



User Control System

For Esteem's House Design

Stage 1 – Bidding Phase

By Hometrics

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Requirements

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1. Introduction

1.1 Purpose

This deliverable entails the requirement specifications for Esteem's user control system, as requested by Alex Maclare; the client and head of Esteem. The purpose of the system is to provide a medium for interaction between home-dwellers and their Internet-enabled smart devices such that it betters their behaviour on energy expenditures to a more efficient approach.

The intended readers of this document are Ron Petrick (project co-ordinator), Alex Maclare, other representatives of Esteem, Mike Chantler (Hometrics' project manager), and the developers of Hometrics.

1.2 Scope

The system is defined as a single service consisting of:

- A backend web server acting as the API.
- A database managing all the data.
- A mobile & web app interface, acting as the frontends served to users.

The system shall act as an effective control system and user interface for the management of smart homes designed by Esteem, providing a medium between home-dwellers and their Internet-enabled smart devices. Concurrently, the system shall record/present energy usage/generation throughout the home, presenting this information to users in different forms (according to the user category).

1.3 References

1. This document was inspired by the User Requirements example reports, provided by the project co-ordinator (Ron Petrick).
2. Source of datasets to be used by the system: <https://sdme-contest.com/>
3. Figure 1 – taken from Esteem's sharable OneDrive folder.

1.4 Abbreviations

Abbreviation	Meaning
F-UR	Functional user requirement
NF-UR	Non-functional user requirement
F-SR	Functional system requirement
NF-SR	Non-functional system requirement

1.5 Overview

The beginning of this document details a high-level approach of the system's functionality and constraints, later followed by a low-level, detailed view of the system's functional and non-functional requirements separately.

2. General Description

2.1 Product Perspective

The user control system being developed for Esteem is targeted at home-dwellers of their energy-conscious house design. The system shall act as a medium between the two, allowing users to control Internet-enabled smart devices, view a representation of their energy usage/generation, and regulate the home's internal environment.

2.2 User Characteristics

The system's functionality has been designed with respect to the following user hierarchy (in order of most important user):

1. Home manager – users have access to the complete set of functionalities and are the only ones capable of performing administrative operations.
2. Home dwellers – users have access to the set of functionalities that are not of an administrative nature.
3. Children – users under the age of thirteen possess the same set of functionalities as a home dweller, though the information and the system's interface are presented to them in a simpler manner, compared to other users.

2.3 General Capabilities

The main functionalities of the system are:

1. The system must simulate Esteem's proposed house design.
2. Home managers can manage the home setup on the system.
3. The system must regulate the home's internal environment.
4. All users can control Internet-enabled smart devices within the home.
5. The system must present all user's energy consumption and device activity.

1. The system must simulate Esteem's proposed house design.

Seeing as we do not have a physical house to test/see the effects of the user control system, Hometrics shall create a web-based house simulator of Esteem's current proposed house design (as of 9th November 2019), by graphically representing the house with an eagle view of the house as produced by Esteem:

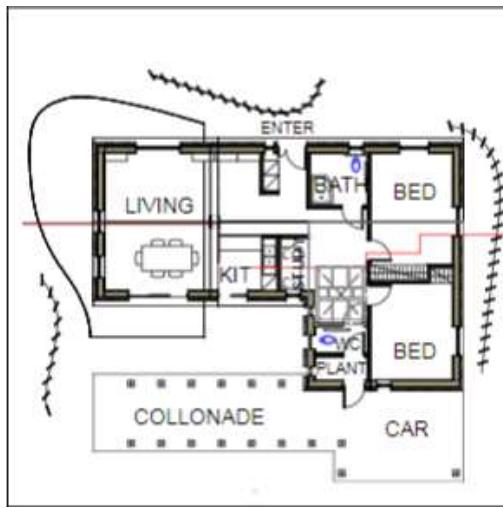


Figure 1: Floor view of Esteem's house design.

Simulations include:

- Results of users managing Internet-enabled smart devices (e.g. turning lights on/off).
- Energy usage (as a result of users' device activity) and production.
- Internal house environment and weather conditions (sensors).

The system shall use datasets provided by <https://sdme-contest.com/> to simulate internal environment and weather conditions.

2. Home managers can manage home setup on the system.

As described by Alex Maclaren (group project client), the proposed house's design is ambiguous on how users shall initially setup their home onto the system, and so is up to Hometrics to define. Therefore, Hometrics has decided to assume the house shall contain a dedicated hub gathering all associated Internet-enabled smart devices into a home network and can be identified with the hub's name and password (which is already predetermined).

When a user signs up onto the system, they shall provide the following credentials:

- Name
- Age *Why do you need this - f >18?*
- Home hub's name & password
- Proposed account username & password

Two cases have been identified for a user signing onto the system:

1. The user's home does not already exist on the system. In this case, the user automatically becomes a home manager (provided they are not a child), and later users signing onto the system require authentication from the home manager to join the home setup.

*Good to be specific about what you think
that the customer is not clear about.*

2. The user's home already exists on the system. In this case, all existing home managers receive an approval request to allow the new user onto the home setup. If successful, then they join as a home dweller.

Only home managers should be able to manage the home setup. This includes:

- Restricting device activity time to certain users (e.g. limiting television on-time).
- Declaring desirable internal environment conditions (e.g. regulate room temperature to 15 °C).
- Declaring other users within the hierarchy (e.g. promote a home dweller to home manager).

Could perhaps use matrix to make clear what rights each user type has.

3. The system must regulate the home's internal environment.

Being an aspect of the simulation, the system must regulate internal conditions according to the preferences set by home managers. We regard internal conditions as:

- Temperature
 - Humidity
 - Air quality
 - Lighting
- Per room or zone or house average?

Weather conditions impact temperature, humidity and air quality, so weather datasets as well as internal environment data shall be gathered from <https://sdme-contest.com/>.

4. All users can control Internet-enabled smart devices within the home.

All users, despite their hierarchy, shall be able to control Internet-enabled smart devices connected to the home setup. Devices are recognised by the system through smart plugs, as well as in-house devices (e.g. thermostat, humidifier).

As mentioned, home managers can restrict certain devices to users.

5. The system must record all user's energy consumption and device activity.

Energy consumption is recorded for every user, by totalling the units of energy produced by the on-time of devices they control with the system.

All users shall receive personal energy and device activity usage reports, though representation of the data differs among the user hierarchy:

- Home managers shall receive energy consumption data in the form of a line graph, which can be filtered by periods of time (i.e. day, week, month, year). Device activity shall be represented as a (scrollable) timeline, indicating the

time and duration of each device's on-time. Home managers may also view other dweller's reports.

- Home dwellers receive the same representation of reports as home managers, except they are restricted to viewing their own reports.
- Children shall receive energy usage reports in the form of textual statements, simply defining the value of their energy consumption in a day/week/year and whether they produced less/more energy than previous periods of time. Children shall also receive the same style of device activity reports as other users.

2.4 General Constraints

The system shall be accessed by home dwellers of Esteem's proposed house design, available through mobile and web app platforms. All users shall require an email address and password to login to the system. Data representation of recorded energy consumption differ among the user hierarchy.

The system's backend shall run on the MACS Linux System and is expected to be accessed daily. An aesthetically pleasing interface shall be provided to complement the system's high-quality functionality and should not require any training/tutorials to navigate it, as the interface's layout should be operable with common sense. *Users don't have this!*

The system shall conform to all legislative matters such as handling customer data/privacy policies, including the recently revised Data Protection Act (2018).

Sample data given by the Solar Decathlon's website shall be used in the house simulation, imported into the database.

As of 5th March 2020, the final implementation of the prototype should be complete for demonstration purposes, keeping true to the development costs declared in the Project Costing document.

2.5 Assumptions and Dependencies

Hometrics shall assume the house designed by Esteem shall contain a dedicated hub gathering all associated Internet-enabled smart devices into a home network and can be identified with the hub's name and password (predetermined) during signup to the system.

An internet connection is required to access the system.

There is at least one adult home dweller capable of acting as a home manager for the home setup in the system.

The house shall be equipped with smart plugs that can record energy consumption and identify devices.

↳ Seems that you are assuming that the home manager will restrict the access of children to smart plugs controlling kettle etc.?

3. Specific Requirements

3.1 Functional System Requirements

F-SR 1 – The system must simulate Esteem's proposed house design.

ID	Description	MoSCoW
F-SR 1.1	<p>The system must provide a graphical representation of Esteem's current proposed house design.</p>  <p>NB: The simulation is separate from the user control system. This is to act as a virtual house, considering we do not have access to a physical design.</p>	Must
F-SR 1.2	<p>The simulation shall indicate a change of state to registered devices that can be managed by the user control system. The states represented are:</p> <ul style="list-style-type: none"> • On • Off 	Must
F-SR 1.3	<p>The simulation shall adapt to the addition/removal of registered devices in real time (<i>i.e.</i> show a newly added device/stop showing a removed device).</p>	Must
F-SR 1.4	<p>The simulation shall represent faults in devices that contain them.</p>	Should
F-SR 1.5	<p>The system shall represent in-house sensors monitoring internal environmental factors. These include:</p> <ul style="list-style-type: none"> • Temperature (Thermometer) • Humidity (Hygrometer) • Air Quality (Air Quality Index) 	Must
F-SR 1.6	<p>The system shall represent in-house devices regulating internal environmental factors. These include:</p> <ul style="list-style-type: none"> • Thermostat • Humidifier • Air Conditioner • Lights 	Must
F-SR 1.7	<p>The system shall represent external weather conditions (which impact internal environmental factors mentioned in F-SR 1.5).</p>	Must

should this not
be under user-control?

F-SR 2 – The system shall regulate the home's internal environment in an energy-conscious manner.

ID	Description	MoSCoW
F-SR 2.1	The system shall record external weather conditions, using a predetermined dataset sourced from the Solar Decathlon's website.	Must
F-SR 2.2	When external weather conditions are cool enough, the system shall decrease AC.	Should
F-SR 2.3	When external weather conditions are warm enough, the system shall decrease the thermostat setting.	Should
F-SR 2.4	When external weather conditions are bright enough, the system shall dim light power.	Must
F-SR 2.5	The system shall adjust the humidifier according to external weather conditions.	Must
F-SR 2.6	The system shall adjust the air conditioner according to external weather conditions.	Must

3.2 Functional User Requirements

F-UR 1 – The system must allow users to setup their home onto the system.

ID	Description	MoSCoW
F-UR 1.1	<p>The system must allow home dwellers to sign up to the system.</p> <p>Details required for signup are as follows:</p> <ul style="list-style-type: none"> Name Date of birth Email address Proposed password Home's hub name & password <p><i>too much personal information this is not required for > 18</i></p> <p><i>How will this be protected and encrypted?</i></p>	Must
F-UR 1.2	Once a user has attempted to sign up, the system must send a confirmation email to their associated email before finalising their sign up.	Must
F-UR 1.3	If the user signing up does not have their home already setup on the system, then the system must declare them a home manager.	Must
F-UR 1.4	If the user signing up does have their home already set up on the system, then an authentication request must be sent to existing home managers, and they must accept it for the user to join the home setup.	Must
F-UR 1.5	Once signed up onto the system, users should be able to login to the system at any time with their email address and password.	Must
F-UR 1.6	The system must provide users with the option to reset their password, by sending an invitation link to their email that will allow them to change their password.	Must
F-UR 1.7	The system must allow home managers to set preferred home conditions. These include:	Must

Will this be recorded
or encrypted?

	<ul style="list-style-type: none"> Preferred room temperatures for the system to regulate. Restricted access to certain Internet-enabled smart devices for other home dwellers. Managing hierarchy of other users within the home setup (i.e. promoting/demoting users to home managers/normal home dwellers). 	
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F-UR 2 – The system shall allow users to interact with Internet-enabled smart devices.

ID	Description	MoSCoW
F-UR 2.1	The system shall allow users to switch lights on/off.	Must
F-UR 2.2	The system shall allow users to setup generic devices via smart plugs and turn them on/off.	Must
F-UR 2.3	The system shall allow users to access smart security cameras and view footage.	Want
F-UR 2.4	The system shall allow users to access the thermostat.	Should
F-UR 2.5	The system shall prevent users from accessing devices, by following restrictions set by home managers in the home setup.	Must

F-UR 3 – The system must record all user's energy consumption and device activity.

ID	Description	MoSCoW
F-UR 3.1	All users' device activity shall be recorded, detailing the device used, time of activity and duration.	Must
F-UR 3.2	The system shall display device activity for all users in the form of a (scrollable) timeline, indicating the time and duration of each device's on-time.	Must
F-UR 3.3	All users' energy usage shall be recorded, by totalling the units of energy used across all on-time of devices they have used.	Must
F-UR 3.4	Home managers and home dwellers shall receive energy consumption reports in a statistical manner (line graph), with time on the x-axis and total energy used in the y-axis.	Must
F-UR 3.5	Children shall receive energy usage reports in the form of simple, textual statements.	Must
F-UR 3.6	Home managers shall be able to view other users' device activity and energy consumption reports.	Should
F-UR 3.7	All users shall receive a comparison report of their energy usage against the home's total energy generation.	Should
F-UR 3.8	Users can filter their energy usage reports by durations of time (i.e. week, month, year).	Should

F-UR 3.9	<i>Gamification of energy consumptions:</i> A scoreboard report shall be sent to all users, ranking users by the most energy-conscious home dweller.	Could
F-UR 3.10	Users should be able to delete their own recorded data.	Must

3.3 Non-Functional Requirements

3.3.1 Hardware

ID	Description	MoSCoW
NF-SR 1	The system's backend shall be hosted on the MACS development server.	Must
NF-UR 1.1	Desktop users' computer hardware must be compatible with supported modern web browsers.	Must
NF-SR 1.2	Mobile users' hardware must be compatible with operating systems that support the system's mobile app form (NF-UR 2.2).	Must

3.3.2 Software

ID	Description	MoSCoW
NF-UR 2.1	The system's web app form shall be accessible to desktops with common desktop web browsers (e.g. Chrome, Firefox, Edge).	Must
NF-SR 2.2	The system's app form shall be compatible with Android ($\geq 8.0.0$) and iOS ($\geq 6.0.0$).	Must
NF-SR 2.1	The system's backend shall manage data with a relational, SQL (MySQL) database.	Must
NF-SR 2.2	The system's backend shall be built with JavaScript, using the Express web server, and running on a Node.js environment.	Must
NF-SR 2.5	The system's frontend shall be developed with JavaScript, using the React Native framework. This unifies cross-platform development for desktop (web) and mobile app platforms.	Must

3.3.3 Data

ID	Description	MoSCoW
NF-SR 3	The system shall use datasets on weather conditions and internal home environment from the Solar Decathlon's website: https://sdme-contest.com/	Must

3.3.4 Security

ID	Description	MoSCoW
NF-UR 3.1	Only home managers have access to administrative functionality.	Must
NF-UR 3.2	Children cannot become home managers.	Must

3.3.5 Reliability

ID	Description	MoSCoW
NF-SR 4	Inaccessibility to the system should only occur when there is no internet connection, or the MACS development server is down.	Must

This should be a robust policy (base for future enhancement.)

3.3.6 Legislation

ID	Description	MoSCoW
NF-UR 5.1	Customer data shall be held in accordance with the recently revised Data Protection Act (2018).	Must
NF-UR 5.2	All data held on the system shall conform to the company's privacy policies.	Must
NF-SR 5	Hometrics will own the full code on completion of the project.	Must

? as how will this be protected?

3.3.7 Robustness

ID	Description	MoSCoW
NF-SR 6	The system shall minimise exceptions that would cause the system to fail. It shall recover from errors as soon as possible.	Must

vague, this could cost you a lot of cash.

3.3.8 Time

ID	Description	MoSCoW
NF-SR 7	The system should be complete by the 5 th March 2020 in time for demonstration purposes, and within with the costs set out in the Project Costing document.	Must

what does this mean - passed handover tests?

3.3.9 Usability

ID	Description	MoSCoW
NF-UR 6.1	The system's frontend shall come across to users as aesthetically pleasing.	Must
NF-UR 6.2	The user interface should have the same style/design for both web and mobile app forms.	Should

Vague - this could cost a lot!

NF-UR 6.3	The frontend's layout should be easy enough for users to navigate with "common sense".	Should
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vague!

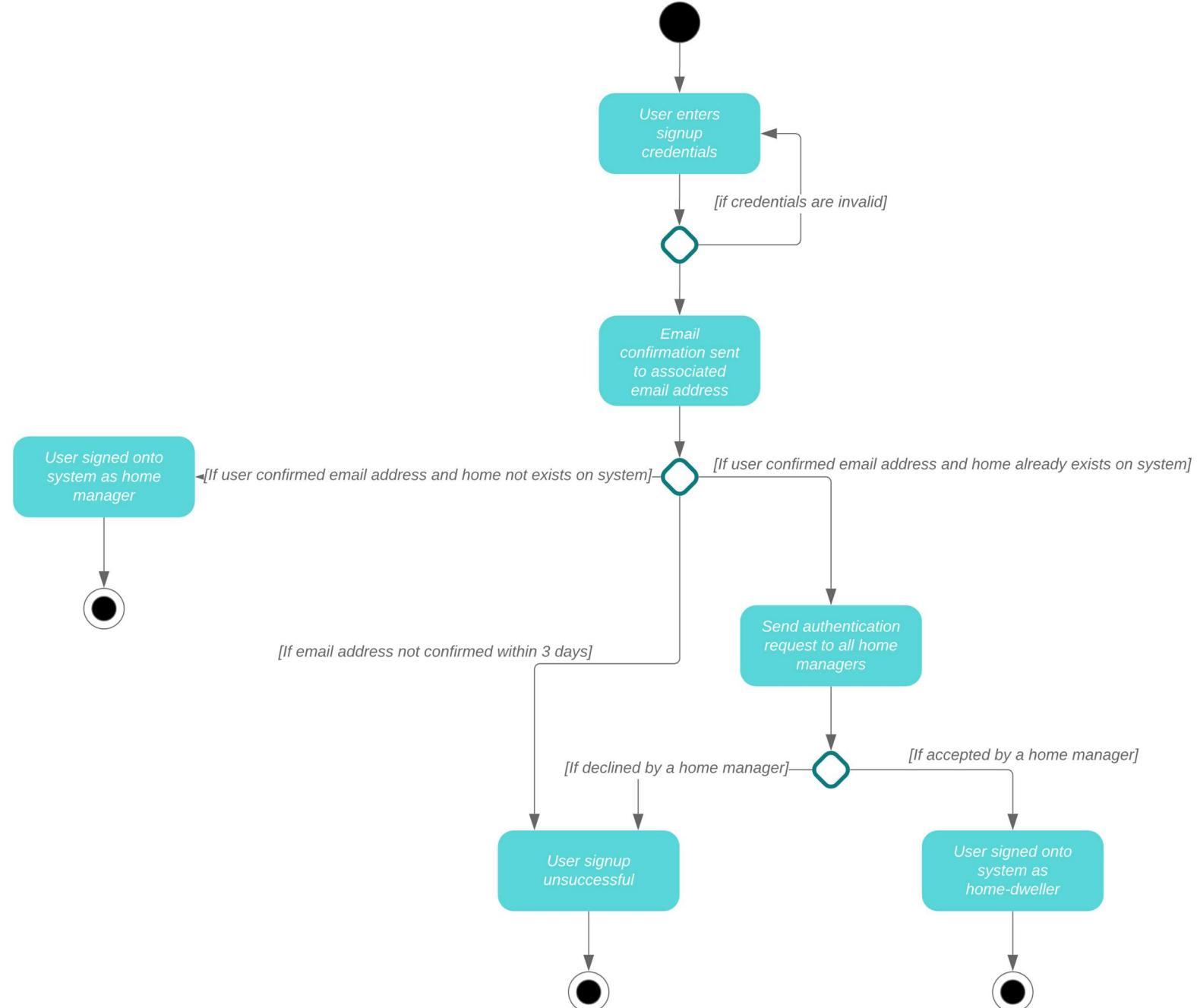
3.3.10 Forgiving

ID	Description	MoSCoW
NF-UR 7	The interface shall contain means to protect users from their own actions with severe, unintended complications.	Must

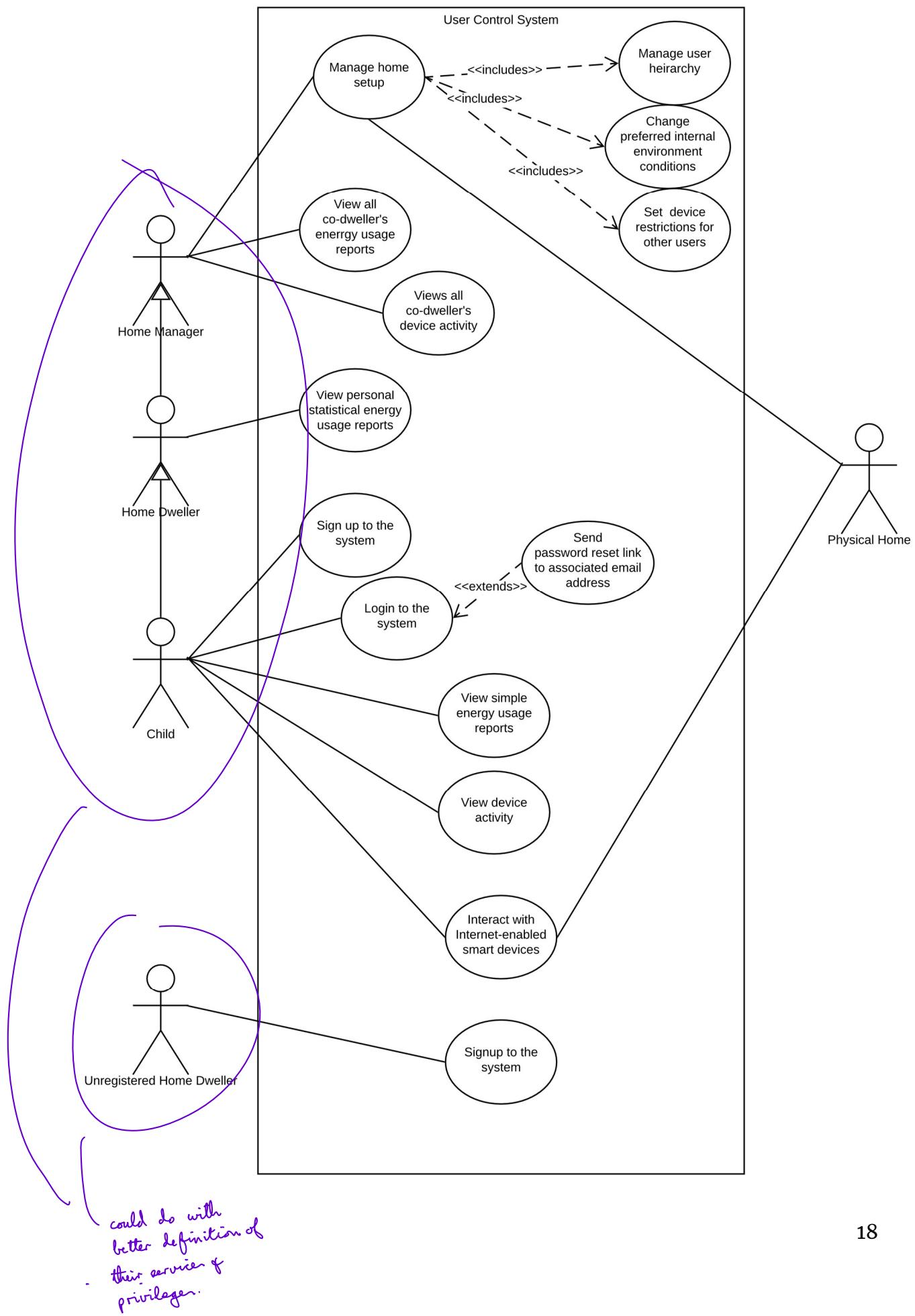
↳ vague
 ↳ potentially expensive ←
 ↳ need tighter definition.

4. Appendix

4.1 Activity Diagram for F-UR 1 (user login/signup flow):



4.2 Use case diagram of all functional user requirements:





Usability Report

Authors
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Last Updated
27th November 2019

Introduction

Abstract

This document outlines the current design decisions we have formed for our prototype and the future ones we will make for our final product in the conclusion. The latter decisions will be based on usability testing – which aims to identify any design flaws – which will all be documented within this document.

References

This document was inspired by the Usability Evaluation Mock-ups example reports, provided by the project co-ordinator (Ron Petrick).

Overview

This document is comprised of four sections:

- Test Plan
- Test Protocol
- Test & Questionnaire Findings
- Conclusion

Test Plan describes the process which will be used to carry out our testing i.e. the methods which will be used and how they will be incorporated in our testing protocol.

Test Protocol forms the guide test participants will follow for us to collect subjective qualitative & quantitative data to be evaluated.

Test & Questionnaire Findings analyses the results we receive from our testing including any user feedback relayed from participants of our study, which will be analysed to highlight any shortcomings of our prototype.

The Conclusion will summarise our findings and any alterations we make to our prototypes design for the final product.

Test Plan

This document defines the Usability Testing Plan for Hometrics. The usability test aims are:

- Run the test prototype in controlled conditions
 - Collect any relevant data to assess whether specified functional and non-functional requirements have been met
- Collect qualitative and quantitative data through user-feedback
- Determine user habits and preferences for evaluation
- Highlight any usability shortcomings with the interface designs e.g. difficulty navigating or issues related to the use of a function in the prototype

Hometrics will be developed to be used by a multi-disciplinary university team. Testing will be on the public and will occur in a variety of locations based on the convenience for each participant under the supervision of a group member. While we aim to be stringent in maintaining similar testing conditions, testing in various locations has the potential to introduce uncontrollable external variables. However, within a small test sample we desire to conduct our usability testing in university environments.

Methodology

Prototype

We will be using a low-fidelity prototype created in Adobe XD to prevent minimal interaction between subjects and the attending supervisor, which would not be the case had the supervisor become a facilitator.



Participants

There are going to be 6-8 subjects recruited to participate in the tests. Participants will be of diverse backgrounds, age groups and levels of computer literacy to allow us to test the ease of use for our design prototype. While recruitment will aim for a diverse set of subjects, participants will most likely be from a university background or be acquaintances of group members.

Subjects are within hence each participant will undertake the same tasks based on the prototype and upon completion of the tasks answer a questionnaire. Participant feedback regarding usability and functionality of the prototype should be honest and to maintain feedback integrity, supervisors will be neutral before and during the testing of the prototype. *Hmm...*

Since we propose to test usability using repeated measures where participants all perform the same tasks (within-subjects) this will allow us to greater assess each function.

Preparation

Subjects will be informed on the context of the prototype, and to question any aspects of the prototype should they wish to, as these queries will be recorded and useful in identifying any correlations in the interface or functionality of the prototype. Subjects will not receive any formal instructions as to using the prototype

to allow for the evaluation on whether the prototypes interface and functionality is intuitive.

Procedure

Based on convenience testing will occur in various locations according to the subject and must always have a group member supervising. The attending group member should provide a consent form and request for it to be signed for the test to be taken, participants will be informed that they are not being assessed and that they are testing the prototype as well as being allowed to withdraw from the testing should the subject choose to do so. After being given the prototype the supervisor will request the participant attempt a set of tasks and will record the progress of each tasks noting any errors or questions. Upon completion of the tasks the subject will be asked to answer a series of questions and to evaluate certain aspects, as well as provide any additional thoughts/feelings towards the prototype.

The test situations are compromised of the requirements and use cases from the User Requirements document (refer to table below). Tasks imitate the most frequent actions to be undertaken by the end products users. These are designed to cover a broad spectrum of functionality that can be tested in a low-fidelity prototype.

At our current prototype stage, it is not possible for subjects to test specific requirements e.g. "F-UR 1.1 The system must allow home dwellers to sign up to the system". This is due to the prototype not having an implemented back-end necessary for full functionality of this feature. Though, the usability study does allow for the testing of requirements such as "NF-UR 9.1 The system's frontend shall come across to users as aesthetically pleasing." The table on the next page contains all the requirements related to the test questions the subjects will undertake in the study.

Question	Related Requirements
1.	F-UR 1.1 - The system must allow home dwellers to sign up to the system.
2.	F-UR 2 – The system shall allow users to interact with Internet-enabled smart devices.
3.	F-UR 3.2 – The system shall display device activity for all users in the form of a (scrollable) timeline, indicating the time and duration of each device's on-time. F-UR 3.8 – Users can filter their energy usage reports by durations of time (i.e. week, month, year).
4.	F-SR 3.3 – All users' energy usage shall be recorded, by totalling the units of energy used across all on-time of devices they have used. F-UR 3.9 – Users can filter device activity and energy usage by durations of time (i.e. week, month, year).
5.	F-SR 1.1 – The simulation must provide a graphical representation of the house, as illustrated in figure 1 (General Requirement). F-SR 1.3 – The simulation must represent in-house sensors monitoring/controlling internal environmental factors. These include: <ul style="list-style-type: none"> • Temperature • Humidity • Air quality • Lighting F-SR 1.4 – The simulation must represent external weather conditions, which impact internal environmental factors mentioned in F-UR 1.3.

Test situations upon completion receive a rating between 0 and 2, where 0 is “Not successful”, 1 is “Successful with difficulties/aid” and 2 being “Successful without difficulties/aid”. We aim for every task to be successful without difficulties/aid. A task is complete when the participant indicates the goal of the task has been completed or when they have received enough help to consider the task unsuccessful, regardless whether its completion is successful or unsuccessfully. This will allow the evaluation of each task to highlight any potential usability issues. The attending group member should note the steps taken by the subject to achieve each goal e.g. the clicks to travel to a different page and any difficulties the subject might encounter, providing insight into any navigation and design flaws.

Critical faults are any errors that results in an incorrect outcome or an error that remains unresolved upon completion of a task. Non-critical faults are errors which are recoverable by the subject without any assistance e.g. taking longer routes, incorrect clicks or making a mistake. Both are to be recorded as they can lead to vital information into user behaviour which can lead to design improvements.

Participants will be questioned in the test to describe a screen of the app to allow when evaluating assess the level a subject understands the purpose of a screens, highlighting any potential presentation issues.

How will you record and analyse this feedback?

In a questionnaire post-test encompasses subjective evaluation regarding ease of use and user satisfaction. The questionnaire aims to collect quantitative data representing usability. This will be formed by demographic questions, Likert rating scales for statements based on aspects of the app e.g. aesthetics. Followed by a request to add any further thoughts and feelings that could lead to an improvement.

Usability Test Goals

In this section we aim to define the usability goals for Hometrics which are:

- Completion Rates – Percentage of test subjects who successfully complete a task without any critical faults. The goal for our usability study is that every task has a completion rate of a 100%.
- Fault Rates – Percentage of test subjects who successfully complete a task without any types of faults. The goal for our usability study is that every task has a fault rate of at least 60%.
- Problem Rating – Ranking system to highlight any reoccurring problems encountered by test subjects, based on the frequency of a problem: high – problem accounts for < 30% of all documented problems , Moderate – problem accounts for 11-29% of all documented problems and Low – problem accounts for < 11 % of all documented problems

Test Protocol

Supervisor initials:

Session Number:

Hometrics

Web Application Testing Protocol

Heriot-Watt University

Notes for supervisor

Please read through the aims and introduction with the participant and take notes alongside each of the questions to record the session. Please use a new protocol sheet for each participant and record your name and session number on the top right corner. In your notes please record the participant's responses and any issues they may have had in completing the tasks.

Aim: The aim of this session is to try out some of the features of a prototype web application which aims to help control the energy usage in a house full of internet devices. The app is in early developmental stage and your input will be used to improve the functions and the way that the information is presented.

Introduction: The app allows you to control certain devices e.g. thermostats, lights in a home, as well as view the homes internal environment e.g. temperature, humidity. You can also use the app to view how much and at what times each device is on/off and the energy usage of each device.

I'll ask you to look at the various screens and describe what you see, and I will ask you to complete a few simple tasks. I'll be taking notes to record your feedback and actions, but my notes won't identify you and they will be completely anonymous. Following this we will ask you to complete an anonymous questionnaire to collect your general comments/feedback on the app. There are no right or wrong answers, and your interpretation of the information presented will be extremely useful in improving the design. You may ask for help or any questions you wish if it is relevant to the test. Please tell the supervisor if you wish to stop at any time.

Let's begin.

Questions

1. Login Page – Refer to appendix to view the Adobe XD screenshot

- a) Please sign up for the app.
[Note any problems or immediate reactions]

- b) Please log in to the app.
[Note any problems or immediate reactions]

2. Control Panel – Refer to appendix to view the Adobe XD screenshot

- a) Please navigate to the control panel
[Note any problems or immediate reactions]

- b) Can you describe what is the purpose of this page?
[Do they realise it is for controlling the devices in the house?]

- c) Are there any devices currently powered on?
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]

- d) What is the thermostats temperature set to?
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]

- e) Please demonstrate how you would turn on/off a light.
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]

- f) Please demonstrate how you would turn on/off a TV
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]

- g) Please demonstrate how you would increase/decrease the temperature of the thermostat
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]

3. Device activity – Refer to appendix to view the Adobe XD screenshot

- a) Please navigate to Device Activity
[Note any problems or immediate reactions]

- b) Can you describe what is the purpose of this page?
[Do they realise it is to view the activity of the devices in the house over a period?]

- c) What device was active (on) for the longest duration on Day 3 of the graph?
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]

- d) Please change the period the device activity graph displays to months.
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]

4. Energy usage – Refer to appendix to view the Adobe XD screenshot

- a) Please navigate to Energy Usage
[Note any problems or immediate reactions]
- b) Can you describe what is the purpose of this page?
[Do they realise it is to view the energy usage in the house over a period?]
- c) What device has used the most amount of energy in total in the graph?
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]
- d) Please change the period the energy graph displays to months.
[Completion: o. Not successful 1. with difficulties/aid 2. without difficulties/aid]

5. House environment – Refer to appendix to view the Adobe XD screenshot

- a) Please navigate to the house environment
[Note any problems or immediate reactions]
- b) Can you describe what is the purpose of this page?
[Do they realise it is to view a simulation of the house including all the information for the internal environment?]

OK, that's our short test completed. I'll now set up the questionnaire for you to complete. This is intended to gather some more general feedback on the app. It should only take 5-10 minutes and then you are finished here for today and free to leave.

Test & Questionnaire Findings

We had 8 subjects that partook in the test, below are the profile characteristics of our subjects:

Gender	
Women	3
Men	5
Other	0

Age	
18-24	5
25-35	1
35-44	0
45-54	2
55-64	0
65+	0

What frequency best describes your access to the internet?	
Multiple times a day	5
At least once a day	3
Once a week	0
Once every 8 – 14 days	0
Once every 14+ days	0
Never	0

Which browser(s) do you use?	
Chrome	5
Firefox	2
Safari	1
Opera	0
DuckDuckGo	0
None	0
Other	

Do you have a smartphone?	
Yes	8
No	0

What operating system does your smartphone run?	
iOS	2
Android	6
Windows	0
Other	0

Findings

1) Login Page

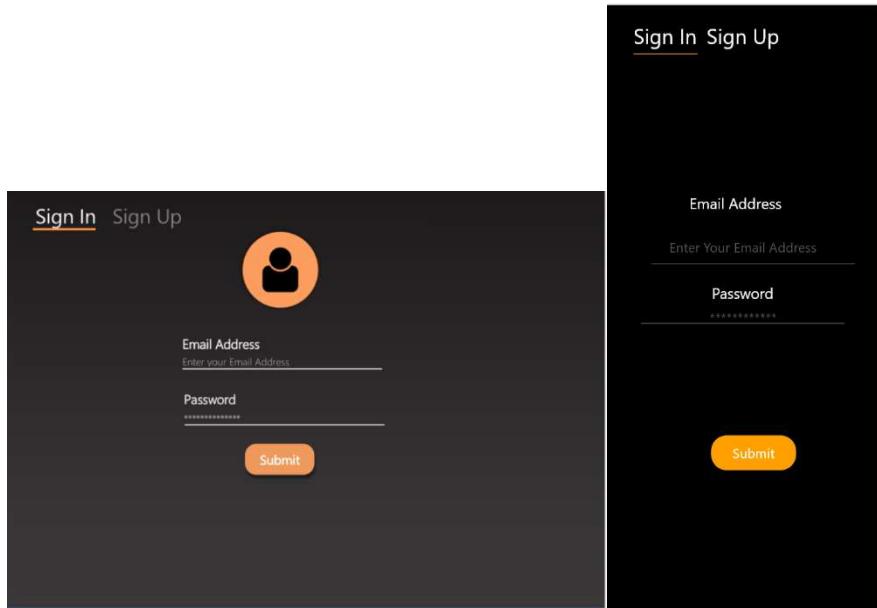
- a) Please sign up for the app

The image displays two side-by-side screenshots of a mobile application's sign-up interface. The left screenshot has a dark background and includes a large orange 'Submit' button at the bottom. The right screenshot has a white background and includes a smaller orange 'Submit' button at the bottom. Both screenshots show the following fields: 'Name' (with placeholder 'Enter your full name'), 'Date Of Birth' (with placeholder 'DD/MM/YYYY'), 'Email Address' (with placeholder 'Enter Your Email Address'), 'Password' (with placeholder '*****'), 'Confirm' (with placeholder '*****'), and 'Hub Name' (with placeholder 'Name Your Home Hub'). A central logo consisting of overlapping orange and grey geometric shapes is visible in both versions.

Participants were able to sign up for the application successfully without any difficulties.

Recommended Changes: None.

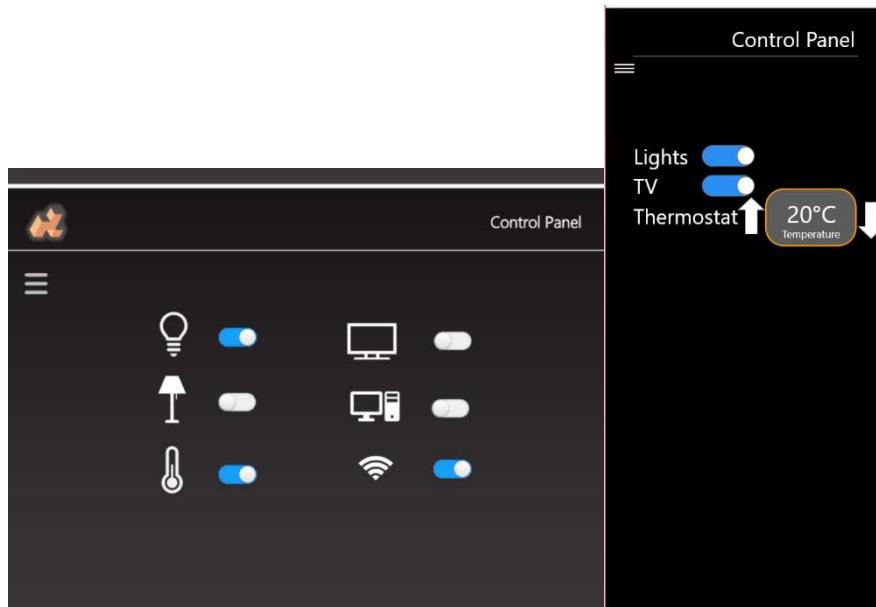
b) Please Log in to the app



Participants were able to log in to the application successfully without any difficulties.

Recommended Changes: None.

2) Control Panel



- a) Please navigate to the control panel

Participants were able to navigate the application successfully to the control panel without any difficulties.

Recommended Changes: None.

- b) Can you describe what is the purpose of this page?

Participants understood that the page provided controls for devices within the house. However, were unsure what devices specifically are being controlled e.g. lights is the control for all of them or one.

Recommended Changes: label devices into sections and list all the devices separately in a section

- c) Are there any devices currently powered on?

Not successful	0
Successful with difficulties/aid	0
Successful without difficulties/aid	8
Completion Rate	100%
Fault Rate	100%

Recommended Changes: None.

- d) What is the thermostats temperature set to?

Not successful	0
Successful with difficulties/aid	0
Successful without difficulties/aid	8
Completion Rate	100%
Fault Rate	100%

Recommended Changes: None.

- e) Please demonstrate how you would turn on/off a light.

Not successful	0
Successful with difficulties/aid	1
Successful without difficulties/aid	7
Completion Rate	87%
Fault Rate	100%

Recommended Changes: List devices separately rather than into sections

- f) Please demonstrate how you would turn on/off a TV

Not successful	0
Successful with difficulties/aid	0
Successful without difficulties/aid	8
Completion Rate	100%
Fault Rate	100%

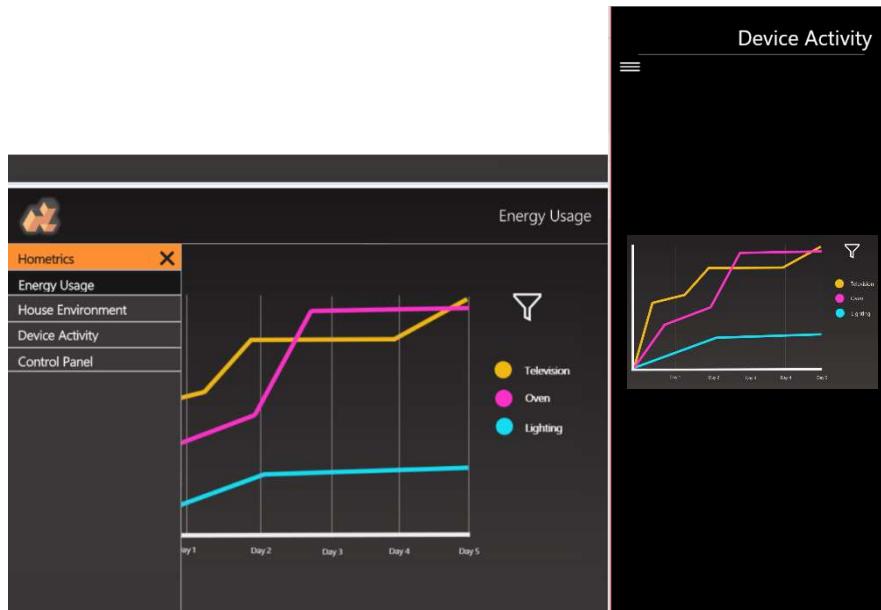
Recommended Changes: None.

- g) Please demonstrate how you would increase/decrease the temperature of the thermostat

Not successful	0
Successful with difficulties/aid	0
Successful without difficulties/aid	8
Completion Rate	100%
Fault Rate	100%

Recommended Changes: None.

3. Device activity



- a) Please navigate to Device Activity

Participants were able to navigate the application successfully to device activity without any difficulties.

Recommended Changes: None.

- b) Can you describe what is the purpose of this page?

Participants understood that the page presented a graph that showed what devices were on during the period of a day. However, were unsure what devices specifically are being shown e.g. lights could be broken down into rooms.]

Recommended Changes:

- Provide minutes metric for the Y axis of the graph, to grasp the quantity of time rather than relative time
- Control what is being presented on the graph e.g. only lighting devices or lighting vs heating

- c) What device was active (on) for the longest duration on Day 3 of the graph?

Not successful	0
Successful with difficulties/aid	5
Successful without difficulties/aid	3
Completion Rate	37.5%
Fault Rate	100%

Recommended Changes: None.

d) Please change the period the device activity graph displays to months.

Not successful	0
Successful with difficulties/aid	2
Successful without difficulties/aid	6
Completion Rate	75%
Fault Rate	100%

Recommended Changes:

- *Have toggles to change the time duration of the graph rather than a drop-down list*
- *Label the drop-down list for people to recognise it*

4. Energy usage



- a) Please navigate to Energy Usage

Participants were able to navigate the application successfully to energy usage without any difficulties.

Recommended Changes: None.

- b) Can you describe what is the purpose of this page?

Participants understood that the page presented a graph that showed the energy usage of every device. However, were unsure what specific devices were consuming e.g. lighting encompasses all the lights in the house.

Recommended Changes:

- Provide kWh metric for the Y axis of the graph, to grasp the quantity of usage rather than relative usage.
- Control what is being presented on the graph e.g. only lighting devices or lighting vs heating.

- c) What device has used the most amount of energy in total in the graph?

Not successful	0
Successful with difficulties/aid	0
Successful without difficulties/aid	8
Completion Rate	100%
Fault Rate	100%

Recommended Changes: None.

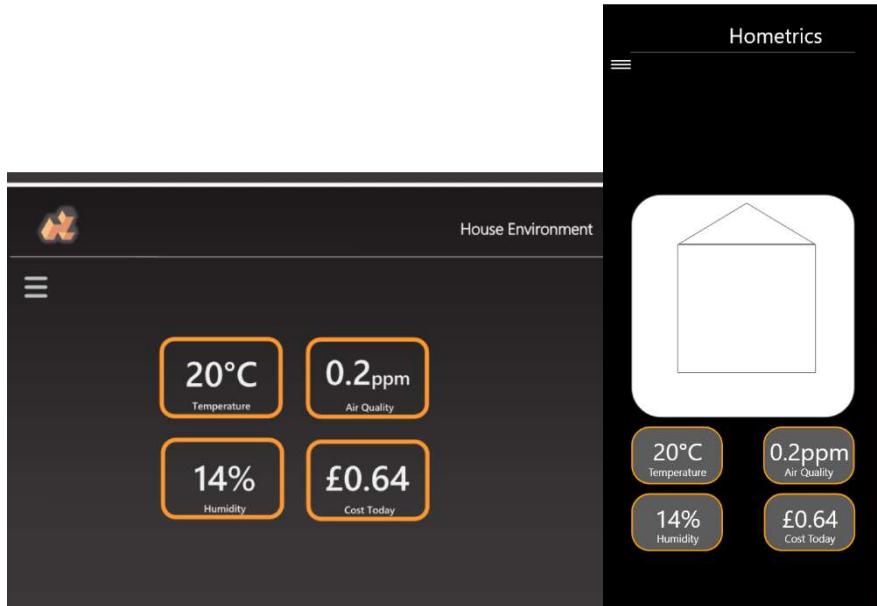
d) Please change the period the energy graph displays to months.

Not successful	0
Successful with difficulties/aid	0
Successful without difficulties/aid	8
Completion Rate	100%
Fault Rate	100%

Recommended Changes:

- *Have toggles to change the time duration of the graph rather than a drop-down list*
- *Label the drop-down list for people to recognise it*

5. House Environment



- a) Please navigate to the House environment

Participants were able to navigate the application successfully to device activity without any difficulties.

Recommended Changes: None.

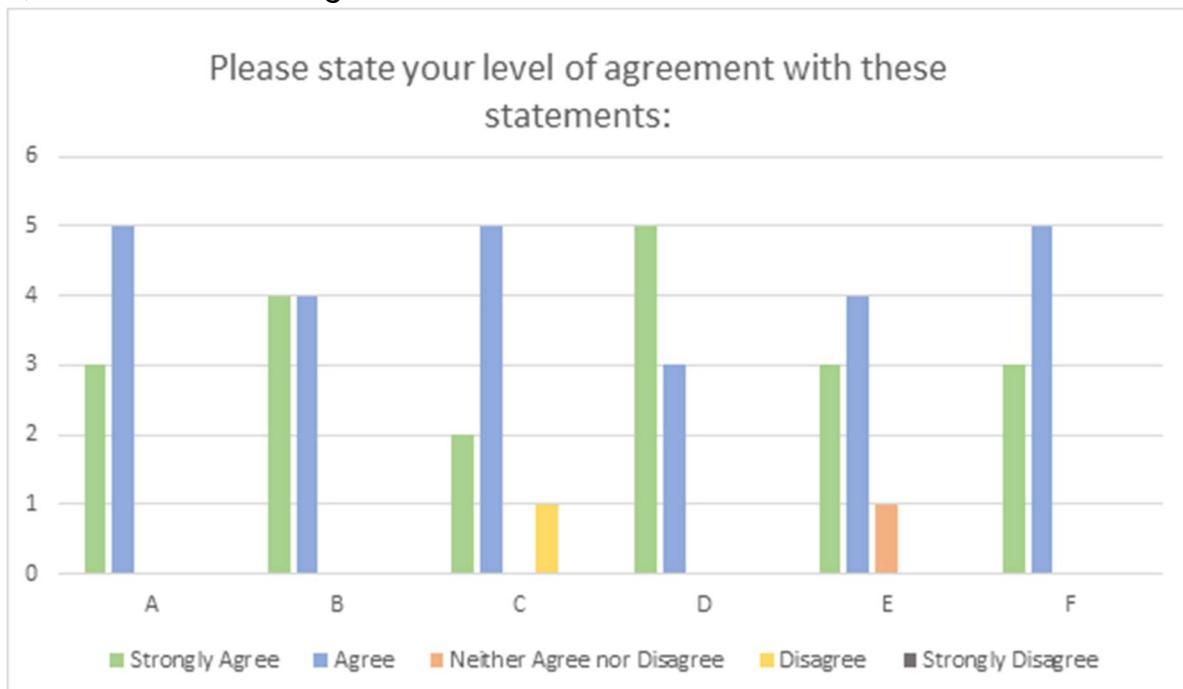
- b) Can you describe what is the purpose of this page?

Participants understood that the labels showed the house's internal environment. However, unsure what the house simulation provided.

Recommended Changes:

- *Use the house simulation to map out the environment on a room to room basis in the house*
- *Ability to make changes to devices from the home environment screen instead of going to control panel*

Questionnaire Findings



	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
A. The application is easy to use	3	5	0	0	0
B. It is user-friendly	4	4	0	0	0
C. The design and layout are aesthetically pleasing	2	5	0	1	0
D. The design and layout are clear and well structured	5	3	0	0	0
E. Grasped the purpose of each page quickly and easily	3	4	1	0	0
F. Easy to navigate throughout the application	3	5	0	0	0

These results are likely to be biased due to the fact that you are not doing A/B testing
→ you should note this.

Conclusion

Navigation

None of our 8 respondents reported that they had issues navigating to any of the different pages within the app. This concurs with the questionnaire results and so because of this we are confident in the navigation method initially proposed and intend on sticking to this moving forward into the implementation stages.

Design/Layout

The overall design and layout of our interfaces were generally well received with 88% of users agreeing that both are aesthetically pleasing. 100% of users thought that the application was easy to use and that the design / layout was well structured. We are satisfied with this response and are comfortable keeping the original design and layout with minor alterations which will be explained in the following breakdowns.

Labelling

From the questionnaire feedback we found that generally the interfaces were enjoyable to use however a recurring theme was that often there was a lack of information on screen which made the interface unclear and difficult to interpret. Examples of this issue include: array icons of devices within the control panel with no text identifier, changing the energy usage graph's x-axis from days to minutes to more easily comprehend the figures, adding a minutes time scale on the y-axis of the energy usage graph for the user to make sense of the data and labelling the drop down list for people to recognise its function more easily. This information was very useful to us as it was easy to take for granted our own design, as the creators we naturally knew what everything meant and so the outsider perspective will be taken on board and changes will be made to improve the design for both novice and expert users.

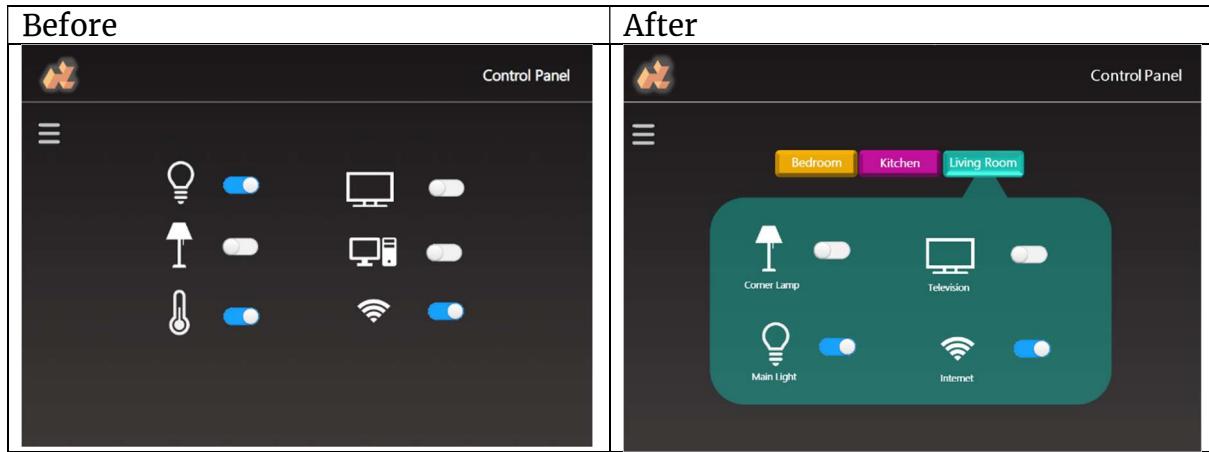
Features

There were a few extra features proposed by respondents which we had not considered when designing the interfaces. One such feature was the ability to control what is being presented on the graph on the energy usage page. Currently the graph shows all devices together identified by a different colour of line however users may wish to separate the data or compare specific data sets, this would be especially useful in cases where there are multiple of the same type of device such as lighting or televisions. Another proposed feature was to replace the drop-down filter list for toggle buttons to change the time scale of the graph. This would simplify the design and improve usability especially on smaller devices such as smartphones. The final requested feature was the ability to make changes to devices from the home environment screen instead of navigating to the control panel. This feature could potentially improve usability however the intended use for the home environment was to display statistics such as humidity and air quality which the user would not be able to directly manipulate. Additionally, we feel it is important to separate the pages to keep the interface clean and clutter free as to not overwhelm novice users with too much data at once.

Alterations

Control Panel

"Label devices into sections and list all the devices separately"

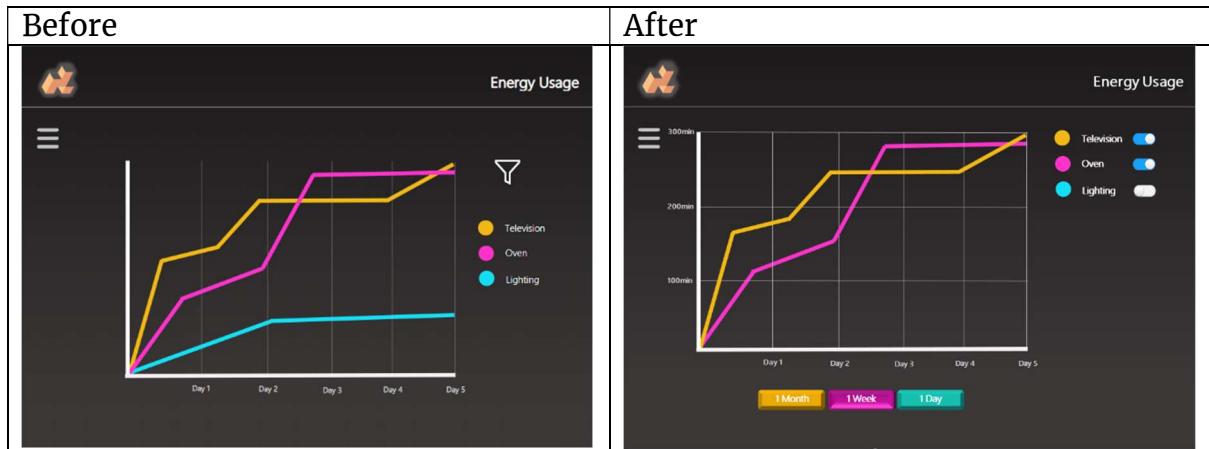


Energy Usage

"provide minutes metric for the Y axis of the graph, to grasp the quantity of time rather than relative time"

"control what is being presented on the graph e.g. only lighting devices or lighting vs heating"

"Have toggles to change the time duration of the graph rather than a drop-down list"



Appendix

Consent form for usability experiments:

Hometrics

Heriot-Watt University

Consent to Act as a Subject in an Experimental Study

Principal Investigator: Mohammed Jamal, Vincent Chung, Lee Donovan, Ram Attra & Eoghan Gibson

Description: The purpose of this study is to test the usability of this applications functionality.

There are minimal risks for you to participate in this study. All personal information will be kept confidential in a secure filing cabinet or in password-protected computer directories. Your participation will not affect how well you do in your courses (if you are a student) or affect your relationship with the university in any way

You are free to decline to participate in this study. Should you decide to participate, you are free to end your participation at any time. Such a decision by you will not adversely affect or alter your status with the university in any way.

Voluntary consent: I certify that I have read the preceding and that I understand its contents. Any questions I have pertaining to the research have been and will be answered by the team. My signature below means that I have freely agreed to participate in this study, and that I agree to the publication of the results for scientific purposes and to the distribution of the recordings and transcripts of the sessions for research purposes so long as my identity is not revealed.

Date
Inv. Initials

Subject Signature

Investigator's certification: I certify that I have explained to the above individual the nature and purpose, the potential benefits, and possible risks associated with participation in this research study, have answered any questions that have been raised, and have witnessed the above signature.

Date

Investigator Signature

Questionnaire for usability tests

1. What is your gender?

- Male
- Female
- Other, please specify

2. What is your age?

- 18 - 24
- 25 - 34
- 35 - 44
- 45 - 54
- 55 - 64
- 65+

3. What frequency best describes your access to the internet?

- Multiple times every day
- At least once a day
- Once a week
- Once every 8 - 14 days
- Once every 14+ days
- Never

4. Which browser(s) do you use?

- Chrome
- Firefox
- Safari
- Opera
- DuckDuckGo
- None

Other, please specify

5. Do you have a smartphone?

- Yes
- No

6. What operating system does your smartphone run?

- IOS
- Android
- Windows

Other, please specify

7. Please answer the following statements:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
A. The application is easy to use					
B. It is user-friendly					
C. The design and layout are aesthetically pleasing					
D. The design and layout are clear and well structured					
E. Grasped the purpose of each page quickly and easily					

F. Easy to navigate throughout the application					
--	--	--	--	--	--

8. Do you have a favourite feature in the application?

No

If yes, please specify

9. Is there anything you felt was missing from the application e.g. a feature or design?

No

If yes, please specify

10. Do you have any further comments or questions?

No

If yes, please specify



Project Decision and Planning

Authors
Lee Donovan

Last Updated
27th November 2019

Technical Stack

A group decision was made to unify technologies used as far as possible. For this reason, Hometrics shall use JavaScript for both ends of the system:

- Frontend: The React Native framework shall be used to concurrently develop for the web, Android and iOS with minimal headache.
- Backend: The Express.js web server running on a Node.js runtime environment.

A relational, SQL database best suits our requirement needs for the system, thus the backend shall handle data with a MySQL database. Our manager recommended using Tableau to help visualize our data which we still must look into as none of us have used this before.

Also, the Bootstrap framework shall be incorporated in our frontends to ensure a solid, reliable unified design for all devices.

We shall use the Mocha.js, a JavaScript test framework, to provide asynchronous testing, and coverage reports on our system to ensure a solid, reliable product.

Version Control

Hometrics has decided to use Git to control and manage concurrent updates to the system, as this shall avoid code duplication and provides a backup source in times of err.

Communication

Outside of group meeting hours, the team has unanimously agreed to keep in contact with each other through a dedicated WhatsApp group chat. Also, in circumstances where certain members are unable to physically attend meetings, Skyping the rest of the team is an acceptable form of attendance.

System Requirements

Hometrics has decided to develop and run the system on the MACS development server, as we all have experience deploying scalable web services there from previous years in the course.

Collaboration Methods

Since we are using Git version control to manage our code implementation, Hometrics has decided to use GitHub.

As for document storage and distribution among members (heavily important for bidding phase), a dedicated OneDrive folder has been created for this purpose.

Mock-up Design

Low-fidelity prototypes of the intended system shall be created using Adobe XD, allowing us to show responsive mock-ups of the system.

Software Process

We have decided to use a combination of the waterfall and scrum development models. Because of the way the project deadlines are set up for term one we are focusing on getting the requirement analysis and system design done. Once this was finished, we changed to a more scrum-based model with sprints of 2 weeks with each one ending with a working viable product.

Planning Team Members' Expected Contributions

At the start of the project we assigned team members roles for the entirety of the project with Mohammed being the technical manager, Lee the reporter, Vincent the liaison and Ram the organizational manager.

For stage one we assigned one team member to oversee one of the deliverable documents. This team member would have final say over the structure of the document. Lee was assigned project decision and planning, Mohammed on requirements, Ram on project costing, Eoghann on usability evaluation and Vince on risk analysis.

good idea!

For stage 2 and 3 we decided to split the project up with one member of the team being lead developer on the back end, one on the front end and one overseeing the whole project. As Mohammed-Yaseen is our technical manager, we chose him to work on integration on all the other members individual work. Vincent was chosen as the main front-end developer and Lee as the main back end developer. Ram is the lead developer on building the house simulation and Eoghann and Troy were assigned to help whoever needed extra development time.

little ☺

Every week we made a contributions table for people to show exactly what they worked on during that week so by the end of the project we can accurately assess how much each member contributed.

Project Hierarchy

We split the project into a back end and a front end and then further split these sub-systems into the UI, the simulation, the database and the server. Figure 1 below shows this diagrammatically along with which software was chosen for each section and who was put in charge of it.

Each of these sub systems should be worked on concurrently.

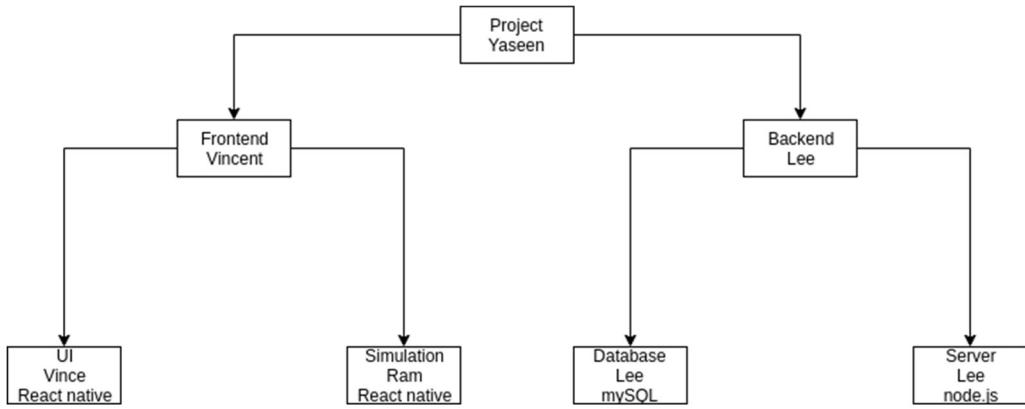


Figure 1.

Software testing

We plan to frequently show prototypes and the current state of the product to the customer as well as individuals with no stake in the project. We then plan to observe them interacting with the system and make notes on where they struggled and what questions they asked.

Development Plan

The Gantt Chart on the following page describes an in-depth view of our planned aspirations:

Name	Work			2020, H1							
				Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020
Stage 1	118d		All								
Miscellaneous tasks	10d	All									
Team assignment	1d	All									
Review stage 1 specification	1d	All									
Assign team member roles	1d	All									
Meet manager	1d	All									
Break down deliverables	6d	All									
Requirements document	22d	Mohammad Yaseen									
Non-functional requirements	6d	Lee Donovan, Mohammad Yaseen									
Functional requirements	6d	Ram Attra									
Requirements first draft	10d	Mohammad Yaseen									
Risk analysis document	15d	Vincent Chung									
Risk analysis first draft	15d	Vincent Chung									
Project planning document	11d	Lee Donovan									
Decide of software to use	6d	Lee Donovan									
Project planning first draft	5d	Lee Donovan									
Project costing document	16d	Ram Attra									
Budget breakdown	6d	Eoghann Gibson									
Project costing first draft	10d	Ram Attra									
Usability evaluation document	22d	Troy Greenaway									
Usability evaluation	6d	Troy Greenaway									
Usability test plan	6d	Troy Greenaway									
Usability evaluation first draft	10d	Troy Greenaway									
Clean up all the documents	21d	All									
Present drafts to manager	1d	All									
Second drafts	11d	All									
Present second drafts to manager	1d	All									
Polish all documents	8d	All									
Submit part 1	1d	Mohammad Yaseen									
Stage 2	86d	All									
Learn frameworks	31d	All									
Sprint 1	30d	All									
Database set up	10d	Lee Donovan									
Basic UI completed	10d	Vincent Chung									
Server set up	10d	Lee Donovan									
Sprint 2	24d	All									
Connect front and back end	8d	Mohammad Yaseen									
Create house simulation	8d	Ram Attra									
Usability testing	8d	Eoghann Gibson									
Submit stage 2	1d	Mohammad Yaseen									
Stage 3	86d	All									
Sprint 3	20d	All									
Integrate tableau	10d	Ram Attra									
Mobile version testing	10d	Mohammad Yaseen									
Sprint 4	20d	All									
Stress testing	10d	Mohammad Yaseen									
Finalize UI	10d	Vincent Chung									
Sprint 5	28d	All									
Finalize server functionality	10d	Lee Donovan									
Prepare for expo	8d	All									
Final usability testing	10d	Eoghann Gibson									
Expo	1d	All									
Sprint 6	16d	All									
Final testing	8d	All									
Polish	8d	All									
Submit part 3	1d	Mohammad Yaseen									

Could do with
a bit more explanation
of the tasks here.
Otherwise good document

WBS	Name	Start	Finish	Work	Duration	Slack	Cost	Assigned to	% Complete	
1	Stage 1	4 Oct	28 Nov	118d	40d	90d	0	All	0	
1.1	Miscellaneous tasks	4 Oct	21 Oct	10d	12d	118d	0	All	0	
1.1.1	Team assignment	4 Oct	4 Oct	1d	1d	129d	0	All	100	
1.1.2	Review stage 1 specification	7 Oct	7 Oct	1d	1d	128d	0	All	100	
1.1.3	Assign team member roles	7 Oct	7 Oct	1d	1d	128d	0	All	100	
1.1.4	Meet manager	14 Oct	14 Oct	1d	1d	123d	0	All	100	
1.1.5	Break down deliverables	14 Oct	21 Oct	6d	6d	118d	0	All	100	
1.2	Requirements document	14 Oct	1 Nov	22d	15d	109d	0	Mohammad Yaseen	0	
1.2.1	Non-functional requirements	14 Oct	16 Oct	6d	3d	121d	0	Lee Donovan, Mohammad Yaseen	100	
1.2.2	Functional requirements	14 Oct	21 Oct	6d	6d	118d	0	Ram Attra	100	
1.2.3	Requirements first draft	21 Oct	1 Nov	10d	10d	109d	0	Mohammad Yaseen	100	
1.3	Risk analysis document	14 Oct	1 Nov	15d	15d	109d	0	Vincent Chung	0	
1.3.1	Risk analysis first draft	14 Oct	1 Nov	15d	15d	109d	0	Vincent Chung	100	
1.4	Project planning document	21 Oct	1 Nov	11d	10d	109d	0	Lee Donovan	0	
1.4.1	Decide of software to use	21 Oct	28 Oct	6d	6d	113d	0	Lee Donovan	100	
1.4.2	Project planning first draft	28 Oct	1 Nov	5d	5d	109d	0	Lee Donovan	100	
1.5	Project costing document	21 Oct	1 Nov	16d	10d	109d	0	Ram Attra	0	
1.5.1	Budget breakdown	21 Oct	28 Oct	6d	6d	113d	0	Eoghan Gibson	47	
1.5.2	Project costing first draft	21 Oct	1 Nov	10d	10d	109d	0	Ram Attra	100	
1.6	Usability evaluation document	21 Oct	1 Nov	22d	10d	109d	0	Troy Greenaway	0	
1.6.1	Usability evaluation	21 Oct	28 Oct	6d	6d	113d	0	Troy Greenaway	0	
1.6.2	Usability test plan	21 Oct	28 Oct	6d	6d	113d	0	Troy Greenaway	0	
1.6.3	Usability evaluation first draft	21 Oct	1 Nov	10d	10d	109d	0	Troy Greenaway	0	
1.7	Clean up all the documents	4 Nov	27 Nov	21d	18d	91d	0	All	0	
1.7.1	Present drafts to manager	4 Nov	4 Nov	1d	1d	108d	0	All	100	
1.7.2	Second drafts	4 Nov	18 Nov	11d	11d	98d	0	All	100	
1.7.3	Present second drafts to manager	18 Nov	18 Nov	1d	1d	98d	0	All	100	
1.7.4	Polish all documents	18 Nov	27 Nov	8d	8d	91d	0	All	56	
1.8	Submit part 1	28 Nov	28 Nov	1d	1d	90d	0	Mohammad Yaseen	0	
2	Stage 2	29 Nov	6 Feb	86d	50d	40d	0	All	0	
2.1	Learn frameworks	29 Nov	10 Jan	31d	31d	59d	0	All	0	
2.2	Sprint 1	13 Jan	24 Jan	30d	10d	49d	0	All	0	
2.2.1	Database set up	13 Jan	24 Jan	10d	10d	49d	0	Lee Donovan	0	
2.2.2	Basic UI completed	13 Jan	24 Jan	10d	10d	49d	0	Vincent Chung	0	
2.2.3	Server set up	13 Jan	24 Jan	10d	10d	49d	0	Lee Donovan	0	
2.3	Sprint 2	27 Jan	5 Feb	24d	8d	41d	0	All	0	
2.3.1	Connect front and back end	27 Jan	5 Feb	8d	8d	41d	0	Mohammad Yaseen	0	
2.3.2	Create house simulation	27 Jan	5 Feb	8d	8d	41d	0	Ram Attra	0	
2.3.3	Usability testing	27 Jan	5 Feb	8d	8d	41d	0	Eoghan Gibson	0	
2.4	Submit stage 2	6 Feb	6 Feb	1d	1d	40d	0	Mohammad Yaseen	0	
3	Stage 3	10 Feb	2 Apr	86d	39d		0	All	0	
3.1	Sprint 3	10 Feb	21 Feb	20d	10d	29d	0	All	0	
3.1.1	Integrate tableau	10 Feb	21 Feb	10d	10d	29d	0	Ram Attra	0	

3.1.2	Mobile version testing	10 Feb	21 Feb	10d	10d	29d	0	Mohammad Yaseen	0
3.2	Sprint 4	24 Feb	6 Mar	20d	10d	19d	0	All	0
3.2.1	Stress testing	24 Feb	6 Mar	10d	10d	19d	0	Mohammad Yaseen	0
3.2.2	Finalize UI	24 Feb	6 Mar	10d	10d	19d	0	Vincent Chung	0
3.3	Sprint 5	9 Mar	20 Mar	28d	10d	9d	0	All	0
3.3.1	Finalize server functionality	9 Mar	20 Mar	10d	10d	9d	0	Lee Donovan	0
3.3.2	Prepare for expo	9 Mar	18 Mar	8d	8d	11d	0	All	0
3.3.3	Final usability testing	9 Mar	20 Mar	10d	10d	9d	0	Eoghan Gibson	0
3.4	Expo	19 Mar	19 Mar	1d	1d	10d	0	All	0
3.5	Sprint 6	23 Mar	1 Apr	16d	8d	1d	0	All	0
3.5.1	Final testing	23 Mar	1 Apr	8d	8d	1d	0	All	0
3.5.2	Polish	23 Mar	1 Apr	8d	8d	1d	0	All	0
3.6	Submit part 3	2 Apr	2 Apr	1d	1d		0	Mohammad Yaseen	0

References

1. <https://facebook.github.io/react-native/>
2. <https://nodejs.org/en/>
3. <https://www.tableau.com/>
4. <https://github.com/yaseenjamal/hometrics>
5. <http://expressjs.com/>
6. <https://www.adobe.com/products/xd.html>



Risk Analysis

Author
Vincent Chung

Last Updated
20th November 2019

Introduction

Purpose

The purpose of this document is to allow Hometrics to identify, analyse and manage risks that arise during the project. All potential risks that may or will occur are recorded in this document; which will evolve iteratively as the project progresses and the team deals with existing risks or encounters unpredictable risks.

Risks are an inevitability in any project life cycle and will affect the project, product and/or organisation. With an effective plan of risk management; the probability of risks occurring, or the impact it has on the project once it occurs can be minimised.

Risks will be identified and listed hierarchically based on both their likelihood of occurring and the potential impact they may have. Each risk will be assigned a management strategy which will either prevent it, attempt to prevent it, soften the impact or a contingency plan in place to deal with the aftermath.

Hometrics will tackle the project with a risk-driven approach, thus this document will be referenced for every action to best decide the optimal approach to a task.

Overall, this will increase the effectiveness of the team's workflow from start to finish and will increase the efficiency in the following areas; project schedule, quality of deliverables, cost, and the amount of staff resources required.

Risk Management Approach

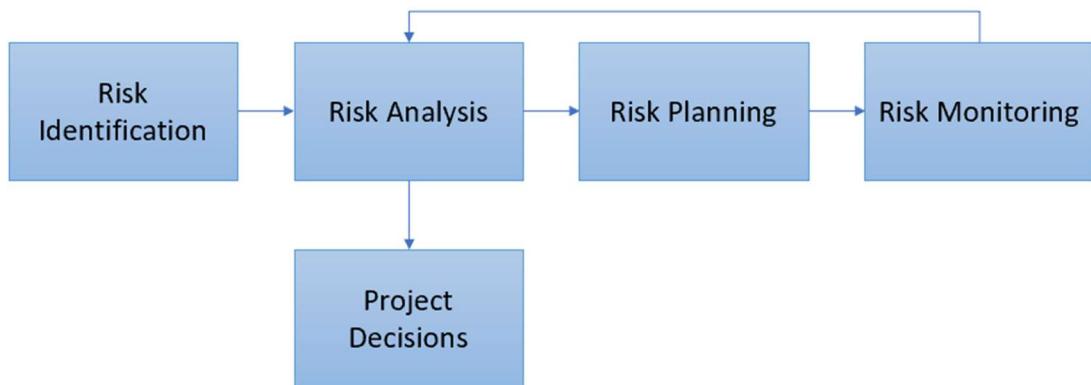
Risks can be approached reactively or proactively. Much of our risk management will be the latter – proactively, although there will be some reactive strategies for any unpredictable risks that arise. Through the proactive approach; the team can confidently advance through the stages of the project knowing which risks will occur, when they occur, why they have occurred, and how to combat them when they do.

All risk management strategies are monitored throughout the entirety of the project to ensure it doesn't affect the project any more than expected. Should this happen; that risk is once again analysed, another plan is created, documented, implemented and once again monitored.

Due to the risk-driven approach that Hometrics have adopted – project decisions are tied in with the risk management cycle.

Hometrics has appointed one of their members Vincent Chung to be the lead of risk management, thus all basic risks are initially identified by this member.

Risk Management Process



The risk management process is a constant iterating cycle of identifying a risk and forming plans to deal with that one risk before moving on and identifying the next. Once it has been analysed – the team will use that analysis as a basis to plan the next step depending on which action carries the least amount of overall risk versus reward.

Risk Identification

This is the initial stage of the process where risks are identified. All newly identified risks are placed on the agenda for team meetings and discussed to gauge whether they need to be added to the risk list or can simply be ignored. Any member of the team can suggest a risk for discussion, although they are discussed – the risk management lead will have the final verdict after considering other members' thoughts during the discussion.

Categories of Identified Risk

- i. Project Risks – Affect the schedule or the resources of the project. These risks will likely delay the completion of tasks or deliverables or require that more resources be assigned to the task to prevent the delay.
- ii. Product – Affect the quality and performance of the system that is being developed. These risks affect components of the system, which can lower the quality of individual sprints. Must be dealt with to prevent the impact of the risk leaking into the final product.
- iii. Business – Affect the team developing the system, the company the team belongs to, and the customer.

Types of Identified Risk

- i. Technology – associated with the various technology used in the project. Including both hardware and software.
- ii. People – associated with the staff involved in the creation and development of the project.
- iii. Organisation – risks arising from the organisation that is responsible for the project or the client organisation. These may indirectly affect the project itself.

- iv. Tools – associated with the tooling used in the project.
- v. Requirements – associated with the system requirements of the project.
- vi. Estimation – associated with the estimation of anything involved in the project.

Risk Analysis

After risks are added to the risk list, they are analysed in terms of their probability to occur and impact they would have on the project should they occur. These factors are recorded in the following manner;

Probability:

- Very low
- Low
- Moderate
- High
- Very High

Impact:

- Insignificant
- Tolerable
- Serious
- Catastrophic

Risks that are high in probability and serious in impact are investigated and strategies are formed to deal with them first. Risks that are low in probability and insignificant in impact are ignored unless either of the factors change, then it will be reanalysed.

Risk Planning and Management

Each risk is considered individually, and a strategy is devised to tackle each one. The type of strategy used depends on the nature and factors of the risk. We use three types of strategies; avoidance, minimisation and contingency.

Avoidance reduces the probability that the risk will occur. If the risk does still occur, then it will be analysed again, and a new strategy is devised to deal with it.

Minimisation reduces the impact to the project or product the risk has if it occurs. Reducing the impact makes the risk a tolerable one.

Contingency plans are formed to deal with a risk when it occurs. This helps maintain a smooth workflow even when errors occur, as there is already a plan of action in place which can be quickly implemented.

Risk Monitoring

Risks are monitored to detect changes in their probability or impact to the project. As the project progresses; risks may change, the project may change, external factors may change – this all affects the existing risks and strategies. When a

change to a risk is found, it is then discussed at a group meeting to determine whether it has become probable, whether the effects have changed, and whether a new strategy is required.

Project Decisions

Every action comes with a risk to the project or product; the aim of the risk-driven project decision approach is to evaluate the risks that come along with each action against other similar actions to determine the action of least risk. This ensures the project will progress more smoothly as less things are likely to go wrong.

Risk Identification and Analysis

Risk	Description	Probability	Category	Type	Impact
R1	Team member leaves the project (critical information may be lost)	Very low	Project	People	Tolerable
R2	Roles within the group change, possibly managerial roles	Low	Business	People	Insignificant
R3	Internet issues within the workplace	Moderate	Project	Technology	Serious
R4	Team members missing vital meetings - new work is discussed or assigned. New sprint is agreed etc. (possibly ill)	Moderate	Project	People	Serious
R5	Customers not satisfied with sprint results	Moderate	Business	Organisational	Serious
R6	Work stored is lost	Very low	Project	Technology	Catastrophic
R7	Requirements change	High	Product	Requirements	Serious
R8	Frameworks do not fit the project as well as planned	Low	Product	Technology	Serious
R9	Team members not completing their assigned work on time to be reviewed	Moderate	Project	People/Estimation	Tolerable - serious

R10	Team members submitting work at an unacceptable standard	Very Low	Project	People	Serious
R11	Changes to scheduling, system must be delivered sooner	Low	Project	Requirements	Serious
R12	Contradicting requirements from the customer	Moderate	Product	Requirements	Serious
R13	Team members not sticking to the agreed schedule	Moderate	Project	People	Serious
R14	Team members not sticking to the agreed naming standards	Moderate	Product	People	Serious
R15	Team members not sticking to the agreed design patterns	Very low	Product	People	Serious
R16	Time wasted on unnecessary features of the system - might fall behind on the required functions of the system as a result	Low	Project	People	Serious
R17	Legislative changes relevant to the system	Very low	Project	Requirements	Tolerable
R18	Time it takes to complete sprint is underestimated - fall behind schedule	Low	Project	Estimation	Serious
R19	Excessive budget	Low	Project	Estimation	Tolerable
R20	Hardware failing	Low	Project	Technology	Serious
R21	Team member may be unfamiliar with software - time to learn	High	Project	People	Tolerable

R22	Unable to contact a team member	Moderate	Project	People	Serious
R23	Design does not meet the customers' expectations and visions	Low	Product/Project	Requirements	Serious - catastrophic
R24	OneDrive is down	Very low	Project	Technology	Tolerable - serious
R25	Team members not getting along	Very low	Project/Business	People	Serious
R26	Issues integrating and combining member's individual documentation work	High	Project	People	Serious

Risk Planning

Risk	Type of Strategy	Strategy
R1	Minimisation	Make sure all critical information is shared among the team so that in the event of a member leaving the team - vital knowledge is not lost or kept to a minimum.
R3	Contingency	Store work on devices while in the workplace and upload to OneDrive/GitHub immediately when the internet is back up there or member is home.
R4	Contingency	Always upload the minutes of meetings with detailed descriptions of the key information discussed, and new plans moving ahead. Get in touch with the member and update them on any new vital information as soon as possible.
R5	Avoidance	Always be specific when asking the customer questions regarding the requirements of each deadline so that as much detail is gathered to reduce the chance of this occurring.
R6	Contingency	Save all work on more than one source - if work is lost from one then it can be retrieved from another.
R7	Minimisation	Complete work as soon as possible before deadlines so that there is an excess period of time we can utilise to manage the highly probable change.
R8	Avoidance	Carefully consider the framework prior to the design and development stages.
R9	Avoidance	If the same team member repeatedly does not submit their work on time; they will be given a shorter deadline to hand it in, if it is still not in then it will be reassigned to another member. This will lead to less vital tasks assigned to that member. This is made clear to all members, thus will reduce the chance of the risk occurring.

R10	Avoidance	Assigned work will be monitored frequently by pair partners and managers. Anything unacceptable will be flagged up for change. All members may request changes on work stored on the shared drives.
R11	Minimisation	We will work with cushioned deadlines - finishing before the deadline to allow for changes to be made if required. This way the deadlines will still be met.
R12	Contingency	Communicate with the customer that there is a clash in requirements and that the customer must make a compromise to allow for them to function.
R13	Minimisation	Tasks are done in pairs; this reduces the chance that absolutely nothing gets done for the deadline.
R14	Avoidance	Naming standards are made clear and are clearly displayed on the shared drives for all members to see. If a member was not present at a meeting where it was decided then the liaison will get in contact to provide important updates.
R15	Avoidance	Design patterns are made clear and are clearly display on the shared drives for all members to see. If a member was not present at a meeting where it was decided then the liaison will get in contact to provide important updates.
R16	Avoidance	Additional unnecessary features will not be worked on until the specified requirements are already in place and the system is functional enough for the deadline. Before new experimental features are being worked on; members will save backup copies.
R17	Contingency	Nothing can be done to prevent this if it happens but, should it occur, the team will simply change the system to abide by the new laws in place.
R18	Minimisation	Completion dates of sprints will be weeks before the actual deadlines to allow for the team additional time if it is required.
R19	Minimisation	Budget will always be considered, but as it is tolerable, we need not be overly strict.
R20	Minimisation	Work will be regularly stored onto shared cloud drives to minimise the impact of this risk should it occur. We will have spare machines so that members will always have access to one.
R21	Minimisation	Time will be assigned to the learning of new frameworks and will be accounted for in the schedule. Paired programming can be adopted to increase the rate at which members can learn.
R22	Minimisation	Make sure that all necessary tasks and work are uploaded onto cloud drives for all members to access; if we are unable to contact a member, at least their work will still be accessible to the rest of the team.
R23	Avoidance	Regularly contact the customer with updates on sprint results and minor changes. If the customer is unhappy with any of it, then changes can be made to satisfy the customer immediately. As there is a cushioned deadline, this will allow time for correction.

R24	Minimisation	All data on the OneDrive will also reside within team member's physical drives. Alternatively, two shared drives could be utilised instead of one.
R25	Avoidance	All members of the team will be expected to act professionally regarding the project in or out of the workplace. Any conflicts will be resolved as soon as possible to prevent it spiralling out of control.
R26	Avoidance	The tasks assigned to each member will be very specific in what is required of them. If there is trouble integrating the work then likely one of the tasks were subpar and will need to be redone to better fit with the other.

Risk Monitoring

Risk	Indicator
R1	Team members and managers should look out for poor morale or poor relationships amongst the team; if one member is consistently part of both issues then the manager should have a talk with that member to discuss if there are any personal issues etc.
R3	Slow or unresponsive internet should be brought to the team's attention so that they may perform more frequent saves of files etc.
R4	If team members are regularly missing meetings then the manager will contact the member to find out why and how to resolve it if there is an issue.
R5	We will ask the customer about their opinions on each of the results to check if they are satisfied.
R6	If OneDrive is unresponsive or laggy it will be reported to the team members so that we can make sure not all is lost.
R7	Frequently communicating with the customer will provide indications of whether they intend to change their requirements.
R8	System does not function as smoothly as anticipated at the beginning of development. If it continues then an impromptu meeting can be held to discuss the possibility of changing to another.
R9	If a member seems to be struggling with an assigned task, this could be a sign that they may not complete the work in time, or that their work will be subpar. Managers and other members will get in touch and provide assistance whenever necessary. If it happens often then the manager will need to be made aware.
R10	If submitted work is below standards it will be flagged up at a meeting and discussed. If the quality of work declines over time this could be an indicator of another issue and the manager should be contacted to discuss it with the member.
R11	Frequently communicating with the customer will provide indications of how urgent they require the system and when they need it to be complete. If the customer starts to cut out requirements this may be a sign that they require the results more urgently than they originally thought.

R12	Customer will make us aware.
R13	If members seem to be falling behind or start their work last-minute then this risks them not sticking with the agreed schedule. This will be flagged up and discussed at both regular and manager meetings. If members begin to adopt this pattern later on in the project and others notice it -they should contact the manager so that they may discuss it with that member and identify if there are any issues leading to this.
R14	Will be evident in the code stored on shared repository. Lack of communication can cause this, but this should not occur more than once - this indicates a bigger issue perhaps some members have disagreements that they have not disclosed.
R15	Will be evident in the code stored on shared repository. Will be discussed at a meeting as perhaps the newer design pattern could be better than the originally agreed design pattern - but this is dependent on whether or not there is enough time for a shift.
R16	If members begin taking too long working on functions that are not necessary for the project this indicates the possibility that they may fall behind schedule. Must be discussed at a meeting to assess whether it is worth it, perhaps other resources could be assigned to the feature if the team decides they want to implement it.
R17	Legislative documentation will change. Either the customer, manager or project manager will notify us of these changes.
R18	If one part of the sprint is taking longer than expected then a meeting may need to be held to discuss the estimation of the sprint and how to better manage it. Progress will be monitored to assess whether it is still possible to stick to the schedule with the proposed sprint design.
R19	If costs start to get too high too quick then the team may have to hold a meeting to discuss where they can cut back on costs.
R20	If some hardware begins to show signs of being faulty then it will be monitored and it won't be used for vital tasks. If it gets worse then we may have to stop using it altogether. We will contact the companies that rent us the machines notifying them of the fault and seek working replacements.
R21	The likelihood of this is fairly high but all members should look out for signs of struggling or frustration when learning the new software. If a member is struggling particularly hard then the manager or other members should step in to provide assistance.
R22	If a member starts to become difficult to contact then this should be brought up in a meeting and the manager should step in to identify if there is an issue with that member.
R23	Frequent contact with the customer will allow them to tell us if anything is not as they expected. This will be addressed immediately so should not be a reoccurring problem. If it is then it may just be lack of technical knowledge on the side of the customer - this should be discussed with them so that our design, their requirements and the product result can be clearly discussed.

R24	If OneDrive is showing signs of lag or unresponsiveness, this should be flagged with the group. If it continues then it can be discussed in a meeting to possibly change which drive is used (if one shows signs of being particularly unreliable).
R25	Any conflicts detected early on should be dealt with and monitored to make sure it doesn't bloom into a serious problem between members. Increasing instances of conflicts should be noted and assessed - do we require a change of leadership or roles? Does the work need to be assigned in a different manner? Is the current dynamic not working as well as intended? Any conflicts or problems will be dealt with within the group if possible. Where it is not, the manager will be contacted and be forced to step in.
R26	Past weeks work will be discussed during meetings and any tasks which we have trouble integrating will be identified here.

Risk Mitigation, Monitoring and Management

The process of mitigating, monitoring and managing risks places additional costs onto the project budget; this will be considered when deciding whether a risk must be dealt with, or whether additional resources should be allocated to correct the error of a risk.

Risks that have a low probability and a low impact can be ignored; despite having plans already made for them, they can generally be ignored as their likelihood of occurring is so low, and even if it does occur, the issue will likely take a few minutes to fix. The cost to consistently monitoring these risks may be higher than the cost to fix the errors that appear as a result of the risk.

Risks in green can generally be ignored, though if budget and resources can be spared, then they can be dealt with.

Yellow indicates risks that require additional resources to correct as they have a significant effect on the project.

Red risks must be planned for rigorously; in the case that they arise, the team should be able to deal with it immediately by allocating as many resources as possible to fix the error before progressing the project.

Risk Table

	Insignificant	Tolerable	Serious	Catastrophic
Very Low	0	0	1	2
Low	0	0	1	3
Moderate	0	1	3	4
High	1	2	4	4
Very High	1	2	4	4



Project Costing

Author
Ram Attra

Last Updated
18th November 2019

Introduction

Abstract

This document outlines the overall budget of the project formed from costs of development and evaluation, including any additional costs to the customer for hardware, propriety software etc. Sections of the budget will be broken down and will explain how costs were calculated.

References

1. *This document was inspired by the Project Costing example reports, provided by the project co-ordinator (Ron Petrick).*

Overview

This document is comprised of 3 sections:

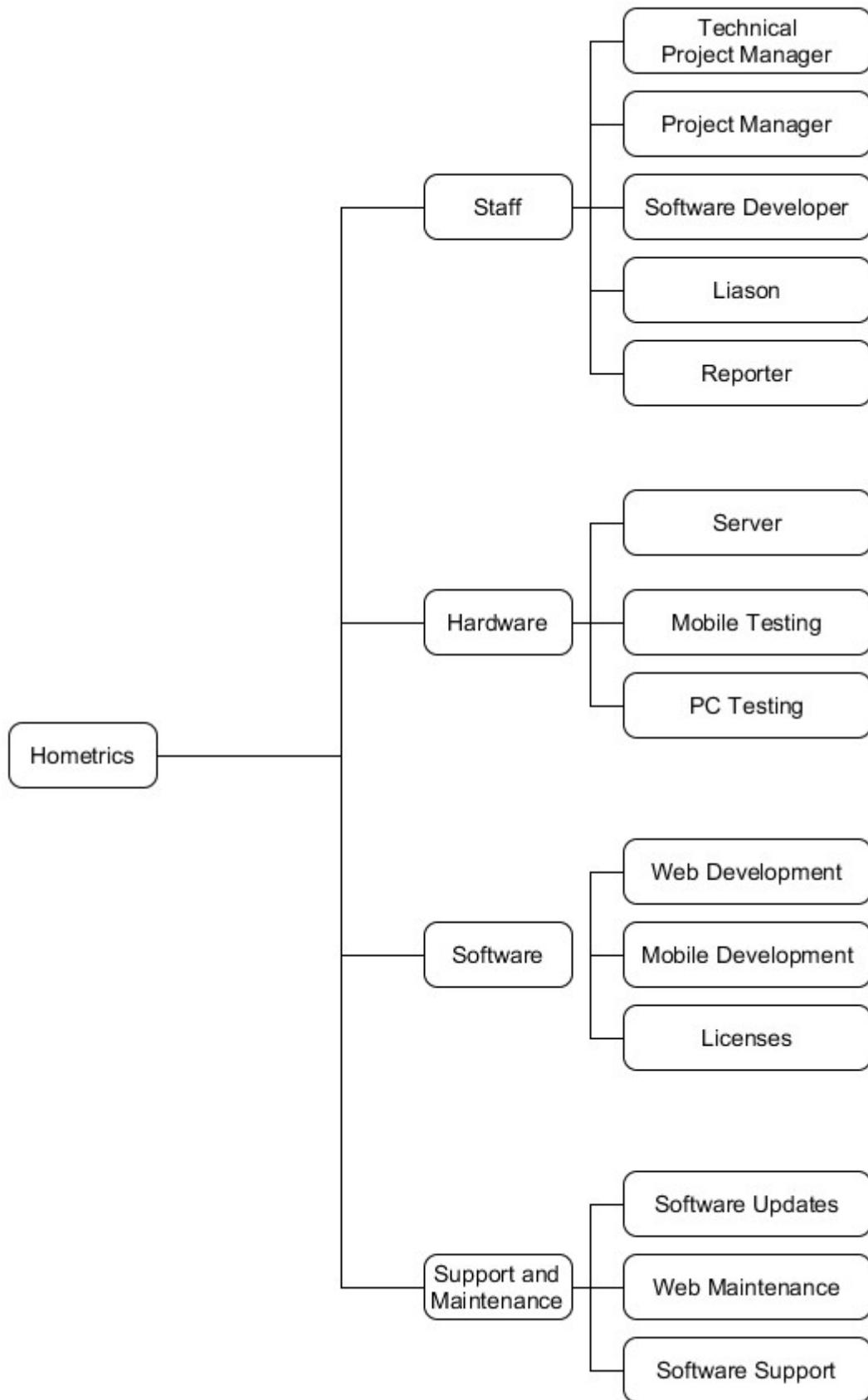
- Budget Breakdown
- Budget Analysis
- Cost Calculations

Budget Breakdown aims to break down the overall budget into separate sections that are all atomic, which should allow us to identify any costs towards the final project.

Budget Analysis aims to build on the sections we identified in Budget Breakdown, and explain what each of the individual costs provides to the project.

Cost Calculations aims to explain the thought process as to how certain costs were arrived, and the sources and values for the current market for the costs we are charging.

Budget Breakdown



Budget Analysis

Staff

- Technical Project Manager - organises and controls the development of the product.
- Project Manager - organises and controls the roles and jobs of the overall project.
- Software Developer - produces and implements a solution to a task within the project.
- Liaison - communicates key project information between all stakeholders.
- Reporter - records what is discussed and the length of group meetings.

Hardware

- Server - hosts the front/backend of the product for it to be accessed across multiple platforms.
- Mobile Testing - the devices (Smartphones) used to test the solution across any mobile device i.e. IOS and Android.
- PC Testing - the devices (PCs) used to test the solution across any computer

Software

- Web Development - the development software used to produce any web applications or websites
- Mobile Development – the development software used to create any mobile applications or websites
- Licenses – the cost of using any software to produce the product

Support and Maintenance

- Software Updates - provide bug fixes to the product post development, as well as any additions, substitution or removals made to the solution.
- Web Maintenance - ensures that the product is still being served by the server therefore making sure it is still functional.
- Software Support - assisting the client in understanding the solution when the product has been handed over i.e. through the creation of system manual or any troubleshooting of the product

Cost Calculations

Preamble

To stay as competitive as possible we have not included costs such as development machines, staff training etc as these costs are viewed as investments towards the company. As well as signifying that our company isn't prepared to undertake a project for a client.

Staff Costs

The cost per hour for the staff are derived from figures provided by Glassdoor. The total number of hours for a single member of staff is 1232 because $40(\text{hr week}) * 39(9 \text{ months}) - 328(\text{hrs of holiday}) = 1232 \text{ hrs}$.

Some members of staff such as the liaison & reporter are not full time but spend some of their time as developers, hence it has been calculated that 30% of their time (370hrs) will be in these roles and the remaining 70% (862hrs) will be as developers.

What do these cover
payroll + overheads
+ profit?

Should be in overheads.

Hardware Costs

Server

As we will be using the MACS servers as students for our project, we will not incur any charges hence will not need to relay this onto the client.

Mobile Testing & PC Testing

As mentioned, before we view the PC & mobile testing devices as investments to the company, thus do not charge the client for them.

Support & Maintenance

Software Updates

We provide a years' worth of updates for £46,816 calculated from the cost of 2 developers working for 9 months because they will not be working full time.

Software Support

This is charged as all 6 developers working a full 40hr week.

Overheads

We have set our overheads to be 30% to include any expenses indirectly involved in producing the solution for the client such as development machines, national insurance etc.

Staff Costs

Staff Role	Cost Per Hour	Hours	Quantity	Total
Technical Project Manager	£28	1232	1	£34,496
Project Manager	£26	370	1	£9,620
Software Developer	£19	1232	2	£46,816
		862	3	£49,134
Liaison	£17	370	1	£6,290
Reporter	£15	370	1	£5,550
Staff Sub Total				£151,906

Seems a bit low.

Hardware Costs

Hardware	Cost	Quantity	Total
Server	£0	1	£0
Mobile Testing	£0	1	£0
PC Testing	£0	1	£0
Hardware Sub Total			£0

Software Costs

Software	Cost
Web Development	£0
Mobile Development	£0
Licenses	£0
Software Sub Total	£0

Support and Maintenance Costs

Service	Cost
Software Updates	£46,816
Web Maintenance	£0
Software Support	£,4560
Support & Maintenance Sub Total	£51,376

Summary

Summary	Cost
Staff	£151,906
Hardware	£0
Software	£0
Support & Maintenance	£51,376
Total	£203,282
Total including overheads	£264,266.6

Appendix

Technical Manager

https://www.glassdoor.co.uk/Salaries/lead-programmer-salary-SRCH_K00,15.htm

Project Manager

https://www.glassdoor.co.uk/Salaries/it-project-manager-salary-SRCH_K00,18.htm

Software Developer

https://www.glassdoor.co.uk/Salaries/software-developer-salary-SRCH_K00,18.htm

Liaison

https://www.glassdoor.co.uk/Salaries/liaison-salary-SRCH_K00,7.htm

Reporter

https://www.glassdoor.co.uk/Salaries/reporter-salary-SRCH_K00,8.htm