Group Report - The Oddjobs

Contents List

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1.1 - Mission Statement - Health Sensor

Our first application is a small subdermal health sensor unit designed to relay information about a user to an app, which compiles sensor readings into an easy to read format. Importantly, the user would only need one unit to monitor many different aspects of their health, or to allow others to monitor their health for them.

The following sensor functions will be included in the sensor unit:

- **Heart Rate** (sensing for abnormal heart rhythm).
- **Blood Pressure** (monitoring over time can help doctors diagnose issues).
- **Blood O_2/CO_2 Level** (monitoring treatment effectiveness of certain diseases).
- **Water/Urea Concentration in Blood** (monitoring intake of water and kidney effectiveness).
- **Insulin Levels** (automated checking for diabetic persons or ongoing monitoring to catch early signs of insulin resistance in non-diabetics).
- **Amino Acid Detection** (showing muscle breakdown caused by starvation).
- **T3/T4 Levels** (monitoring effectiveness of the Thyroid).
- **Prothrombin Levels** (monitoring blood thickness).
- **Body Temperature** (allowing the system to warn the user before the body slows down to dangerous levels).
- **Usual Movement** (monitoring activity or exercise levels).
- **Sudden and Unusual Movement** (which can indicate a fall or seizure).

In order to monitor these health aspects, the device we are developing would be a small unit inserted into the arm of the user, where the sensor's microscopic probes will insert into the Axillary Artery, allowing easy access to precisely read the user's health values while minimising discomfort. The device uses so little power that it can be powered from the glucose in the user's blood. The values read from the sensors are then sent wirelessly to, and securely stored on, our servers, which our bespoke app can then read and interpret.

The smartphone app we are developing alongside the above device will make it easy for both the user and healthcare professionals to understand the data coming from the sensors and how it changes over time. The app will allow the user to view only what they want depending on their age, health and activity level. It also has the ability to contact family automatically if the user has a fall, and contact emergency services when the user's life is in danger, providing location using AML.

In short our aim for this product is:

> ***"Give our customers the freedom to live without regular medical checkups and security in knowing that if something goes wrong, they will be safe."***

1.2 - Mission Statement - Automated Lawnmower

Our second application is a small lawnmower which can automatically plot the size and shape of a lawn, determine the best time to cut based on user input and requirements, and run autonomously using RTLS technologies.

The physical device will consist of two main parts, the lawnmower unit itself and a base station for charging, communication and minor maintenance tasks. These units will also utilise a bespoke smartphone app.

For the lawnmower unit to work autonomously it will be equipped with the following features:

- **Detection of immovable obstacles** in the garden and the ability to manoeuvre around them.
- **Detection of movable objects** such as balls or small toys and the ability to move them out of the path of the lawnmower.
- **Edge detection** for the lawn, fences, walls and buildings in order to map the shape of the lawn into memory.
- Using the data gathered from mapping the garden to work out the **best route** around the garden.
- The ability to **navigate back to the base station** when the lawnmower requires maintenance or is low on power.

In addition, the base station will be able to swap blades and strimmer line in and out of the lawnmower unit when docked, as well as keep track of how much of each is left in the storage of the basestation. This then allows the base station to notify the user via the app of which components require restocking, and allow the user to order the replacement items straight from us.

The app would also allow the user to specify which times are good for cutting, then pair this with data from weather forecasters to ensure it doesn't cut when wet. In addition to this, the app would notify the user some time before activation via push notifications to avoid the machine activating when the toddler is in the garden.

By cutting the lawn weekly during growing periods, the machine can keep the grass short enough that it does not need to collect the trimmings, allowing the trimmings to mulch the lawn and improve its quality, all without human intervention.

In short our aim for this product is:

> ***"Give our customers the ability to automate a mundane task to its furthest extent, while delivering a solution that remains safe to use around pets and children."***

2.1 - Persona - Mr John Doe

John Doe

Demographics

Age:	43
Location:	Smallton, southwest of Norwich
Education:	Business Management
Occupation:	Middle Manager at BigCo
Family:	Wife, baby son, two step-children

“I love my job, but it’s impacting my home life in a way I can’t manage.”

Goals

- To satisfy upper management at BigCo and earn promotion
- To produce high quality work
- To achieve a healthier work/life balance

Frustrations

- Workload is too heavy
- No time to interact with kids
- Mother-in-law requires constant care

Bio

John Doe is a hardworking father, husband and employee of BigCo. He is extroverted, friendly, and a capable leader. His track record of management is exemplary, but the amount of work he is taking on is becoming overwhelming. His workload is creeping into his home life in a way that makes him uncomfortable, and leaves him with less time to spend with his wife and children. On top of that, his mother-in-law requires constant care, leaving him with less time with his wife. He wants to regain control of his time and achieve a healthier work/life balance.

2.2 - Persona - Mrs Jane Doe

Jane Doe

Demographics

Age:	39
Location:	Smallton, southwest of Norwich
Education:	Education
Occupation:	Full time school teacher
Family:	Husband, baby daughter, two children from previous marriage

“I’m worried about my mother, but I wish I could spend more quality time with my husband and children.”

Goals

- To spend more time with family
- To manage the household more efficiently
- To monitor her mother’s wellbeing

Frustrations

- Too many chores to do at home
- Husband is always busy with work
- Mother lives too far away and is difficult to stay in contact with

Bio

Jane Doe is a loving wife and mother who is trying to focus on her family. She works full time as a teacher at a local primary school and is good at keeping her work and home life separate. She struggles with staying on top of maintaining the home and garden, while finding time to spend with her husband and children, especially when her husband is preoccupied with work. She is also concerned about her mother’s declining health, and the distance makes it difficult for her to stay in regular contact. She wants to make the best use of her time so that she can devote more of it to her family.

2.3 - Persona - Andrew Doe

Andrew Doe

Demographics

Age:	15
Location:	Smallton, southwest of Norwich
Education:	High School
Occupation:	None
Family:	Step-father, mother, sister, step-brother

“My mum and dad are always busy, they have no time for me.”

Goals

- To achieve satisfactory grades in high school
- To excel at gaming
- To avoid trouble with the rest of the family

Frustrations

- Heavy load of homework
- Parents are always busy
- Dislikes being dragged out to see his grandmother

Bio

Andrew Doe is a typical teenage boy who is struggling with social interactions both in and out of school. He loves to spend time gaming, often to the detriment of his grades. He feels distant from his sister and his parents, who are often too busy to pay attention to him. He cares about his grandmother but resents being taken to see her so often by his mother. He wishes he could optimise his homework flow so that he could maximise his gaming time. He also wishes that his relatives had more time to listen to his concerns.

2.4 - Persona - Beth Doe

Beth Doe

Demographics

Age:	17
Location:	Smallton, southwest of Norwich
Education:	College
Occupation:	Retail assistant (weekends)
Family:	Step-father, mother, brother, step-brother

"I enjoy college, and my weekend job provides me with enough spending money, but I wish I could spend more time out with my friends."

Goals

- To excel in college
- To remain in contact with her social circle
- To look after her pets at home

Frustrations

- She is solely responsible for looking after the family pets
- College work can be difficult to manage
- Responsibilities and weekend work are cutting into her socialising time

Bio

Beth Doe is half-way through her sixth-form course in English Literature. She enjoys college, but the time she devotes to it, coupled with her weekend job and her responsibilities at home, mean that she is struggling to stay in contact with her circle of friends. She would appreciate seeing more of her father, although she is more independent than her siblings, and plans to move away to university next year. She loves her pets, but wishes she could share the responsibility of looking after them with the rest of the family.

2.5 - Persona - Charlie Doe

Charlie Doe

Demographics

Age:	3
Location:	Smallton, southwest of Norwich
Education:	None
Occupation:	None
Family:	Father, mother, step-brother, step-sister

“I love getting into things!”

Goals

- To excel at walking
- To explore the house (safely)
- To enjoy his time at the creche

Frustrations

- Parents are often too busy to pay attention to him
- Certain areas of the house have been ‘baby proofed’ and are off limits
- Other kids at the creche are not always friendly

Bio

Charlie Doe is a curious, energetic toddler whose drive to explore is exhausting his mother. While at home, he is always looking for nooks and crannies to squeeze into and loves playing in the garden. He enjoys attending the creche on weekdays but wishes that his parents had more time to spend with him. He doesn’t like being taken to see his grandmother, and often complains of his boredom.

2.6 - Persona - Alexandra Abbott

Alexandra Abbott

Demographics

Age:	76
Location:	Otherton, southeast of Norwich
Education:	Business Reception
Occupation:	None (retired)
Family:	Daughter, son, son-in-law, three grandchildren

“I love to stay in contact with my daughter and her family, but I feel guilty that my health is taking up so much of their time.”

Goals

- To retain as much independence as possible
- To keep track of her own health, and ensure her doctors are kept up-to-date
- To take charge of monitoring her health

Frustrations

- Her health requires the constant attention of her daughter
- It is more difficult for her to get around without risk of a fall
- She relies on her carers to monitor her wellbeing

Bio

Alexandra Abbott is a retiree who lives in a sleepy little village not far from Norwich. She is heavily involved in the local community--church, bingo, bowls club etc--and is reticent to leave. Her remote location and ailing health require both carers and her daughter to visit her often. She feels guilty about the burden she is placing on her daughter and wishes she could manage her health problems more independently. Alexandra has suffered from heart problems for the last few years and is currently taking Warfarin to prevent blood clots.

3.1 - Prioritised Requirements List - Health Sensor

Must Have

Ability for the device to be implanted safely into the body.
Sensor to monitor Heart Rate and Blood Pressure.
Ability to monitor blood thickness.
Constant monitoring of potential falls.
Secure app login system.
Ability for the app to be paired with multiple smart devices.
Simple app interface with large icons and information at-a-glance.

Should Have

Sensor to monitor blood O_2/CO_2 level.
Monitoring of water concentration in blood.
Thyroid monitoring.
Body temperature monitoring.
App options for the colour-blind.
Ability for health professionals to access data (with user consent).
The ability for the system to handle loss of connection between sensor and server.
Automated contact of Emergency Services when user is in danger (eg. loss of pulse).
Toggle for automatic Emergency Services contact.

Could Have

Monitoring of insulin levels.
Sensor to monitor activity or exercise levels.
Amino Acid detection system.
App storage of emergency contact details.
Ability to automatically contact emergency contact with minor issues (eg. a fall).

Won't Have

Installable by people not medically trained.
Ability to monitor drug intake.
Ability to turn off the sensor unit.
Facility to connect the device directly to the app bypassing our servers.
Connection the user's nervous system.
Monitoring of lymphatic system.
Ability for unauthorised persons to access user data.
Separate system at launch for physician monitoring and backup.

3.2 - Prioritised Requirements List - Automated Lawnmower

Must Have

Detection of the edge of the lawn, as well as obstacles within the lawn area.
Ability to map the garden into memory via sensors.
Ability for the map to be used to guide the lawnmower on a basic level.
Charging function for base-station to charge lawnmower without intervention.
Capability for the user to swap out replaceable parts (such as blades).
Ability for unit to be paired with app.
Settings on app to control when the lawnmower can activate.

Should Have

Strimmer attachment to deal with lawn borders.
Detection of smaller objects, in order to push them along or move around them.
Ability for base-station to count the number of blades remaining in storage.
Automated replacement of cutting blades / strimmer cable.
Ability for user to order new replaceable parts via app.
Connection to weather forecast to ensure activation only in dry conditions.

Could Have

Ability to safely move small objects out of the path of the lawnmower.
Ability of the basestation to clean the lawnmower unit.
Use of garden mapping to work out the most efficient route to cut the lawn.
Option for app to automatically order new replacement parts.
Push notifications from app detailing when the lawnmower will activate.

Won’t Have

Ability to change the cutting height.
System to collect grass trimmings.
Facility to pull up weeds from garden.
Means for the base-station to relocate to the lawnmower.
Diagnosis of complex issues (such as motor problems).

4.1 - Use Case List - Health Sensor

Actors

- **Accessor** - A person or entity that has access to data produced by the device.
- **Monitor** - An *Accessor* (*User* and/or designated person) who uses the app.
- **Physician** - An *Accessor* (Healthcare Professional) that can install the *Health Sensor Unit* and back up the *User's* medical data.

Use Case Index

In this case, priority 1 is high, 3 is low.

ID	Name	Primary	Complexity	Prio.
1	Implant *Health Sensor Unit* safely into the body.	Physician	High	1
2	Monitor heart rate and Blood Pressure.	Monitor	Medium	1
3	Monitor blood thickness.	Monitor	Medium	1
4	Monitor potential falls.	Monitor	Medium	1
5	Log in to app.	Accessor	Low	1
6	Pair *Health Sensor Unit* to Primary app.	Physician	High	1
7	Pair *Health Sensor Unit* to additional apps.	Monitor	High	1
8	Bring up basic info at-a-glance.	Monitor	Low	1
9	Monitor blood O_2/CO_2 level.	Monitor	Medium	2
10	Monitor water concentration in blood.	Monitor	Medium	2
11	Monitor condition of Thyroid.	Monitor	Medium	2
12	Body temperature monitoring.	Monitor	Medium	2
13	Access colour-blind settings.	Accessor	Low	2
14	Download or back-up data.	Physician	High	2
15	Toggle emergency services contact	Monitor	Low	2
16	Monitoring of insulin levels.	Monitor	Medium	3
17	Monitor activity or exercise levels.	Monitor	Medium	3
18	Monitor amino acid levels.	Monitor	Medium	3
19	Adjust emergency contact details.	Monitor	High	3

4.2 - Use Case List - Automated Lawnmower

Actors

- **User** - Designated person who has control over the App.

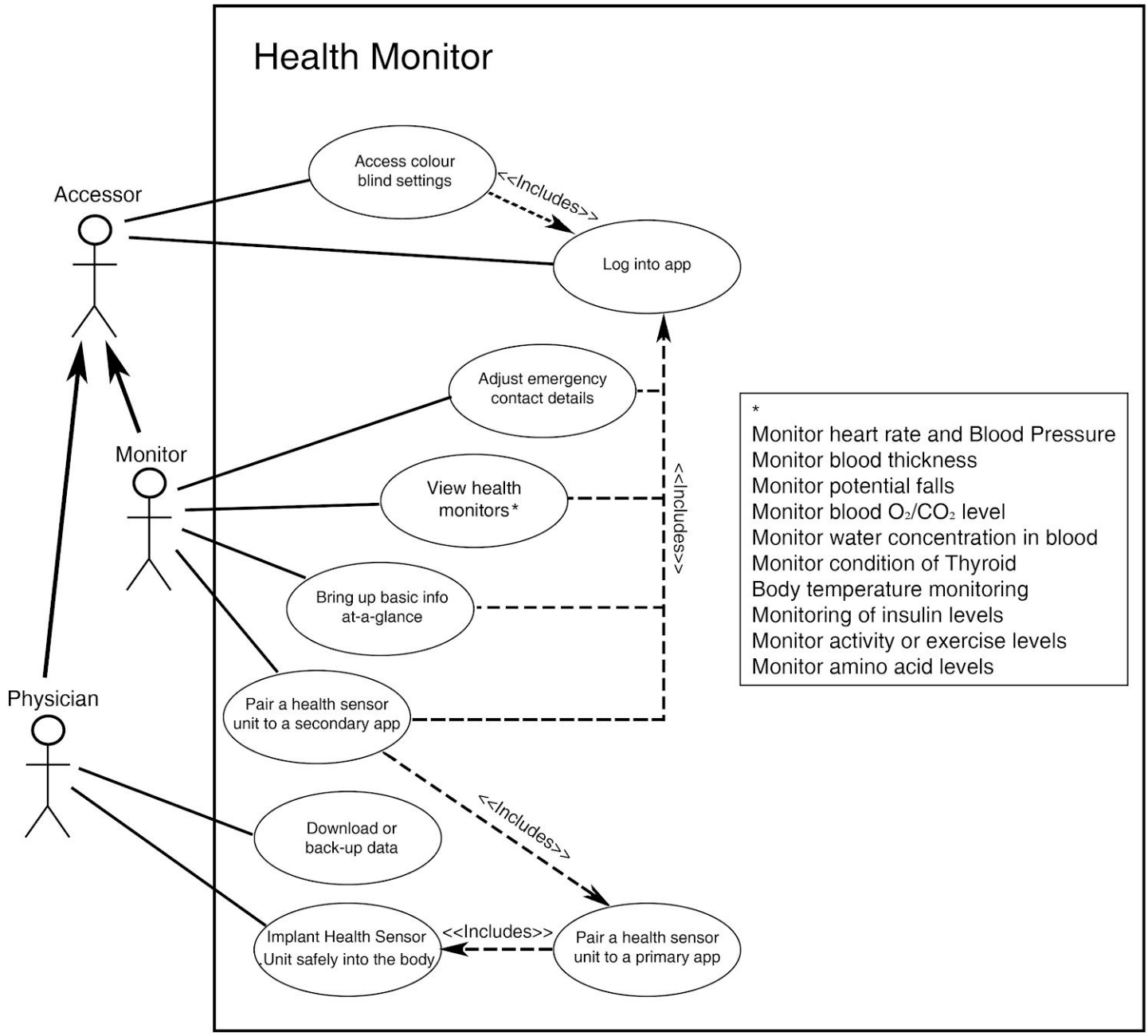
Use Case Index

In this case, priority 1 is high, 3 is low.

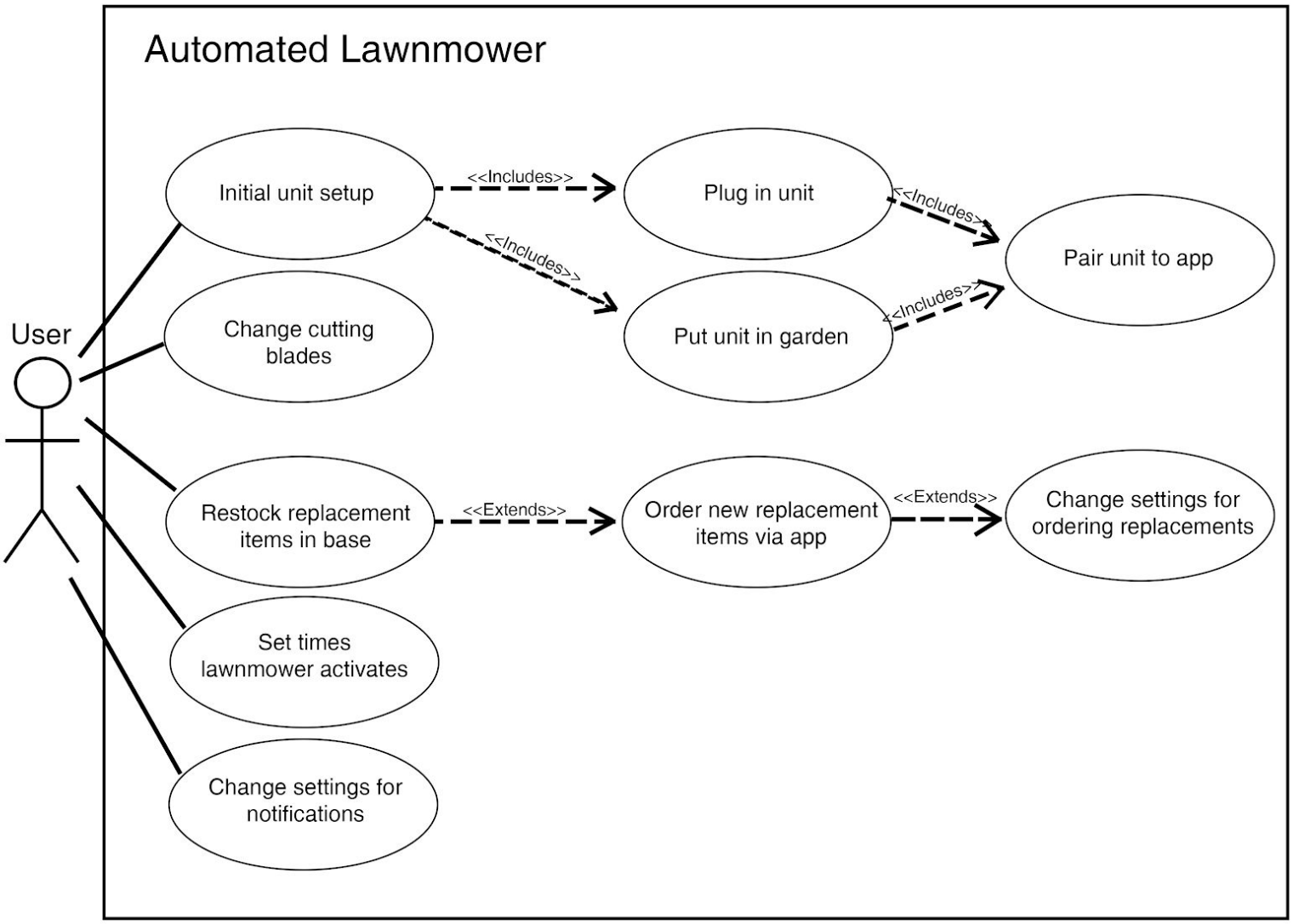
ID	Name	Primary	Complexity	Prio.
1	Initial unit setup.	User	Medium	1
2	Change out cutting blades.	User	Hard	1
3	Pair *Lawnmower System* to app.	User	Medium	1
4	Set times and days that the lawnmower activates.	User	Medium	1
5	Order new replacement items via app.	User	Easy	2
6	Restock replacement items in base station.	User	Easy	2
7	Change setting that orders new replacement parts.	User	Easy	3
8	Change setting that allows push notifications	User	Easy	3

Since many of the features of this device are automated within the lawnmower or base station itself, there is little need for input from outside the system. This was a conscious decision by the design team in order to allow us to fulfill the product aim as listed in our Mission Statement.

5.1 - Use Case Diagram - Health Sensor



5.2 - Use Case Diagram - Automated Lawnmower



6 - Textual Use-Case Description

Name: Pair a health sensor to a secondary app

Version: 1.0

Goal: Allow a secondary monitor to access data from the sensor.

Summary: Primary monitor relays sensor key to secondary monitor, secondary monitor navigates to pair screen and enters key, primary monitor is notified that another device is attempting to connect, primary monitor allows connection.

Actors: Primary monitor, secondary monitor

Stakeholders: Monitor, physician

Preconditions: Sensor successfully implanted, sensor successfully paired with primary app, network access, primary monitor has logged in, secondary monitor has logged in.

Triggers: Secondary monitor wishes to access sensor data.

Happy path:
- Primary monitor retrieves sensor key from provided product information
- Primary monitor relays sensor key correctly to secondary monitor
- Secondary monitor accesses settings menu
- Secondary monitor accesses pair screen
- Secondary monitor enters key correctly
- Secondary monitor's device successfully connects to sensor
- Primary monitor is notified that a new device is attempting to pair
- Primary monitor allows connection
- Secondary monitor's device is successfully paired with sensor.
- Successful pairing logged

Unhappy path:
- Sensor key provided with product is incorrect
- Primary monitor relays sensor key correctly to secondary monitor
- Secondary monitor accesses settings menu
- Secondary monitor accesses pair screen
- Secondary monitor enters key correctly
- Secondary monitor's device fails to connect to sensor
- Failure logged

Unhappy path:

- Primary monitor retrieves sensor key from provided product information
- Primary monitor relays sensor key incorrectly to secondary monitor
- Secondary monitor accesses settings menu
- Secondary monitor accesses pair screen
- Secondary monitor enters key correctly
- Secondary monitor's device fails to connect to sensor
- Failure logged

Unhappy path:

- Primary monitor retrieves sensor key from provided product information
- Primary monitor relays sensor key correctly to secondary monitor
- Secondary monitor accesses settings menu
- Secondary monitor cannot access pair screen (technical error in app)
- Failure logged

Unhappy path:

- Primary monitor retrieves sensor key from provided product information
- Primary monitor relays sensor key correctly to secondary monitor
- Secondary monitor accesses settings menu
- Secondary monitor accesses pair screen
- Secondary monitor enters key incorrectly
- Secondary monitor's device fails to connect to sensor
- Failure logged

Unhappy path:

- Primary monitor retrieves sensor key from provided product information
- Primary monitor relays sensor key correctly to secondary monitor
- Secondary monitor accesses settings menu
- Secondary monitor accesses pair screen
- Secondary monitor enters key correctly
- Secondary monitor's device fails to connect to sensor (connection error)
- Failure logged

Post conditions: Secondary monitor receives data from sensor. Primary monitor is aware that they are paired with sensor.

Notes: 'Relay' refers to any method of communication between primary and secondary monitors; in person, over the phone, over email etc. Although the importance of keeping the key private will be stressed in product information.

Author and date: Chris Sutton, December 03 2018

7 - Management Summary

Deciding upon a development methodology is an extremely important part of developing any system. The benefits and drawbacks of each must be carefully considered in relation to the requirements of the project to ensure that it delivers a working, high quality product in a timely and efficient manner.

There are many different development methodologies that we could have chosen for this project, however due to the nature of the Vital Sign monitor and the fact that a human life could depend upon it the methodology chosen would need to include vigorous and regular testing to ensure every feature worked flawlessly. This eliminated methods such as Lean as the focus on eliminating waste and delaying decisions until the last minute could potentially cost somebody their life.

In the end the development methodology we decided upon was Crystal Sapphire as the Vital Sign monitor will be responsible for ensuring that doctors are aware of any changes in the Grandmothers condition as well as providing them with important information on her Heart Rate, Blood Pressure, Etc. Crystal Sapphire is a good methodology for this project as it features regular testing to ensure that any bugs are found early and fixed, this is especially important with such a critical project that could have severe consequences if a bug causes the device to not work correctly.

Another main feature of Crystal methodology that will improve the likelihood of the projects success is the face that emphasis is put on developer opinion and what the people actually working on the project have to say. Taking into account any concerns that the developers might have would ensure that if someone doesn't think a certain feature would be possible to implement safely or wouldn't be finished on time they could simply speak up and the project delivery date could be delayed to ensure that it was finished and not rushed. This is where crystal methodology greatly wins out over Lean as the regular updates allow problems to be detected and fixed rather than decisions being delayed causing potential harm to the user of the product.

In conclusion to this summary we decided to use the Crystal Sapphire methodology as its the most suitable for projects that can pose a risk to human life which in the end caused it to be more suitable for our needs than other heavily testing focused methods like extreme programming. It also relies on regular updates, empowering the employees to speak up about their concerns and testing every feature from the point it’s implemented until the release of the final product and beyond.

8 - Gantt Chart

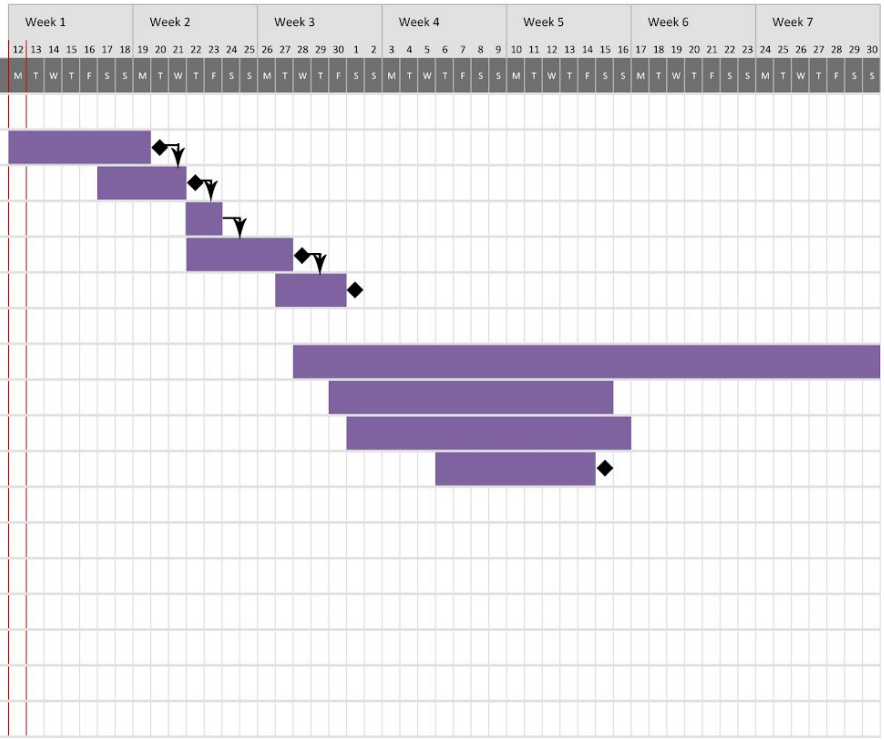
Internal Vital Sign Monitor

OddJobs

Project Start: Mon, 11/12/2018

Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Planning and Prototyping				
Initial Planning	Name	0%	11/12/18	11/19/18
Concept Art		0%	11/17/18	11/21/18
Final Design Selection		0%	11/21/18	11/22/18
Prototype Created		0%	11/22/18	11/27/18
Design Adjusted and Final Prototype Presented		0%	11/27/18	11/30/18
Development				
Client Side Software Development		0%	11/28/18	1/1/19
Construction of monitor begins		0%	11/30/18	12/15/18
Testing of Hardware			12/1/18	12/16/18
Network Connectivity Implemented			12/6/18	12/14/18
First Working Prototype Finished			1/1/19	1/1/19
Testing				
Software Testing			1/1/19	1/8/19
Hardware Testing			1/1/19	1/8/19
Testing on Volunteers			1/9/19	1/14/19
Report Compiled on Findings			1/15/19	1/19/19
Final Product Released			1/20/19	1/22/19



Continued:

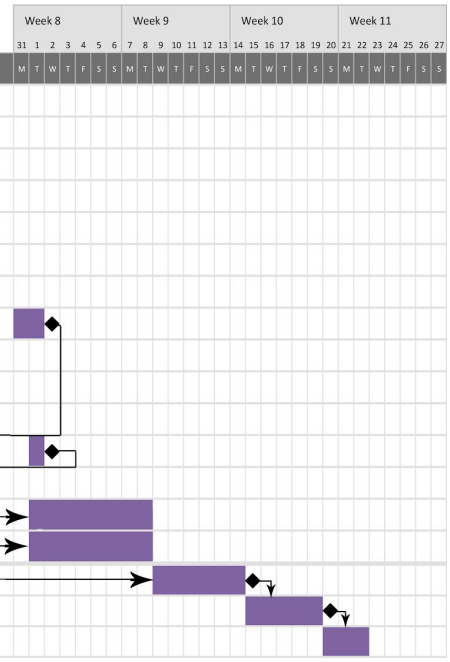
Internal Vital Sign Monitor

OddJobs

Project Start: Mon, 11/12/2018

Display Week: 8

TASK	ASSIGNED TO	PROGRESS	START	END
Planning and Prototyping				
Initial Planning	Name	0%	11/12/18	11/19/18
Concept Art		0%	11/17/18	11/21/18
Final Design Selection		0%	11/21/18	11/22/18
Prototype Created		0%	11/22/18	11/27/18
Design Adjusted and Final Prototype Presented		0%	11/27/18	11/30/18
Development				
Client Side Software Development		0%	11/28/18	1/1/19
Construction of monitor begins		0%	11/30/18	12/15/18
Testing of Hardware			12/1/18	12/16/18
Network Connectivity Implemented			12/6/18	12/14/18
First Working Prototype Finished			1/1/19	1/1/19
Testing				
Software Testing			1/1/19	1/8/19
Hardware Testing			1/1/19	1/8/19
Testing on Volunteers			1/9/19	1/14/19
Report Compiled on Findings			1/15/19	1/19/19
Final Product Released			1/20/19	1/22/19

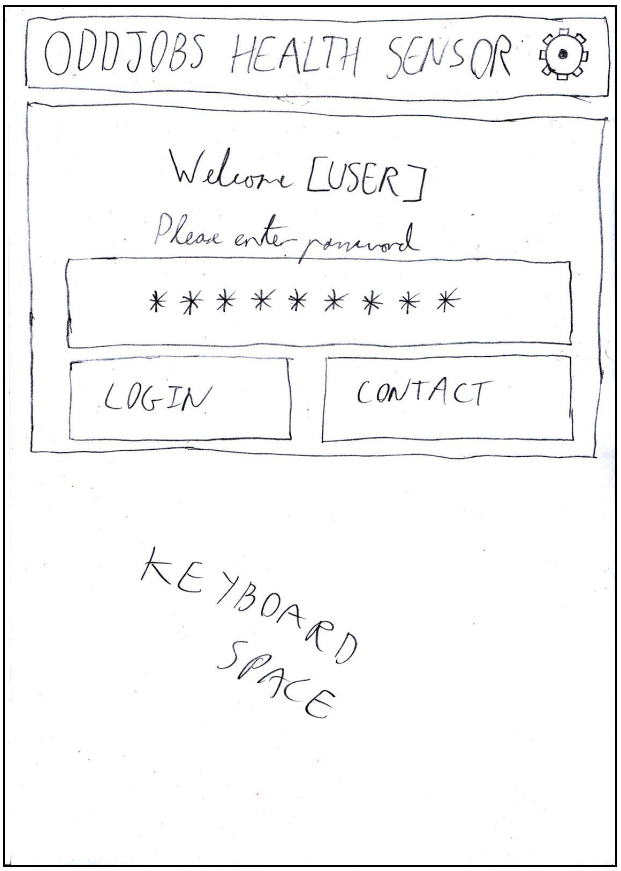


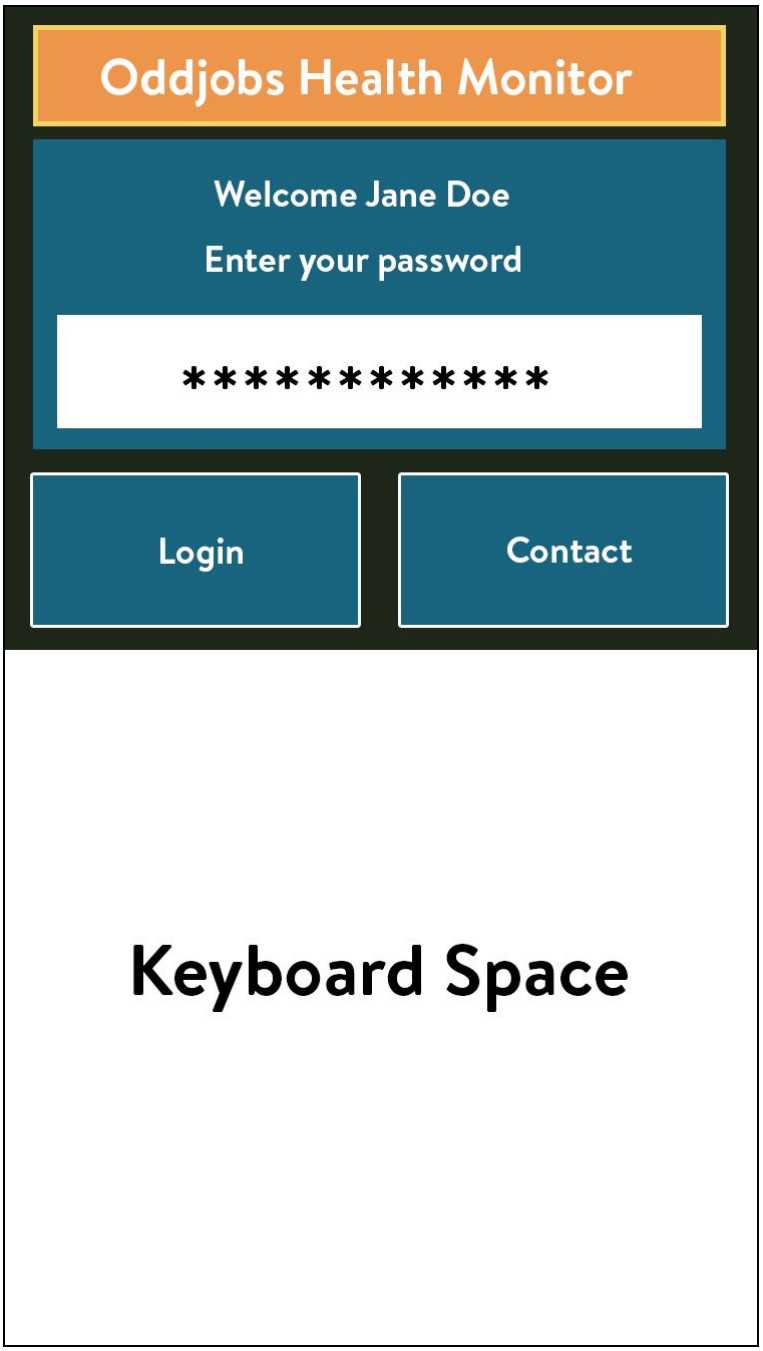
Project Risks and Contingency Plans:

There are many risks that can become prevalent during the development of a project, even more so when it is a product closely linked to the users health as our Internal Vital Sign Monitor is.

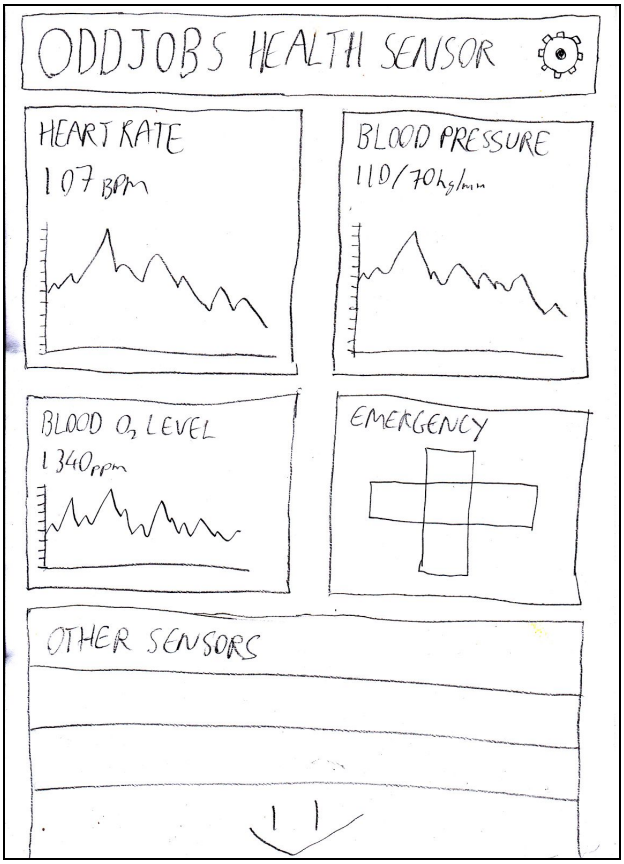
Risk	Prevention	Solution
Project Bottleneck.	Ensure everyone understands the current stage of the project.	Allocate extra developers to help with parts of the project that are falling behind.
Parts of the project not working with others.	Regularly combine the different parts of the project to find bugs early.	Allocate time to find incompatibilities and fix them.
The Final Prototype not working as intended.	Ensure that testing is thorough and covers all use cases.	Go back and attempt to fix the issue if possible.
Finished product being rejected by public safety agencies.	Ensure that guidelines are followed and regularly check to make sure no rights are breached.	Go back to prototyping and redesign a suitable model that will be suitable for human use.
Major bugs not being discovered until product is in use.	Allot a large amount of resources to testing and bug fixing.	Recall devices so that issues can be fixed without further risking users.

9 - Lo-fi Prototype Interface

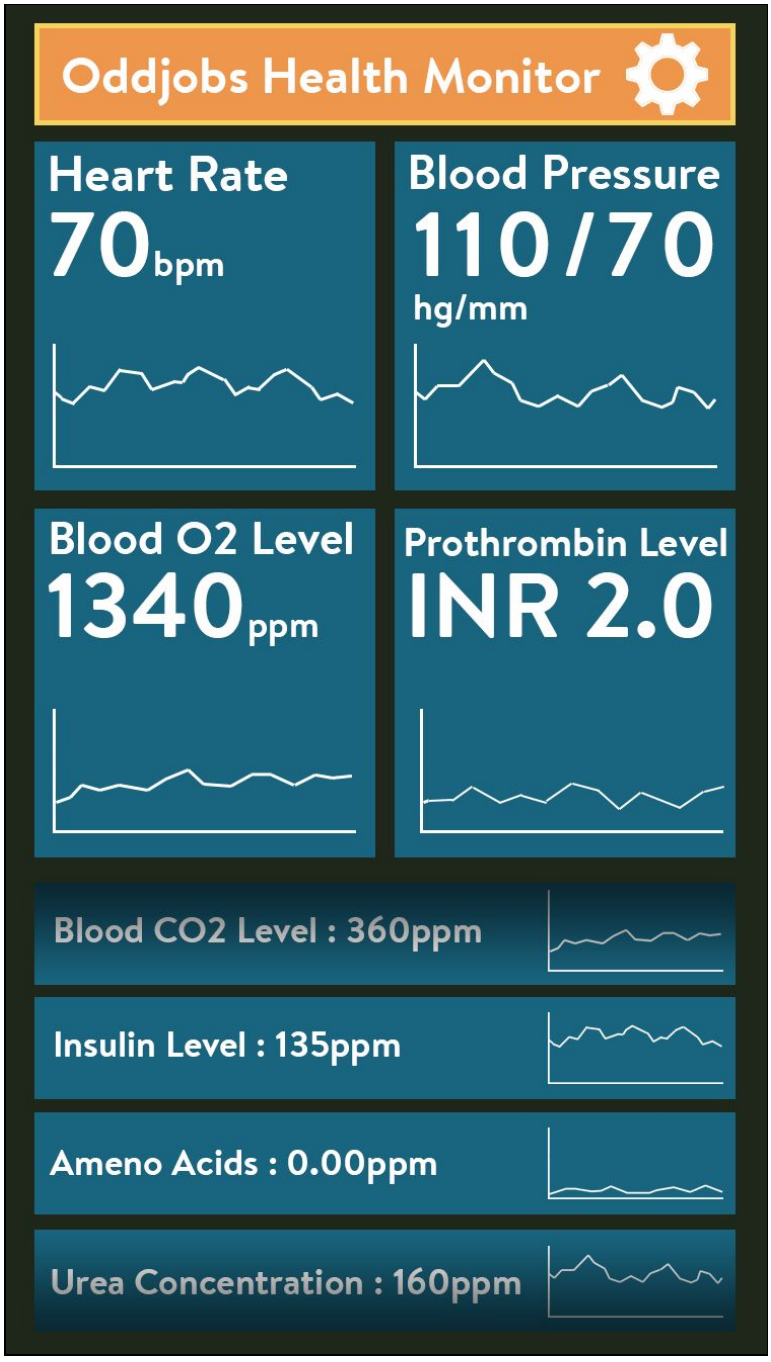


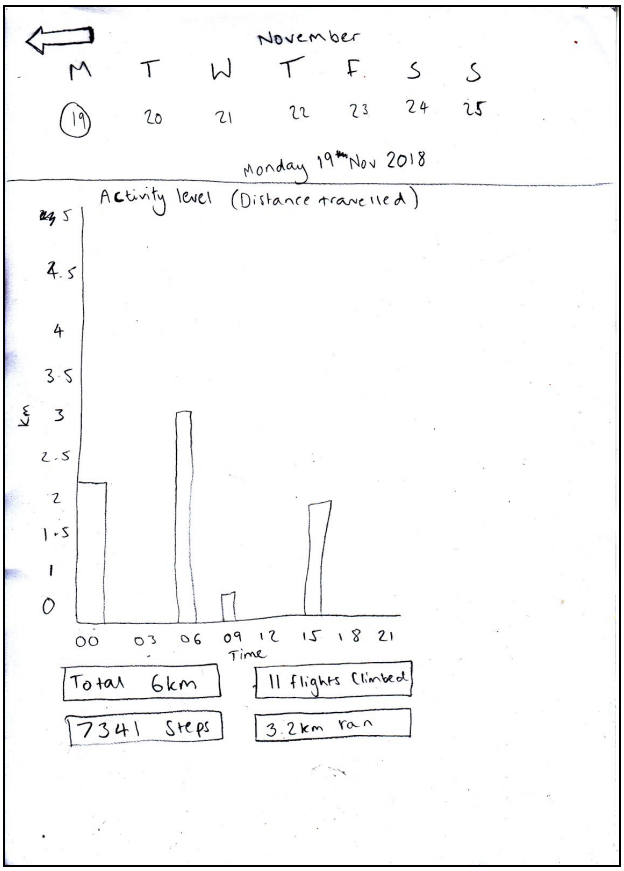


The login screen greets the user whenever they access the app on their mobile device. It will generate a welcome message based on their device data. The contact button will direct them to technical support (if they have forgotten their password etc.) In testing we realised that a user should not be able to access the settings menu before they have logged in, so that option was removed.

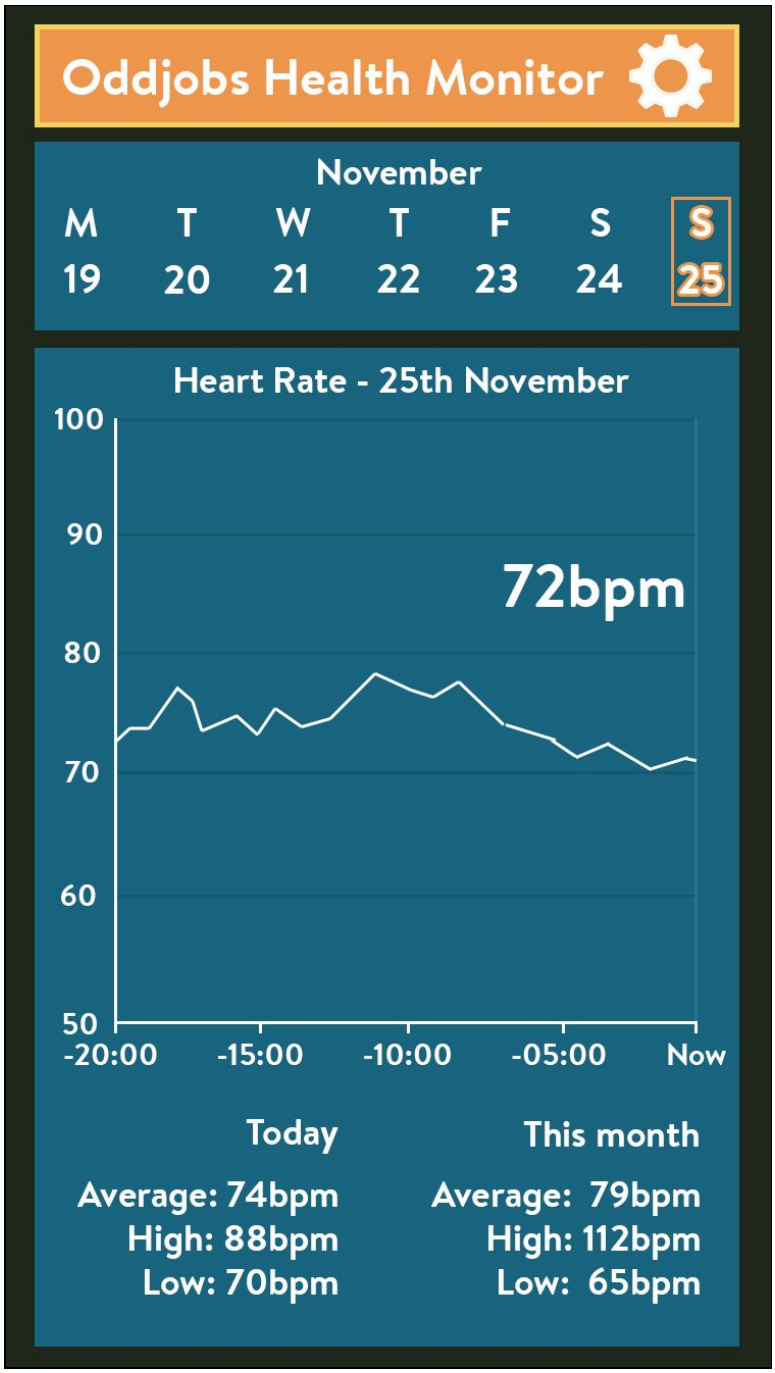


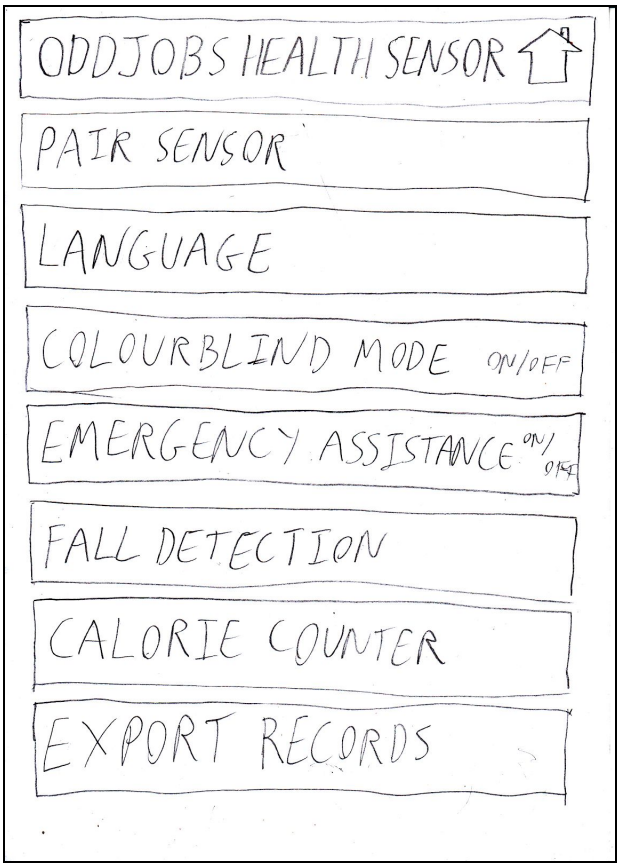
The home screen offers four large buttons which give an at-a-glance overview of selected statistics. They can be swapped out for any of the other monitors on the scrolling list below by holding and dragging. The settings menu is accessible by tapping the cog icon in the top right. In testing we received feedback that proved the emergency button to be redundant, so it was removed and replaced with another large button.



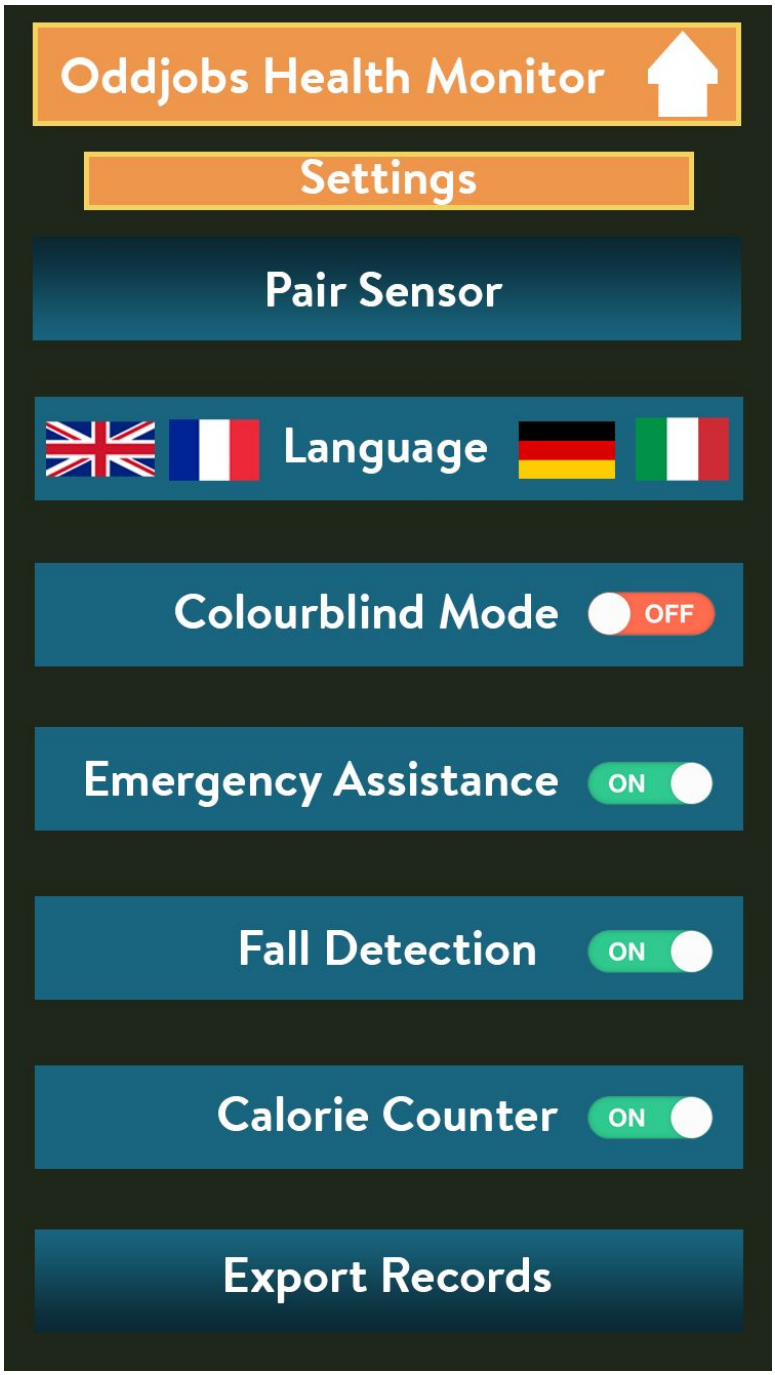


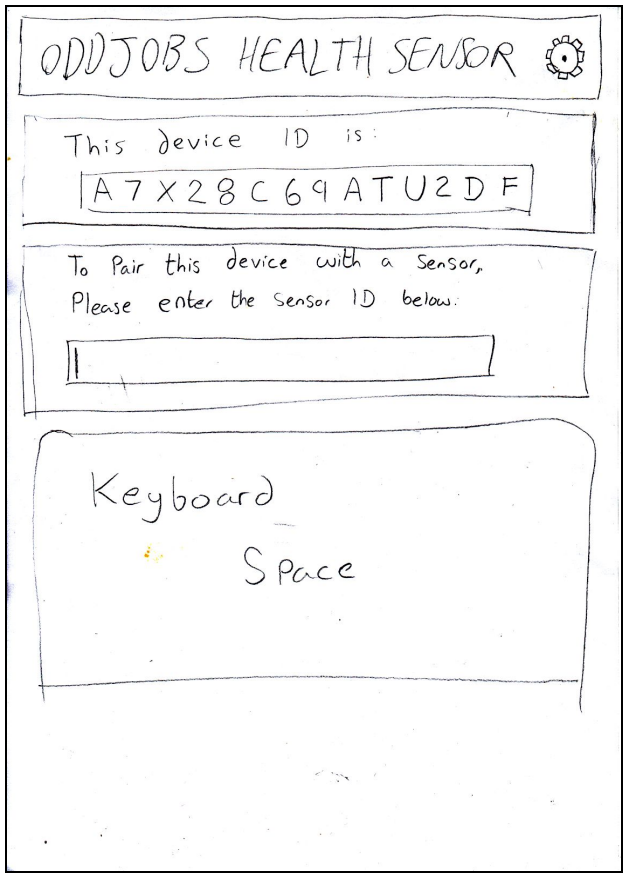
Tapping any of the monitor buttons on the home screen will bring you to a more detailed overview of that statistic. You can scroll through dates to view them individually, and can scroll in and out on the graph itself to change the time frame. In addition, useful averages will be displayed underneath the graph. In testing we realised that the ability to select future dates is redundant, as there would be no data for them.



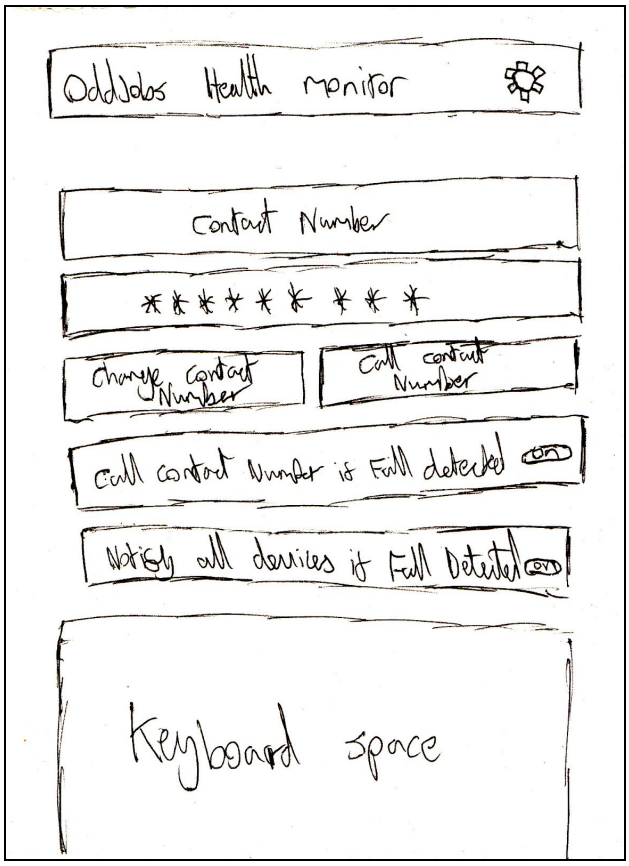


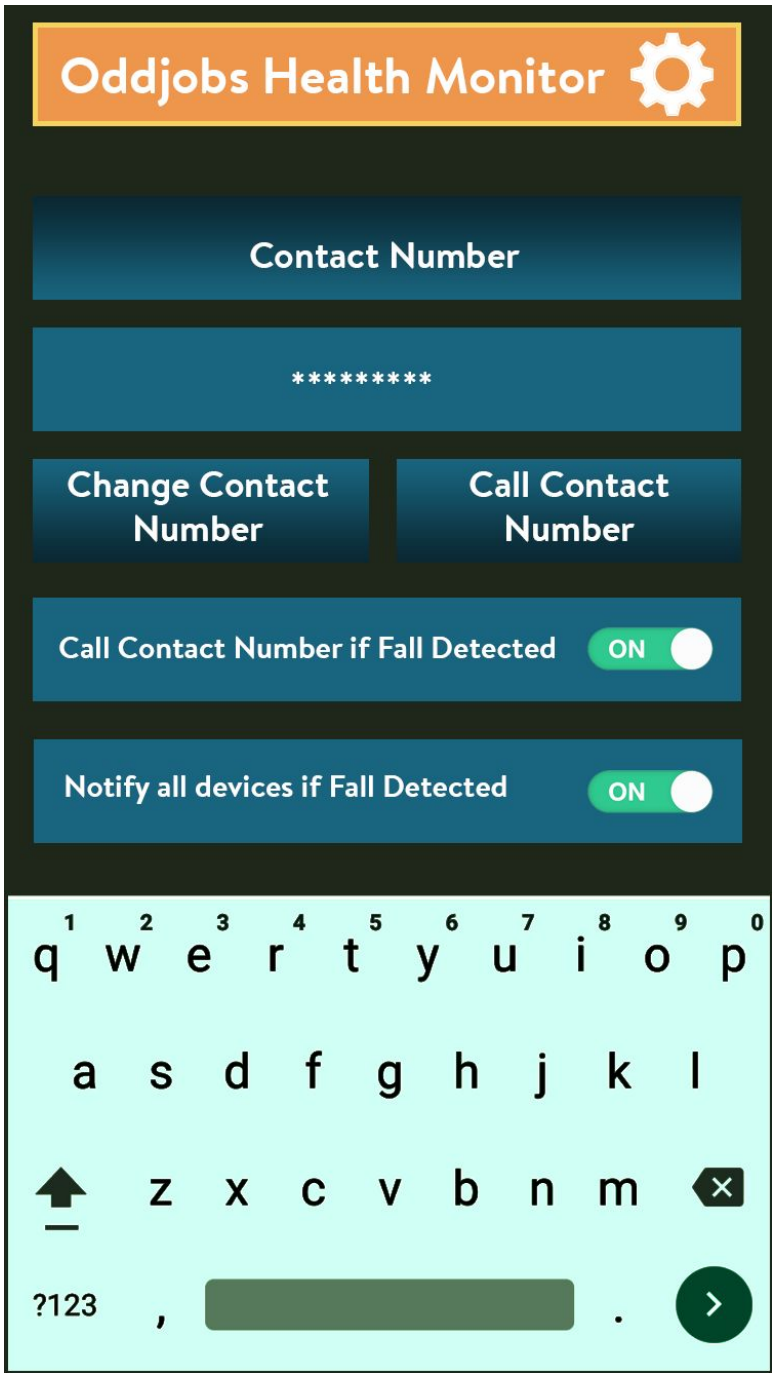
The settings screen allows you to modify various functions of the app, including accessibility options and emergency assistance. In testing we received feedback that the language button should have some non-textual indicators for non-english speakers, hence the addition of flag icons.





The pairing screen allows you to pair a device to the implanted sensor (providing you know the sensor ID). In testing we realised that it would be beneficial to display what other devices are connected to the same sensor, including the device names. The primary monitor can remove devices from the list at will.





The contacts screen allows for the user to enter in an emergency contact phone number that will be automatically called in the event of the heart rate dropping to zero or a fall occuring. This feature can be toggled off if the user desires. Once the number has been entered the user will have to press a button to change it, this prevents them from accidentally entering an additional digit when viewing the contacts page.

10 - Critical Success Factors

The 10 Critical Success Factors that we are focusing on include:

1. Clear requirements and specifications
2. Clear objectives and goals
3. Realistic schedule
4. Effective project management skills/methodologies
5. Client involvement
6. Effective communication and feedback
7. Skilled and sufficient staff
8. Adequate resources
9. Familiarity with development methodology
10. Proper planning

Evaluation Plan:

The purpose of the evaluation will be to check whether the final solution has met all the criteria and works as intended. This will entail comparing the initial expectations of the product to reality with the use of the critical success factors, prioritised requirements and data which has been collected.

The critical success factors will be used to make sure that the entire development of the solution is carried out as intended which will most likely result in a fully completed, working solution. During the evaluation, the efficiency and usefulness of the factors will be measured by checking how they've benefited the development stage and the results of using the success factors.

The main component which will be measured during the evaluation is the solution's intended outcomes and how it has turned out in reality. The intended outcomes have been listed previously in the prioritised requirements list which has adopted the MoSCoW method. The evaluation will measure and acknowledge what criteria the solution has met and what post development measures will be carried out if the product has not met at least the 'must have' requirements. This will be done through thorough testing of the product, including black box and white box testing.

Data will be collected to answer evaluation questions measuring the expectations vs reality of the final product. Data can be collected through questioning stakeholders about the final product; This can include asking end clients and testers how the product has turned out and if it works as intended. Data can also be used from the Health Sensor itself to see the accuracy at which the required vital signs are measured. Finally, the data collected needs to then be analysed and used for comparison to determine the products overall success.

11 - Professional Considerations

There are various data protection and biotechnology laws that must be abided by when developing the Vital Sign monitor. Biotechnology is the human use and application of biology for human advancements; therefore, it has stricter legal standards compared to other technological solutions.

The first legality which must be abided by is the General Data Protection Regulation 2018, the successor of the outdated Data Protection Act of 1998. This updated regulation is very in-depth but has 5 key points which will affect how we develop and maintain this solution:

1. Lawful, fair and transparent processing

This is especially important for this solution as there will be a large amount of data processing which will be carried out on a regular basis such as scanning vital signs from the monitor. Lawful processing of data will require us to only use the gathered for the stated purpose, in this case, to monitor vital signs. Specifically, we will have to inform the data subjects about processing activities on their personal data which we plan to distribute to chosen persons and medical staff.

2. Limitation of purpose, data and storage

All gathered data must be relevant to our solution which means that only required personal details such as contacts and the actual vital signs e.g. Heart Rate, Blood Pressure etc. can be retrieved. Also, the data can only be processed for the purpose it was collected for and must be deleted once the purpose it was collected for is fulfilled.

3. Personal data breaches

In the case of a data breach, we will have to inform the data subject within 72 hours of identifying the breach depending on the severity of the breach. Also, we will have to maintain a Personal Data Breach Register. However, this can be avoided if proper organisational and technical data security measures are incorporated when developing the program.

4. Data Protection Impact Assessment

If a large update or a major change is planned in terms of data processing, a Data Protection Impact Assessment should be conducted. This is to ensure that personal data is still as secure and doesn’t introduce new risks into the system.

5. Data transfers

The two main actors that will be interacting with the system is any chosen family members and medical staff who will access the data of the client. Specifically,

medical staff will have full access to the required medical data of the client and it may be transferred to their system. The transfer of data to a third party will have to be secure and we will still be accountable for the data, even if the third party is processing it.

Another regulation that will affect us is the Copyright, Designs and Patents Act of 1988. This specifically affects the development stage of the system in which we will have to make sure that all third-party software used is licensed, resources such as graphics is royalty free or permissible to use and the design of our product has individual character in order to avoid conflict with an existing registered design.

The Computer Misuse Act of 1990 goes hand in hand with the Copyright, Designs and Patents Act above as authorisation will be required to access and modify third party software if needed during the development stage of our solution, through the purchase of software licenses.

Apart from legalities that must be abided by, there are various ethical and social issues that may be linked with an embedded Vital Signs monitor. Queries may be raised questioning the necessity of this solution and the privacy of clients involved. The main ethical and social concerns that have been gathered are:

- How is the product going to be tested before human implementation? We are going to ethically test the product on animals with a similar cardiovascular system to the human body, such as pigs to ensure that the product is safe to implement and doesn't cause any bodily harm when in use.
- How long is the health data going to be kept for and what happens to the data after? The data will be kept for 20 years and disposed safely once its use will be fulfilled and will not be required anymore.
- How is the sensor going to be kept secure? The sensor will have an omni-directional data connection to the main system, therefore it won't be prone to malware attacks from external sources.

Throughout the development stage, we will abide by the general moral principles, professional responsibilities and leadership principles within the ACM code of ethics in order to address any worry that the client may have and to ensure that this bespoke solution is primarily for the benefit of the client; As it will reduce chances of a severity happening as the monitor will be able to detect major changes in vital signs and contact all required persons before a severity. Also, as the family involved is very busy and don't have the required time to constantly check up on the Grandma, this solution is a necessity for them.

In terms of privacy, we will have to make sure that all data collected and processed from this solution is kept secure and in line with the legalities discussed above; especially with the reformed GDPR, privacy and data security will be a priority which will further reduce any concerns that the family may have.

Appendix - References

Mission Statement: Health Sensor:
Smart wearable body sensors for patient self-assessment and monitoring - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4166023/
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IoT Solutions for the SD Family

The Odd Jobs

Harshil Patel
Martin Siddons
Chris Sutton
Mark Wilkins

Personas

Jane Doe

Mother

"I'm worried about my mother, but I wish I could spend more quality time with my husband and children."

- Wishes to spend less time maintaining home and garden.
- Wants to ensure her toddler is safe, but allow him to keep himself entertained.
- Would like to make sure her mother is in good health without visiting so often.

Alexandra Abbott

Grandmother

"I love to stay in contact with my daughter and her family, but I feel guilty that my health is taking up so much of their time."

- Wishes to retain her independence without burdening her family.
- Wants to know that should she have a fall or end up in distress, help will find her.
- Wants to keep track of her own health, ensuring doctors have the information they need.

Health Sensor

A *subdermal* implant delivered by physician to measure elements of a person's health and send that encrypted information back to our servers. There, it can be accessed by the user(s) via a bespoke Smartphone app. It has the ability to contact Emergency Services or a nominated person if needed.

Sensor Monitoring:

Heart Rate
Blood Pressure
Blood O_2/CO_2 Level
Blood Thickness

Water / Urea Concentration
Insulin Levels
T3/T4 Levels

Amino Acid Detection
Body Temperature
Usual Movement
Sudden Movement

Automated Lawnmower

An automated system designed to cut the grass while detecting and avoiding obstacles. The *Lawnmower* is web-connected to determine the best time to cut the grass and when doing so, maps it's surroundings to determine the best route. The *Base Station* replaces used parts and can order more automatically, if needed.

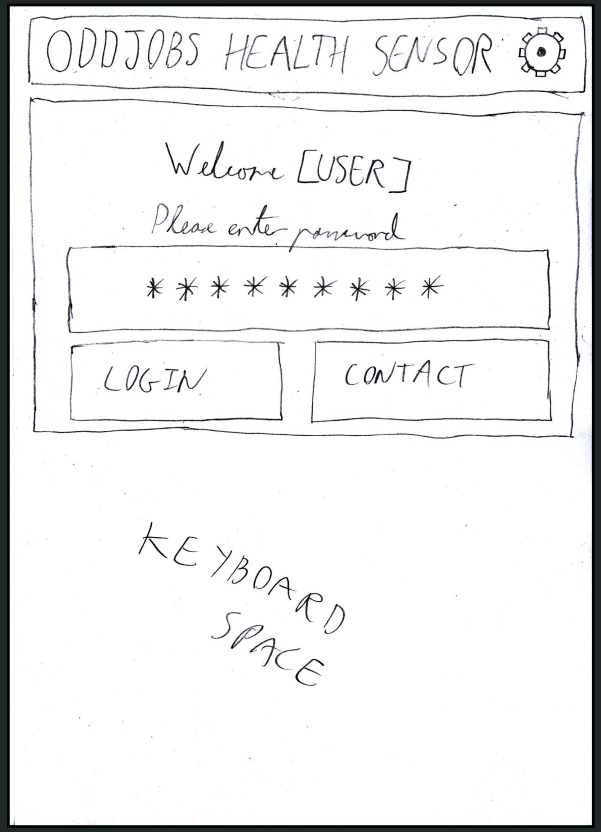
Comprising:

Base Station
Lawnmower Unit

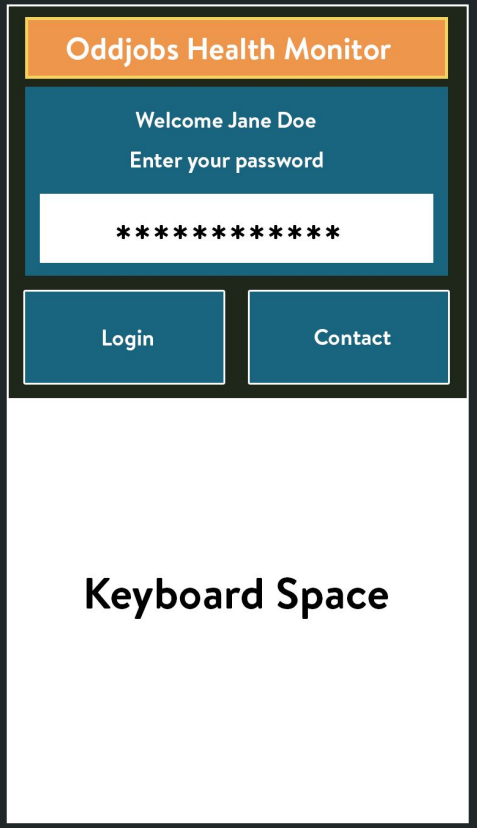
Bespoke Smartphone App

Health Monitor prototype - Login

- Will generate a welcome message based on user's device name.
- Contact button will direct them to technical support.
- Password will require:
  - 8 characters
  - At least one uppercase
  - At least one number or special character



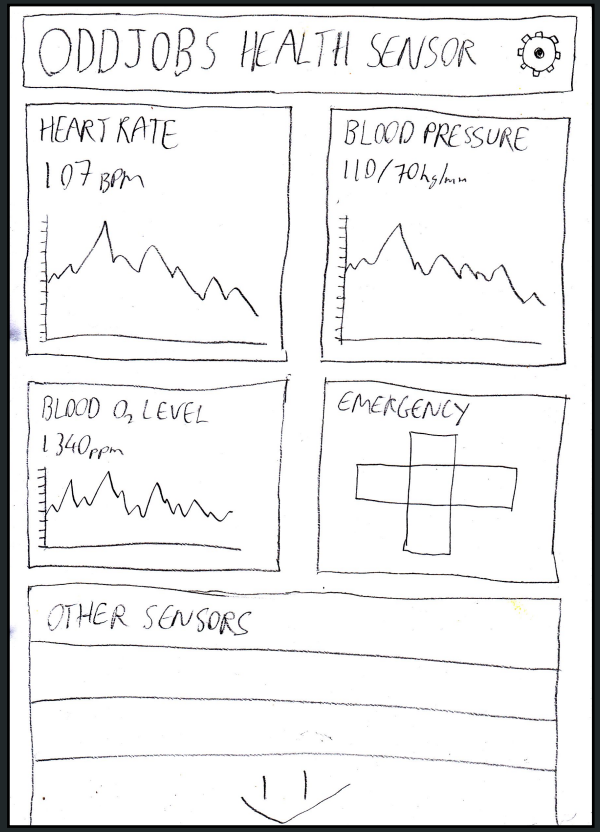
Lo-fi



Medium-fi

Health Monitor prototype - Home

- Offers a broad overview of grandmother's health.
- Large, customisable buttons.
- Access settings menu with cog in top right.
- 7 +- 2 UI element design.
- In testing, we found the emergency button was redundant.



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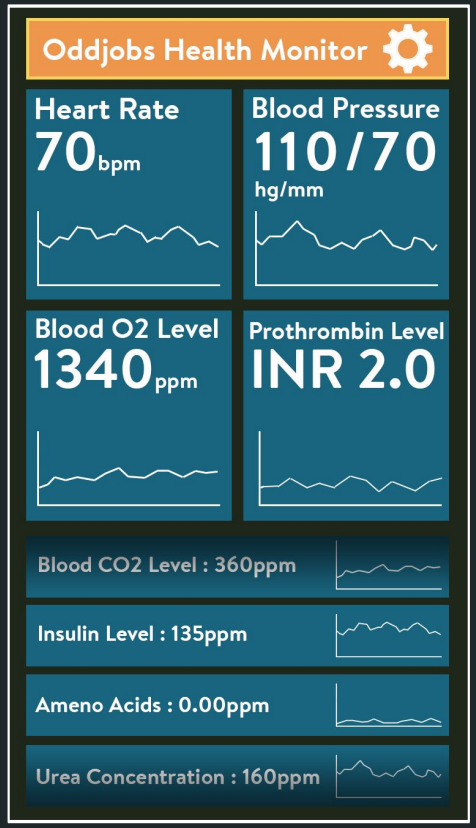
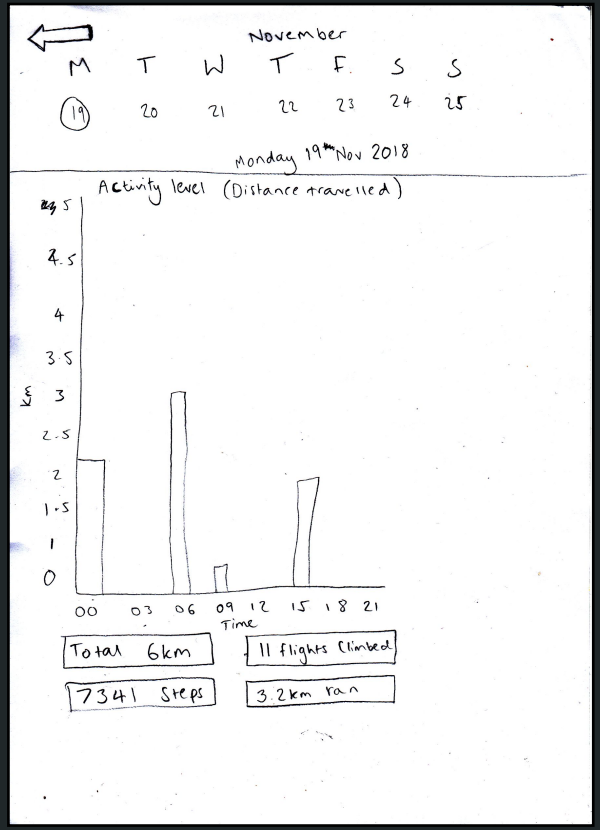


Medium-fi

Health Monitor prototype - Details

- Offers a more detailed view of a monitored statistic.
- Can scroll through dates and scroll in and out of graph to change time frame.
- In testing we realised that the last date displayed would always have to be the current date.



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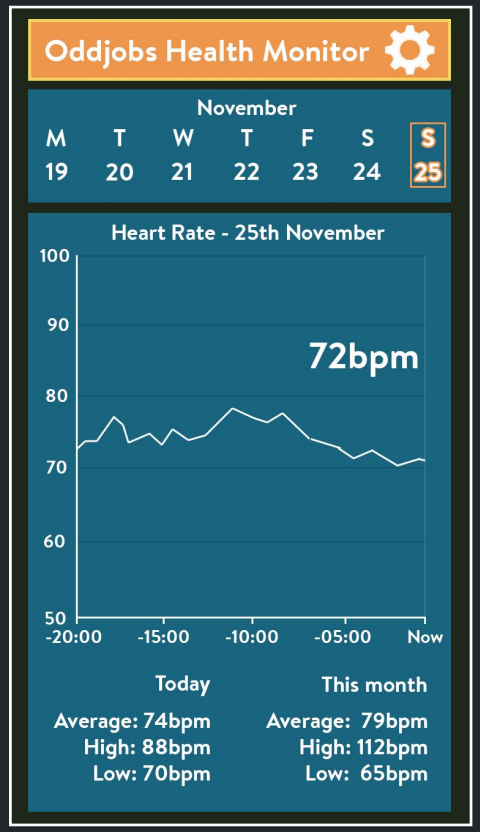
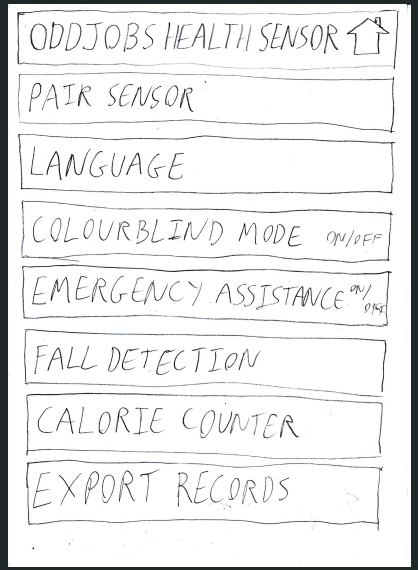


Medium-fi

Health Monitor prototype - Settings

- Allows the user to customise the settings of the App and Device.
- Optional features can be toggled on or off.
- Colorblind and language settings for accessibility.
- Flags indicate how to change language easily.



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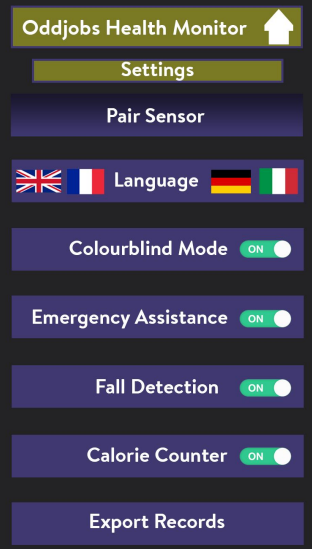
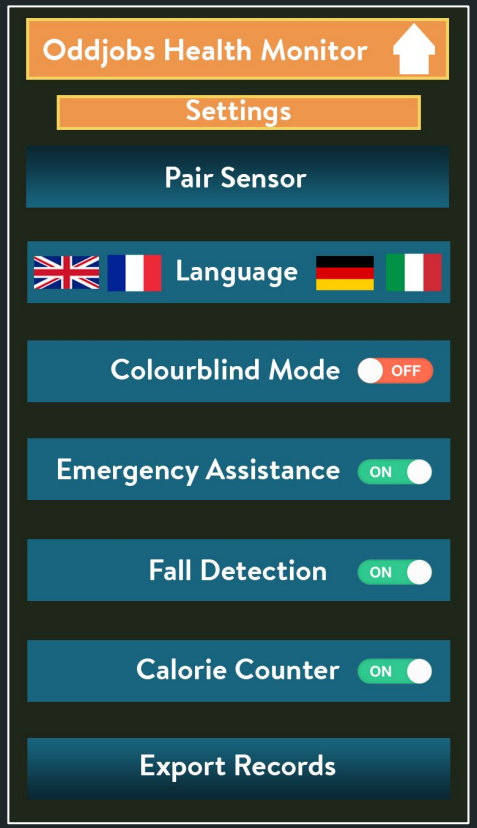


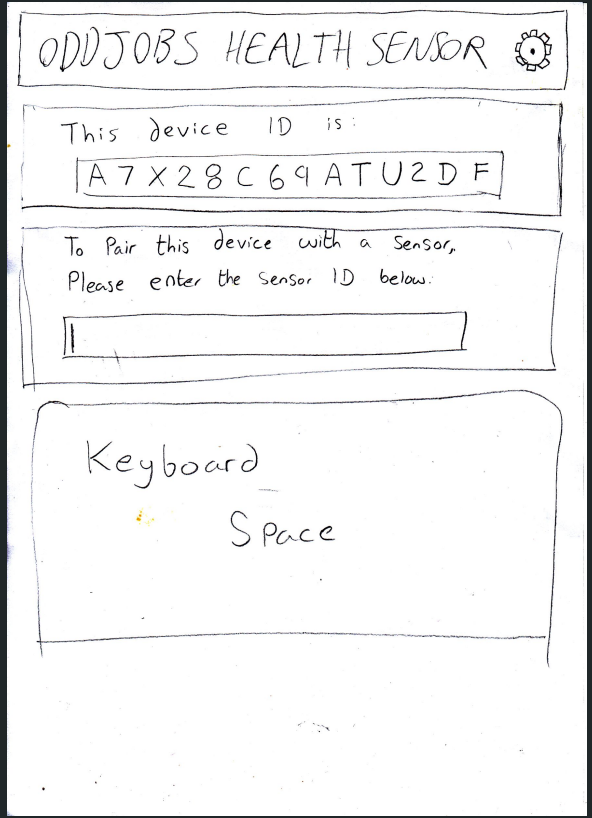
Colourblind mode



Medium-fi

Health Monitor prototype - Pairing Screen

- Allows the user to easily connect their devices to the Health Monitor.
- Provides an easy to read list of currently connected devices.
- Allows the user to connect using an ID associated with a sensor.

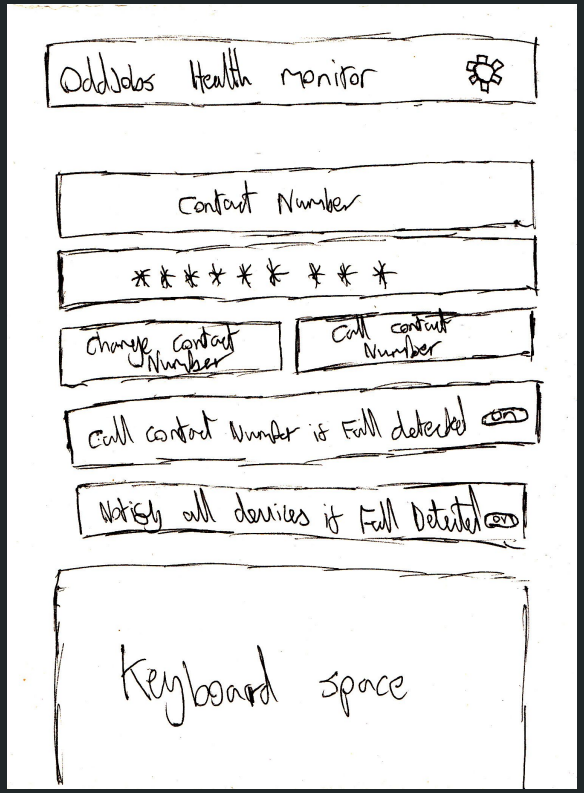


Lo-fi

Medium-fi

Health Monitor prototype - Contact Screen

- Allows the user to enter a contact number to be called in the event of a fall.
- Toggleable settings to turn feature on/off as well as notifications for connected devices.
- Ability to call the contact number manually if necessary.



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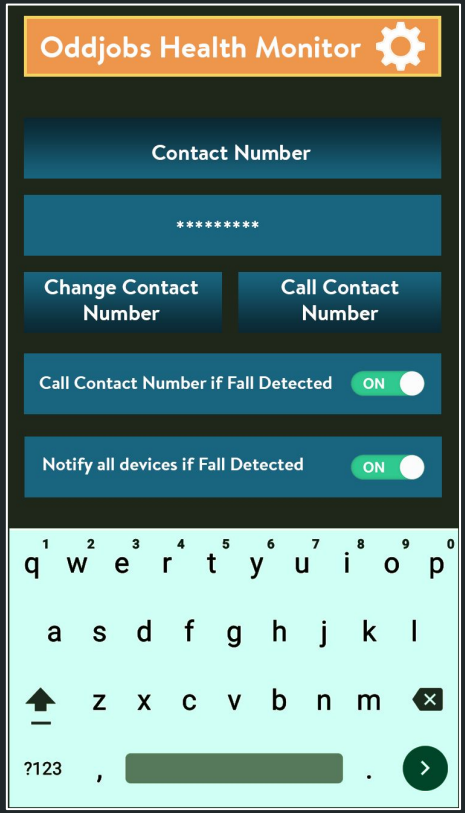

Medium-fi

Professional Considerations

Laws to abide by:

- General Data Protection Regulation 2018
  - Lawful, fair and transparent processing
  - Limitation of purpose, data and storage
  - Personal data breaches
  - Data Protection Impact Assessment
  - Data transfers
- Copyright, Designs and Patents Acts 1988
  - Making sure graphics used are royalty free
  - Design of app must have individual character to avoid conflict with existing registered designs
- Computer Misuse Act 1990
  - Making sure we have all required software licenses
- Regulation of Investigatory Powers Act 2000
  - Allowing data to be accessed by higher bodies if required

Ethical Issues

ACM Code of Ethics and Professional Conduct:

1. General moral principles
2. Professional responsibilities
3. Professional leadership principles
4. Compliance with code

Data Security and Privacy:

- Encrypting data
- Records kept for 20 years
- Only authorised bodies

Safety of Health Sensor:

- Sensor has an omni-directional data connection
- New versions of sensor as opposed to update patches
- Health sensor is embedded by professionals
- Sensor is animal and medically tested

Conclusion:

Our Health Monitor will allow the family member to live without regular medical checkups and give them security in knowing that if something goes wrong, they (or their family member) will be safe.

Our Lawnmower will give the family the ability to automate a mundane task to its furthest extent while delivering a solution that remains safe to use around pets and children.

Any Questions?