CSE360 Lab Project

Project Name: Automated Plant Monitoring System (APMS) based on Soil Moisture, Sunlight, Methane Detection & Temperature Monitoring with Arduino Uno R3

Section: 1

Group: 5

Submitted by:

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Introduction:

This project paper discusses the design, development, and implementation of an Automated Plant Monitoring System (APMS) aimed at improving agricultural efficiency and plant sustainability. The system leverages an Arduino Uno R3 microcontroller coupled with an array of sensors to measure critical environmental parameters such as soil moisture, methane concentrations, proper sunlight and temperature. The system will read the moisture value of the soil using soil moisture sensor and amount of sunlight, according to that a motor will be turned on or off to water the plant. Additionally the system should determine current temperature from the Temperature sensor and detect any presence of harmful methane gas with the Gas sensor. In case such values surpass the threshold limit, a buzzer will be turned on to report the situation immediately.

By automating the data collection process, the APMS provides continuous, real-time monitoring of plant growth conditions, allowing for timely interventions and informed decisions in plant care. Through practical application and rigorous testing, the APMS proves its capability to support farmers in the transition to a more technologically integrated and environmentally friendly form of agriculture.

Application Area:

- **Indoor Gardening:**

  Simplify the task of nurturing indoor plants and nursery greenery with an automated system. This ensures a seamless watering schedule, fostering optimal plant health.

- **Customised Plant Care:**

  Tailor the plant monitoring system to specific plant species and their unique requirements. The flexibility of the Arduino Uno R3 allows for customization of parameters such as watering intervals, temperature thresholds, and methane concentration limits, ensuring precise care for diverse plant varieties.

- **Urban Crop Cultivation:**

  The use of APMS could significantly improve plant maintenance routines by ensuring optimal growing conditions, thus enhancing agricultural productivity. This promotes effective resource management and reduces manual labour.

- **Water Conservation in Arid Zones:**

  Tackle water scarcity challenges in drought-prone areas by optimising water usage for effective plant hydration.

Technology & Equipments:

- Arduino Uno R3
- Tinkercad
- Arduino IDE
- YL-69 Soil Moisture Sensor
- MQ4 Methane Gas Sensor
- TMP36 Temperature Sensor
- LDR Sensor
- Mini DC Water Pump
- 5V Relay Module
- MB102 Large Breadboard
- 16x2 Standard LCD Module Display
- 5V Passive Buzzer
- LED light
- Jumper Wires
- 470 Ohm & 1 KOhm Resistors
- Plant & Soil

Programming Language:

In order to control the entire system, a modified version of C++ serves as the programming language, conventionally applied through the Arduino IDE.

Working Mechanism of Sensors:

- **YL-69 Soil Moisture Sensor :** This is a simple humidity sensor with a power indicator and a digital switching output indicator that is also used to measure soil moisture. In our project, we are using the sensor to identify the condition of the soil. This sensor will help us to identify whether the soil is dry, wet or optimum. It will send readings to the Arduino, which will show the condition via the LCD monitor. Alongside, if the moisture shows dry, the automated watering system will kick in by the control of Arduino, and it will start watering the soil. When the soil moisture will become normal, the sensor will send a signal to Arduino which in return will stop the water pump. Again on rainy days, as the sensor will detect the water level as full, Arduino will not start the watering unless the moisture condition drops to a certain threshold.

- **MQ4 Methane Gas Sensor :** The MQ4 methane gas sensor is a Metal Oxide Semiconductor (MOS) type gas sensor that is mostly used to measure the concentration of methane (CNG) gas in the air. As we know, methane gas can cause damaging problems to the trees. So, it is necessary to identify if a location contains an excessive amount of methane gas or not. In our project, the gas sensor shows its values through the LED connected with the Arduino. By measuring the values, we will be able to identify if the area is safe of extreme methane gas.

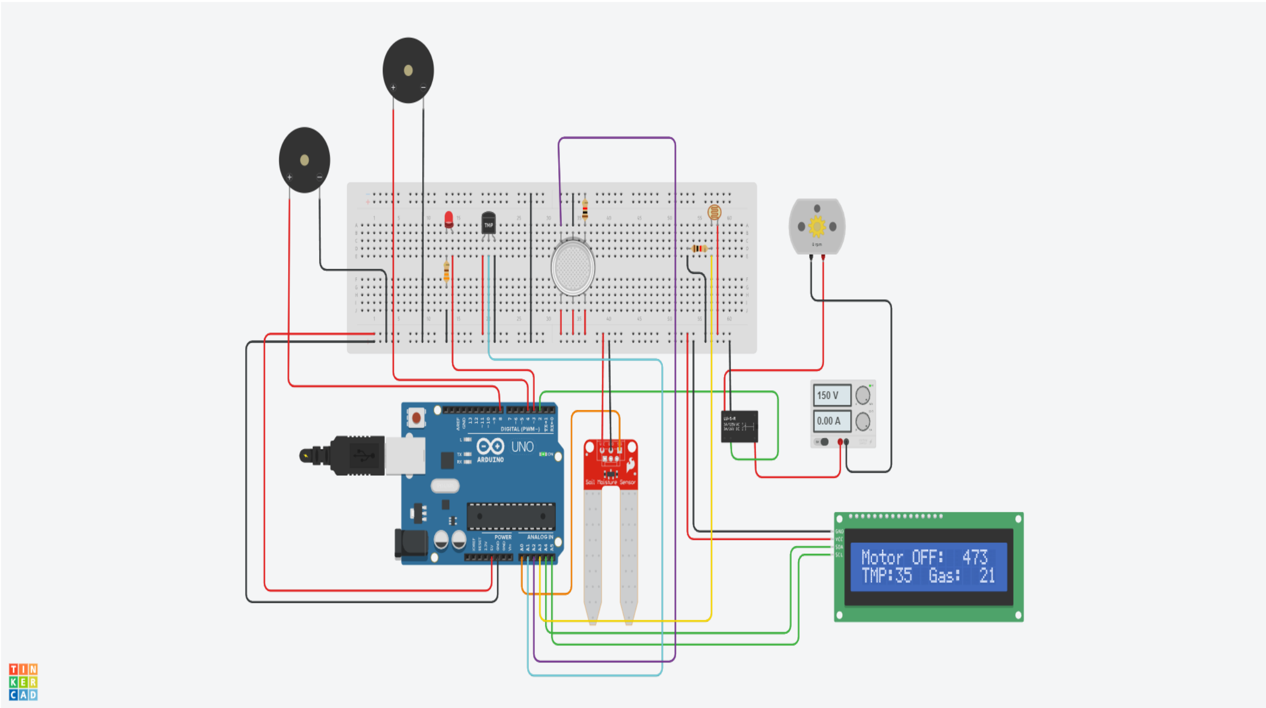
- **TMP36 Temperature Sensor :** The TMP36 is a low voltage, precision centigrade temperature sensor which operates from 2.7V to 5.5V. With this sensor integrated in our project, we want to identify the temperature in the environment to measure if it is safe for the plants. For our experiment, we decided that a 25-30 Decree is best for a tree, meaning if the temperature is below 25 or above 30, the Arduino will send a signal which will turn on a LED light and start a buzzer. If it is cold a blue LED will turn on, and if hot, a red LED will turn on instead. By this we can take necessary steps to stabilise the temperature for the plants.

- **LDR Sensor :** Light Dependent Resistors, or LDRs, are particularly helpful in circuits involving light and dark sensors. When exposed to light, their resistance to it drastically decreases. By doing that, it measures the light amount around itself. We are using a LDR sensor to identify how much sunlight falls over a place and taking readings from it we can determine if a plant is getting enough sunlight or getting more than needed and take necessary cautions.

Connection with ICs:

Here, The 5V pin and the GND pin are connected to the breadboard's positive and negative series sequentially. A0 pin is connected to the Signal pin on the Soil Moisture Sensor. A1 is connected to the Vout of the TMP36 Temperature Sensor. A2 is connected with the MQ4 Methane Gas Sensor. A3 is connected with the LDR sensor. SDA and SCL of the LCD monitor are connected to the A4 and A5 pin of the Arduino. Pin D2 is connected with the Relay Module which in turn is connected with the Water Pump. D3 is connected to a LED Anode. D4 and D8 are connected with the Buzzers for Gas and Temperature respectively. Vcc and GND of all the components are connected with the Positive and Negative pins of the breadboard.

Diagram:



Check Diagram Simulation

Estimated Cost Analysis:

Components	**Estimated Price(BDT)**
Arduino Uno R3(ATmega328)	1,100
YL-69 Soil Moisture Sensor	120
MQ4 Methane Gas Sensor	180
TMP36 Temperature Sensor	199
MB102 Large Breadboard	159
Mini DC Water Pump	150
16x2 Standard LCD Module Display	340
LDR Sensor	75
5V Relay Module	75
Jumper Wires	100
LED Light	20
Total Estimation	**2,518**

Conclusion:

In conclusion, the project presented in this paper underscores the significant potential of the Automated Plant Monitoring System in transforming agricultural practices. By integrating a suite of sensors with the Arduino Uno R3 microcontroller, the system effectively monitors crucial environmental factors such as soil moisture, amount of sunlight, methane levels, temperature and water supply which are vital in ensuring optimal plant growth. The utilisation of such an automated system could lead to substantial improvements in crop yield, resource efficiency, and sustainability of food production. Ultimately, with ongoing development and adaptation, this automated monitoring system stands to offer a valuable contribution to the field of agriculture, potentially revolutionising the way we grow our food and manage natural resources.

Future Work:

- **Check Plant condition:** Including sensors that measure the concentration of key nutrients like nitrogen, phosphorus, potassium etc in the soil. Image sensors can help in the early detection of pests on crops.
- **pH condition:** Integrating pH sensors would ensure that the soil acidity or alkalinity is maintained.
- **Optimal weather condition:** Optical Rainfall Sensors can detect rain events, allowing the system to adjust irrigation schedules .
- **A compact System:** The system along with all the equipment can be made compact so that it can be fitted anywhere.

Responsibilities of Each Member:

- **M.A. Diganta**
  - Diagram Design
  - Cost analysis & tools selection
- **Sanjida Afroz Shefa**
  - Coding and analysis of Methane Gas Sensor
  - Research work.
- **Lamia Khan Shoily**
  - Coding and analysis of Temperature Sensor
  - Applicable fields and future prospects
- **Zaki Habib**
  - Sensors mechanism
  - Coding and analysis of LDR Sensor
- **Sadat Hossain**
  - Physical Implementation
  - Equipments assembling

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