CS 4605/7470

Project Proposal

**Buffalo Concussion Treadmill Tests (BCTT) Application**

1. **Group Members and their Roles** 
   1. Joshua Kent:
      1. iOS/WatchOS application development
   2. Sami Belhareth:
      1. Django web server (back-end)
   3. Karan Jit Singh
      1. Django web server (front-end)
         1. ReactJS
2. **Description**

The Buffalo Concussion Treadmill Test (BCTT) is a metric used by trained professionals (physical therapists, certified trainers, etc.) to help patients recovering from concussions and usually those suffering from post-concussive symptoms (PCS). This project will digitalize the traditional test into a mobile iOS application and SMART-on-FHIR web application such that it can be conducted more efficiently. Furthermore, the digital setup will permit the use of the data for health informatics and clinical decision support in future work.

Overall, the project will consist of three main aspects. First, the IOS application. This will be the patient-facing interface that will prompt them along the BCTT and capture biometric information like their heart rate. Second, the front-end of the web server. This will require designing an interface for the physical therapists to input notes, capture data about the patient for the BCTT, and have a portal to all previous tests. Third, the back-end of the web server. This will entail receiving the data from the iOS app, saving it in a database, and using it to track performance.

1. **Motivation**

One of the members of the team has undergone the BCTT in physical therapy while recovering from multiple concussions in previous years. They have first hand experience with it and understand user needs, and how digitalizing the process can bring about significant improvements to patient care. By storing the data, we will be able to provide recovery analytics that would’ve been infeasible previously. This aligns with the increasing push to digitize information in the healthcare industry, as the storage of digital information allows for better record-keeping and accountability, as well as the potential to take advantage of big data for better patient care [1].

In addition to the aforementioned reasons, this application could have a wide reaching impact due to the large number of Americans who experience traumatic brain injuries (TBIs) every year. The US Centers for Disease Control and Prevention (CDC) estimates that, “1.6 to 3.8 million concussions occur in sports and recreational activities annually.” This number is more than likely an underestimation since many individuals suffering from mild or moderate TBI do not seek medical advice [2]. Even worse, the effects of concussion are cumulative in athletes who return to play prior to complete recovery.

1. **Previous Research**

While there has not been substantial literature pertaining to the digitization of the BCTT, there has been work in proving the efficacy and validity of the BCTT, particularly literature detailing the relationship between BCTT performance over time and concussion recovery [3].

Using Google Scholar, we searched for the following pairs of boolean search terms: “Buffalo concussion treadmill test” AND “digital”; “Buffalo concussion treadmill test” AND “FHIR” (acronym for fast healthcare interoperability resources, a standard in the electronic medical record field). There were no relevant search results that included these terms of interest, indicating that there is little or no work pertaining to implementing the Buffalo concussion treadmill test in a digital format.

The protocol used for conducting the BCTT test currently will guide our work [4].

1. **Resources** 
   1. What do we need?
      1. IDE for IOS development: Xcode
         1. This comes free with all apple computers, so all team members with a mac will have access
      2. Web development (Django, ReactJS)
         1. Team members already have access to these frameworks
      3. iPhone or iPad
         1. Some team members have devices that we will use for testing
      4. Apple Watch
         1. Some team members have devices that we will use for testing
      5. Treadmill
         1. We have access at the CRC or other off campus gyms
2. **Timeline**

Below is a rough outline of what we hope to have finished in each week

* 1. Week 1 (6/14):
     1. Scoping out repositories with code that can be used for this project.
     2. Begin set up of our code repositories.
  2. Week 2 (6/21):
     1. Set up key functionality on iOS app (sending health information data to server)
     2. Write code for back end logic for web app
  3. Week 3 (6/28):
     1. Create user interface for iOS app and web application
  4. Week 4 (7/5):
     1. Initial testing and debugging
  5. Week 5 (7/12):
     1. Further testing and final revisions
  6. Week 6 (7/19):
     1. Completed application
     2. Begin write-ups, reports, and presentations
  7. Week 7 (7/26):
     1. Complete write-ups, reports, and presentations
  8. Week 8 (8/2):
     1. Extra week in the event of unforeseen circumstances

1. **Grading Criteria**

The team should be assessed by whether each individual component can deliver on its requirements. The three primary components of this assignment are: the WatchOS/iOS application, the web application front end, and the web application back end.

1. The WatchOS application should be able to measure patient heart rate data and send it to a server.
2. The web application front end should be intuitive and allow for the physician to input data, as well as provide options to save the data that the clinician is working with.
3. The back end should be able to process both data coming in from the WatchOS application, as well as data coming in from the clinician’s inputs on the front end. It should be able to save the data upon request, and process it in such a way that the clinician can obtain a clear understanding (this can be in the form of figures or statistical analysis).
4. **References**

[1] Halamka, J. D., & Tripathi, M. (2017). The hitech era in retrospect. The New England

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[2] Daniel H. Daneshvar, Christopher J. Nowinski, Ann C. McKee, and Robert C. Cantu. 2011.

The Epidemiology of Sport-Related Concussion. Clinics in Sports Medicine 30, 1: 1–17.

[3] Mohammad N. Haider, John J. Leddy, Charles G. Wilber, et al. 2019. The predictive capacity

of the buffalo concussion treadmill test after sport-related concussion in adolescents.

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[4] John J. Leddy and Barry Willer. 2013. Use of graded exercise testing in concussion and return-to-activity management. Current Sports Medicine Reports 12, 6: 370–376.