Department of Computer Science
University of Hong Kong
Final Year Project

Project Plan

Development of a smartphone app and website for prediction of coronary heart disease risk (Industry-based Project)

Students:
Hadipranata Mellisa (3035663019)
Harney Vieri (3035663368)
Chan Hay Yin (3035686047)
Hom Long Hin (3035692450)

Supervisor:
Dr. Loretta Choi
1. Outline
This report will first introduce the background and objectives of this project. The potential methodologies for platform set-up, front-end service and UI design, and backend service and database design will then be provided. A clear project schedule will also be shown, followed by a brief conclusion of the report.

2. Background
In the last 60 years, heart-related diseases have been the third most common cause of death in Hong Kong, with coronary heart disease (CHD) as the leading cause. According to HealthyHK, a daily average of around 10.5 people died in 2020 because of CHD. The risk of developing CHD is affected by lifestyle factors (e.g., BMI, blood pressure) and genetic factors. With the recent rapid technological advancement, CHD risk prediction can be monitored in real time by integrating genetic risk information and activity data collected from a wearable fitness tracker. Together with the School of Public Health of The University of Hong Kong, this project aims to provide an accurate, intuitive, and user-friendly platform that allows users to self-monitor their risk of developing CHD.

3. Objectives
The main objective of this project is to promote self-awareness of one's risk of CHD and how a change of lifestyle may lower it. The goal is to build a cross-platform smartphone application that allows users to constantly self-monitor their CHD risk prediction according to their wearable-determined physical activities. This project will mainly use users' activity data through Fitbit and user-input data to calculate the prediction of CHS risk which may change over time. Since the target user for this application varies in age, this project aims to deliver an application that is easy to use and with a seamless UI/UX design.

4. Project Methodology
This section of the report will explore the methodology that will be used for this project, i.e., how the project will be set up and what tools will be used to build the final product of the project. Some of the initial set-ups that must first be done before the project can be carried out effectively are as follows:
4.1 Equipment / Platform set-up

This project deals with a prediction algorithm which will be further explained in subsection 4.1.1 below, as such, relevant data first need to be collected which upon further processing will act as input to the algorithm. Hence, this section will discuss the equipment and set-up of this project to collect the necessary data for this project.

4.1.1 Prediction Algorithm

This project will not be focusing on the building of the algorithm for risk prediction. The algorithm has been developed by Dr. Youngwon Kim’s team from the School of Public Health at The University of Hong Kong. Our team will translate the algorithm into code and perform the calculation in our application. The prediction will be based on a series of equations that take into account several factors, such as multiple lifestyle indicators including physical activities and genetic risks.

4.1.2 Fitbit

As the algorithm requires the user’s physical activity data as part of the input, some kinds of hardware will be needed for the collection of the data. The hardware will need to collect the user’s physical activity at all times and other health-related data which will be further discussed in more detail in the following sub-section. Collecting this kind of data is no longer difficult in today’s day and age with the advanced development of smartwatches and the accessibility of different brands. In the interest of time, this project will primarily focus on integrating data from one smartwatch brand. Given its affordability, compatibility with popular phones and tablets, and ability to provide all the essential data for the prediction, Fitbit is an ideal choice for this project. Furthermore, Fitbit is one of the most used fitness trackers in the world, therefore, it adds credibility to the accuracy of the data collected for this project. According to the record in 2021, a total of 111 million users were registered in the Fitbit database.
4.1.3 Physical Activity Data

As aforementioned, the collection of users’ physical activity data is essential for this project. This physical activity data will be collected from the hardware as mentioned earlier. Another important aim to consider in this project is to show the importance of physical activity and its correlation to changes in chronic disease risk. Hence, the physical activity data of the user plays a vital role in this project. Some of the physical activity-related data that will be collected through the wearable include, steps taken in a day, average heart rate, walking distance, and running distance. The physical activity data will be collected regularly, and a comparison can then be made during different activities level and ultimately shows how a healthier lifestyle can help reduce the risk of developing CHD.

4.1.4 User Input Data

Aside from the activity data retrieved from the Fitbit watch, the CHD risk prediction calculation also considers health-related user-input data, such as age; sex; body mass index (BMI); smoking status; alcohol consumption; dietary intake; medication use of cholesterol; blood pressure; and insulin. Upon user creation, users will have to answer a series of basic questions relating to their general information and health conditions, and this data will be used as the foundation for the prediction calculation. Users may also input their direct-to-customer (DTC) genetic test results into the app. Another option for inputting the data is by syncing the data already stored in the user’s Fitbit profile with our application.
4.2 Frontend and User Interface Design

The main goal of this project is to develop a smartphone that can run on both Android and iOS. In order to achieve the best app performance on both platforms, it is better to use programming languages native to their respective platforms. However, developing the same application on different codebases consumes more time. Considering the limited time frame of this project, React Native is a preferable choice since it can run both on Android and iOS. Having a single codebase for a cross-platform application can also promote consistency in features and design. Additionally, React Native also allows the development of web apps in the same codebase as its mobile counterpart. Although applications developed in React Native may not perform better than Native applications, this project will not include heavy animation or heavy computation, which makes React Native a safe choice. Also, considering the fact that quite many popular brands (e.g., Facebook, Instagram, Bloomberg) are already using React Native, the performance of React Native is acceptable for this project.

The initial design of the final deliverable of this project is shown in the figure above. We are planning to have a simple, yet effective UI to allow users to understand the data that has been processed easily. We also want the UI to be attractive and easy on the eye but also efficient at the same time. Furthermore, some extra features will also be implemented in the application such as health articles, diet articles, etc. It is important to note that the final design of the mobile application might change in the future as the development progresses (i.e., implementation of additional features currently not mentioned).
4.3 Backend and Database Design

As the mobile application deals with extensive data and a series of calculations, we have decided that the calculation would be best done in the backend of our application. As such, API endpoints will be developed and provided for the client side to return relevant data accordingly. The reason behind this decision is that the application will be storing raw data in the same server as our backend. Therefore, it is more sensible for the calculation to be done in the backend because the result will be immediately stored in the backend as well. Furthermore, the calculated result will be used in the future as well for the comparison feature of changes in chronic disease risk. Doing the calculations on the client-side would mean that once calculations are done, data will need to be sent back to the server, hence, making two API calls (i.e., one to get the raw data and one to send the final calculated data back to the server) as compared to one if the calculations were done in the backend.

However, it is important to keep in mind that by doing the calculations in the backend, the app responsiveness and user experience will be relatively worse as the client will need to wait for the API to produce the corresponding result.

The server-side of the mobile application will be developed in **Firebase and Firestore**. The client-side will communicate with the Firebase server which will act as a backend service to the application. The reason behind choosing Firebase, a service made by Google, is because of its availability of detailed documentation and also its support for mobile application development. Firebase also offers a ton of features that will help the development of mobile applications, which includes authentication, cloud hosting, and storage. Furthermore, it has an integrated database feature called Firestore, a NoSQL database, as mentioned earlier. The close integration between the database and the backend service will help not only performance but the availability of documentation for development. Lastly, Firestore is also very easy to set up and is very scalable.
4.4 System Architecture Design

This section will explain how each component explained in sections 4.2 and 4.3 earlier will connect and integrate to form the final product of this project. The initial system design of our mobile application is shown in the figure below. Note that this is still a high-level system design at this stage of the project. The system design might change and increase in terms of complexity as the project develops.

4.4.1 Fitbit API

The application will be communicating with Fitbit through the API endpoints that have been provided by the Fitbit developers. Upon user creation, the user needs to go through user authentication and agree to share his/her data from Fitbit to our application. The application will then retrieve data from Fitbit by calling the APIs from time to time to update the risk prediction.

4.4.2 Client-Side

As mentioned earlier in section 4.1.4, in addition to the data collected by the Fitbit API, users will also need to input other health-related data. The user-inputted data will be sent to the server to be stored in the database. The frontend service will call Fitbit APIs from time to time and store the data in the front end. The frontend service will send the data collected from Fitbit to the backend service for prediction calculation.
4.4.3 Server-Side

The server side will act as the brain of the application, it will do the computation while also storing relevant data for each user accordingly in the database. Upon client request for the risk prediction, the server will perform calculations based on the user-inputted data from the database and the Fitbit data from the front end, and then send the results to the front end.
5. Project Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Milestones</th>
</tr>
</thead>
</table>
| **October 2022** | - Detailed project plan  
- Project web page  
- Finalized app architecture  
- Finalized UI design  
- Set up database |
| **November 2022** | - Complete basic UI (Front-end)  
- Fitbit API integration |
| **December 2022** | - Disease risk prediction algorithm implementation  
- Complete basic app features (e.g., account creation, user data input) |
| **January 2023**   | - First presentation  
- Preliminary implementation  
- Detailed interim report |
| **February 2023**   | - Additional features implementation (e.g., health article page, personalized health tips) |
| **March 2023**      | - Finalized web platform |
| **April 2023**      | - Finalized project web page  
- Finalized tested implementation  
- Final report  
- Final presentation |
| **May 2023**        | - Project exhibition |
6. Conclusion
Coronary heart disease will continue to take more lives if people are not aware of the risks earlier in life. One of the key catalysts to increasing one’s longevity is by preventing common chronic diseases such as coronary heart disease from developing. With the right methodologies and implementations, this project will promote self-awareness of one’s coronary heart disease risk in the hope to encourage one to take action and lower his/her risk.

References
Heart Disease Related

Development
1. https://reactnative.dev
2. https://firebase.google.com