

GNANAMANI COLLEGE OF TECHNOLOGY  
DEPARTMENT: BIO MEDICAL ENGINEERING

YEAR: Third Year

TOPIC: ENVIRONMENTAL MONITORING

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## **PROBLEM:**

Let's consider a common environmental monitoring problem:

Monitoring soil moistures in a garden to optimize irrigation and conserve water resources.

## **SOLUTION USING IOT AND ARDUINO:**

### **COMPONENTS NEEDED:**

#### **1.ARDUINO BOARD:**

You can use an Arduino Uno or Arduino Nano for this project.

#### **2.SOIL MOISTURE SENSOR:**

A soil moisture sensor to measure the moisture level in the soil.

#### **3.WIFI MODULE:**

An IOT Wi-Fi module like a ESP8266 or ESP32 for internet connectivity.

#### **4.POWER SOURCE:**

A power source for your Arduino and Wi-Fi module (e.g. Batteries or a power adapter).

#### **5.BREAD BOARD AND JUMPER WIRES:**

To connect and prototype the circuit.

#### **6.CLOUD PLATFORM:**

Choose an IOT cloud platform AWS IOT,google cloud IOT or adafruit.

## **SOLUTION STEPS:**

### **1.CONNECT THE HARDWARE:**

- \* Connect the soil moisture sensor to the Arduino board.
- \* Connect the wifi module to the Arduino for internet connectivity.

## 2.CODE THE ARDUINO:

- \* Write Arduino code to read data from the soil moisture sensor.
- \* Use the Wi-Fi module to send this data to your choose IOT cloud platform.

## 3.SET UP CLOUD PLATFORM:

- \* Create an account on your choose IOT cloud platform.
- \* Set up a device and topic for your Arduino to publish data to.

## 4.PUBLISH DATA:

- \* Modify your Arduino code to publish soil moisture data to the cloud platform at regular intervals(e.g. Every 15 minutes).

## 5.DATA STORAGE AND VISUALIZATION:

- \* Use the cloud platform services to store and visualize the data.
- \* Create graphs or dashboards to monitor soil moisture levels remotely.

## 6.THRESHOLD AND ALERTS:

- \* Define moisture level threshold for your specific plants.
- \* Set up alerts or notifications throw the cloud platform when moisture levels fall below or exceed these thresholds.
- \* With this IOT and Arduino solution, you can monitor soil moisture levels *remotely, enabling you to optimize irrigation and prevent under watering.*
- \* It conserves water resources by ensuring that plants receive the right amount of water.
- \* Alerts and notifications help you take timely action when moisture levels or not with in the desired range.

- \* The data collector over time can also provide insights into plant health and watering patterns, helping you make informed decisions.

## **USES:**

\*Environmental monitoring often involves the use of strategically placed data collection points to gather information about various environmental factors such as air quality, water quality, temperature and more.

\*These points can be sensors or monitoring stations that help assess the state of the environment and track changes over time.

## **ADVANTAGES:**

### **Resource Management:**

- \* Helps in the sustainable management of natural resources like water, air, soil, ensuring their preservation for future generations.

### **Public Health Protection:**

- \* Monitoring can identify threats to public health, such as air quality issues or contaminated water sources, allowing for interventions.

## **DISADVANTAGE:**

### **Environment Impact:**

- \*The monitoring process itself can have environmental consequences.

### **Data Management:**

- \* Storing, managing, and analyzing large volumes of data can be challenging.

## **DEVELOPMENT OF ENVIRONMENTAL MONITORING:**

### **Selecting soil moisture sensors:**

- \* Choose appropriate soil moisture sensors. There are various types, including Capacitance sensors, resistance and TDR sensors. Select the one that suits your specific needs And budgeted.

### **Sensor placement:**

- \* Install the sensors at various depths in the garden to monitor moisture levels throughout the soil profile. Ensure they are evenly distributed to get a comprehensive view of moisture content.

### **Data collection:**

- \* Connect the sensors to a data logging system. This could be a microcontroller, IoT device, or a dedicated soil moisture monitoring system. Collect data at regular intervals

### **Weather data integration:**

- \*Integrate local weather data into your system. This can help you make irrigation decisions based on weather forecasts, preventing overwatering when rain is expected. Set

### **Setting thresholds:**

- \*Define moisture level thresholds that trigger irrigation. For instance, if the soil moisture drops below a certain level, the system should initiate irrigation.

### **Smart integration control:**

- \*Use actuators like solenoid valves to control integration. When the system detects that soil moisture is below the define threshold, it can automatically turn on the integration system.

### **Remote monitoring and control:**

\*Implement remote monitoring and control capabilities. This allows you to access the system's data and make adjustment from a smartphone or computer.

### **Feedback Loop:**

\*Continuously monitor the effectiveness of your system and make improvement as needed. Adjust the threshold levels and irrigation schedules based on the performance of your garden.

### **Alerts and Notification:**

\*Implement an alert system to notify you of any issues or emergencies, Such as sensor malfunction or unusually dry conditions.

### **Maintenance:**

\*Regularly maintain the sensors and irrigation equipment to ensure accurate and efficient operation.

### **Documentation:**

\*Keep detailed records of sensors readings, irrigation schedules, and any adjustment mode. This documentation can be valuable for future reference and improvement.

## **APPLICATION:**

### **1.Air quality monitoring:**

This involves measuring the concentration of pollutants such as particulate matter, ozone, and carbon monoxide to assess and mitigate air pollution.

### **2.Water quality monitoring:**

To ensure the safety to drinking water and protect aquatic ecosystems, water quality monitoring measures parameters like pH, dissolved oxygen, and contaminants like heavy metals.

### **3.Climate change tracking:**

Monitoring changes in temperature, carbon dioxide levels, and sea level rise to understand and address the impacts of climate change. Data from weather stations, satellites, and climate models are used.

#### **4.Biodiversity conservation:**

Environmental monitoring helps protect endangered species populations, habitat quality, and illegal activities such as poaching. Camera traps, GPS tracking, and acoustic monitoring are employed.

#### **5.Soil health assessment:**

Monitoring soil parameters like nutrient levels and erosion to optimize agricultural practices and prevent land degradation. Soil moisture sensors and remote sensing are commonly used.

#### **6.Waste management:**

Monitoring waste disposal sites and recycling efforts to reduce pollution and landfill use. Sensors and tracking systems are used to optimize waste collection and disposal

#### **7.Disaster preparedness:**

Monitoring natural disasters such as earthquakes, floods, and wildfires to provide early warning systems and coordinate disaster response efforts. Seismometers, weather satellites, and fire detection systems are involved.