Arizona State University

From Sensor to Dashboard

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Lab 12 - Sense HAT Data Pipeline

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Today’s agenda

- Overview
- Architecture
  - Hardware Stack
  - Software Stack
- Database
- Dashboard

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Overview

- A Python script runs on your Raspberry Pi, continuously reading sensor data from the Sense HAT.
- Populate sensors data in a Relational database.
- Web application retrieves this database every few seconds and dynamically updates charts.

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Hardware Stack

Level 2: Monitoring and Spervisory (SCADA)

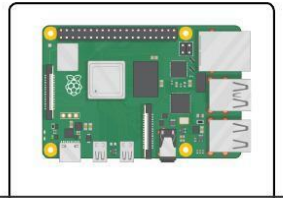
Laptop/PC

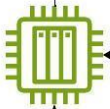
- Sends requests to the server to fetch the latest sensor readings from the database.
- Show the retrieved data into live charts(Dashboard)

Level 1: Control Level (Edge Comuputing)

Raspberry PI

- Runs the Python script to collect sensor data.
- Hosts the database to store the data.
- Server side to retrieve data





Database

Level 0: Field I/O Devices and Instrumentation

Sense HAT

Board attached into the Pi and contains the physical sensors:

- Temperature sensor
- Humidity sensor
- Barometric pressure sensor
- Gyroscope

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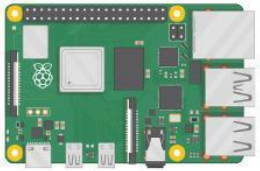
Software Stack

Windows 11

python™

pandas

plotly | Dash



Raspberry Pi OS

python™

PostgreSQL

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Database

```
group2@raspberrypi2:~ $ psql -U group2 -d iiot_lab -h localhost -W
Password:
psql (15.14 (Debian 15.14-0+deb12u1))
SSL connection (protocol: TLSv1.3, cipher: TLS_AES_256_GCM_SHA384, compression: off)
Type "help" for help.

iiot_lab=> SELECT * FROM sensor_data LIMIT 5;
 id |         timestamp          |    temperature     |      humidity      |       pressure       |       pitch        |        roll        |        yaw
----+----------------------------+--------------------+--------------------+----------------------+--------------------+--------------------+--------------------
  1 | 2025-10-30 00:24:44.50062  |  33.82613409902533 |  17.76518651089275 | -0.09650075752382414 |   359.276716210707 | 1.5159597392323896 | 147.64527596720086
  2 | 2025-10-30 00:24:49.520242 |  33.92345527576922 | 18.938091730490278 |    972.8105289427757 |   359.438957429322 |  0.863321130133361 | 151.57169217385274
  3 | 2025-10-30 00:24:54.541541 |  33.57753438090619 | 19.221512584929407 |    972.5658845017923 | 359.13970330964764 |  359.8900943254977 | 155.34679236963214
  4 | 2025-10-30 00:24:59.561363 |  33.75169561750492 | 18.493194893234072 |    972.4710781570033 |  358.6471522217801 |  359.3503469306202 | 158.98053497034897
  5 | 2025-10-30 00:25:04.58096  | 34.151312706303436 |  18.87310612903991 |    972.6015018133912 | 358.88804744427773 |  358.7365776474272 |  162.5551281328535
(5 rows)
```

Purpose

- It acts as a time-series log, storing historical sensor readings from the Sense HAT.

Data Flow

- New sensor readings are continuously added as new rows to the bottom of this table.

Columns

- id: A unique integer for each row
- timestamp: Records the exact date and time
- temperature: Stores the temperature value
- humidity: Stores the relative humidity
- pressure: Stores the barometric pressure
- pitch, roll, yaw: Store the three-axis orientation

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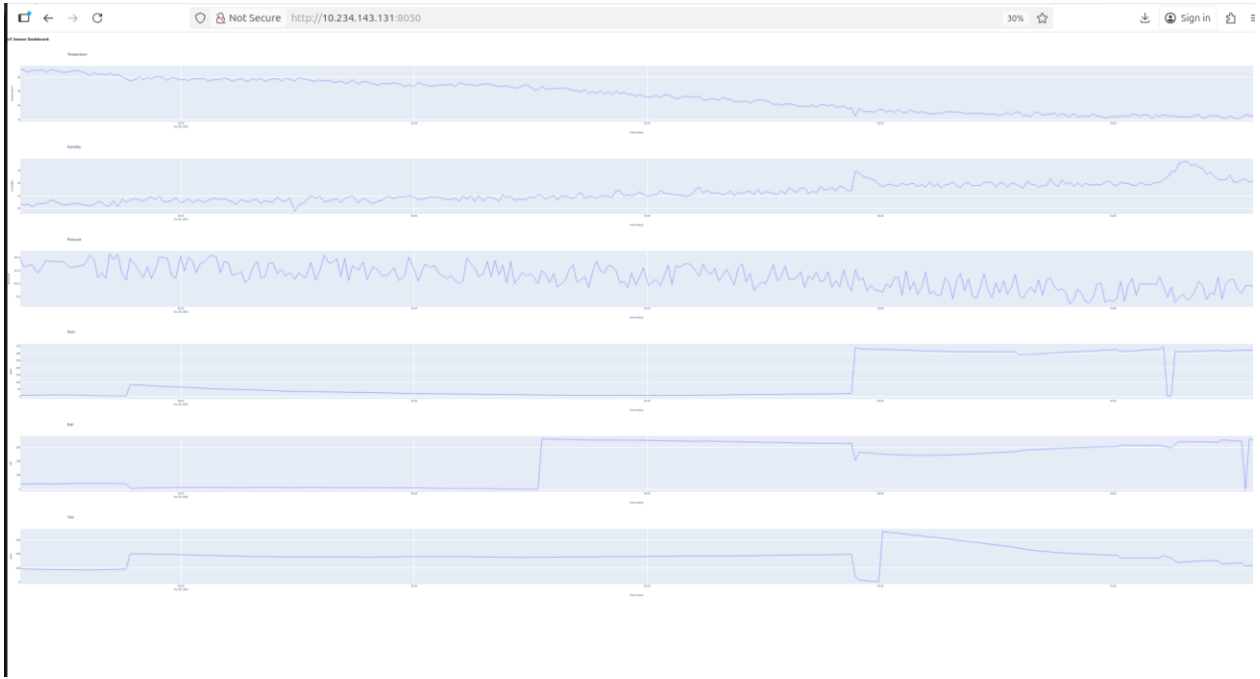
Dashboard



Time-Series Charts
Line graphs that plot the history of your sensor data

Auto-Refresh
The dashboard automatically queries the database real-time view of the sensor data.

Web Server
The dashboard is a web application powered by Plotly-Dash

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