Department of Computer Science and Engineering

University of Nevada, Reno

The CTAR All-Star

Project Part III: Design

Team #3

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November 19, 2018

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## 

## Abstract

Our team will be joining another senior projects group in the Electrical Engineering department this year. We have been asked to create a medical therapy device for the UNR School of Medicine Speech Pathology and Audiology Department. Our contact there is Dr. Kristine Galek. We were introduced to this project by Dr. Fred Harris.

The project, a device used for rehabilitation, will consist of a rubber ball with an embedded system that will measure air pressure and transmit that data via bluetooth to a smartphone. Our part will be to create a mobile application that interfaces with this device and the data it outputs. We have been asked to make a cross platform application that presents the data in real time in the form of a line graph. We should be able to set goals and track stats, likely using a web or cloud-based database like SQL. We will need to learn how to work with that database, bluetooth, and real-time graphing. We have also been challenged to use the fingerprint functionality of modern phones for our login mechanism. If time permits, we may also create a game to make the program more interesting and interactive.

## Introduction

Dysphasia is a medical condition that is primarily seen in stroke victims and the elderly. The condition makes the act of swallowing difficult and affects millions of people every year. One current treatment exercise is known as the Chin Tuck Against Resistance or CTAR. This exercise involves squeezing a ball between the chest and chin in order to strengthen the muscles in the neck. The CTAR exercise is effective for rehabilitating dysphasia, but it has been shown that patients are able to perform better and work harder with visual feedback. The CTAR All-Star will be a system consisting of a pneumatic ball with an embedded pressure sensor and a bluetooth transmitter. The system will be coupled via bluetooth with a cross-platform mobile device application. The system will be used in a similar fashion to the CTAR exercise but it will have additional functionality including graphics that show the pressure inside the ball, different exercise modes, and the ability to store and retrieve the results and statistics from an online server. The real time graphics will help both the patient and the medical professional/clinician visually see the pressure reading from the device. As a result of the stakeholders’ interviews, some features were clarified and additional features have been added to the project. These features include incorporating different exercise modules to target isometric and isotonic muscle contractions. It is necessary to include different exercise modes because isometric exercises improve endurance which is important for joint stabilization while isotonic exercises use repetitive muscle shortening and lengthening against resistance which generates more muscle damage and improves strength.

## High-Level and Medium-Level Design

## Detailed Design

## Initial Hardware Design

## User Interface Design

## Glossary

|  |  |
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| 1. | **1-Rep Max**: The maximum amount of pressure a person can possibly exert for one repetition. Sometimes an average of three repetitions at max strength is used to determine this. |
| 2. | **Bluetooth**: A standard for the short-range wireless interconnection of mobile phones, computers, and other electronic devices. |
| 3. | **Cross-Platform**: Able to be used with different software packages such as iOS or Android. |
| 4. | **CTAR**: Chin Tuck Against Resistance. An exercise used in rehabilitation that strengthens the suprahyoid muscles in the neck. |
| 5. | **Database**: A structured set of data held in a computer, especially one that is accessible in various ways. |
| 6. | **Dysphagia**: A condition which makes it difficult or painful to swallow and is common in stroke victims and the elderly. |
| 7. | **Electronic Medical Record (EMR)**: A digital version of the traditional paper-based medical record for an individual. Represents a medical record within a single facility such as a doctor’s office. |
| 8. | **HIPAA**: Health Insurance Portability and Accountability act of 1996 is the United States legislation that provides data privacy and security provisions for safeguarding medical information. |
| 9. | **Isometric**: an exercise or a program of exercises to strengthen specific muscles or shape the figure by pitting one muscle or part of the body against another or against an immovable object in a strong but motionless action, as by pressing the fist of one hand against the palm of the other or against a desk. (Dictionary) |
| 10. | **Isotonic**: an exercise or a program of exercises to increase muscular strength, power, and endurance based on lifting a constant amount of weight at variable speeds through a range of motion. (Dictionary) |
| 11. | **Pneumatic Ball**: A ball that is operated by putting air or gas under pressure. |
| 12. | **Real-Time Graph**: A graph that depicts the input data as it is received. |
| 13. | **Speech Pathology**: The study and treatment of speech and language problems. |
| 14. | **Surface Electromyography (sEMG)**: The electrical activity of individual muscles or muscle groups is detected, amplified, and analyzed by a computer. |
| 15. | **Xamarin**: A cross-platform application development tool owned by Microsoft. |

## Contributions of Team Members

### Terri Heglar

### Austin Yount

### Andrew Penrose