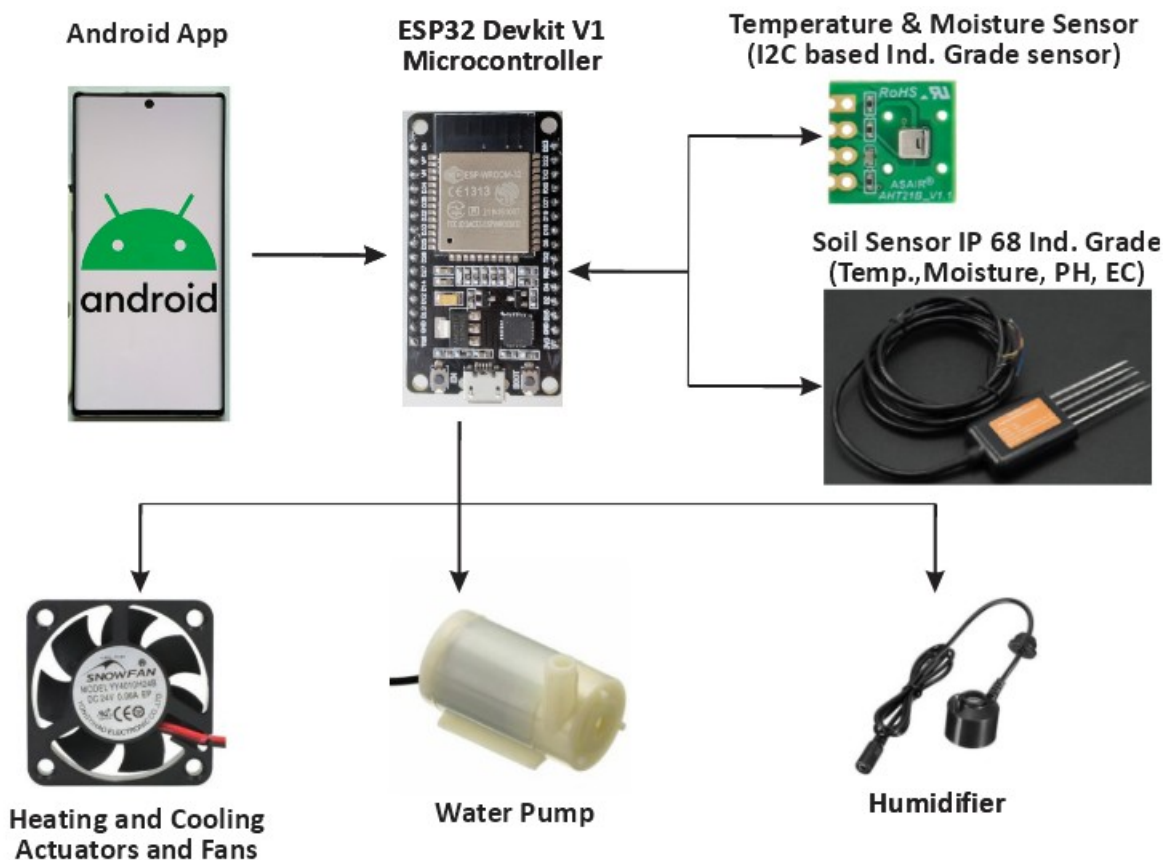# Smart Indoor Crop Cultivation System with Android-Based Lifecycle Control

Abstract:

This project presents the design and implementation of a **smart indoor crop cultivation system** using the **ESP32 Devkit V1 microcontroller**, aimed at automating the environmental conditions necessary for crops like **saffron** that require precise microclimate control. The system is capable of **monitoring and adjusting temperature, humidity, and soil moisture levels** throughout the crop's growth cycle, based on **daily setpoints** provided by a companion **Android application**.

The **ESP32** acts as the central controller, receiving setpoints for each environmental parameter over **Wi-Fi communication** from the Android app. These setpoints are mapped to the crop's growth stages, allowing the system to **adapt dynamically** to the specific requirements of the crop on each day of its lifecycle.

Based on the received setpoints and real-time sensor data, the ESP32 controls various actuators such as **heaters, fans, humidifiers, dehumidifiers, and irrigation pumps** to regulate the conditions. The system ensures that the environment remains optimal for maximum yield and quality, while reducing manual labor and human error.

Block Diagram:

Android App

ESP32 Devkit V1 Microcontroller

Temperature & Moisture Sensor
(I2C based Ind. Grade sensor)

Soil Sensor IP 68 Ind. Grade
(Temp., Moisture, PH, EC)

Heating and Cooling Actuators and Fans

Water Pump

Humidifier

Key Features:

- ESP32-based wireless microcontroller for IoT control
- Real-time monitoring and control of temperature, humidity, and soil moisture
- Android app interface to input daily setpoints for the entire crop lifecycle
- Automated actuator control: heaters, humidifiers, pumps, etc.
- Wi-Fi communication between Android device and ESP32
- Customizable for various crops and growth patterns
- Low-cost and scalable alternative to commercial greenhouse systems

Applications & Pros of the Project:

1. **Precision Crop Management:**
   Provides crop-specific environmental control by adjusting temperature, humidity, and moisture in real time.
2. **Automated Lifecycle Control:**
   The Android app allows predefined scheduling of environmental parameters throughout the crop's lifecycle.
3. **IoT-Enabled System:**
   Utilizes **Wi-Fi connectivity** and **mobile app integration**, enabling remote control and monitoring.
4. **Cost-Effective Alternative:**
   Replaces expensive commercial greenhouses or PLC-based solutions with a compact and affordable ESP32 setup.
5. **Energy and Resource Efficiency:**
   Actuators operate only when needed based on sensor feedback, reducing energy and water consumption.
6. **Flexible and Expandable:**
   Can be easily extended to support more crops, parameters, and data logging features.
7. **Ideal for Research & Education:**
   Combines real-world applications of IoT, embedded systems, agriculture, and automation in a single academic project.