ChronoSense

SCIENTIFIC SENSOR DATA SYSTEM

ChronoSense User Guide

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Introduction

ChronoSense is a data acquisition application designed specifically for science and technology classrooms. It enables teachers and students to collect, visualize, and analyze data from Microbit devices paired with various sensors. The application consists of two main components:

- ChronoSense Launcher: Allows you to launch and manage multiple instances of ChronoSense
- ChronoSense Application: The main data collection and visualization tool

This guide will walk you through both applications and explain all the features available to help you make the most of ChronoSense in your classroom.

ChronoSense Launcher

The ChronoSense Launcher allows you to run multiple instances of the ChronoSense application simultaneously. This is useful when:

- Working with multiple Microbit devices at once
- Collecting data from different experiments simultaneously
- Setting up a classroom with multiple student workstations

Getting Started with the Launcher

1. Open the ChronoSense Launcher in your web browser (file is csLauncher.html)
2. You'll see a clean interface with the ChronoSense logo and a single instance listed by default.
3. Each instance has:
    - An instance number (in a blue circle)
    - A name field that you can customize
    - A launch button (play icon)
    - A remove button (× icon)

Managing Multiple Instances

Adding a New Instance:

1. Click the "Add Instance" button at the bottom of the launcher.
2. A new instance will appear in the list with a default name "ChronoSense X" (where X is the instance number).
3. You can customize the name to identify what each instance will be used for (e.g., "Temperature Experiment", "Light Sensor Station").

Launching an Instance:

1. Click the launch button (play icon) next to the instance you want to start.
2. A new browser window will open running the ChronoSense application.
3. The instance name will appear under the ChronoSense title in the header.
4. Active instances will be indicated with a green dot in the launcher.

Removing an Instance:

1. Click the remove button (× icon) next to the instance you want to remove.
2. If the instance is currently running, the window will be closed.

Tips:

- Your instance configuration is saved automatically in your browser's local storage.
- When you reopen the launcher, your previously configured instances will still be available.
- Each instance operates independently with its own data collection and settings.

ChronoSense Data Collection Application

The main ChronoSense application is where you'll connect to Microbit devices, collect data, visualize results, and export your findings.

Connecting to a Device

1. In the ChronoSense application, locate the "Connect" button in the top-right corner.
2. Click the button to open a connection dialog.
3. Select your Microbit device from the list of available serial ports.
    - Note: Your Microbit must be connected via USB and have the appropriate code loaded to communicate with ChronoSense.
4. Once connected, the connection indicator will turn green, and the button will change to "Disconnect".
5. To disconnect, simply click the "Disconnect" button.

Data Collection

Once connected, ChronoSense will automatically:

1. Start receiving data from your Microbit device.
2. Display incoming data in the data table.
3. Dynamically create and label columns based on the data received.
4. Update the chart with real-time visualizations.
5. Show a count of records collected at the top of the data section.

Working with the Data Table

The data table displays all collected data with the following features:

- Status Column: Shows checksum validation status (green checkmark for valid data, red alert icon for invalid data).
- Timestamp Column: Shows when each data point was collected.
- Data Columns: Display values received from your Microbit device.
- Sort Order: Newest records appear at the top of the table.
- Row Coloring: Valid data rows have a slight green tint, while invalid data rows have a slight red tint (if checksum validation is enabled).

Data Visualization

The visualization panel allows you to create charts from your collected data:

1. Selecting Columns to Visualize:
    - Check the boxes next to column names you want to include in the chart.
    - Columns with checkboxes checked will appear on the chart.
2. Time Window Selection:
    - Use the "Time window to display" dropdown to control how much data is shown on the chart.
    - Options include: All data, Last 1 minute, Last 5 minutes, Last 15 minutes, Last hour.
3. Exporting Chart:
    - Click the "Chart PNG" button to save the current chart as a PNG image.
    - The file will be named with the instance name and timestamp.

Y-Axis Controls and Scale Settings

ChronoSense supports dual Y-axes for comparing different types of data:

1. Assigning Variables to Axes:
    - For each selected column, you can choose whether to display it on the Left or Right axis.
    - This is helpful when plotting values with different scales (e.g., temperature and humidity).
2. Scale Type Selection:
    - For each axis, choose between Linear and Logarithmic scales.
    - Logarithmic scales are useful when dealing with values that vary by orders of magnitude.
3. Scale Warnings:
    - ChronoSense will display warnings when it detects potential scale conflicts.
    - For example, if two variables on the same axis have very different ranges, it will suggest moving one to the other axis.
    - It may also recommend using logarithmic scale when appropriate.

Calibration

The calibration feature allows you to adjust sensor readings to match known reference values:

1. Opening Calibration:
    - Click the "Calibrate" button in the data collection panel.
    - The calibration modal will appear.
2. Selecting Column to Calibrate:
    - Choose which data column you want to calibrate from the dropdown.
3. Choosing Calibration Method:
    - Single Point (Offset): Applies a constant offset to all readings.
        - Enter the current reading from your sensor.
        - Enter the expected/known value.
        - The difference will be applied as an offset to all readings.
    - Two Point (Linear): Creates a linear transformation between two reference points.
        - Enter low point raw value and expected value.
        - Enter high point raw value and expected value.
        - ChronoSense will calculate the slope and intercept for the calibration line.
4. Applying Calibration:
    - Click "Apply Calibration" to implement the calibration.
    - All values in the selected column will be updated, including historical data.
    - The chart will also update to reflect the calibrated values.
5. Cancel or Close:
    - Click "Cancel" to exit without applying calibration.

Exporting Data

ChronoSense provides flexible data export options:

1. Manual Export:
    - Click the "Export CSV" button to save all collected data to a CSV file.
    - The file will include all data columns plus expanded timestamp information.
    - Expanded timestamps include date, time, day of week, month, hour, and minute columns.
2. Auto Export:
    - Set a value in the "Auto (min)" field to enable automatic exports.
    - ChronoSense will automatically export data at the interval you specify (in minutes).
    - This is useful for long-running experiments or as a safeguard against data loss.
3. Export Naming:
    - Exported files are named with the pattern: chronosense-data-[instance-name]-[timestamp].csv

- Chart images are named with: chronosense-chart-[instance-name]-[timestamp].png

Advanced Features

Checksum Validation

ChronoSense includes built-in data validation to ensure data integrity:

- The application assumes the last column of data from your Microbit is a checksum value.
- It validates this checksum against the other values to detect transmission errors.
- Valid data is indicated with a green checkmark, invalid data with a red alert icon.
- This helps identify potential issues with sensor readings or data transmission.

Auto-Export

For long-running experiments, ChronoSense offers automatic data export:

1. In the data collection panel, find the "Auto (min)" field.
2. Enter a number of minutes between automatic exports (e.g., 5 for exports every 5 minutes).
3. While connected to a device, ChronoSense will automatically export the full dataset at the specified interval.
4. Set to 0 to disable auto-export.

Renaming Columns

You can customize column names to better describe your data:

1. Click on any column header in the data table (except the Status and Timestamp columns).
2. The header will become editable.
3. Type a new name and press Enter or click elsewhere.
4. The column name will update in both the table and the chart.

Troubleshooting

Unable to Connect to Microbit:

- Ensure your Microbit is properly connected via USB.
- Check that you have the correct firmware loaded on your Microbit.
- Try a different USB port or cable.
- Restart your browser and try again.

No Data Appearing:

- Verify your Microbit is sending data in the correct format (comma-separated values).
- Check that your sensor connections are secure.
- Ensure your Microbit code is running properly.

Browser Compatibility:

- ChronoSense requires a browser that supports the Web Serial API.
- Chrome and Edge are recommended browsers for optimal compatibility.
- Firefox and Safari currently do not support the Web Serial API.

Export Issues:

- If export doesn't start, check if your browser is blocking downloads.
- Try disabling download blockers or add the ChronoSense site to your allowed list.