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, ...	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 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 Background

See above.

Already explained in context

2.2 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.

2.3 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.

2.4 Success metrics

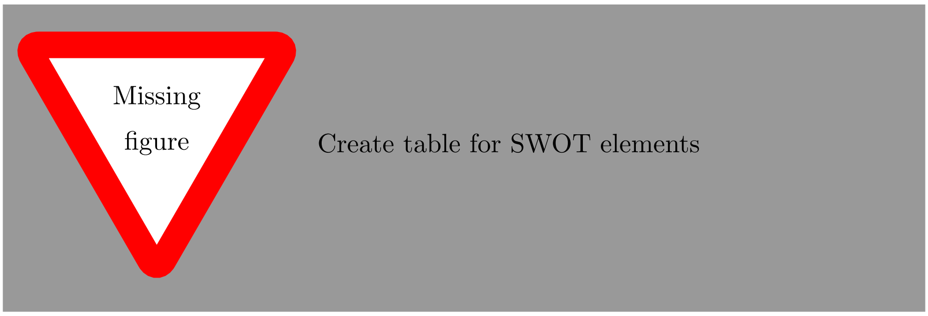
- SM- 1 : 80% of the people who receive a warning successfully get to a safe environment in time.
- SM- 2 : 80% of the people that received information (before or during) a flood, reported it helped them safe extra lives or goods.

2.5 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 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.

2.6 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.

2.7 Business assumptions and dependencies

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

2.8 Scope and limitations

2.8.1 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.

2.8.2 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.

Create tables and diagrams of this?

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

2.9 Target audience

The product will be sold to governmental institutions.

2.10 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

3 Requirements

3.1 Architectural vision

3.2 Stakeholder and their concerns

3.3 Stories and use-cases

- A user receives a 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

3.3.1 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.

3.4 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	Coaching session, meetings, providing feedback on requirements	5.5
Brandsma	First version of use-cases, coaching session, meeting	5
Menninga	First version of the functional requirements, coaching session, meeting	10.25