PM Tracker Manual

User Guide and Documentation

Version 3.0
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Contents

1 Introduction

1.1 Overview of the PM Tracker

The PM Tracker is a compact, intelligent device designed for continuous air quality monitoring. It measures a range of environmental parameters crucial for assessing atmospheric health and safety. Specifically, the device is capable of detecting particulate matter (PM) concentrations for three key size ranges: $PM_{1.0}$, $PM_{2.5}$, and PM_{10}. These fine airborne particles are known to pose significant health risks when inhaled, especially for individuals with respiratory conditions.

In addition to particulate matter, the PM Tracker monitors ambient temperature and relative humidity—both of which influence the behavior and concentration of airborne pollutants. Furthermore, the device is equipped with sensors to detect various gases such as carbon dioxide (CO_2), ammonia (NH_3), and nitrogen oxides (NO_x), providing a comprehensive overview of environmental quality.

1.2 Key Features

- **Multi-Parameter Sensing:** Simultaneous monitoring of $PM_{1.0}$, $PM_{2.5}$, PM_{10}, temperature, humidity, CO_2, NH_3, and NO_x.

- **Real-Time Data Acquisition:** Provides live environmental insights, useful for health assessments, industrial applications, and academic research.

- **User-Friendly Interface:** Operated through an intuitive menu system controlled by two rotary encoders, allowing users to navigate and adjust settings with ease.

- **Web Interface:** Allows remote access to sensor data over Wi-Fi for real-time visualization.

- **Data Logging:** Automatically logs data to onboard SD card and optionally syncs to Google Sheets.

- **Interactive Plots:** Includes zoomable graphs, adjustable axes, and screenshot functionality.

- **Power Options:** Operates using USB 5V supply or internal battery.

- **Custom Timestamping:** Supports both NTP-based and manual timestamp settings.

- **Email Alerts:** Sends automated daily reports and threshold warnings via email.

- **Multi-Device Networking:** Supports deployment in distributed networks; for setup support, contact Qosain Scientific.

1.3 Applications

The PM Tracker is suitable for a wide range of applications, including:

- Indoor and outdoor air quality assessments

- Smart building and HVAC system integration

- Environmental research and academic use

- Industrial and workplace safety monitoring

Designed for portability, ease of use, and robustness, the PM Tracker provides reliable environmental data to help users make informed decisions about their surroundings.

1.3.1 Specifications

The device is equipped with several modern features and hardware components, offering robust performance for environmental monitoring applications:

Technical Specifications:

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Parameter	Details
Particulate Matter Sensor (SSAP10)	PM1.0, PM2.5, PM10.0 ($\mu g/m^3$)
Detection Efficiency	50% at 0.3 μm, 98% at 5 μm
Measurement Range (PM)	0 to 1000 $\mu g/m^3$
Resolution (PM)	1 $\mu g/m^3$
Environmental Sensor (DHT22)	Temperature: –40°C to 80°C Humidity: 0% to 100% RH
Gas Sensor (MQ135)	NOx: upto 100 ppm (approx.) CO_2: upto 10000 ppm (approx.) NH_4: upto 300 ppm (approx.)
Display Type	OLED graphical display
Wi-Fi Connectivity	Enabled (local and web interface)
Data Storage	SD card (16–32 GB), Google Sheets
Power Supply	5V via USB adapter or internal battery
Firmware Upload Method	Via PRG Port (PlatformIO IDE)
Dimensions	Compact and portable form factor
Weight	Approx. 320 grams
User Interface	Menu-driven navigation via rotary encoders

Table 1: Technical Specifications of the PM Tracker

2 Device Setup

2.1 Powering the Device

To power on the PM Tracker, connect a regulated 5V power supply to the USB-C port labeled **BATT**. This port supports both wall adapter input and battery-based power sources, offering flexibility for indoor and portable use. Once connected, activate the

device by sliding the physical power switch to the **left** position. The device will initialize and begin its startup sequence, indicated by activity on the onboard LED display.

2.2 Hardware Interfaces

- **BATT Port (USB-C):** Used for powering the device through a 5V adapter or USB power bank.

- **Power Switch:** A sliding switch located on the side of the device. Sliding it left powers on the unit; sliding it right turns it off.

- **Reset Button:** A dedicated Reset button is available on the device. Pressing this button will reboot the system, reinitialize all hardware components, and return the user to the main menu. This is useful for troubleshooting or recovering from system errors without disconnecting power.

- **PRG Port (Programming):** This port is reserved for firmware uploading and debugging. It allows the user to connect the device to a computer for programming using a standard USB-to-serial interface or compatible programming cable.

2.3 Initial Power-On Checklist

1. Ensure all components are properly connected and that the SD card is already inserted.

2. Connect the power supply to the BATT port.

3. Slide the power switch to the left to turn on the device.

4. Wait for the device to boot and initialize its sensors.

Following successful initialization, the main menu will appear on the display, and the PM Tracker will be ready for operation.

Figure 1: **Left:** Side view of the PM Tracker showing the BATT (USB-C) port, power switch, reset button, and PRG (programming) port. **Right:** Initialization stages of the PM Tracker.

3 Startup Process

3.1 System Initialization

When the PM Tracker is powered on, it automatically begins its initialization routine. During this process, the device performs the following tasks:

- **Sensor Initialization:** All onboard sensors—including those for particulate matter, temperature, humidity, and gas concentrations—are initialized and prepared for data acquisition.

- **OLED Display Activation:** The OLED screen is powered on, and the user interface is loaded.

- **SD Card Detection:** The system checks for the presence of a valid SD card. If detected, it prepares the file system for data logging.

3.2 Main Menu Interface

After successful initialization, the device transitions to the main menu screen. The first option, **Start Data Collection**, is highlighted by default if internet is not connected. From this menu, users can navigate through various functions using the rotary encoders. If any component (e.g., SD card or a specific sensor) fails to initialize, the system will display a corresponding error message to assist with troubleshooting.

4 User Interface and Controls

4.1 Rotary Encoders

The PM Tracker features two rotary encoders that serve as the primary input method for navigating the device's menu system and adjusting parameters:

- **Left Rotary Encoder:**
  - Rotating the encoder navigates **left or right** within menu tabs or horizontal options.
  - Pressing the encoder acts as a **Back** button, returning the user to the previous screen or menu level.

- **Right Rotary Encoder:**
  - Rotating the encoder navigates **up or down** through menu items or increases/decreases numerical values.
  - Pressing the encoder confirms a selection or enters a submenu.

4.2 Display and Feedback

An integrated **OLED display** presents the menu interface, sensor readings, system messages, and real-time data in a clear, user-friendly format. This display ensures that users can interact with the device efficiently and monitor environmental parameters at a glance.

5 Network Behavior and Time Synchronization

5.1 Automatic Time Sync and Data Collection

After initialization, the PM Tracker checks for an active internet connection:

- If the device detects internet connectivity, it automatically fetches the current date and time from the network and transitions directly into **Data Collection Mode**, bypassing the manual menu interface.

- If no internet is found, the device waits for **30 seconds** while attempting to establish a connection in the background. If still unsuccessful, it proceeds to the **Menu Selection** screen but continues to search for a connection in parallel.
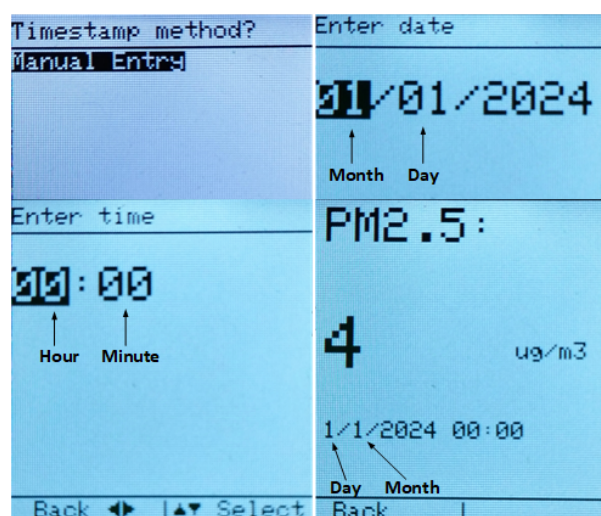

Figure 2: Manual date and time entry stages followed by the PM2.5 data collection screen. The interface allows users to set the timestamp manually if no internet is available, after which the device begins displaying real-time particulate matter data.

5.2 Manual Date and Time Entry

If internet remains unavailable, the user is prompted to enter the date and time manually through a guided interface:

1. The user first selects **Start Data Collection** from the menu.

2. A **Manual Entry** prompt appears, leading to the date adjustment window.

3. In the date window:

   - The first two digits represent the **month**.
   - The next two digits represent the **day**.
   - The final four digits represent the **year**.

4. After confirming the date, the system proceeds to the **Time Adjustment** window.

5. Once the time is configured, the device transitions to the **Data Collection** screen, where PM2.5 readings and the configured timestamp are displayed.

5.3 Realtime Sync and Auto-Correction

At any point during manual operation or data collection:

- If the device connects to the internet, it will automatically switch to **online mode** and begin synchronized data logging.

- If a manually entered timestamp is incorrect, the device will detect the discrepancy upon reconnecting to the internet and **automatically correct the date and time**.

5.4 Data Logging Behavior

- In the absence of internet, data is continuously saved to the onboard **SD card**.

- Once the device reconnects, it begins transmitting data to the connected **Google Sheet**, starting from the moment of reconnection.

6 Real-Time Visualization and Web Interfaces

The PM Tracker supports two methods for real-time data monitoring:

- **Local Interface (Wi-Fi-based)**

- **Online Web Interface**

6.1 Local Interface

The Local Interface enables direct access to the device's internal web server over your Wi-Fi network. Follow these steps:

1. Open your computer's **Command Prompt** and type `arp -a`, then press Enter.

2. This command lists IP and MAC addresses of all devices connected to your local network.

3. Identify the IP address corresponding to your PM Tracker by matching its labeled MAC address.

4. If you cannot locate the IP address using this method, log in to your router's admin panel and check the list of connected devices to find the matching MAC address.

5. Once you have the IP address, open a web browser on your laptop or mobile device, enter the IP address in the address bar, and press Enter.

You will be directed to the **Qosain Scientific Web Server** home page. Depending on the device state, you will see one of the following messages:

- `In case, if data collection is not active. ``No data and plot available".`

- `If data collection is active. ``Real-time data and plot"`

The following two options are available:

- **List Files**: Opens the file management interface.

- **Real-time Data and Plot**: Displays live sensor readings and dynamic plots.
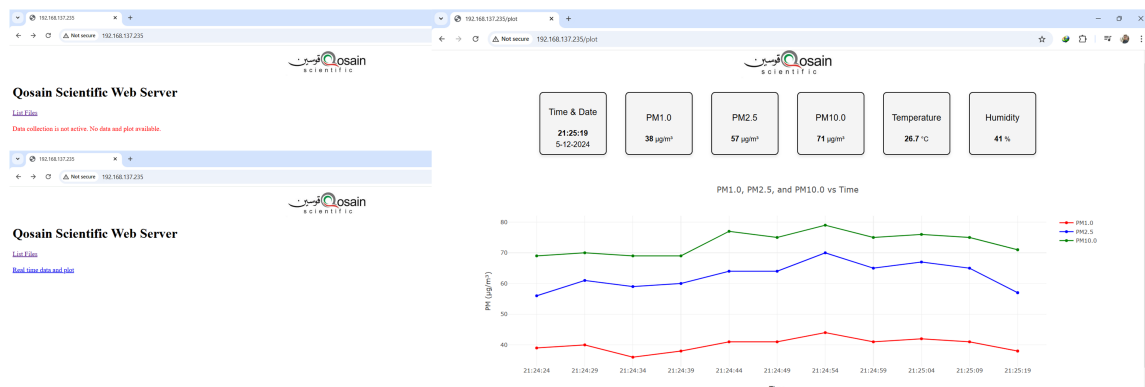

Figure 3: **Left:** The local Qosain Scientific Interface displays options depending on whether the device is actively collecting data. **Right:** The real time view and plot of particulate matter values PM1.0, PM2.5 and PM10.0.

6.1.1 File Management

In the "List Files" window, users can:

- View individual data files.

- Download specific files or **download all files** at once.

- Delete individual file or all the files at once to free up storage space.

- Download the `config.txt` file, which allows users to modify key device parameters.

The `config.txt` file contains settings such as:

- Wi-Fi credentials (SSID and password).

- Threshold values for PM2.5, temperature, and humidity.

- Email addresses for receiving daily alerts.

After modifying the `config.txt` file:

- Upload it back to the device using the "List Files" interface.

- **Do not change the file name**—it must remain `config.txt` for the device to recognize and apply the new settings.

- **Only edit the designated parameters**; changing other parts of the file may result in configuration errors.
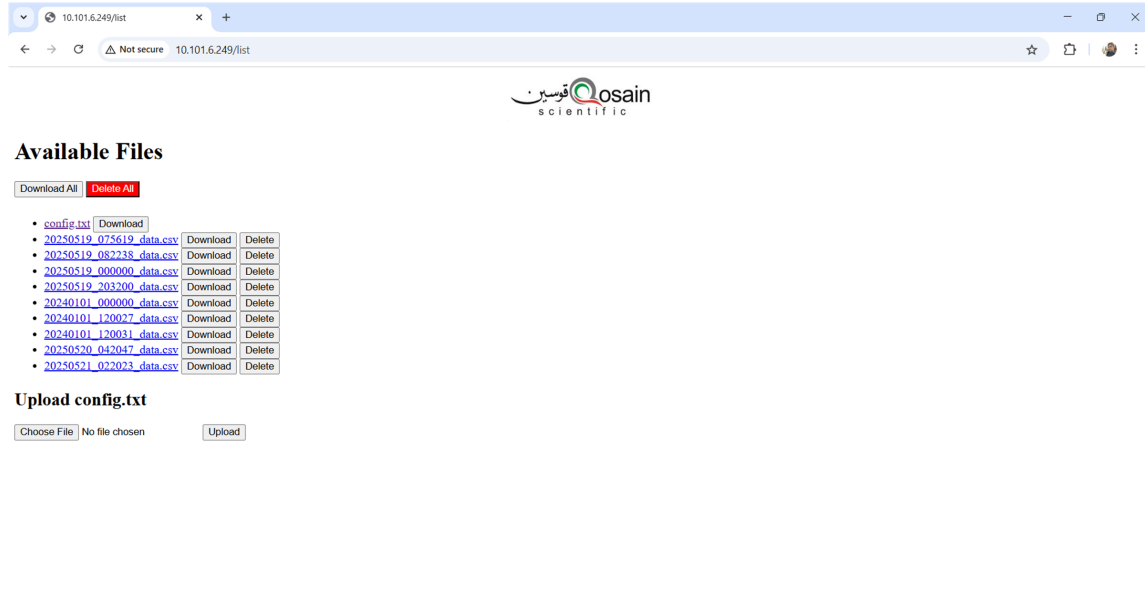
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Figure 4: Web interface showing available data files and the `config.txt` file for download, upload, and file management.

Note 1: If a data file is deleted, a new file with the same name (as defined during data collection) is automatically created and data logging resumes from the point of deletion.

Note 2: If you are unable to find the device IP address for accessing the web interface, simply power off the device, remove the SD card, insert into your computer's card reader, open the `config.txt` file on your computer, make the required changes, reinsert the SD card, and power the device back on.

Note 3: It is recommended to **download and archive files weekly** and delete older logs to ensure optimal storage performance.

6.2 Online Web Interface

The PM Tracker also supports a cloud-based web interface for remote access and visualization. Simply visit the provided URL to:

- View real-time sensor data.

- Access interactive plots.

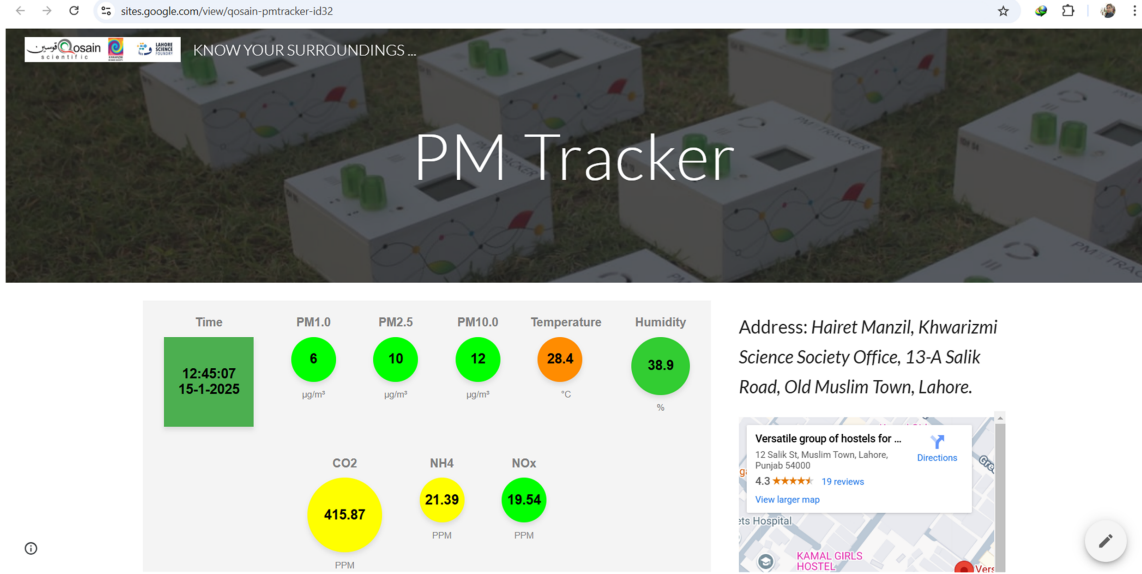- Collaborate and share readings via linked Google Sheets.

Figure 5: Real-time web interface accessible through the provided URL.

6.3 Visualization Window

The Visualization Window displays real-time readings for the following environmental parameters:

- Time

- PM1.0, PM2.5, and PM10.0 concentrations

- Temperature

- Humidity

In addition to numerical values, the interface includes dynamic plots for PM1.0, PM2.5, and PM10.0. These plots feature interactive controls such as:

- Zoom in/out functionality

- Adjustable axes

- Screenshot capture for saving plot images

Each time the visualization window is opened, the plots are reset and begin fresh. However, data logging to the SD card continues uninterrupted from the start of the data collection session, ensuring all readings are securely stored for future analysis or retrieval.