both hardware, like Arduino and ESP32, and network simulation in Cisco Packet Tracer to build a connected office environment.

The office is divided into six rooms: Server Room, Conference Room, Reception Area, Inventory Room, Workstation Room, and Manager's Cabin. Each room has sensors and actuators designed for its specific purpose, such as monitoring the environment, improving security, or automating tasks.

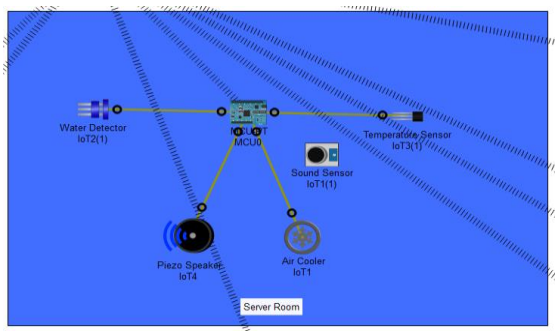
This system collects real-time data and shares it over the network, making it easy to monitor and control the office. The Smart Office project is an example of how technology can make workplaces smarter and more effective for everyone.

In this project, we used Cisco Packet Tracer to simulate the smart office network. Instead of traditional routers and switches, we used a **Home Gateway** for IoT connectivity and an **MCU (Microcontroller Unit)** to manage hardware devices. The Home Gateway facilitated wireless communication between sensors and actuators, while the MCU allowed us to control and simulate the physical behavior of devices in each room.



Now, let's explain each room in detail and its specific functions.

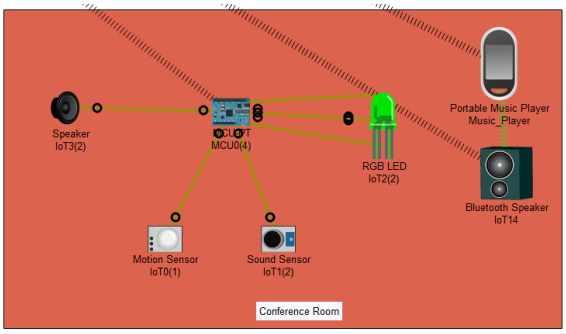
Server Room:



The **Server Room** is a critical space in the smart office, designed to ensure the safety and optimal functioning of IT equipment. It includes the following components:

- Sensors:
  - **Temperature Sensor**: Constantly monitors the room temperature to prevent overheating of servers and electronic devices.
  - **Water Detector**: Detects any water leakage or flooding that could damage sensitive equipment.
- Actuators:
  - **Air Cooler**: Automatically activates when the temperature exceeds a safe threshold, maintaining a cool environment for the servers.
  - **Piezo Speaker**: Sounds an alarm immediately if water is detected, alerting staff to take quick action.
- Scenario:
  - If the temperature rises above the predefined safe limit, the temperature sensor triggers the air cooler to activate, reducing the temperature to protect the equipment. In the case of water detection, the water detector sends a signal to the Piezo Speaker, which sounds an alarm to notify staff of the issue.
- Programming:
  - This program is designed to monitor and control the **Server Room** environment by managing temperature and water detection. It reads data from the temperature and water sensors to take appropriate actions based on predefined thresholds. If the temperature exceeds a set threshold, the air cooler is activated to lower the temperature, ensuring that the server room remains within safe operating conditions. Similarly, if water is detected, the piezo speaker is triggered to alert users of potential water leaks. The program continuously monitors the sensors, printing the current conditions and activating the necessary actuators to maintain the room's environment. The use of delays ensures stable sensor readings and reliable system performance.

Conference Room:

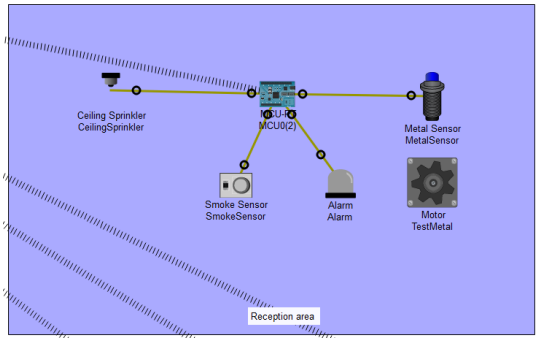


The **Conference Room** is designed to ensure comfort and functionality during meetings while maintaining noise control. It uses sensors and actuators to automate the room's operations and enhance the user experience.

- Sensors:
  - **Motion Sensor**: Detects occupancy to automatically activate devices when someone enters the room and deactivate them when the room is vacant.
  - **Sound Sensor**: Continuously monitors sound levels to ensure a quiet environment. If noise exceeds a permissible limit, the system takes corrective action.
- Actuators:
  - **RGB LED**: Provides a visual status of the room. When the room is occupied, the LED turns red, indicating it is in use; when unoccupied, it glows green.
  - **Speaker**: Plays notifications or alerts, such as reminders or warnings when noise levels become too high.
- Scenario:
  - When someone enters the room, the motion sensor triggers the RGB LED to change to red, indicating that the room is occupied. It also activates other necessary devices in the room, such as lighting or audio systems. Meanwhile, the sound sensor monitors noise levels. If the noise exceeds the set threshold, the system activates the speaker to play an alert, ensuring that meetings or activities remain undisturbed.
- Programming:

  - This program automates the monitoring and control of a conference room using motion and sound sensors to manage occupancy and noise levels. It begins by initializing the pins for the motion sensor, sound sensor, RGB LED channels, and speaker. The system initially sets the room as "available," turning on the green LED to indicate its status.
  - In the **main loop**, the program continuously checks the motion sensor to determine if the room is occupied. If motion is detected, the red LED is activated to show that the room is in use; otherwise, the green LED indicates availability. Simultaneously, the sound sensor monitors the room's noise level. If the noise exceeds a predefined threshold, the speaker is activated to alert occupants. This system ensures the room is dynamically managed for efficient usage and a quiet environment.

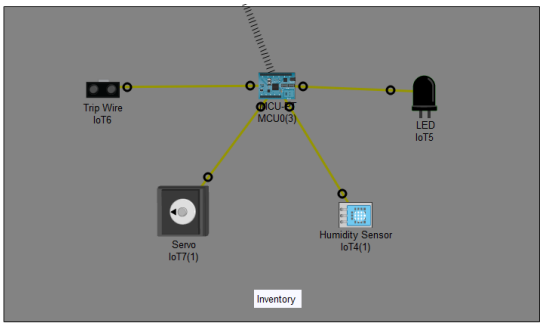
Reception Area:



The **Reception Area** is a key security and safety zone in the smart office, designed to handle potential threats and ensure quick responses in emergencies. It utilizes sensors and actuators to monitor the environment and respond to fire risks or unauthorized objects.

- Sensors:
  - **Metal Sensor:** Scans individuals or items entering the area for metallic objects, enhancing security by detecting unauthorized or suspicious items.
  - **Smoke Sensor**: Continuously monitors the air for smoke, ensuring early detection of potential fire hazards.
- Actuators:
  - **Ceiling Sprinkler**: Automatically activates to extinguish fires when smoke is detected.
  - **Alarm**: Sounds loudly to alert staff and visitors if the metal sensor identifies unauthorized metallic objects.
- Scenario:
  - If smoke is detected in the area, the ceiling sprinkler is immediately activated to suppress the fire, preventing its spread. Simultaneously, if the metal sensor detects a suspicious object, the alarm system is triggered to notify security personnel and raise awareness.
- Programming:
  - This program is designed to enhance safety in the **Reception Area** by automating fire detection and security alerts. The setup function initializes the smoke sensor and metal detector as inputs, and the ceiling sprinkler and alarm as outputs. This prepares the system to respond dynamically based on sensor readings.
  - In the **loop function**, the program first checks the smoke sensor. If smoke is detected, the sprinkler is activated, and **"FIREEE!!!"** is printed to the serial monitor as a warning. After a delay, the metal detector is checked. If it detects a suspicious metallic object, the alarm is triggered to alert security. These processes run continuously, ensuring the system remains responsive to potential hazards in real-time.

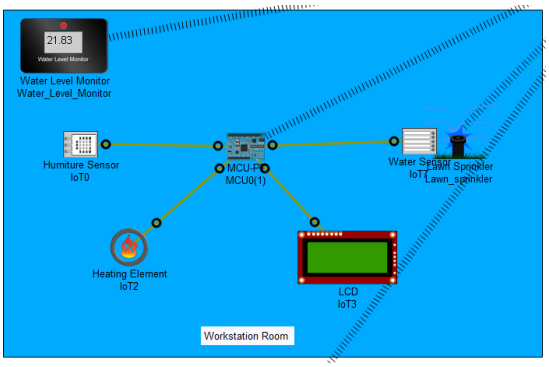
Inventory Room



The **Inventory Room** is a critical part of the smart office, focusing on security and maintaining ideal storage conditions. It uses sensors to monitor environmental factors and ensure unauthorized access is prevented.

- Sensors:
  - **Humidity Sensor**: Measures the air humidity to ensure the room maintains the right conditions for stored items.
  - **Trip Wire**: Detects unauthorized entry into the room, ensuring security by locking the door when access is not permitted.
- Actuators:
  - **LED**: Indicates the status of the pantry. The LED lights up in different colors to signal whether the pantry is locked or if the humidity levels are within ideal storage conditions.
  - **Servo**: Controls the pantry door, locking or unlocking it based on the status of the trip wire, ensuring that only authorized personnel can access the room.
- Scenario:
  - If unauthorized access is detected by the trip wire, the servo activates to lock the pantry door. Simultaneously, if the humidity in the room deviates from the ideal range, the LED changes color to alert staff about the potential risk to stored items. This system ensures both security and proper storage conditions, making the inventory room efficient and secure.
- Programming:
  - This program manages the **Inventory Room** by automating security and environmental monitoring. It continuously reads data from the humidity sensor and trip wire to ensure the room's conditions are optimal and secure. If the **trip wire** detects unauthorized access, the pantry door is locked using the **servo** actuator. Simultaneously, the **humidity sensor** monitors the room's humidity level. If the humidity goes beyond the specified range (either too low or too high), an **LED** is turned on to signal a warning. Otherwise, the LED remains off, indicating normal conditions. This system helps maintain both security and the proper environment for storing sensitive items, ensuring the pantry is only accessible to authorized personnel and the room's conditions are kept within safe limits.

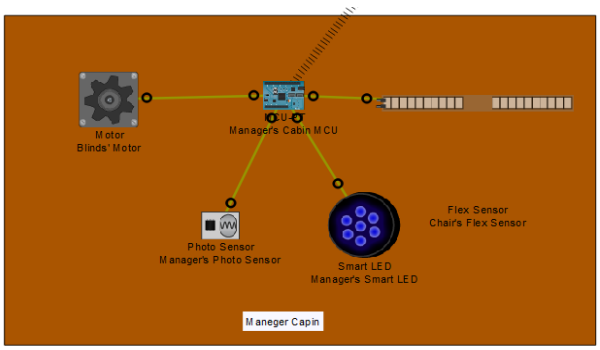
Workstation Room:



The Workstation Room is designed to maintain a comfortable working environment by regulating temperature, humidity, and water levels, ensuring optimal conditions for employees. It uses sensors to monitor environmental factors and actuators to make real-time adjustments.

- Sensors:
  - **Humiture Sensor**: Measures both humidity and temperature to ensure the room remains within optimal air conditioning conditions.
  - **Water Detector**: Monitors the room for any water leakage, particularly from air conditioning units.
- Actuators:
  - **Heating Element**: Activates when the room's temperature or humidity falls below the ideal level, ensuring comfort during colder conditions.
  - **LCD**: Displays the current room conditions, including humidity and temperature levels, and provides warnings if water levels exceed a safe threshold.
- Scenario:
  - If the **Humiture Sensor** detects that the room's temperature or humidity falls outside the optimal range, the **heating element** is activated to restore the balance and maintain a comfortable environment. Simultaneously, the **water detector** monitors the floor for any water leakage, and if the water level exceeds a certain threshold, the **LCD** displays a warning to alert employees about a potential leak from the air conditioning unit. This system helps ensure a safe and comfortable workspace by automatically responding to environmental changes.
- Programming:
  - This code is a part of a room monitoring system designed to control and automate room conditions using IoT sensors and actuators. It continuously monitors the humidity level using a humidity sensor and checks for water leaks using a water detector. Based on these sensor readings, the system adjusts the heating element and displays status updates on an LCD.
  - The **mapValue** function is used to convert the raw analog input from the humidity sensor (0–255) into a percentage (0–100) for easier interpretation. Inside the main loop, the program reads the humidity value and determines whether to activate or deactivate the heating element based on a predefined threshold. Additionally, the water detector sends a signal to the system, which updates the LCD with either "Water Detected" or "No Water Detected" based on the sensor's state.

Manager's Cabin:

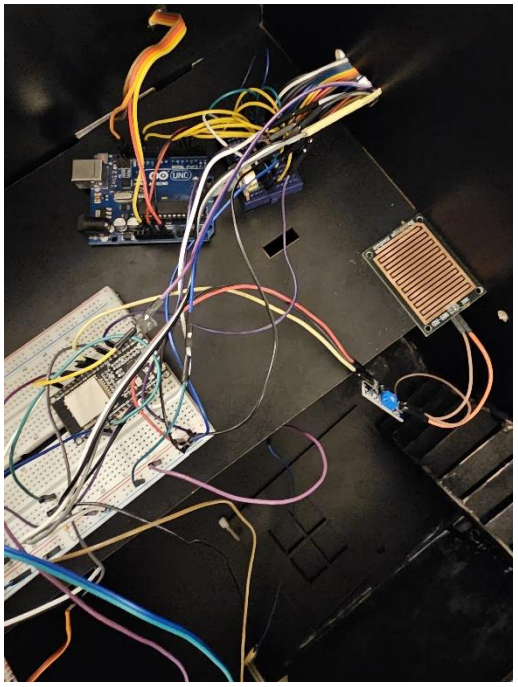


The Manager's Cabin is designed to enhance comfort and energy efficiency by automatically adjusting the room's lighting and blinds based on the manager's presence and the ambient light levels.

- Sensors:
  - **Photo Sensor**: Measures the ambient light in the room to adjust the lighting based on the natural light available, ensuring energy efficiency.
  - **Flex Sensor**: Embedded in the manager's chair, this sensor detects when the manager is seated, triggering actions to optimize the room's environment.
- Actuators:
  - **Smart LED**: Adjusts the brightness of the room's lights based on the reading from the photo sensor, ensuring the room is neither too bright nor too dim.
  - **Motor**: Automatically adjusts the blinds when the manager is seated, based on the available light, to maintain the optimal lighting for comfort and productivity.
- Scenario:
  - When the **flex sensor** detects the manager is seated, the **motor** adjusts the blinds to optimize natural light, and the **smart LED** adjusts the room's lighting to maintain the desired brightness level. This system ensures that the manager's cabin is always well-lit without wasting energy, creating a comfortable and efficient workspace.
- Programming:
  - This program automates the **Manager's Cabin** by adjusting the blinds and lighting based on the manager's presence and the ambient light levels. The system uses a **flex sensor** to detect when the manager is seated and a **photo sensor** to measure the surrounding light. When the manager sits down, the system opens the blinds and adjusts the **smart LED** based on the light level. If the ambient light is low, the LED turns on, and if the light is sufficient, the LED turns off. The **blinds motor** operates to open or close the blinds based on the flex sensor's readings, ensuring the cabin remains well-lit and comfortable for the manager without wasting energy. The use of flags ensures the blinds only adjust when necessary, and serial print statements help monitor the actions taken.

After explaining the software, let’s detail each room in the hardware and its specific functions.

Server Room:



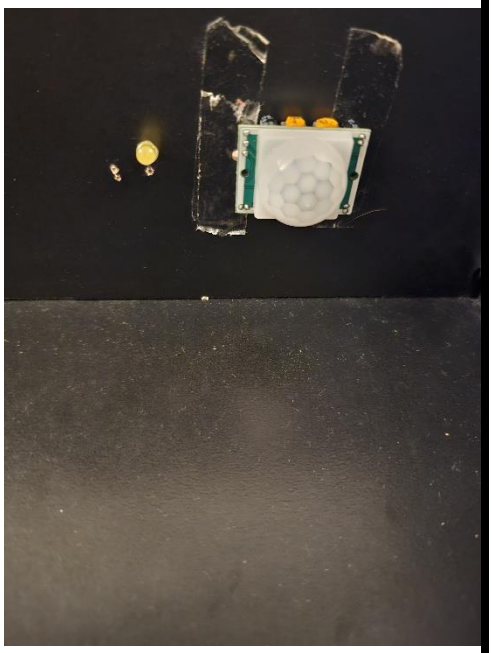
The **Server Room** is a critical space in the smart office, designed to ensure the safety and optimal functioning of IT equipment. It includes the following components:

- Sensors:
  - **Rain sensor**: Detects any water leakage or flooding that could damage sensitive equipment.
- Actuators:
  - **Buzzer:** Activates when water is detected, emitting a sound alert.
- Scenario:
  - If detect water , the water detector sends a signal to the buzzer, which sounds an alarm to notify staff of the issue.

- Programming:

  - This program is designed to monitor and control the server room environment by detecting water leaks. It reads data from the water sensor to take appropriate actions based on predefined thresholds. If water is detected, the buzzer is triggered to alert users of potential water leaks. The program continuously monitors the sensor, printing the current conditions and activating the necessary actuators to maintain the room’s environment. The use of delays ensures stable sensor readings and reliable system performance.

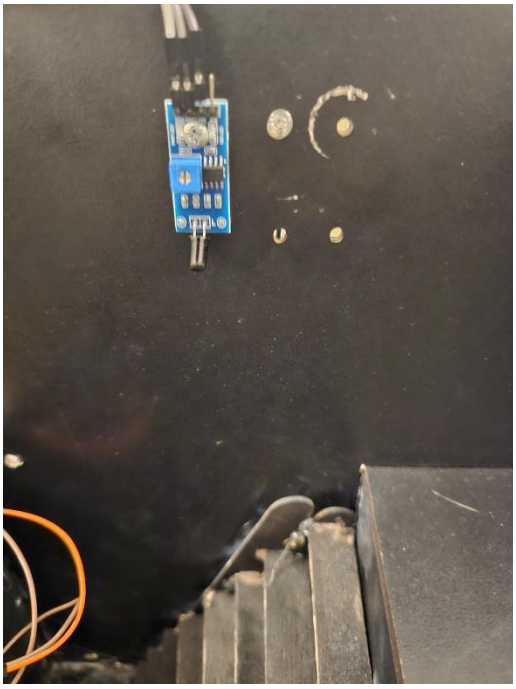
Conference Room:



The **Conference Room** is designed to ensure comfort and functionality during meetings while maintaining noise control. It uses sensors and actuators to automate the room's operations and enhance the user experience.

- Sensors:
    - **Motion sensor:** Detects occupancy to automatically activate devices when someone enters the room and deactivate them when the room is vacant.
- Actuators:
    - **LED**: Provides a visual status of the room. When the room is occupied, the LED turns red
- Scenario:
    - Someone briefly enters the room to pick up an item, The motion sensor detects occupancy, and the LED turns red, If no further motion is detected within a specified timeout period, the system assumes the room is vacant, The LED turns off, and devices deactivate automatically.
- Programming :
    - This program automates the monitoring and control of a conference room using a motion sensor to manage occupancy. It begins by initializing the pins for the motion sensor and RGB LED channels. The system initially sets the room as "available," turning on the green LED to indicate its status.
    - In the main loop, the program continuously checks the motion sensor to determine if the room is occupied. If motion is detected, the red LED is activated to show that the room is in use; otherwise, the green LED indicates availability. This system ensures the room is dynamically managed for efficient usage.

Reception Area:



The **Reception Area** is a key security and safety zone in the smart office, designed to handle potential threats and ensure quick responses in emergencies. It utilizes sensors and actuators to monitor the environment and respond to fire risks or unauthorized objects.

- Sensors:
    - **flame Sensor**: Continuously monitors the air for smoke, ensuring early detection of potential fire hazards.
- Actuators:
    - **LED**: Provides a visual status of the room. When the room is occupied, the LED turns red
- Scenario:
    - The LED turns on (e.g., red) to indicate the presence of smoke and alert occupants of a potential issue.
- Programming :
    - This program is designed to enhance safety in the Reception Area by automating fire detection and security alerts. The setup function initializes the smoke sensor as an input and the LED as an output. This prepares the system to respond dynamically based on sensor readings.
    - In the loop function, the program first checks the smoke sensor. If smoke is detected, the LED turns on (e.g., red) to indicate a fire hazard, and "FIREEE!!!" is printed to the serial monitor as a warning. After a delay, the program continuously monitors the smoke sensor, ensuring the system remains responsive to potential fire hazards in real-time.

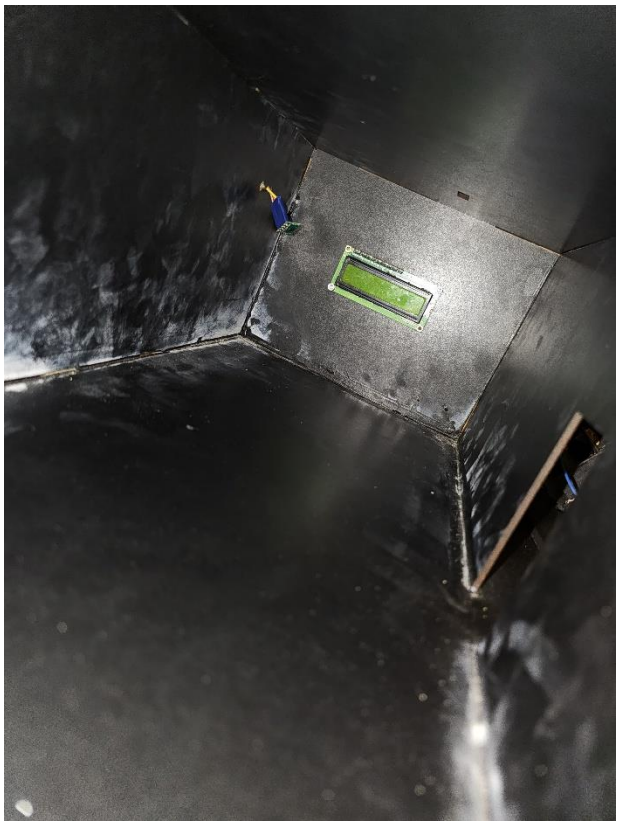
Inventory Room:

The **Inventory Room** is a critical part of the smart office, focusing on security and maintaining ideal storage conditions. It uses sensors to monitor environmental factors and ensure unauthorized access is prevented.

- Sensors:
  - **IR Sensor:** Detects unauthorized entry into the room
- Actuators:
  - **Servo:** Controls the pantry door, locking or unlocking it based on the status of the trip wire, ensuring that only authorized personnel can access the room.
- Scenario:
  - If unauthorized access is detected by the IR sensor, the servo activates to lock the pantry door. This system ensures security, making the inventory room safe and protected.
- Programming:
  - This program manages the Inventory Room by automating security monitoring. It continuously reads data from the IR sensor to ensure the room's security. If the IR sensor detects unauthorized access, the pantry door is locked using the servo actuator. This system helps maintain security, ensuring the pantry is only accessible to authorized personnel.

Workstation Room:

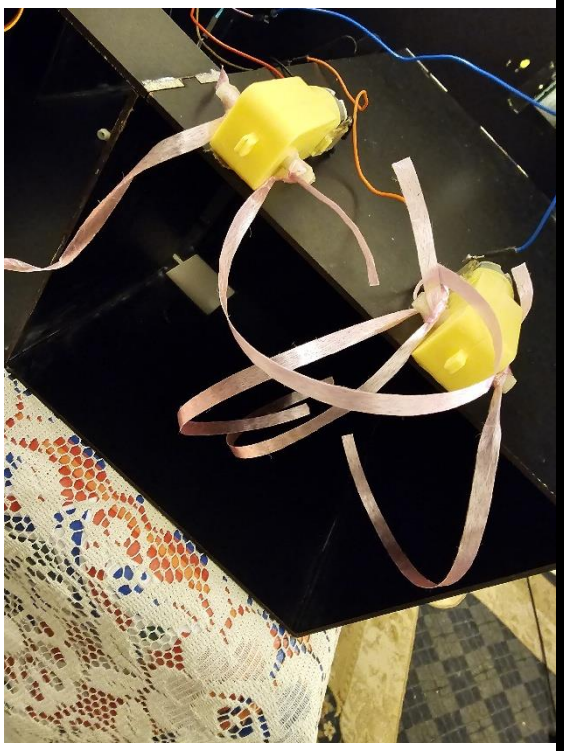
The Workstation Room is designed to maintain a comfortable working environment by regulating temperature, humidity, and water levels, ensuring optimal conditions for employees. It uses sensors to monitor environmental factors and actuators to make real-time adjustments.



- Sensors:
    - **Temperature sensor :** Measures temperature to ensure the room remains within optimal air conditioning conditions.
- Actuators:
    - **LCD:** Displays the current room conditions, including humidity and temperature levels
- Scenario:
    - Measure temperature and sending to LCD to display the current room conditions
- Programming:
    - This code is a part of a room monitoring system designed to automate room conditions using IoT sensors. It continuously monitors the temperature level using a temperature sensor and displays status updates on an LCD.

Manager's Cabin:

The Manager's Cabin is designed to enhance comfort and energy efficiency by automatically adjusting the room's lighting and blinds based on the manager's presence and the ambient light levels



- Sensors:
  - **Force Sensor:** Embedded in the manager's chair, this sensor detects when the manager is seated, triggering actions to optimize the room's environment.
- Actuators :
  - **Motor**: Automatically adjusts the blinds when the manager is seated, based on the available light, to maintain the optimal lighting for comfort and productivity
- Scenario:
  - When the **force sensor** detects the manager is seated, the **motor** adjusts the blinds to optimize natural light
- Programming :
  - This program automates the Manager's Cabin by adjusting the blinds based on the manager's presence. The system uses a force sensor to detect when the manager is seated. When the manager sits down, the system activates the motor to open the blinds. The blinds adjust based on the force sensor's readings, ensuring the cabin remains well-lit and comfortable for the manager without wasting energy. The use of flags ensures the blinds only adjust when necessary, and serial print statements help monitor the actions taken.