FitByte

Requirements Document

12/6/18
Jake Farrar
Jacob Lemon
Austin Pederson

Ana Paula Chaves Steinmacher

Dr. Kyle Winfree
Dr. Gregory Dominick

Accepted as baseline requirements for the project:

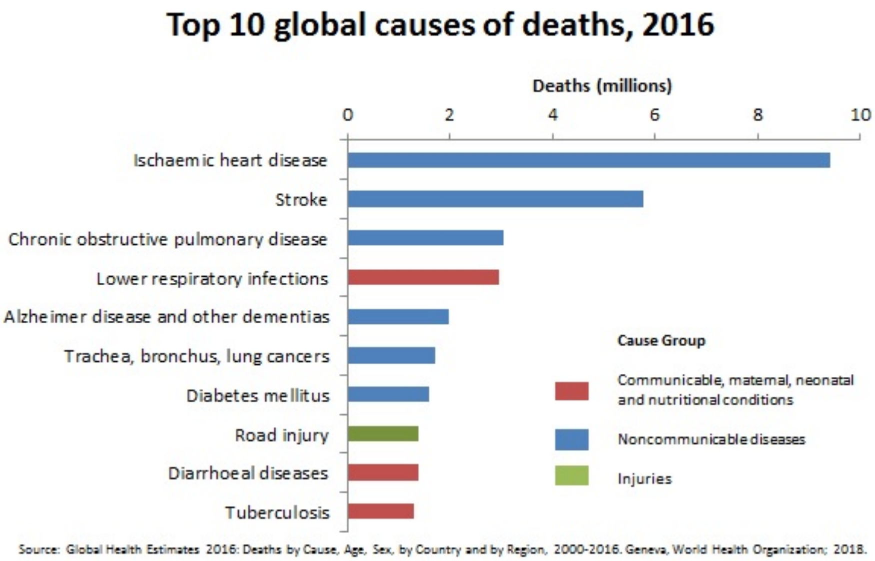
For the client: ________________________ Date: ________________

For the team: ________________________ Date: ________________

Table of Contents

1. Introduction

In 2016, the number one cause of death was ischaemic heart disease (**Fig. 1**). In fact, ischaemic heart disease claimed over four times as many lives as road injuries(**Fig. 1**). The fact that heart disease is such a big killer should motivate people to try and prevent it, and the easiest way to help prevent ischaemic heart disease is by completing at least 30 minutes of aerobic exercise five times per week. There are technologies that help motivate people to exercise and these technologies are usually in the form of a wearable. The most prominent example of this is the Fitbit.


Top 10 global causes of deaths, 2016

Source: Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016. Geneva, World Health Organization; 2018.

Fig. 1: Graph detailing top 10 causes of death across the globe in 2016.

Fitbit was established in 2007. Since then, Fitbit has enjoyed an enormous amount of success. In 2017 alone, Fitbit sold 15.3 million devices. The success of Fitbit is in part due to its social features. These social features are what help drive users to exercise. For example, users can challenge each other to competitions to see who can get more steps in a day.

This is very interesting to both our sponsors as they are both in the field of study having to do with human interaction with technology and its potential effects on fitness. Our sponsors are Dr. Kyle Winfree and Dr. Gregory Dominick. Dr. Winfree, a researcher at Northern Arizona University, leads the research centers on the use of devices engineered for therapies and assessment. Dr. Gregory Dominick is a researcher at University of Delaware whose research focuses on health-related topics.

They have been conducting research by giving their users Fitbits to wear for a month. This allows them to track all of the data that the wearable technology offers. Currently, they have a software called WearWare that grabs the data, and dumps it to a CSV. They are running into issues sifting through the data, sharing it, analyzing it, and giving their users feedback in a reasonable amount of time.

One of the glaring issues that our sponsors are facing is sharing the data with each other. They currently have no easy solution for sharing data. Another large issue is that the data that is acquired from the Fitbit devices can be somewhat unreliable, which means more processing is necessary on the data to ensure correctness. The last big problem Dr. Winfree and Dr. Dominick have is that it is difficult to assess the data in real time, so they can determine who needs to be contacted in order get them back on track.

Team Fitbyte consists of Jake Farrar as Team Lead, Jacob Lemon as QA and Enforcer, and Austin Pederson as Web Designer and Code Base Manager. We have been tasked with helping Dr. Kyle Winfree and Dr. Gregory Dominick with their research about the functionality and accuracy of Fitbit data. Their current issues are regarding sharing data, analyzing data in realtime, and keeping users motivated without having to manually check up on their participants. Their research has proven that Fitbits data has some flaws that need to fixed. We will be creating a web API that allows the team in Delaware (led by Dr Dominick) to request data that is produced by WearWare in order to solve one of these issues. If our team has time, Dr. Winfree would like us implement our own way to dynamically analyze the WearWare data and send users motivational SMS text messages.

In this document, we will be covering the requirements that our software must meet in order for us to fulfill our obligations to our sponsors. We will start with a statement of the problem our sponsors have. That will be followed with a section describing our vision of our solution to this problem. We will then discuss the actual requirements for this project. This section will be followed by a section outlining all potential risks associated with our software. A brief schedule will be laid out in the next section. The last section will be a conclusion and recap of what we have discussed in this document.

2. Problem Statement

This section of the document will be used to outline the issues that our sponsors are currently experiencing. We will start this section by discussing the current workflows of our sponsors. This will be followed by a section highlighting the breakdowns, efficiencies, and any missing pieces contained within the current workflows.

2.1.Client workflow

2.1.1.WearWare

Dr. Winfree has currently implemented a solution with help from NAU employee, Mike Fell and it is called WearWare. This program runs on Mac mini and it’s goal is to get the data from Fitbit. This is shown below in figure 2.

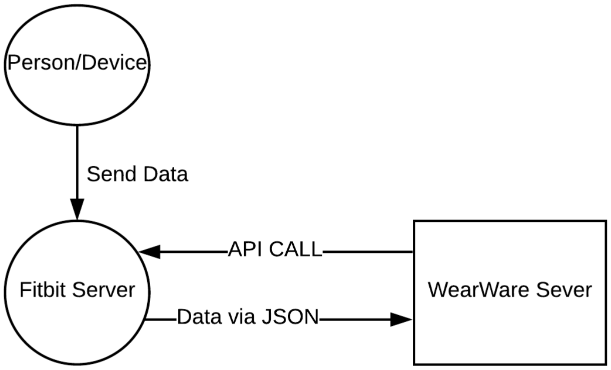


Fig. 2 : This shows the current workflow of Wearware.

Regularly throughout the day, a research participant’s Fitbit syncs with the app on their smartphone. This data is then regularly synced from the participant’s smartphone and sent to the Fitbit servers, where it is stored. Fitbit will hold that data and it can then be accessed via an API. The WearWare server will ask for the information from the Fitbit servers via the provided API. WearWare then stores this information in its own database. The WearWare program also has an interface that can be used to view all the information from all the participants it has data for. It allows for simple graphs to be created and shown to the user. The program is quite simple and is used by Dr. Winfree at this time.

The currently working solution has a few problems that both the team and Dr. Winfree have examined. The first problem is the Wearware storage is only accessible locally. It can only be retrieved if a person is on the NAU server and has the login information. This means that only Dr. Winfree and a few members of the team have access to the data. This leaves Dr. Dominick without direct access to the data, necessitating unneeded contact between Dr. Winfree and Dr. Dominick. Another step is then required after this contact, which is Dr. Winfree gathering the data requested by Dr. Dominick, exporting the data requested by Dr. Dominick, and then sending that data to Dr. Dominick. This ends up with a lot of time being wasted. Dr. Winfree also has a problem with WearWare being unable to communicate to the wearer of the fitbit. This can result in bad data for any study that Dr. Winfree is currently conducting. For example, a participant could take their fitbit off in order to take a shower and then forgetting to put it back on. This could lead to large swaths of data being missed before Dr. Winfree has a chance to sit down and view the data to ensure it is all being collected. The next problem is that the graphs created take a long period of time to construct since they have to view a file with a large amount of data and find the correct info. The user is left with a screen that just has a spinning icon for upwards of 10 minutes. These issues with WearWare provide an incomplete solution for Dr. Winfree and our goal is to help him solve his concerns.

3. Solution Vision

This section of the document will outline our vision for a solution to the problems outlined in Section 2. This will be a general overview of our solution. A more complete and detailed outline of our envisioned solution will be provided in Section 4 of this document. We will start with a very general overview and then we will go into slightly more detail about each piece of our solution.

Dr. Kyle Winfree did an excellent job outlining the problem and his ideas for a potential solution. He wants us to create a web API that allows the team in Delaware to securely fetch data that has been produced by WearWare. This is the MVP for the project and should be the most important aspect in our research. As soon as we are able to complete the web API, we can move on to implementing a way to analyze the JSON file provided by WearWare. This would include the use of programs such as Octave, and if all else fails, Matlab. This data analysis software would allow us to read in a JSON file, analyze the data, and spit out an output. Based on the output that was generated, we would send the user an SMS update if they are making poor progress to a goal, or have been sitting for long period of time.

Our envisioned solution will contain all parts the parts that were just discussed. These parts may be all physically located on the same machine, or may be distributed and only connected in that they are part of the same software system. To recap, these parts are as follows: a web API, real-time data analysis, SMS messaging, and UI improvements. These parts will interact together to create a cohesive software system.

The API will be able to be called upon by authorized users, specifically keeping in mind researchers at University of Delaware, in order to return data data from specific studies. This data will be retrieved from the database located here at NAU.The data will be transformed into the JSON format via Python code. This will increase productivity for both of our sponsors.

The real-time data analysis will be used to identify and reduce inconsistencies in the data. It will also be used to help increase participant adherence to FitBit usage guidelines. The data to be analyzed will be retrieved from WearWare.

After data analysis has been completed, SMS messages will be sent if it is deemed necessary. These messages will be sent to participants not adhering to participation guidelines, in any study. The SMS messages that are sent using our software will be sent using a program such as Twilio. These messages will be used to encourage users to continue adhering to the guidelines, and will completely remove the necessity for Dr. Winfree to hire anyone to manually analyze the data and send the SMS message.

The UI improvements will pertain to the existing WearWare web interface. Our UI improvements will be used to increase the efficiency of the web interface and decrease the inconsistencies in the web interface. This will improve the workflow of Dr. Winfree by reducing the time he has to search for the functions he wishes to perform (i.e. searching for a way to download CSV files for a certain study). This will also improve the workflow of Dr. Winfree by reducing the time that he spends waiting for the CSV files to be generated.

4. Project Requirements

4.1. Functional requirements

4.1.1. Access of Database

User	Researchers, Others requesting the database, WearWare server
System Before	The server is notified that another server wants data.
Flow of Solution	Wearware will connect to the database and be processed in FR 4.1.2.
System After	The server returns to where is was before the notification.
Error Handling	Wearware will be alerted if the database can’t be accessed.

4.1.2. Retrieving Information of Database

User	Wearware Server
System Before	The server is notified that a specific amount of time has based and database needs be accessed.
Flow of Solution	Wearware will connect to the database. The correct information that the server requested will be returned.If need be analyzed through a program (FR 4.1.3).
System After	The server returns to where is was before the notification with the data retrieved.
Error Handling	The researcher will be alerted if the data they requested is not there or the database can’t be accessed.

User	Researchers logged into Wearware
System Before	The server is notified that the database needs be accessed.
Flow of Solution	Wearware will connect to the database. The correct information that the researcher requested will be returned.If need be analyzed through a program (FR 4.1.3).
System After	The server returns to where is was before the notification with the data given to the researcher.

Error Handling	The researcher will be alerted if the data they requested is not there or the database can’t be accessed.

User	Other servers asking for data from the Wearware server
System Before	The server is notified that the database needs be accessed.
Flow of Solution	Wearware will connect to the database. The correct information that the other server requested will be returned.The data will be sent via JSON format.
System After	The server returns to where is was before the notification with the data sent out.
Error Handling	The other server will be alerted via JSON if the data asked for can’t be retrieved.

4.1.3.Analyzing Data

User	WearWare Server
System Before	The server is notified that the data check needs to occur.
Flow of Solution	After satisfying 4.1.2., the data will be sent to an data analytics tool to be processed. The tool will provide information that will determine details for FR 4.1.5.
System After	The server returns to where is was before the notification.

Error Handling	The server will be alerted if the data asked for can’t be retrieved or if the processed data was not retrieved where it will try again after a set amount of time.

User	Researchers logged into WearWare
System Before	The server is notified that the data wants to be analyzed.
Flow of Solution	After completing 4.1.2, the researcher will have the data and they will be allowed to request for the set to be analyzed by the program.The data that is analyzed will be sent to the researcher to view.
System After	The server returns to where is was before the analysis.
Error Handling	The researcher will be informed if the data asked for can’t be retrieved or if the processed data was not retrieved

4.1.4.Web Application

User	Researchers logged into WearWare
System Before	The server researcher asked the server to view a data set

Flow of Solution	While completing 4.1.2 & 4.1.3, the user will be prompted in someway that the data is being prepared and will be notified again when the data is fully analyzed.
System After	The server is now on the page with the completed data for the user.
Error Handling	The researcher will be informed if the data asked for can’t be retrieved or if the processed data was not retrieved.

4.1.5.End User Notification

User	Users in the study
System Before	The server analyzed data and a condition occurred from the analysis.
Flow of Solution	After completing 4.1.3, the server will call a program to send the user a text based on what condition was met. They can be both positive or negative.
System After	The server is back to where it was before the call.
Error Handling	The server will tell the researcher that incorrect number was input into the database and it needs to be updated..

4.2.Performance

The performance of our web API will depend on where it will be hosted. At the current state, we will be hosting on a Mac Mini in the SICCS building. Performance will be increased based on getting access to AWS and a better machine. The API may see poorer performance with the use of the current server and the increased workload of 30,000 more participants from the American Cancer Society. The increased activity will be easily accommodated with increased equipment.

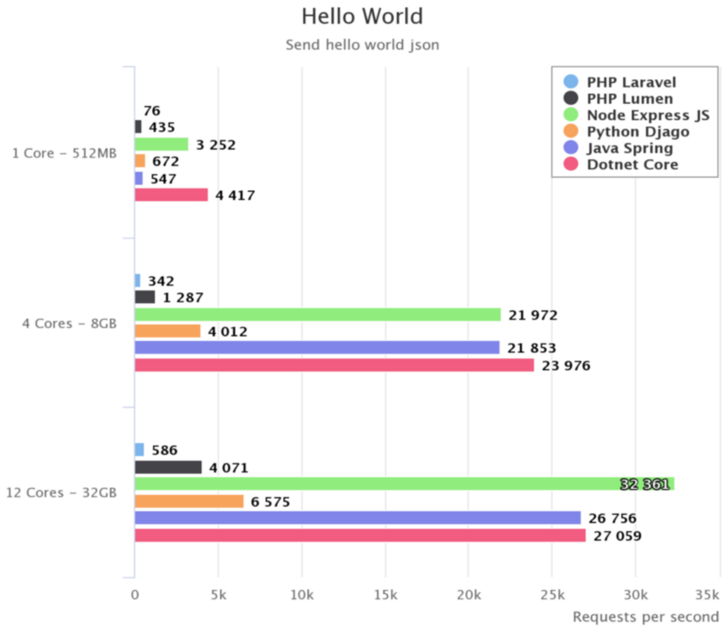


Fig. 3 Requests per minute using different frameworks

Above(Fig. 3) is a graphic that shows the potential requests per minute using Django. With a fairly standard system, we should be able to handle about 4,000 requests per minute. Because the API should only be access by, at most, a few hundred admin users, Django should be able to properly handle all of the traffic that it is going to be receiving.

4.3.Environmental Requirements

The project already has a current working solution. The solution uses Django so in order to keep the same framework. Dr. Winfree has expressed that Django should be used. The server for Wearware is currently being hosted on an Amazon server and with the amount of potential data it should remain being hosted there.

5. Potential Risks

In this section of the paper, we will focus on the potential risks that our software faces. For the purpose of this paper, we define a risk as something that presents a threat to our software that we cannot control. According to this definition, the only risk associated with our software is that our software could need to scale quite rapidly to a potentially much larger user base.

Currently, our sponsor has only a handful of people that would be accessing our software. However, it is possible that our software would need to scale in order to allow far more users access to it. We were recently informed by Dr. Winfree that he spoke with the American Cancer Society and they are interested in his research with FitBit data and the potential extensibility of WearWare to any studies that the American Cancer Society is currently conducting. When we spoke to Dr. Winfree, he stated that this was a very new potential reality and that we should continue as if nothing had changed, but that we should keep in mind scalability. If this risk were to become a reality and we were not prepared, it could lead to immediately making our software obsolete. Dr Winfree has also mentioned the API may be moved to and hosted on AWS. As a team, we feel prepared to handle the change and do not suspect any major change to our development plan.

6. Project Plan

6.1.Overall Goals

In this section, we will discuss the plan to carry out the project. The first thing we need to do to get started with our project is getting access the hosting platform(likely AWS) that we plan on using. We will then create a simple mock web API with Django that is able to handle basic requests for sample CSV data. After this, we will try and expand our simple API to handle some of the scenarios that will be seen within the sample CSV data from Mike. Our team will continue to flush out our Web API until it is fully functional and able to handle all of the data that is required. This will allow us to continue moving forward and begin analyzing the data with a data analysis tool. We will use the tool to import and analyze the data to find trends between the different data sets. Once the analysis work is finished up, we can move into to sending SMS messages to the users that will update them with motivational fitness messages. We hope to have all of this done by Spring Break. The remaining time in the semester will be spent testing and revising our solution to ensure it meets the standards outlined in this document.

6.2.Milestones

1) Get access to AWS
2) Create a mock web API
3) Implement mock API into AWS
4) Extend the mock API to sample data
5) Use a data analysis tool to analyze data
6) Use a text messaging service to send SMS
7) Test and Refactor.

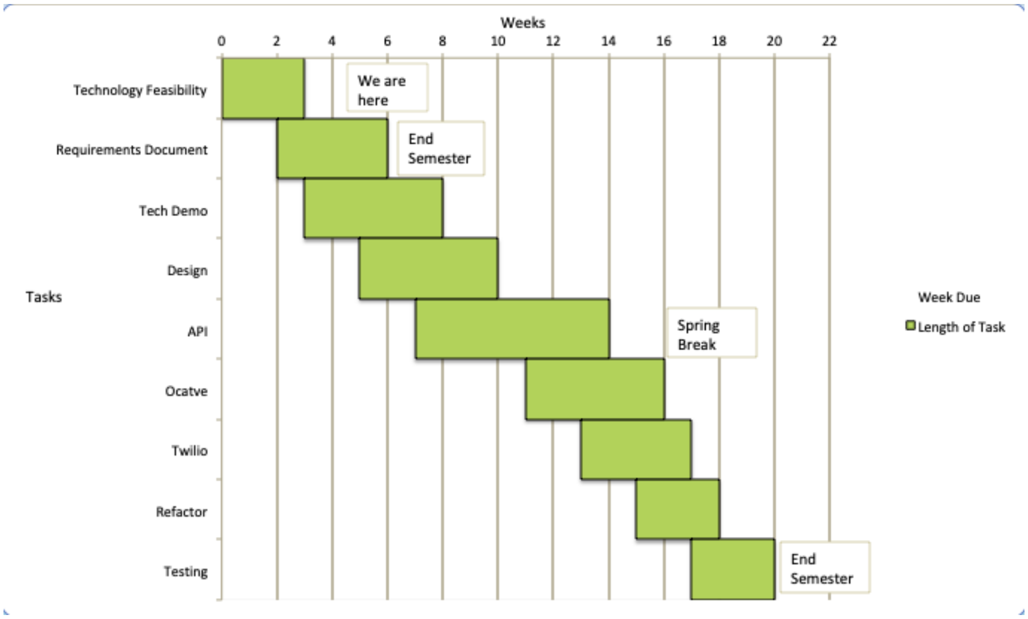


Fig. 4: Gantt chart for outlining our project timeline

7. Conclusion

In conclusion, this project is important to Dr. Winfree and Dr. Dominick because it will save them time and allow them to expand their research base. It will allow them to increase the number of actively watched participants from three or four, to upwards of tens of thousands. Our project will also allow them to request data remotely instead of only at NAU with NAU ID’s. Dr. Winfree wants us to create an API that allows Delaware to send a request to our API which will retrieve data from Wearware and send it to them in JSON format, safely and securely. We also plan to improve the overall look and functionality of wearware as a whole. The team plans to implement all that is listed in the project requirements above. Our plan for approaching the problem is going to be done through the use of milestones which are also stated above(Fig 4).

Our team feels confident with all of the technologies that we have researched. Each technology that we have found fits nicely into place without us having to try and stretch and accommodate something that will not likely work. Our next steps are to attempt to mock up simple examples that relate to our problem to verify that all of our technologies are the right fit. Our team is very optimistic with the outcome of this project after all of the research we did on all of the various technologies.