University of Groningen

Software Architecture

Group 3

Smart Flood Monitoring

Authors:

Eedema, Gerrit
Putra, Guntur
Fakambi, Aurélie
Schaefers, Joris
Klinkenberg, Guus
Brandsma, Jeroen
Menninga, Wouter

Version: 0.1
13 Sept, 2015

Authors

Name	E-Mail
Eedema, Gerrit	G.Eedema@student.rug.nl
Putra, Guntur	G.D.Putra@student.rug.nl
Fakambi, Aurlie	A.Fakambi@student.rug.nl
Schaefers, Joris	J.Schaefers@student.rug.nl
Klinkenberg, Guus	G.Klinkenberg@student.rug.nl
Brandsma, Jeroen	J.T.Brandsma@student.rug.nl
Menninga, Wouter	W.G.Menninga@student.rug.nl

Revision History

Version	Author	Date	Description
0.1	?	06/09/15	Setting up the working environment and the initial document structure. Draft versions of the first four chapters created, which are (respectively) Context, Architectural business information, Requirements and Analysis.
0.2	Menninga, ...	13/09/15	First version of functional requirements

Contents

1 System Context

This section shows the context of the system.

1.1 Context

We are the architecture team in a company that specializes in making smart systems for environmental monitoring.

In many parts of Europe, natural disasters cause allot of trouble. These disasters can result in catastrophic events that can take human lives and where it will take a huge amount of money to repair the damage caused.

Floods, for example, of rivers and lakes destroy huge amounts of farmlands and sometimes even causes deaths. Climate change and extreme weather phenomena cause these floods to get worse every year. This makes it hard to timely anticipate on these upcoming floods in order to control the damage it will do. There's a huge need for a system that will help the people during natural disasters like these, which is what this system aims to do.

The goal of our first product is to reduce the damage and problems caused by floods by trying to predict upcoming floods as correctly as possible. By using various kinds of sensors, vehicles and control units, this system monitors the areas and gives warnings about upcoming floods. It then also provides guidance to the people in the (about to be) flooded area to reduce the nuisance the flood causes.

When this flood monitoring system works as planned and shows that it can indeed reduce the damage of floods, new products will be made by our company that will focus on reducing the damage of other kinds of natural disasters.

Over time, the system will try to reduce the amounts of human lives that are lost by natural disasters, starting with floods, and will try to reduce the social and financial consequences. This will revolutionize the way we think about natural disasters. Though the market around environmental monitoring is very competitive, this system aims at being a core part of future monitoring systems by being as dynamic and flexible as possible. Thereby allowing new features to be added easily, allowing the system to grow over time, including new upcoming user needs.

2 Architectural business information

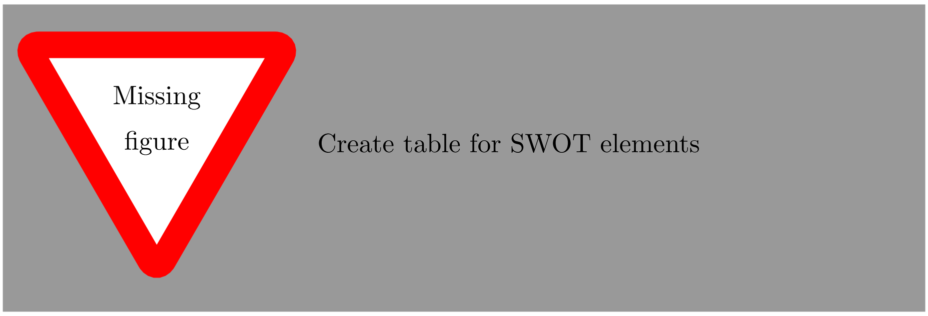
The following section describes the different aspects of the business environment of the Smart Flood Monitor. First we will explain our vision and why there is place for us at the market. After this the product and its customers will be explained. This chapter is completed with a more detailed look at the business model and some models about the market and the financial prospect.

2.1 Business vision

The Smart Flood Monitor will cause a revolutionary innovation on the environmental monitoring market. RugSAG3 will offer a system which can detect floods early and correctly. This system helps us to enforce our vision, to limit the social and financial consequences of floods and avoid the loss of human lives.

RugSAG3 will not be the only competitor on the environmental monitoring market. This means RugSAG3 will have to take their own strength and weaknesses into account. If we combine these qualities with an analysis of the opportunities and weaknesses on the market, we should be able to become a core part of the future environmental monitoring systems.

Such an analysis is called a SWOT-analysis.



Strengths: Quality of the product and affordable price.
Weaknesses: [No experience?]
Opportunities: Due to climate change, the market will grow.
Threats: New competitors will enter the market.

Our unique selling point is to provide the product with best quality, combined with the best service that is available.

2.2 Business rationale

2.3 Product and service description

2.4 Target audience

The product will be sold to governmental institutions.

2.5 Business model

2.6 Roadmaps

2.7 Financial model

The financial model will be a low product cost. This in order to price the product low in the market. A service description for maintenance will be offered. Also updates will be sold to the customer

2.8 Competitors

3 Requirements

3.1 Architectural vision

3.2 Stakeholder and their concerns

There are eight stakeholders who are involved in our system. Detailed description is written below.

Product owner is concerned about usability, reliability, profitability, affordability. Product owner funds the whole project. Product owner has to make sure that the system is reliable and profitable. As the product owner is willing to get a good market penetration, this system has to be affordable to the customers.

Developers are concerned about usability, reliability, maintainability, and testability. They are those who are responsible for the development of the systems until its ready for production. Including designing, analysis, testing and implementing the RugSAG3.

Competitors are concerned about usability, reliability, adaptability, profitability, and affortability. Competitors give negative effect on the system because competitors will be aiming on the same customer target. Thus, competitors must be kept in consideration.

Government is concerned about reliability, adaptability, and affortability. Government will be part of mitigation when the flood is immitent. This system will also notify government when this system detects flood. Thus, government have to make sure that the sistem is reliable, adaptable and affordable.

Citizens are concerned about usability, reliability, and affordability. They will be one of the main user of the system. Citizens want this system to run correctly and notify them with the reliable information. They also want to have this system to be as affordable as possible.

Insurance companies are concerned about reliability, profitability, and affordability. The damages caused by flood sometimes are also covered by the insurance companies. Thus, the insurance companies will also be part of the stakeholders and they will make sure that their business is running well.

Local companies are concerned about reliability, adaptability, and affordability. Local companies will also be affected by the flood, they also have a lot of resources that are in danger. Local companies want to know whether or not this system is reliable so that they can arrange a proper action sets when the flood comes to save their assets.

Emergency services are concerned about usability, reliability, adaptability, and testability. Emergency services are important when any accident happens, including flood. They will be really concerned about the thing that makes this system reliable, adaptable to their current system, and could be tested in order to make sure things are running correctly.

Table 3.1 illustrates the stakeholder concern matrix. In our approach, each stakeholder receives 100 points in total that has to be distributed among all the concerns.

Table 3.1: Matrix of stakeholders concern.

		Concerns						
		Usability	Reliability	Adaptability	Profitability	Affordability	Maintainability	Testability
Stakeholder	Product owner	30	30		20	20		
	Developers	30	20				30	20
	Competitors	20	20	20	20	20		
	Government	30	40			30		
	Citizens	30	30			40		
	Insurance companies		30		30	40		
	Local companies		30	30		40		
	Emergency services	30	30	30				10
	Total	140	230	80	70	190	30	30

3.3 Stories and use-cases

- A user receives a warning about warning about an upcoming flood in his or her area, within a reach of 30 kilometer
- A user requests guidance to get to a certain place in a flooded area
- A user reports an obstruction
- A user reports a (upcoming) flood
- A user verifies a reported flood warning

3.4 Functional requirements

Nr.	Prio	Description
FR-1	**Must**	The system is able to receive and process input from sensors with regards to the water level. This information will be used to determine if there is an imminent flood.

FR-2	**Must**	The system is able to receive and process input from sensors with regards to the pressure/consistency of the dykes. This information will be used to determine if there is an imminent flood.
FR-3	**Must**	The system retrieves weather forecasting data from weather forecasting services. The retrieved weather forecasting data consists of predictions about the precipitation and wind data. This data will be used by the system to help in determining when a flood becomes imminent.
FR-4	**Must**	The system is able to detect from the sensor data and weather forecast information when a flood is imminent.
FR-5	**Must**	The system can compute (from geographic information) the area which will be affected by a flood.
FR-6	**Must**	The system is able to collect information pertaining to the severity of the flood. The severity can be deducted from the expected water level, how fast the water level in the flood area will rise, and by the number of civilians living in the affected area (population density).
FR-7	**Must**	The system provides emergency services with information about the flood. This includes the area affected by the flood and information needed to deduct the severity of the flood.
FR-8	**Must**	When a flood is imminent, the system should send a warning to the emergency services and to the authorities.
FR-9	**Must**	The system is able to compute a safe route to a safe area where citizens can be evacuated to in case of an (imminent) flood.
FR-10	**Must**	When a flood is imminent, the system should send a warning to citizens who are subscribed for such warnings. This warning will contain information about how to get to a safe area.
FR-11	**Must**	The system is able to predict the development of the water level. This information can be used to predict how fast a flood will develop.
FR-12	**Must**	The system uses different sources to confirm imminent flood warnings, in order to limit false positives.
FR-13	**Must**	The system can detect a faulty sensor, either when the sensor raises an error or when the data from the sensor is inconsistent with other sensor data.
FR-14	**Must**	The system can report faulty sensors, so these sensors can be repaired or replaced.
FR-15	**Must**	In case of a flood, the system will provide emergency services with safe routes to incident locations.
FR-16	**Must**	Citizens are able to subscribe to flood warning messages.
FR-17	**Must**	The system has access to geographic information, including road data and terrain height data.
FR-18	**Must**	The system can determine the area affected by a flood, by using the location data of the sensors and geographic information.
FR-19	**Must**	The system can determine the location of the citizen, after he/she is warned about a flood, in order to compute a safe route to a safe area.

FR-20	**Must**	The system can determine the location of an emergency vehicle, so it is able to compute a safe route to incident locations.
FR-21	Future	The system is able to detect extreme weather phenomena, like storms etc.

3.5 Commercial non-functional requirements

3.6 Technical non-functional requirements

In this section, the technical non-functional requirements important to this system are discussed.

3.6.1 Resilience

The system will have many connected sensors, which can have failures. The system should be able to recognize such failures timely and recover from them without the QoS or the functionality of the system being affected.

The system should be able to continue functioning with the same QoS in a situation where up to 5% of the sensors suffer from failures.

3.6.2 Interoperability

The system has dependencies on third-party systems. For example, to make predictions about the development of waterlevel, the system will need to retrieve information from water forecasting services.

Not only for input, but also for output, the system will need to interoperate with third-party systems. If the system has registered a risk of a flood, it should interact with systems of emergency services and other authorities to alert them and sent relevant information.

3.7 Evolution requirements

3.8 Risk assessment

4 Analysis

Assumptions:

- People requesting guidance have access to a phone that is either connected to a mobile network or to the internet
- The system is able to monitor various kinds of sensors
- The system has access to the internet
- The sensors are (in some way) connected to the system
- The system is able to use various kinds of sensors in order to predict floods.
- When the system has enough proof of a flood, the users will be informed in a timely manner (within 30 seconds maximal).
- People within a range of (30km?) will be warned about a detected flood
- The system uses multiple weather forecasting services to make its own predictions about possible upcoming floods.

Decisions:

- Security? (What if someone tries to manipulate a sensor?)
- One or multiple warning systems (failover)
- Networking? Redundancy of cables (trunked?)
- When to alarm? What to do if only 1 sensor warns about a flood?
- Security decisions?
- Operating system decision
- Storage decision
- Push or pull updates? (Pushing Im hoping)
- Programming language(s) for the system? Web-interface, sensor monitoring, weather forecasting system, push notification system
- In what ways will the system detect a flood? Sensors, UAVs, forecasting?
- How to detect a flood based on the forecasting? Warn beforehand? Pay extra attention to the new upcoming flood by sending extra robots/uav's?

Name	**Linux**
Decision	**1**
Status	**New**
Problem/Issue	The warning system software for the natural disasters need a platform to work on.
Decision	The warning system will use Linux as a platform
Alternatives	*Linux* Linux is a free platform that has proven itself and is used by many servers. It is reliable and more secure.
Arguments	

5 System Architecture

6 Hardware Architecture

7 Software Architecture

8 Architecture evaluation

9 System evolution

A Time Tracking

A.1 Week 1

Person	Task	Hours
Gerrit	Reviewing the document, reading the assignment, initializing requirements, & installing environment for project	8
Putra	Intial preparation for the course	5
Fakambi		
Schaefers	Setting up the working environment, create the context page and analysis page drafts. Setting up and improving the the document structure.	8
Klinkenberg		
Brandsma	Creating working environment, reading assignment, first draft business part	8
Menninga	Reading assignment, setting up working environment, first non-functional requirements	5

A.2 Week 2

Person	Task	Hours
Gerrit		
Putra		
Fakambi		
Schaefers		
Klinkenberg		
Brandsma		
Menninga	First version of the functional requirements, coaching session, meeting	10.25