

Grid Disturbance Database

This project is divided between a Java prototype, HTML pages, MySQL codes to interact with databases and a Django project to create the final HMI (Human-Machine Interface) that is to be used by the clients. The first aim of this project is to give clients a *Proof of Concept*, as the real project is currently under development by RTE and other similar firms in Europe, in order to create a common database on a European scale, in order to improve the response to grid disturbances in electric networks. Instead of continuously simulating single disturbances in the network by using the “n-1” algorithm, clients may benefit from past experiences of similar problems in order to deal with them more effectively.

As a result this project was developed while keeping in mind the objective to create a *Proof of Concept*. Consequently this project went through several steps, always decreasing the complexity whilst improving its functionality and the interaction between all its different elements. Below is explained how each part works and interacts with other parts.

I. Java prototype

The Java prototype is meant to show what the HMI would ideally look like and how it would ideally work. However this prototype doesn't yet show the full extent of the ideal version of the interface. Actually it could be simplified by having only one main app, in which the choices in the different drop-down lists influence the display. For example the first choice of data type would change the characteristics we can choose in the next text boxes.



You enter the main application, where you can choose what type of data you want to enter : ‘Grid Disturbance’, ‘Fault’, ‘Outage’ or ‘Interruption’. Depending on the answer a new window will open, in which you can enter the characteristics of the data you want to add to the database.

A. Grid disturbance

In the ‘Grid Disturbance’ window you may enter the ID, the date and time of occurrence of the grid disturbance you want to upload to the database.

All information regarding the format of the characteristics can be found in the ‘HVAC_guidelines_2018’ or in the HTML pages. Once all known information has been written, you can ‘Save’ it in the database, which can be found in ‘ToSave.txt’.

B. Fault

In the ‘Fault’ window, you may enter the serial number, the reference to the grid disturbance this fault caused and the repair time, but also choose the component type, the voltage level, the system grounding, the statistical area and fault, and choose between component fault or system disturbance with drop-down lists.

All information regarding the format of the characteristics can be found in the ‘HVAC_guidelines_2018’ or in the HTML pages. Once all known information has been written, you can ‘Save’ it in the database, which can be found in ‘ToSave.txt’.

C. Outage

The 'Outage' window is a software interface for recording outage data. It contains the following fields and controls:

- System unit:** A text input field.
- Fault causing the outage:** A text input field.
- Type of system unit:** A dropdown menu with 'Power transformer' selected.
- Energy not supplied:** A text input field.
- Duration of interruption:** A text input field.
- Characterisation of the distance:** A dropdown menu with 'Automatically' selected.
- Characterisation of reclosing:** A dropdown menu with 'Automatically after less' selected.
- Duration of outage:** A text input field.
- Save:** A button at the bottom left.

In the 'Outage' window, you may enter system unit number, the reference of the fault causing the outage, the amount of energy not supplied, the duration of interruption and the duration of outage, but also choose the type of system unit, the characterisation of the distance and the characterisation reclosing with drop-down lists.

All information regarding the format of the characteristics can be found in the 'HVAC_guidelines_2018' or in the HTML pages. Once all known information has been written, you can 'Save' it in the database, which can be found in 'ToSave.txt'.

D. Interruption

The 'Interruption' window is a software interface for recording interruption data. It contains the following fields and controls:

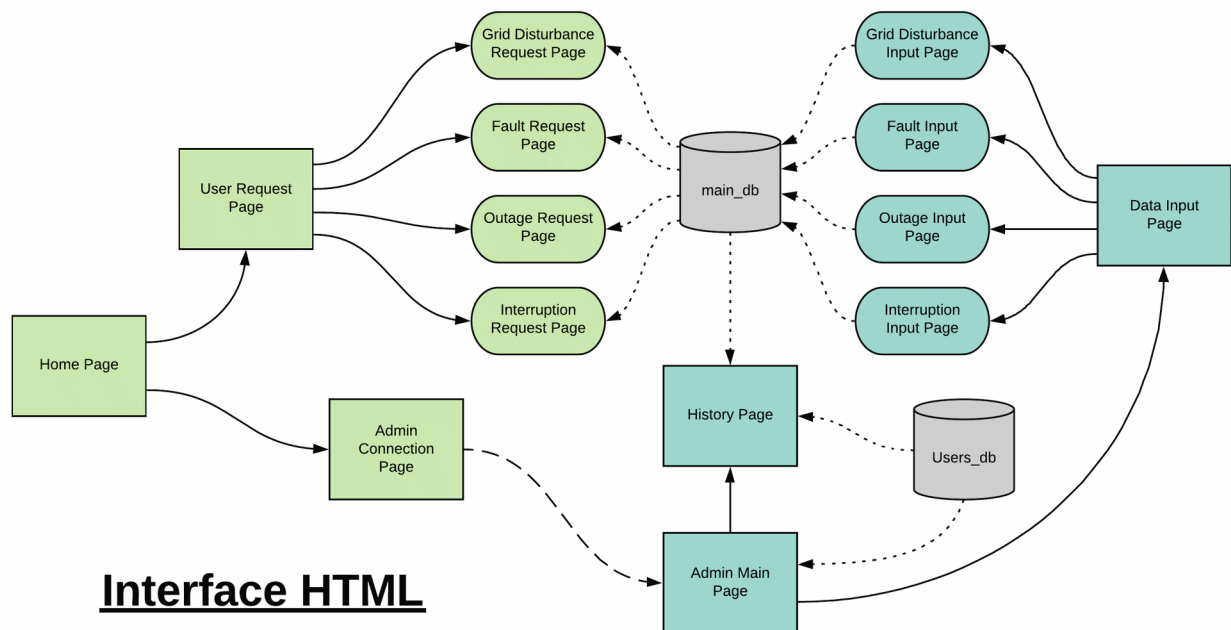
- Name of delivery point:** A text input field.
- Duration of interruption:** A text input field.
- Reference to grid disturbance:** A text input field.
- Save:** A button at the bottom right.

In the 'Interruption' window, you can enter the name of the delivery point affected by the interruption, its duration and the reference of the grid disturbance created by this interruption.

All information regarding the format of the characteristics can be found in the 'HVAC_guidelines_2018' or in the HTML pages. Once all known information has been written, you can 'Save' it in the database, which can be found in 'ToSave.txt'.

II. HTML pages

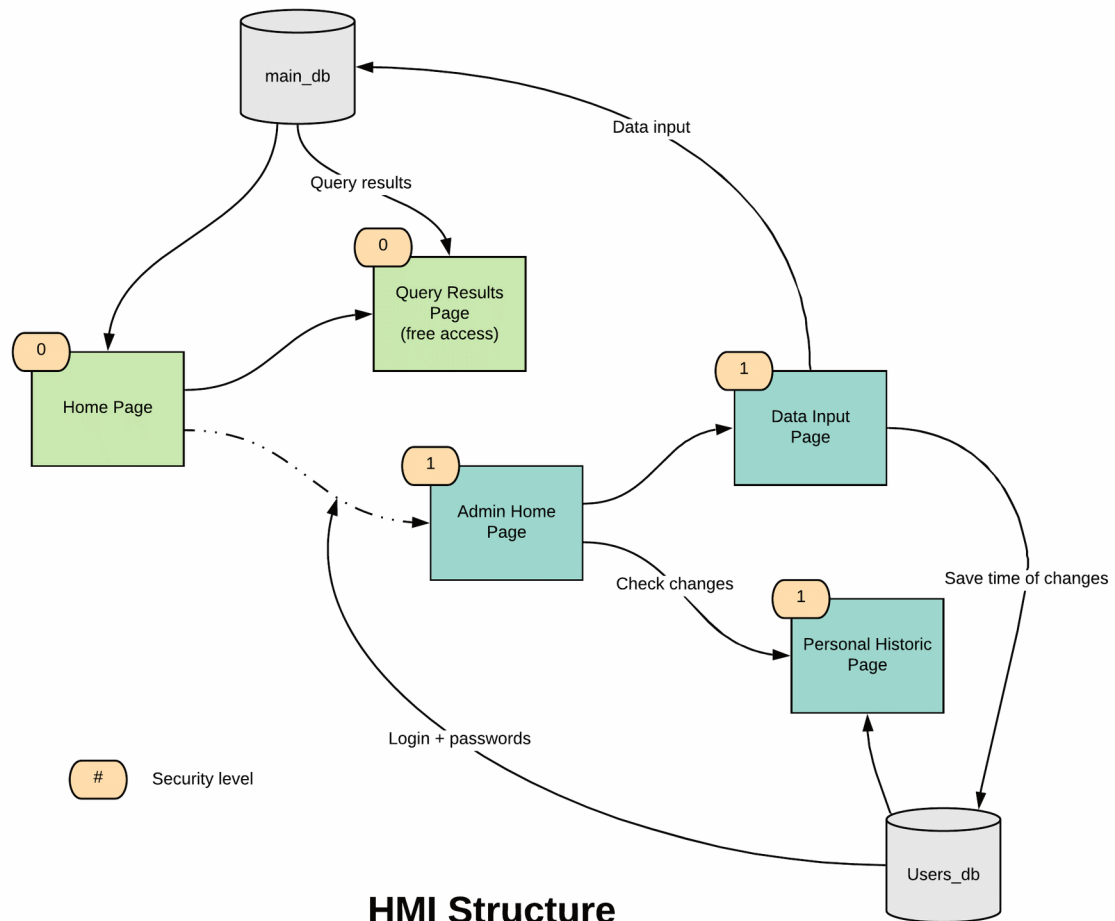
The HTML pages of this project are the basis of the final HMI interface, as the Django project will directly use them as its interface. They are linked as described in the chart below.



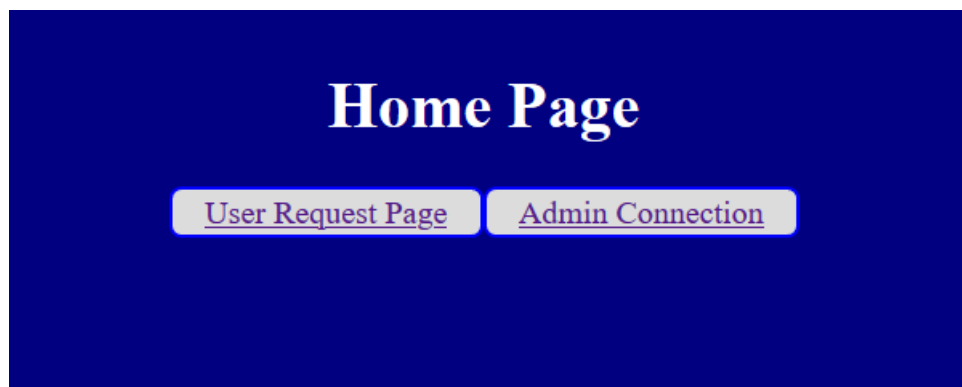
Currently we simplified this interface by dividing pages based on the type of data, as right now the Django project is devoid of any drop-down lists. On the contrary you may see the semi-final version of the interface in the Java prototype.

Ideally this interface would be organised as shown in the chart below. In the home page administrators may log in, and everyone may go to the 'Query Results Page'. Once logged in thanks to their login and password, administrators may add new data to the database and look up the history of all changes. This could be useful to 'blame' wrong data added to the database, just like the 'Blame' function in GitHub.

The current HTML pages have a simplified layout, without any regards to the aesthetics of the website (we do apologize for the current choice of colours, which is highly debatable...) Below are presented some of these HTML pages.



A. Home Page



The 'Home Page' currently only links to the 'User Request Page' and 'Admin Connection Page'.

B. User Request Page

The 'User Request Page' links to all data input pages, which are divided by data type, but also includes a link back to the 'Home Page' in the short description below the title. It is similar to the 'Admin Data Input Page'.

User Request Page

This page is meant to send queries to the database.
Once you have finished, you can return to the [Home Page](#).

[Grid Disturbance Search Page](#)

[Fault Search Page](#)

[Outage Search Page](#)

[Interruption Search Page](#)

C. Grid Disturbance Search Page

It is nearly identical to the 'Grid Disturbance Input Page', except for the button and the notification zone : used to send a request to the database here, whereas it is used to send data to the database in the Input Page.

Grid Disturbance Search Page

This page is meant to search Grid Disturbances in the database.
Please use the filters below for your query to the database.
Once you have finished, you can return to the [Home Page](#).

Identification

Usually in the form of a serial number counting from one every year.
Not important for the statistical compilation.

A serial number, for example, 2016-1, 2016-2.

Date

Date of grid disturbance, e.g., 2016-01-17

Time

Time of disturbance, e.g., 17:19:23.

D. Fault Search Page

It is nearly identical to the ‘Fault Input Page’, except for the button and the notification zone : used to send a request to the database here, whereas it is used to send data to the database in the Input Page.

Fault Search Page	
This page is meant to upload new Faults into the database. Once you have finished, you can return to the Home Page .	
Serial Number The serial number counts from one for every grid disturbance.	<input type="text"/> <i>1, 2, 3, etc.</i>
Reference to Grid Disturbance	<input type="text"/> <i>Identification of the disturbance</i>
Component Type	<input type="text"/> <i>See the classification of components</i>
Voltage Level Three possible levels	<input type="text"/> <i>100-150 kV, 200-330 kV or 380-420 kV</i>
System Grounding This information is optional for faults in units with reactive compensation with voltages lower than 100 kV.	<input type="text"/> <i>Directly earthed or compensated</i>
Fault in own or other area If the fault occurs in another statistical area, nothing more of the fault needs to be reported.	<input type="text"/> <i>Own or other network</i>
Component Fault or System Disturbance Only system disturbances causing or aggravating a grid disturbance needs to be registered.	<input type="text"/> <i>Component Fault or System Disturbance</i>
Fault Types One fault can consist of several fault types. If a fault consists of several fault types, the most significant fault type is used. In case of developing faults, that is in faults changing from one type to another, the final type is given.	<input type="text"/> <i>Please see all different types in the document.</i>
Primary Fault or Secondary/Latent Fault The statistics do not distinguish between secondary and latent faults.	<input type="text"/> <i>Primary or Secondary/Latent Fault</i>
Temporary or Permanent Fault See sections 5.2.4 and 5.2.5.	<input type="text"/> <i>Temporary or Permanent Fault</i>
Intermittent or Non-intermittent Fault See Section 4.2.6.	<input type="text"/> <i>Intermittent or Non-intermittent Fault</i>
Fault Cause The fault cause must always be reported. If the fault cause is a combination of several fault causes, choose the most significant one.	<input type="text"/> <i>See Section 4.2.9</i>
Repair time Not required but may be useful for internal use. Voluntary waiting time should not be included.	<input type="text"/> <i>Must be given in hours and minutes. See Section 4.4.11.</i>
<input type="button" value="Search"/>	

E. Outage Search Page

Outage Search Page

This page is meant to upload new Outages into the database.
Once you have finished, you can return to the [Home Page](#).

System Unit The name of the system unit is used to calculate how often the same system unit is affected by outage.	<input type="text"/> <i>Identification of the system unit affected by outage.</i>
Fault Causing the Outage If two faults occur within the same system unit the fault causing the outage of the longest duration will be chosen.	<input type="text"/> <i>Serial number of the fault which caused the outage according to Table 5.2.1.</i>
Type of System Unit	<input type="text"/> <i>See Section 4.3.</i>
Energy Not Supplied To calculate ENS the end-user outage must have lasted at least 2 seconds.	<input type="text"/> <i>See Section 4.4.8.</i>
Duration of Interruption	<input type="text"/> <i>See Section 4.4.4.</i>
Characterisation of the disconnection In case of a fault in the reclosing automatics resulting in lack of reclosing, automatically should be chosen as an alternative.	<input type="text"/> <i>Automatically (with unsuccessful automatic reclosing) or Manually</i>
Characterisation of reclosing If high speed automatic reclosing is successful at one end of a line, but the line needs to be reclosed manually at the other end, choose manual reclosing.	<input type="text"/> <i>Please see all different types in the document.</i>
Duration of Outage	<input type="text"/> <i>See Section 4.3.1.</i>

Search

It is nearly identical to the ‘Outage Input Page’, except for the button and the notification zone : used to send a request to the database here, whereas it is used to send data to the database in the Input Page.

F. Interruption Search Page

Interruption Search Page

This page is meant to upload new Interruptions into the database.
Once you have finished, you can return to the [Home Page](#).

Name of Delivery Point Not relevant to the compilation of statistics.	<input type="text"/> <i>Name of the delivery point affected by outage.</i>
Duration of Interruption	<input type="text"/> <i>The time the interruption lasts.</i>

Search

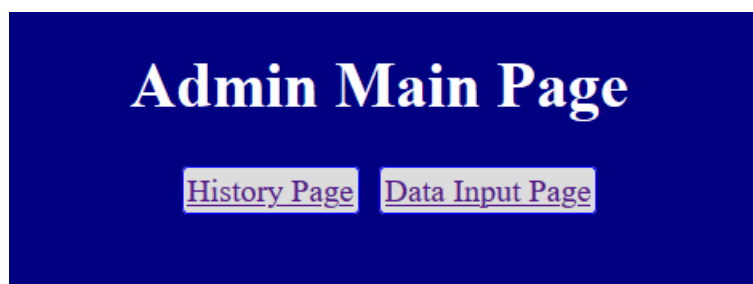
It is nearly identical to the ‘Interruption Input Page’, except for the button and the notification zone : used to send a request to the database here, whereas it is used to send data to the database in the Input Page.

G. Administrator Connection Page

The screenshot shows a dark blue background with white text. At the top, the title "Administrator Connection Page" is centered in a large, bold, serif font. Below the title, there is a paragraph of text: "This page is meant to prevent any unauthorized person to directly interact with the database. If you are an administrator please insert you connection IDs below. Otherwise please return to the [home page](#) ." The text is centered. Below the text, there are two input fields. The first is labeled "User ID" and the second is labeled "Password". Both labels are in a white serif font. The input fields are light gray with a thin black border. Below the input fields, there is a button labeled "Connection" in a white serif font, with a light blue gradient and a thin black border.

This page enables administrators to log in the system and is the only access to the 'Admin Main Page' with access to all admin only pages and actions.

H. Admin Main Page



The 'Admin Main Page' gives access to all admin-only pages, and should only be accessed by administrators.

I. History Page

This page would display the current state of the history of changes brought to the database, based on what has been saved in the user database.

III. MySQL codes

Their aim is to send requests to the database via SQL protocols, but all written in Python. It also takes care of the creation and upload of these databases. It is based on pymysql, and thus is unfortunately incompatible with Django, which is used to sqlite3.

All characteristics of all data types have been implemented and it is fully functional in the Python console. The main problem was that it needs to connect to the SQL server, which triggers security problems as you have to connect on another computer. The choice of ID for the server and its security (firewalls, VPN, ...) can greatly affect this. However it did work locally on a computer.

IV. Django project

The Django project was to link all elements of the project together. However it couldn't be completed as it was to continuously adapt to all changes brought to the other incomplete parts during its development. Furthermore as explained before Django uses Python, but only officially works with sqlite, whereas our interaction with the servers was implemented with pymysql. As a result, it would still take more time to adapt all the code.