**🌱 Automated Aeroponic Farming System (On-Grid, Sensor Controlled)**

**🔹 Introduction**

Modern agriculture is rapidly adopting **automation and smart control systems** to reduce labor, optimize resource use, and improve crop yields. Aeroponics, a method where plants are grown without soil and supplied with nutrients through misting, is highly efficient but requires **precise environmental control**.

This project presents a **fully automated, on-grid aeroponic farming system** controlled by an **Arduino microcontroller**. It integrates **sensors, pumps, relays, LEDs, and a local control panel with display** to provide continuous nutrient delivery, smart misting, safety mechanisms, and user interaction — **without requiring any mobile app or internet connectivity**.

**🔹 Objectives**

1. To design a **plug-and-play aeroponic farming unit** powered by an on-grid SMPS.
2. To automate **nutrient circulation** and **temperature-controlled misting** using pumps and sensors.
3. To ensure **safety and water management** using a soil moisture/water-level sensor.
4. To provide a **user-friendly local control panel** with pushbuttons, LEDs, and a display for real-time monitoring.
5. To demonstrate how **robotics and embedded electronics** can make farming smarter and more efficient.

**🔹 System Components**

* **12 V DC Pumps** (Main pump for circulation, Mist pump for temperature-based spraying)
* **SMPS 12 V 15 A** – primary power source (on-grid)
* **12 V → 5 V Buck Converter** – powers Arduino and sensors
* **Arduino Microcontroller** – central controller
* **Relay Module** – switching pumps safely
* **Temperature & Humidity Sensor** – monitors ambient air for misting control
* **Soil Moisture / Water-Level Sensor** – ensures safety by stopping pumps if water is low
* **Pushbuttons (7 total)** – manual/auto pump control, misting control, sensor readings, and navigation
* **LED Indicators** – pump status, water low alert, temperature alert, system OK
* **Display (LCD/OLED)** – shows plant details, sensor readings, and mode status

**🔹 Working Principle**

1. **Pump Control:**
   * **Pump1 (Main circulation pump):** Runs in a continuous cycle of **5 minutes ON, 1 minute OFF**.
   * **Pump2 (Misting pump):** Activates automatically if **ambient temperature > 45 °C**, and stops immediately if the temperature falls.
2. **Sensor Integration:**
   * **Temperature & Humidity Sensor** provides real-time environmental data.
   * **Soil Moisture / Water-Level Sensor** acts as a safety mechanism — if the reservoir is low, both pumps stop and a **red LED alert** is activated.
3. **Control Panel (User Interaction):**
   * **Button1:** Manual Pump ON → Display: “Manual mode motor ON”
   * **Button2:** Manual Pump OFF → Display: “Manual mode motor OFF”
   * **Button3:** Auto Mode → Display: “Auto mode”
   * **Button4:** Show Temp & Humidity readings
   * **Button5:** Manual Misting ON → Display: “Manual misting ON”
   * **Button6:** Manual Misting OFF → Display: “Manual misting OFF”
   * **Button7:** Return Home → Display: Fake heartbeat graph (visual design element)
4. **Display Features:**
   * Shows **plant name, planting date, harvesting date, and TDS/nutrient info** (entered manually).
   * Displays **pump status, water level alerts, and environmental readings** in real time.
5. **LED Indicators:**
   * LED1 → Pump1 ON/OFF
   * LED2 → Pump2 ON/OFF
   * LED3 → Water low alert
   * LED4 → Temperature/system status

**🔹 Power Setup**

* The system is **fully on-grid**, powered directly via **SMPS 12 V 15 A**.
* Pumps run directly from 12 V (through relays).
* A **12 V → 5 V buck converter** powers the Arduino, display, and sensors.
* No batteries or solar storage are required, making it **plug-and-play**.

**🔹 Advantages**

* **Automation:** Reduces manual effort and ensures optimal plant growth.
* **Safety:** Water-level monitoring prevents pump damage.
* **User-Friendly:** Pushbuttons and display make operation easy.
* **Scalable:** Can be expanded for larger farms or integrated with solar in future.
* **Educational:** Demonstrates practical use of robotics and electronics in agriculture.

**🔹 Applications**

* Small-scale urban farming setups
* School/college science exhibitions
* Research projects in precision agriculture
* Prototype for future smart farming solutions

**🔹 Conclusion**

This project demonstrates how **embedded systems and robotics can revolutionize farming practices** by making them more efficient, reliable, and automated. By integrating sensors, relays, and a microcontroller with a simple control panel, this system offers a **low-cost, practical solution for aeroponic farming**. It eliminates the need for internet or mobile apps, making it **fully standalone and plug-and-play**, while ensuring plant health and system safety.