Department of Computer Science

Individual Project - CS3IP16

Hypothyroid symptoms & fitness tracker

Finley Williams

23013019

Supervisor: Lily Sun

04/06/2018

# 1. ABSTRACT

# 2. ACKNOWLEDGEMENTS

Contents

[1. ABSTRACT 1](#_Toc515451866)

[2. ACKNOWLEDGEMENTS 1](#_Toc515451867)

[3. GLOSSARY OF TERMS AND ABBREVIATIONS 3](#_Toc515451868)

[4. INTRODUCTION 4](#_Toc515451869)

[5. PROBLEMS ARTICULATION 5](#_Toc515451870)

[5.1 Situation as is. 5](#_Toc515451871)

[5.1.1 Situation A (Pen and Paper) 5](#_Toc515451872)

[5.1.2 Situation B (Non-specific apps) 5](#_Toc515451873)

[5.1 Problem statement and Justification. 6](#_Toc515451874)

[5.2 Key stakeholders and their concerns. 6](#_Toc515451875)

[5.2.1 Diagnosed hypothyroid patients 6](#_Toc515451876)

[5.2.2 Suspect hypothyroid patients 6](#_Toc515451877)

[5.3 Ideal situation to be. 6](#_Toc515451878)

[5.4 Technical specification. 7](#_Toc515451879)

[6. LITERATURE REVIEW 7](#_Toc515451880)

[6.1 Existing solutions 7](#_Toc515451881)

[7. THE SOLUTION APPROACH 7](#_Toc515451882)

[8. IMPLEMENTATION 7](#_Toc515451883)

[9. TESTING: VERIFICATION AND VALIDATION 7](#_Toc515451884)

[10. DISCUSSION: CONTRIBUTION AND REFLECTION. 7](#_Toc515451885)

[11. SOCIAL, LEGAL, HEALTH, SAFETY AND ETHICAL ISSUES 7](#_Toc515451886)

[12. CONCLUSION AND FURTHER IMPROVEMENTS 7](#_Toc515451887)

[13. REFERENCES 7](#_Toc515451888)

[14. APPENDICES 7](#_Toc515451889)

# 3. GLOSSARY OF TERMS AND ABBREVIATIONS

**Hypothyroidism** – The shortage of T3 and T4 thyroid hormone which causes the unwanted slowdown of the body’s function causing suffering and damage to the patient’s organs.

**Hyperthyroidism** – The overabundance of T3 and T4 thyroid hormone which causes the unwanted speedup of the body’s function causing suffering and damage to the patient’s organs.

**TSH –** Thyroid Stimulating Hormone. A hormone created by the pituitary gland to regulate the production of T4 and T3. Low levels of T4 cause a heighten level of TSH production whereas high levels of T4 cause a reduced level of TSH. Typical hypothyroidism has a low level of T4 which results in an extremely elevated level of TSH.

**T4 –** Thyroxine. (Four Iodine molecules) This is converted into triiodothyronine inside the cell when required. T4 is basically a stepping stone for T3.

**T3 –** Triiodothyronine. (Three Iodine molecules) The active form of the thyroid hormone which influences the bodies processes, the most important of which being the regulation of the body’s metabolism.

**Levothyroxine –** Levothyroxine Sodium. A synthetic drug that is identical biologically to T4 allowing the body to convert this into T3 for use within cells.

# 4. INTRODUCTION

By conservative estimates hypothyroidism affects two in one hundred with many doctors believing the true rate is much higher than this, with the president of the International Hormone Society believing the true number lies between twenty percent and fifty percent of the population having some level of thyroid deficiency.

Hypothyroidism as a condition is characterised by the slowing of almost all bodily functions as the body is short on the hormones primarily used in relation to your metabolism. This “slowing” affects all parts of your body, from your brain, digestive track to muscles causing memory issues and problems concentrating, digestive problems such as constipation and increased risk of other issues like Celiac disease and Crohn’s disease and Graves’ disease and frequent painful muscle cramps and decreased muscle strength.

During May 2017 the writer of this document was diagnosed with hypothyroidism after several months of suffering several of the symptoms. During the period after the diagnosis, there was an attempt to gather as much data about the symptoms as possible. To the writers surprise there was a distinct lack of apps available to aid in this pursuit which led to having to record everything on pen and paper, which was both impractical and not useful when it came to viewing trends and getting a picture of how the sufferer felt in relation to previous time periods.

When it came time to choose a project, inspired by the other app’s available for different medical issues, the writer decided to attempt to create a app that could record the data on the issues encountered and present them to the user in a useful manner allowing conclusions and issues to be raised in a timely manner rather than waiting for the symptoms to get truly bad.

Given this potentially huge section of the population who are either misdiagnosed or undiagnosed having the ability to predict if you have thyroid issues via an easily installed app seems like a useful app to exist.

A side benefit of having historical records of the symptoms is that due to memory issues associated with hypothyroidism having a record of what you feel greatly reduces the requirement to remember exactly what you felt on a day to day basis when discussing your issues with a doctor.

Given the above the overarching goal of this individual project is:

* Provide a method of easily recording your symptoms on a day to day basis.
* Reduce the memory load on the user by allowing easy reviewing of the data.
* Provide recommendations on what the users should be doing to improve their condition.
* Further reduce the memory load on users by giving reminders to user regarding taking their medication if the medication varies from day to day.

Within this document we will be covering the process from design and research to the final product.

# 5. PROBLEMS ARTICULATION

## 5.1 Situation as is.

The current problem for suffers of hypothyroidism is that if they wish to collect data on their condition there are extremely limited options which give more options than simply collecting the data.

Currently there are no solutions designed specifically with hypothyroidism in mind. Meaning if they decide to record the data digitally the data they may need to separate over multiple apps

The current situation regarding recording symptom, food and behavioural triggers for hypothyroidism is one of two different situations.

### 5.1.1 Situation A (Pen and Paper)

The first situation for the recording of data is pen and paper. This is simply carrying around a notebook or something similar with you and whenever you notice something you feel may be significant just writing it down.

This has several drawback related to its paper based nature:

* Loosing or misplacing records is easy, misplacing the notebook could result in multiple months of data being lost, which could be difficult to replace and could majorly affect the long term tracking of your symptoms.
* Examining the data visually comparing symptoms against other symptoms or other trigger factors can be difficult. As you would have to draw a graph on transfer the data into something like excel.
* There is little context to the data making consistency and quantifying the data very difficult. If you recorded a headache one day and a headache the next day, it may be difficult to tell which headache was worse a month later.
* Another issue is that it may be difficult to carry pen and paper around whereas you are likely always carrying a phone or laptop on you at all times.

In regards to pure data collection there is no issues with using pen and paper however whenever you want to do anything more with the data other than simply review it becomes significantly more difficult.

There is however one key advantage to pen and paper which is, given the extremely low cost of pen and paper you’re likely to have these in your house already, meaning you can start recording almost as soon as you’d like.

### 5.1.2 Situation B (Non-specific apps)

The second situation is using any combination of non-thyroid specific apps. This could be using any number of “generic” medical apps. These can be useful however they are not designed specifically for hypothyroid suffers.

These are varied and each app contains different functionality so it’s very difficult to say what can do what however as none of them have been designed with hypothyroidism in mind it is clear that they may require additional work to make it work for a hypothyroid suffer and may need to use one or more apps to get the functionality you want.

Another issues these generic apps have is if you have been diagnosed as a sufferer of hypothyroidism it may be distressing/annoying to have these medical apps constantly tell you that you may be at risk of other diseases when you have already been diagnosed with hypothyroidism which is an additional unwanted stress on the user.

## 5.1 Problem statement and Justification.

Given the wide availability of technology, the best way of recording the data for hypothyroid suffers shouldn’t be using pen and paper. There should be a comprehensive digital solution available which allows the user to record their data for later use. Even showing just the basic information you’ve recorded chronologically when discussing the issues with a doctor would be an improvement as the current pen and paper solution means you will need to manually order all the data and cannot quickly jump to specific parts of the data you wish to look at.

The current solution lacks the ability to do anything more than just record data chronologically without the ability to go back and address previous data or do anything more impressive with the data provided.

The ideal problem solution would contain the ability to include more data than just symptoms and provide the ability to visually examine the data compared to other data sets.

This gives the problem statement as:

“*There is no simple solution for tracking symptoms, consumed medication and specific food triggers for analysis and visual investigation/inspection.*”

## 5.2 Key stakeholders and their concerns.

### 5.2.1 Diagnosed hypothyroid patients

The first group of stakeholders is the currently diagnosed with hypothyroidism. This is the group this project will be aimed at. Their main concerns consist of accurately tracking their data, keeping their confidential medical data secure and assisting in the regular consumption of medication.

CHEAP

### 5.2.2 Suspect hypothyroid patients

The second group of stakeholders are those who suspect they are diagnosed with hypothyroidism. This project is not being made for these people, however they will definite use for this product even if all functionality is not usable or made for them.

CHEAP

## 5.3 Ideal situation to be.

## 5.4 Technical specification.

# 6. LITERATURE REVIEW

Within this literature review we will be discussing the existing research done within the field of medical application and the existing solutions to the problem defined within the problem statement. The strengths and weaknesses of each will be discussed and where possible the advantages of these will be incorporated into the design of this project.

## 6.1 Medical Background Research

### 6.1.1 Symptom Tracking

Within this section we will be discussing why people track their data and the issues that come about from tracking it.

Whilst the menstrual cycle isn’t a “medical condition” but simply something half the population suffers from. It does however share almost all of the characteristics of hypothyroidism when considering the symptoms. None of the symptoms are binary and have a range of values as well as consistently reoccurring within the patient’s life.

Within [1] the reasons for their tracking of symptoms are: “*(1) be aware of how their body is doing, (2) understand their body's reactions to different phases of their cycle, (3) be prepared, (4) become pregnant, and (5) inform conversations with healthcare providers. Participants were typically motivated by multiple factors.”*

The particularly relevant from this are being aware of how the users body is doing and informing conversations with the healthcare providers as previously mentioned within the introduction in section 3. The reduction in mental load bearing is of particular relevance to hypothyroid suffers as this condition reduces your ability to remember things.

Interestingly, when deciding how to track their symptoms their first instinct is simply to look for an app with 47% of all participants thinking “*Common sense, there had to be an app for it. There’s an app for everything.*” The fact that there is no such app for hypothyroid suffers shows that there is a definite niche for an application of this nature even just for basic symptom tracking.

Another interesting point raised within this paper is that if predictions are to be included accurate prediction are a must have as predictors will be rapidly abandoned if they are shown to be inaccurate. This will be expanded upon in 6.1.2.

In regards to design from this specific paper there is a strong emphasis on having the design be gender neutral however for this project this will not be an issue however the comment is relevant none the less, “*Why can't keeping track of my menstruation be a professional and organized task?”* From this having a clear and professional design is important for the usability and keeping people using the application.

Overall, the visual design of the data entry for tracking of symptoms is very important as without a professional, clear look the user is unlikely to use the app in the long term which is where the app is most relevant and has the most benefits to the user.

With [2] several diseases and condition are discussed in relation to apps designed to support those suffering. The covered conditions are: Cancer, diabetes, disability, mental health and wellness.

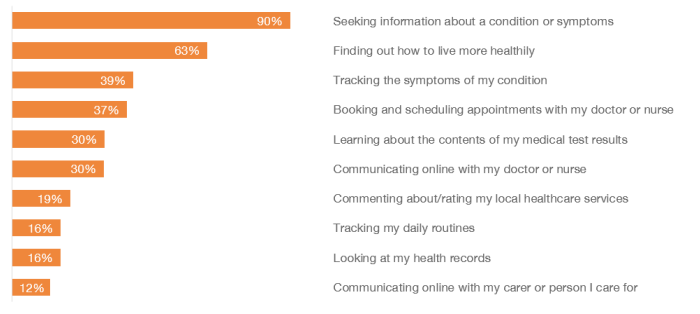
From this white paper we will be focusing on the wellness and diabetes categories as these two have the most overlap with the hypothyroid condition. Ignoring the disease specific requirements such as carb rations there are several features overlapping over these two categories. From this, we will be discussing the most relevant of these in relation to tracking of hypothyroidism.

“Barriers to using health apps: When asked to define the obstacles that prevent patients from downloading, or using health apps, the group believed there are too many health apps for patients to be able to distinguish the right apps for them. The health apps may be too generic, and not relevant to individual patients.”

6.1.2 Symptom Prediction

6.1.3 Alarms and medication consumption

6.1.4



## 6.2 Existing solutions

### 6.2.1 Butterfly [1]

The iOS app found online in beta contains many of the features which are aimed to be included within this app.

Butterfly is what was envisioned when this project was decided on however several flaws make it difficult for this app to do the job in a way that is optimal.

Another issue is this app is currently in a closed application only beta programme showing no signs of opening up further.

There is a wide array of features from tracking thyroid and adrenal medication, medication reminders and monitors when your adherence to the schedule. It also has “over 275” symptoms built in for tracking so that you can track any number of symptoms you may have.

A good feature it has is keeping track of your lab work all in one place so that you can see the changes over time from one place.

Butterfly also contains the ability to set “reminders” which are like alarms but come with a input screen so that you can be reminded to record data, take medication or anything else that you think you should be inputting regularly.

However all this functionality comes with two large and significant flaws:

Firstly this app is not “done” or even near release as I have been completely unable to get a hold of it which makes it fairly useless for a someone who needs it now this is made worse by the fact the news regarding its release it extremely sparse and not forth coming with sporadic updates every couple of months saying that they’re doing something.

The second larger issue is as of writing this it is iOS only, which puts a rather large price barrier in front of anyone who might have legitimate use of the program, whereas an android app or web app would be vastly more accessible and affordable for those with the condition which I think is important as many people struggle hold down normal lives while their conditions are hitting them hard.

Overall Butterfly is a great potential solution however the huge cost barrier to entry of having to own an iPhone is too large as not everyone may be able to afford a high end luxury mobile phone, especially those who may be struggling to hold down a job due to the symptom they are suffering from. Whilst this issue may not be a large problem in England where 42% [2] of all phones in the UK are iPhones, this however is greatly different from the worldwide market share of 15.6% [3] of all phones. This huge market share disparity shows that should we want the product to be available to a wider world wide audience, especially those who are struggling financially we should aim to develop on a platform where the potential users can afford to get on the platform.

This price however does not detract from vast number of features which butterfly brings to the table. Many of these features had not been considered and will be aimed to be included in the solution which will be created where possible.

### 6.2.2 mySymptoms [4]

This is an App for both android and iOS which is not designed specifically for hypothyroidism however it is extremely applicable to it as it allows you to track intake of food, medication, drink, sleep, symptoms and other conditions to track how they affect you.

One thing I think it does well is that it tracks what symptoms you have and what you have them after and attempts to predict what will cause you problems. Meaning that it works with you to work out what causes problems which if it correctly guesses the problem you can remove the substance or issue and see if the symptoms disappears and then bring it up with your doctor which would be extremely useful.

Beyond this analysis however it does not do reminders for medication or anything else. It is essentially a smarter, more high tech version of pen and paper. This however is not a bad thing but I think the potential of this program is wasted when they could easily add so much more and make a much more in depth and useful app. I do realise however that it is designed as a generic tracker rather than as an aid for a specific condition.

# 7. THE SOLUTION APPROACH

# 8. IMPLEMENTATION

# 9. TESTING: VERIFICATION AND VALIDATION

# 10. DISCUSSION: CONTRIBUTION AND REFLECTION.

# 11. SOCIAL, LEGAL, HEALTH, SAFETY AND ETHICAL ISSUES

# 12. CONCLUSION AND FURTHER IMPROVEMENTS

# 13. REFERENCES

|  |  |
| --- | --- |
| [1] | Salubrious Ltd, “Butterfly,” Salubrious Ltd, [Online]. Available: http://getbutterfly.net/. |
| [2] | Statistia, “Great Britain iPhone market share.,” Statista, [Online]. Available: https://www.statista.com/statistics/288870/market-share-of-apple-iphone-in-great-britain/. [Accessed 2018]. |
| [3] | Statista, “Global market share of iPhones.,” Q1 2018. [Online]. Available: https://www.statista.com/statistics/216459/global-market-share-of-apple-iphone/. |
| [4] | SkyGazer Lab Ltd, “Google Play Store,” SkyGazer Lab Ltd, [Online]. Available: https://play.google.com/store/apps/details?id=com.mhs.mysymptoms&hl=en\_GB. |

# 14. APPENDICES