January 23, 2016

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

RE: ENSC 440 Project Proposal – Intelligent wearable wristband for personal safety

Dear Dr. Rawicz,

The attached document is our Proposal for an intelligent wearable wrist band for personal safety. Our goal, as a team, is to design a lightweight wearable sensor and integrate its services with the user’s smart phone. By measuring the user’s vitals and external elements, the wristband is capable of detecting emergency events. When said events are detected, the user's smart phone will automatically relay a real time notification to the user's emergency contacts.

The purpose of this proposal is to provide an overview of our prototype, an explanation of the main system elements, a provisional projected budget, and information on project scheduling and organization. Furthermore, this proposal illustrates the market and social benefits of our project.

Smart Trak Solutions is founded by five dedicated senior engineering students: Tom Ou Yang, Ashton Novak-Louie, Farah Ishita, Peter Le, and Gifty Quansah. If you have any questions or concerns regarding our proposal, please do not hesitate to contact me at touyang@sfu.ca.

Sincerely,

Tom Ou Yang
CEO
Smart Trak Solutions

Enclosure: Project Proposal for a Intelligent wearable wristband for personal safety
Smart Band

by

Project Team: Tom Ou Yang
Farah Ferdous Ishita
Peter Le
Ashton Novak-Louie
Gifty Quansah

Prepared for: Dr. Andrew Rawicz
Steven Whitmore
Simon Fraser University
School of Engineering Science

Date: January 25th 2016
Executive summary

In a dire situation such as having a sudden stroke or heart attack, falling down and being unable to get up, sudden loss of consciousness, or even in perilous fight or flight situations, people often rely on others for help. However, what happens if there are no immediate people around your surroundings? Who will be able to take care of us when such an event occurs? At Smart Trak Solutions, we are proposing to alleviate this problem by designing an intelligent personal safety device.

There are currently many different types of personal safety devices available on the market. Some of these existing solutions are quite expensive and require the purchase of a monthly subscription for their services, while other devices requires the person to physically activate the distress signal. As mentioned earlier, in many situations one cannot activate the device manually. Therefore, to solve these problems, we are designing a lightweight intelligent wearable utilizing open source hardware and various sensors to be able to detect those dire situations. An SOS distress signal will then be sent via the user’s smart phone.

In this proposal, we will give a further in-depth overview of the project, the design process, the risks and social benefits, system overview, market research, estimated timeline and milestones, as well as a cost analysis and budget.

Smart Trak Solutions consists of five dedicated engineers from a variety of engineering disciplines such as computer, electronics and systems engineering. Together as a team, we are confident in our abilities to execute our plan, deliver a high quality product and solve any challenges that will arise.
# Table of Contents

List of Figures ........................................................................................................... i  
List of Tables .......................................................................................................... ii  
Glossary ................................................................................................................ iii  

1. Introduction ....................................................................................................... 1  
2. Scope ............................................................................................................... 2  
   2.1 Risks ........................................................................................................... 4  
   2.2 Benefits ..................................................................................................... 4  
3. System Overview .......................................................................................... 5  
4. Market Research ............................................................................................. 6  
5. Cost Considerations ....................................................................................... 8  
   5.1 Budget ...................................................................................................... 8  
   5.2 Funding .................................................................................................... 8  
6. Project Planning .............................................................................................. 9  
7. Conclusion ..................................................................................................... 10  
8. Company Profile ........................................................................................... 11  

References .......................................................................................................... 13
List of Figures

Figure 1: A mobile Controlled Wristband.................................................................2
Figure 2: FlowChart of the Smart Trak Solution.........................................................3
Figure 3: Gannt Chart Outlining Planned Progress....................................................9
Figure 4: Milestones Shown on a Timeline..............................................................10
List of Tables

Table 1: Current products available from competitors………………………………………….6
Table 2: Breakdown of costs including contingency options…………………………………….8
# Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smartwatch</strong></td>
<td>Computerized wristwatch, wearable computer</td>
</tr>
<tr>
<td><strong>SOS</strong></td>
<td>Distress signal acronym for “save our souls”</td>
</tr>
<tr>
<td><strong>SMS</strong></td>
<td>Acronym for Short message service, more commonly known as text messaging</td>
</tr>
<tr>
<td><strong>Java</strong></td>
<td>Computer programming language developed by Oracle Corporation</td>
</tr>
<tr>
<td><strong>Android</strong></td>
<td>Mobile device operating system developed by Google Inc.</td>
</tr>
<tr>
<td><strong>BLE</strong></td>
<td>Bluetooth Low Energy</td>
</tr>
</tbody>
</table>
1. Introduction

The market for wearable technology has grown tremendously over the past few years. With the recent craze of smartwatches, fitness trackers, biomedical and other safety devices, the demand for these high tech gadgets are on the rise. With a projected market share of $101.2 billion USD by 2018, the growth of smart watches, fitness trackers and other devices are expected to grow to over 135 million units sold by 2018 [1]. The primary focus at Smart Trak Solutions is to develop an intelligent wristband that will serve as a personal safety device.

Although there already are similar existing products on market, none of the products currently available offers our range of services at an affordable price. By integrating our Smart Band with the user’s smart phone, we can avoid monthly services fees which are often charged by other competitors. Below is a quick comparison of similar products.

As shown, Smart Trak’s Smart Band is able to offer services unavailable from our other competitors. Because Smart Band utilizes the highest quality sensors available on today’s market, its functionality can be expanded upon via the mobile application. Using the onboard sensors such as the accelerometer, gyroscope, temperature sensor and heart rate monitor, we can create an algorithm that can accurately determine when a user is in distress, falls down or becomes unconscious. Once a certain event is detected, the mobile application will then send a SOS message to the user’s emergency contacts based on the event detected by the Smart Band.
2. Scope

The primary objective of the smart wearable wristband project is to design and integrate a wearable wristband to the phone via Bluetooth connection. The purpose of the project is focused on designing a safety application, which will use sensor data on the wristband. The project is mostly aimed towards catering to seniors and disabled people. The scope of the proposed prototype is expected to cover the following incidents:

- Fall detection of the user
- Stroke/heart attack of the user
- Robbery/unpredictable incident
- GPS for determining user’s location
- Audio/video recording system for capturing an unpredictable incident

An emergency alert will be provided when any of the above events are triggered. The user will be given a short time frame to disable an event response, such as in the case of a false positive. However, if the user fails to disable the response within the expected time frame, then the smart wristband will be expected to send an emergency SOS text (SMS) to the emergency contact list of the user. Hence, the smart wristband is expected to provide sufficient support by responding to several unforeseen incidents that the user may encounter. The assistance solution proposed for various unanticipated incidents encountered by the user would be achieved by using the open source hardware. This affordance supports our project goal, since we can program the module for functions to support of different incidents encountered by the user.
The system performance can be described by the following flow chart:

![Flow Chart of the Smart Trak Solution](image)

*Figure 2: FlowChart of the Smart Trak Solution*

We will be using an open source hardware module, which will be programmed for providing solutions to multiple incidents described above. We will not be required to use any additional sensor or microcontroller since the module will be have those components built-in. JAVA will be used to code the Android application that will communicate with our wristband. The mobile application is expected to exchange data with the module through Bluetooth connection.
2.1 Risks
The open end source will be programmed to fulfil several cases, but we may not be able to get a very precise outcome if the algorithm is not written accurately. Keeping the prototype small and portable is another large obstacle as it will have multiple sensors with a built in micro controller. Hence keeping the device light and easily wearable is a vital aspect for our project. Time is a large risk factor for the project as well. If the hardware ordered online is not delivered on time then our team will be pressed for time towards the end of the term. Moreover, if one of the team members withdraws from the course, does not communicate well within the group or co-operate well with the team work, then eventually it may put our project in jeopardy as well.

2.2 Benefits
Smart Trak Solutions will be implementing a user friendly wristband that will mostly be intended for the senior citizens of our society. The safety wrist band is going to be durable and comfortable to wear for a long periods of time. Despite being supported with numerous functions, our prototype will still be very light and easily wearable. Moreover, the wristband will be engineered to reduce the potential health risks associated with a senior person’s life by triggering a signal associated with the person’s fall, heart rate, body temperature and so on. Our product is expected to be economical and cost effective so that it is within everyone’s reach. Smart Trak Solutions has great educational impact on engineering students as it provides us with the opportunity to learn about the open source module and mobile application programming on Android.
3. System Overview

The design of our device is largely based on the Angel Sensor hardware module, which is intended for use in the form of a wristband. The Angel Sensor is a fully open source, standalone system with Bluetooth low energy (BLE) integration to enable communication with a smartphone or another BLE-compatible device. The Angel Sensor provides several modules to accommodate a variety of sensors. Of particular interest to our project are the heart rate, temperature, acceleration, and orientation modules which we will use to design and implement the event detection functionality of our safety band.

Data captured by the Angel Sensor will be transmitted to the user’s smartphone via BLE communication. Currently, we will only support Android devices while developing our application. The application will then handle and organize the data for ease of use and user understanding. By defining constraints and conditions on the captured data, the application can then be configured to decide which captured events are beyond an acceptable, safe level. Upon recognizing such an emergency situation, the application will then notify the user’s predetermined emergency contact.
4. Market Research

Smart wearable devices have seen an increase in consumer interest over the past 3 years and their demand is projected to rise to a staggering 135 million shipments by 2018 [3]. Although there are already many wearable devices that can feed heart rate and temperature data wirelessly to smartphones, there does not seem to be many that also function as an emergency device. In contrast, there are many emergency necklaces and wristbands available but lack the ability to also monitor vital signs and automatically request emergency services. For the rare products that offer the services of an emergency wearable and a smartphone connected wearable, prices are high and monthly service subscriptions are usually required. In the following table, current solutions similar to our product are shown along with their features, prices and drawbacks.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Price</th>
<th>Picture</th>
<th>Features</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amulyte [4]</td>
<td>$149 + $29.99 service fee per month</td>
<td>- Click button to alert emergency contacts</td>
<td>- Location tracking using GPS, Wi-Fi and mobile towers</td>
<td>- No fall detection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Does not need mobile phone to work</td>
<td></td>
<td>- No heart rate and body temperature sensors</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Loose necklace not comfortable for exercising</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Monthly fee</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Automatically alerts emergency contact after fall or immobility detection</td>
<td></td>
<td>- Expensive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Does not need mobile phone to work</td>
<td></td>
<td>- Design caters more to elderly, not so much to younger users</td>
</tr>
<tr>
<td>Product</td>
<td>Price</td>
<td>Features</td>
<td>Drawbacks</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| ATS Elderly Fall Detection Medical Alert System [6] | $299.99 (sale) regular price $349.99 | - Click button to alert emergency contacts  
- Can use with landline or mobile phone  
- Automatically alerts emergency contact when a fall is detected | - No heart rate and body temperature sensors  
- Large, bulky and unattractive  
- Expensive |
| Smart Trak Solutions Smart Band              | $149        | - GPS  
- Upgradable  
- Fall detection  
- Can detect other emergency situations  
- Emergency panic button | - Requires a Smartphone |

**Table 1: Current products available from competitors versus our product**

Smart Trak Solutions’ wearable device will be designed to be an affordable and full-featured smartphone integrated wristband with safety and emergency response as the first priority. The product will be marketed towards all ages, and will have a sleek design that eliminates the stigma of wearing a bulky personal safety device for the elderly.
5. Cost Considerations

5.1 Budget
Due to the small and portable nature of our product, our budget is far more reasonable than our original conjectures. The Angel Sensor device conveniently supports the data we currently wish to collect. As a result, we are left with a significant contingency fund and room to be flexible with our selection of additional parts. Should the Angel Sensor become insufficient or unavailable to use for any reason, we have also considered implementation with the MetaWear RG hardware modules. The outline is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Angel Sensor</th>
<th>MetaWear RG (Contingency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Price</td>
<td>$299</td>
<td>$110</td>
</tr>
<tr>
<td>Pulse Sensor</td>
<td>-</td>
<td>$30</td>
</tr>
<tr>
<td>Flat Flexible Connector</td>
<td>-</td>
<td>$20</td>
</tr>
<tr>
<td>Housing</td>
<td>-</td>
<td>$200</td>
</tr>
<tr>
<td>Shipping</td>
<td>$50</td>
<td>$50</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>$349 (494 CAD)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Contingency</strong></td>
<td><strong>$150</strong></td>
</tr>
<tr>
<td><strong>Total with Contingency</strong></td>
<td><strong>$499 (705 CAD)</strong></td>
<td><strong>$460 (650 CAD)</strong></td>
</tr>
</tbody>
</table>

Table 2: Breakdown of costs including contingency options. Prices are in USD unless otherwise noted.

5.2 Funding
Presently, Smart Trak Solutions has acquired 315 CAD from the Engineering Science Student Endowment Fund (ESSEF). For the remaining costs, we intend to present our project idea to the Wighton Engineering Development Fund in hopes of covering our remaining budget requirements. We remain in the process of searching for alternative funding sources, although should our project require out-of-pocket expenses, each member has agreed to share the outstanding costs evenly.
6. Project Planning

The figures in this section illustrate the proposed timeline for our group’s project. The Gantt chart that shows a detailed list of tasks and their proposed deadlines that will help us keep track of our progress and the development cycle for the entire duration. The first part of the project is focused on the software design, whilst the latter is focused on software and hardware integration and testing. We aim to complete the prototype by March 31st which will give our group adequate time to prepare for the demo. As there may fluctuations in the proposed schedule in the course of the project design, the following Gantt chart will change to reflect these uncertainties.

![Gantt Chart](image)

**Figure 3: Gantt Chart Outlining Planned Progress**
Milestones for our project are shown below in a timeline figure.

![Milestone Timeline]

**Figure 4: Milestones Shown on a Timeline**

### 7. Conclusion

Smart Trak Solutions believes that there is a need for our product in the rapidly growing smart wearables market. Similar products to our wristband lack the features we plan on integrating into our device and are quite expensive as a standalone device or become expensive after factoring the monthly service charges. Various incidents such as falling, assault, health complications and being victims of crime can be responded to using our product. Through mobile application programming with Java, we will be able to integrate our product with a smartphone which will eliminate the need for a monthly service charge sold with our product. Our efforts will come together to develop a reliable and affordable device that can give customers some peace of mind. Through our product, we hope to be able to allow our customers to be able to live life freely and be rest assured that assistance can be requested at any time.
8. Company Profile

Tom Ou Yang - (CEO)

Tom is a fifth year systems engineering student at Simon Fraser University. As a system engineer, Tom has strong interdisciplinary knowledge from other disciplines of engineering such as mechanical, electronics, software and hardware. However, Tom’s interest lies in software development; where he recently completed two co-op term as a web developer at a Vancouver based web start-up company. During his co-op term, he assisted in developing an enterprise web application. As CEO, Tom hopes he can apply his skills and insight to ensure the project is a success.

Farah Ferdous Ishita – (COO)

Farah is a fifth year Electronics Engineering student at SFU. She will be working as a Chief Operation Officer for Smart Trak Solutions. She has completed three consecutive co-op terms as a Service Quality Analyst at ZE PowerGroup Inc. During her co-op terms, she ensured that the client’s servers and the applications are functioning properly by performing several smoke tests, source checks and database checks. She has high interest in microelectronics and has familiarity with various electronics equipments such as analog and digital power supplies, oscilloscopes, spectrum analyzer and function generator. She has gained a good knowledge of both hardware and software by taking several engineering courses at SFU. Farah’s goal is to work cooperatively with the talented team of Smart Trak Solutions and perform all the tasks with great motivation, while following good engineering ethics.

Peter Le – (CAO)

Peter is a fourth year student specializing in SFU’s Systems Engineering program. A systems engineering curriculum has allowed for Peter to gain a broad understanding of various engineering disciplines focusing on computer, mechanical, electronics, and control. Peter is fascinated by manufacturing and hopes to gain valuable work experience in this field. Since high school, Peter has been planning for a career in engineering and learned drafting both by hand and through computer software such as Autocad. Solidworks and CAM programming techniques for CNC machining have since been added onto Peter’s skillset. Peter hopes his meticulous attention for detail will be able to help elevate Smart Trak Solutions into becoming a well respected company in the professional business world.
Ashton Novak-Louie – (CTO)

Ashton is currently a fifth year Electronics Engineering student at Simon Fraser University. He has completed four co-op terms with Ericsson in Burnaby, Canada, and Nippon Telegraph and Telephone (NTT) in Yokosuka, Japan. Throughout his time at Ericsson he has gained experience developing and implementing automated software testing modules. During his terms at NTT, he assisted a research and development team involved in computer vision topics such as free-viewpoint video and 3D image reconstruction. Ashton’s interests are focused in software development and its associated entrepreneurial facets. His goal with Smart Trak Solutions is to create an innovative yet marketable device that will showcase the experience he has accumulated during his time at SFU.

Gifty Quansah – (CFO)

Gifty is a fifth year Computer engineering student. She has completed 3 Co-op work terms in Goldcorp, where she worked as an Applications Support intern. Among her roles, was facilitate change management to the different stakeholders in the company. She has interest in microelectronics and embedded systems and is familiar with embedded software programming. During her 5 years in SFU, she has leadership role as the President of Engineers without Borders where part of her duty included fundraising. She is passionate about giving back hence she organized a summer project to Ghana and Nigeria, where she led a team that were able to fundraise over $5000 for the trip. Her leadership, financial and technical skills are what have made a perfect fit for the role of Chief Financial Officer.
References


