**CONCEPT :**

Environmental monitoring refers to the tools and techniques designed to observe an environment, characterize its quality, and establish environmental parameters, for the purpose of accurately quantifying the impact an activity has on an environment.

**OBJECTIVE:**

Environmental objectives are the overall aims that your business sets itself to improve environmental performance through its EMS. They indicate the environmental aims of your business - eg to reduce waste going to landfill by 25 per cent over five years.

**IOT DEPLOYMENT**:

IoT environmental monitoring is a process that uses Internet of Things (IoT) technology to collect data about the environment, such as air quality, temperature, and humidity levels.

**PLATFORM DEVELOPMENT:**

IoT-powered environmental monitoring solutions, when installed for particular premises, can be used to identify the particulate matter in the air and capture the data through sensor devices. Organizations can transfer the data to a cloud platform for processing.

**CODE IMPLEMENTATION:**

Implementing an environmental monitoring system using IoT requires several components, including sensors, a microcontroller or IoT device, a communication protocol, and a data processing and visualization platform. Below is a simplified example of an environmental monitoring system using an Arduino microcontroller, a temperature and humidity sensor, and the MQTT protocol to communicate data to a cloud-based platform (in this case, we'll use Adafruit IO as the platform). This example focuses on monitoring temperature and humidity, but you can expand it to include other sensors as needed

Hardware Components

1. Arduino or compatible microcontroller board (e.g., ESP8266, ESP32).

2. DHT11 or DHT22 sensor (for temperature and humidity).

3. Wi-Fi module (if not built into the microcontroller).

4. Power source (battery or USB power).

5. Breadboard and jumper wires.

Software Components:

1. Arduino IDE (for programming the microcontroller).

2. Adafruit IO account (for data visualization).

Implementation Steps:

1. Set up your hardware by connecting the DHT sensor to the microcontroller and ensuring the microcontroller is connected to your Wi-Fi network.

2. Install the necessary libraries for your Arduino IDE. You can install libraries for the DHT sensor and MQTT communication.

3. Create an Adafruit IO account if you don't already have one. Set up a new feed to receive temperature and humidity data.

4. Write and upload the Arduino code to your microcontroller:

```cpp

#include <Adafruit\_MQTT.h>

#include <Adafruit\_MQTT\_Client.h>

#include <Adafruit\_MQTT\_Publish.h>

#include <ESP8266WiFi.h>

#include <DHT.h>

#define WIFI\_SSID "your\_wifi\_ssid"

#define WIFI\_PASS "your\_wifi\_password"

#define AIO\_USERNAME "your\_adafruit\_io\_username"

#define AIO\_KEY "your\_adafruit\_io\_key"

#define DHT\_PIN 2 // Use the GPIO pin connected to your DHT sensor

#define DHT\_TYPE DHT22

DHT dht(DHT\_PIN, DHT\_TYPE);

WiFiClient client;

Adafruit\_MQTT\_Client mqtt(&client, "io.adafruit.com", 1883, AIO\_USERNAME, AIO\_KEY);

Adafruit\_MQTT\_Publish temperature = Adafruit\_MQTT\_Publish(&mqtt, AIO\_USERNAME "/feeds/temperature");

Adafruit\_MQTT\_Publish humidity = Adafruit\_MQTT\_Publish(&mqtt, AIO\_USERNAME "/feeds/humidity");

void setup() {

Serial.begin(115200);

delay(10);

dht.begin();

WiFi.begin(WIFI\_SSID, WIFI\_PASS);

while (WiFi.status() != WL\_CONNECTED) {

delay(500);

Serial.println("Connecting to WiFi...");

}

Serial.println("Connected to WiFi");

mqtt.subscribe(&temperature);

mqtt.subscribe(&humidity);

}

void loop() {

Adafruit\_MQTT\_Client\* mqttClient = mqtt.connect();

if (mqttClient) {

float temp = dht.readTemperature();

float hum = dht.readHumidity();

if (!isnan(temp) && !isnan(hum)) {

Serial.print("Temperature: ");

Serial.print(temp);

Serial.println(" °C");

Serial.print("Humidity: ");

Serial.print(hum);

Serial.println(" %");

temperature.publish(temp);

humidity.publish(hum);

}

mqtt.disconnect();

} else {

Serial.println("Failed to connect to MQTT");

}

delay(60000); // Delay for 1 minute before sending data again

}

```

Replace the placeholders in the code with your Wi-Fi credentials and Adafruit IO credentials.

5. Upload the code to your microcontroller.

6. Open the Serial Monitor in the Arduino IDE to view the sensor data being collected and sent to Adafruit IO.

7. In your Adafruit IO account, you can create a dashboard to visualize the temperature and humidity data from your IoT device.

This is a basic example to get you started with environmental monitoring using IoT. In a real-world scenario, you may need to consider additional sensors, error handling, security measures, and a more robust IoT platform depending on your specific requirements.

**The real-time environmental monitoring system benefits park visitors and promotes outdoor activities**

A real-time environmental monitoring system that utilizes the Internet of Things (IoT) technology offers numerous benefits to park visitors and promotes outdoor activities in various ways. Here's how:

1. \*\*Safety Assurance:\*\* IoT sensors can continuously monitor environmental conditions such as temperature, humidity, air quality, and weather forecasts. Visitors can access this information through mobile apps or park kiosks, ensuring they are adequately prepared for their outdoor activities. This promotes safety by helping them avoid extreme conditions or take necessary precautions.

2. \*\*Real-time Alerts:\*\* In case of sudden changes in weather, such as approaching storms or wildfires, the monitoring system can send real-time alerts to park visitors. This proactive approach helps visitors make informed decisions to protect their safety and encourages responsible outdoor exploration.

3. \*\*Enhanced Engagement:\*\* IoT technology can provide real-time information on wildlife sightings and plant life. Visitors can use dedicated apps to learn about the flora and fauna around them, enriching their outdoor experience and fostering a deeper connection to nature.

4. \*\*Trail and Activity Recommendations:\*\* Using data from IoT sensors and visitor preferences, the system can recommend specific trails, activities, or points of interest that match the current environmental conditions. This encourages visitors to make the most of their time in the park while ensuring a positive and enjoyable experience.

5. \*\*Crowd Management:\*\* IoT sensors can track the number of visitors in different areas of the park. This information can be used to manage crowds and direct visitors to less crowded areas, reducing the impact on the environment and ensuring a more serene outdoor experience.

6. \*\*Resource Conservation:\*\* Real-time monitoring allows park authorities to efficiently manage resources. For example, it can help optimize irrigation systems, ensuring that water is used sparingly and effectively to maintain the park's natural beauty. This environmentally friendly approach is appealing to ecologically conscious visitors.

7. \*\*Education and Awareness:\*\* IoT sensors can collect data on air and water quality, wildlife behavior, and more. This data can be shared with visitors, promoting environmental education and awareness. It encourages a greater understanding of the park's ecosystems and fosters a sense of responsibility for their protection.

8. \*\*Convenience:\*\* IoT-powered smart infrastructure, like connected restrooms, waste bins, and parking facilities, can enhance visitor convenience. For instance, smart parking systems can help visitors find available parking spaces quickly, making their trip more enjoyable and stress-free.

9. \*\*Data for Research and Conservation:\*\* The data collected by IoT sensors can be invaluable for park management and environmental researchers. It can assist in conservation efforts, better park planning, and ensuring the long-term sustainability of the park's natural resources.

10. \*\*Personalized Experiences:\*\* IoT technology can offer visitors personalized experiences by tailoring recommendations and information based on their preferences and past activities in the park. This makes outdoor activities more engaging and encourages return visits.

In summary, a real-time environmental monitoring system that leverages IoT technology provides park visitors with improved safety, information, engagement, and convenience. It also benefits the environment by promoting responsible outdoor activities and resource conservation. By creating a more enjoyable and educational experience, it encourages people to explore and appreciate the natural beauty of parks, ultimately contributing to the sustainability and preservation of these outdoor spaces.