Real-Time Bridge Monitoring Design Description

Version 1.0

Revision History

Date	Version	Description	Author
2002-00-00	0.01	Initial Draft	Jörn Tillmanns
2013-11-04	1.0	First version of Design	Andrea Bottoli, Lorenzo Pagliari, Marko Brčić, Ghazal Shojaee, Jörn Tillmanns

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1. Introduction

Real-Time Bridge Monitoring is a project for the Distributed Software Development course held by Politecnico ti Milano, Malardalen University and University of Zagreb.

1.1 Purpose of this document

The purpose of this document is to assist in the development of the project 'Real-Time Bridge Monitoring", as a part of the Distributed Software Development course. This document specify the entire architecture and design of the "RTBM"-Software. These design decisions directly relate to the requirements, use-cases, attributes and interfaces of the system, as they are mentioned in the Software Requirements Specification document.

1.2 Intended Audience

This document is written mainly for the development team. It will assist the team during the development-phase and will be updated, if any design-decision will be changed.

1.3 Scope

The scope of this document it to present the overall architecture, then go into the details of each model, interface, technology that we used and other architectural aspects needed.

1.4 Definitions and acronyms

1.4.1 Definitions

Keyword	Definitions
Real-Time Bridge Monitoring	Project Title
Web App	The web application of the project

1.4.2 Acronyms and abbreviations

Acronym or abbreviation	Definitions
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
HTML	HyperText Markup Language
GUI	Graphical User Interface
AJAX	Asynchronous Javascript And XML
JSON	JavaScript Object Notation
MVC	Model View Controller
DB	Database
RTBM	Real-Time Bridge Monitoring

1.5 References

The main reference to this project is:
www.fer.unizg.hr/rasip/dsd/projects/real-time_bridge_monitoring

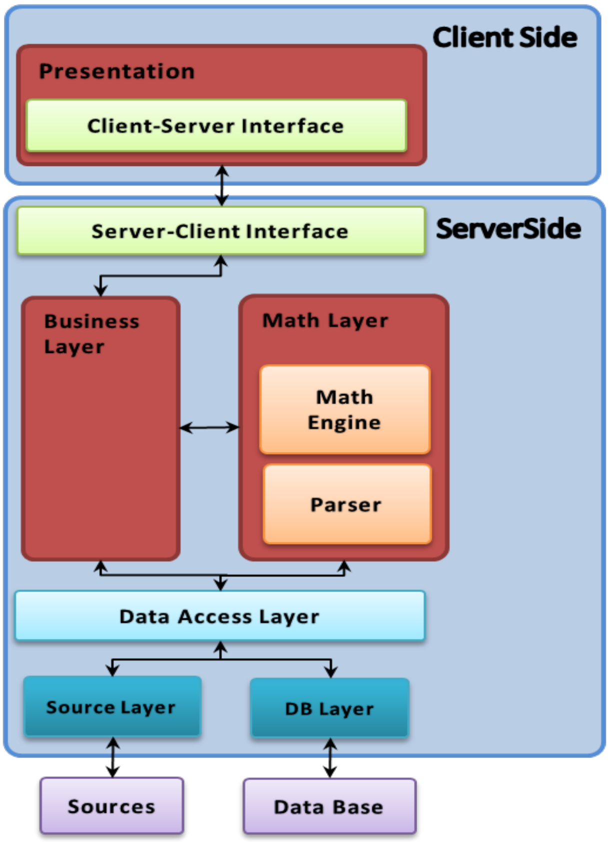
Other useful references:

- Project Plan: http://www.fer.unizg.hr/_download/repository/Project_Plan_v1.1.pdf

2. Software architecture

2.1 Conceptual design

"RTBM"-Software will mainly consists of four components: a web-service, a calculation-engine, a database and parsing script.



2.1.1 Sources

The objects sources represent the input files that come from the sensors.

2.1.2 Source layer

The only layer that permits the parser to access the data stored which are retrieved from the sensors.

2.1.3 MySQL-Database

As Database we will use MySQL. The Database will, except of the media-data like photos and videos, contain all necessary data of the software. These data are:

1. the raw-data from the sensors
2. the pre-calculated sensor and danger-level data
3. user-data
4. parameters

5. technical instrumets

The database model will be described detailed in Chapter Error: Reference source not found.

2.1.4 DB layer

This layer gives access to other layer to database. In this layer we work with SQL which is not accessible with other layers.

2.1.5 Data access layer

It is a layer between logic which is the upper level and storage which is the down side which is directly connected to source and db layer. This inherits from source and DB interfaces.

2.1.6 Math layer

This part is consist of 2 principal components which are Math engine and parsing.and give you unique interface to use parse and math engine which can modify something like database.

2.1.6.1 Parser

The data from the sensors are delivered as raw text-files. These text-files has to be parsed and written into the database. During this process the script will detect and compensate inconsistent data. This script will be automatically running in certain intervals. Also we have archive images from two Web cams and create a film from the daily, weekly and monthly pictures.

The script will be divided into four submodules:

1. The parsing-submodule will parse the data-files
2. The image-submodule will recognize the new images.
3. The consistence-check will validate the read data and patch inconsistency
4. The SQL-submodule will write all data into the database.
5. The film-submodule will create overview-movie for every day, week and month.

This component required access to the data-files and the database. The format of the required data-files will be described in chapter 17.

2.1.6.2 Math Engine

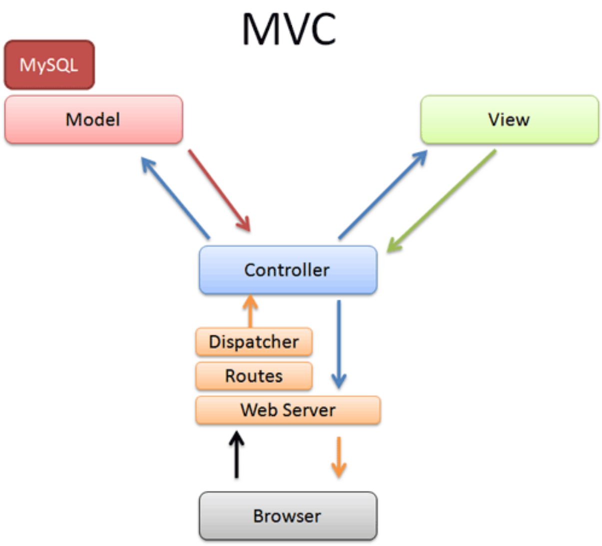
The Calculation-Engine will the main-part of the software. It will process the calculations of the danger-level and other additional parameters based on the raw-data from the database. The calculations will be performed in certain time-intervals. The calculated results will be stored in the database. The performed calculation will be described in chapter Error: Reference source not found.

2.1.7 Business layer

This layer can control the flow of data between the presentation layer and data layer ;moreover ,this can check some validation of user input for instance log in.

2.1.8 Presentation layer

The web service will present all data to the user. It will be the only way how the user interact with the system. To use the web service the user will use a common browser. The web service give to the user the possibility to log in and see information based on his access level. Also for high access level there is the possibility to do some extra actions, as add or remove some users, give or remove access level, change parameters of calculation engine and so on. We will use a MVC pattern to develop the web service.



2.2 System specification

We use a Linux Debian 6.0 to build the server. To client side, the access to the web service can do by using each common browser as Google Chrome, Mozilla Firefox, Safari, Internet Explorer, Opera.
To programming we will use at server side Python for the parser, Java for the calculation engine and client side we will use html/css with JavaScript for the web pages.

2.3 External Components

For the server we will use Apache with Tomcat for publish the web service, Cron as job scheduler to schedule the parser and calculation operations and MySQL to build the database.

On client-side we will use XXX for display graphs.

3. External interfaces

3.1 Hardware Interfaces

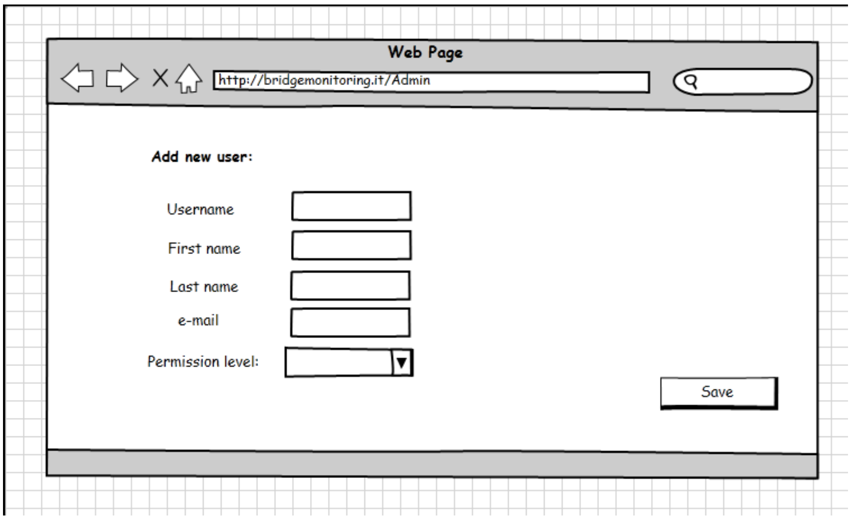
The system gathers values from some sensors and cameras:

- Anemometer: to measure wind speed and direction
- Hydrometer: to measure the water height
- Echo sonar: to measure the height of the bottom of the river and its changes
- Camera: two camera that periodically take a photo of the bridge

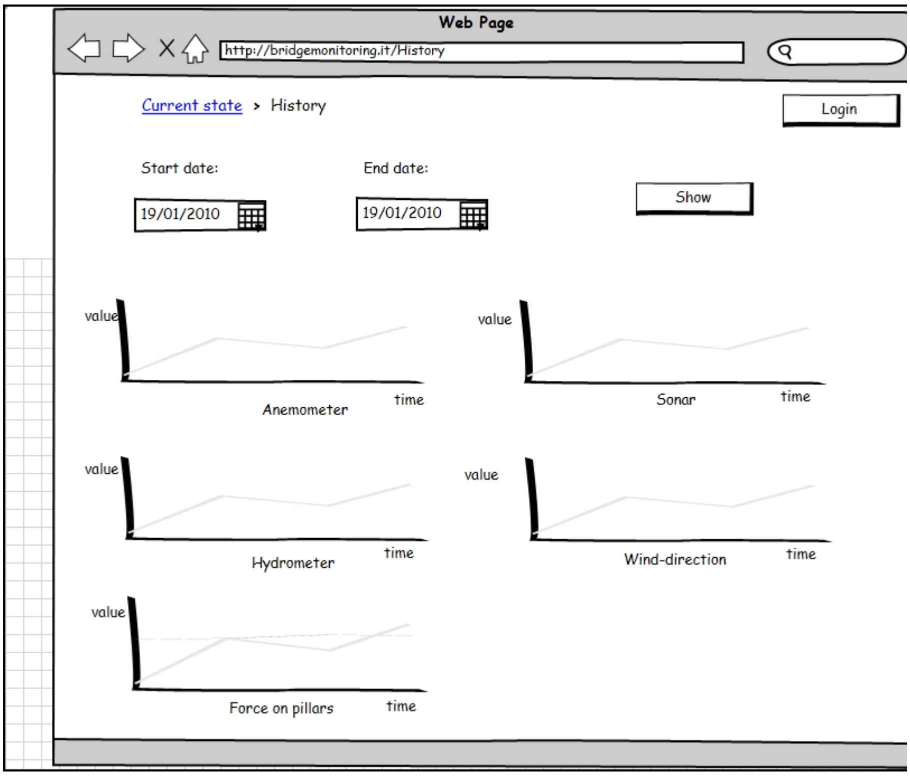
By the way this hardware part is out of our control and we can't manage the sensors, the camera and also the way which the data is gather and send to the system.

3.2 User Interfaces

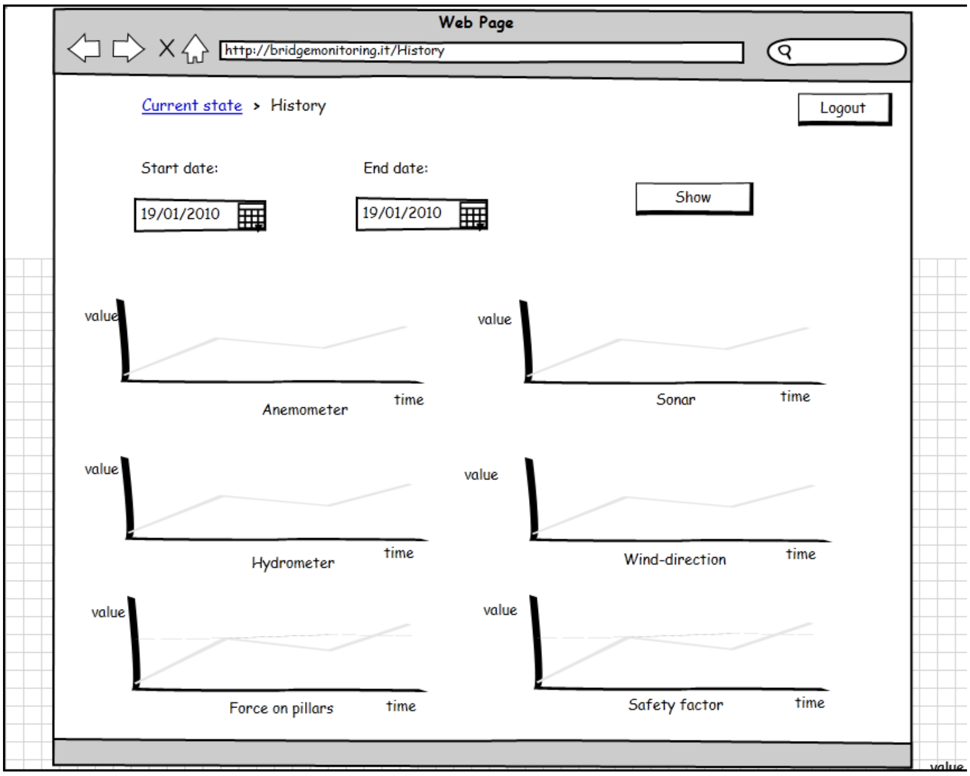
3.2.1 AddUser



3.2.2 Historical View

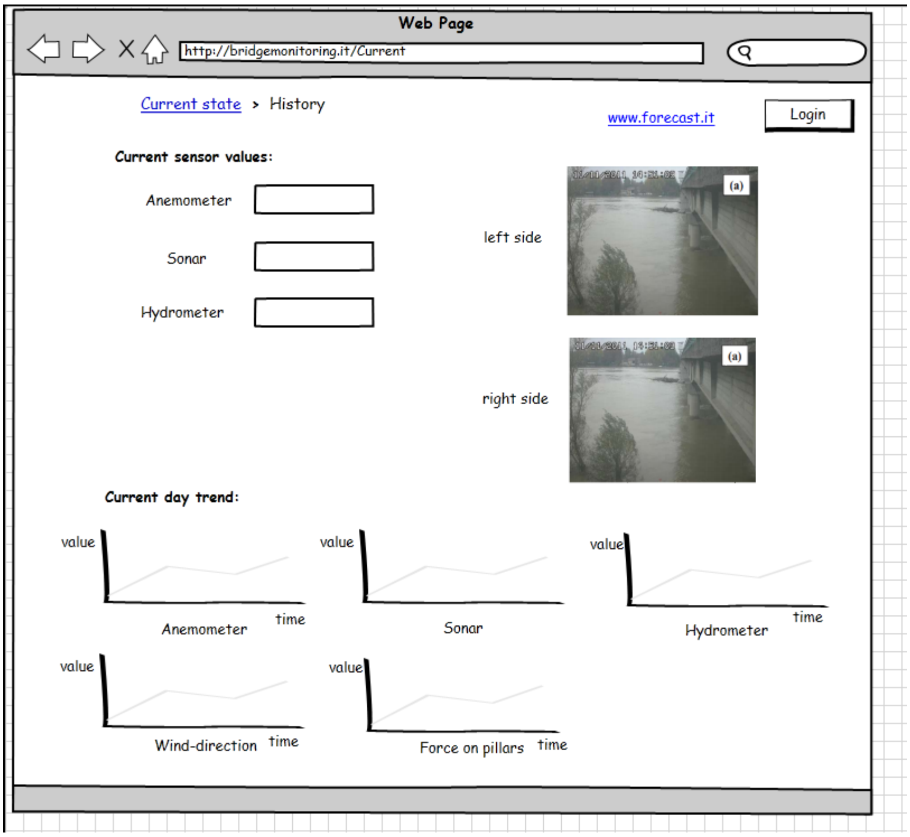


If the user is loged in, he will the also the risk-level (-diagrams):



Web Page
http://bridgemonitoring.it/History
Current state > History
Logout
Start date:
19/01/2010
End date:
19/01/2010
Show
value
time
Anemometer
value
time
Sonar
value
time
Hydrometer
value
time
Wind-direction
value
time
Force on pillars
value
time
Safety factor

3.2.3 DataView

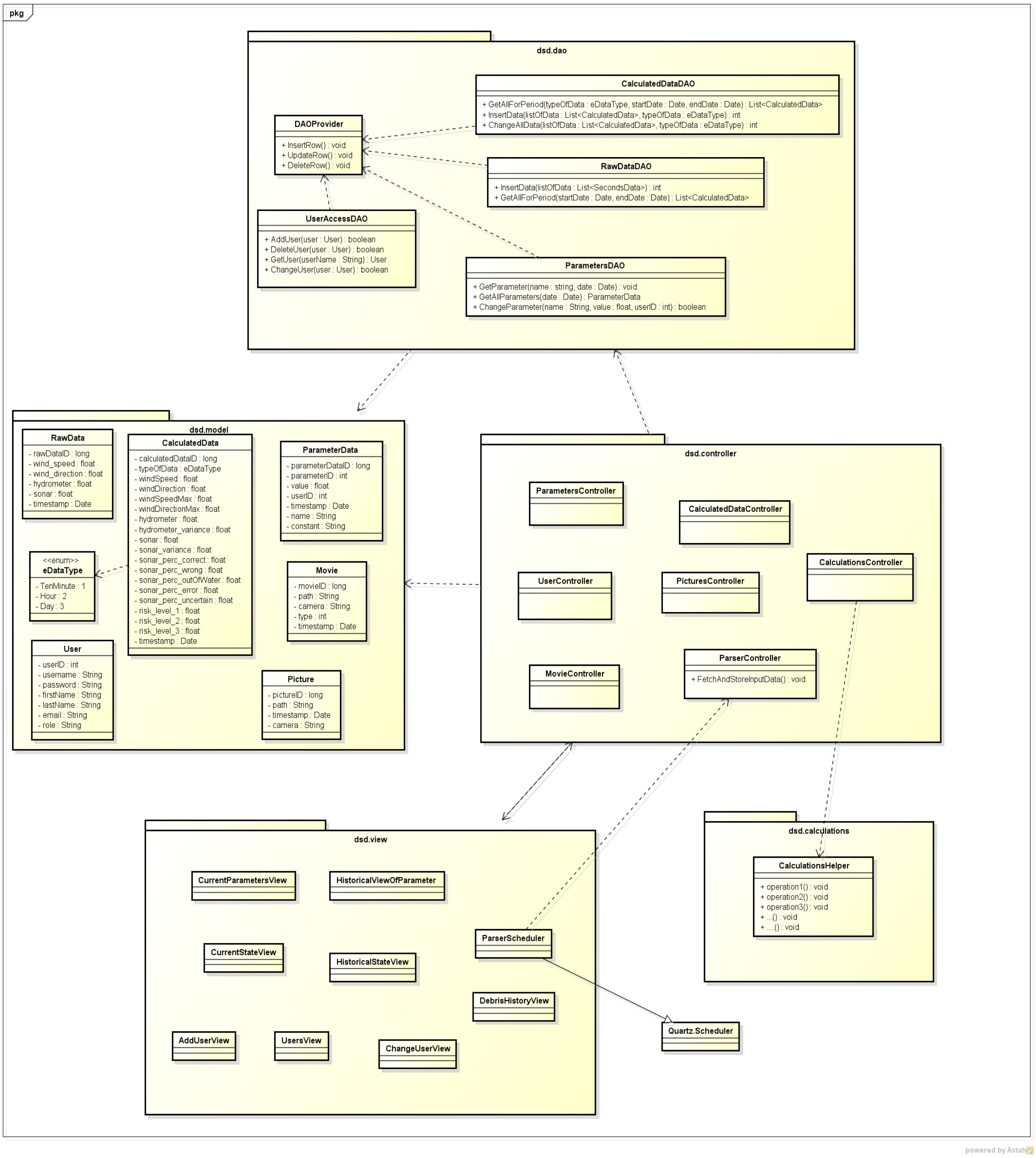


If the user is loged in, he will the also the risk-level (-diagrams):

4. Detailed software design

4.1 Implementation modules / components

4.1.1 Structured view

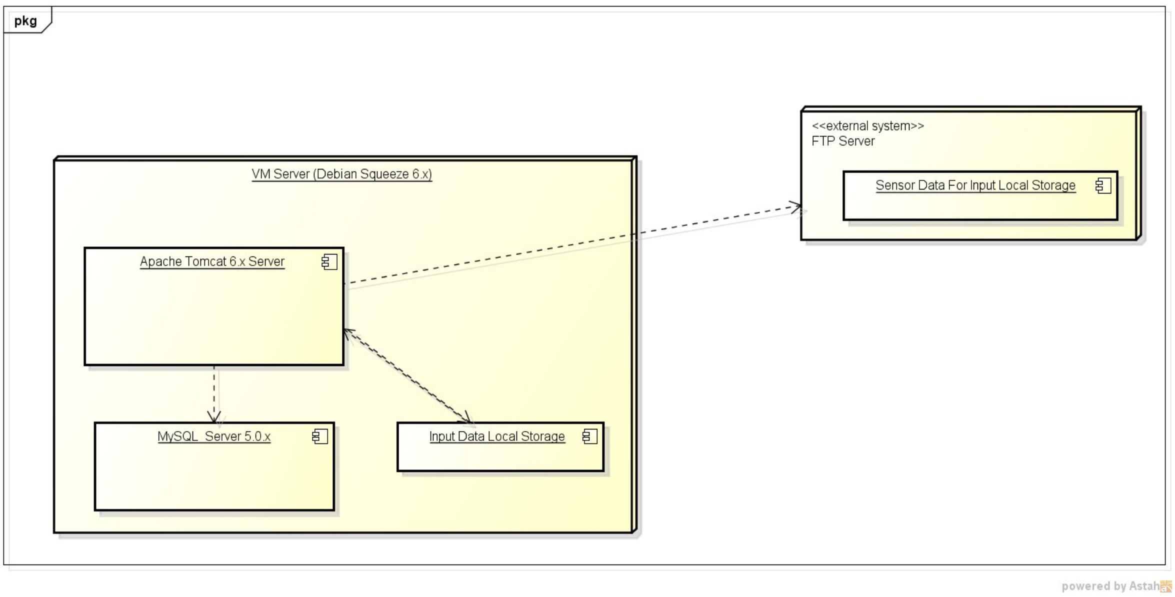


We are conforming to model – view – controller pattern. With additional layer for communicating with database called DAO. Since it is hard to plan the whole system design in advance, we were able to sketch the detail only for lower layers, since we have also the database design. When the development process will be at a further stages, we will be able to get the more detailed picture of the class diagram.

Layers described :

- DAO – layer for communicating with the database, knows about the controller and the model layer
- model – contains raw classes with their fields and properties
- controller – layer which combines all the other layer because other layers usually communicate through this layer
- view – layer that consists mainly from Servlets and .jsp pages

4.1.2 Deployment



The communication with the external server that holds the input files is still subject of discussion. What we received from the customer for testing are row files from the years 2011 and 2012. Because of that and because of the fact that we are not allowed to access the real system, we don't have the possibility to test the system for a real environment use.

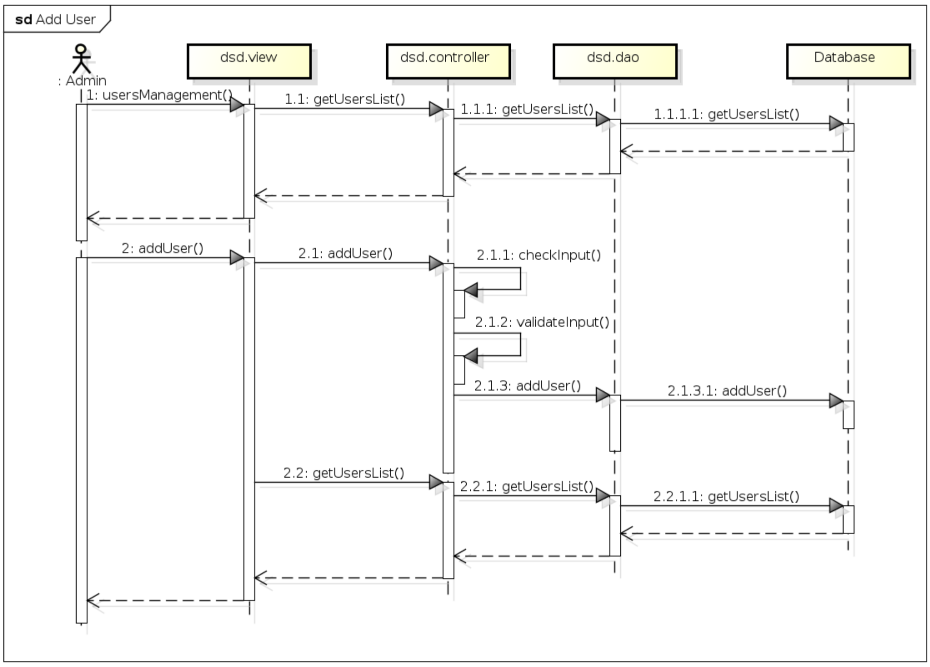
Regardless of this difficult constraints, we will deploy the data from the history to our server without accessing the ftp server and we will parse the data directly from our server.

Our server is a compact hardware unit consisting of 3 major components:

- MySQL database
- Apache tomcat web application server
- Input data local storage (storing the real input text files)

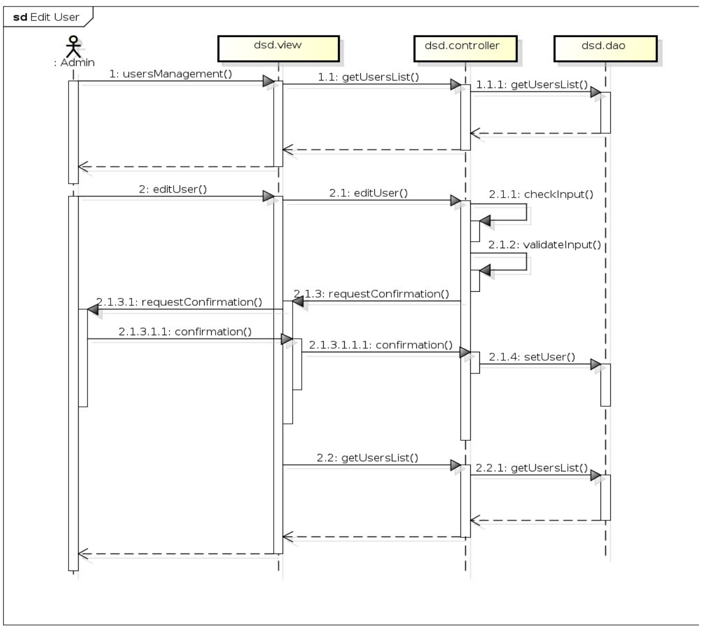
4.2 Data flow / Interactions / Dependencies

4.2.1 Add User



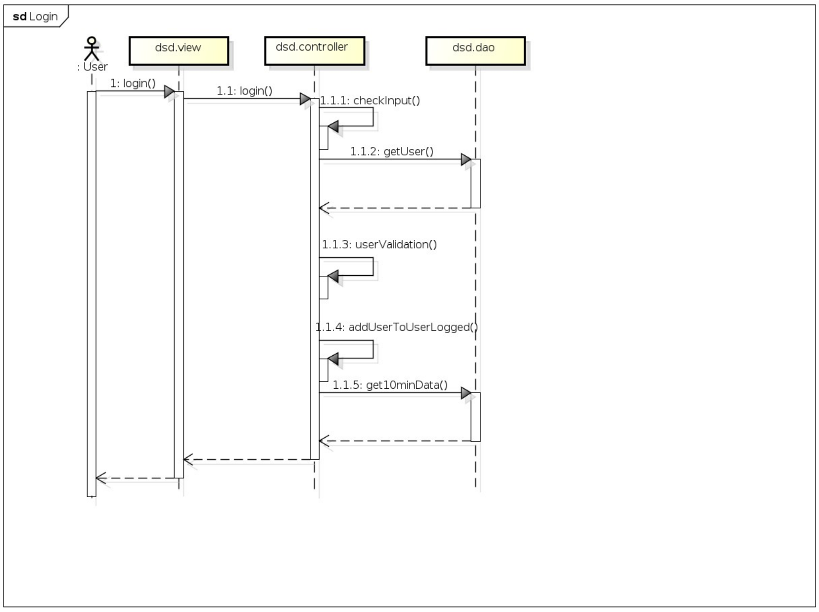
If the user want to add a new user he go to the UserMangement. On this side he will provide Information above all user, fetching through the controlling. In this view, he can create a new users. This question will be provided by the view to the controller, who will perfom the task.

4.2.2 Edit User



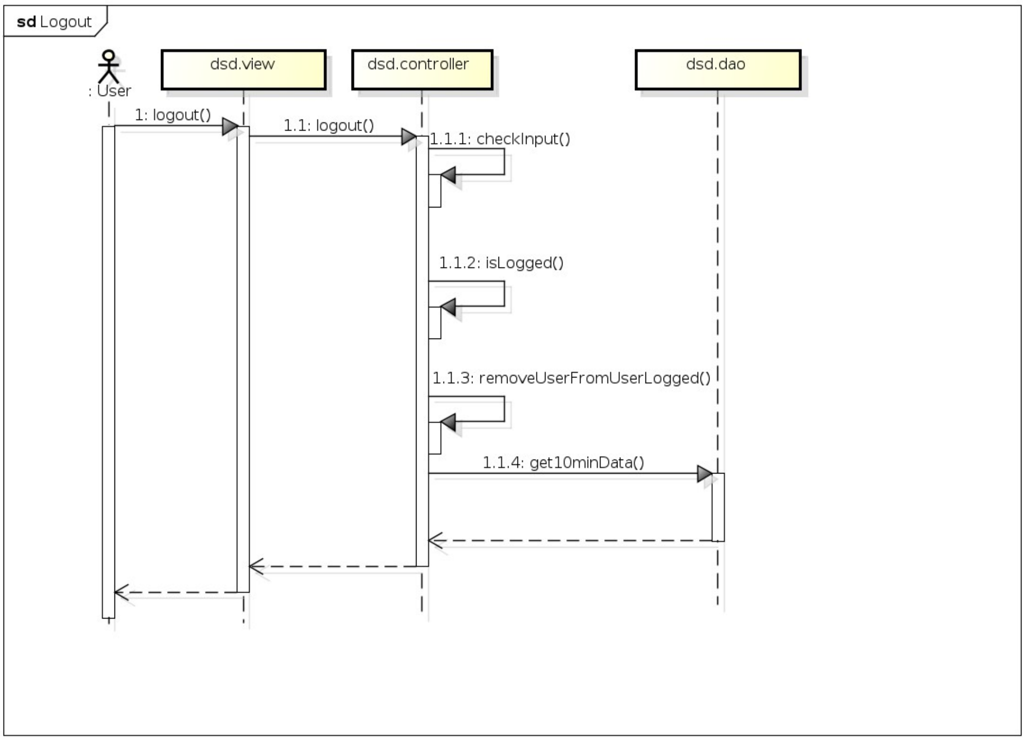
In the UserMangementView the administrator is able to edit a user. If he edit a user, the view give the call to the controller, who will perform the task.

4.2.3 Login



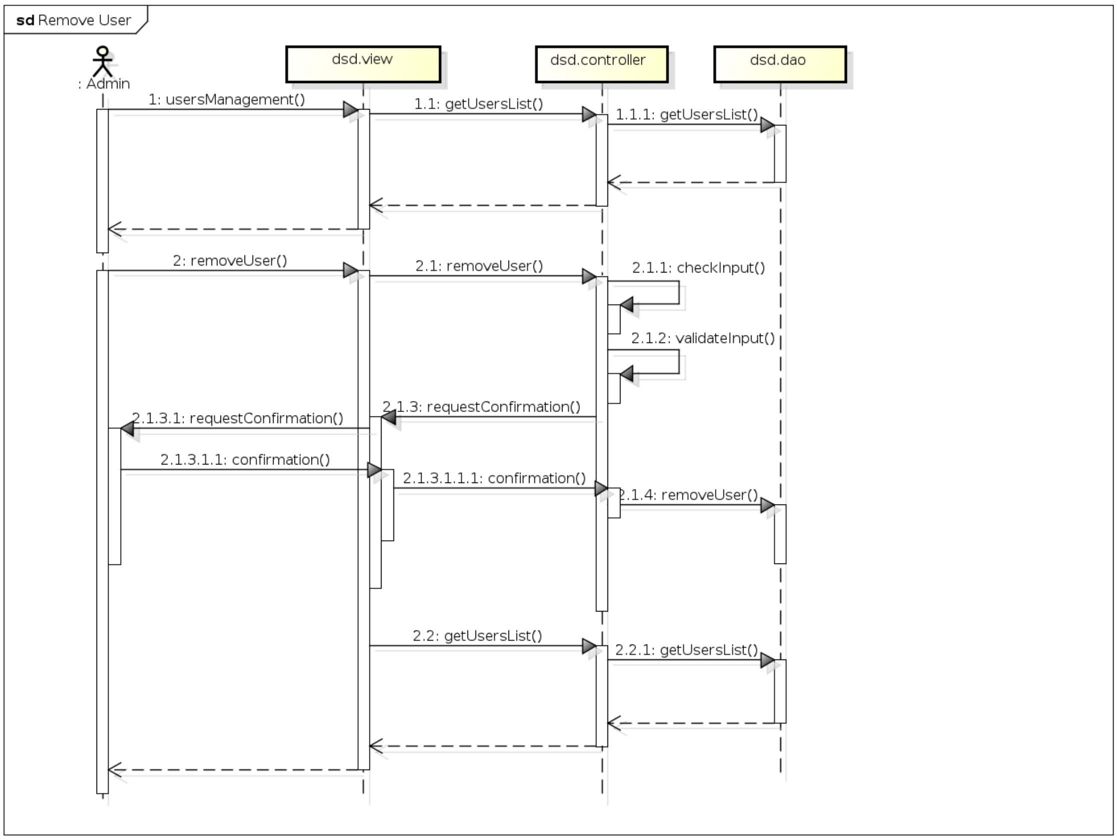
If a user login, the view will send the credentials to the controller, who will fetch the necessary data from the dao and check the login-request.

4.2.4 Logout



If the view get a logout-request, he will provied the info to the controller, who performed the task.

4.2.5 Remove User



The Administrator can over the userMangementView remove a User. If the view regonize such a request, it will provide the information to the controller. The controller will perfome the taks.

4.3 Data Types / Formats

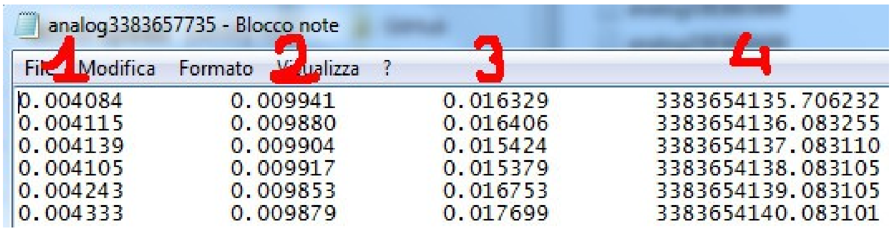
As data source for the Database adf.

There are three kind of inputs in two kind of formats:

- analog****.txt
- sonar*****.txt
- picture****.jpg

The analog file contains:

1. **Wind speed** (unity measure mA)
2. **Distance between the Hydrometer and the level of water** (unity measure mA)
3. **Wind direction** (unity measure mA)
4. **Timestamp of the detection of the sample** (Labview encode → see before)[*decimals can be dropped]*

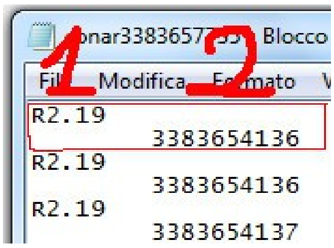

analog3383657735 - Blocco note

Modifica Formato alizza ?

1	2	3	4
0.004084	0.009941	0.016329	3383654135.706232
0.004115	0.009880	0.016406	3383654136.083255
0.004139	0.009904	0.015424	3383654137.083110
0.004105	0.009917	0.015379	3383654138.083105
0.004243	0.009853	0.016753	3383654139.083105
0.004333	0.009879	0.017699	3383654140.083101

The sonar file contains 2 columns of values, offset of a line (*fig.5*):

1. **Distance between the sonar and the bottom of the river** (unity measure meters)
2. **Timestamp of the detection of the sample** (Labview encode → see before)


Blocco

Modifica

1 2

R2.19
3383654136
R2.19
3383654136
R2.19
3383654137

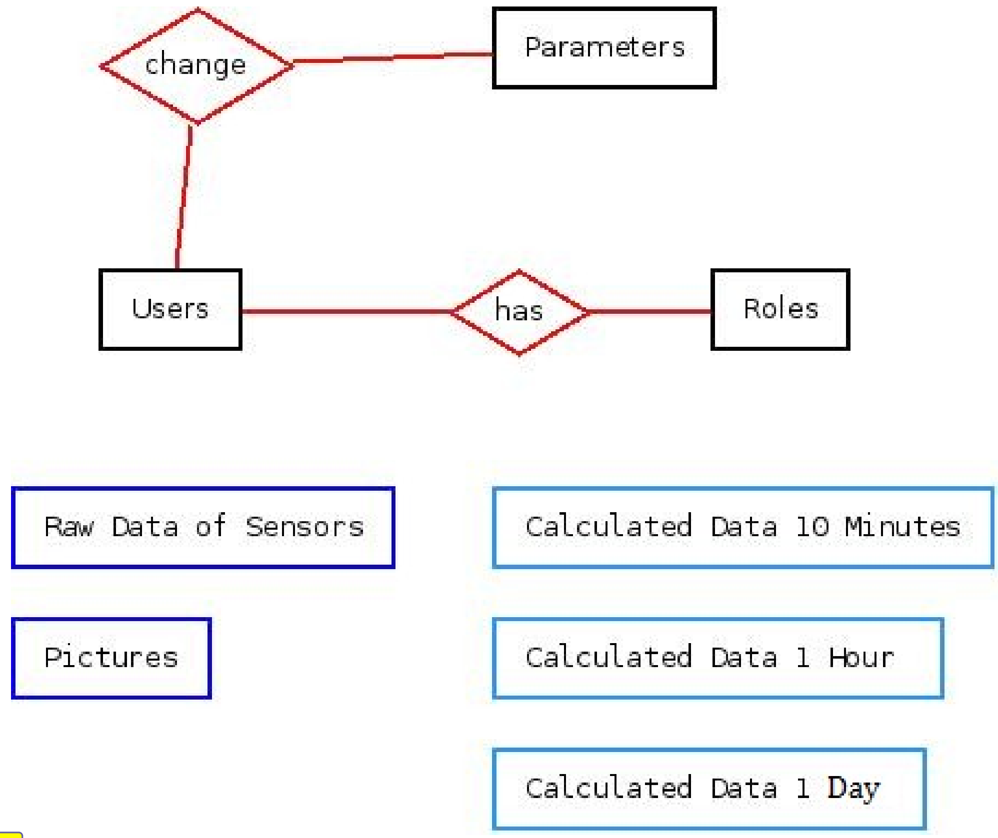
The images are two, one for each direction (Mantova – Modena):

(Mantova)

(Modena)

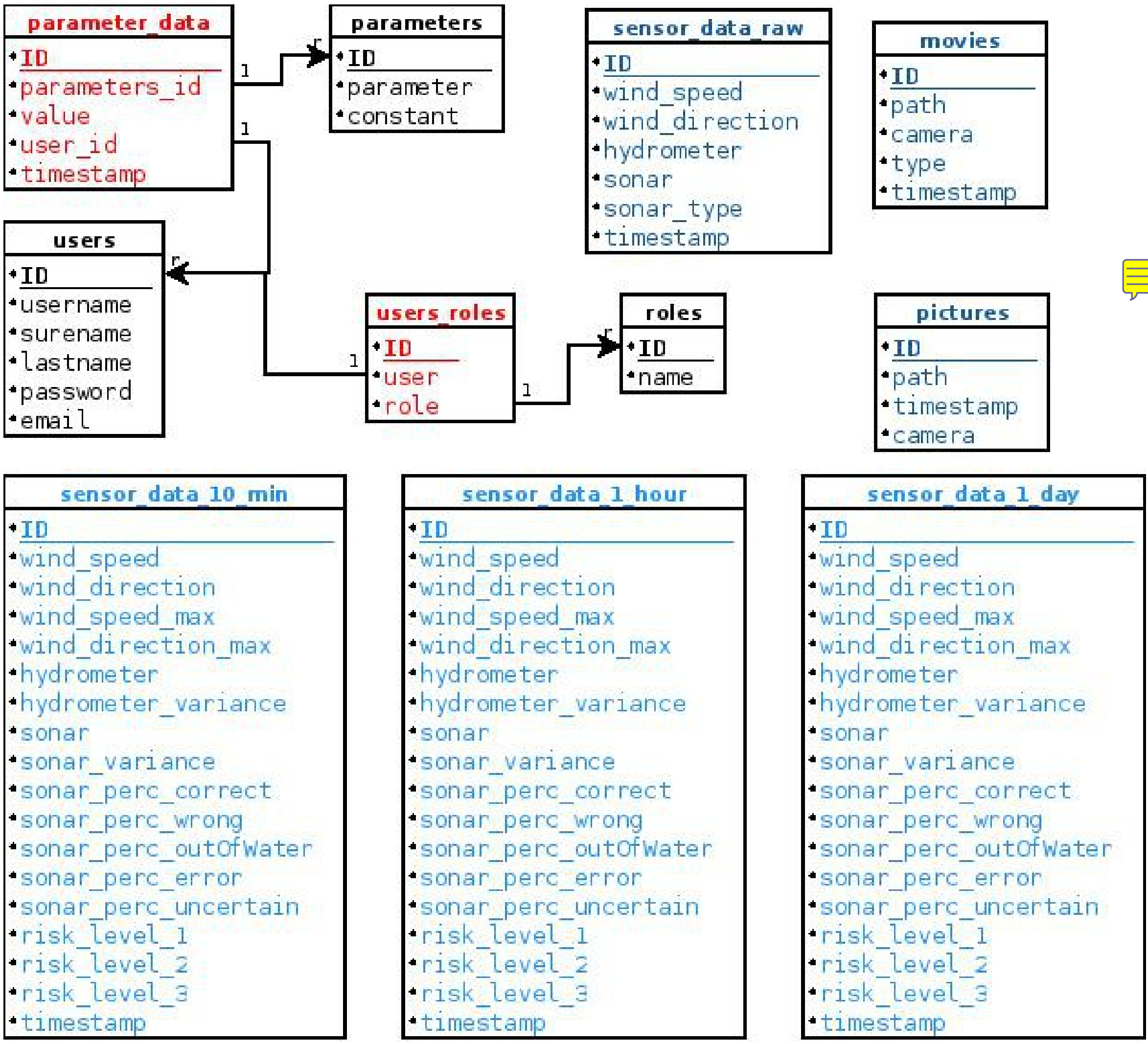
4.4 Database Model

In the Database we will two different kind of data. At the one side we have the sensor-data and calculated data and on the other side we will have administration data, like the users and their roles.



Entity-Relationship-Diagram of RTBM-Database

This Entity-Realtionship-Diagram shows a abstract view on the database. We will have four tables to store the raw and calculated data. Also we need one table to store meta-data like path and date of the pictures.



Detailed Diagram of RTBM-Database

For administration and the website-access we need to store the users and their role. Also we need to store the parameters and their values and changes.

4.4.1 Table structure for table parameters

The table "parameters" store all available parameters of the system and the information, if this parameter is changeable by the user.

Column	Type	Null	Default
ID	int	No	
parameter	varchar	No	
constant	tinyint	No	

4.4.2 Table structure for table parameter_data

The table “parameter_data” stores every change of an parameter and the according timestamp and the users, who changed the parameter. So this table also contains the actual value of every parameter.

Column	Type	Null	Default	Links to
ID	int	No		
parameters_id	float	No		parameters (ID)
value	int	No		
user_id	int	No		users (ID)
timestamp	timestamp	No	CURRENT_TIMESTAMP	

4.4.3 Table structure for table pictures

The table “picture” provide meta-information to every picture from the both webcames.

Column	Type	Null	Default
ID	int	No	
path	varchar	No	
timestamp	timestamp	No	CURRENT_TIMESTAMP
camera	int	No	

4.4.4 Table structure for table movies

The table “movies” provide meta-information to every movie created from the pictures.

Column	Type	Null	Default
ID	int	No	
path	varchar	No	
type			
timestamp	timestamp	No	CURRENT_TIMESTAMP
camera	int	No	

4.4.5 Table structure for table roles

The table “roles” holds the roles the user can have.

Column	Type	Null	Default
ID	int	No	
name	int	No	

4.4.6 Table structure for table sensor_data_1_day

In the table “sensor_data_1_day” the precalculated-mean-data for every day will be stored.

Column	Type	Null	Default
ID	int	No	
wind_speed	float	No	
wind_direction	float	No	
wind_speed_max	float	No	
wind_direction_max	float	No	
hydrometer	float	No	
hydrometer_variance	float	No	
sonar	float	No	
sonar_variance	float	No	
sonar_perc_correct	float	No	
sonar_perc_wrong	float	No	
sonar_perc_outOfWater	float	No	
sonar_perc_error	float	No	
sonar_perc_uncertain	float	No	
risk_level_1	float	No	
risk_level_2	float	No	
risk_level_3	float	No	
timestamp	timestamp	No	CURRENT_TIMESTAMP

4.4.7 Table structure for table sensor_data_1_hour

In the table “sensor_data_1_hour” the precalculated-mean-data for every hour will be stored.

Column	Type	Null	Default
ID	int	No	
wind_speed	float	No	
wind_direction	float	No	
wind_speed_max	float	No	
wind_direction_max	float	No	
hydrometer	float	No	
hydrometer_variance	float	No	
sonar	float	No	
sonar_variance	float	No	
sonar_perc_correct	float	No	
sonar_perc_wrong	float	No	

sonar_perc_outOfWater	float	No	
sonar_perc_error	float	No	
sonar_perc_uncertain	float	No	
risk_level_1	float	No	
risk_level_2	float	No	
risk_level_3	float	No	
timestamp	timestamp	No	CURRENT_TIMESTAMP

4.4.8 Table structure for table sensor_data_10_min

In the table "sensor_data_10_min" the precalculated-mean-data for every 10 minutes will be stored.

Column	Type	Null	Default
ID	i	No	
wind_speed	float	No	
wind_direction	float	No	
wind_speed_max	float	No	
wind_direction_max	float	No	
hydrometer	float	No	
hydrometer_variance	float	No	
sonar	float	No	
sonar_variance	float	No	
sonar_perc_correct	float	No	
sonar_perc_wrong	float	No	
sonar_perc_outOfWater	float	No	
sonar_perc_error	float	No	
sonar_perc_uncertain	float	No	
risk_level_1	float	No	
risk_level_2	float	No	
risk_level_3	float	No	
timestamp	timestamp	No	CURRENT_TIMESTAMP

4.4.9 Table structure for table sensor_data_raw

The table "sensor_data_raw" contains all raw data.

Column	Type	Null	Default
ID	int	No	
wind_speed	float	No	
wind_direction	float	No	

hydrometer	float	No	
sonar	float	No	
sonar_type	int	No	
timestamp	timestamp	No	CURRENT_TIMESTAMP

4.4.10 Table structure for table users

The table “users” contains all users and the according to information.

Column	Type	Null	Default
ID	int	No	
username	varchar	No	
surename	varchar	Yes	NULL
lastname	varchar	Yes	NULL
password	varchar	No	
email	varchar	Yes	NULL

4.4.11 Table structure for table users_roles

The table “users_roles” contain the relationship between users and roles.

Column	Type	Null	Default	Links to
ID	int	No		
user	int	No		users (ID)
role	int	No		roles (ID)

4.4.12 Used Libraries to Excess-Database

Since our program only communicate over Java with the MySQL server, we can use JDBC for every communication with the Database.

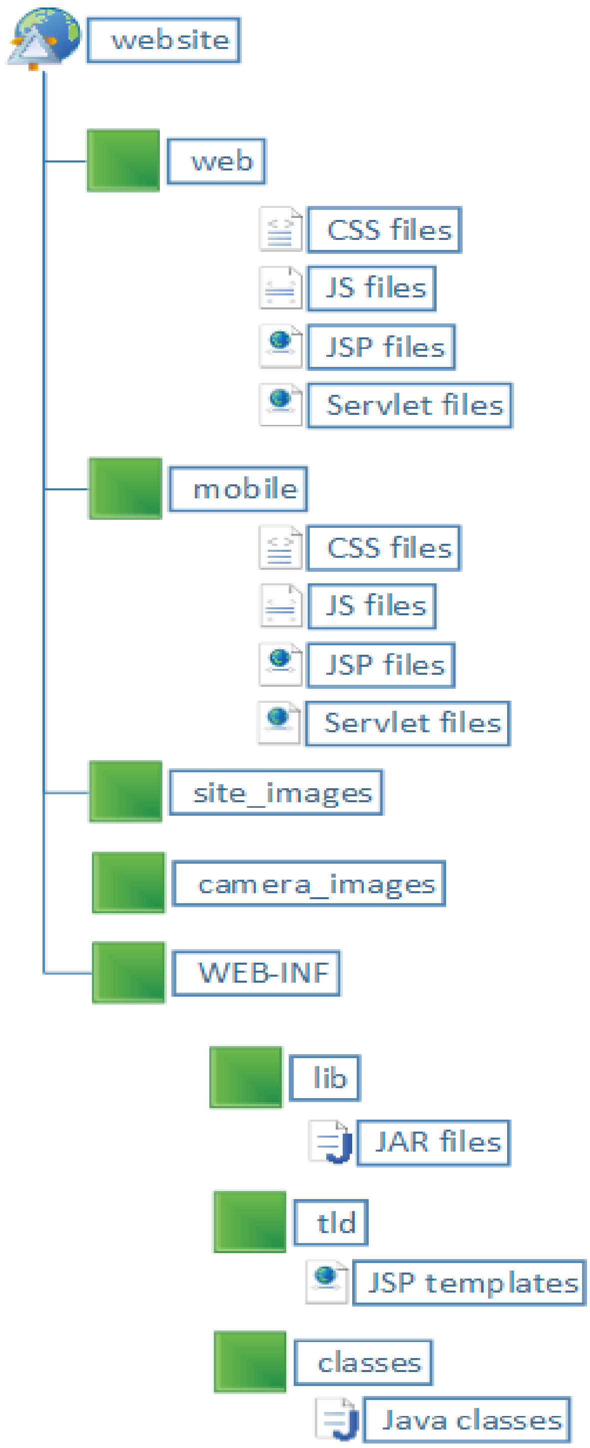
4.4.13 Security

For security reason we use a own user for access to database. This user has only access to the RTMS-DB and can only create local connections to database.

4.5 Web site organization

4.5.1 Web site organization

We are following the usual tomcat web application organization expanded with other components needed for our web application.



4.5.2 Website organization structure described

Website Folder	Files included
web	All the style sheet files, .jsp files, html files, javascript files, etc.
mobile	The web application of the project
site_images	Static images used for the page design
WEB-INF/lib	Other external java libraries needed for our project
WEB-INF/tld	Folder for storing the templates
WEB-INF/classes	Folder where our classes and our java code goes