



Lesson 5:

Data Collection with Drones

Data Collection

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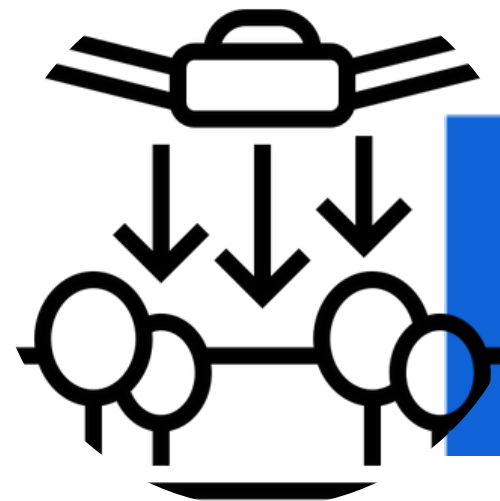


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Lesson Objectives

Learn to operate a drone for measurement and data collection

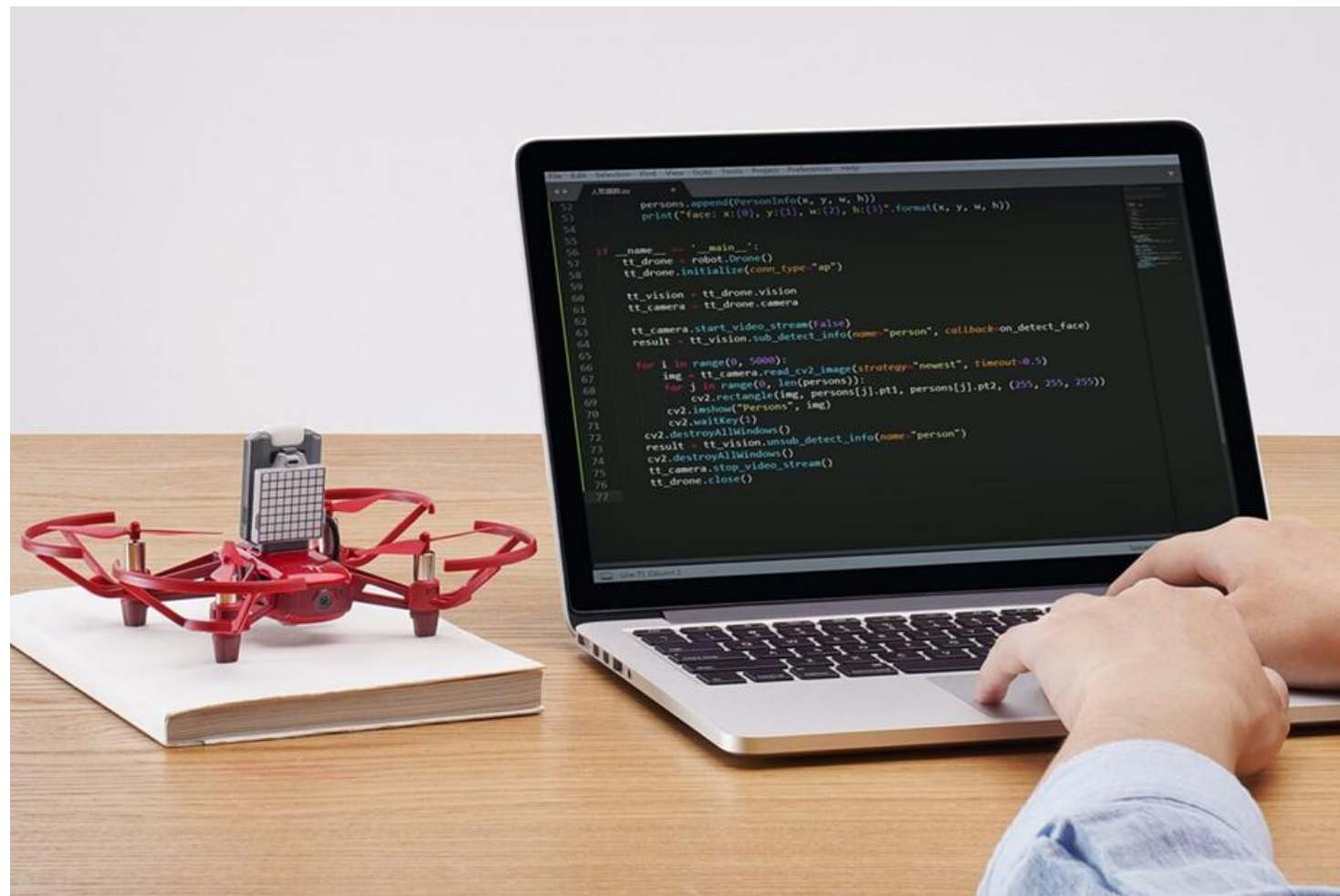


Got temperature, humidity, pressure and air quality data using a drone

Transfer and organize captured data for analysis



Materials Needed



HARDWARE

DJI Robomaster TT Drone

Drones4STEM FloorMat

PC SOFTWARE

MIND+ Scratch GUI Platform

Advance Flight Planning Project File

Indoor Drone Flying Safety Rules

1 Before the Flight:

- Inspect the Drone
 - Check for damage or loose propellers.
 - Ensure the battery is fully charged.
- Prepare the Area
 - Remove obstacles like chairs, desks, and other items.
 - Ensure a spacious and open environment.
 - Close Windows or air stream sources
- Inform Participants
 - Brief everyone on safety protocols.
 - Maintain a safe distance of at least 2 meters from the drone.

Indoor Drone Flying Safety Rules

2 During the Flight:

- Controlled Takeoff and Landing
 - Launch and land on a flat, stable surface.
 - Avoid flying near people or objects.
- Flight Boundaries
 - Keep the drone within visual line-of-sight.
 - Fly at low altitudes to avoid ceiling impact.
 - Land when battery <20%
- Emergency Protocol
 - Stop the drone immediately if it veers out of control. (SPACE initiates LANDING)

Indoor Drone Flying Safety Rules

3 After the Flight:

- Power Off Safely
 - Turn off the drone and disconnect the battery.
- Inspect for Damage
 - Check for any issues after flight.
- Store Safely
 - Keep the drone in a secure, dry place.

ALWAYS STAY CALM AND FOCUSED

Measuring Methodology

Before starting data collection:

- **Define the Objective:**
 - Identify the environmental data to be measured (e.g., temperature, humidity).
 - Select the area of interest for data collection.
- **Create a Flight Plan:**
 - Use mapping software to draw a grid or define waypoints covering the area of interest.
 - Plan for overlapping paths to ensure comprehensive data coverage.
- **Optimize Parameters:**
 - Set the desired altitude for accurate readings without disturbing the environment.
 - Adjust flight speed to match sensor data collection rates.
- **Execution:**

Measuring Methodology

Data Collection Techniques

- **Data Logging:**
 - Use drones equipped with onboard storage or data loggers to save sensor readings continuously.
- **Batch Data Transfer:**
 - Transfer data in batches to avoid overloading storage during long flights.
- **Data Compression:**
 - Compress data files to reduce storage requirements and enable faster transfer.
- **Real-Time Monitoring:**
 - Use a ground station to visualize incoming data and ensure its quality.
 - If anomalies occur, adjust the flight or sensor settings during the mission.
- **Post-Flight Data Management:**

Measuring Methodology

Pre-Flight Preparation

As we learned in the previous lesson, sensors must be integrated and calibrated before the flight. These are the main steps to do so:

- **Attach Sensors:**

- Securely mount environmental sensors (e.g., temperature or air quality sensors) to the drone using brackets or mounts.

- **Calibrate Sensors:**

- Before the flight, perform sensor calibration to ensure accurate measurements. For example:
- Use known temperature sources for temperature sensors.
- Place air quality sensors in a controlled environment for baseline readings.

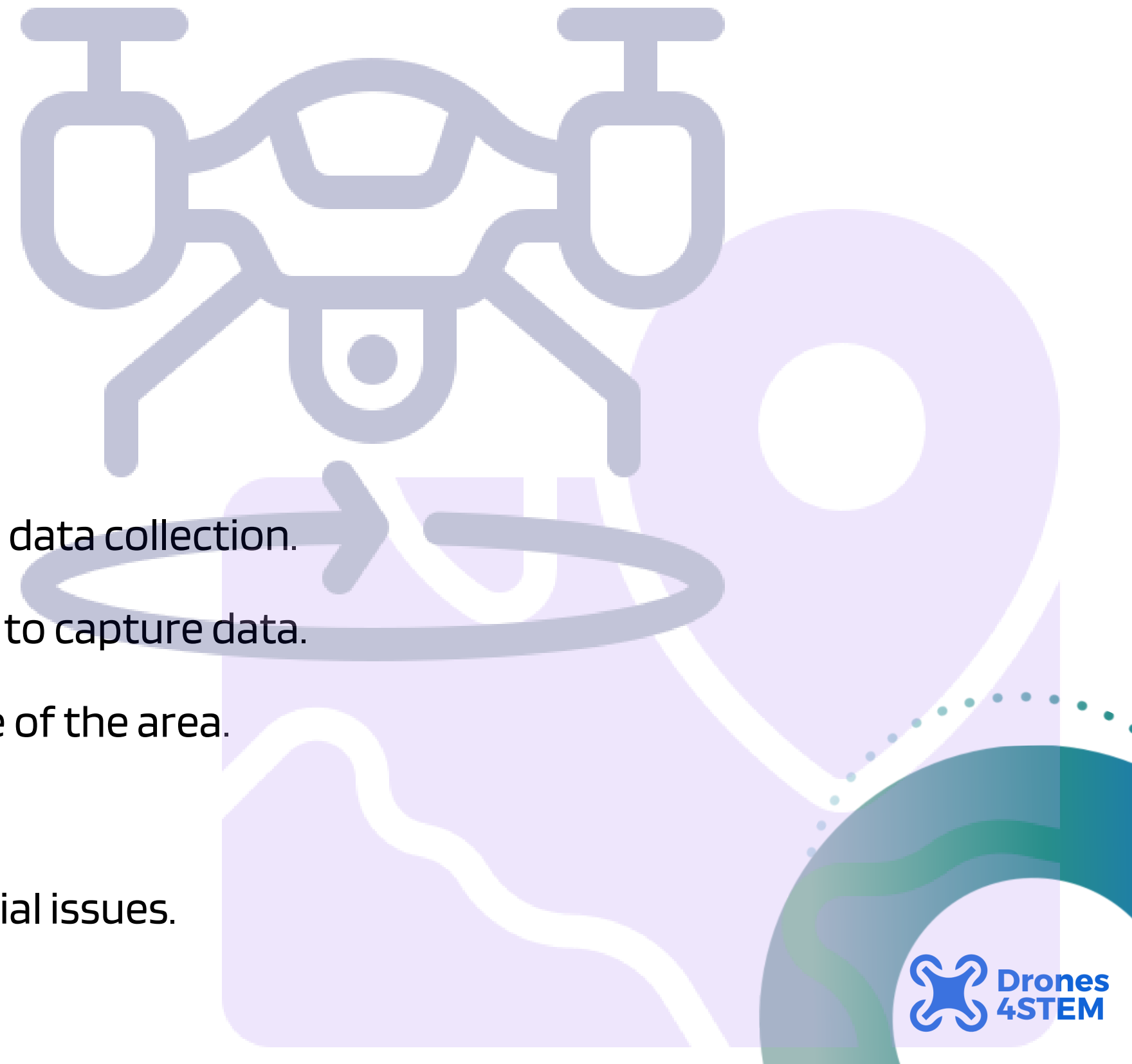
- **Connect to Drone:**

- Link sensors to the drone's onboard data logger or processor via wired or wireless connections.

Measuring Methodology

Pre-Flight Preparation: Software setup

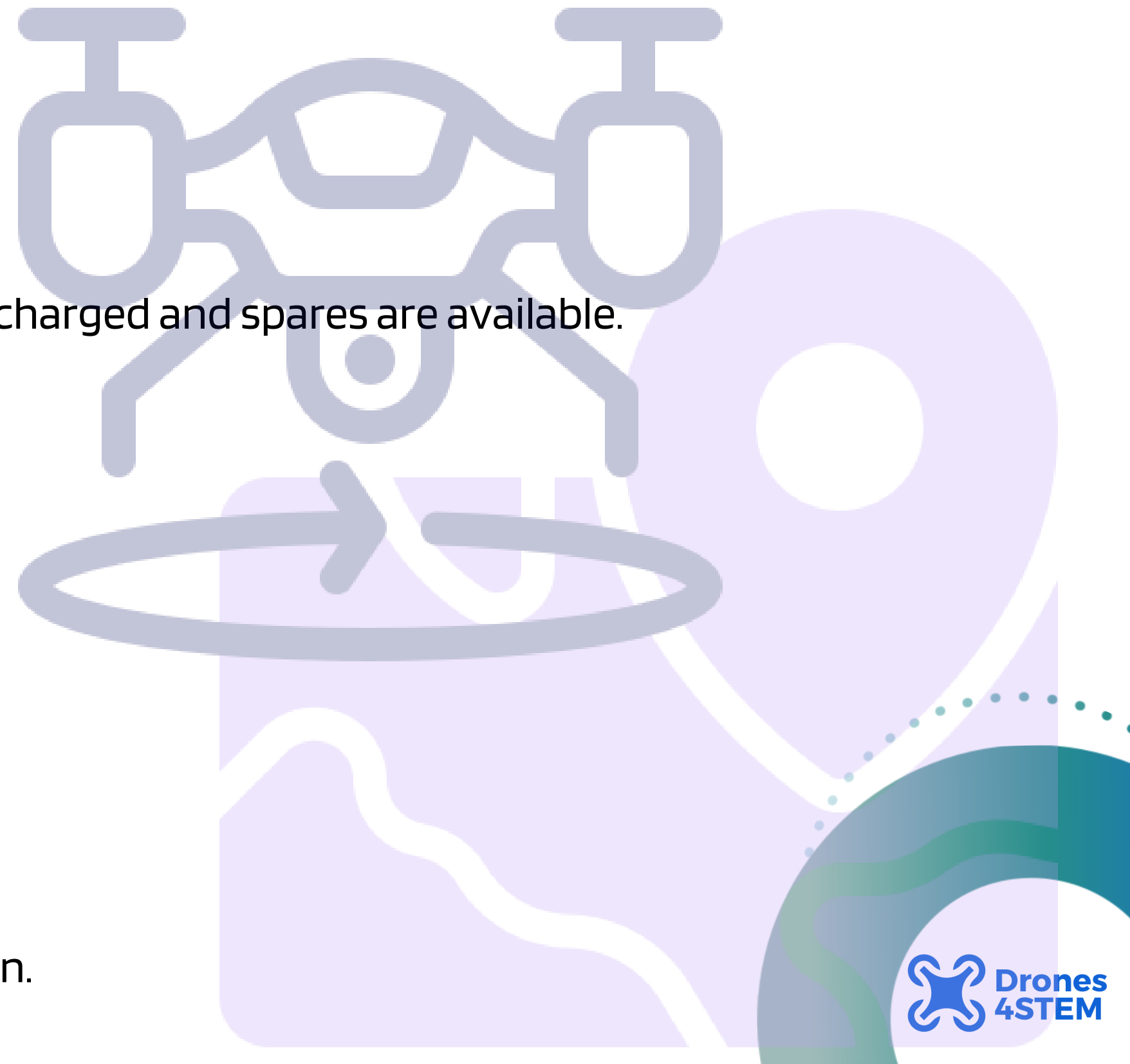
- **Install Drone Control Software:**
 - Use software to program the flight.
- **Create a Flight Plan:**
 - Define waypoints and set the parameters:
 - Altitude: Ensure it allows for safe flight and accurate data collection.
 - Speed: Adjust to match the time needed for sensors to capture data.
 - Duration: Calculate based on battery life and the size of the area.
- **Test the Configuration:**
 - Simulate the flight on the software to detect any potential issues.



Measuring Methodology

Pre-Flight Preparation: Safety Check

- **Battery Check:**
 - Ensure all batteries (drone, controller, and sensors) are fully charged and spares are available.
- **Sensor Check:**
 - Confirm that sensors are functioning and calibrated.
- **Weather Check:**
 - Avoid flying in high winds, rain, or extreme temperatures.
- **Drone Inspection:**
 - Inspect propellers, motors, and frames for damage or wear.
 - Test GPS signal and connection to the ground control station.
- **Emergency Protocols:**



Measuring Methodology

Flight Steps: Launch and Flight Execution

- **Launch:** Place the drone on a flat surface in the takeoff zone. Power on the drone and connect it to the control software.
- **Upload the Flight Plan:** Load the predefined waypoints and flight settings onto the drone.
- **Takeoff and Monitoring:**
 - Initiate takeoff and observe the drone as it stabilizes at the desired altitude.
 - Monitor the drone's position and performance throughout the flight.



Measuring Methodology

Flight Steps: Launch and Flight Execution

- **Data Collection:**

- **Sensor Readings:**

- Ensure sensors collect environmental data (e.g., temperature, humidity).
 - Check for real-time logging and verify that data is being stored onboard.

- **Hovering at Waypoints:**

- Ensure the drone pauses at each waypoint for accurate data readings.

- **Error Handling:**

- Monitor sensor outputs for anomalies and make real-time adjustments if needed.



Measuring Methodology

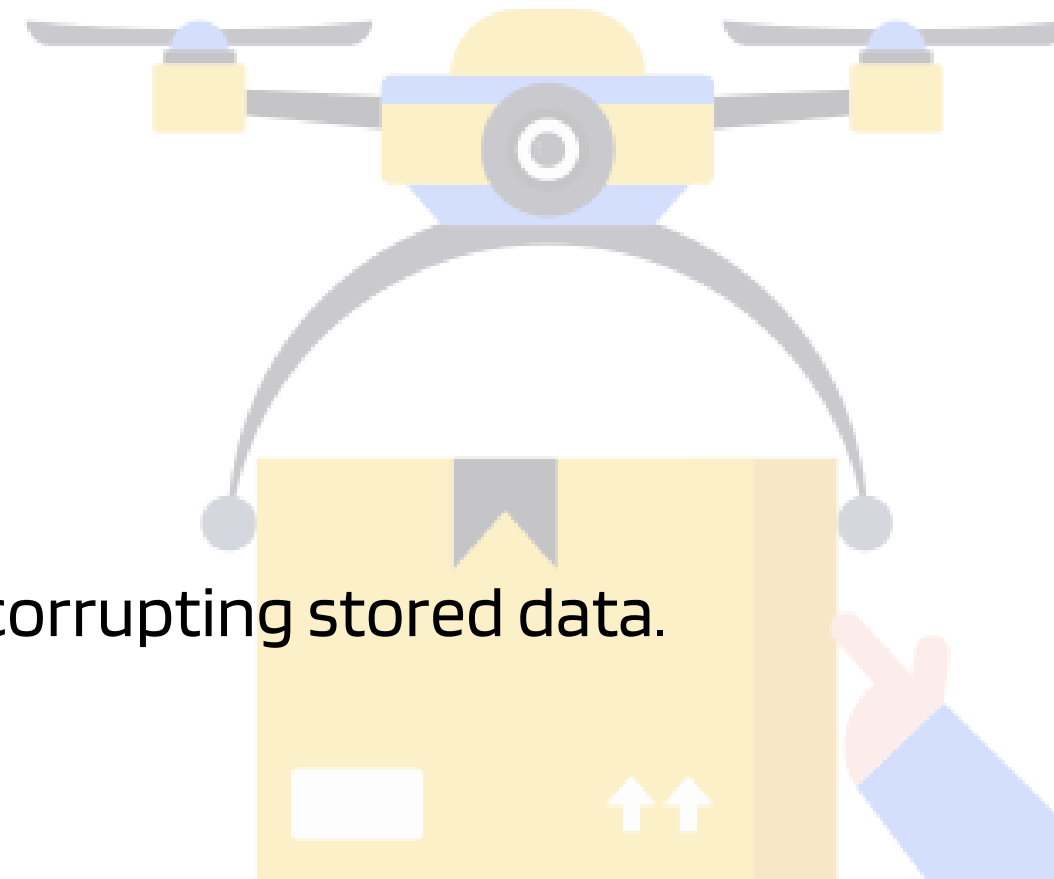
Landing and Data Retrieval

- **Landing:**

- Guide the drone to a safe landing area.
- Ensure the drone powers down properly to avoid corrupting stored data.

- **Data Retrieval:**

- Disconnect the data logging device from the drone.
- Transfer collected data to a laptop using USB, SD card, or Wi-Fi



Transferring data

How to Transfer Collected Environmental Data

- **Physical Methods:**

- Use a USB cable to connect the drone directly to a computer or tablet to access and transfer collected data files.
- Remove the drone's SD card and insert it into a card reader for data transfer. Ensure the data is saved in compatible formats like CSV or TXT for easy analysis.

- **Wireless Methods:**

- Use Wi-Fi for transferring data wirelessly to a computer or mobile device if supported by the drone.
- For smaller files or quick transfers, Bluetooth can be used, (it may be slower)

- **TIP:** After transferring, verify that all files are intact and not corrupted. Use a backup system, such as cloud storage or external hard drives, to safeguard the collected data.

Organizing Data

How to Organize Collected Data

- **Tips to organize measurements' data:**
 - Organize data based on location, date, or the type of measurement collected (e.g., temperature, humidity, air quality)
 - Use descriptive filenames to avoid confusion. For instance, rename files as 2024_Temp_RegionX_Day1.csv.
 - Use Spreadsheets or Data Analysis Tools:
 - Import the data into tools like Microsoft Excel, Google Sheets, or software designed for environmental data analysis.
 - Categorize, sort, and filter the data for easier processing.
- **TIP:** Encourage consistent naming conventions and systematic organization to make data retrieval and analysis straightforward and error-free.

Organizing Data

How to Organize Collected Data

- **There are several software and apps designed to read**
 - Excel and Google Sheets (General Purpose Tools)
 - OpenSenseMap
 - Arduino IDE with Sensor Libraries
 - Blynk IoT Platform
 - ThingSpeak
 - MyAirly or Plume Labs' Flow (Air Quality Specific)
 - QGIS (Geographic Information System)
- ***Which Should You Choose?:***
 - **For students and beginners:** Google Sheets, Blynk, or OpenSenseMap are ideal.
 - **For advanced analysis:** QGIS, ThingSpeak, or Arduino IDE.

Importance of Data Collection

How to Organize Collected Environmental Data

- **Why Accurate Data Collection Matters**

- Environmental data such as temperature, humidity, and air quality are crucial for monitoring changes in ecosystems. Inaccurate data can lead to incorrect conclusions, affecting research or conservation efforts.
- It has many applications:
 - Detect Trends: Identify long-term changes like climate shifts or pollution levels.
 - Support Decisions: Aid policymakers in creating sustainable strategies for environmental protection.

- **TIPS:**

- Data collected by drones can be used to create visualizations, such as graphs and charts, to understand trends and patterns.
- Combined with geographic data, environmental measurements can produce detailed maps highlighting affected areas, aiding in conservation planning or disaster response.

FAQ: Frequently Asked Questions

How to Organize Collected Environmental Data

- **What is the best way to transfer environmental data from drones?**

- For quick and reliable transfers, use USB cables or SD cards. For wireless setups, Wi-Fi is the preferred option for larger datasets

- **How can I prevent data loss?**

- Double-check data integrity after transferring. Save backup copies in multiple locations, such as external drives or cloud storage services.

- **Why is organizing environmental data important?**

- Well-organized data allows for faster and more accurate analysis.

- **How frequently should environmental data be collected?**

- Collection intervals depend on the goals of the project. For real-time monitoring, collect data continuously or at regular intervals (e.g., hourly or daily). For periodic assessments, monthly or seasonal collections might be sufficient.

Troubleshooting

1 Drone Connection

- Is the drone connected?
- Initiate connection again

2 Mission Start

- Did you add an event?
- Did you add the take off command?

3 Flight Path

- Check for correct commands
- Clockwise vs Counter Clockwise



Additional Resources

Further Reading

<https://www.croptracker.com/blog/drone-technology-in-agriculture.html>

Videos

<https://www.youtube.com/watch?v=263dJ7Fm>



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