



February 20<sup>th</sup> 2006

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

Re: ENSC 440 – Functional Specifications for the Oxygen Caddie

Dear Dr. Rawicz,

The attached document, Functional Specifications for the Oxygen Caddie, will cover the functional requirements of the Oxygen Caddie. The goal of Orange Health Group is to provide an assistive device that will caddie around an oxygen tank and follow the user. This product is meant to make life easier for those who are in need of an assistive respiratory device.

The purpose of this document is to outline the functional specifications of our Oxygen Caddie in detail for both the prototype and final product. This document dissects the various components of the Oxygen Caddie and lists the operational functions of each. Also included in this document is the list of functions to be completed by the deadline as well as the functions we hope to accomplish after the course is over.

Orange Health Group consists of five enthusiastic 4th-year SFU Engineering Science Students; Richard Chan, Robin Chuang, Nathaniel Culham, Jason Czerniej, and Rex Lin. For questions or concerns you may contact Rex Lin at 604-783-3167, or contact us via email at [OHGroup@gmail.com](mailto:OHGroup@gmail.com).

Sincerely,

Rex Lin

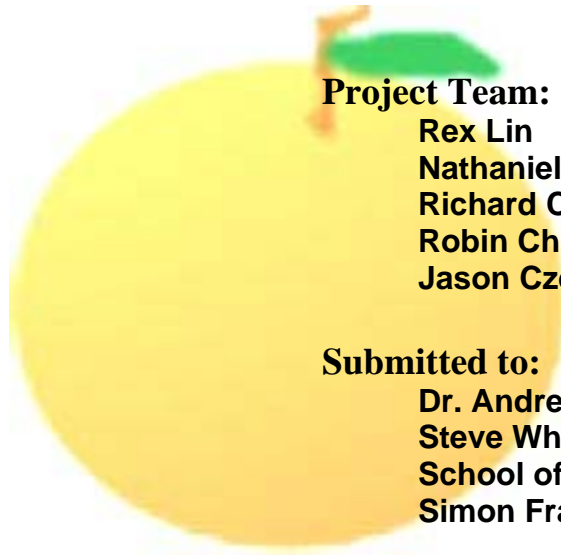
A handwritten signature in black ink that appears to read "Rex Lin". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

CEO

Orange Health Group

# **Functional Specifications of the Oxygen Caddie**

**By Orange Health Group**



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## **Submitted to:**

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## Executive Summary

As we get older, our body begins to wear down, and the systems we took for granted when we were young begin to fail.

Today we live in an age where we have many working bodies to take care of our elderly. We are fast approaching the time when this will not be the case. Soon, many, many baby-boomers will be entering retirement and we won't have as many hands available to take care of the elderly. This gives rise to the need to automate care systems to make the elderly increasingly independent. Our contribution to this cause is a robot that will caddie around an oxygen tank for those in need of assistive respiratory systems.

The development of the technology for this Oxygen Caddie is underway and will undergo 3 stages of development. The main goals of the 3 respective stages will be as such:

### Stage 1: Designing the technology

- We will design a robot that will be able to track the location of and follow its master.

### Stage 2: Consumer Product Development

- We will refine the tracking and following algorithm as well as refine the aesthetics of the robot, making our Oxygen Caddie a consumer ready product.

### Stage 3: Broadening the Scope

- Applying the tracking and following technology to various other consumer applications.

We expect that in the scope of our ENSC 440 Capstone Project Course we will be able to complete stage 1 of development, and make some progress into stage 2 of development.

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# 1 Introduction

As the baby-boomers begin to retire and the number of seniors increase, there will be less people in the workforce and the man hours necessary to take care of our elders will increase. To reduce the man hours that will be required, our device will allow seniors to become more independent. Our proposed device, the Oxygen Caddie, is intended to carry an oxygen supply around for seniors such that the seniors or the people looking after them do not have to spend time or effort moving around the oxygen supply. Our goal for this project course is to develop a prototype that is able to perform all the necessary functions for a working product. The functions are outlined in this document and our targeted deadline for a finished prototype is the end of April 2006.

## 1.1 Scope

In this document, we will point out functions and objectives that we hope to achieve by the end of this project. We will discuss what our device should be able to do and what it should have. This document should outline the goals we have set for ourselves through the project and illustrate the concept of our device. With a clear set of objectives in mind, we can then proceed to design our device to efficiently meet these requirements.

## 1.2 Intended Audience

This document is the result of requirement analysis prepared by the Orange Health Group for the Oxygen Caddie product. The designers have this guideline in mind as they progress in developing the system. The purpose of this document is to guide and ensure the designers meet the specific behaviors of the system that were intended to be developed.

## 1.3 Convention

The following convention will be used to denote functional requirements:

[Rn-x] – A functional requirement.

where n is the requirement numbers and x will be the priority of this particular requirement. There will be two priorities and they are denoted as follow:

- c – The core functional requirements are the requirements that are the most important and are going to be implemented and applied to the prototype.
- lc – The less functional core requirements are those that will be considered and might be applied to the final product. They are usually called the “nice-to-have features”.

## 2 System Requirements

### 2.1 System Overview

Figure 2.1 below is a top level overview of our product. The product will simply be able to carry an oxygen tank and follow the user without the user directly moving the oxygen caddie. The prototype will be able to follow the user; however, will not be able to recognize possible obstacles in its path or changes in its environment.

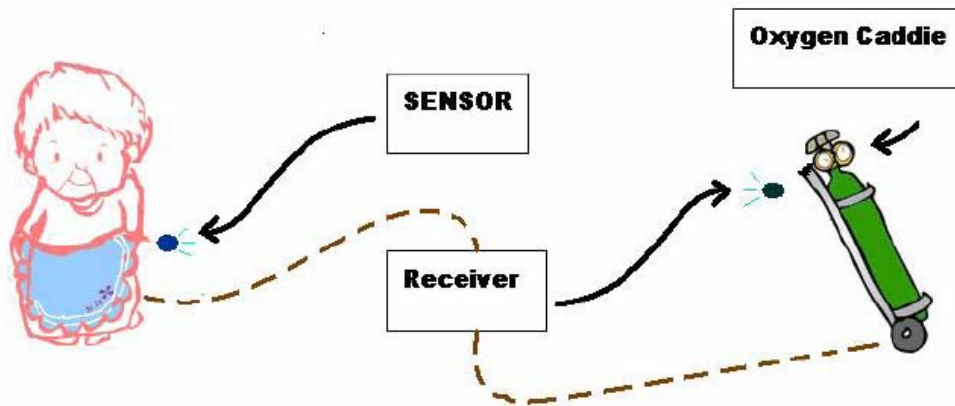


Figure 2.1: System Overview

## 2.2 Physical Requirements

- [R0-1c] The system will be able to withstand up to 50 lbs of vertical resistance without breaking
- [R1-1c] The system will have sufficient weight at the base so movement toward the user will not make the system tip over
- [R2-1c] The system will have sufficient width to achieve the balance of the overall system
- [R3-c] The prototype will be powered by rechargeable 12 Volt lithium battery that will be installed in between the wheel and motors
- [R4-1c] The battery will be recharged by a two meter cord to a typical wall outlet
- [R5-c] There will be two motors placed beside each wheel for controlling the speed of each wheel and managing turns
- [R6-c] The control micro-chip will be enclosed and secured in box to prevent damage from exterior
- [R7-c] All parts that may cause electrical or physical damage to the customer will be secured so that the user cannot access it



## 2.4 Environmental

- [R8-c] Our device should be able to start and operate properly under temperatures between  $-10^{\circ}\text{C}$  and  $40^{\circ}\text{C}$
- [R9-c] Our device should be able to start and operate properly under typical humidity levels in North America
- [R10-c] Our device should be able to withstand small amounts of rain for over 5 minutes
- [R11-1c] Our device should be able to withstand 20 km/hr winds without a decline in efficiency
- [R12-c] Our device should be able to work on cement, wood flooring, and carpets
- [R13-c] Our device should not be able to produce enough heat such that our device will heat up above  $40^{\circ}\text{C}$
- [R14-c] Our device should work in an environmental friendly manner and will not emit harmful gases

## 2.5 Performance

[R15-c] The device will have the ability to sense a person within a 120 degree range relative to the front of the device

[R16-c] The device should be able to track the movement of the person as long as the person is within 2 meters of the device

[R17-c] The device will pick up the movement of the user when the user has displaced more than 30 centimeters

[R18-c] The device should respond to a user's reaction when needed within 1 second of the movement

[R19-c] The device should be able to operate over 2 consecutive hours with a full battery

[R20-c] The device should be able to move up a bump in the road up to 2 cm

[R21-c] The device should be able to move up an incline of 20 degrees

[R22-c] The device will be able to carry one oxygen tank (up to 10 lbs)

[R23-c] The device will not bump into the user. It will not move within 10 cm of the user

[R24-c] The device should be able to follow a person moving in a straight line at a rate of 1 meter a second

### 2.5.1 Motor Requirements

[R25-c] The motors should be able to run the product at a constant speed under ideal load conditions

[R26-1c] The motors should be able to run the product at a constant speed under dynamic load conditions

[R27-1c] The motors should be able to accelerate at a rate at least that of the user

[R28-1c] The motors should be quiet enough to not cause disturbance to the user and others around the user

[R29-c] Must be able to fit inside the chassis of the product and not be visibly seen

[R30-c] Must be able to be replaced or repaired by a qualified technician

[R31-c] Would like product to have constant speed under variable load conditions and varying inclines

## 2.6 Compatibility

[R32-c] The user should be able to recharge the device with power from a standard North American outlet

[R33-c] The unit will be able to securely hold an oxygen tank in a shape of cylinder with a 15 cm diameter

[R34-1c] The system will be adjustable to secure and hold oxygen cylinders of size D and E

## 2.7 Reliability and Serviceability

Reliability is a key issue in our product. The consequences in where the product would fail are detrimental to the user

[R35-1c] Must be fully operational continuously for a long period of time (2 hours) while the user is active and doing tasks

[R36-1c] Impacts to the product with the intensity of it running at max speed on flat terrain into a solid object should not damage its efficiency

[R37-1c] Impacts such as those explained above may damage the aesthetics of the product

[R38-1c] Must be able to recharge fully, from empty power, in eight hours

[R39-1c] Speed and response of product may be adversely affected when battery is low on power. So there will be a low power indicator

[R40-1c] In case of failure, product can be reset and recovered completely

[R41-1c] In cases of failure where product cannot be recovered by cycling the power or replacing the battery, the user should not service it

[R42-1c] Long term use of the product will lead to the degrading of the battery's lifetime. User should replace when this affects activity habits due to frequent recharging

[R43-1c] Due to high amount of mechanical parts, product may undergo mechanical failure and is expected to have a mean time before failure of three years

[R44-1c] Upgrades of any kind, may they be mechanical or software should be done by a qualified technician and not by the user

### **3 User Interface**

The user interface will allow the user to change various preferences that change how the Caddie will perform.

[R45-1c] The input to the user interface will be via buttons

[R46-1c] The user interface will output information via a screen

[R47-1c] The screen will display the dynamic purpose of each button

[R48-c] The user interface will give options for preferences in: following distance, speed

[R49-c] While in operation, the screen will output the state of the device

[R50-c] The user interface will allow the user to turn the device on and off

## 4 Documentation and User Manual

Our target audience will probably not have good grasp of new technologies in the market today. As a result, our documentation will have to explain how to operate our device assuming our customers know little or nothing about new technologies and conventions.

[R51-1c] A user manual will be provided in the following languages: English, French, Spanish, and Chinese

[R52-1c] An electronic version of our documentations will be provided on our website.

[R53-c] Our website will have a FAQ explaining commonly asked questions or problems a user might have about our device

[R54-c] The user manual will be written in terms so that users with non technical background can understand

[R55-1c] The user manual shall contain lots of descriptive pictures so that a person can have an idea of what to do without having to read the manual

[R56-1c] The user manual will explain how to maintain the device to maximize the device's life expectancy

[R57-c] The user manual describes what is covered under our warranties

[R58-1c] Methods to contact us will be provided in case the user has still has questions about our user manual

[R59-c] A more technical version manual will be provided detailing procedures for troubleshooting the device

## **5 Conclusion**

The functional specifications outlined here are intended to describe in detail features that our device will have. It also breaks down our design features into phases of the development cycle to explain how we aim to bring this product to market. We classified functions into key tasks that must be done to build a prototype of our design, and tasks that we would like to complete for a final design of our product



## 6 Reference

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