



---

# SmartE SMART ENERGY FOR YOUR HOME FINAL REPORT

Version 1.1

Smart Energy for Your Home	Version: 1.1
Final Report	Date: 2016-1-22

### Revision History

Date	Version	Description	Author
2016-1-22	1.0	Initial Draft	Elena Kyorova
2016-1-22	1.1	Review	Marius Schlinke

Smart Energy for Your Home	Version: 1.1
Final Report	Date: 2016-1-22

## Table of Contents

1. Introduction .....	4
1.1. Purpose of this document .....	4
1.2. Document organization .....	4
1.3. Definitions and acronyms .....	4
1.3.1. Definitions .....	4
1.3.2. Acronyms and abbreviations.....	4
2. Background information .....	5
3. Project results .....	5
3.1. Overview .....	5
3.2. Deliverables .....	5
3.3. Satisfied requirements .....	6
3.4. Future improvements .....	6
4. Project work.....	6
4.1. Organization and routines .....	6
4.2. Total project effort .....	6
4.3. Worked hours .....	8
4.4. Positive experience.....	9
4.5. Possible improvements.....	9

Smart Energy for Your Home	Version: 1.1
Final Report	Date: 2016-1-22

## 1. Introduction

### 1.1. Purpose of this document

The purpose of this document is to summarize the experiences of the SmartE project, both in terms of the produced results and of the project work.

### 1.2. Document organization

The document is organized as follows:

- Section 1, *Introduction*, describes contents of this guide, used documentation during developing process etc.
- Section 2, *Background and Objectives*, describes the background (i.e. the problem of which the project will address)
- Section 3, *Project Results*, gives an overview of the results produced during the project.
- Section 4, *Project work*, summarize organization of the work, project efforts and working hours.

### 1.3. Definitions and acronyms

#### 1.3.1. Definitions

Keyword	Definitions
SmartE	Name of the application
User	The actor which use the system
Energy usage management	Managing usage of energy for specific unit
Sprint	Iteration (basic unit of development)

#### 1.3.2. Acronyms and abbreviations

Acronym or abbreviation	Definitions
SE4YH	Smart Energy for Your Home
FER	Faculty of Electrical Engineering and Computing, University of Zagreb
MDH	Mälardalen Högskola, Sweden

Smart Energy for Your Home	Version: 1.1
Final Report	Date: 2016-1-22

## 2. Background information

SmartE project was planned and implemented during the Distributed Software Development course provided by Mälardalen University in Västerås, Sweden and Faculty of Electrical Engineering and Computing in Zagreb, Croatia. The SmartE team have developed a mobile application which allows a user to interact and define rules/profiles for their smart devices in their homes. Whilst energy usage management is a key concept of SmartE the user should be able to manage all the devices in his/her house via the mobile application. Simple and intuitive design of the application should help the user to monitor and control these devices easily. A user should be able to define their own rules which determine how and when a smart device is used. For example, a user could define a rule for the lights to turn on automatically at a specific time of day, another where the power consumption determines which appliances can run concurrently or perhaps the user wishes to have the air conditioning turn itself off if a window is opened. Currently, existing solutions generally only offer a fixed set of profiles that contain pre-determined rules. In contrast, our goal is to allow the user to have complete control of their smart devices as well as the rules that govern them.

For more information about the project background and overview of the project refer to Project Plan document, version 1.3.

## 3. Project results

### 3.1. Overview

Current project allows the user support for four different types of devices: heater, air conditioner, light and contact sensor. For the device type heater we created five different rules:

- turn on at a specified time
- turn off at a specified time
- turn on if temperature is lower than entered value
- turn off if temperature is higher than entered value
- and a rule to turn off heater if window contact sensor is opened

For lights there are three rules offered:

- turn on at a specified time
- turn off at a specified time
- turn off after entered amount of seconds (delay)

Device type air conditioner offers five rules similar to heater: turn on and turn off at specified time, turn off if temperature is lower than entered value, turn on if temperature is higher than entered value and a rule to turn off if window contact sensor is opened.

The project is developed to ensure easy expansion of rules as well as different types of devices. Rule functionality depends on the openHAB's rule engine features and on the device type, more precisely on the configurable items of the device.

### 3.2. Deliverables

Following documentation was produced during the planning and implementing SmartE project:

- Project Plan document<sup>1</sup>
- Requirements Definition document<sup>2</sup>
- Design Description document<sup>3</sup>
- Acceptance test plan<sup>4</sup>

<sup>1</sup> Final version: [http://www.fer.unizg.hr/\\_download/repository/ProjectPlanSmartE.pdf](http://www.fer.unizg.hr/_download/repository/ProjectPlanSmartE.pdf)

<sup>2</sup> Final version: [http://www.fer.unizg.hr/\\_download/repository/RequirementsSE4YH.pdf](http://www.fer.unizg.hr/_download/repository/RequirementsSE4YH.pdf)

<sup>3</sup> Final version: [http://www.fer.unizg.hr/\\_download/repository/Design\\_Document.pdf](http://www.fer.unizg.hr/_download/repository/Design_Document.pdf)

<sup>4</sup> Final version: [http://www.fer.unizg.hr/\\_download/repository/AcceptanceTestPlanSmartEv1.1.2.pdf](http://www.fer.unizg.hr/_download/repository/AcceptanceTestPlanSmartEv1.1.2.pdf)

Smart Energy for Your Home	Version: 1.1
Final Report	Date: 2016-1-22

In order to document our meetings Minutes of meeting documents were produced. They included meeting's agenda and outlined the decisions which were taken by team members. In the end of every week Weekly report summarize the activities and the most important events that happened during the week.

### 3.3. Satisfied requirements

As specified in Requirements Definition document, there are 18 User Stories which represent functional requirements. 15 User Stories were completed during the development of the project. 3 of the User Stories (which are described with details in mentioned document) are not implemented and they are not referred in Acceptance Test Plan.

### 3.4. Future improvements

Proposal for future improvements can be implementing the user stories which are not implemented. The system can be advanced by defining and implementing User Stories, which fulfill defined non-functional requirements (see Requirements Definition document)

## 4. Project work

### 4.1. Organization and routines

Scrum was chosen by the members of the team as an agile software development methodology. The reason for choosing this methodology is described in Project Plan document.

The product is developed within iterations called Sprints that were twelve days each. In the beginning we decide to make sprints shorter (7 days each) but we decide that it will be harder to deliver a working version of the product for such short time. The number of sprints was 4 as the first sprint started 1 week later than expected. <sup>5 6</sup>

In order to ensure good communication between the team members of SmartE system we have scheduled the following meetings as part of the Scrum process. Each sprint started with sprint planning meeting in which team members defined the sprint backlog, the tasks that had to be finished and estimated the time each task would take. In the beginning of the project backlog refinement meetings were held near the end of every sprint, but since the team was more productive in the last days of the sprint there were held before sprint planning meeting. After each sprint the team had a sprint review in which accomplished tasks were presented to the stakeholders. Following the review meeting, the sprint retrospective meeting was held in order to evaluate the past sprint and determine what can be improved. The Scrum master reviewed the changes to backlog that are made during review meetings and documented them using excel sheets. Regular meetings with the sponsor have been held in order to check if any changes in requirements, architecture or analysis should be made. The responsible team member for the communication was the Project Owner. The whole team had regular weekly meetings (twice a week). They were held on Wednesday (between 14:00 and 14:30) and on Friday (between 11:00 and 11:30). These meetings contained status reports, common issues, upcoming activities, and so on. Daily status was given as in the last sprint there was a specific hour for giving the status of the members.

### 4.2. Total project effort

Figure 4.1 shows completeness of the tasks, which were planned and implemented during all four iterations. Percentages of complete tasks during each sprints are as follows:

- Sprint 1: 69%
- Sprint 2: 40%
- Sprint 3: 22%
- Sprint 4: 92%

<sup>5</sup> Project Plan v1

<sup>6</sup> Project Plan v1.7 [http://www.fer.unizg.hr/\\_download/repository/ProjectPlanSmartE.pdf](http://www.fer.unizg.hr/_download/repository/ProjectPlanSmartE.pdf)

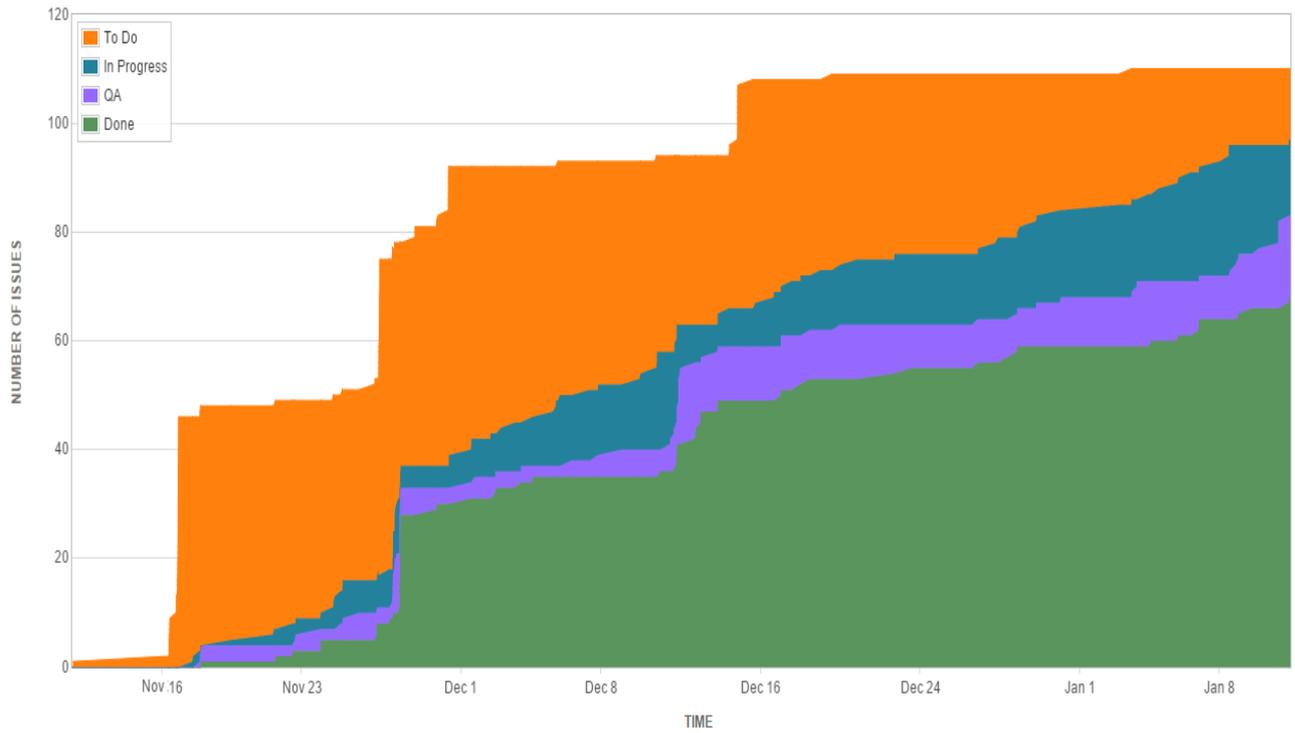


Figure 4.1: Task statistic

The project was completed with four sprints in total. Detailed project schedule is included in Section 3 in Project Plan document. Here we attach burndown charts which were created after the end of each sprint.

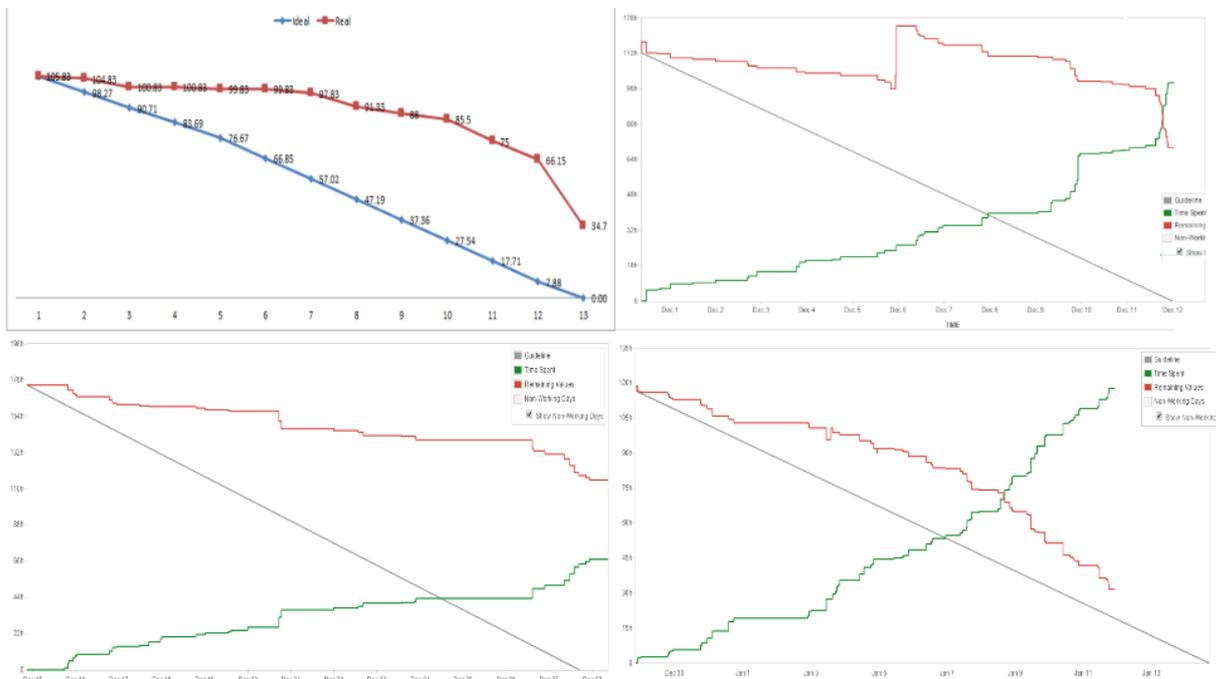


Figure 4.2: Burndown charts - Sprint 1, 2, 3 and 4

### 4.3. Worked hours

Here we present the working hours of each team member from the beginning of the project till the end of the project implementation. If we exclude the team members which are not active and did not participate in finalizing the project, the hours are distributed almost equally among the team members as it is shown on Figure 4.3.

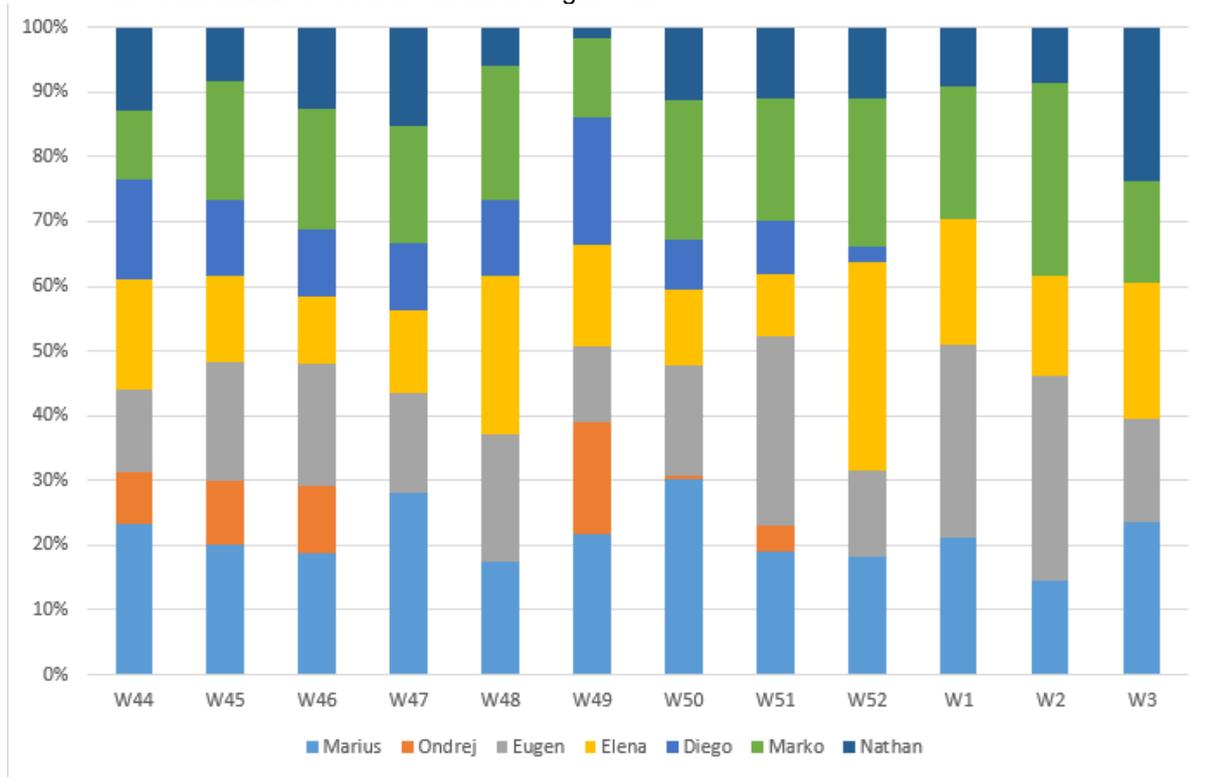
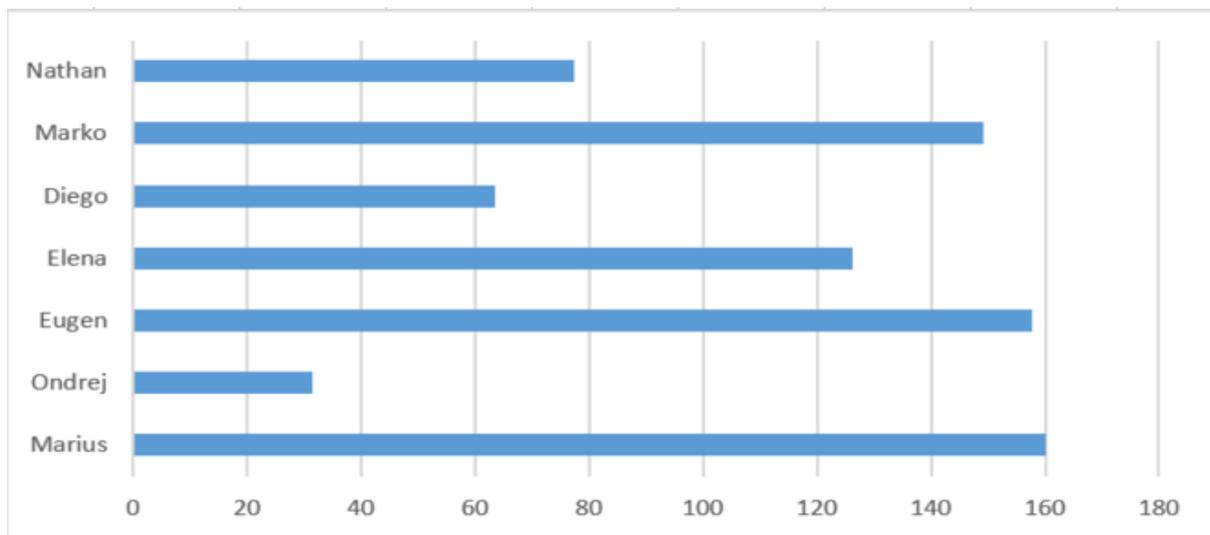


Figure 4.3: Working hours - week report

Figure 4.4 shows how many hours each of the team members has spent working on the project.



Smart Energy for Your Home	Version: 1.1
Final Report	Date: 2016-1-22

*Figure 4.4: Working hours - total*

#### **4.4. Positive experience**

Despite of the problems we had, the working environment was relaxed and all team members agree that working in this team was a great pleasure. Most of the team members participated in multicultural collaborating for the first time and found it useful for future projects.

During the last sprint we achieved the best results regarding completed tasks and predicting issues estimates. We adopted successfully Scrum methodology and after the team got used to it, project results improved.

#### **4.5. Possible improvements**

If we could do a similar project again, then we would address different aspects. First we would increase our frequency of the communication. The team experienced a lot of challenges while planning and developing the project. Because of the distributed nature of the project and missing face-to-face communication between the team members, there were often misunderstandings while discussing specific problems. Second we would start earlier in transferring knowledge, so that other team members are able to develop. Third we would start to work on difficult aspects earlier. Because of the lack of domain experience, we would also try harder to find a domain expert to speed up the development.