Lab Automation System Using ESP32 with IoT, IR, PIR Sensor

1. Project Overview:

The project aims to design and implement a **smart lab automation system** using an **ESP32** microcontroller. The system will allow users to control appliances through multiple input methods, including:

- **IoT platform (Blynk)** for remote access and control.
- **IR remote** for local wireless control.
- **Manual switches** for direct physical interaction.
- **PIR sensor** to automate the operation based on motion detection.

Additionally, the system will feature real-time **voltage** and **temperature monitoring** displayed on LCD**.**

2. Objectives:

- Automate control of lab appliances like lights, fans, or other devices.
- Provide flexibility by offering multiple control methods: IoT, IR remote, and manual switches.
- Implement motion-based automation using a PIR sensor for energy-saving and convenience.
- Ensure reliable connectivity through the IoT platform (Blynk) to allow control from anywhere.

3. Features and Functionality:

1. **IoT Control with Blynk**:
   - Control all lab appliances remotely through the Blynk app on a smartphone.
2. **IR Remote Control**:
   - Local control using an IR remote for quick access and usability without internet dependency.
3. **Manual Switch Control**:
   - Physical manual switches to allow conventional control when IR or Internet not available.
4. **PIR Sensor for Automation**:
   - Automatically control lights or other appliances when motion is detected, and turn them off when no one is present for a defined period.
5. **Voltage and Temperature Monitoring**:
   - The system will continuously measure voltage and temperature using sensors.
   - Display real-time data on LCD display to inform the user.

4. Flow of Operation:

1. **User Interaction:**
   - User sends a command via Blynk (or presses a button on the IR remote or manual switch).
   - ESP32 processes the command and controls the respective relay to turn on/off the appliance.
   - The status of the appliance is updated on the Blynk app.

2. **PIR Sensor:**
   - When motion is detected and all device are off state, the ESP32 will turn on all the device. If no motion is detected for a specific time, the device will turn off to save power.

3. **Voltage and Temperature Monitoring:**
   - ESP32 continuously reads the voltage and temperature sensor data.
   - The values are shown on the LCD display and updated in real-time.

5. Future Enhancements:

- Integration with **voice assistants** like Google Assistant or Amazon Alexa for voice control.

6. Limitation:

- **BLYNK** free version allows upto **5 datastreams**, so the project can handle only **5 devices** concurrently.

Thank you for your patience in reading