



October 16, 2002

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Re: Functional Specifications for a Voice Activated Remote Control System (ENSC 340 Project)

Dear Dr. Rawicz,

The attached document, *Functional Specifications for a Voice Activated Remote Control System*, defines the attributes of our voice-activated remote control system for our ENSC 340 project. It describes in detail the physical characteristics, user interface requirements, and system attributes of each component of the project, presenting a clear idea of our final product.

The attached functional specifications ensures that our project idea is clearly defined, aiding in development of product design. As well, a test plan is included, providing a series of tests to ensure the product meets the defined specifications.

If you have any questions regarding our functional specifications, please contact me at 604-325-8569 or email at [fls-340@sfu.ca](mailto:fls-340@sfu.ca).

Sincerely,

*Roger Lum*

Roger Lum  
CEO  
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Enclosure: *Functional Specifications for a Voice Activated Remote Control System*

Functional Specifications for a

# Voice Activated Remote Control System

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## Executive Summary

The VoiceIR is a voice-activated remote control system. This product allows those physically disabled to enjoy the convenience of remote controls. The versatility and simplicity of this product is unmatched in the current market place.

The functional specifications define all attributes of the VoiceIR system, ensuring a smooth transition between concept and development. The VoiceIR is split into three modules: a wireless microphone, a central control unit, and multiple IR modules. Our concept allows many small IR modules to be placed in front of every device the user wishes to control. The central control unit is able to handle multiple IR modules, making the product completely customizable. Each module has defined physical characteristics, user interface requirements, and system attributes, presenting a clear idea of what the finished product should look like and how it should function.

A test plan has also been created to confirm our final product meets the requirements set out in this document. This will ensure that our final product is a manifestation of the product we originally envisioned.

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# 1 Introduction

The VoiceIR is a voice activated remote control system. This product allows disabled individuals to enjoy the convenience of remote controls through trainable voice commands. The user is able to control any device that uses infrared (IR) remotes simply by talking into a wireless microphone. Through the versatility of the design, the user is able to control devices located anywhere in the house.

## 1.1 Scope

This document outlines in detail the requirements to which this product adheres. This includes physical, user interface and system requirements. As well, a test plan is included to demonstrate how to verify these requirements in the finished product.

## 1.2 Intended Audience

This document is intended for design engineers and project management. This document will help design engineers create the product within a specified set of guidelines. For project management, this document will help ensure the product is being developed with the required functionalities.

## 1.3 Notation

The requirements are numbered with the following convention:

R[Mx.y.z], with  
x = module number (0 = overall system)  
y = requirement category (0 = overall requirements, 1 for physical requirements, 2 for user interface requirements, and 3 for system requirements)  
z = requirement number

Test cases are numbered with the following convention:

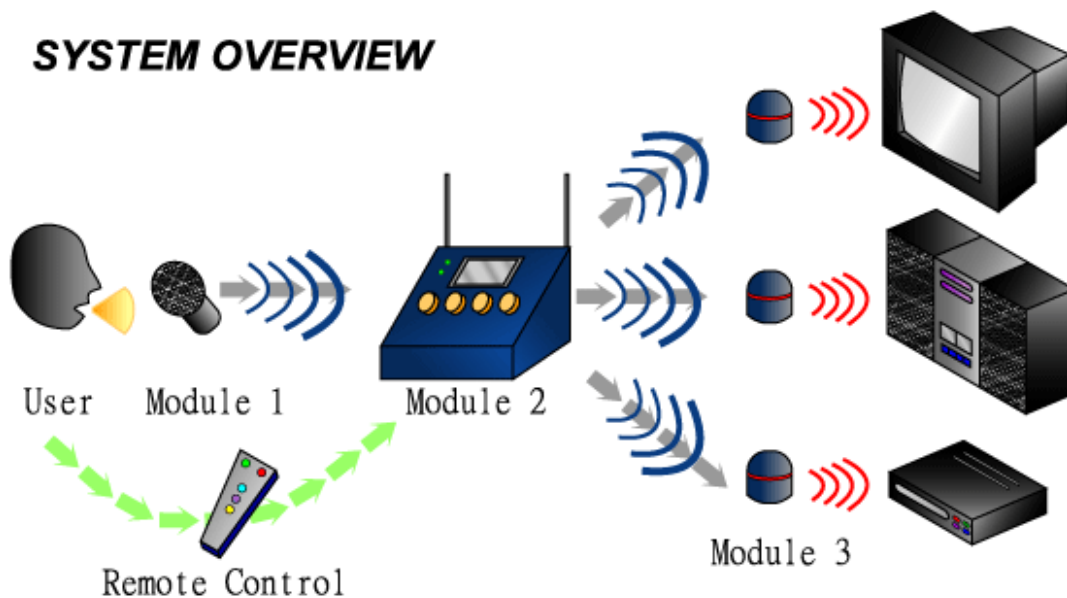
T[Mx.y], with  
x = module number (0 = overall system)  
y = test case number

## 2 System Requirements

### 2.1 System Overview

The VoiceIR system overview is shown in Figure 2.1. This figure shows a user engaging the VoiceIR system to control various devices with voice commands.

The VoiceIR system consists of three modules. The user first needs to train the VoiceIR system at Module 2 (M2). M2 will store the user's voice and the corresponding remote control signals. After initial training, the user simply speaks commands to Module 1 (M1) in order to control target devices. M1 sends the voice commands to M2 for processing. M2 interprets the voice signal and looks up the appropriate IR signal. A command signal is sent to Module 3 (M3). M3 then receives the signals and transmits the appropriate IR signal to target devices. To control numerous devices, the user may place multiple M3s in different locations in front of each target device.



**Figure 2.1: System Overview**

### 2.2 Overall Requirements

**R[M0.0.1]** VoiceIR must receive voice commands from users and control target devices correspondingly.

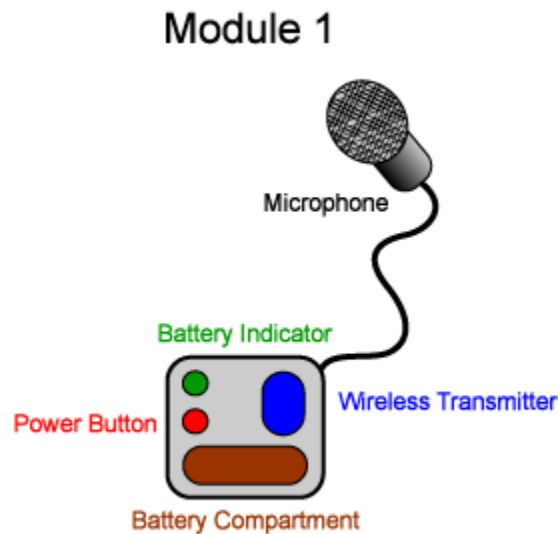
**R[M0.0.2]** VoiceIR shall consist of three modules.



- R[M0.0.3]** VoiceIR must facilitate controlling multiple devices placed in different locations.
- R[M0.0.4]** VoiceIR shall allow the user to control target devices up to 75 meters away from the user.
- R[M0.0.5]** VoiceIR must not modify target devices and their existing remote controls.

### 3 Module 1 Requirements

Module 1 is the wireless microphone into which the user speaks the voice commands. A sketch of module 1 is presented below.



**Figure 3.1: Module 1 Overview**

#### 3.1 Physical Requirements

- R[M1.1.1]** This module must weigh less than 100 grams.
- R[M1.1.2]** This module shall consist of a microphone which is attached to a main body by a wire.
- R[M1.1.3]** The microphone shall have a size no larger than  $2 \times 2 \times 3 \text{ cm}^3$ .
- R[M1.1.4]** The main body shall have a size no larger than  $3 \times 3 \times 5 \text{ cm}^3$ .
- R[M1.1.5]** The connecting wire shall be approximately 60 cm long.



## 3.2 User Interface Requirements

- R[M1.2.1]** The microphone must have a clip for attaching onto the clothes or another convenient location on the user.
- R[M1.2.2]** The main body shall have a clip for attaching onto the belt or another convenient location on the user.
- R[M1.2.3]** The main body shall have a power button.

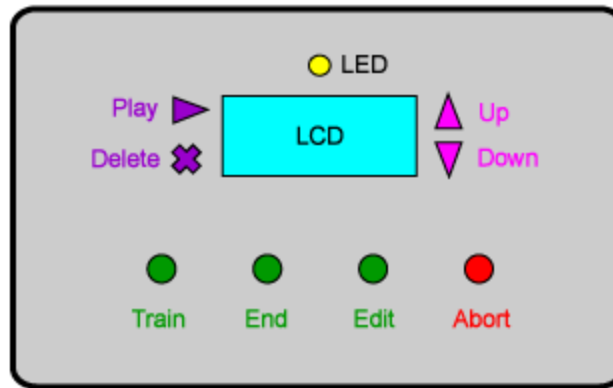
## 3.3 System Requirements

- R[M1.3.1]** This module operates on one 9V battery.
- R[M1.3.2]** There shall be a battery-low indicator once the battery has been depleted 90%.
- R[M1.3.3]** This module must wirelessly transmit voice commands to Module 2 to a maximum distance of 25 meters.

## 4 Module 2 Requirements

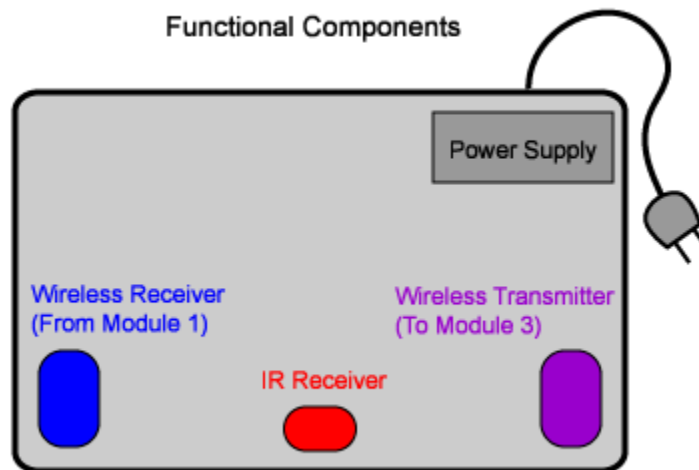
Module 2 is the central control unit that stores the trained voice commands and associating IR sequences. This module receives voice commands from Module 1 and processes them. It then sends command signals to Module 3 to execute the desired control of the target device. An overview is presented in the diagrams below.

## Module 2 User Interface



**Figure 4.1: Module 2 User Interface**

## Module 2 Functional Components



**Figure 4.2: Module 2 Functional Components**

### 4.1 Physical Requirements

**R[M2.1.1]** This module shall weigh less than 5 kg.

**R[M2.1.2]** This module shall have a size no larger than 30x30x30 cm<sup>3</sup>.

## 4.2 User Interface Requirements

- R[M2.2.1]** An LCD screen must be mounted on the top of the module to display status messages.
- R[M2.2.2]** There shall be a “train” button used to initiate storing voice commands.
- R[M2.2.3]** There shall be an “end” button used to complete IR training.
- R[M2.2.4]** There shall be an “abort” button used to quit at any stage of the voice-train process.
- R[M2.2.5]** The steps to program a voice command shall be carried out as follows:
1. LCD indicates that it’s ready for voice training.
  2. Press the “train” command button. (LCD indicates that recording in progress)
  3. Hold button while speaking command into Module 1 (microphone).
  4. Release button to end recording. (LCD indicates that recording has ended).
  5. LCD then indicates that it’s ready for IR training. If there is a problem, the LCD will report the error. Problems may include bad voice recording, or IR detected prematurely.
  6. Once Module 2 is ready, user presses a remote control button while pointing the remote towards the IR copier. When the signal is successfully captured, a beep will sound and an LED will flash.
  7. If more remote control commands are needed, repeat step 6. Once the sequence of commands is finished, the user needs to press the “end” button.
  8. LCD indicates the success of programming the voice/remote sequence.
  9. An abort button is available if at any step the user wishes to quit the training process.
- R[M2.2.6]** There shall be an edit button used to edit an existing list of voice commands.
- R[M2.2.7]** There shall be an up button and a down button used to navigate the list of voice commands displayed on the LCD.
- R[M2.2.8]** There shall be a “play” button used to play out a selected voice command through an embedded speaker.
- R[M2.2.9]** There shall be a “delete” button used to delete an existing voice command.
- R[M2.2.10]** The steps to delete an existing voice command shall be carried out as follows:
1. Press the “edit” button to enter management mode.
  2. A list of commands shows up on the LCD and one command will be highlighted.



3. Using the “up” and “down” button the user can scroll up and down the list to highlight different commands.
4. User may press the “play” button to verify the voice command.
5. User may press the “delete” button to delete a voice command.
6. User presses the “edit” button again to quit the management mode.

**R[M2.2.11]** There must be a LED indicating that this module is powered on.

### 4.3 System Requirements

**R[M2.3.1]** This module must be powered through a standard 120V AC outlet.

**R[M2.3.2]** This module shall always be on when power is supplied.

**R[M2.3.3]** Non-volatile memory shall be used to store voice commands and corresponding remote control signals programmed by the user.

**R[M2.3.4]** This module shall allow a maximum voice recording time of 10 seconds for each command.

**R[M2.3.5]** This module shall allow a maximum IR signal recording time of 15 seconds for each command.

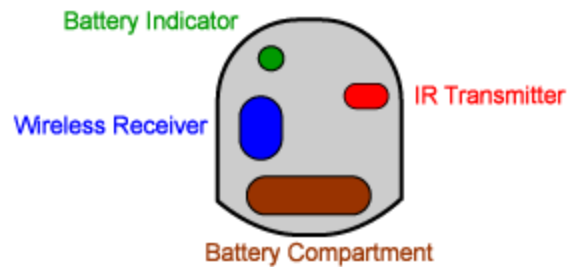
**R[M2.3.6]** The maximum distance between this module and Module 3 shall be 50 meters.

**R[M2.3.7]** This module shall be able to record a maximum of 50 voice commands.

## 5 Module 3 Requirements

Module 3 is placed in front of the IR device the user wishes to control. It accepts signals from Module 2, and then transmits the corresponding IR command to the target device. An overview of the module is presented below.

## Module 3



**Figure 5.1: Module 3 Overview**

### 5.1 Physical Requirements

**R[M3.1.1]** This module shall weigh less than 500 grams.

**R[M3.1.2]** This module shall have a size no larger than  $5 \times 5 \times 5 \text{ cm}^3$ .

### 5.2 User Interface Requirements

**R[M3.2.1]** This module must not require any user input.

### 5.3 System Requirements

**R[M3.3.1]** This module operates using two AA batteries.

**R[M3.3.2]** There shall be a battery-low indicator once the batteries have been depleted 90%.

**R[M3.3.3]** This module must emit IR signals to execute the appropriate command on the target device based on the command it receives from Module 2.

**R[M3.3.4]** The maximum distance between the target device and this module shall be 10 meters



## 6 System Test Plan

The overall requirements do not need to be tested since they are inherent in the requirements of the other modules and in the structure of the product.

## 7 Module 1 Test Plan

Each test case encompasses a set of requirements by presenting a test procedure, as well as pass conditions.

### 7.1 T[M1.1]

#### 7.1.1 Scope

Requirements R[M1.1.1], R[M1.1.2], R[M1.1.3], R[M1.1.4], R[M1.1.5], R[M1.2.1], R[M1.2.2], and R[M1.2.3]. These are the physical and user interface requirements.

#### 7.1.2 Procedure

1. Visually verify the physical requirements.
2. Visually verify the user interface requirements.

#### 7.1.3 Pass Condition

All the requirements are satisfied.

### 7.2 T[M1.2]

#### 7.2.1 Scope

Requirements R[M1.3.1] and R[M1.3.2], dealing with power source.

#### 7.2.2 Procedure

1. Plug in one 9V battery.
2. Keep unit on until battery-low indicator has lit.

#### 7.2.3 Pass Condition

Battery-low indicator comes on when battery is approximately 90% depleted.



## 7.3 T[M1.3]

### 7.3.1 Scope

Requirement R[M1.3.3].

### 7.3.2 Procedure

1. Must have at least one trained voice command.
2. Move 25 meters away from Module 2.
3. Speak a voice command.
4. Verify that Module 2 has received the command and is processing it.

### 7.3.3 Pass Condition

Module 2 is able to receive the signal 25 meters away.

## 8 Module 2 Test Plan

Each test case encompasses a set of requirements by presenting a test procedure, as well as pass conditions.

## 8.1 T[M2.1]

### 8.1.1 Scope

Physical requirements R[M2.1.1], R[M2.1.2] and user interface requirement R[M2.2.1], R[M2.2.11].

### 8.1.2 Procedure

1. Visually verify the requirements.

### 8.1.3 Pass Condition

All the requirements are satisfied.

## 8.2 T[M2.2]

### 8.2.1 Scope

Requirements R[M2.2.2], R[M2.2.3], R[M2.2.4], R[M2.2.6], R[M2.2.7], R[M2.2.8], R[M2.2.9].





## 8.2.2 Procedure

1. Visually verify that existence of the buttons presented in the requirements.

## 8.2.3 Pass Condition

All buttons are present.

## 8.3 T[M2.3]

### 8.3.1 Scope

Requirement R[M2.2.5].

### 8.3.2 Procedure

Following the training steps outlined in R[M2.2.5]. Verify that each step works, including the function of the buttons.

### 8.3.3 Pass Condition

The procedure in R[M2.2.5] is as expected.

## 8.4 T[M2.4]

### 8.4.1 Scope

Requirement R[M2.2.10].

### 8.4.2 Procedure

Following the deletion steps outlined in R[M2.2.10]. Verify that each step works, including the function of the buttons.

### 8.4.3 Pass Condition

The procedure in R[M2.2.10] is as expected.

## 8.5 T[M2.5]

### 8.5.1 Scope



Requirements R[M2.3.1], R[M2.3.2], and R[M2.3.3].

### 8.5.2 Procedure

1. Plug in Module 2.
2. Verify that the machine is operationally without the need to push any power-on button.
3. Train one voice command.
4. Unplug the machine and leave unplugged for a minute.
5. Re-plug the machine.
6. Bring up the command list and locate previously trained command.

### 8.5.3 Pass Condition

The machine should be on when plugged into an AC outlet. The voice command recorded in step 3 should still be in memory in step 6, after unplugging the machine.

## 8.6 T[M2.6]

### 8.6.1 Scope

Requirements R[M2.3.4] and R[M2.3.5].

### 8.6.2 Procedure

1. Follow the procedure outlined in R[M2.2.5].
2. In step 3, while recording the voice command, depress the voice-train button for more than 10 seconds.
3. Verify that after 10 seconds, the LCD indicates that it is ready for IR training.
4. In step 6, record a sequence of IR signals for more than 15 seconds.
5. Verify that after 15 seconds, the LCD indicates success of user programming.

### 8.6.3 Pass Condition

Module 2 continued the procedure of R[M2.2.5] after 10 seconds of voice recording and 15 seconds of IR training, despite the fact that the user attempted to record more than 10 seconds of voice and 15 seconds of IR sequences.

## 8.7 T[M2.7]

### 8.7.1 Scope

Requirement R[M2.3.6].



### 8.7.2 Procedure

1. Train a voice command.
2. Move Module 3 50 meters away from Module 2.
3. Speak the voice command.
4. Verify that Module 2 was able to command Module 3 to execute the appropriate command.

### 8.7.3 Pass Condition

Module 2 and 3 communicates while separated 50 meters.

## 8.8 T[M2.8]

### 8.8.1 Scope

Requirement R[M2.3.7].

### 8.8.2 Procedure

1. Repeat the voice training procedure for 50 voice commands.

### 8.8.3 Pass Condition

All 50 voice commands should be in memory.

## 9 Module 3 Test Plan

Each test case encompasses a set of requirements by presenting a test procedure, as well as pass conditions.

### 9.1 T[M3.1]

#### 9.1.1 Scope

Physical requirements R[M3.1.1], R[M3.1.2].

#### 9.1.2 Procedure

1. Visually verify the requirements.

#### 9.1.3 Pass Condition



All the requirements are satisfied.

## 9.2 T[M3.2]

### 9.2.1 Scope

Requirements R[M3.3.1] and R[M3.3.2], dealing with power source.

### 9.2.2 Procedure

1. Plug in two AA batteries.
2. Keep unit on until battery-low indicator has lit.

### 9.2.3 Pass Condition

Battery-low indicator comes on when battery is approximately 90% depleted.

## 9.3 T[M3.3]

### 9.3.1 Scope

Requirement R[M3.3.3].

### 9.3.2 Procedure

1. Train a voice command with a corresponding IR command.
2. Verify that Module 3 sends the correct signal to the target device.

### 9.3.3 Pass Condition

Module is sending IR commands that correspond to the trained command.

## 9.4 T[M9.4]

### 9.4.1 Scope

Requirement R[M3.3.4].

### 9.4.2 Procedure

1. Train a voice command.
2. Move Module 3 10 meters away from the target device.
3. Speak the voice command.



4. Verify that Module 3 was able to control the target device.

#### 9.4.3 Pass Condition

Module 3 controlled the target device while 10 meters away.

## 10 Conclusion

The functional requirements imposed on each module of the VoiceIR completely define the product and leads to a clear vision within the development team while designing and assembling the first prototype. Through these rigorous requirements, the product will be created with the functionality and features we had originally envisioned.

The test plan will help to verify that all the requirements are met in the product. Through the test plan, we can ensure that the finished product is a reflection of the sharply defined requirements.

With the functional specifications, creating a design and moving onto prototyping should be a smooth process with a high chance of success.