Smart Wall Art

Interactive Art That Changes Based on Environmental Input

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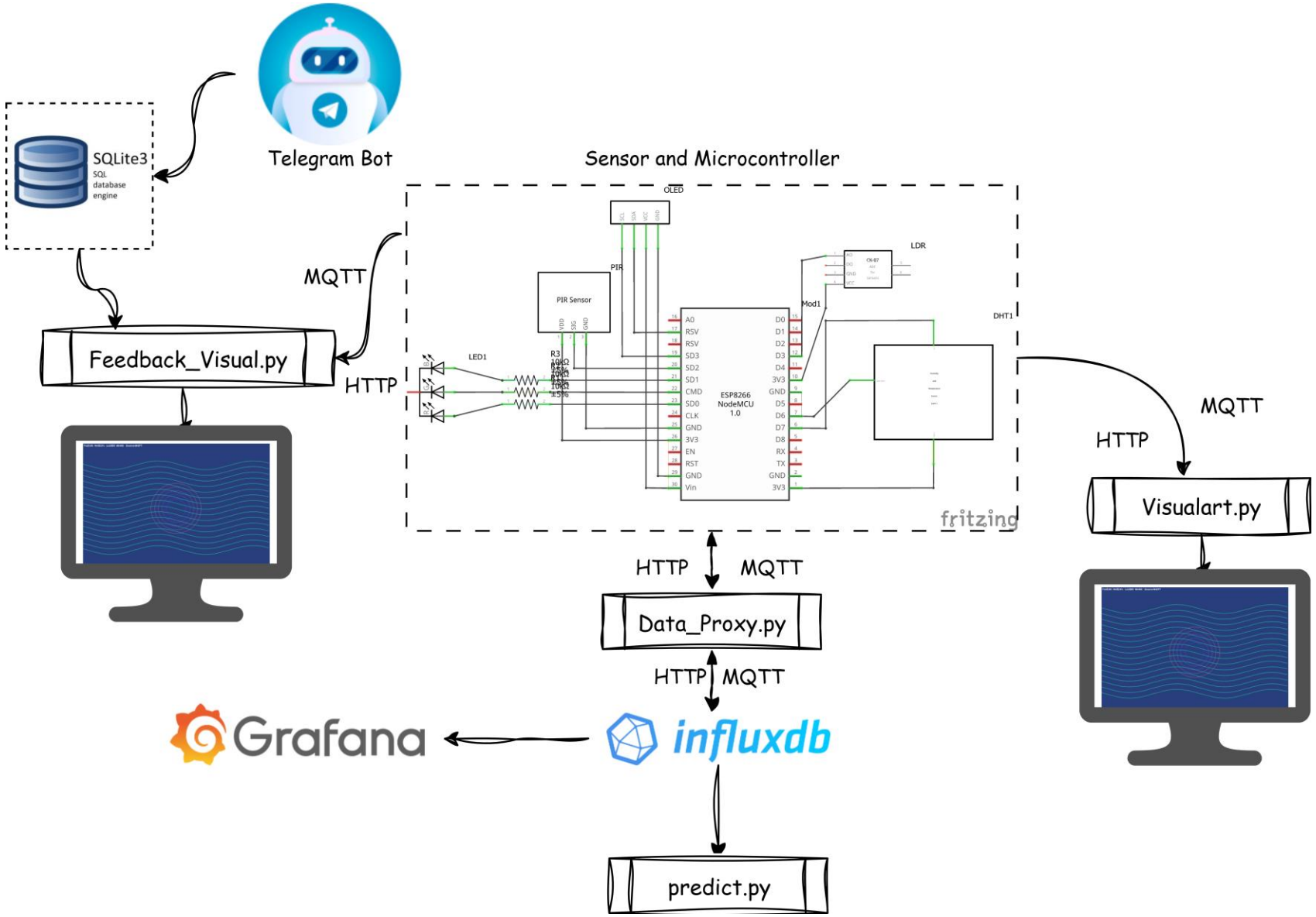
Introduction

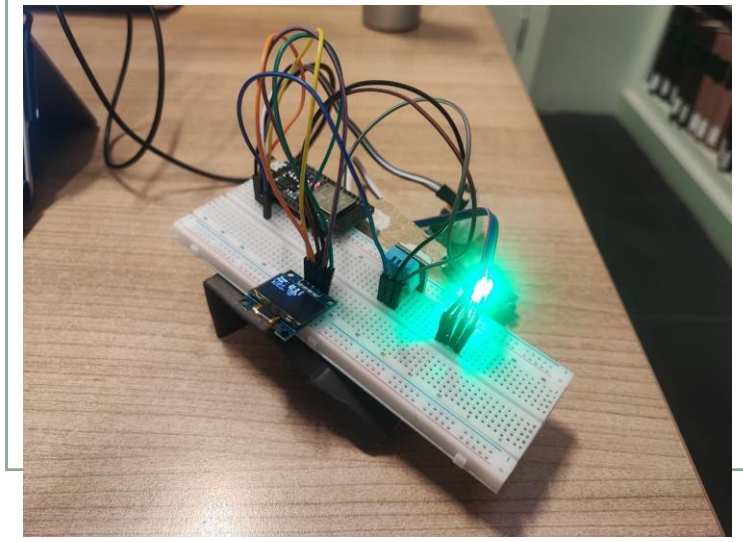
The **Smart Wall Art** project explores the fusion of art and technology to create dynamic digital artworks that adapt to real-world conditions. By using sensors to detect environmental inputs such as **temperature, light**, **Humidity and motion**, the system modifies the displayed visuals in real time, offering a personalized and interactive experience. This approach helps to increase the Human–Computer Interaction (HCI) and Human–Machine Interfaces (HMI).

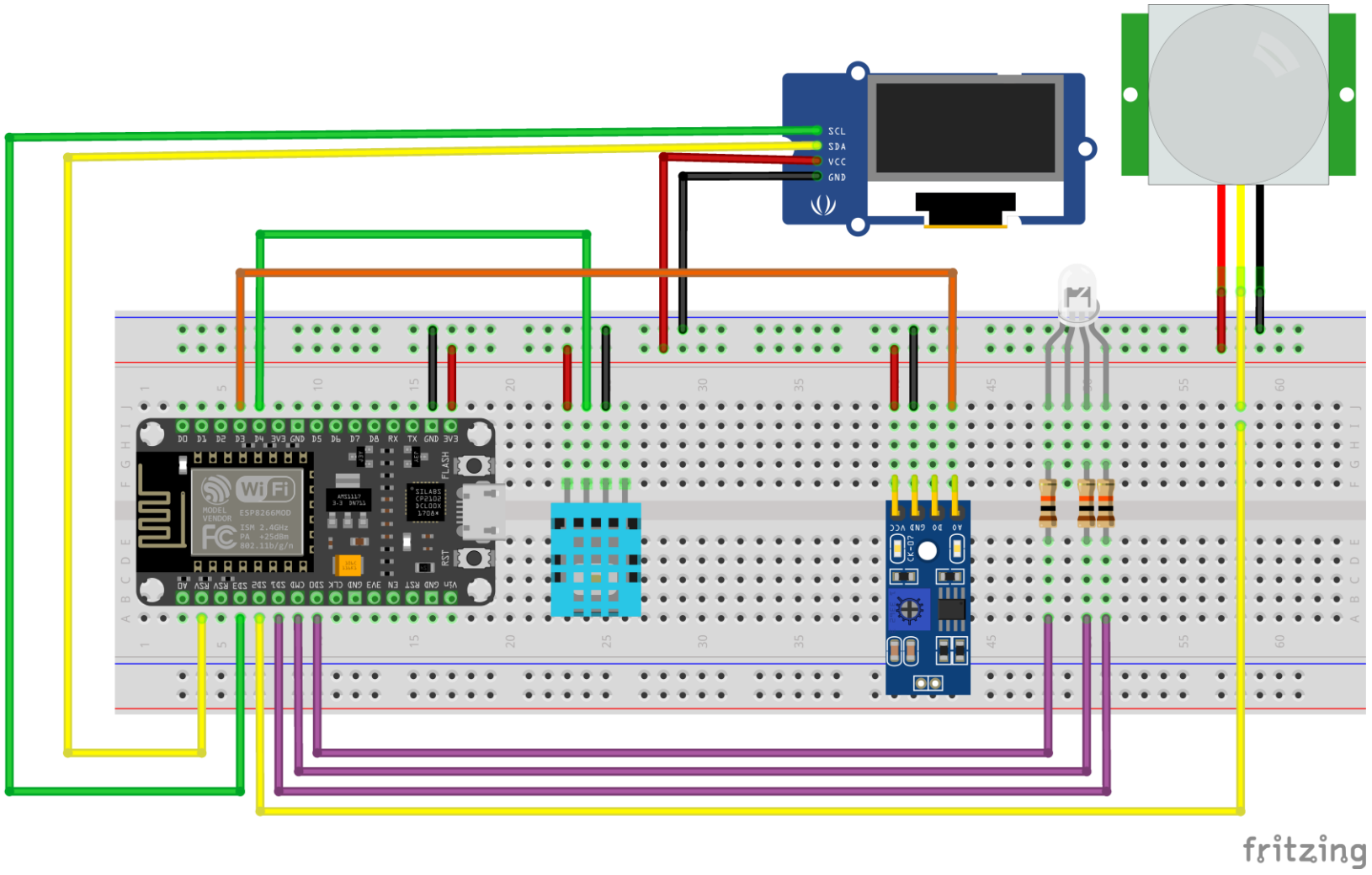
System Architecture:



Wiring Diagram:

Equipment Name	Pinout	ESP32
OLED	VCC	3.3
	GND	GND
	SCL	IO22
	SDA	IO21
DHT11	VCC	3.3
	GND	GND
	DATA	IO04
PIR	VCC	3.3
	GND	GND
	Out	IO15
LDR	VCC	3.3
	GND	GND
	AO	IO34
RGB (LED)	GND	GND
	R	IO27
	G	IO26
	B	IO25





Data acquisition:

- **Reads sensors**: DHT11 (temperature & humidity on GPIO 4), LDR (light on ADC GPIO 34), PIR (motion on GPIO 15).

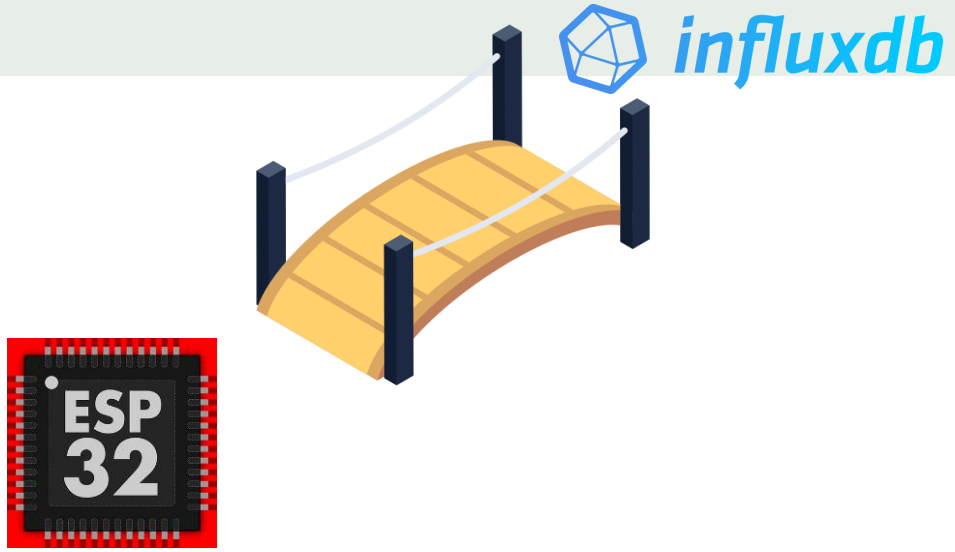
- **Shows data** on OLED and Drives RGB LED

- **Flexible telemetry**: Builds a JSON payload and sends it either via MQTT (smartart/sensordata) or HTTP (http://myip:8080/ingest) depending on the selected mode.

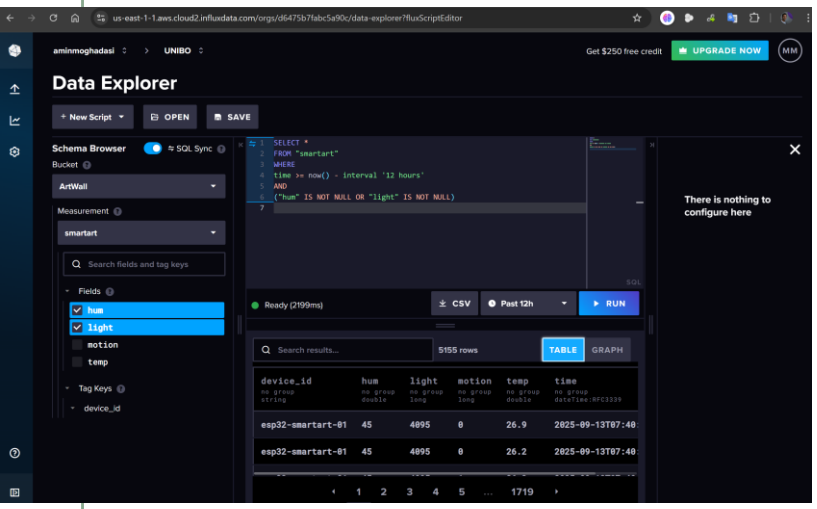
- **Runtime commands** over MQTT:
  - smartart/cmd/sampling_rate → sets sampling interval (sec).
  - smartart/cmd/motion_alert → sets how many consecutive PIR HIGHs count as “motion.”
  - smartart/cmd/mode → switch transport: mqtt or http.

- **Motion debouncing**: Counts consecutive PIR hits; only reports motion=1 if the count ≥ threshold.

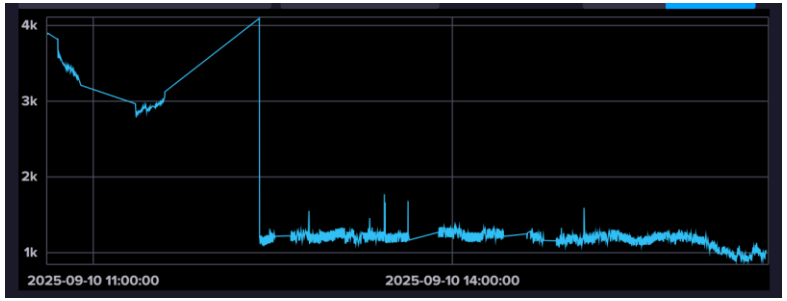
Data Proxy:



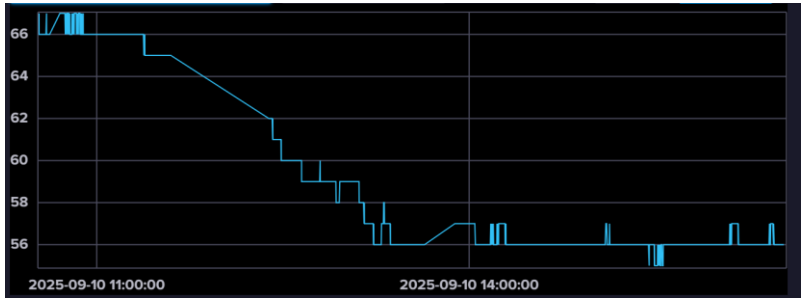
- The data proxy is an application that like bridges for ESP32 IoT device with an InfluxDB time-series database, handling telemetry via both MQTT and HTTP
- It connects to a **Mosquitto MQTT broker** (with port 1883) and subscribes to the topic smartart/sensordata, where the ESP32 publishes its JSON sensor data. Each incoming message is parsed, validated, and written into InfluxDB with appropriate fields
- The proxy also provides an HTTP ingestion API (/ingest on port 8080) that accepts POST requests with JSON payloads, supporting ESP32 devices configured in HTTP mode



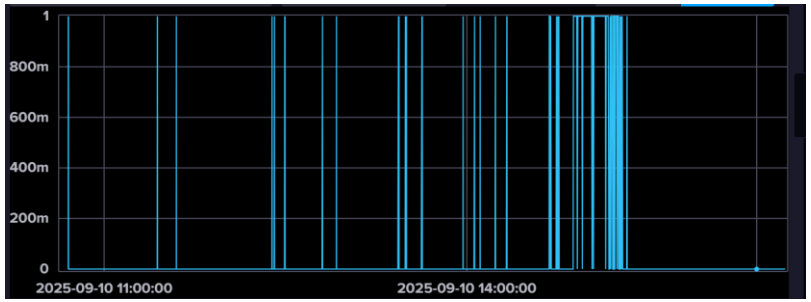
influx Dashboard



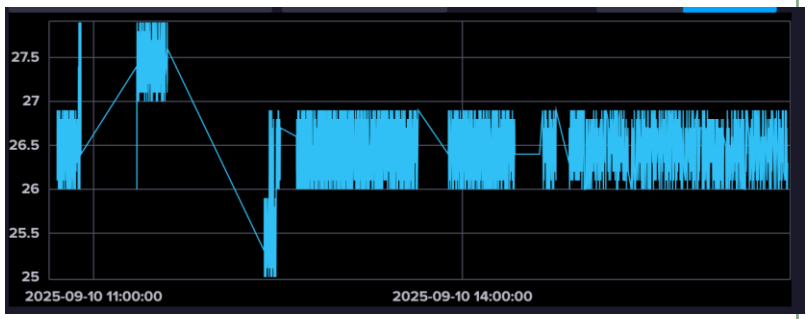
Light graph in influx cloud



Humidity graph in influx cloud



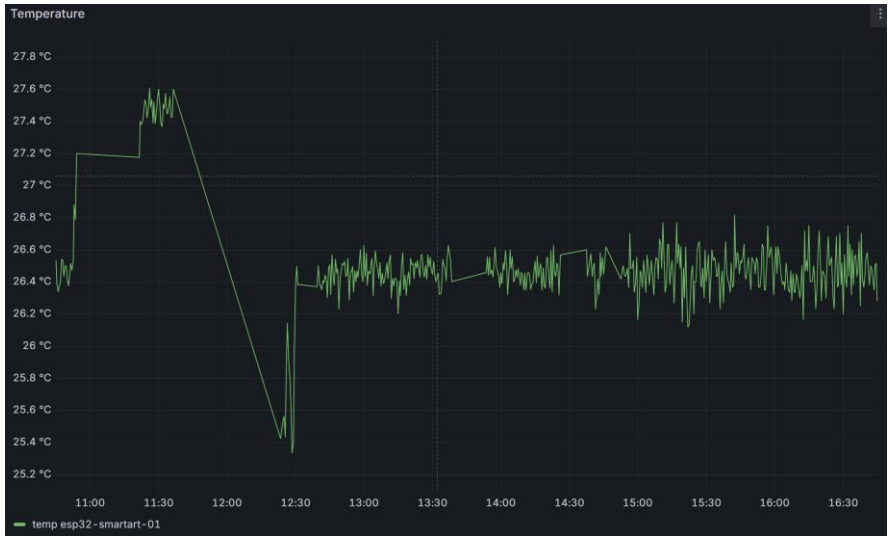
Motion graph in influx cloud

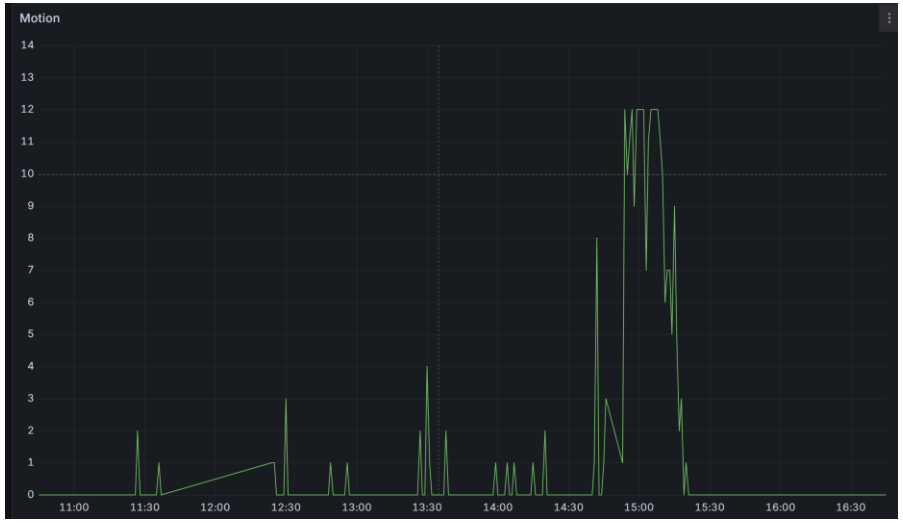


Temperature graph in influx cloud

Grafana

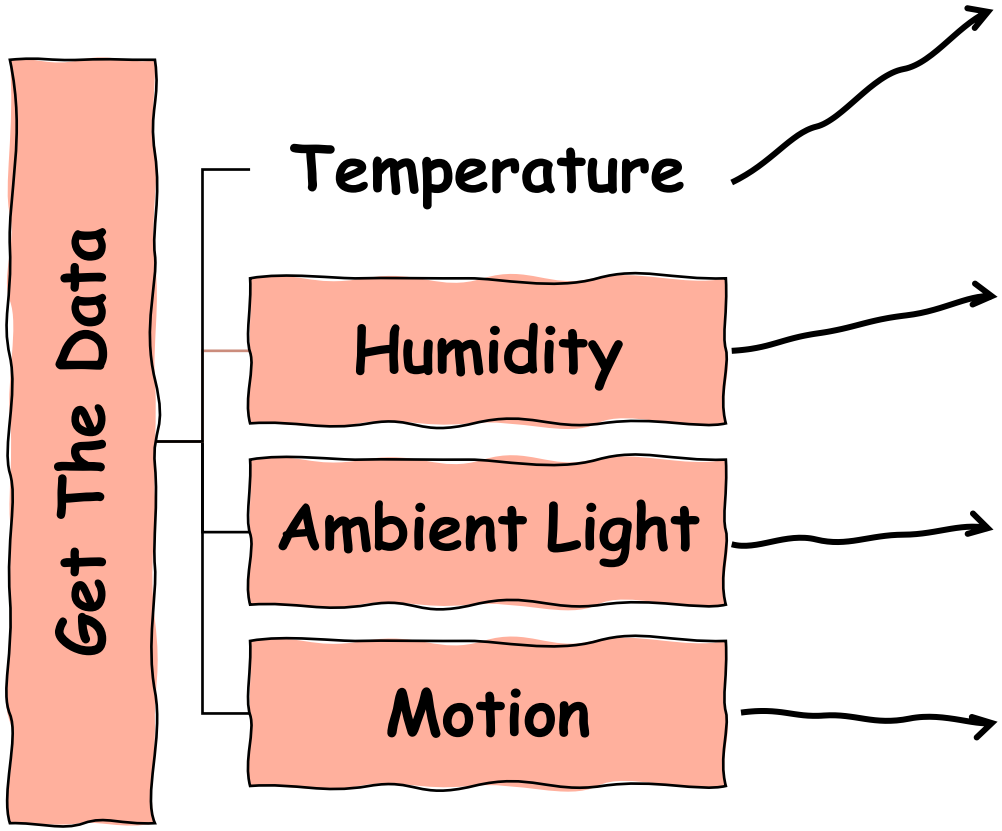

Humidity
69%
68%
67%
66%
65%
64%
63%
62%
61%
60%
59%
58%
57%
56%
55%
54%
53%
11:00
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30


Temperature
27.8 °C
27.6 °C
27.4 °C
27.2 °C
27 °C
26.8 °C
26.6 °C
26.4 °C
26.2 °C
26 °C
25.8 °C
25.6 °C
25.4 °C
25.2 °C
11:00
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30
temp esp32-smartart-01


Motion
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
11:00
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30


Light
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
11:00
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30

Smart Art Actuator :



Ring Number = $3 + \frac{Temp + 15}{5}$

Ring Radius = $40 + 26i + 12\sin(\frac{t}{30} + i * 0.6)$

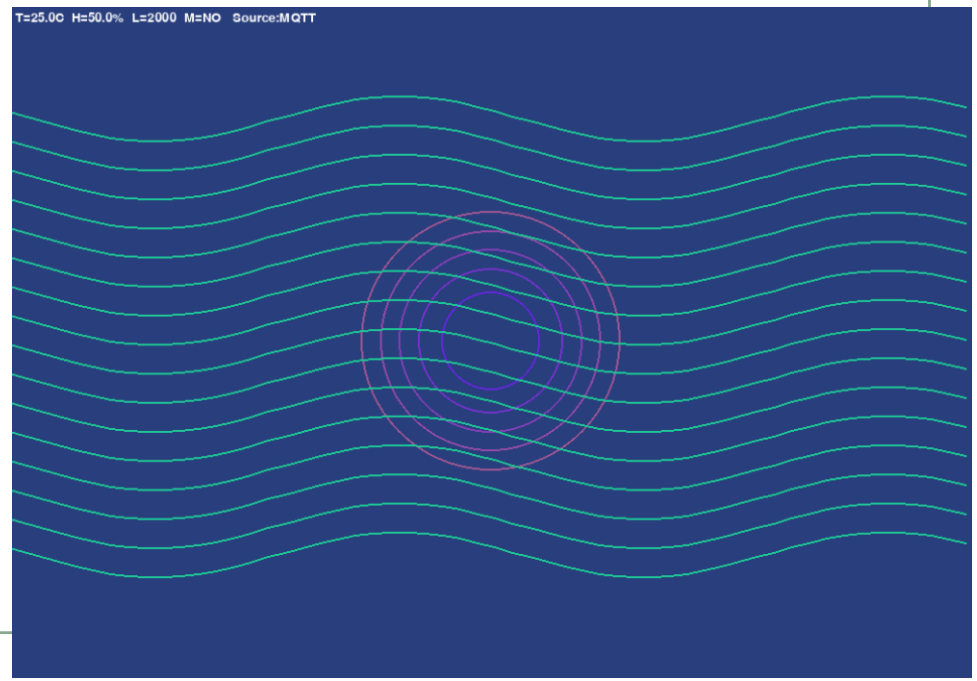
Ring Color = $(100 + i * 15, 40 + i * 12, 220 - i * 18)$

Wave Amplitude = $8 + \frac{Hum}{3}$

Wave Moving = Amp * $\sin\frac{x}{80} + \frac{t}{80}$

Normalized = $\frac{Light}{4095}$

Flash Light For 2.5s



Data Analytics Module:

- **Data Source**

  Get the data by flux query from the InfluxDB.

- **Add lagging (k = 2)**

  Build lagged predictors for all variables

- **Modeling**

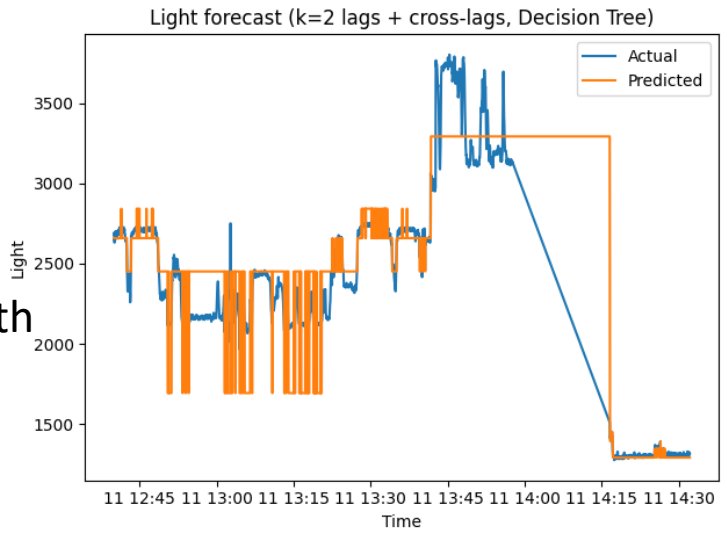
  One *DecisionTreeRegressor* for targets with *max_depth=4.*

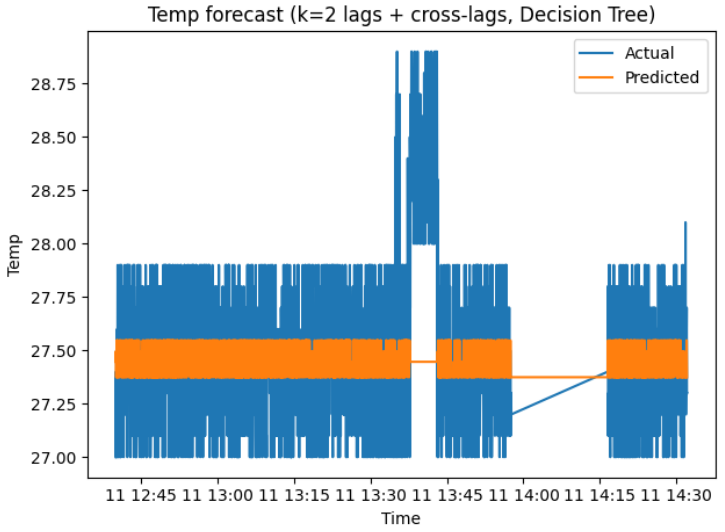
  Chronological split: 80% train → 20% test.

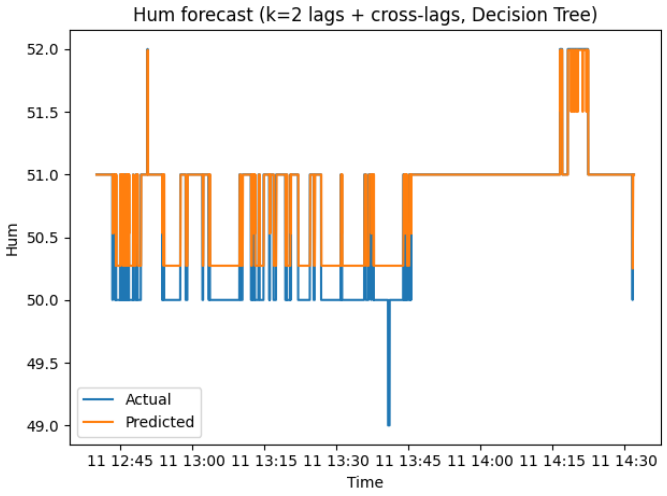
- **Evaluation & Outputs**

  MAE, MSE on the held-out window.

  Plots and CSV

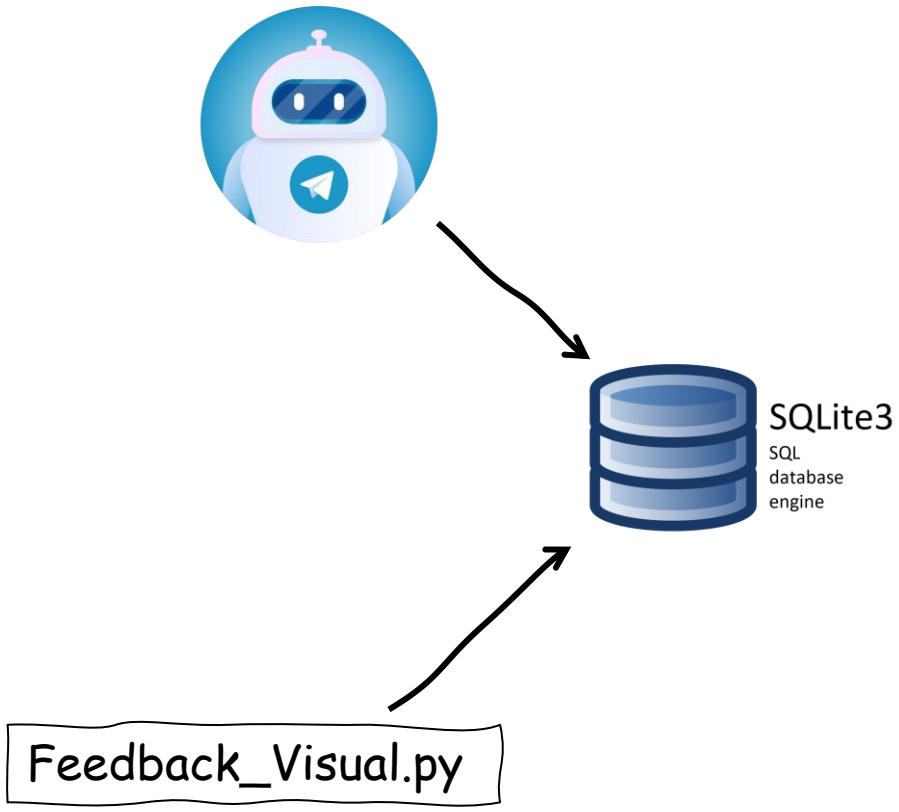


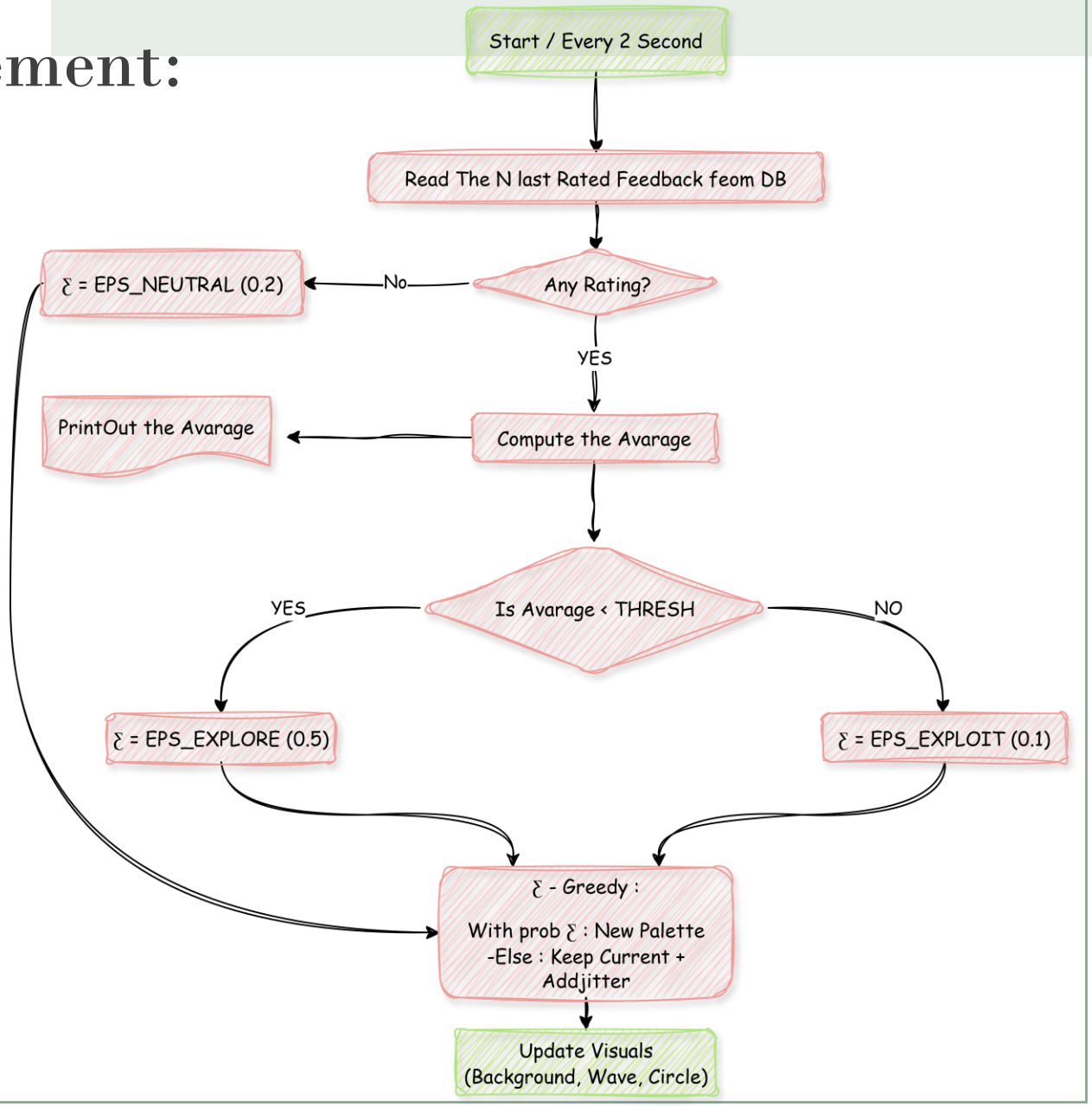


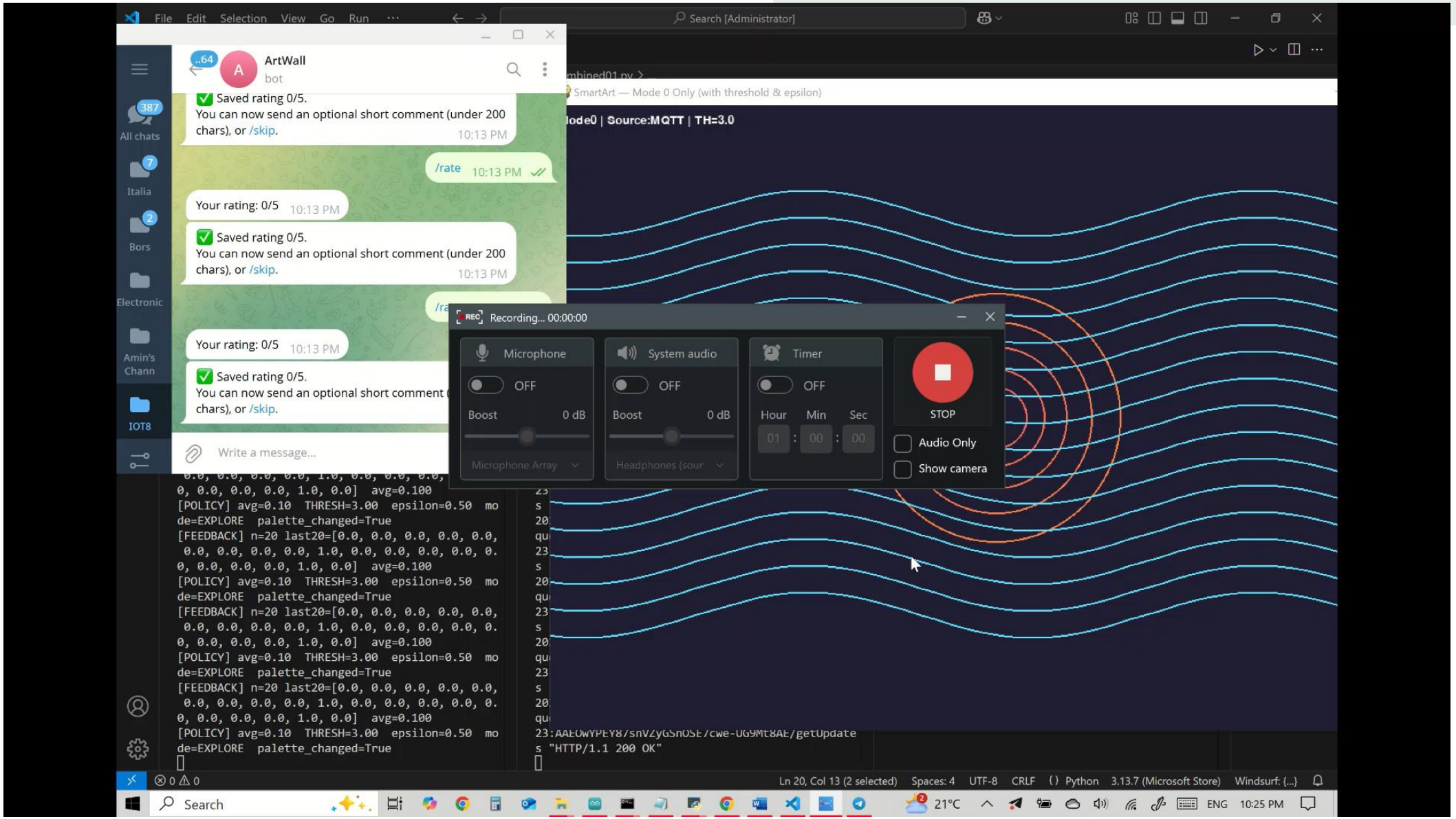


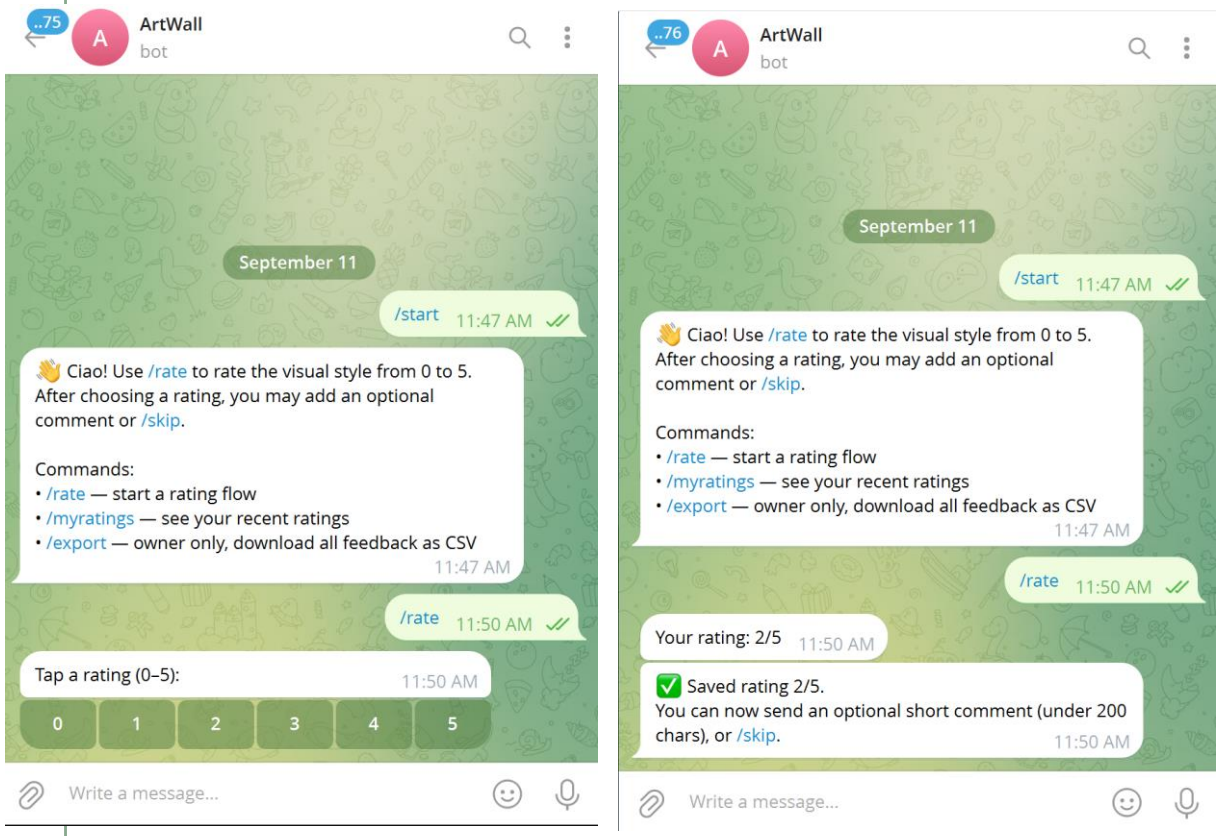
Telegram bot and User Engagement:

Based on **epsilon-greedy** strategy

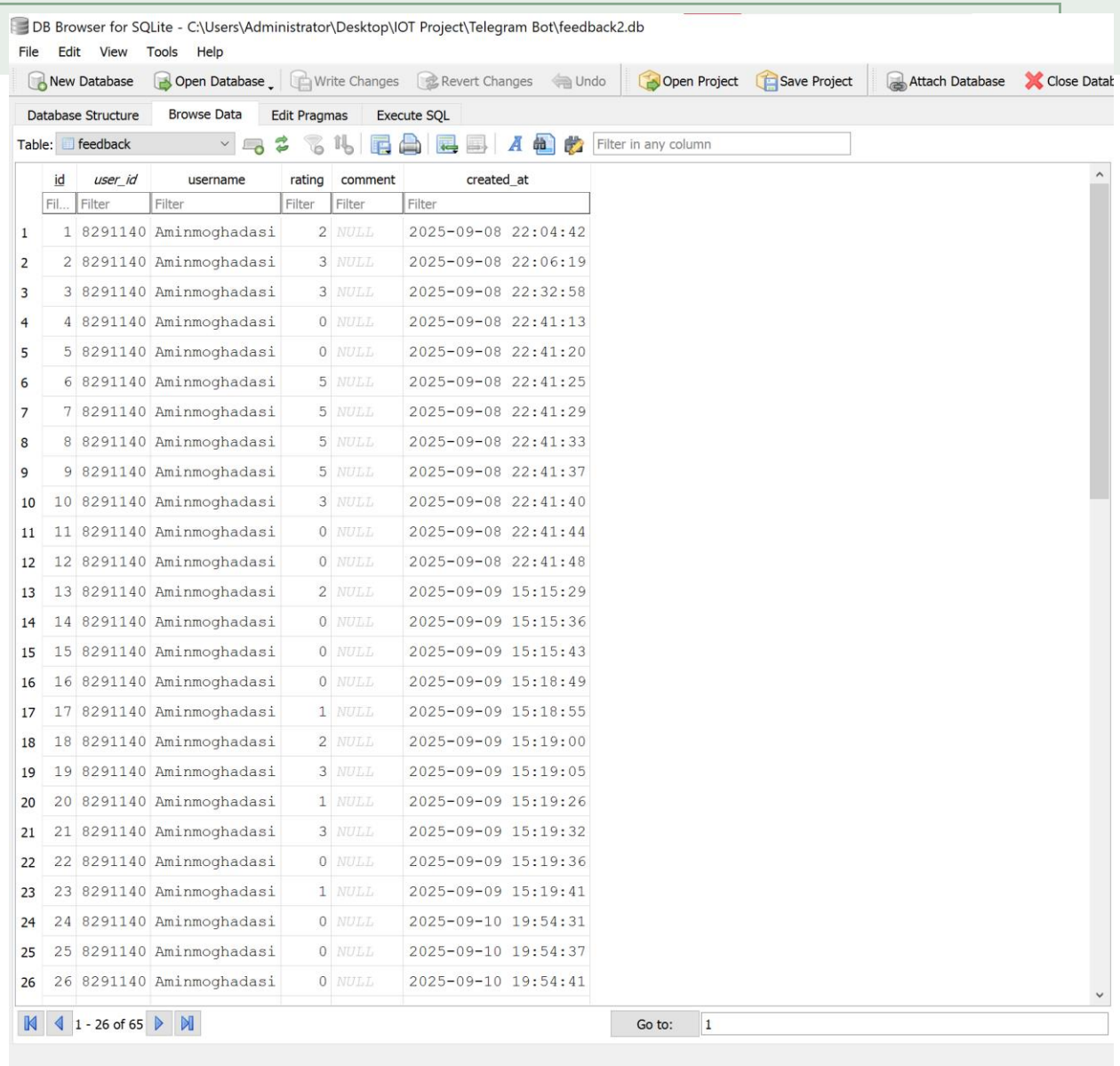





ArtWall
bot
Saved rating 0/5.
You can now send an optional short comment (under 200 chars), or /skip.
10:13 PM
/rate 10:13 PM
Your rating: 0/5 10:13 PM
Write a message...
Recording... 00:00:00
Microphone
OFF
Boost 0 dB
System audio
OFF
Boost 0 dB
Timer
OFF
Hour Min Sec
STOP
Audio Only
Show camera
SmartArt — Mode 0 Only (with threshold & epsilon)
Source:MQTT | TH=3.0
[POLICY] avg=0.10 THRESH=3.00 epsilon=0.50 mode=EXPLORE palette_changed=True
[FEEDBACK] n=20 last20=[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0] avg=0.100
Ln 20, Col 13 (2 selected)
Spaces: 4
UTF-8
CRLF
Python
3.13.7 (Microsoft Store)
Windsurf: {...}
21°C
ENG
10:25 PM



Screenshot From The Telegram Bot Interface



	id	user_id	username	rating	comment	created_at
1	1	8291140	Aminmoghadasi	2	NULL	2025-09-08 22:04:42
2	2	8291140	Aminmoghadasi	3	NULL	2025-09-08 22:06:19
3	3	8291140	Aminmoghadasi	3	NULL	2025-09-08 22:32:58
4	4	8291140	Aminmoghadasi	0	NULL	2025-09-08 22:41:13
5	5	8291140	Aminmoghadasi	0	NULL	2025-09-08 22:41:20
6	6	8291140	Aminmoghadasi	5	NULL	2025-09-08 22:41:25
7	7	8291140	Aminmoghadasi	5	NULL	2025-09-08 22:41:29
8	8	8291140	Aminmoghadasi	5	NULL	2025-09-08 22:41:33
9	9	8291140	Aminmoghadasi	5	NULL	2025-09-08 22:41:37
10	10	8291140	Aminmoghadasi	3	NULL	2025-09-08 22:41:40
11	11	8291140	Aminmoghadasi	0	NULL	2025-09-08 22:41:44
12	12	8291140	Aminmoghadasi	0	NULL	2025-09-08 22:41:48
13	13	8291140	Aminmoghadasi	2	NULL	2025-09-09 15:15:29
14	14	8291140	Aminmoghadasi	0	NULL	2025-09-09 15:15:36
15	15	8291140	Aminmoghadasi	0	NULL	2025-09-09 15:15:43
16	16	8291140	Aminmoghadasi	0	NULL	2025-09-09 15:18:49
17	17	8291140	Aminmoghadasi	1	NULL	2025-09-09 15:18:55
18	18	8291140	Aminmoghadasi	2	NULL	2025-09-09 15:19:00
19	19	8291140	Aminmoghadasi	3	NULL	2025-09-09 15:19:05
20	20	8291140	Aminmoghadasi	1	NULL	2025-09-09 15:19:26
21	21	8291140	Aminmoghadasi	3	NULL	2025-09-09 15:19:32
22	22	8291140	Aminmoghadasi	0	NULL	2025-09-09 15:19:36
23	23	8291140	Aminmoghadasi	1	NULL	2025-09-09 15:19:41
24	24	8291140	Aminmoghadasi	0	NULL	2025-09-10 19:54:31
25	25	8291140	Aminmoghadasi	0	NULL	2025-09-10 19:54:37
26	26	8291140	Aminmoghadasi	0	NULL	2025-09-10 19:54:41

Screenshot From The Database

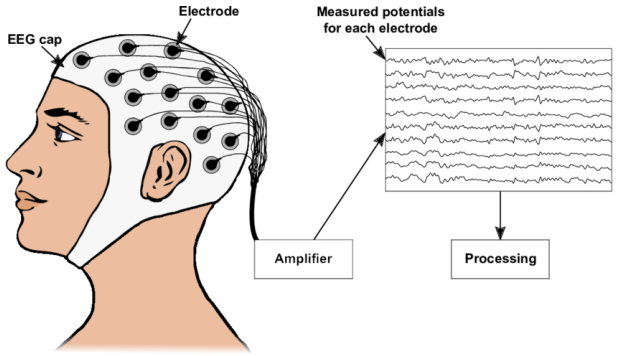
Future Work:

Software Part

- Adding a Language Model (LM) to Make changes Based on the users feedback comments.

Electronic Part:

- Adding more sensors (e.g. Eye-Tracking Sensors, **Electroencephalography (EEG)**…) to increase the Human–Computer Interaction (HCI)



EEG: Read brainwave activity for control signals.

Thank you