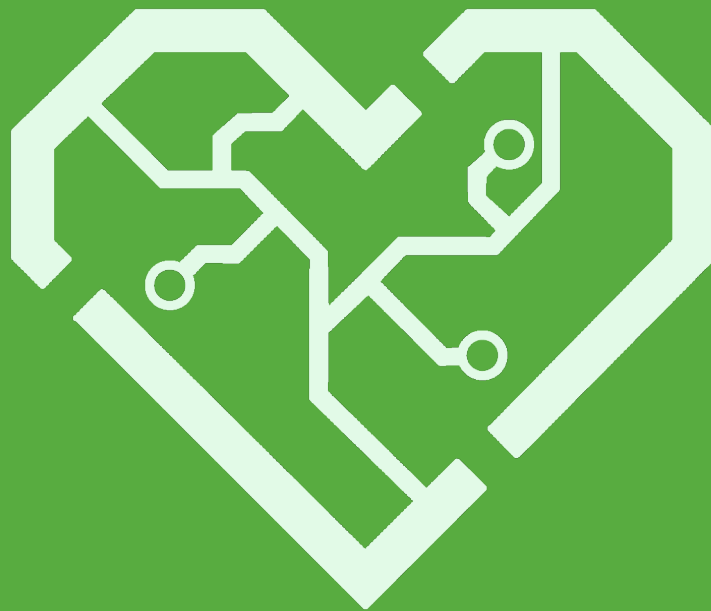ATHLETIC**INNOVATIONS**

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RunWare

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FUNCTIONAL SPECIFICATIONS

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Executive Summary

The joy of running outdoors is seldom matched by marching in place on a treadmill. Runners can enjoy the weather and go on different trails and elevations. However when indoors, runners can use a treadmill to monitor their heart rate and track their distance. The objective of *RunWare* by Athletic Innovations is to provide runners with an elevated running experience and to promote an active lifestyle. The *RunWare* product will be able to provide: Communication, Health Monitoring, Entertainment, Navigation, and Safety.

As a proof of concept, the *RunWare* system will be fully incorporated into one jacket and an accompanying Android mobile phone application (app) will be implemented. The app will allow the runner to use voice recognition to interact with the sensors and different phone features. *RunWare* will also have LED lights to give the runner added safety and visibility. Furthermore, all the electronic parts of the jacket will be either waterproof or encased in a waterproof cover so *RunWare* can be used in all weather conditions.

To create the *RunWare* prototype the development will be done in two stages, plus a final testing phase as follows:
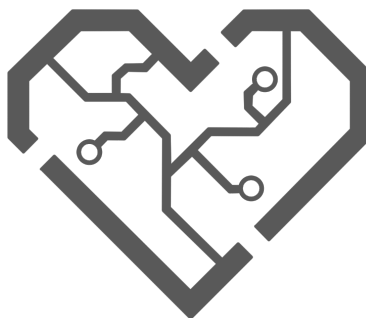
Stage I:
- Configure the heart rate sensor to work with the microprocessor
- Configure the LED lights to work with the microprocessor
- Integrate the application and Bluetooth connectivity

Stage II:
- Incorporate the heart rate sensor and lights into the jacket
- Power sensors and lights with a lithium ion battery
- Add voice recognition capability to the application

The Athletic Innovations team will design the prototypes to meet the functional specifications and standards outlined in this document. Hence, this document will be used as a guide by the designers and testers and updated as required. Two prototypes, a male and female version, of *RunWare* will be completed by April 2015.

The freedom to Run Anywhere, with RunWare

ATHLETIC**INNOVATIONS**

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Glossary

App – Software, commonly used in reference to smart phone applications

ANSI – American National Standards Institute

CSA – Canadian Standards Association

GPS – Global Positioning System

IEC – International electrotechnical commission

In-Situ – Latin for 'On-site' or 'In-position', meaning in its expected environment

IP – Ingress Protection

LED – Light emitting diodes

OEL – Occupational Exposure Limits

Introduction

Athletic Innovations' newest product, *RunWare*, will combine an athletic jacket with electronic necessities. Features such as a heart-rate monitor and Bluetooth speakers will create an elevated running experience. By observing the tools runners choose to take with them, the enjoyment and effectiveness of an athletic experience can be dissected down into a very specific criteria, made of five necessities: communication, health monitoring, entertainment, navigation, and safety. Currently in the market, there are many products that are able to address one or some of these criterion, but RunWare combines various technology to create one easy product to address all needs. To address safety concerns, the jacket will feature light-sensitive LED lights to increase visibility in low light conditions. The jacket will also feature speakers, which not only provide entertainment, but add safety by allowing users to be more aware of their surroundings. To communicate with the user, RunWare will have a voice recognition capability to audibly report health monitoring statistics such as heart rate, pace, and calories burned. Voice commands will also be able to communicate with the users Android phone application, allowing for phone calls and navigation features. The application will eliminate the need for route preplanning. This document outlines the functional requirements and the professional standards needed for *RunWare*.

Scope

This document provides the functional requirements for *RunWare*. The specifications describe the proof-of-concept and the prototype, as well as our vision for the final product. Athletic Innovations will closely abide by the requirements listed throughout the entire development process.

Intended Audience

All members of the Athletic Innovations team will use this document. The requirements mentioned will be used to guide the design and implementation of *RunWare*. Furthermore, this document will be used to test *RunWare's* functionality and whether it upholds to the necessary standards.

Classification

For this document, we chose the following convention to clearly indicate the type of functional requirement for each section.

| Rx | P | This is a functional requirement. X denotes the number of the functional requirement, while P denotes the priority and is separated into the following: |

I   Critical for Proof-of-concept design

II   Proof-of-concept or prototype

III Production requirement only

System Requirements

General requirements applicable to *RunWare* as a complete system are presented in this section. The overall system will be divided into a hardware and software overview. The high-level diagram shown below show's how RunWare will operate. In order to provide the user with maximum satisfaction when using the jacket, the subsystems must be integrated into the jacket while minimizing discomfort to the user. Since the purpose of the jacket is for running, in our design we must consider how to weatherproof our subsystems once integrated (i.e. rain, snow, wind). It is our goal to design *RunWare* with the intention to minimize difficulties when integrating into different kinds of jackets in the future.
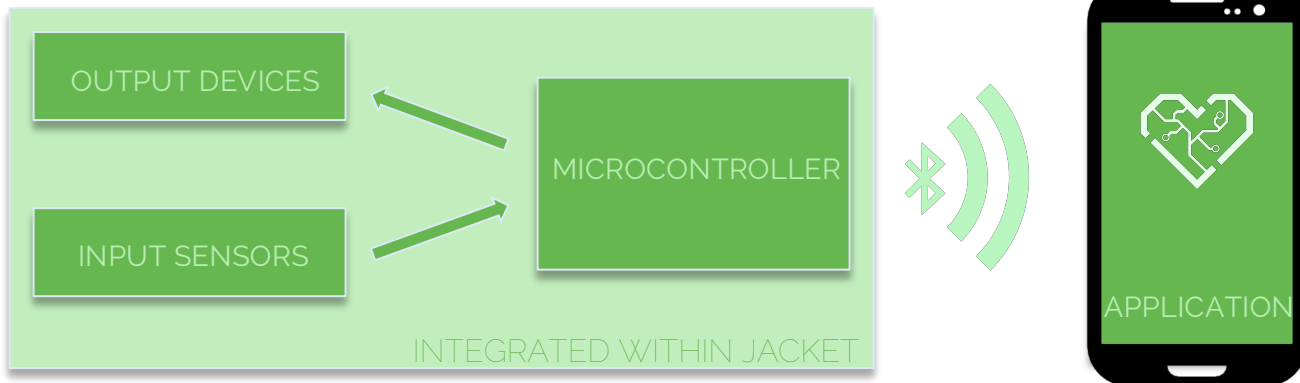

FIGURE 1 - RUNWARE SYSTEM ARCHITECTURE

Hardware Overview

The hardware side of *RunWare* encompasses the jacket and all the electronic components integrated within it. It will consist of five subsystems: Heart Rate Detection, Audio Input/Output, Microcontroller, and LED Visibility. A high level overview of the hardware system is shown in figure 2.

The Heart Rate Detection subsystem contains the necessary circuitry to collect data on the user's heart rate. The Audio Input/Output subsystem provides two functionalities: voice input and sound playback for command recognition as well as music streaming. The microcontroller will provide processing power and Bluetooth connectivity to communicate with the app. Lastly the LED Visibility subsystem contains the circuitry for the LEDs that light up when visibility is low.
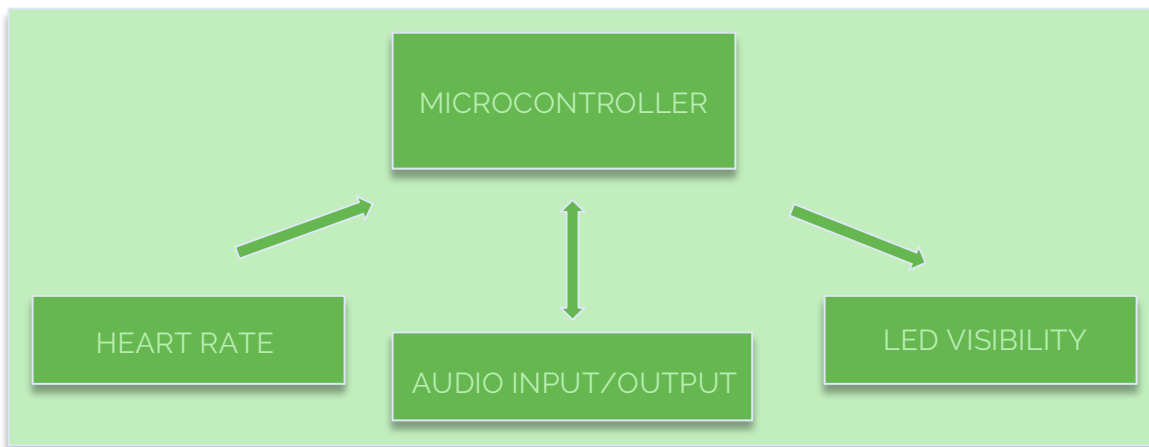
FIGURE 2 – HARDWARE SUBSYSTEM

General Requirements

R1	I	The costs of hardware components for a proof-of-concept jacket shall not exceed $600
R2	I	The device will encourage users to exercise outdoors
R3	III	The device can be easily incorporated into various types of jackets
R4	II	The core jacket will remain machine washable
R5	I	The jacket will communicate with the user's smart phone and relay information
R6	III	The technology will be licensed to interested manufacturers to be incorporated into their clothing line

Physical Requirements

| R7 | II | The device shall be attractive and form fitting to the user |

| R8 | II | The device will not be cumbersome |

| R9 | III | The device will weigh between 0.3 kg and 0.6 kg, while a regular jacket weighs around 0.2 kg |

Electrical Requirements

| R10 | II | A lithium ion battery will power the system |

| R11 | II | The device will not exceed 5 volts and 5 milliamperes at all times [1] |

| R12 | II | The jacket will be charged using a USB wall charger meeting CSA standards |

Environmental Requirements

| R13 | III | The jacket will use recycled parts where possible |

| R14 | III | The jacket will contain no components that cannot be safely disposed of |

Reliability and Durability Requirements

| R15 | II | The jacket will withstand daily usage within reasonable operating conditions |

| R16 | I | The electronic components will be water resistant or weather proof |

| R17 | III | The electronics will be able to function for at least 3 days without recharging |

| R18 | III | The app will automatically update when new releases are available |

| R19 | II | All components will be easily removable when the jacket needs to be washed |

Safety Requirements

| R20 | II | The device will not cause harm to the user under expected weather conditions and normal operating conditions |

R21   II   The electronics will not heat up greater than 40° Celsius under no circumstances [2]

Usability Requirements

R22   I   The jacket and the application must pair easily via Bluetooth

R23   I   The jacket shall turn on and off easily

R24   III   The application shall include instructions on how to operate the various functions of the jacket

R25   III   A trained user can install new software revisions

Standards

R26   III   All electronics must meet CSA International standards [3]

Sustainability

R26   III   All electronic modifications will be easily removable and unused jackets will be donated to charity

R27   II   Materials used in waterproofing fabrics will not be harmful to the environment

R28   III   Methods will be in place to use electronic components such that their life is extended as much as possible

R29   III   All electronics will be recycled and disposed of properly

Heart Rate Detection Requirements

The Heart Rate Detection subsystem is responsible for collecting data on the user's heart rate. This subsystem will send the data, via wires, to the microcontroller for processing. It will be located on the wrist area of the jacket and consist of three components. The accuracy of our heart rate measurement will depend on the ability of this subsystem to detect changes in the vein.

General Requirements

| R30 | I | The device will collect data on the user's heart rate |

| R31 | I | The device will send the data to the microcontroller for processing |

| R32 | I | The device will detect changes in heart rate based on a set sampling period |

Physical Requirements

| R33 | III | The heart rate monitor will not cause the user discomfort |

| R34 | III | The heart rate monitor will be lightweight and compact |

| R35 | I | The heart rate monitor will be located at the wrist area of the jacket |

| R36 | III | The heart rate monitor will be easily detachable |

Audio Input/Output Requirements

To provide added entertainment and safety to *RunWare* users, a microphone and speakers will be embedded into the collar of the jacket. The speakers will output GPS directions, phone audio, and music, while the microphone will take in voice commands and call audio. The data will be transmitted between the mobile phone application and components in the jacket via Bluetooth.

General Requirements

| R37 | II | The microphone will collect verbal data from the user |

| R38 | I | The speakers will emit music, phone services, and GPS directions for the user's entertainment and safety |

| R39 | I | The speakers will be open-ear, so they will not obstruct the user's spatial awareness |

Physical Requirements

| R40 | II | The microphone and speakers will be lightweight and unobtrusive |

| R41 | I | The microphone and speakers will be contained in the collar of the jacket |

| R42 | I | The microphone will be located near the front, center of the jacket's collar |

| R43 | I | The speakers will be located behind the ears in the jacket's collar |

Performance Requirements

| R44 | II | The speakers will not exceed 80dB for the safety of the user's hearing as per the Canadian Occupational Health and Safety OEL's [4] |

| R45 | III | The microphone and speakers will be able to withstand various weather conditions and will be waterproof |

| R46 | II | The microphone and speakers will be removable for washing of the jacket |

Usability Requirements

| R47 | II | The user will be able to control the speakers via voice command and Bluetooth connectivity with their mobile phone application |

| R48 | I | The user will be able to trigger voice control with the use of a push button located at the end of the right-hand sleeve |

Standards

| R49 | I | The microphone will be waterproof to IEC:IP57 standards [5] |

| R50 | III | The speakers shall be rated IP67 [6] |

Microcontroller Requirements

The microcontroller is a wearable programmable computer that is at the center of our implementation. The microcontroller will be able to send and receive signals from the application via the Bluetooth module. One input will be from the heart rate monitor, which will send a set of measurements to the microcontroller to be averaged. Another input will be from the microphone. The Microcontroller will output

to the speakers. Finally, the Microcontroller will also control the lights to go on in low light situations.

General Requirements

R51	II	The microcontroller shall remain dry at all times
R52	I	The microcontroller shall output energy to power up sensors, LEDS, and the Bluetooth module
R53	I	The microcontroller shall process the desired inputs and output the required signals
R54	I	The microcontroller shall turn off when the jacket is not in use
R55	III	The microcontroller shall not be easily tampered with

Physical Requirements

| R56 | I | The microcontroller shall be connected securely to the jacket sensors, LEDS and Bluetooth module |
| R57 | II | The microcontroller shall be attached so it does not obstruct the user's movement |

LED & Visibility Requirements

The LED subsystem will serve as the main illumination mechanism for the jacket. A small lithium ion battery will power it, which will be located in the lower back of the jacket. The LED's will connect to the battery with a series of wires, sewn throughout the jacket.

General Requirements

R58	I	The LED's will illuminate the user such that they're visible at night
R59	I	The LED's will be placed on the front, back and shoulders of the jacket
R60	I	The LED's will be small enough to not be intrusive to the user

Electrical Requirements

| R61 | II | LED's will be powered with a 3.6V source battery |

Standards

| R62 | II | The LED's shall conform to the ANSI 107 standard for Class 1 high-visibility clothing. [7] |

Software

The software side of *RunWare* encompasses the Android application, Bluetooth connectivity to the hardware, and voice recognition and commands.
The Android application designed for *RunWare* will be the source for the users feedback regarding their heart rate, distance travelled, and entertainment.

General Requirements

| R63 | I | The minimum Android OS compatible with the mobile application will be Jelly Bean 4.2 |

| R64 | I | The application will be compatible with over 50% of Android smart phones [8] |

| R65 | I | The mobile phone application will be able to receive data from the jacket |

| R66 | I | The mobile phone will be able to transmit audio to the jacket |

| R67 | II | The mobile phone will be able to track and display GPS information |

| R68 | I | Heart rate, location, and pace will be synced regularly |

| R69 | II | The mobile phone will display accurate running statistics during and after activity |

| R70 | III | The application will be available on the Google Play Store |

Safety Requirements

| R71 | I | The mobile phone will be carried in the jacket in a waterproof compartment |

| R72 | III | The users information will be kept anonymous |

Performance Requirements

| R73 | I | The application will continue to run and receive information from the microcontroller while the phone screen is locked |

| R74 | I | The application will only run essential services while the phone is screen is locked, such as Bluetooth connection, GPS monitoring, heart rate monitoring, and audio playback |

| R75 | II | The application will respond quickly when the user initiates the button corresponding to an incoming voice command |

Usability Requirements

| R76 | I | The user will be able to understand all relevant information at a glance |

| R77 | II | The app will use pictures instead of words where necessary without losing meaning |

Standards

| R78 | II | The app will conform to Google's Android design and usability standards [8] |

Testing

User Documentation

The user will be able to check the Athletic Innovations website (to be designed) where a support information document will be made available. This document will be geared toward the more technical user. The information will be available in English, French, Spanish, German, Hindi, Farsi and Mandarin.

In addition, the Athletic Innovation website will have 1 or 2 short videos to assist the user, which will be more visually impactful. The videos will cover all the information covered in the documentation on the company website.

A user manual in the form a brief pamphlet will accompany each individual jacket. This pamphlet will be written for non-technical users, but will suggest checking the Athletic Innovations online manual for more technical details and support. This

pamphlet will be available in English and French, but the user manuals for international markets will be available in other languages.

System Plan

Initial testing and debugging will be done separately on each subsystem in order to confirm their performance meets our expectations. Once we are satisfied with individual subsystem development, we will begin the integration process. As each subsystem is integrated together, we will again test that the subsystems maintain their expected functions. Finally once hardware integration is completed with testing and debugging, we will connect the hardware and software systems together. At this stage, we will test the jacket as a whole, as well as put it through in-situ performance testing.

Individual Subsystems

Heart Rate Detection Test Plan

We will simulate our circuitry for the heart rate monitor, to ensure our design performs as expected. Next we will begin by confirming the circuitry is capable of outputting signals. Next we will tune the position of the components in order to attain steady heart rate readings. Lastly, we will ensure the data meets our expectation and can be sent to the microcontroller.

Audio Input/Output Test Plan

To test the audio input and output, we will begin by ensuring we receive an accurate and expected signal through the microphone and speakers. Incorporating Bluetooth connectivity, we will then test that the expected signal can be transmitted to and from an Android phone. Finally, we will ensure that our app can control the signal and subsystem.

Microcontroller Test Plan

In order to test the microcontroller, we will first operate under the assumption that the other subsystems have the appropriate signal outputs to the microcontroller. We will test the capabilities of the microcontroller to send digital signals and to receive digital and analog signals. In addition to the signals, we will also confirm its capability to calculate values based on stored data.

LED Visibility Test Plan

To test the LED's we will drive the circuit with the signal from the microcontroller and ensure it lights up to the intensity that we desire.

Software Test Plan

The application testing will start with ensuring a Bluetooth connection is formed from the users smartphone to *RunWare.* We will ensure that audio playback can be controlled from the application. Next, we will confirm that the application can display the heart rate information sent from the microcontroller correctly, and be updated in a timely manner. We will then check that the users GPS coordinates are updated accurately and the users travel distance is displayed on the application. Lastly, we will test that the user can interact with the application using voice commands.

Future Developments

After completing a proof-of-concept prototype, we will work towards creating a stand alone *RunWare*. The production version of *RunWare* can be integrated into any athletic jacket. We hope to create other versions for different sports and activities like skiing. We are aiming to keep the cost of the stand alone product at eighty dollars.

Conclusion

In conclusion, this document outlines the functional specifications and standards that the Athletic Innovations team will use to aid design and implementation of the *RunWare*. This all-inclusive athletic jacket will feature a heart rate monitoring subsystem to provide health monitoring and safety features, an audio subsystem to address communication, navigation, and entertainment, and an LED subsystem to create more safety through visibility. By April 2015 Athletic Innovations hopes to have all proof-of-concept functional requirements completed.
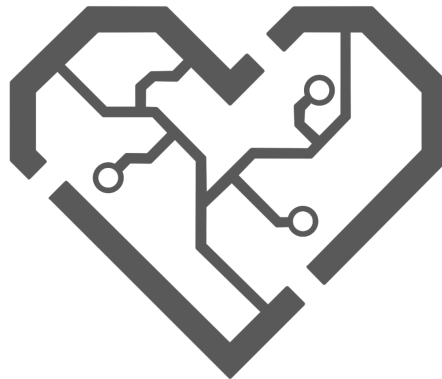
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