IDEASTUDIO
THE MAKERSPACE @ WEST HOUSTON INSTITUTE

Module 3 - micro:bit Soil and Environment Data Analysis

Overview

This intermediate module extends your micro:bit skills from live sensing to data logging, analysis, and simple forecasting. You will log soil moisture (plus light, sound, temperature) with a BBC micro:bit, export a CSV, and analyze it in Google Colab. You'll visualize trends and build a small XGBoost model to forecast soil moisture. This project serves as a first step into ML and IoT.

Outcomes

After completing this training, you should be able to:

a. Configure and flash a .hex logger to a micro:bit using Microsoft MakeCode.
b. Log soil/environmental data to the micro:bit and export a CSV dataset.
c. Perform EDA(plots, correlations, outliers) on the dataset in Colab.
d. Build a simple time-series feature set(lags, rolling stats) and train an XGBoost regressor.
e. Evaluate model performance (e.g. RMSE) and interpret results to inform watering decisions.

Assessment

To successfully complete this training, you will need to demonstrate competency and earn at least 20 points on the assessment. The following are the individualized criteria on which you will be assessed.

CRITERIA	Needs Work (0 points)	Competent (5 points)	Exceptional (10 Points)
Configure & flash logger(micro:bit)			
Log & export CSV			
Explain EDA and Visualizations			
ML Forecast & Eval			
TOTAL SCORE:			

IoT with micro:bit - Sensors to Data Insights

The soil data logging project is a practical way to explore the micro:bit's ability to function as an IoT edge device, bridging the gap between physical sensing and digital analysis. In this training, you will collect soil moisture and environmental readings, store them as datasets, and process them in the cloud for visualization and forecasting. By combining hands-on electronics with data science tools, the project demonstrates how microcontrollers can support smarter environmental monitoring and decision-making.

This project highlights:

- Input sensing & logging: Recoding soil moisture and related environmental data over time.
- Data export & integration: Transferring collected data into CSV format for cloud-based analysis.
- Insight generation: Using Python and machine learning models to visualize trends and forecast future soil conditions.

Step-by-Step Instructions

1. Set Up Your Hardware

   You will need:

   a. 1 x BBC micro:bit(V2 for extended features)
   b. 1 x micro:bit Sensor Shield V2
   c. 1 x Soil Humidity Sensor(analog output)
   d. 3 x Jumper Wires
   e. 1 x micro:bit battery pack(2 x AAA)
   f. 1 x USB cable (micro-USB)
   g. A computer with internet access

2. Software Setup
   In this step, we will flash the code to micro:bit using MakeCode Web IDE either with instructions or with prepared .hex file in our GitHub repository.
   a. Get the logger:
   Introduction-to-Electronics-on-microbit/3-Microbit_Soil_Data_Analysis/Software_Setup at main · WestHoustonInstitute/Introduction-to-Electronics-on-microbit. Download the microbit-data-log.hex
   b. Review/customize in Makecode:
   Open https://makecode.microbit.org → Import → Import File → select microbit-data-log.hex. After you open the file, confirm the data and log frequency (e.g. every 1-5 seconds). Adjust as needed

c. Flash the micro:bit:

- Connect the micro:Bit over USB; a MICROBIT drive appears. Click on "Download" inMakeCode and pair the device with your computer. After that it should automatically start downloading.

3. Hardware & Data Logging

In this step, we will simply connect the sensor to the micro:bit using a "shield" for the pins.

a. Open the *2-)Hardware_Setup* folder and follow the image steps.

b. Wire the soil sensor to the shield:

VCC → 3V

GND → GND

SIG → Pin 0

c. Insert the soil probe into soil.

d. Power & start logging:

- Power via USB or a battery pack (not both at the same time, as it stalls the micro:bit).
- The program logs at your set interval to the micro:bit's storage.

e. Export the CSV:

- Finish data logging, and reconnect data to the computer over USB. Open MY_DATA.HTML file and click on "Download" to export the CSV file to your computer's 'Downloads' folder.

4. Data Analysis & ML (Google Colab)

You'll use our starter notebook to keep things simple and reproducible.

a. Open the notebook:

- Go to Google Colab → https://colab.research.google.com
- Go to our GitHub repo and download Introduction-to-Electronics-on-microbit/3-Microbit_Soil_Data_Analysis/Software_Setup/Soil_Moisture_ML_Microbit .ipynb at main · WestHoustonInstitute/Introduction-to-Electronics-on-microbit. Upload it to → Google Colab.

b. Upload your CSV:

- In Colab left sidebar → Files → Upload files → select your exported .csv. This step is also shown in the notebook.

c. Run the notebook

Troubleshooting

- No readings in CSV? Check sensor wiring and confirm the soil sensor is connected to Pin 0. If the CSV shows blank rows, re-flash the logger .hex file and restart logging.
- Always shows 0 in data? Ensure the probe is fully inserted into soil and not left in open air. Test by moistening the probe with water, values should rise.
- No CSV file available? Verify the logger code was flashed correctly. After logging, reconnect the micro:bit and open the MY_DATA.HTML file to download your .csv. If the file is missing, re-run the logger setup and log for at least 1-2 minutes.
- Weak/unstable numbers? Confirm jumper wires are firmly connected and the soil has consistent contact.
- Colab libraries not working?

  !pip install numpy pandas matplotlib seaborn xgboost

  Run the above code in an empty cell in Colab → Restart runtime and run everything again.