**Project Title:- AQUA ALERT**

**OBJECTIVE:-**

The objective of this project is to create an automated plant watering system using an ESP32 microcontroller, a soil moisture sensor, solar panels, and batteries. The system monitors soil moisture levels in real-time and automatically activates a water pump when needed. It efficiently manages power by using solar energy during sunlight and switching to battery power when needed, ensuring continuous operation. This solution aims to be cost-effective, eco-friendly, and scalable for various plant types and environments, reducing the need for manual intervention.

**KEY COMPONENTS:-**

1. **ESP32 Microcontroller** – The brain of the system that processes sensor data and controls the water pump.
2. **Soil Moisture Sensor** – Measures the soil’s moisture levels and sends the data to the ESP32.
3. **Solar Panel** – Provides power to the system during daylight hours.
4. **Rechargeable Batteries** – Stores energy and powers the system when solar energy is not available.
5. **Water Pump** – Delivers water to the plants when the soil moisture drops below a certain threshold.
6. **Relay Module** – Controls the switching of the water pump based on the ESP32 signals.
7. **LCD –** The LCD provides real-time display of system information, including soil moisture levels, pump status, and power source (solar or battery), for easy monitoring and maintenance.

**Project Workflow:**

1. **Power Supply Setup:** Connect the solar panel and batteries to the power management circuit to ensure the system switches between solar power during sunlight and batteries afterward.
2. **Sensor Integration:** Install the soil moisture sensor in the soil and connect it to the ESP32 microcontroller to monitor moisture levels.
3. **Microcontroller Programming:** Program the ESP32 to read moisture data, determine when to activate the water pump, and switch power sources based on available solar energy or battery status.
4. **Water Pump Control:** Connect the water pump through a relay module to the ESP32, enabling automated watering based on sensor readings.
5. **LCD Display Integration:** Set up the LCD to display real-time data such as soil moisture levels, pump status, and power source.
6. **Testing and Calibration:** Test the system to ensure the sensor accurately measures moisture levels, the pump activates as expected, and the power source switches seamlessly between solar and battery.
7. **Deployment:** Install the system in the desired location, ensuring all components are securely connected and functional for long-term use.

**Challenges to address:-**

1. **Power Management**: Ensuring seamless switching between solar power and battery backup without interruptions in system operation.
2. **Weather Dependence**: Managing system performance during extended periods of low sunlight, which may deplete battery reserves.

**Potential Future Enhancements:**

1. Implementing AI-based algorithms that learn and optimize watering schedules based on plant growth patterns and environmental conditions.
2. Making it completlty automated without any manual support.

**Cost Analysis:**

The estimated total cost for the project should be **less than 250 CAD**. Here's a breakdown of the expected costs: