School of Engineering Science, Burnaby, BC V5A 1S6

January 22nd, 2015

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 440 Project Proposal for Health Reporter
Dear Dr. Rawicz

Proposal for Health Reporter, attached below gives an overview of our project for ENSC440W. The goal of our project is to give people an alternative way to perform regular health check-ups at home instead of a need of going to clinic or booking appointment with family doctor.

The proposal below demonstrates our design infrastructure, market planning, source of funding, anticipated budget, and project planning. Also, this proposal will give a detailed future plan after we finished the prototype of Health Reporter.

D-Health Solution Inc. is a collection of five engineering students' knowledge and passion. Jue(Carter) Chen, Simone Liu, Janice Mardjuki, Kai Geng, Xing Qiao. We will dedicate our best effort to this project. If you have any questions or concerns about our project. Please do not hesitate to contact us. My phone number: 604-728-7157 or E-mail: carterc@sfu.ca.

Yours Sincerely,

Jue Chen

Jue Chen
CEO
D-Health Solution Inc.

Enclosure: *Proposal for Health Reporter*

Proposal for Health Reporter

Project Team: Jue(Carter) Chen
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Submitted to: Dr. Andrew Rawicz
Steve Whitemore
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Executive Summary

33% percent of patients waiting for more than 6 days just for an appointment with family doctors. We starting with this number because the patient in real life, who does feel an unexpected level of uncomfortableness need to wait more than a week for an appointment. Therefore, people have mild symptoms of cold or fever at the beginning and may last for a week. They tend to just get rest at home instead of seeking a doctor until the symptoms become more and more serious. And we all know, there are a lot of severe diseases come first with mild symptom such as slightly body temperature changes. That is why regular health check should be performed for everyone, especially the patients with medical histories. In fact, because of the unreasonable waiting time for medical services, not many people perform their regular health check. The provision of medical services becomes a remarkable problem in Canada and worldwide. That is the reason for us to bring up the "Health reporter" to families, hospitals, nursing home and so on.

"Health Reporter" will provide body monitoring by 5 different sensors, including pulse and oxygen sensor, body temperature sensor, patient position sensor, air flow(breathing) sensor and galvanic skin response(sweating) sensor. It will detect and predict emergency situations of patients, send notifications and process real time data to smart-phone or laptop. We also implement Face detection by add-on camera module. With the camera add-on, we provide two identification methods for logging in, face detection and password authentication. Additionally, we will upload the clients' personal data to server so our clients can access it anywhere around the world as long as they have internet access.

Since our product is mostly related to biomedical field and working closely to human body, we will research on different biomedical papers and will consult professors in related areas to verify our algorithm for data analysis. Additional to biomedical area, this project also includes computer networking, analog and digital signal processing, server side development and mobile application development. We five engineering students who are passionate and knowledgable to this project.

We will follow the agile software development process for this project including serveral milestones. The whole process will take 12 weeks, which includes finalizing requirments, design, implementation, verification and maintenance. The official completion date for "Health Reporter" is April 3rd, 2015. The anticipated budget for this project is 885 canadian dollars.

D-Health Solution Inc.

Table of Contents

1. Introduction

85% of Canadians age 12 and up reported having regular family physician but there are people who have reported difficulties in accessing resources for routine check-ups and ongoing health care. 45% of them reported of having to wait for too long for an appointment, and 33% of them reported to wait six or more days. The problem does not end here; some of them would require further medication and follow-ups. [1]

There are many complex problems that attribute to Canadians having to wait longer times for medical check ups. This is the reason why Canadian's health institute require a lot of improvements on their whole system in order to reduce the wait-times. Here are some of the reasons:

- The services are organized very poorly: inefficiencies and lack of coordination while delivering services and lack of planning.
- The shortages of health care workers: health care in Canada is unaffordable since Canada provides their residents free health check-ups.
- Physicians does not working in teams: most of doctors work independently; so all appointments and procedures are managed individually, which resulting in delays and inefficiencies.
- Cuts to hospital services: the Canadian health institute reduced the hospitals between 1988 and 2002
- The need for longer-term health care and home care: the increased of under-funding of home care and residential long term care.
- Better outcomes: while Canadian health care institute tried to improve their services, so more people can get more benefit for them, there are opportunity cost to this such as lack of funding. [2]

A survey was made in 1998 from Queen's Health Policy of health care providers, administrators and consumers, inadequate funding was ranked as the primary factor that contributes to this wait times. The other factors are:

- Aging population
- Ineffective management of current resources
- Hospital restructuring
- Health care provider shortages
- Restricted access to technology
- Past failure to invest in prevention
- Patient expectations [3]

Based on the result on this survey and reasons of the longer wait time for Canadians to obtain their rights, which is regular medical check-ups, we decided to establish this company in order to create a product that is able to improve the system of the health care these days.

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2. Market Planning

"*33% patients waiting for 6 days to see a family doctor.*" [1]
"*Up to 15% of Canadian do not have family doctor.*" [4]
"*60% of patients waiting for a month to see a specialist. When some of the patients finally get a seat in the specialist's office, they figure out that their family doctor has not send over their lab results.*" [4]
"*Canada ranked last among OECD countries in health care wait times.* "[4]

Some people may believe those are just rumours. But even if those are rumours, they come out for reasons. Our whole medical system do need improvement, including family doctors, lab specialists, Hospital, Nursing Home, School medical room and so on.

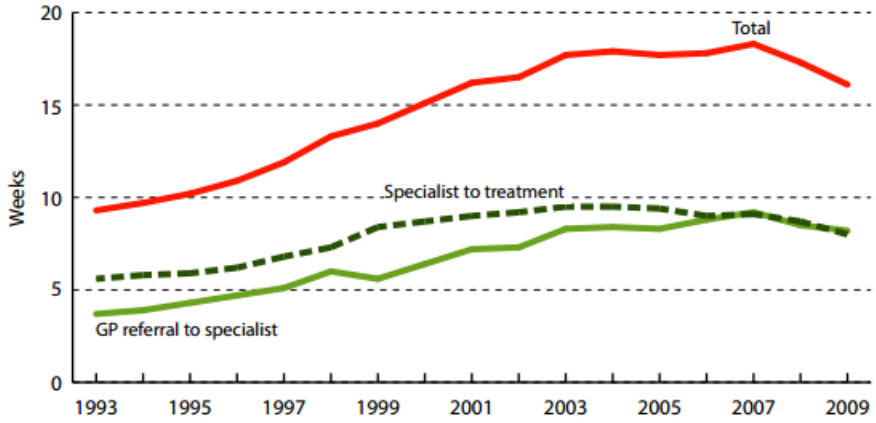

Figure1. Median waiting time for care, Canada, 1993-2009[5]

The figure shown above is the reason why "Health Reporter" should be seating in everyone's house. First of all, we provide a quick and accurate check of your body conditions like temperature, pulse and oxygen in blood, skin response and body position. Everyone can do it in their home instead of picking up phones and book appointments with doctors. Then we store those data by hourly, daily, weekly or monthly by clients' preference. Additionally, we upload client's data to the server. Therefore Clients can check their personal data anywhere around the world as long as they have internet access. Also doctors and nurses associated to our clients can check those data. By utilizing the power of database and server, our people will have better experience when they trying to analyse whether their health condition is good or not.

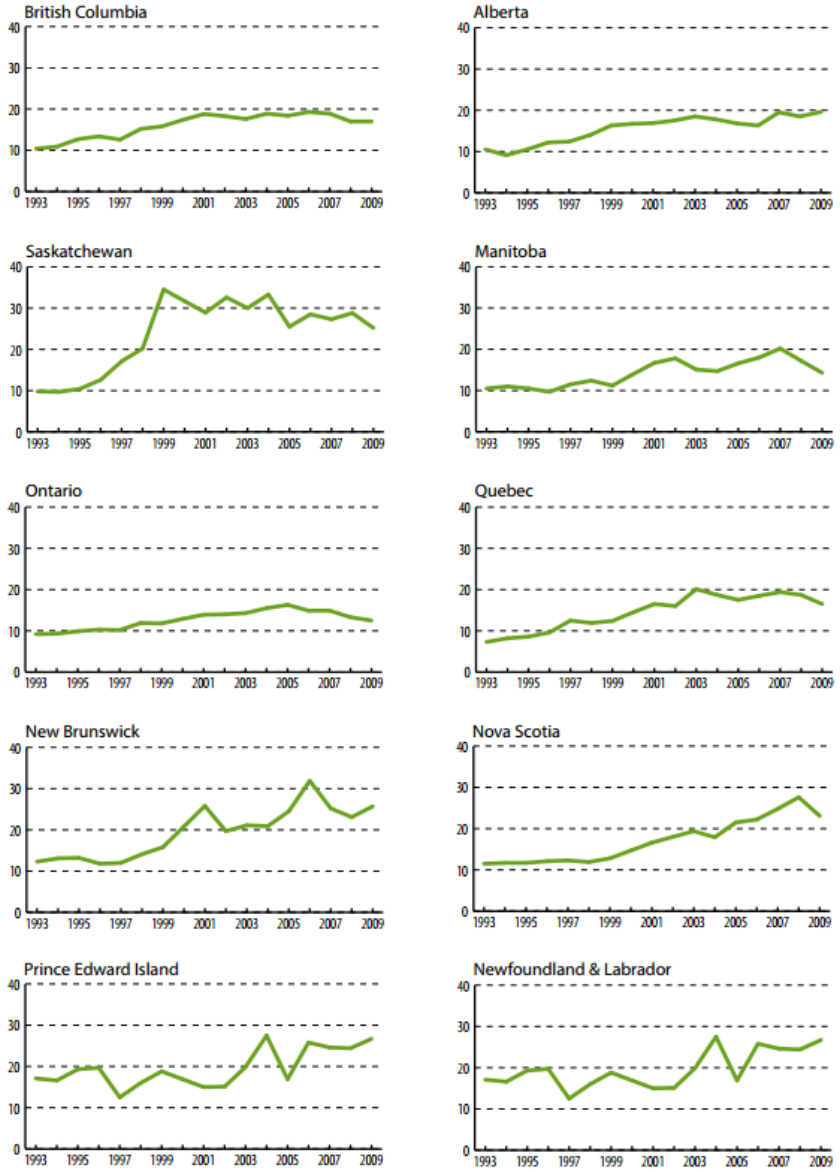

Figure2. Median waiting time for care by province, Canada, 1993-2009[5]

According to figure 2, the waiting time in middle area of Canada are extremely high compared to west and east coast. Our product should first be introduced to those area with longer waiting time. To see whether our product can significantly reduce the waiting time or not. Just like if you are 400 lbs, it is easier for you to losing weight compared to those people who are just 100 lbs and still trying to diet. Additionally, not only Canada has problem with medical services, other countries are also suffering from it. Because medical service is really a specialized area that only well trained staff can suit the position.

So limited amount of people can become doctors or nurses. But the number of request for medical services and treatments are always huge. So the second area to introduce our product is the countries with huge population like China, India, USA and Japan.

As a summarization, we first introduce “Health Reporter” to the middle area of Canada and then spread to east and west coast, then to USA, and travel across continent to East Asia. Hopefully we can introduce our product to Europe and Africa but that is far away from now. Also, a lot harder because Europe has really advanced medical system and Africa is really price sensitive, also most area are still not well developed. Therefore Africa could be the hardest.

3. System Overview

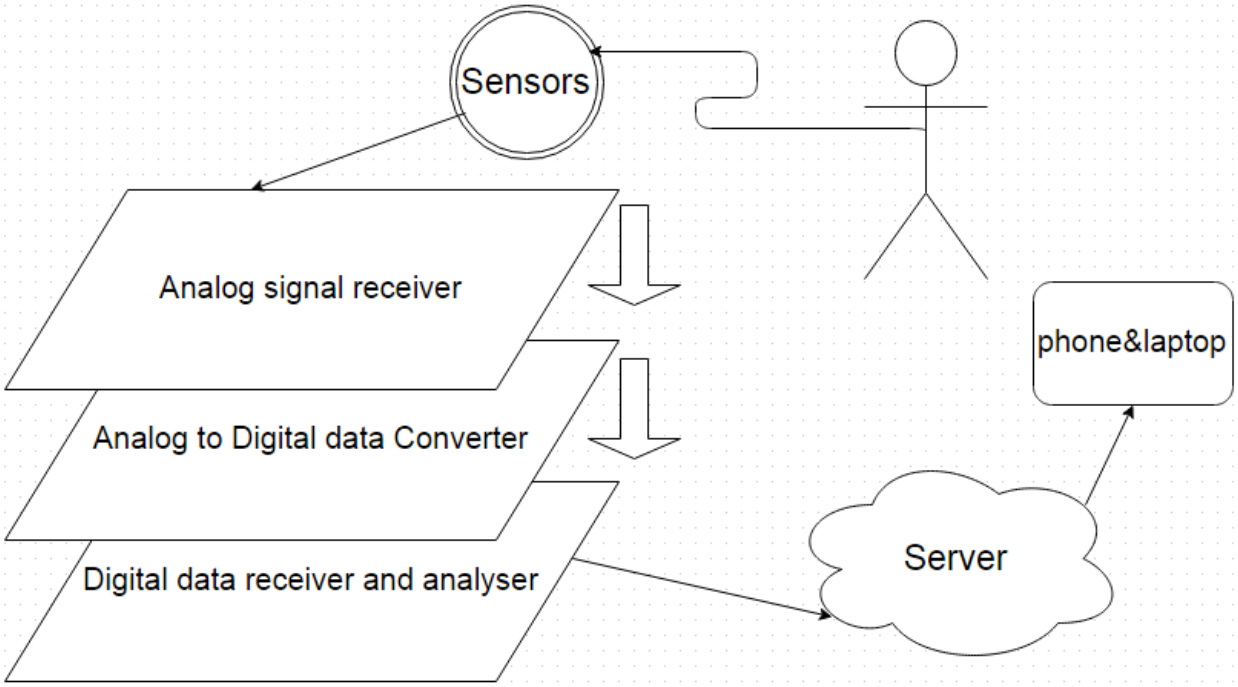

Figure 3. The high level overview of the system

Figure 3 illustrated the high level structure of our “Health Reporter”. Sensors are attached to human body in order to take samples like human body temperature, body position and so on. Then those data will be sent to the Analog signal receiver. However, data need to be in digital form in order to transfer to our server, smart-phone through Wi-Fi. Therefore we need to apply an ADC (analog digital converter) to our system. So the analog data captured by those sensors can be transformed to digital form and upload to our server. Finally our clients can read those data.

To summarize, the workflow of “Health Reporter” is
(1). Sensors get data from Human body
(2). “Analog Data Receiver” receives the analog data transferred from sensors.
(3). Analog data will be transformed to digital data by ADC (Analog Digital Converter).
(4). Then digital data will go to our “digital data receiver and analyser” through GPIO pins.
(5). Next, digital data will be uploaded to our server and smart-phone through wifi.
(6). Finally our clients can read the data by web-application on computer or smart-phone application.

4. Possible and Proposed Solutions

4.1. Sensor Implementation

4.1.1. Possible Design Solution

Nowadays, Wi-Fi has already find its own popularity among the entire human race. And that happened for a reason. It makes our daily lives connected to each other. We can read news by just pressing a simple button on the screen instead of looking at the newspaper. So in future, we can make every sensor to be wireless and can transfer data through Wi-Fi. Because of that, our clients will not be annoyed by those long wires connected with sensors anymore. Our clients can just simply let the sensor attached to their body and read data from smart-phone. The only thing clients need to do is to make sure that the distance between smart-phone and sensor is in the range of Wi-Fi transmission distance.

4.1.2. Proposed Design Solution

4.1.2.1. Body Temperature Sensor

As its name, it measures the body temperature. It is of significantly important to measure the body temperature because changing in body temperature is a main symptom for many severe diseases. When the body temperature is changing out of the normal boundaries, our device will report that to the server and finally reaches to the associated doctor in order to initiate the medical treatment as soon as possible.

4.1.2.2. Pulse and Oxygen in Blood Sensor

It measures the heart rate and detects the arterial oxygen saturation of functional hemoglobin in a non-invasive approach. Here the oxygen saturation means the rate of oxygen dissolved in blood. Measuring heart rate is also important to determine whether the client’s health condition. Any heart rate out of boundaries without physical action involved should be reported to the doctor to determine whether the client needs treatment or not.

4.1.2.3. Galvanic Skin Sensor

The sympathetic nervous system controls the sweat glands. Then when a pulse occurs to the nervous system, people will sweat. And then the conductance of the skin changes and that is how the skin sensor works. Generously saying, the Galvanic Skin Sensor is an ohmmeter.

4.1.2.4. Air-Flow Sensor

The Air-Flow Sensor detects the rate of airflow goes into the patient body. And that determines whether the patient needs respiratory or not.

4.1.2.5. Patient Position Sensor

The patient Position Sensor detects the patient body position: Sitting, Falling down, Left and Right. It will help the nurses to know whether the patients need emergency help or not.

4.2. Platform

4.2.1. Possible Design Solution

In future, the only platform we need is smart-phone. All sensors will be wireless and transferring data by Wi-Fi. Therefore, as long as the smart-phone has hot-spot function, sensors can data to our smart-phone. Then uploaded to server and can be viewed by associated doctors, nurses and clients. There will not be any more devices included in “Health Reporter”.

4.2.1. Proposed Design Solution

Since wireless sensors are still not available in the market, we need other platform to receive data and transfer the information by a medium, which is our project “Health Reporter”. We first receive analog data from all sensors and utilize an ADC (Analog Digital Converter) to transform analog data to digital. Then we transfer the digital data to “raspberry pi”, which functioned as digital data receiver and analyser. After that, the digital data can be transferred to server and smart-phone by wifi. Lastly, our clients can read those data by web-application or smart-phone application.

4.3. Web Server and Mobile User Interface

After data collection and analysis done by Raspberry Pi, we would like to develop a website which allows user to access their profile and history as well as a mobile application which provides notification and user data.

4.3.1. Possible Design Solution

Based on the ability of Raspberry Pi, there are several options for hosting a website. Raspberry Pi can be configured as a small webserver that will not receive too much traffic. Other than Raspberry Pi itself, there are different web-hosting methods such as shared hosting, dedicated hosting and cloud computing.

There are three main operating system that modern mobile application running on, which are Android, iOS and Windows. Based on the functionality of the application, it can be further divided into three categories, such as native apps, mobile web apps and hybrid apps.

4.3.2. Proposed Design Solution

Considering the fact that we have limited timeline and resources, we tend to choose an easy and less cost way to build our website and mobile application. With small amount of customers and less requirement of storage, we will use shared web hosting. We choose GreenGeeks as our web hosting company, which provides fast data access, competitive monthly plan, and various software features such as cPanel, Wordpress. On our website, we will provide user to access to their profile as well as real-time and historical sensor data.

As for mobile application, we will develop a hybrid Android app that can download data from the server, store and access the data locally. We will use Android SDK as our development platform as it has comprehensive APIs and gives user complete access to device capabilities. Our mobile application will send notification to registered user when their following user requires immediate help. User profile and sensor data are also accessible from mobile app.

With more time and money, we would implement data analysis using machine learning to detect and predict the user's health condition. We would also build an iOS application with the same functionality. As the scale getting larger and the traffic amount getting higher, we would change shared web hosting to dedicated web hosting. We would set up our own server in order to reduce the cost and guarantee fast simultaneously data access.

5. Sources of Information

For this project, we will obtain information from different fields. For sensor usage and data collection, we will get information from cooking-hacks website. We learn human body statistics standards and analysis from textbooks, online documents, and family doctors. Our resource for platform configuration would be online documentation, tutorials for e-Health Sensor Platform and Raspberry Pi. We can get help from support team and forum on various website. In order to develop our website and mobile application, we will be learning website development and android development from w3schools, codecademy, and Android developer site. We will be

also using our knowledge from previous experiences, asking Professors, Teaching Assistants and friends in certain area.

6. Budget and Funding

6.1 Budget

The table below outlines the estimated cost based on the information online. It shows our expected budget and the different category of component for our product “Health Reporter”. Small components are not included.

Equipment List (Include brand and model if applicable)	Estimated Unit Cost
Raspberry Pi starter kit with Wi-Fi dongle	$ 120
Waterproof temperature sensor with digital output	$ 45
Heart rate sensor with digital output	$ 120
E-HEALTH SENSOR SHELD V2.0	$ 180
RASPBERRY PI TO ARDUINO SHELDS CONNECTION BRIDGE	$ 105
GALVANIC SKIN RESPONSE SENSOR	$ 85
PATIENT POSITION SENSOR	$ 100
AIRFLOW SENSOR	$ 75
Raspberry Pi Camera Module	$ 55
Total Cost	$ 885

Table-1: Tentative Budget

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6.2 Funding

Due to the high cost of budget for our project, our team has considered various sources. Firstly, we are planning to apply for the Engineering Science Society Endowment Fund (ESSEF). If the first plan is not sufficient for the entire project, our team has discussed the cases and all of us have agreed to provide the remaining financial costs of our project equally. We will also be looking for other sources of fundings.

7. Project Timeline

Task Name	Start Date	End Date	Duration
Research and Planning	**01/02/15**	**02/13/15**	**31**
Documentation	**01/30/15**	**04/06/15**	**47**
Function Specification	**01/30/15**	**02/16/15**	**12**
Design Specification	**03/02/15**	**03/16/15**	**11**
Written Progress Report	**03/16/15**	**03/30/15**	**11**
Presentation/Demo Preparation	**03/30/15**	**04/06/15**	**6**
Assembly of Modules	**02/06/15**	**02/27/15**	**16**
Sensor integration	02/06/15	02/13/15	6
Platform integration	02/13/15	02/27/15	11
Software Development	02/06/15	03/20/15	31
Web Development	02/06/15	03/20/15	31
Mobile Application Development	02/20/15	03/20/15	21
Integration/Prototype Testing	03/16/15	03/31/15	12
Debugging and bug fixing	03/23/15	04/03/15	10

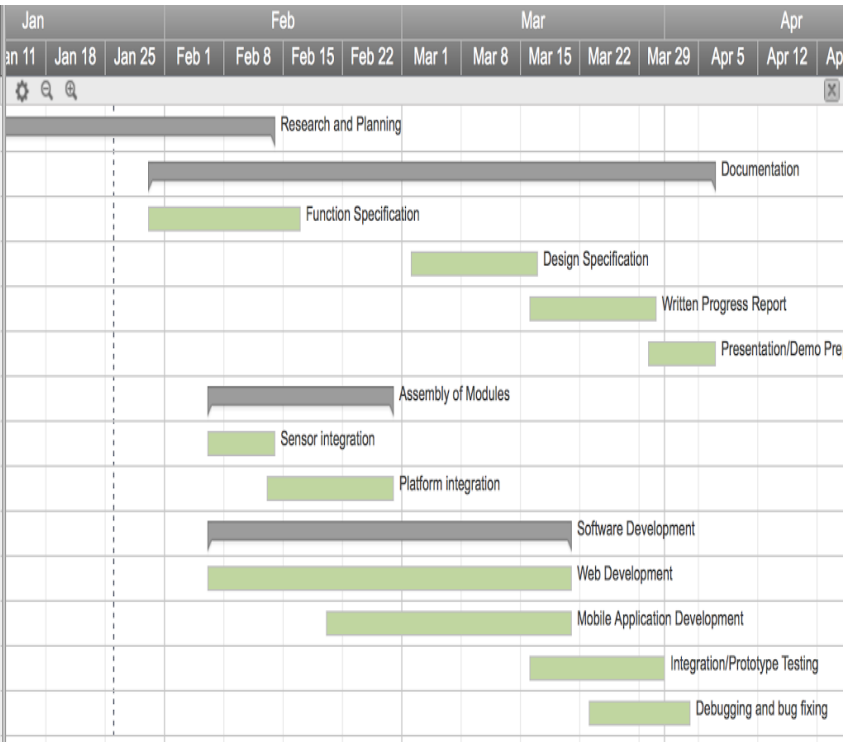

Figure4. Gantt Chart outlining project timeline and large milestones

8. Team Organization

D-Health Solutions Inc. is a company based in Burnaby, established in January 6, 2015 in Simon Fraser University; it provides solutions to the health care system problems in Canada. Our mission is to improve Canadian health care system, and provide innovative solutions to problems by producing revolutionary technology. D-Health Solutions consists of a group of five passionate engineering students; Jue(Carter) Chen, Simone Liu, Janice Mardjuki, Kai Geng, Xing Qiao, that are enthusiastic to develop ingenious solutions for health care technology. These five students are in their last year and have equipped themselves with unique experiences and are knowledgeable in many engineering aspects.

Each member will focus on the specific area of our project:

Jue(Carter) Chen as Chief Executive Officer(CEO) will focus on the overall progress of the project "Health Reporter". Also acting as problem solver, who will deal with either technical or organization conflicts.

Simone Liu as Chief Technology Officer(CTO) will focus on the whole system setup and function development of "Health Reporter".

Janice Mardjuki as Chief Information Officer (CIO) will focus on managing the information collected from internet, either technical or non-technical.

Kai Geng as Chief Financial Officer (CFO) will focus on budget controlling and funding issues.

Xing Qiao as Chief Operating Officer (COO) will focus on journal management and daily tasks organization.

9. Company Profile

Jue(Carter) Chen – Chief Executive Officer(CEO)

I am a fifth year Electronic Engineering Student at Simon Fraser University with 16-month coop and 8-month Lab Researcher experience. I gained my software development skills during my coop terms. Additionally, I have learned mechanical skills from the robotic arm project when I was a lab researcher. Those experiences really helped me transferring from a book-smart engineering student to be a real engineer.

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Simone Liu – Chief Technology Officer(CTO)

I am a fourth year Computer Engineering Student at Simon Fraser University. I have accomplished 16-month coop with three different companies: Sierra Wireless, Netgear and SAP. I also had experience as Research Assistant focusing on embedded system. I am familiar with embedded system, software development process, mobile application and front-end web application. I will be learning server side web development on the go. As a CFO, I will provide useful knowledge in system building and software developing.

Janice Mardjuki – Chief Information Officer(CIO)

Janice Mardjuki is a fifth year Electronics and Systems Engineering, with an extensional knowledge of Biomedical Engineering. She has many experiences in both and hardware in Biomedical aspect. She is proficient in many programming languages, such as C, C++, Objective-C, Python, VHDL, Assembly language, and Matlab. She has built numerous types of circuited design, including for microelectronics and biomedical instrumentation. As a CIO, she will be responsible for the information technology and computer systems in order to support the company goal.

Kai Geng – Chief Financial Officer(CFO)

I am a fifth year electronic engineering student at Simon Fraser University. I have experienced in variety of fields both hardware and software. In the past few years i took courses and studied about circuits, microelectronics, linear systems, feedback control and real time embedded system. I also have 12-month co-op experience with Blackberry. During my co-op, I was focus on the unit-testing procedure and components assembly. I really enjoyed designing and testing the product to optimize the results. As a CFO, I will exam the product the functionality and optimize it in all the area to make sure it is ready to release in the market.

Xing Qiao – Chief Operating Officer(COO)

I am a fifth year Computer Engineering student at Simon Fraser University with two co-op work terms in the Experimental Robotics Lab of SFU Burnaby campus and ACD Systems International. I am good at software development with various programming languages. More specifically, I developed image processing system and control program using C++ for micro robot in Robotics

Lab, and joined application development on iOS platform in ACD Systems Company. Through internship experiences, I am able to work in both individual and team environment. For the hardware, I have learned extensive knowledge in semi-conductor devices, analog and digital communications, and I am familiar with the operations of most electronics equipment used in the lab such as oscilloscopes, function generators, and spectrum analyzers.

10. Conclusion

Our projects aim to check and record people's health on time by providing a reporter which applies in hospital, nursing home and families. Health Reporter will detect their body situation in any place and memories for each people's body health record. The main components of our product include the pulse and oxygen sensor, body temperature sensor, patient position sensor, air flow(breathing) sensor and galvanic skin response(sweating) sensor. In the marketing of our product we target families and public people who is looking for health checking in urgent. our product is easy to use and fits for everyone. People need a health body all the time to do anything and Health Reporter is the best choice product for them to understand how are they right now. The project is scheduled to have a functional model of our system ready for demo and testing by early April. The further development of our product for industrial production will continue after the success of the demo. Furthermore, the funding for the product will be received from ESSEF if the application has been approved. Otherwise, all cost will be covered by teammate equally.

11. References

[1] Canadian Institute for Health Information (2012). Health Care in Canada: A Focus on Wait Times. Available: https://secure.cihi.ca/free_products/HCIC2012-FullReport-ENweb.pdf

[2] Canadian Health Coalition (2009). Medicare Privatization. Available: http://medicare.ca/main/the-facts/wait-times-causes-and-cures.

[3] A Policy Paper by the BCMA's Council on Health Economics & Policy (June 2006). Waiting Too Long: Reducing and Better Managing Wait Times in BC Online: https://www.doctorsofbc.ca/sites/default/files/waiting_too_long.pdf

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[5] The Effect of Wait Times on Mortality in Canada(May 2014). Available http://www.fraserinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/effect-of-wait-times-on-mortality-in-canada.pdf

