



University of L'Aquila

Department of Engineering and
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Report Homework #1

Water Distribution, Leakage and Quality Control System

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Github Project Repository:

<https://github.com/GaetanoFichera/Water-Quality-Control-System>

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Chapter 1

Who we are

We are Gaetano Fichera and Giovanni Lezzi, two students who are attending the course of Master Degree in Computer Engineering.

In this homework we have applied our knowledge of Model Driven Engineering in order to model a Water Distribution, Leakage And Quality Control System (WCS). We spent three weeks and half in this homework, with an average of ten hours of work per week.

Chapter 2

Our Homework

The task is to profiling and modeling a Water Distribution, Leakage And Quality Control System. In this area we are required to model a WCS through UML, using the extension mechanism called profiling.

First we have designed the Profile of this kind of systems and then we have modeled it through the use of these UML diagrams:

- Use Case Diagram;
- Deployment Diagram;
- Component Diagrams;
- Sequence Diagrams.

Since the extension of the domain, the task left many decision points to be analyzed. So we have limited to model only a part of the whole system.

Chapter 3

Work Planning

The first step of our work was to plan the various stages of the work. We have never managed such application domain so our first care was to study it consulting some domain expert and reading some documents online in order to understand how to design our model and imaging future possible stakeholders of the system.

After that we restricted our software model to a single portion of the system: the Water Quality Control System, in particular the inlet water pipes and the outgoing water pipes building the corresponding profile.

On the basis of the concerns of the stakeholders we have made the Use Cases Diagram and their detailed versions. Then we designed the Component Diagram driven by the Use Cases Diagram and for each Use Cases we have made a Sequence Diagram.

In the end we have done the Deployment Diagram.

Chapter 4

Study Of The Domain

We started our work collecting informations about the WCS through the Web but it was to bare for us, for this reason we have get in touch with a Master's Degree Chemical Engineering. Thanks to his help we have satisfied our doubts.

Our Vision Of The Domain

To make the Homework funnier we have decide to introduce some technologies we are not sure exist like:

- **SeaweedPicking**

particular "mechanical algae" placed at precise points of the water pipes. They are equipped with advanced water samplers that draw small amounts of water to be sent to the analysis center, each SeaweedPicking is connected to an internal network that will head the Control Center

- **Magikarp**

in the event of contamination detection in inlet water pipes, "mechanical fish" is sent to search for the possible cause inside the pipelines, it will automatically look for the cause of the problem and send the data to the Control Center. They are equipped with advanced water sampler and analyzer in order to speed up the recovery process

Activities in the our system can be attribute into three macro areas:

- The Sampling Aspect

the activities dedicated to the sampling water

- The Quality Control Aspect

the activities dedicated to the water quality monitoring and discovering of possible problems and their causes

- The Water Retrieving Information Aspect

the services provided to the Company to retrieve information about the water quality

Stakeholders & their System Required Features

The stakeholders of our system and the future they are asking for are:

- Sample Supervisor
 - Manage Seaweed Picking
 - Collect Water Samples
 - Water Samples to Analysis Center
- Quality Control Supervisor
 - Manage Magikarp
 - Monitor Informations about Water Quality
 - Send Warnings in case of Water Quality problems
- Water Information Supervisor
 - Connect to the Company Water Archive
 - Retrieve information about Water Quality

Use Cases Diagram

After identifying the stakeholders we decided the Use Cases for each of them so as to make the modeling phase simpler. Below are listed all Use Cases in the detailed version.

7.1 Sampling Water Use Case

| | |
|--|---|
| Primary Actor | Sample Supervisor |
| Interested parties and interests | <ul style="list-style-type: none"> ▪ Sample Supervisor: <ul style="list-style-type: none"> – He starts water monitoring processes in the inlet and outlet channels related to the SeaweedPicking processes |
| Principal Flow | |
| Actor's Action | System's Responsibility |
| <p>1. He expresses the will to start sampling the waters;</p> <p>3 He chooses which part of the system he wants to sample;</p> | <p>2 It asks which part of the system you want to sample if the inlet or outbound waters;</p> |

| | |
|--|---|
| | <p>4 It starts SeaweedPicking belonging to the required subsection;</p> <p>5 It provides water sample data.</p> |
|--|---|

7.2 Send Water Samples To Analysis Center Use Case

| | |
|--|--|
| Primary Actor | Sample Supervisor |
| Interested parties and interests | <ul style="list-style-type: none"> ▪ Sample Supervisor: <ul style="list-style-type: none"> – He wants to send the data to the analysis center |
| Principal Flow | |
| Actor's Action | System's Responsibility |
| <p>1. He expresses the will to want to send the data to the analysis center;</p> <p>3 He chooses the sample(s) to be sent;</p> | <p>2 It provides a list of samples lacking analysis;</p> <p>4 It starts the sample(s) sending process.</p> |

7.3 Check Water Quality Use Case

| | |
|----------------------|----------------------------|
| Primary Actor | Quality Control Supervisor |
|----------------------|----------------------------|

| | |
|--|---|
| Interested parties and interests | <ul style="list-style-type: none"> ▪ Quality Control Supervisor: <ul style="list-style-type: none"> – Start up the Magikarp protocol (described in the other document) for inlet waters and an alarm resulting in blockage of the flow of water for the outgoing waters. |
| Principal Flow | |
| Actor's Action | System's Responsibility |
| <p>1. He expresses the will to start the Solution Protocol;</p> <p>3 He chooses between the two options;</p> | <p>2 It asks whether to activate the magikarp for entry or block the flow of outgoing water;</p> <p>4 It executes the solution related to the option selected.</p> |

7.5 Retrieve Water Information Use Case

| | |
|--|---|
| Primary Actor | Water Quality Supervisor |
| Interested parties and interests | <ul style="list-style-type: none"> ▪ Water Quality Supervisor: <ul style="list-style-type: none"> – Wants to check water parameters. |
| Principal Flow | |
| Actor's Action | System's Responsibility |
| <p>1. He expresses the will to control the data on water parameters;</p> | |

2 It returns the parameters.

Chapter 8

Drawing-Up Of The Profile

8.1 Water Sample Profile

| | |
|---------------------|--|
| Water Sample | |
| Metamodel Class | Element |
| Description | It is a representation of the physical meaning of water sample |
| Tagged Values | <ul style="list-style-type: none">▪ Amount: Integer;▪ Pick Point: String. |
| Constraints | |

8.2 Water Quality Supervisor Profile

| | |
|---------------------------------|--|
| Water Quality Supervisor | |
| Metamodel Class | Actor |
| Description | He is an actor involved to retrieve information about the water state |
| Tagged Values | <ul style="list-style-type: none">▪ Task: String = Water Reviewer. |
| Constraints | |

8.3 Sample Supervisor Profile

| | |
|--------------------------|-------|
| Sample Supervisor | |
| Metamodel Class | Actor |

| | |
|---------------|--|
| Description | He is an actor involved to start up the sampling water |
| Tagged Values | <ul style="list-style-type: none"> ▪ Task: String = Sampling. |
| Constraints | |

8.4 Quality Control Supervisor Profile

| | |
|-----------------------------------|---|
| Quality Control Supervisor | |
| Metamodel Class | Actor |
| Description | He is an actor involved to check the water quality and in case of some unmet parametres he can start up a solution protocol as Magikarp |
| Tagged Values | <ul style="list-style-type: none"> ▪ Task: String = Quality Control. |
| Constraints | |

8.5 Water Parameters Profile

| | |
|-------------------------|---|
| Water Parametres | |
| Metamodel Class | Property |
| Description | It is a collection of chemical property |
| Tagged Values | <ul style="list-style-type: none"> ▪ Bicarbonate: Integer; ▪ Magnesium:Integer; ▪ Potassium:Integer; ▪ Calcium:Integer; ▪ Sodium:Integer; ▪ Sulphate:Integer. |
| Constraints | |

8.6 Outgoing Water Quality Warning Profile

| | |
|---------------------------------------|---|
| Outgoing Water Quality Warning | |
| Metamodel Class | Element |
| Description | It represents the action that activates the stop flowing protocol |

| | |
|---------------|--|
| Tagged Values | |
| Constraints | |

8.7 Inlet Water Quality Warning Profile

| | |
|------------------------------------|---|
| Inlet Water Quality Warning | |
| Metamodel Class | Element |
| Description | It represents the action that activates the Magikarp protocol |
| Tagged Values | |
| Constraints | |

8.8 Magikarp Profile

| | |
|-----------------|--|
| Magikarp | |
| Metamodel Class | Component, Node |
| Description | It is a representation of the physical meaning of Magikarp |
| Tagged Values | Model Number: Integer |
| Constraints | |

8.9 SeaweedPicking Profile

| | |
|-----------------------|--|
| SeaweedPicking | |
| Metamodel Class | Component, Node |
| Description | It is a representation of the physical meaning of SeaweedPicking |
| Tagged Values | Model Number: Integer |
| Constraints | |

8.10 Water Sampler Profile

| | |
|----------------------|---|
| Water Sampler | |
| Metamodel Class | Component |
| Description | It is a representation of the physical meaning of Water Sampler |
| Tagged Values | Model Number: Integer |
| Constraints | |

8.11 Water Analyzer Profile

| | |
|-----------------------|--|
| Water Analyzer | |
| Metamodel Class | Component |
| Description | It is a representation of the physical meaning of Water Analyzer |

| | |
|---------------|-----------------------|
| Tagged Values | Model Number: Integer |
| Constraints | |

Chapter 9

Our Purification System

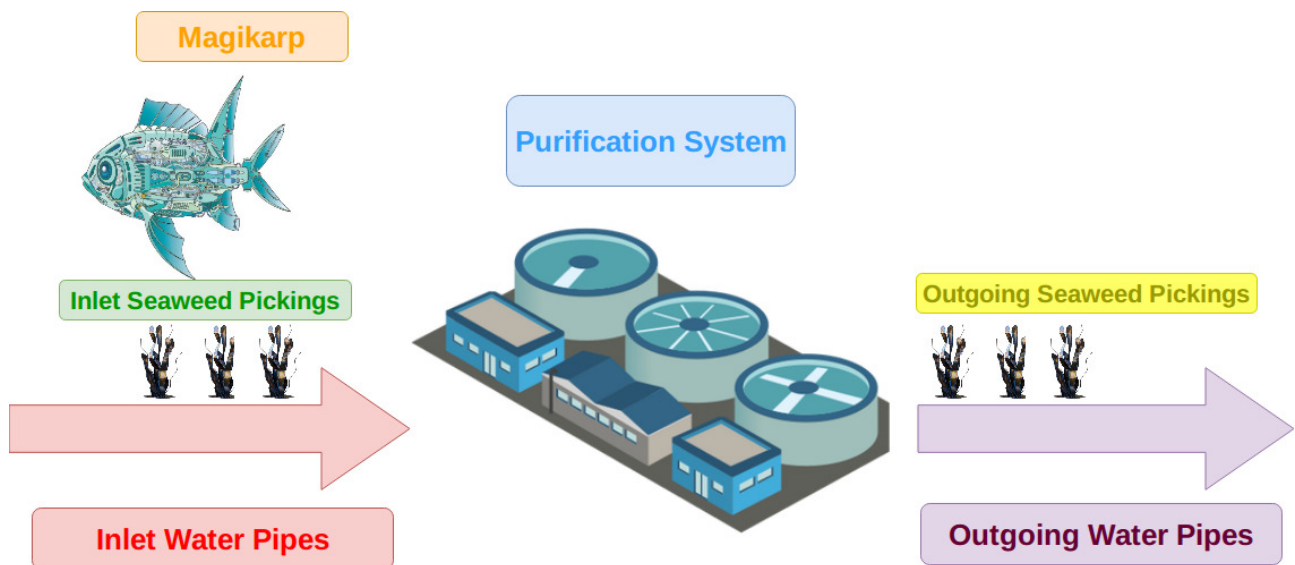


Figure 9.1: WQCSDiagram

Component Diagram And Sequence Diagrams

The diagram of the components allowed us to divide our system in different parts each of them is characterized by an high cohesion. First we listed the components linked to the macro functions described by use cases then we added other micro components thanks to the detailed version of our use cases. After that we created the Sequence Diagrams and sometimes we refined our Component Diagram because of some demands arising from Sequence Diagrams.

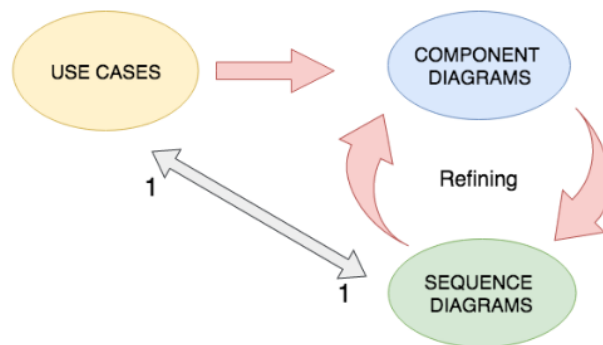


Figure 10.1: Component - Sequence

The model was created through design tool: MagicDraw. It has allowed us to maintain consistency in the model between the various diagrams.

Chapter 11

Deployment Diagram

The Deployment diagram shows how the various parts of the system are distributed physically. This diagram represents the physical architecture of the whole system. There are three center linked between them: Control Center, Analysis Center and a Purification System. Inside the Control Center, the node where we focused our attention, there a Qs Sampling App linked to the Seaweed Pickings, one for inlet and other for outgoing water pipes, also there is a QS Quality Control App involved to control the Magikarp node. Magikarp and Seaweed Picking nodes are linked to their Qs Apps through a wireless connection defined in our Profile. Both of Qs Apps are linked to the Water Company Server connected to the DB. Also there an other node, the Qs Water Info App, concerned to retrieve information from Water Company Server.

Chapter 12

Our Conclusion

During the development of this homework we have faced for the first time with the abstraction thinking about classes and meta-classes. At the beginning we had difficulty because before this we thought only about class and object view of an application domain.

Also we used for the first time MagicDraw and we appreciate its functionality. It is much better from another UML CASE tool that we used in the past named Visual Paradigm. At first we were disoriented, especially building Profiles, later we found certainty during the creation of the Diagram Component.

To make our project management and the sharing between us easier, we used a Git repository where we could keep track of all the changes we made to the project itself.