A15

Home Temperature Automation: Report

Jens Olaf Kukk

1. Setting up

Github repo exists here: https://github.com/ol4f/Home-Temperature-Automation

2. Business understanding

1. Identifying business goals

Since my previous idea was a bit controversial, I swapped it over for a more practical one. I got the new idea when I was in my dorm room. I had opened the window, only to have my feet freeze few minutes later. Or sometimes it would be the opposite, I had not opened the window for a while and the air became sort of thick.

The goal here is to train an algorithm, which would tell me according to the current outside and inside temperature, whether I should open/close the window or change the heating level on radiator. And perhaps in the future I can augment mechanisms to automate it entirely.

I consider the goal complete if I can train an algorithm that keeps my room fresh and cozy enough most of the time.

2. Situation assessment

As a computer engineer major, I already have all of the technology required to construct such a temperature tracking device. I have a spare digital humidity & temperature sensor, which I can connect to an Arduino microcontroller and then connect that through serial to a (micro)computer where the collection script runs and where it also fetches the outside temperature.

I have time to collect the data until the deadline of this project, even though I will most likely keep developing it later on. The current limitations that exist here is a very limited dataset span (of one month, essentially). We'll have to assume the dataset is only good for winter and my self-reporing is accurate. The main risk here is that my self-reporting is too subjective. That's the risk I just have to accept.

There are no cost-savings to have here since I already have all the tools and devices required for such a project.

3. Data-mining goals

The goal here is to have a database, that gets updated with current temperature & humidity data every 2 minutes. It also gets updated with my current state, whether the window is open and what the current radiator heating configuration is, whenever I self-report that they change. It also takes

hourly data from Estonian Weather Service to get the outside temperature, humidity, wind speed & direction.

I consider it successful if I can predict according to the trend of outside weather and inside temperature & humidity whether I should open/close window or change my radiator settings to achieve a comfy setting.

3. Data understanding

1. Gathering data

I will be working with datetimes, numeric and categorical values. All the data I have will be self-collected, except the outside weather by Estonian Weather Service API.

I will get my inside temperature & humidity data from DHT21 temperature & humidity sensor that's positioned under my other table. The data whether I have opened my window, changed my radiator settings, whether I'm home or how I am currently feeling (cold, fine, warm) is all self-collected through a program shown in **Figure 1**. All the automated data gathering runs through an arduino & a python script in my Zotac ZBox computer, that polls the temperature values every 2 minutes and saves it to a sqlite3 database. It also takes requests from my computer to change the aforementioned values and then there's a script that takes the weather service data on a hourly basis.

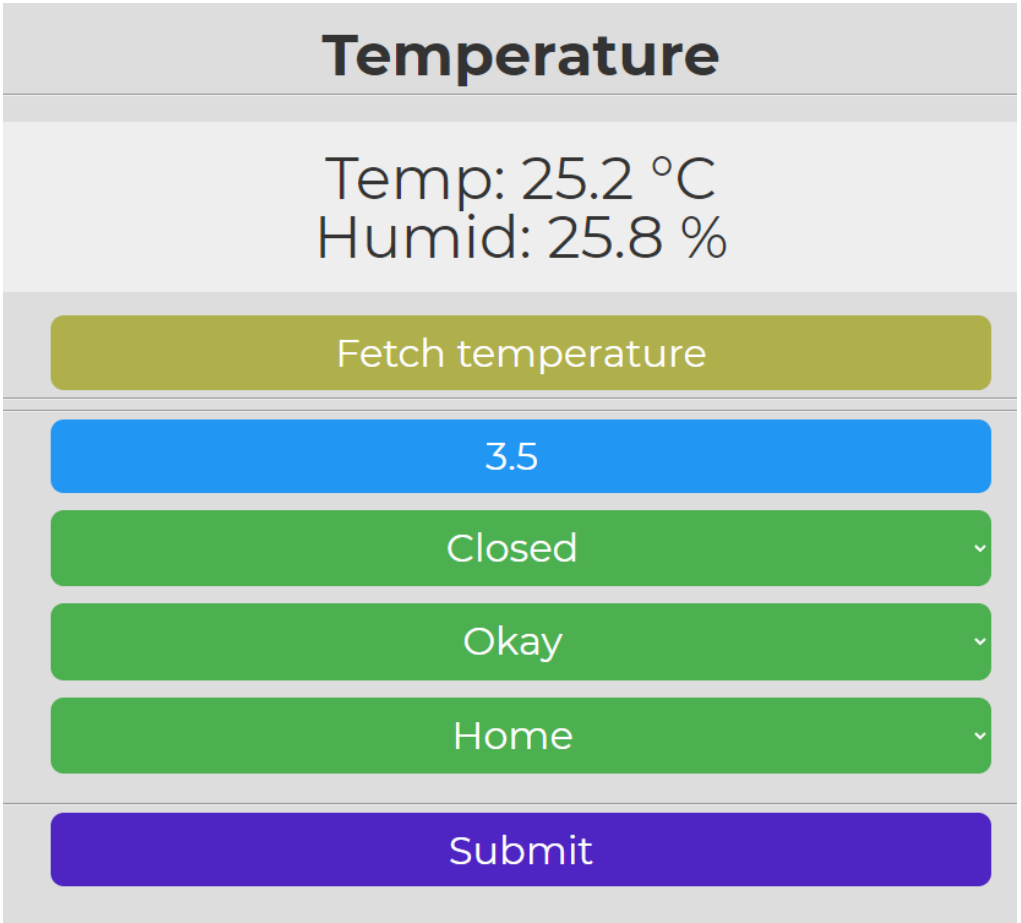

Figure 1. My program to self-collect values

2. Describing data

I have DHT21 sensor's data getting polled every 2 minutes, which gives me inside temperatures (°C) and relative humidity (%). The aforementioned self-collection platform has the radiator heating as a numeric value from 0-5, 3 categorical values for my window state (widely open, opened, closed), 4 categoric values for my own state (cold, cold feet, cozy & too warm, even though I might convert it to numeric later) and 2 values whether I'm home or not (1, 0, respectively). From EWS I collect weather data from their API (https://www.ilmateenistus.ee/teenused/ilmainfo/eesti-vaatlusandmed-xml/), where I use Tartu-Tõravere station's data on temperature, humidity, phenomenon, wind speed and wind direction.

3. Exploring data

My data starts from 27.11.2021. I will be showing different distributions from various fields.

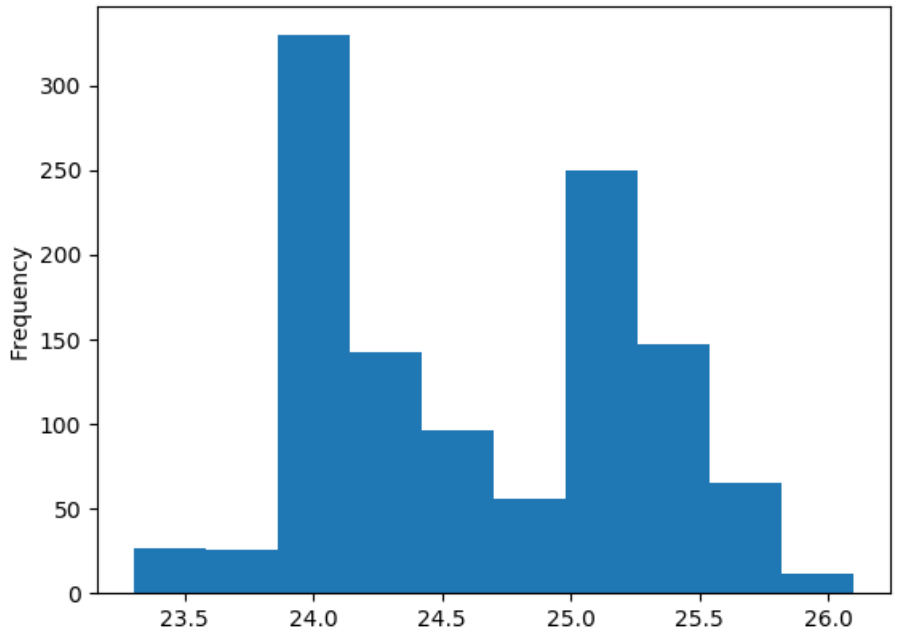

Figure 2. Temperature (inside)

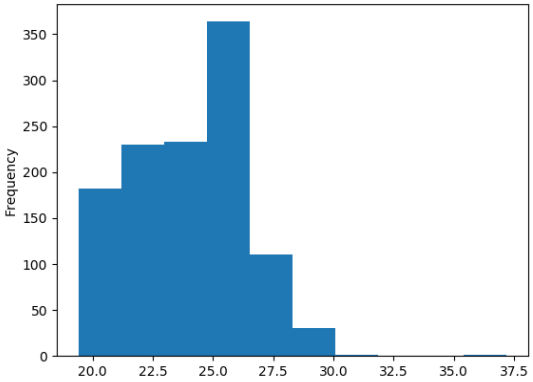

Figure 3. Humidity (inside)

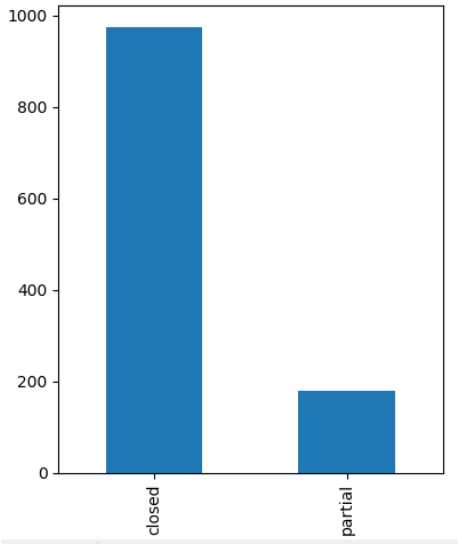

Figure 4. Window state

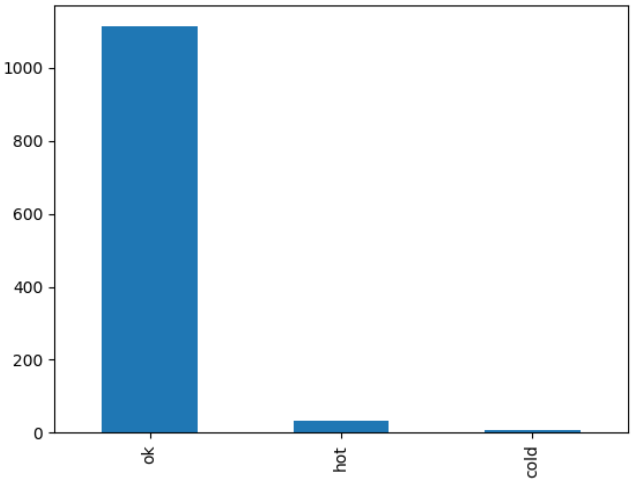

Figure 5. Self-reported status (might redo)

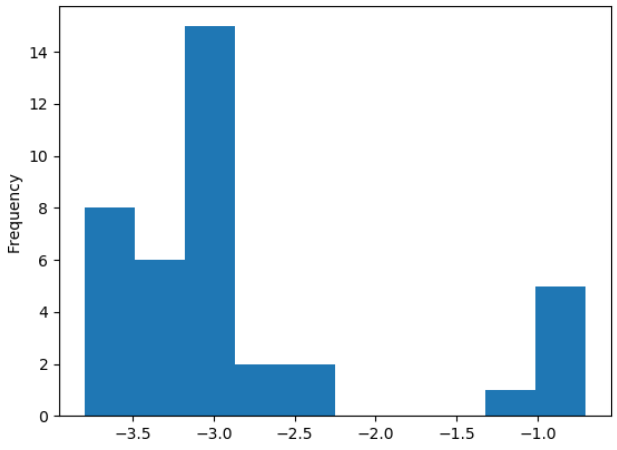

Figure 6. Outside temperature

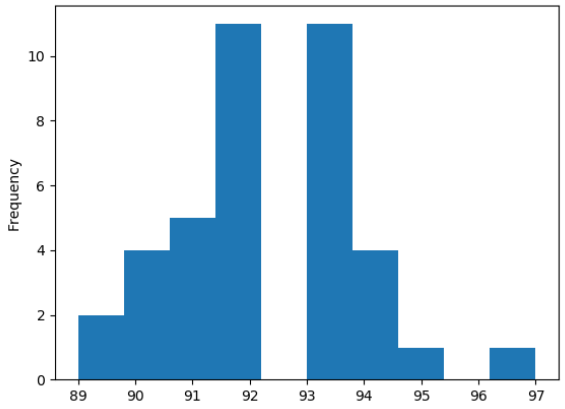

Figure 7. Outside humidity

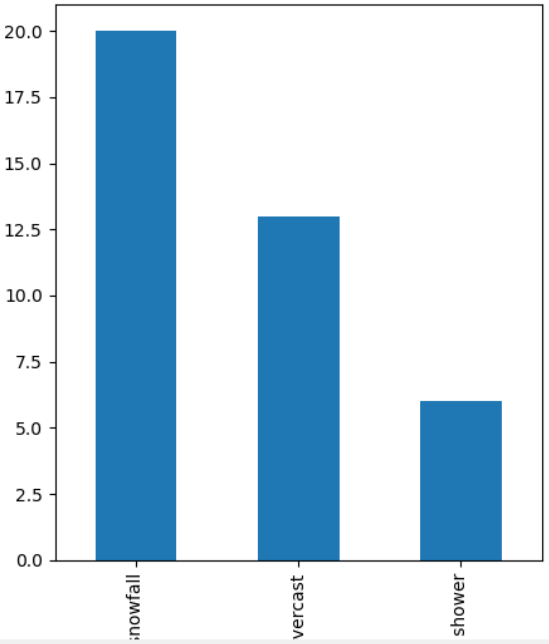

Figure 8. Phenomenon

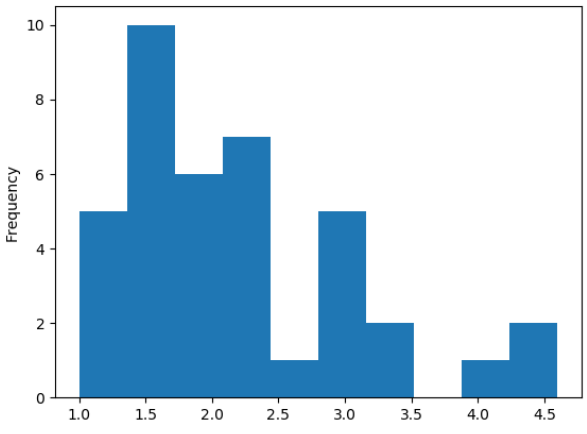

Figure 8. Wind speed

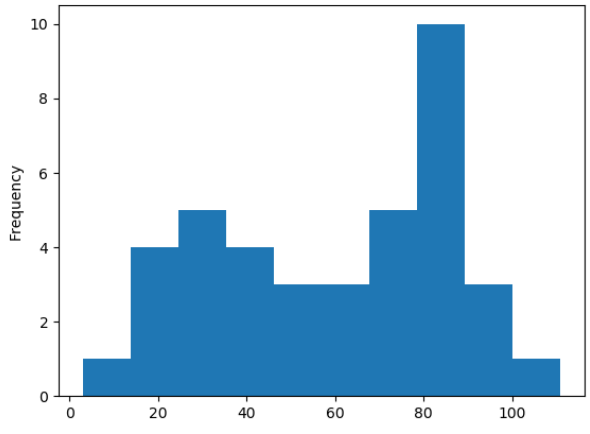

Figure 9. Wind direction

I'd say my data has only few outliers, but generally reliable.

4. Verifying data quality

Since all the data is self-collected and EWS is generally accurate, then the only quality issue I see is identifying my own state.

4. Plan

I do everything by myself, but so far I've done:

1. Assemble physical device (took 30 minutes)
2. Write code for data collection & make software work (took 5 hours)

And my next steps are:

3. Collect data (few weeks)
4. Process the data (maybe 10h?)
5. Turn it into a presentation (few hours)

I've described my tools already and the software is written by myself on Python. I will process the data with scikit and pandas, most likely use linear regression to predict my values.