Scope of the Solution

1. Continuous Sensing and Data Collection

- Continuously measure:
    - **Temperature** using the DHT22 sensor
    - **Humidity** using the DHT22 sensor
    - **Soil moisture percentage** using an analog soil moisture sensor
- Convert raw sensor data into meaningful environmental readings.
- Ensure stable values through repeated sampling and processing.

2. Automatic Water Pump Control

- Compare the measured soil moisture with a predefined moisture threshold.
- **Pump ON** when soil moisture is below the threshold (dry condition).
- **Pump OFF** when moisture is sufficient.
- Provide continuous automated irrigation with no manual involvement.

3. Automatic Fan Control

- Monitor real-time temperature using the DHT22 sensor.
- **Fan ON** when temperature exceeds the set temperature threshold.
- **Fan OFF** under normal conditions.
- Maintain an ideal temperature inside the greenhouse.

4. Cloud-Based IoT Monitoring (ThingSpeak)

- Send real-time data to the cloud including:
    - Temperature
    - Humidity
    - Soil moisture
    - Pump status
    - Fan status
- Allow remote monitoring through live graphs and analytics dashboards.
- Enable easy visualization and analysis of greenhouse conditions.

5.Local Decision-Making

- All decisions (pump ON/OFF, fan ON/OFF) are processed locally on the **Raspberry Pi Pico 2W**.
- Ensures fast control and reliable greenhouse operation even if internet availability fluctuates.

6. Minimal Maintenance and User Effort

- The system automates watering and cooling based on sensor feedback.
- Reduces the need for manual monitoring of plants.
- Supports healthier plant growth through consistent regulation.

7. Low-Cost and Easy Deployment

- Uses affordable and commonly available sensors and modules.
- Simple wiring and MicroPython-based firmware.
- Can be deployed in small to medium-sized greenhouse environments.

8. Future Upgrade Possibilities

Scope for future additions such as:

  - Additional sensors (light intensity, CO_2, pH)
  - Mobile app alerts
  - Automated nutrient control
  - Larger multi-node greenhouse networks