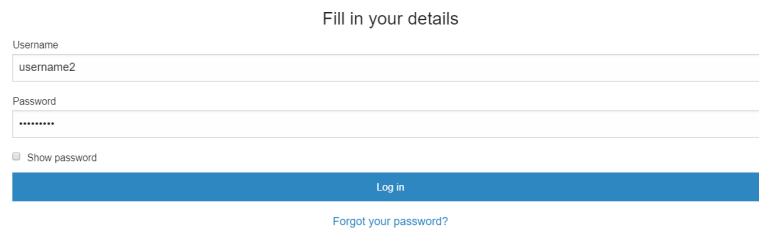## 1.1. Website

To monitor the output of the turbines a website was created. This website displays the measured data, so that the user can easily check up on the turbines. The code for the webpages is given in *Appendix E – website code*.

1.1.1. Log in

Figure 8.1 - Log in screen

The log in screen is shown in *Figure 8.1 - Log in screen*. Here the details must be filled in to connect to the website. The webserver will connect to the database to check if the details are correct, and if they are then the user will be logged in. The passwords in the database are encrypted to ensure that the passwords will not be stolen. If a user forgot his/her password, then there is a "Forgot your password?" button which will tell you to contact the support.
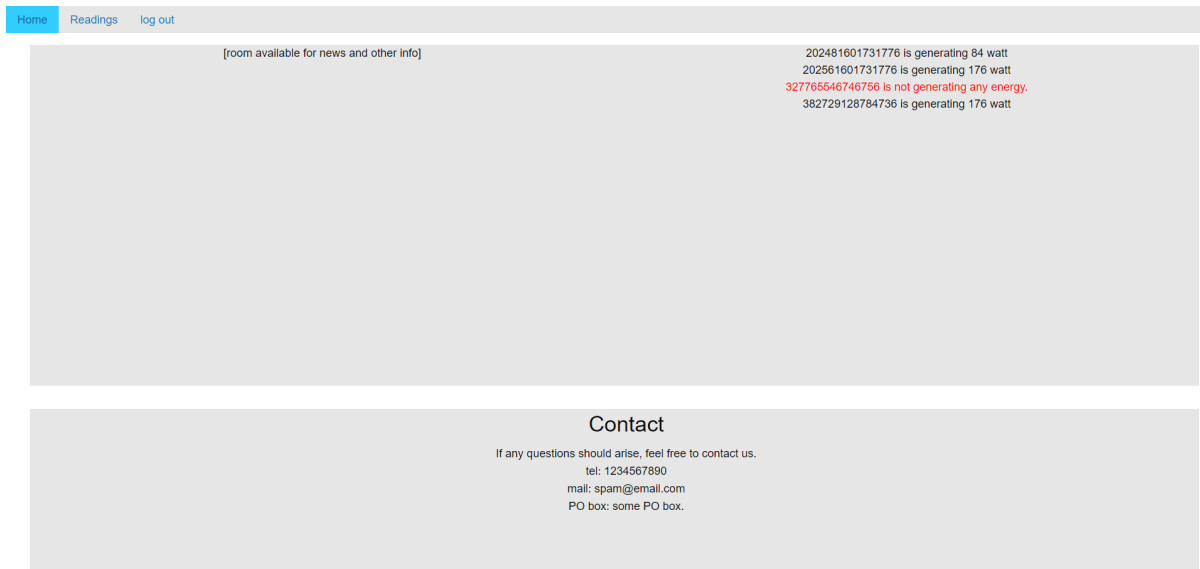
1.1.2. Homepage

Figure 8.2 - Home screen

Once the user is connected he will be redirected to the homepage as shown in *Figure 8.2 - Home screen*. On the right side the user can see how much energy every wind turbine is generating at that moment. To the left there is room to write news and other information. Also, there are contact details at the bottom in case of any error or if any questions have arisen. On the top of the page there is a navigation bar in which the user can switch between pages or log out.

Readings and forecast

select/deselect windmills
☑ 202481601731776
☑ 202561601731776
☑ 327765546746756
☑ 382729128784736

current total of selected values: power in = 719V, power out = 436W, avg. windspeed = 1189km/h
current values for 202481601731776: power in = 191V, power out = 84W, windspeed = 19

current values for 202561601731776: power in = 176V, power out = 176W, windspeed = 390

current values for 327765546746756: power in = 176V, power out = 0W, windspeed = 390

current values for 382729128784736: power in = 176V, power out = 176W, windspeed = 390

go to forecast   click on one of the legend members to show/hide that member   ⦿single ◯field ◯all   202481601731776 ▾

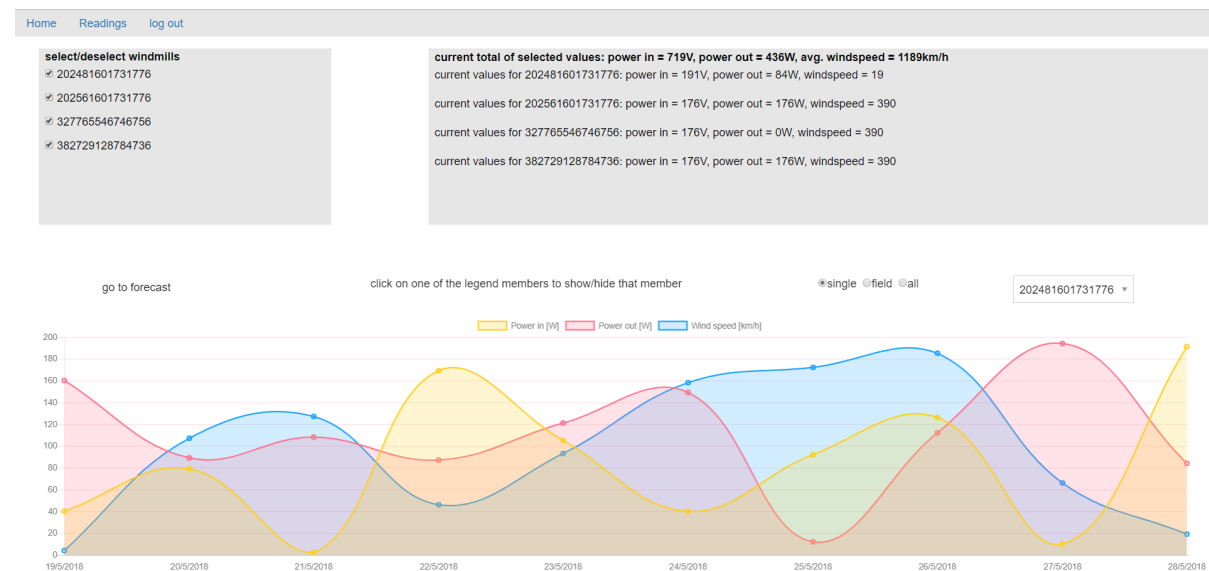Power in [W]   Power out [W]   Wind speed [km/h]

Figure 8.3 - Readings page with graph (with test values)

When the user arrives at the readings page the website will display a list of devices, a list of current values and a graph of the selected turbine. This can be seen in *Figure 8.3 - Readings page with graph (with test values).*

If the user wants to see the current values of specific turbines, then on the left side the desired turbine can be selected. On the right side of this list the current values of the selected turbines will be displayed, along with the total of all these selected values.

The graph at the bottom shows how much energy the selected turbine has generated over the past few minutes. To select another turbine there is a dropdown box which contains all turbines connected to the logged in user. Also, the user can switch to display a field of turbine and select the desired field to display or select all turbines to show in one graph.

If the user does not want to see the power in, power out or the wind speed then these lines can be disabled by clicking on the corresponding coloured box just above the graph.

To see a forecast of the wind speed in an area, then there is the button "go to forecast" which will swap out the graph to show a forecast of the wind.
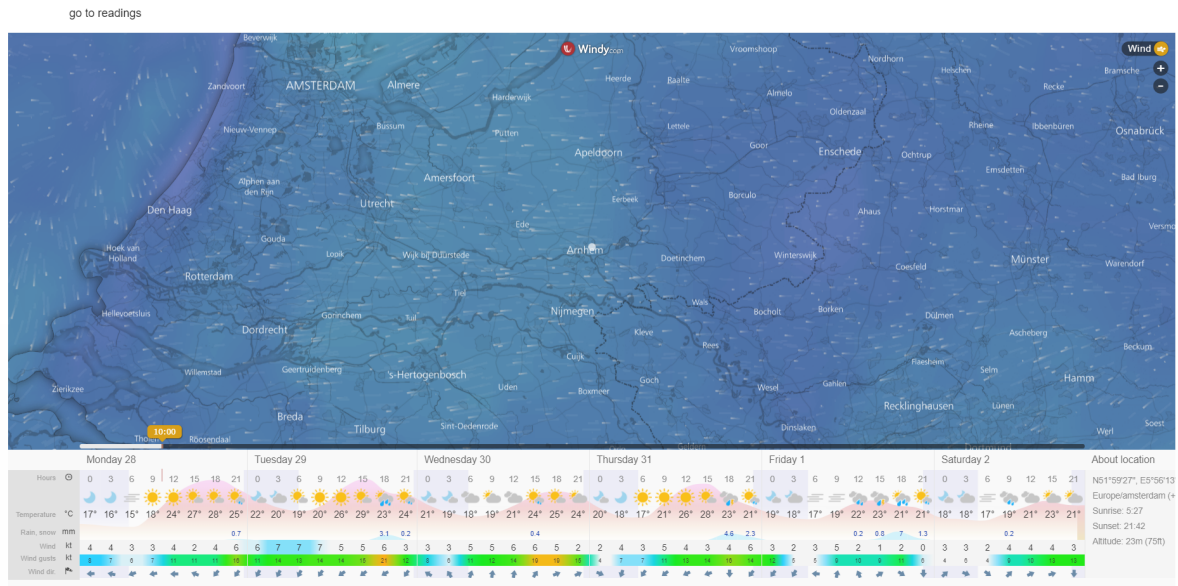
Figure 8.4 - Graph swapped out with forecast

The forecast in *Figure 8.4 - Graph swapped out with forecast* shows how high the wind speed is in the area. It will display Arnhem at the start, but the map can be dragged around and zoomed in/out to show different areas all around the world. To select an area just press somewhere else on the map. Underneath the map there is some information about the selected area, which shows the wind speed, gusts of wind and direction of the wind along with some other information. To switch back to the graph, the button "go to readings" must be pressed. The map is created with the windy plugin. (Windy, 2018)

1.2. Database

The database contains all the data that needs to be displayed on the website, the data is send from the microcontroller inside the box on the wind turbine which updates to more recent values every so often. The database is made with SQL. (MySQL documentation, 2018)

1.2.1. Users

Table 8.1: Users

userID	username	password	reg_date
5	username2	$2y$10$XLpCfZSvV8SjBrcppc1bSuixKuAijA8LWhpViP3PD57...	2018-04-23 12:42:37
12	username	$2y$10$akCJNwgI1/qHVuDcHNkGx.ONJveNW9Xc2ZO5F0gI63s...	2018-04-23 12:21:22

In *Table 8.1: Users* the users are stored. The column userID is used to find the corresponding turbines in the other table for this user. The column username contains all the different usernames created. The column password contains the corresponding password of the user. The password is encrypted to ensure that nobody else will log in with someone else's details. The last column shows when the user was created.

1.2.2. Data

Table .: Data

userID	deviceID	PowerIn	PowerOut	windspeed	Field	LastUpdated
5	202481601731776	40-79-2-169-105-40-92-126-10-191	160-89-108-87-121-149-12-112-194-84	4-107-127-46-93-158-172-185-66-19	1	2018-05-15 11:19:01
5	202561601731776	117-372-182-492-746-298-187-154-198-176	117-372-182-492-746-298-187-154-198-176	185-198-726-109-287-210-178-903-187-390	1	2018-05-15 09:42:59
5	382729128784736	117-372-182-492-746-298-187-154-198-176	117-372-182-492-746-298-187-154-198-176	185-198-726-109-287-210-178-903-187-390	0	2018-05-15 11:36:22
5	327765546746756	117-372-182-492-746-298-187-154-198-176	117-372-182-492-746-298-187-154-198-0	185-198-726-109-287-210-178-903-187-390	0	2018-05-22 11:29:43

In *Table 8.2: Data* recent data for the turbines is stored. To see which turbine belongs to who, this table has the column userID as well which makes it possible to connect the two tables. The deviceID contains the ID or name of the turbine, which makes it easier to find specific turbines on the website. PowerIn contains the input power of the last 10 minutes, divided with dashes with the newest value on the right and the oldest value on the left. PowerOut contains the output power of the last 10 minutes. And windspeed contains the wind speed of the last 10 minutes. The column Field makes it possible to differentiate between different fields of turbines. And the column LastUpdated shows when the values have been updated the last time.