Team 5

NGRY HUB virtual testbed

16th january, 2020

1. Purpose

This final documentation is a summary of the outcome of the project. The purpose of this document is that the reader should, on a clear way, understand what results that have been produced from the project and also get a summary of the experiences from working with this project. From reading the documentation the reader should get a good knowledge about what has been done and what the team members have learnt from doing this project.

2. Client and Project

Our client is Future Energy Center, MDH. The European Regional Development Fund project, NRGY HUB, aims at creating a HUB for innovative energy solutions, and one important part of the project is a virtual testbed that will digitally describe a city with open data on its various flows with regards to energy and district heating. The city that will be digitally described is Västerås, and in order to accomplish that a map of the city will be used. Due to GDPR regulations the data on energy and water usage can only be displayed by clustering at least five close buildings together, and then calculate the average heating and energy usage within each building . The displayed data will be averaged district heating and energy usage within each cluster.

However the requirements for the project changed halfway as the client's demand changed. The clustering was no longer considered important, so the different flows will be shown for each building individually. Also they changed the data that is going to be displayed for district heating and energy as the only service to be considered. The new requirement was to create different

user access based on account level and the type of company that a specific user works for. These were the most important changes needed to be made for the final work.

3. Implemented features for the final product

- **Registration for users**

  In order to access the page (to login) and to be able to see the map with the markers with the information about district heating and electricity, the user must be registered.
- **Open Street Map**

  The main platform that was used to display the information, OSM is a map of the world, free to use under an open license.
- **Markers (Buildings)**

  Around Västerås, with open data, markers are displayed on its various flows with regards to energy and electricity. They represent building and the usage of those services.
- **Information buildings (Heating and Electricity)**

  Each marker when clicked, they will display the data of usage of the heating and electricity of the building
- **Database (MySQL)**

  For the database, MySQL was used, which is a relational database in order to have relationships for different user permissions.

4. Features not implemented in the final product

- **Clustering**

  At first clustering was needed for the buildings to display the services information together, after meeting with the client, they switched the focus from clustering to different user levels and access type. So clustering was off the table.
- **Cloud deployment**

  Due to limitations of time and the change on the client priorities, it was not possible to deploy the application into the Cloud with Amazon Services on time.
- **Increase the number of different users and company access**

The client wanted to create different kind of users and companies that can access to different to information provided by the meters.

5. Major changes from client during project

The client put clustering as the main focus for the project from the first meeting. We were told that the important thing was to make clusters of at least 5 buildings and to display the information about the whole area. The group started implementing the project from those information. The client then switched the focus from clustering to different user levels and access type. This major change forced us to review the whole database structure and the whole back-end implementation for the database.

For the first part, the group had created a non relational database (noSQL) based on MongoDB. As the requirements changed the group needed to switch to a relational database as it was important to check different user levels and access type. The entire database was then dropped as the group switched platform to Amazon Aurora which is a mySQL database. This change had a heavy impact on the project as database design, structure, relations and connection to the webpage needed to be updated.

A big change that was made but had nothing to the clients requirements to do was that the Amazon database got hacked when the project was almost completed. This forced the group to change database once again. This time it was switched to a MySQL database and not Amazon in order to avoid being hacked again.

The client originally wanted to have the map offline. We have at first tried to satisfy the client's demand but further on in the project we noticed that this was not going to work due the offline map was to big. After consultation with the steering group we decided to go for a connected map. The client has later on approved that.

6. Acceptance test

In order to check the program's functionality, the group made some acceptance tests that were made without the client. Some tests were successfully while some were not. The first tests we did were on the registration. We fully tested the registration of a user by entering the correct information, incorrect information and incomplete information. These tests gave the correct result back, that the user is registered in the database when correct information was given, and not if incorrect or incomplete information is given.

Not all acceptance tests were a success for the admin page. When we enter the correct information we get the correct result. But if we enter incorrect information or partly fill in the information we do not get error messages for that, something we did not have the time to implement. This resulted in wrong or empty data inserted into the database.

The login form was not completely implemented in lack of time and therefore no tests were done on that. If the login had been done, the test should have included the same tests that were made on registration and admin. There is an error message placed on the login form so it would be displayed when incorrect information is given when fully implemented.

	Correct information	**Incorrect information**	**Partially information**
Register			
Admin			

Figure 1: Test scheme for Register and Admin panel

In the table below we will show the output of the system depending on the different privileges that each user has. This was the main requirement from the client and it was fulfilled with the accepted results. By trying different users, with different permissions, we get the expected results.

Output	Normal user in heating company	Normal user in electricity company	Admin user in heating/electricity company	Super admin
District heating				
Electricity				
Adding new meters				

Figure 2: Output for tests on showing heat/electricity and adding meters for different users

7. Changes of the organization during the project

The biggest change in the group that was made during the project, was that a team member quit. It was a bit unclear if he was going to come back or not. Therefore the team members who were left had to work extra hard for him too.

There was at least one meeting a week and continuously contact through the message application “Whatsapp” which worked well for the group. The project plan said that there will be much contact with the client through the project. Unfortunately, it did not happen as much as wanted due the clients were difficult to get hold of and did not seem to want so many updates.

As for the different role of the team, Nejra and Clara helped in the leading process by helping scheduling meetings, updating information on Trello and completing other tasks that relieved some job from Donatello which was originally the only project leader.

8. Total effort and the distribution over activities

The groups total spent hours were 719,5 on the project. The largest amount of hours were spent on front-end, back-end and database. A very large amount of time was spent on the map development as well. The client wanted the map to be offline which was a big issue for the project. After some consultation we got to use the map online which was easier and saved us a lot of time. The remaining hours were spent on documentation, presentations and others. Due the fact that the database had to be changed two times, a lot of time was spent to fix that. The hacking of the database did not help the project as a new database instance had to be made just days before the deployment in order to show the functionality of the project. The rest of the time was spent on presentations for the steering group, documentation writing and meetings with the client.

9. The responsibilities for different activities in group

Donatello has been responsible for both the databases in both creating the database and tables. This was done with Nejra and Andrés's help as Nejra also worked on the back-end of the webpage meanwhile Andrés helped with the structuring. Nejra worked also on connection between front-end and back-end as well as the controllers. Tables and relationships between them in the database were done with the help of back-end code automatically in the end. So Nejra made it possible to create database only by putting the correct connection string in the properties of backend application. She also helped on front-end parts as she was the one with most knowledge in react JS which is the language used for the web page. Isabelle and Clara were responsible for the front-end of the project. They developed different design suggestions to the group and implemented what was decided. Oskar was in the beginning responsible for

implementing the offline map and kept working after requirements changed with some help at the end from both Donatello and Nejra. Juan worked on finding a way to display the markers and cluster each of them on the map, we struggled since the client did not give us the specific data needed to make the clustering, after that the requirements were changed. When it comes to the documentation, everyone has participated by writing some parts of the documentation, mostly the parts regarding the work done during implementation. Clara managed to display all the markers on the map and bind the popup with the information on them. Donatello who was the project leader tried to coordinate the group work with the help of Nejra and Clara which helped in booking meetings, organizing Trello workflow and motivating the team. They worked as additional project leaders which helped a lot during the project.

10. Hours of working for each team member

Members	Week 1	Week 2	Week 3	Week 4	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Total
Muhammad										0	0
Nejra	11	4	20	17	17	8	12	10	14	22	135
Juan	7	0	10	13	15	7	6	0	6	9	73
Andrés	10	0	6	13	15	9	7	2	12	9	83
Isabelle	10	10	16	16	15,5	10	7	11	10	10	115,5
Donatello	11	10	13,5	15	17	10	7	12	10	10	115,5
Clara	10	10	18	16	15,5	10	8	12	10	10	119,5
Oskar	5	6	14	12	15	6	6	0	5	9	78
											719,5

Figure 3: Scheme for worked hours for every team member

11. What have been learnt from working with the project

The project seemed small at the beginning, but different issues and requirements changes had a huge impact on the project. The project has taught us how important it is to get the right information from the beginning and that communication with the client is very important.

We have learned how to work as a team and to divide the work, even though we have divided the tasks to do we have had different levels of contribution to the project. However, we have been working with technologies that we have had no prior experience with which took some time to understand.

12. What would have been done different

If we had known that the requirements were to change we should have been more active in trying to meet up with the client. We tried to get weekly meetings with the client but it was hard to get to meet them because of schedule issues and others. If we knew that getting a meeting was going to be this hard we could have put more effort in trying to get to meet the client. Even if we still did not manage to book more meetings with the client, we would have sent more emails with updates on what we have finished and are currently working on. Because that could have lead to the new requirements in an earlier stage in the project.

On the leadership part we believe that we probably should have divided the work better and give precise descriptions on the work that needed to be done. Also have a more clear deadlines on tasks to force the team members to work hard in intention to reach the deadlines.

13. Advice to next year's students

The advice our group would give to the students taking the course next year would be to divide the work properly, and be precise on what needs to be done. Also try to have more meetings with the group, as you will be most productive when you are together. It is also very important to talk about issues, and do not be afraid to ask for help. If you feel that there is a lack of information about the project, do not hesitate to push the client to give you all the information you need. Meet with them to be sure that you’re on the right track so that you do not have to change the whole project after you worked on half of it. If you feel that the project is small and the clients do not have a lot of requirements and

features, try to come up with additional features that would suit the project. Then propose the ideas to the client, because your new features might be something that they did not think of and might really like and benefit from.