SAMPLE SUBMISSION - PRIMARY SCHOOL

Innovation Type: Applied Technology / Automation

Focus Area: Cyber-Physical Convergence (Smart Agriculture)

Idea Description: Our project explores how micro-controllers and simple sensors can automate daily plant care to prevent soil over-drying and crop damage. Normally, soil moisture in potted plants decreases rapidly due to high ambient temperatures, leading to underwatering or sudden plant wilting. Traditional watering methods rely entirely on manual effort, which can be inconsistent in busy school or home environments.

Instead of manual watering, our team will build an automated soil hydration monitor using a BBC micro:bit microcontroller connected to a moisture sensor, LED light board, and a small servo motor. When the sensor detects that the soil moisture drops below a pre-set threshold, it triggers a red warning LED display and turns a small servo-gate to release water from an overhead gravity feeder into the pot. Once the moisture reaches an optimal level, the servo closes the gate automatically. This offers an accessible, low-cost micro-automation system that keeps plants healthy while conserving water, especially useful for local school gardens during warm dry periods.

STEM Concepts:

1. **Computer Science & Coding:** Logic loops (If-Else conditions), input-output signal processing, and threshold calibration using MakeCode block programming.
2. **Physics & Electrical Engineering:** Closed electric circuits, resistance/conductivity sensing in soil, and mechanical energy transmission via servo motor movement.
3. **Biology & Agricultural Science:** Plant soil-water relations, transpiration rates, and maintaining optimal soil hydration levels for root health.
4. **Mathematics:** Data collection, mapping moisture percentages, and calculating irrigation flow rates.

Methodology:

1. **System Circuit Setup:** Connect the soil moisture sensor to the micro:bit analog input pin, and connect the servo motor and LED module to output pins.
2. **Coding & Logic Configuration:** Write a block program that continuously reads soil moisture levels every 5 seconds.
    - *Condition A (Dry Soil < 30%):* Flash Red LED array, open servo-gate 45 degrees for 3 seconds to release water.
    - *Condition B (Wet Soil > 60%):* Display Green LED checkmark, keep servo-gate closed.
3. **Testing & Calibration:** Place the sensor in three soil samples (Dry, Damp, Wet) to verify sensor accuracy and smooth servo operation.
4. **Water Delivery Test:** Measure the exact volume of water released per servo activation to prevent over-watering.

5. **Observation & Garden Trial:** Test the automated system over a 5-day period with a potted vegetable plant, recording daily soil moisture stability and plant health.

Final Product/Outcome: A fully functional, low-cost automated soil moisture controller that successfully monitors soil conditions in real-time and triggers automatic watering. The system maintained healthy soil moisture levels consistently without human intervention, preventing water waste and protecting plants against dry heat.

Economic & Social Impact: This project supports local STEM education and sustainable practices through the following focus areas:

- **Smart Farming Foundations:** Introduces primary students to basic Internet-of-Things (IoT) and cyber-physical concepts used in modern precision agriculture.
- **Resource Conservation:** Minimizes water wastage in school gardens and domestic farming by delivering water only when plants need it.
- **Rural STEM Literacy:** Demonstrates how simple, affordable micro-controllers can solve real-world agricultural problems using basic automation tools.

Supporting Documents