University of Groningen

Software Architecture

Group 3

Smart Flood Monitoring

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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, ...	10/09/15	First version of functional requirements
0.3	Joris	Gerrit 13/09/15	Changed the context and enhanced the business information
0.4	Brandsma	13/09/15	Updated the requirements part

Contents

1 System Context

This section shows the context of the system.

1.1 Context

We are the architecture team of the company RugSAG3 . Our team is specialized in making smart systems for environmental monitoring.

All around the world, natural disasters cause allot of trouble. These disasters can result in catastrophic events that causes deaths and take a huge amount of money to repair damage caused.

Floods of rivers and lakes for example, 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 causes the damage of the floods to increase, which means that there is a great need for a system that can reduce this damage. 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:

1. Safe lives
2. Reduce damage costs
3. Reduce the social consequences

In order to do this, the system tries to predict upcoming floods as correctly as possible. The system will provide warnings and guidance to the necessary people during and, if possible, before a flood. By using various kinds of sensors, vehicles and control units, this system monitors certain areas. If something suspicious is happening, the system will check and verify the information in order to not give false flood warnings. When a flood is (or will) indeed occur, the system provides warnings and guidance to the necessary people during and, if possible, before a flood.

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 reduce social, financial and human losses of natural disasters, starting with floods. 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 opportunity

There are many natural disasters happening each year all over the world. Each year these disasters take lives, waste a lot of property and money and cause social disturbance. It is expected that natural disasters will cause $300 billion in losses annually in the upcoming decade. Climate change causes the natural disasters to get worse every year. Also the number of natural disasters has increased significantly since 1970.
Looking at, for example, the Indian ocean's tsunami in 2004, it looks that the damage could have been significantly reduced if the necessary people were warned. A system that would reduce the damage of natural disaster, could result in billions.
A system that warns and guides the people before or during the floods can result in billions being saved and will save allot of lives.

2.2 Business objectives

Main problem: natural disasters cause too much damage
Main objective: reduce natural disaster damage costs by 20%

- BP- 1 : People don't know when a natural disaster is about to happen
- BP- 2 : People don't know how to prepare for a natural disaster
- BP- 3 : People don't know what to do during a natural disaster

- BO- 1 : Warn the people in and around the area of a flood, at least 1 hour in advance.
- BO- 2 : Inform people about the details of the flood so the right preparations are made.
- BO- 3 : Inform people how to save themselves, others or goods.

2.3 Success metrics

- SM- 1 : 80% of the people who receive a warning successfully get to a safe environment in time.
- SM- 2 : 80% of the people that received information (before or during) a flood, reported it helped them safe extra lives or goods.

2.4 Vision statement

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 low selling place.
Weaknesses: No experience with creating such system
Opportunities: Due to climate change, the market will grow and such a system becomes more urgent
Threats: New competitors will enter the market and Climate change will force to improve the system over time.

Our unique selling point is to provide a system with low selling price and profit from the service contracts and upgrades.

2.5 Business risks

- RI- 1 : The warning system does not detect floods in time
- RI- 2 : The system sends warnings of a non-excising flood (false positive), making people more negligent to future messages.
- RI- 3 : The system can't send messages to the necessary people because the communication platform is also destroyed by the flood.
- RI- 4 : The system sends incorrect information, causing extra damage.

2.6 Business assumptions and dependencies

- DE- 1 : The system uses the emergency services already in place by the government in order to message the citizens.

2.7 Scope and limitations

2.7.1 Major features / key drivers

- FE- 1 : Detect floods accurately
- FE- 2 : Predict floods using weather forecasts
- FE- 3 : The system can communicate with all necessary people.
- FE- 4 : The system correctly sends the right warnings and messages.

2.7.2 Scope of Initial and subsequent releases

The initial release will only focus on floods as a natural disaster. The subsequent releases will further increase the different kinds of natural disasters that are supported by the system.

- More individual guidance
- Interaction with the system, users can give input
- More sensor support
- Using multiple communication networks to send information

2.8 Product and service description

The product is a flood warning system. When there is a high tread of a flood that is probably coming a warning system will be triggered to warm people in the area. The company will provide a complete package of software and hardware. The hardware part will consist of products which are currently available on the market. In the future the product must be scalable to install new innovations. For customers it must be possible to interact with other systems they use.

The service will consist of maintenance for the product and upgrades.

2.9 Target audience

The product will be sold to governmental institutions.

2.10 Financial model

The financial model will be a low product price. 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

2.11 Competitors

Siemens designed a flood-warning system via SMS in Belgium.

3 Requirements

3.1 Architectural vision

[This needs to be edited, depending on our final vision of the project]
The smart flood monitoring system consists of multiple parts. First of all there is the monitoring part. This part monitors the current state of the environment. To achieve this, we need a lot of data. This data is obtained by sensors and weather data. First of all we use sensors to get the current water level of waterways. The data that is obtained through these sensors is monitored in a control station. In the control station works a person who keeps track of all the relevant information.

In case of an imminent flood a warning will be issued to the government and the citizens who live in the threatened area. This can be done in multiple ways. We issue a warning to the government, who then in their turn, warns the citizens. They do this by using the sirens that are installed through the netherlands. Besides this they also use the NL-Alert service. We can also do this by warning the citizens ourselves. We do this by sending a text message to all the people that are in the threatened area. This is done by sending text messages to all the phones that are connected to the celltowers of the providers.

After a warning is send, the citizens can use our smartphone application to get a proper guidance to a safe place. The application gives the shortest route and takes obstacles into account. A citizen can report an obstacle to our system. This means the guidance part of out system becomes flexible.

3.2 Stakeholder and their concerns

- Product owner
- Developers
- Government
- Citizens
- Insurance companies
- Companies
- Emergency services
- Competitors

3.3 Stories and use-cases

3.3.1 A citizen receives a warning about an upcoming flood

Scope: Warning part of the system

Level: Main process

Primary actor: Citizen

Stakeholders and interests:
1. Government - the government wants to warn the citizens in case of a flood
2. Citizens - citizens want to be warned in case of a flood

Precondition: There is an upcoming flood and the citizens are not warned
Postcondition: There is a flood and the citizens are warned

Main succes scenario:
1 - There is the threat of an upcoming flood.
2 - A warning mechanism is triggered.
3 - The authorities are warned about the upcoming flood.
4 - The authorities use their systems to warn the citizens.
5 - The citizens are warned and can move to a safer place.

Extensions:
2a - The flood doesn't get to dangerous, it retreats. No warning mechanism is triggered.

3.3.2 A citizen requests guidance to get to a safe place in a flooded area

Scope: Guidance part of the system

Level: Main process

Primary actor: Citizen

Stakeholders and interests:
1. Government - the government wants to guide the citizens to a safe place in case of a flood.
2. Citizens - citizens want to be guided to a safe place in case of a flood.

Precondition: There is a flood and the citizen wants guidance to a safe place.
Postcondition: Citizen is guided to a safe place.

Main succes scenario:

1 - There is a flood going on.
2 - A citizen requests guidance to a safe place.
3 - The citizen gets guidance through a smartphone.
4 - The citizen makes it to the safe place.

Extensions:
3a - Smartphone has no internet connection, provide latest information available.
3b - GPS of smartphone doesn't work, provide the citizen with the right information to make decisions by himself.
4a - Citizen can't make it to the safe place. Provide the citizen with a route to an alternative safe place.

3.3.3 A citizen reports an obstruction

Scope: Monitoring part of the system

Level: Main process

Primary actor: Citizen

Stakeholders and interests:
1. Citizen - A citizen wants to report an obstruction to make the guidance part more reliable.

Preconditions: There is an obstruction which is not yet reported.
Postconditions: There is an obstruction which is reported by a citizen and is known in the system.

Main succes scenario:
1 - There is an obstruction somewhere in the area.
2 - The citizen opens our application on his smartphone.
3 - The citizen reports the kind of obstruction and the location.
4 - The system gets the obstruction information as input.
5 - The obstruction is processed in the system and visible to other citizens.

Extensions:
3a - The citizen doesn't know the location, GPS can be used in this case. If GPS doesn't work, the obstruction can't be reported.
4a - The smartphone can't send the information. In this case, the obstruciton can't be reported.

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 and is 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 has access to geographic information, including road data and terrain height data.
FR-6	**Must**	The system can determine the area affected by a flood, by using the location data of the sensors and geographic information.
FR-7	**Must**	The system computes (from geographic information) the area which will be affected by a flood.
FR-8	**Must**	The system collects information pertaining to the severity of the flood: the expected water level, how fast the water level in the flood area will rise, and the number of civilians living in the affected area (population density).
FR-9	**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-10	**Must**	When a flood is imminent, the system sends a warning to the emergency services and to the authorities. The warning contains information about the area affected by the flood.
FR-11	**Must**	The system is able to compute a safe route, free of obstruction and floods, to a safe area, not affected by the flood, where citizens can be evacuated to in case of an (imminent) flood.
FR-12	**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-13	**Must**	Citizens are warned about imminent floods through an app.
FR-14	**Must**	The location of citizens who are warned through the app can be determined in order to supply them with a safe route to a safe area.

FR-15	**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-16	**Must**	The system uses different sources to confirm imminent flood warnings, in order to limit false positives.
FR-17	**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-18	**Must**	There is a control panel, where an overview of warnings and errors of the system can be viewed.
FR-19	**Must**	The system can detect and report faulty sensors, so these sensors can be repaired or replaced.
FR-20	**Must**	In case of a flood, the system provides emergency services with safe routes to incident locations.
FR-21	**Must**	The system can determine the location of an emergency vehicle, so it is able to compute a safe route to incident locations.
FR-22	Optional	The system is able to detect extreme weather phenomena, like storms etc.

3.5 Quality attributes / non-functional requirements

Attribute priority:

Attribute	Score	Availability	Integrity	Interoperability	Performance	Reliability	Robustness	Security	Usability	Verifiability
Availability	8		<	<	<	<	<	<	<	<
Integrity	7			<	<	<	<	<	<	<
Interoperability	3				<	ˆ	ˆ	ˆ	<	<
Performance	2					ˆ	ˆ	ˆ	<	<
Reliability	5						ˆ	<	<	<
Robustness	6							<	<	<
Security	4								<	<
Usability	3									<
Verifiability	1									

Nr.	Prio	Description
AVL-1	**Must**	The system shall be at least 99% available.
INT-1	**Must**	The system shall protect against unauthorized addition, deletion or modification of sensor data

INT-1	**Must**	The system shall verify unusual sensor data that shouldn't happen in normal situations, with at least one other sensor
INT-1	**Must**	The system shall send warning and guidance messages only in case of a flood

3.6 Evolution requirements

3.7 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
Prob-lem/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	Coaching session, project planning session and work on business information chapters	9
Putra		
Fakambi		
Schaefers	First coaching session, improved and enhanced the context and business information chapters. Also created a quality attributes prioritization table.	8
Klinkenberg	Coaching session, meetings, providing feedback on requirements	5.5
Brandsma	First version of use-cases, coaching session, meeting, use-cases, architectural vision	6.5
Menninga	First version of the functional requirements, coaching session, meeting	10.25