University of L'Aquila

Department of Engineering and
Information Science and Mathematics

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;
- 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 Plannig

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 systems.
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.

Chapter 5

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

Chapter 6

Stakeholders & their System Required Features

- 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

Chapter 7

Use Cases Diagram

Sampling Water Use Case

Primary Actor	Sample Supervisor
Interested parties and interests	▪ Sample Supervisor: – He starts water monitoring processes in the inlet and outlet channels related to the SeaweedPicking processes
	Principal Flow
Actor's Action	**System's Responsability**
1. He expresses the will to start sampling the waters;	
	2 It asks which part of the system you want to sample if the inlet or outbound waters;
3 He chooses which part of the system he wants to sample;	
	4 It starts SeaweedPicking belonging to the required subsection; 5 It provides water sample data.

Send Water Samples To Analysis Center Use Case

Primary Actor	Sample Supervisor
Interested parties and interests	▪ Sample Supervisor: – He wants to send the data to the analysis center
	Principal Flow
Actor's Action	**System's Responsability**
1. He expresses the will to want to send the data to the analysis center;	
	2 It provides a list of samples lacking analysis;
3 He chooses the sample(s) to be sent;	

	4 It starts the sample(s) sending process.

Check Water Quality Use Case

Primary Actor	Quality Control Supervisor
Interested parties and interests	▪ Quality Control Supervisor: – He wont analyze the results obtained from the analysis center by comparing them with the parameters required by the Inland Water Purification System and with the parameters for outgoing water
Principal Flow	
Actor's Action	**System's Responsability**
1. The user expresses the will to control the quality of the water;	
	2 It asks which part of the system you want to control, whether inlet or outbound;
3 He chooses which part of the system to control ;	
	4 If input water analysis is selected, it checks the parameters of the water under examination and those required by the purification system; 5 If the outbound water analysis is selected, it checks the parameters of the water under examination and the legislative ones; 6 Provides the results of the control (if the water respects the parameters or not and returns the parameters as well).

StartUp Solution Protocol Use Case

Primary Actor	Quality Control Supervisor

Interested parties and interests	▪ Quality Control Supervisor: – 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 Responsability**
1. He expresses the will to start the Solution Protocol;	
	2 It asks whether to activate the magikarp for entry or block the flow of outgoing water;
3 He chooses between the two options;	
	4 It executes the solution related to the option selected.

Retrieve Water Information Use Case

Primary Actor	Water Quality Supervisor
Interested parties and interests	▪ Water Quality Supervisor: – Wants to check water parameters.
Principal Flow	
Actor's Action	**System's Responsability**
1. He expresses the will to control the data on water parameters;	
	2 It returns the parameters.

Chapter 8

Drowing-Up Of The Profile

Water Sample Profile

Water Sample	
Metamodel Class	Element
Description	It is a representation of the physical meaning of water sample
Tagged Values	• Amount: Integer; • Pick Point: String.
Constraints	

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	• Task: String = Water Reviewer.
Constraints	

Sample Supervisor Profile

Sample Supervisor	
Metamodel Class	Actor
Description	He is an actor involved to start up the sampling water
Tagged Values	• Task: String = Sampling.
Constraints	

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	• Task: String = Quality Control.
Constraints	

Water Parametres Profile

Water Parametres	
Metamodel Class	Property
Description	It is a collection of chemical property
Tagged Values	• Bicarbonate: Integer; • Magnesium:Integer; • Potassium:Integer; • Calcium:Integer; • Sodium:Integer; • Sulphate:Integer.
Constraints	

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	

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	

Magikarp Profile

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

SeaweedPicking Profile

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

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	

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

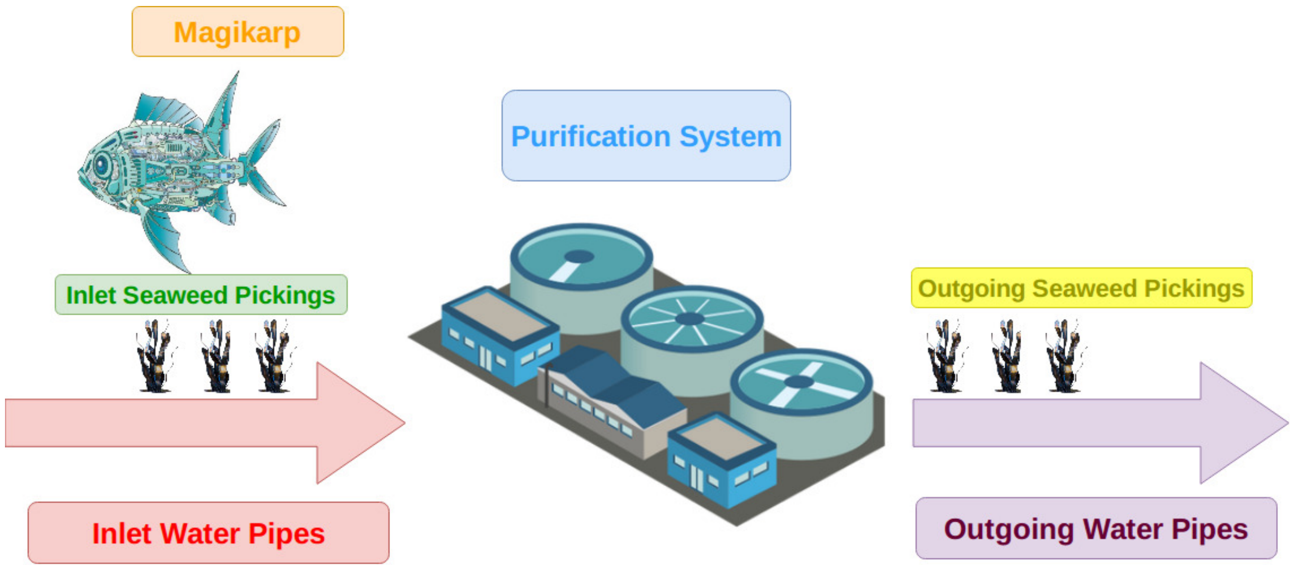

Figure 9.1: WQCSDiagram

Chapter 10

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 bacause of some demands arising from Sequence Diagrams.

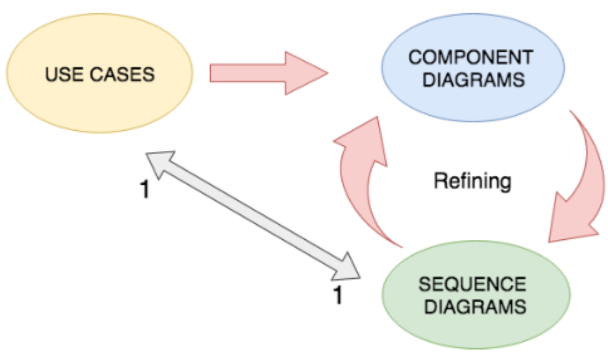

Figure 10.1: Component - Sequence

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 nods 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 abstractation thinking about classes and meta-classes. At the beginning we had difficulty because before this we though 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.