

**MAKERERE UNIVERSITY**

**COLLEGE OF COMPUTING AND INFORMATION SCIENCE**

**SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY**

**DEPARTMENT OF COMPUTER SCIENCE**

**COURSE: CSC 2118 Embedded and Real-time Systems**

**LECTURE: Dr. Mary Nsabagwa**

**ORGANISED BY: group Q**

|  |  |  |
| --- | --- | --- |
| **NAME** | **STUDENT NO.** | **REGISTRATION NO.** |
| Mwizerwa Timothy | **2400724330** | **24/U/24330/PS** |
| Kinda Kelsey Naluwafu | **2400705862** | **24U/05862/PS** |
| Aroba Joseph | **2400703646** | **24/U/03646/EVE** |
| Kato Adrian Mugerwa | **2400725909** | **24/U/25909/PS** |
| Kisakye Rita | **2400700571** | **24/U/0571** |

**Project Report:**

**Smart Plant Monitoring System**

This report outlines the components and operational logic of the Smart Plant Monitoring system, which is designed to monitor environmental conditions, specifically soil moisture and leaf movement, and respond automatically.

**System Overview and Core Technology**

The primary objective of the project is **smart plant monitoring**. The system uses an **Arduino (atmega328)** for processing and control, and it employs **USAIT communication and interrupts**. The system handles both **analog** signals, which involve measuring or generating values, and **digital** signals, represented by 0s and 1s (on & off).

**Components and connections**

The system integrates various input and output components:

| **Component** | **Pin(s)** | **Arduino Pin** | **Direction** | **Purpose / Reason** |
| --- | --- | --- | --- | --- |
| **Soil Moisture Sensor** | Analog Output → A0 | PC0 (ADC0) | **Analog Input** | Reads analog voltage corresponding to soil moisture level (0–1023). Analog pins are needed because they measure continuous voltage, not just ON/OFF. |
| **Tilt Switch (KY-017)** | Signal → D2 | PD2 / INT0 | **Digital Input (Interrupt)** | Detects leaf movement (wind). Connected to external interrupt pin **INT0** so it can trigger an interrupt whenever state changes. |
| **Relay Module (SRD-05VDC-SL-C)** | IN → D7, VCC → 5V, GND → GND | PD7 | **Digital Output** | Controls the water pump. The relay allows Arduino’s low-power signal to switch ON/OFF the higher current needed by the pump. |
|  |  |  |  |  |
| **Red LED** | Anode → D9, Cathode → GND | PB1 | **Digital Output** | Lights when moisture is **very low** — below alert threshold — “Water the Plant”. |
| **Green LED** | Anode → D10, Cathode → GND | PB2 | **Digital Output** | Lights when pump is ON — indicates watering in progress. |
| **I2C LCD (16x2 with I2C adapter)** | SDA → A4, SCL → A5 | PC4, PC5 | **I²C Communication (Digital)** | Displays soil moisture %, messages like “Moisture Low”, “Water the Plant”, or “Wind Available”. |
| **Water Pump (3–5V Micro Pump)** | +V → Relay COM, GND → GND | Controlled by Relay | **Output Device** | Activated via relay when soil moisture is below 4%. Waters the plant automatically. |
| **USART (Serial for Debugging)** | TX → USB via Serial | PD1 | **TX Output** | Sends real-time data (like moisture readings) to PC terminal for debugging. |

**Operational Logic**

The monitoring system employs specific logic thresholds for moisture control and interrupt handling for wind detection:

**Moisture Monitoring and Watering Automation**

The water sensor sends real-time moisture levels to the Arduino, which then prints these readings onto the LCD. The system uses three main thresholds for moisture levels, resulting in corresponding visual and action outputs:

1. **Low Moisture Warning:** When the moisture level falls **below 10**, a **yellow LED** lights up. Concurrently, the word **"moisture is low"** is printed on the LCD.
2. **Critical Low Moisture:** When the level drops further (implicitly below 10), a **red LED** lights up, and the word **"water the plant"** is printed on the LCD.
3. **Watering Activation:** When the level reaches **4**, a 'one' is sent to the **relay module**. This signal activates the relay model (SRD-05VDC-SL-C module), putting the **water pump** on. Simultaneously, the **green LED** lights up.

**Wind Detection**

The system utilizes the tilt switch (LED-switch) fixed on the leaves to detect movement:

* The movement of the leaves causes the tilt switch to put **on and off**.
* If this switching action occurs **10 times**, it flags an **interrupt**.
* When the interrupt is flagged, the word **"wind available"** is shown on the LCD.