H2

ATiSA Exercise 2: Architectual design

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Step 4 – Identification architectural drivers

We started by adding some architectural drivers for other quality attributes. We ended up having the following list:

Availability:
The system should be able to work for servereal years without breaking.

Robustness:
HS07 should be able to handle or recover from partial breakdowns as a total breakdown would cause economical loss by either damage to the home due to very low temperatures or overspending due to overheating.

Modifiability:
It should be easy to implement new communication protocol/channel/method.
It must be possible to modify HS07 to include new types of sensors and actuators.

Performance:
The system shall be able to heat the house when it is turned on.
HS07 should be performant so that a large number of thermometers and radiators may be part of the system.
System should be stable and not turn the heat up and down.
It should be friendly to the environment, by not using too much electricity and heat.
Our system must live up to the requirements of an envrionment friendly certificate and a quality certificate.

Security:
Only the owner of the home should be able to access and control the system from the Internet.

Testability:

It should be easy to test for an external quality ensurance company how good quality the system is.

Usability:

It should be easy to turn it on from the internet.

Design:

The system should have an appealing design such that people do want to have it in their home.

Business:

System should be affordable for an average family.

The system should be cheap to manufacture.

Step 5 – scenario brainstorming

When doing scenario brainstorming we assigned roles to every person in the group. The roles were as follows:

Home Owner

CEO of the HS07 manufacturing company

Team leader of development team /Architect

Chief of Marketing

The brainstorming face gave us the following scenarios:

Scenario(s):	1 - Out of water
Relevant Quality Attributes:	Availability
Source:	System
Stimulus:	”Not enough water”
Artifact:	System
Environment:	Normal usage

Response:	Stop – then recover when flow is normal
Response Measure:	10 minutes after work supply
Questions:	
Issues:	

Scenario(s):	2 - Breakdown of thermometers
Relevant Quality Attributes:	Availability/robustness
Source:	Internal to the system
Stimulus:	5 thermometers break down
Artifact:	Sensors
Environment:	Normal usage
Response:	Set temp to 18 degrees
Response Measure:	The temperature will reach 18 degrees within 30 minutes
Questions:	
Issues:	

Scenario(s):	3 - New wireless technology is available
Relevant Quality Attributes:	Modifiability
Source:	Developer
Stimulus:	New wireless technology is available on the market
Artifact:	The gateway code
Environment:	Design time
Response:	New module implementation without side effects
Response Measure:	It should be possible to do the implementation in 5 days
Questions:	
Issues:	

Scenario(s):	4 - New radiators are available
Relevant Quality Attributes:	Modifiability
Source:	Market
Stimulus:	Provides new radiators that are more energy efficient
Artifact:	The device-subsystem of HS07

Environment:	At any given time
Response:	Implementation of the required interface is done without side effects
Response Measure:	It should be possible to do the implementation in 5 days
Questions:	
Issues:	

Scenario(s):	5 – Turn on heat using smartphone
Relevant Quality Attributes:	Usability
Source:	User
Stimulus:	Wants to turn on the heat using a smartphone
Artifact:	The gateway (the system)
Environment:	Online
Response:	The user gets access to a web interface suitable for his smartphone
Response Measure:	It should fit the smartphone screen in such a way that margins are not bigger than 20%
Questions:	
Issues:	

Scenario(s):	6 - Average family buys HS07
Relevant Quality Attributes:	Business
Source:	Average family
Stimulus:	Wants to buy a HS07 system
Artifact:	Retailer
Environment:	Market
Response:	The family is able to pay and get the system
Response Measure:	The family pays no more than €500
Questions:	
Issues:	

Scenario(s):	7 - External quality testing
Relevant Quality Attributes:	Testability
Source:	The developer company

Stimulus:	The system has been completed and is ready to be tested by quality insurance company
Artifact:	System
Environment:	Design time
Response:	It will be possible for the company to test the system using their standards
Response Measure:	The first quality test should last at most 3 weeks. Any further modification should last no longer than one week.
Questions:	
Issues:	

Scenario(s):	8 - Environment testing
Relevant Quality Attributes:	Testing
Source:	The developer
Stimulus:	Want to test device interaction under different conditions
Artifact:	System
Environment:	Design time
Response:	It will be easy to simulate the presence of any number of devices in any possible state (e.g. working or not working)
Response Measure:	The environment should be setup within one hour.
Questions:	
Issues:	

Scenario(s):	9 - External attack on system
Relevant Quality Attributes:	Security, robustness
Source:	External to the system, not an owner of the home
Stimulus:	An outsider is trying to change the temperature to a high level
Artifact:	HS07 Gateway (The system)
Environment:	Under normal conditions
Response:	Temperature is set to default
Response Measure:	The temperature is set to 18 degrees within 30 minutes
Questions:	

Issues:	

Scenario(s):	10 - Outsider trying to get access
Relevant Quality Attributes:	Security
Source:	External to the system, not an owner of the home
Stimulus:	An outsider is trying to log in to the system
Artifact:	The system
Environment:	Under normal conditions
Response:	Access is denied, access attempt is being logged
Response Measure:	Access is denied for 99,9% of all attempts.
Questions:	
Issues:	

Scenario(s):	11a - ”Temperature increase”
Relevant Quality Attributes:	Performance
Source:	Gateway
Stimulus:	Detects temperature above desirable max
Artifact:	Thermometers
Environment:	Normal usage
Response:	Turn off the radiators (could be many)
Response Measure:	All radiators should be turned off in less than 5 minutes
Questions:	
Issues:	By responding quickly to temperature increases, this scenario covers the architectural driver stating that the system should be performant such that a large number of thermometers and radiators may be part of the system. It also covers part of the architectural driver saying that the system should be friendly to the environment.

Scenario(s):	11b - ”Temperature decrease”
Relevant Quality Attributes:	Performance
Source:	Gateway
Stimulus:	Detects temperature decrease below desirable min

Artifact:	Thermometers
Environment:	Normal usage
Response:	Turn on the radiators (also here, it could be many)
Response Measure:	All radiators should be turned on in less than 2 minutes
Questions:	
Issues:	This scenario should cover:"The system shall be able to heat the house when it is turned on".

Scenario(s):	12 - Radiator availability
Relevant Quality Attributes:	Availability
Source:	The gateway
Stimulus:	Turns on the system
Artifact:	Radiator
Environment:	Under normal operations
Response:	The radiator works with requested intensity
Response Measure:	It does so without interruptions 99% of the time.
Questions:	
Issues:	

Scenario(s):	13 - Thermometer Performance
Relevant Quality Attributes:	Performance
Source:	Gateway
Stimulus:	Turns on the system
Artifact:	Thermometer
Environment:	Under normal operations
Response:	Thermometer measures the heat
Response Measure:	The temperature is measured with a max deviation of 1 degree Celsius.
Questions:	
Issues:	

Discussion

When doing the scenario brainstorming we found out that some of our architectual drivers were hard to find scenarios for. E.g. we had an architectural driver stating that “The system should be able to work for several years without breaking”, which we think is more of a hardware requirement than it is software.

For the architectural drivers that covers business quality we haven’t made scenarios, because we think that the business quality interacts with all the other qualities.

Step 6 – Scenario consolidation

We looked at the scenarios and we decided to merge 11a with 11b given us 11c as is listed above.

Scenario(s):	11c - ”Temperature change”
Relevant Quality Attributes:	Performance
Source:	Gateway
Stimulus:	Detects temperature not in a desirable interval
Artifact:	Thermometers
Environment:	Normal usage
Response:	Turn radiators on/off depending on the context
Response Measure:	All radiators should be turned on/off in less than 5 minutes
Questions:	
Issues:	By responding quickly to temperature increases, this scenario covers the architectural driver stating that the system should be performant such that a large number of thermometers and radiators may be part of the system. It also covers part of the architectural driver saying that the system should be friendly to the environment. The scenario should also cover:”The system shall be able to heat the house when it is turned on”.

Step 7 – Scenario prioritization

1 - Out of water	
2 - Breakdown of thermometers	(h)(a)
3 - New wireless technology is available	(a)
4 - New radiators are available	(a)(a)
5 – Turn on heat using smartphone	(h)(m)(c)
6 - Average family buys HS07	(h)(m)(c)
7 - External quality testing	(m)(c)(m)(c)
8 - Environment testing	
9 - External attack on system	
10 - Outsider trying to get access	
11c - ”Temperature change”	(h)
12 - Radiator availability	
13 - Thermometer Performance	

(h) is a vote from the home owner

(c) is a vote from the CEO

(a) is a vote from the system architect

(m) is a vote from the chief of marketing

Scenarios listed in prioritized order

7 - External quality testing	(m)(c)(m)(c)
5 – Turn on heat using smartphone	(h)(m)(c)
6 - Average family buys HS07	(h)(m)(c)
2 - Breakdown of thermometers	(h)(a)
4 - New radiators are available	(a)(a)
3 - New wireless technology is available	(a)
11c - ”Temperature change”	(h)
1 - Out of water	
8 - Environment testing	
9 - External attack on system	

10 - Outsider trying to get access	
12 - Radiator availability	
13 - Thermometer Performance	

Result

We chose the top 5 QAS to be the ones to refine and consider the most important. They are marked with yellow.

Summarization of outcome

When talking about the results in the group, we notice that maybe the scenarios with many votes are the most important to the user. Maybe this is because when doing the voting we think of the system from a user-point-of-view, because it is from this point we have most of our software experience. Also we think there are scenarios quite important in the real world, which didn't get any votes. This may be because we when doing the prioritization we thought of them in a way like "they should be in the system no matter if we vote for them or not".

Step 8 – Scenario refinement

When we began on the scenario refinement step, we realized that we have kind of already done refinement in step 5. It probably should have been done in a less structured and detailed fashion. More like sentences instead of tables we think.

Discussion

We think that the Quality Attribute Workshop is a good way of coming up with requirements for a software system. It provides a structured way of gathering information from different stakeholders, which forces the stakeholders to discuss their ideas and requirements, and also to agree (by voting and prioritizing). Alternatively we could have gotten a note from each containing different requirements, and then struggled trying to solve the conflicts between the different requirements. This approach instead of giving us the struggle with conflicts, places the struggle on the stakeholders, which we think places the responsibility at the right place. A downside of the

QAW approach could be that some stakeholders may not express their true meaning. It could be that they are afraid of saying their opinion because maybe their boss, or other higher in grade stakeholders are present.

Choosing Tactics

7 - External quality testing: An external company should be able to test our system through specialized interfaces conforming to their standards. To allow this behaviour we define "*specialized access routes/intefaces"* that support either the internal need of the developer company and also serves for the external quality testing.
We also chose to implement *"built-in Monitors"* such that we can deliver a more robust product that will pass the external quality test with high probability, and this will reduce the cost of external testing, but of course will increase internal cost regarding testing. The benefits of using this tactic is that the quality insurance company gains a lot of freedom to test the system they prefer. The drawback of this is that cost will go up because of the time used to create and maintain this approach.

5 – Turn on heat using smartphone: The user shall be able to turn on the system by using a smartphone. This requires a special interface for mobile devices, therefore the tactics *"separate user interface"* should be used. The goal can be achieved by using a Model-View-Controller design pattern.
It is also important to *"support user initiative"*, so that the system is easy to use and it is really possible to control it by smartphone. The benefits of this tactic is that the system could be modified to support a wide variety of devices. The drawback is that the cost will go up to develop/maintain this, but in the long run money could be saved since this tactic also addresses modifiability by anticipating change. Maybe performance is going to be lowered a little because of the separation of the components.

2 - Breakdown of thermometers: In this case we find it important to have some sort of fault detection. One way would be to let the gateway have the ability to react when it does not get information from the thermometers. In the system the communication is implemented in a ping/echo fashion where the gateway asks the thermometers for the temperature and the thermometers send some data back. So if a ping is not followed by some data the gateway should react, knowing there is something wrong. The gateway should

inform the user that a fault in some device has been discovered, and then the user can find which device is faulty and find a spare.
In the case the gateway receives a strange value the user should also be informed that something is wrong, and the gateway should remove the device from its service.
The benefit of this tactic is that the ping/echo is already at hand in the system, so the gateway just needs a way to warn the user. Another benefit is that we keep the logic part of the system centred at the gateway.
There is no particular important drawbacks of the tactic of ping/echo. Maybe performance will be lowered a little, and the cost will go up a little because of the time and money needed to implement the ping/echo feature.

Discussion

We discussed tactics for the scenario Average family buys HS07. We concluded that none of the tactics in the book captures steps needed to reach the goal of the scenario. The scenario is of an economic nature and tactics in the book are looking at the system from the architect's point of view.

After working with choosing tactics, we feel more close to the implementation of the system. Some of the tactics chosen can be used for providing requirements for the architecture, but also as a guideline for the implementation design.