Feb 14, 2016

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

RE: ENSC 440W functional specification for smartBand that enhances social interaction

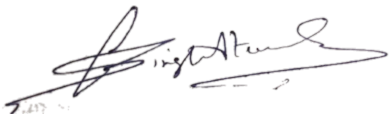
Dear Dr. Rawicz,

The attached document contains functional specifications for smartConnect's electronic gadget, smartBand, that would help to enhance in person socialization using a simplified hardware attached to the wrists of the users and connected to a mobile application installed on the user's cell phone.

The functional specifications are mainly divided into four parts: system, hardware, software and integration requirements. Each section in the document provides the details on the functionality that must be obtained from the prototype or refinements of the finished product. Furthermore, this document will also be used by our team for research and development purposes as well as for the future implementation of the product.

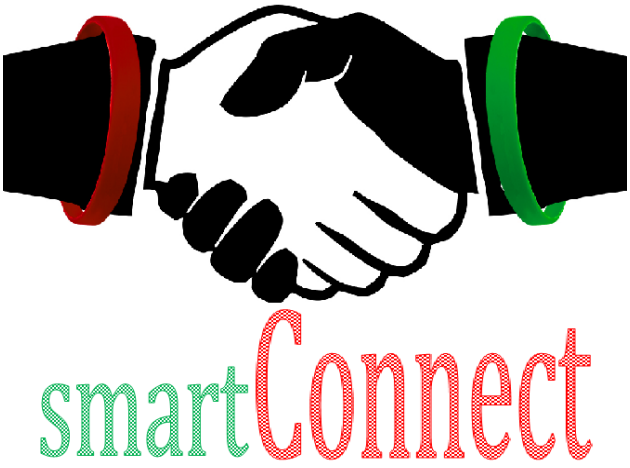
At smartConnect, we are a team of 5 determined, passionate and focused engineering students working to provide a smart solution for people with difficulties in communicating and socializing in person. If you have any questions or concerns regarding our functional specification, please do not hesitate to contact our Chief Project Manager Sukhreet Kaur by email at ska142@sfu.ca.

Sincerely,



Gurjot Singh Atwal
CEO
smartConnect

Enclosure: Functional specification for smartBand



Project Team: Gurjot Singh Atwal
Sukhreet Kaur
Rajdeep Kaur
Masih Amiri
Kevin Chang

Contact Person: Sukhreet Kaur
Ska142@sfu.ca

Submitted to: Dr. Andrew Rawicz – ENSC 440W
Steve Whitmore – ENSC 305W
School of Engineering Science
Simon Fraser University

Issued On: February 15, 2016
Revision: 1.0

Executive Summary

According to CNBC news “the millennials spend more time engaged on social media platform, it’s causing them to be less social in real life” which means that people under 30 have spent too much time on cell phones or other electronic devices and consequently have become less social [1]. The habit of sticking to the cell phones or other electronic devices is limiting their ability to go interact with others in person which ultimately leads to communication troubles. Having difficulties to start or keep a conversation going is indeed a big problem, and since we are in an era of technology, we are going to solve this issue in a smart way. At smartConnect we are working on a solution to help people who face difficulties having in person conversations. We will be developing a product comprising a wristband and an app to connect the band with a specific user. When two users wearing the bands shake hands, the product matches them based on their behavioral characteristics like habits, interests or anything they have in common that will speed up the process of connecting them to the people of their interests. The product would be extremely helpful for the people at various social gatherings whether they are at professional networking events or casual social parties. We as a team of 5 Engineering students will bring our experiences from different group projects and previous work terms, in order to prototype the device and finally build a successful working product at the end of the term. This document gives an overview of the functional specifications of the smartConnect product and lists all the requirements that the various development phases will meet. The requirements are further classified in terms of software, hardware, environment, engineering standards employed, safety and performance etc.

Contents

List of figures

List of tables

Glossary

A2LA: American Association for Laboratory Accreditation
ANSI: American National Standards Institute
App: Software application installed on user's phone
CA Proposition: California Proposition
CAT: Carrier Acceptance Test
CTIA: Cellular Telephone Industries Association
EN: European
FCC: Federal Communications Commission
FDA: Food and Drug Administration
ID: Identification
IEC: International Electrotechnical Commission
IECEE: IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components
NFC: Near Field Communication
R&TTE: Radio Equipment and Telecommunications Terminal Equipment
RFID: Radio Frequency Identification
RoHS: Restriction of Hazardous Substances
SAR: Specific Absorption Rate
SCC: Standards Council of Canada
SD card: Secure Digital storage card
UKAS: United Kingdom Accreditation Service
UL: Underwriters Laboratories

1. Introduction

Are you shy or uncomfortable when it comes to start conversations with people you want to connect with? Is it too long that you have not made any new friends? Or do you want to expand your social or business network? If yes, smartConnect has a perfect solution for all your needs from making new friends to expanding your social or professional network. In today's world where people spend more time on their cell phones or other electronic devices rather than interacting in person, it has become really hard to start the conversations or keep the conversations going [2]. To eliminate the problem, smartConnect brings a unique solution to use an electronic device to enhance in person communications.
At smartConnect, we are working to develop a gadget (wristband with an app), that matches one user's interests and behavioral characteristics to the other when both shake hands together, enabling the bands to share information through an app installed on their phones.

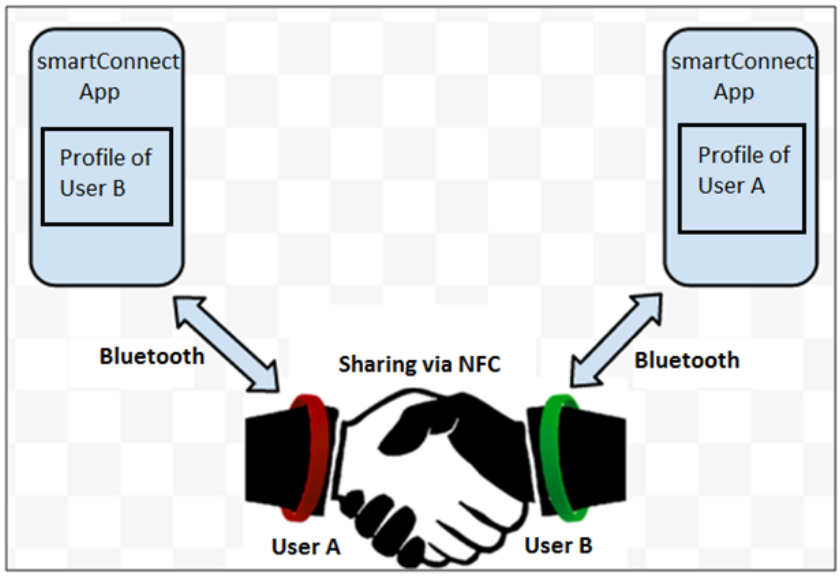


Figure 1: Working of the system for martBand

The smartBand includes a transmitter wristband with an app associated to it through user's phone and will require two types of communications: NFC between two bands and Bluetooth communication between the band and the app installed on the phone. When two users shake hands, the bands will interact via NFC and will share the information stored on the bands. Once the band receives the data from the other band, it will communicate with the app on the user's phone, which will display the matching profile (behaviors or skills) of the other user that the current user might be interested in. Therefore, based on the common characteristics, users can easily find a shared platform to start the conversations.

1.1 Background

Our main objective at smartConnect is to solve the communication problems for the people facing difficulties to start and keep a conversation going and give them a platform to connect to the other people of their interests in a personal setting. To achieve our motive, we propose to develop a gadget (wristband with an app), that stores user's behavioral characteristics and match them to the characteristics of the other user when both users shake hands together, enabling the wristbands to share information through an app installed on their phones. As a result, the device will provide information on the criterion both users share; making it easier for them to start a conversation on the topics they have common interests in. Therefore, by bringing a common platform of thoughts, interests and things to talk about, smartConnect will enhance social interaction between the users.

1.2 Intended Audience

Our product is suitable for all set of people who somehow encounter the troubles of starting or keeping up a smooth conversation in social settings. However, we have subdivided our audience list into three main categories as follows:

1.2.1 Entrepreneurs:

The first challenge that entrepreneurs face is to promote their business, which requires expanding their social network. A huge hurdle in the process of sharing their inventions with the world could be lack of communication. Even attending a great networking event might be useless if people are shy or do not know how to start a conversation. Our product will find its proper use at the social and networking events, and will enable people to share their company's profile and promote their business through interesting conversations.

1.2.2 Businessman:

Not only the entrepreneurs but an established businessman also loses the opportunity of not getting introduced to great ideas due to lack of communication. Through good communication of the ideas, a businessman can attract job seekers and build a strong team that shares the same core values as the company. Therefore, our band will enable businessmen to know their potential employees or partners not just based on their relevant skills or values but also in terms of their own individual personality too, helping them to build strong business.

1.2.3 Common public:

The most important use of our product would be for the young people seeking employment. Sometimes a person could be a good fit for a job but the resume might not convey all the interesting qualities that the employers might be interested in. Our product will help people to share all the interesting facts about themselves, which they might forget

or cannot share through the resumes. Apart from business perspective our product can also be useful gadget for people to socialize in person at clubs, concerts, parties and other places where people get together and make new friends.

1.3 Classification

Throughout this document we will be labeling our requirements using the following convention: [R- X.Y- P#]
Where R stands for the Requirement, X.Y is a placeholder for the section number and P# will be replaced by the development phase number where we want the particular requirement to be fulfilled. The 'P#' will be replaced by considering the following three stages of development:
I: Requirement for prototype
II: Requirement for the complete product
III: Requirement for both the prototype and the complete product

2. System Requirements

2.1 System Overview

The system is composed of two main modules: Hardware and Software. On the hardware side, there are again three sub modules consisting of microprocessor, NFC and Bluetooth; and on the software side we have an app installed on the user's phone. We will be developing the prototype first and then the final product. Following section covers the working of the system and all the requirements to be met by the prototype and the final product.

Following flowchart explains the working of smartBand:

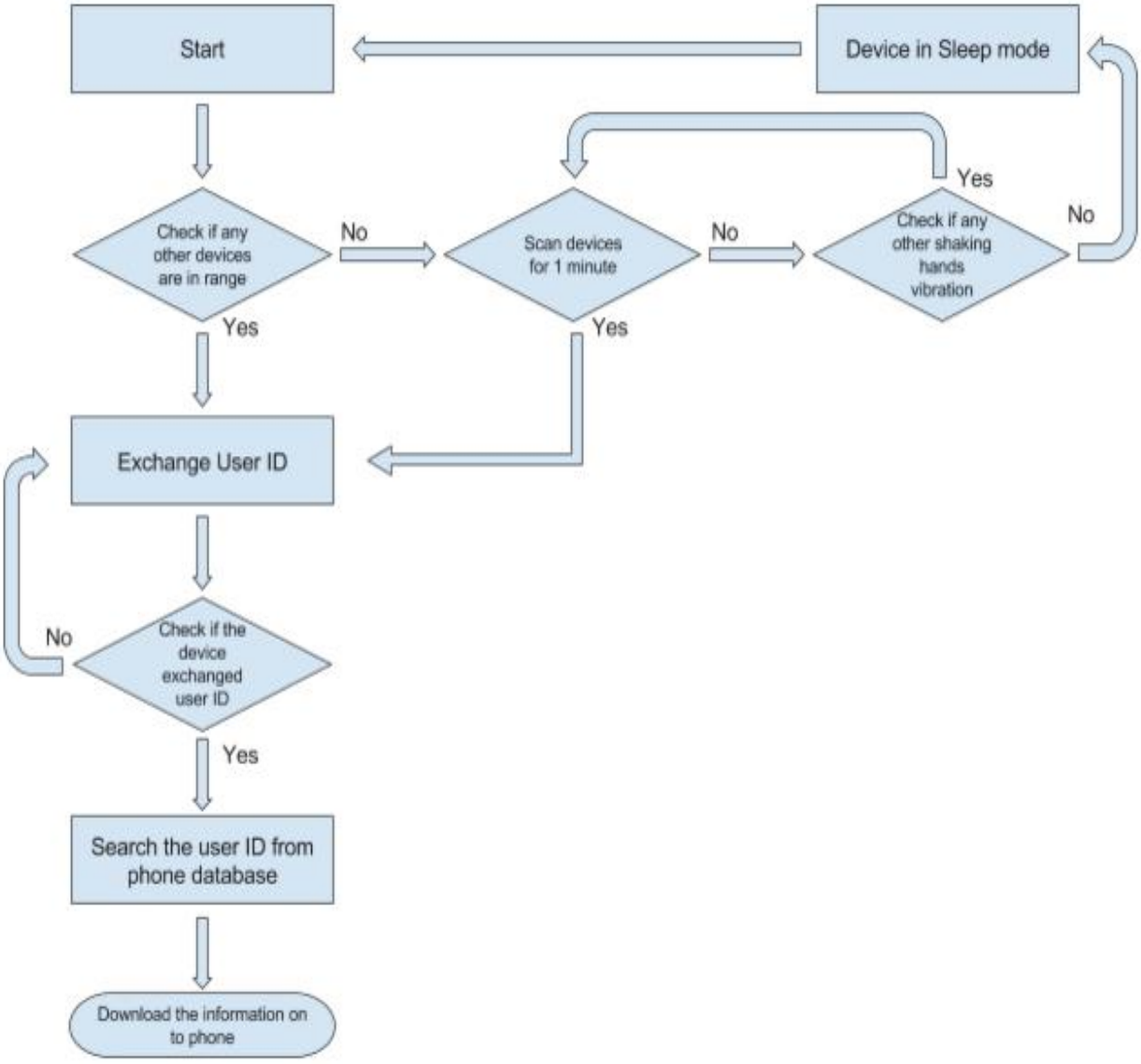


Figure 2: Flowchart for the working of SmartBand

2.2 General Requirements

[R-1.1-I] The prototype shall cost within $150 to $200

[R-1.2-II] The final product shall cost within $300 to $350

[R-1.3-I] The prototype shall be able to receive user ID with NFC

[R-1.4-I] The prototype shall be able to send user ID with Bluetooth signal

2.3 Physical Requirements

[R-1.5-I] The prototype shall weigh less than 2 kg

[R-1.6-II] The final product shall weigh less than 0.5 kg

[R-1.7-II] The final product shall optimize shape to a wristband

2.4 Electrical Requirements

[R-1.8-I] The prototype shall be powered by 5V, 1A micro USB [3]

[R-1.9-I] The prototype shall have minimum 700 mA [4]

[R-1.10-I] The prototype shall have maximum 1200 mA [4]

[R-1.11-III] The vibration sensor shall activate the prototype

[R-1.12-III] LED shall stay on when prototype is activated

[R-1.13-II] The final product shall be powered by 5V rechargeable battery

[R-1.14-II] The final product shall have 10 hours of battery life

[R-1.15-III] The prototype shall have 8GB SD Memory

2.5 Environment

[R-1.16-II] The final product shall be designed to minimize waste using recycled components

2.6 Reliability and Durability

[R-1.17-I] The prototype shall work below 70 ℃

[R-1.18-I]The prototype shall work above 0℃

[R-1.19-I]The prototype shall not heat above 60℃

[R-1.20-III]The battery shall work operational within 0 ℃ to 45 ℃[5]

2.7 Safety

[R-1.21-II] The battery shall support Raspberry Pi

[R-1.22-II] The battery shall not cause damage to Raspberry Pi and NFC module

[R-1.23-I] The prototype shall not be combustible

2.8 Performance

[R-1.24-I] The prototype shall turn on by shaking hand’s vibration

[R-1.25-I] The prototype shall turn off without shaking hand’s vibration

[R-1.26-II] The final product shall turn off if battery is running lower than 5%

[R-1.27-III] The prototype shall scan tag ID when device is on

[R-1.28-III] The prototype shall send tag ID to connected phone

3. Hardware Requirements:

The complete product will have three main hardware modules namely: Microprocessor, NFC and Bluetooth. We will use Raspberry Pi B as our Microprocessor, which will be powered by minimum 5V and will be activated with the vibration sensor. After certain time of inactivity, the prototype should enter sleep mode. This module will support the Bluetooth and NFC modules by getting the tag ID from NFC board and sending it to the phone via Bluetooth signal. We will use pluggable USB Bluetooth 4.0 adapter that will be programmed in Python [6]. The adaptor will be able to connect to one phone at a time and send tag ID to the phone. For the NFC module we will use NFC model PN512 that reads the tag ID within 100 mm and stores it in SD Memory. The NFC module will write tag ID into NTAG 213 chip that will be the user ID. Python will be used as the main programming language to make all the communications between different modules.

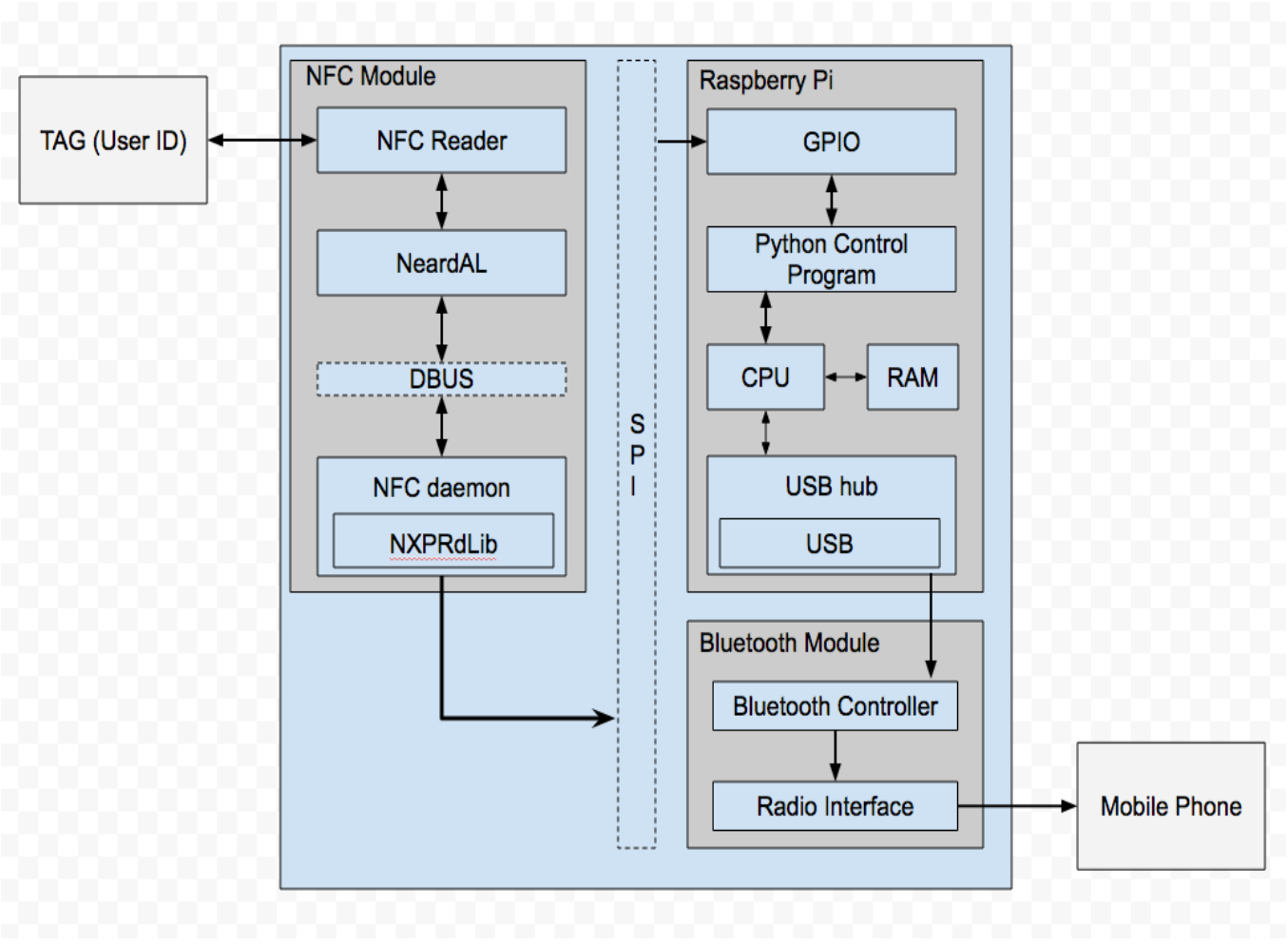


Figure 3: Hardware architecture of smartBand

All three modules should individually meet the following requirements for the proper functionality of the system.

3.1 Microprocessor Requirements:

This section will explain the requirements for the microprocessor used for smartBand that is Raspberry Pi B, which will be activated with the vibration sensor.

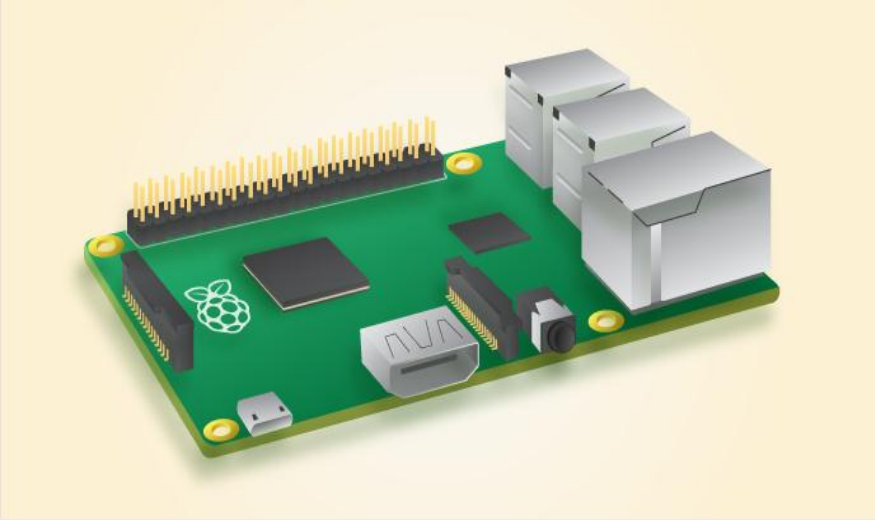


Figure 4: Raspberry Pi B microprocessor [6]

3.1.1 General Requirements

[R-2.1-I] Program in Python shall support Raspberry Pi

[R-2.2-I] Microprocessor shall be re-programmable with Python

[R-2.3-I] Microprocessor shall able support Bluetooth module

[R-2.4-I] Microprocessor shall able to support NFC module

[R-2.5-I]The Microprocessor shall function between 0 ℃ to 70 ℃ [7]

3.2 NFC requirements

For smartBand we will use NFC model PN512 that reads the tag ID and stores it in SD Memory. Given below is a flowchart that explains working of NFC module in SmartBand:

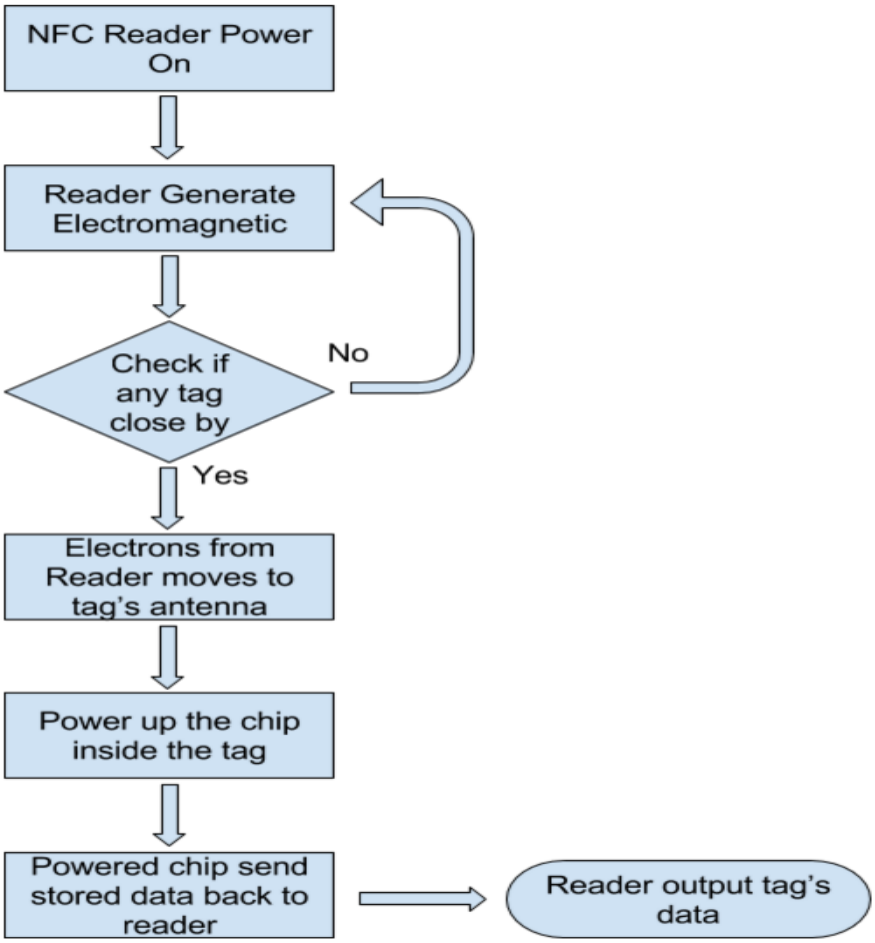


Figure 5: NFC module for smartBand[7]

3.2.1 General Requirements

[R-3.1-III] NFC board shall have power less mode

[R-3.2-III] NFC board shall be powered within 2.5V to 3.6V power supply [7]

[R-3.3-III] NFC board shall have programmable I/O pin [7]

[R-3.4-III] NFC board shall function within -30 ℃to 85 ℃ [7]

[R-3.5-III] NFC board shall be able to read/write the tag [7]

[R-3.6-III] NFC board shall be able to read the tag within 80mm to 100mm [7]

4. Software Requirements

Software Part plays a vital role for this product as all the results will be displayed on an Android application. The main purpose of this App will be processing data from the hardware device, which in this case is a wrist band, through Bluetooth and displaying it in an intuitive way to increase user interaction. There are important components of the software those need exceptional attention, like our testing device, user interface and strong database. We will be

using virtual device for testing because testing device has to be versatile so that we don't have to test the application on different hardware devices. The user interface for the device has to be both graphically modern and easy to use.
To full fill all these requirements we will be using the latest android version, Marshmallow and to build our app the perfect platform will be Android Studio and Android SDK. Android studio uses Java as the programming language, so we are using tutorial from Lynda.com and YouTube to learn java. As it is a team work and multiple members will be working on different parts of the software code, we will be using GitHub to maintain revision control for our code.

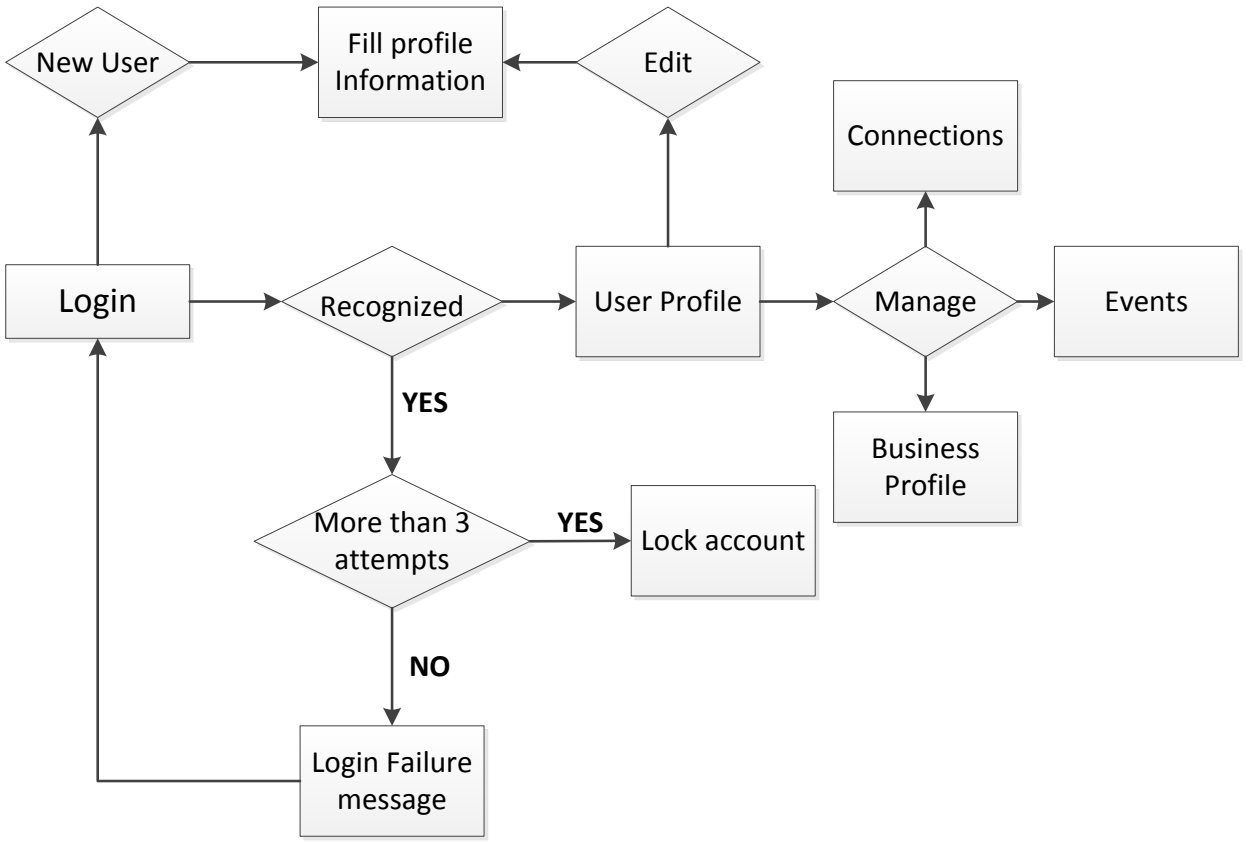


Figure 6: Flowchart of a software application in SmartBand

4.1 Application requirement:

4.1.1 General App. Requirements

[R-4.1-III] Application (App) should be invoked only when needed to save battery power
[R-4.2-I] Data should be compressed for faster data transfer; max 2 sec to transfer all data
[R-4.3-III] App must establish communication between the band and the phone
[R-4.4-I] App must constantly look for data from the band

[R-4.5-I] Once the data is transferred to the App, it must enforce deletion of the data from the hardware device
[R-4.6-I] App must send notification as soon as it receives data from the device
[R-4.7-III]] User should have options to either delete or save the profile
[R-4.8-III] User will see information of any future events for the saved profile
[R-4.9-II] User can request contact information of the saved connections

4.1.2 Graphical User Interface

[R-4.10-III] GUI should be customizable
[R-4.11-II] Avoid written content and use graphics for presentation
[R-4.12-II] GUI should be easily understandable, interactive and fancy
[R-4.13-II] The content should be divided into multiple panels, if too congested

4.1.3 Platform: Android studio and SDK

[R-4.14-I] Require Microsoft windows Vista or higher / Mac® OS X® 10.8.5 or higher,
[R-4.15-I] Minimum 2 GB RAM but 4 GB recommended
[R-4.16-I] 400 MB required for hard disk
[R-4.17-I] Memory 1 GB for Android SDK, emulator system images and caches
[R-4.18-I] Minimum required Screen Resolution is 1280 x 800
[R-4.19-I] Java Development Kit (JDK) needed for building app in android studio
[R-4.20-II] JAVA will be the main programming language for development

5. Standard

While our product may lead us to smarter ways of communicating, we cannot afford to neglect safety testing and performance verification, and should be aware of the standards that our product needs to meet. The following are some of the associations that have established standards for wearable technologies:
IEC/ IECEE, ANSI, FCC, Wi-Fi Alliance, Bluetooth SIG, A2LA, CTIA, Qualcomm Quick Charge 2.0, ENERGY STAR®, The California Energy Commission (CEC), UKAS, SCC, FDA and various national regulatory bodies in Japan, Taiwan, India, Singapore[8].

Following are examples of regulations and evaluation standards for wearable technology products:

Regulations and evaluation standards	Details
Product Safety	a) Information technology equipment (IEC 60950-1, IEC 62368-1) b) Medical equipment (IEC 60601-1) c) Batteries (IEC 62133) etc.
EMC (Electromagnetic Compatibility)	a) USA FCC Part 15, subparts B and C b) Japan Radio Law c) Europe R&TTE Directive, EN 300328, EN 301489-1/-17, EMC Directive, EN 61000-6-1, EN 61000-6-3 etc.
SAR (Specific Absorption Rate)	a) FCC Part 2.1093, EN 50360, EN 62311
Interoperability	a) Bluetooth b) Wi-Fi c) CAT
Energy efficiency	a) Measurement of battery characteristics, product battery life, etc.
Chemicals	a) CA proposition 65, RoHS directive, REACH, etc.
Environment and sustainability	a) UL 2887, etc. [9]
Privacy and information security	a) User personal information

Table 1: Regulations and evaluation standards for wearable technology products [10]

5.1 Standards' References

a) Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields, EN 62311, 2008

b) Standard for radio equipment and services, EN 301489, 2002

c) Outline of Investigation for Sustainability for Wearable Electronics Products, UL 2887, 2014

d) Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields, EN 50360, 2001

e) Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments, EN 61000-6-1, 2005

f) Radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity, R&TTE Directive, 1999

g) Radio Frequency Devices, USA FCC Part 15, 2006

h) Test and Certification Service on Radio Devices, JRL, 2011

i) Secondary cells and batteries containing alkaline or other non-acid electrolytes, IEC 62133, 2012

j) Information technology equipment safety, IEC 60950, 2005

k) Audio/video, information and communication technology equipment, IEC 62368, 2014

6. Environment & Safety

As mentioned in section 5, the safety standards for wearable applications are carefully taken into consideration in development of smartConnect. Regulations and standards in wireless and wearable technologies have high priority in designing our product. Moreover, special care is taken to ensure the smartConnect will be able to be safely worn as all electronic components and wires are enclosed to prevent potential danger to our users in case of component failure or malfunction [9].

Using Cradle-to cradle design approach, we aim to develop a product that affects people's lives in a positive way with minimum negative impact on the environment. Each component of the prototype or final product will be individually reusable and recyclable including the wristband that contains the circuit. Instead of disposing of the product in case of component failure, each part will be simply repairable or replaceable. All our electronic components are RoHS

compliant, in other words, they do not contain any environmentally harmful substances such as cadmium, lead, mercury, etc.[11].

The safety of any user of this product is paramount to our company. The product will be designed in a way to ensure there is no risk of electrical shocks, and burns for the user [10]. Additionally, the band containing the circuit will be waterproof to minimize potential damage to circuit components from water, sweat, and high humidity.

7. Conclusion

At smartConnect, we are working to provide a smart solution to the people facing troubles communicating with others. In coming two months we will be working to prototype a wrist band storing user's personal information that will be shared when two people will shake hands together. Our product is divided into two big modules: Hardware and Software, where hardware module involves the wrist band and the software involves developing a mobile app to connect the band with user's profile on the phone. The phone will display the information that one user has in common with the other once their bands have shared the data. This document covered all the functional requirements of our product. Therefore, meeting all the requirements in terms of software, hardware, safety, environment etc., and our product will provide efficient solution for promoting in person conversations.

Reference

[1] J. Fowlkes. (2012, Oct 11).” Viewpoint: Why social media is destroying our social skills” [Online]. Available: http://college.usatoday.com/2012/10/11/opinion-why-social-media-is-destroying-our-social-skills/. [Accessed: 8- Feb- 2016].

[2] U. Saiidi. (2015, Oct 17). Social Media making millennials less social: Study [Online]. Available: http://www.cnbc.com/2015/10/15/social-media-making-millennials-less-socialstudy.html [Accessed: 8- Feb- 2016].

[3]Raspberry Pi. (Feb, 12, 2016). “Raspberry 2 Model B”. [Online]. Available: https://www.raspberrypi.org/products/raspberry-pi-2-model-b/. [Accessed: 11- Feb- 2016].

[4] Raspberry Pi.(Feb, 08, 2016). “FAQS”. [Online]. Availiable: https://www.raspberrypi.org/help /faqs/. [Accessed: 9- Feb- 2016].

[5] Isldor Bunchman. (2016). “Charging at High and Low Temperature”. [Online]. Available: http://batteryuniversity.com/learn/article/charging_at_high_and_low_temperatures. [Accessed: 12- Feb- 2016].

[6] Plugable Technologies (2014). “Plugable USB 2.0 bluetooth adapter”. [Online]. Available: http://plugable.com/products/usb-bt4le. [Accessed: 11- Feb- 2016].

[7] NXP Semiconducor N.V. (2015). “PN512”. [Online]. Available: https://www.nxp.com/ documents/data_ sheet /PN512.pdf. [Accessed: 10- Feb- 2016].

[7] Adafruid. (Feb, 12, 2016).” Collin’s Lab: RFID”. [Online]. Available: https://learn.adafruit. com/collins-lab-rfid/transcript. [Accessed: 9- Feb- 2016].

[8] Industries.ul.com, "Testing Solutions for Wearable Technologies", 2016. [Online]. Available: http://industries.ul.com/blog/testing-solutions-for-wearable-technologies. [Accessed: 12- Feb- 2016].

[9] Lynda.com and Youtube (https://www.youtube.com/watch?v=hzrGAZnMOMQ&list= PLonJJ3BVjZW6hYgvtkaWvwAVvOFB7fkLa). [Accessed: 12- Feb- 2016].

[10] C. Vairamuthu Ramasamy, "The basics of designing wearable electronics with microcontrollers", *Embedded*, 2014. [Online]. Available:

http://www.embedded.com/design/real-world-applications/4431259/The-basics-of-designing-wearable-electronics-with-microcontrollers. [Accessed: 11- Feb- 2016].

[11] S. Raman Sharma, "Winning design strategies for the wearables market", *Embedded*, 2014. [Online]. Available: http://www.embedded.com/design/real-world-applications/4434482/Winning-design-strategies-for-the-wearables-market. [Accessed: 11- Feb- 2016].