Safety Baseline Injury Testing System

by

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A Proposal Submitted to
The Faculty of the School of Information Technology
In Partial Fulfillment of the Requirements for
The Degree of Bachelor of Science
In Information Technology

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to all my cousins, especially Lawrence S. Beard, and to Jack Danheiser who’s words inspired me to pursue higher education.

I am dedicating this work to my wife, Kathleen and our four beautiful children, Abigail, Kevin, Matthew, and Nathan. “My cup runneth over (Psalm 23:5)”. As the years go by, if you should return to this, remember these two poems, which filled my heart every day as I pursued this endeavor. First a poem from Edgar Albert Guest:

“There are thousands to tell you it cannot be done,

There are thousands to prophesy failure,

There are thousands to point out to you one by one,

The dangers that wait to assail you.

But just buckle in with a bit of a grin,

Just take off your coat and go to it;

Just start in to sing as you tackle the thing

That “cannot be done,” and you’ll do it (Guest).”

Lastly, these profound words from the Quaker poet, Stephen Grellet, were given to me by my grandmother, Dorothy Beard:

“I shall pass through this world but once. Any good therefore that I can do or any kindness that I can show to any human being, let me do it now. Let me not defer or neglect it, for I shall not pass this way again (Grellet).”
Safety Base Line Injury Testing System

Abstract

Safety BLITS (Baseline Injury Testing System) is a mobile application for the Apple iPad on iOS7 that delivers cognitive and neurological concussion metrics for athletes and anyone participating in activities that are high-risk for a concussion. The application represents an affordable solution to several major areas of need in concussion management. Additionally, it is the first of its kind to use simulated video game-like obstacles to test a person performance two dimensionally in the game, and three dimensionally while performing the obstacle. Safety BLITS leverages the enormous power of the iPad’s internal hardware to deliver comparative data between an athlete’s baseline normal and injured state to a diagnosing physician, trainer, coach or parent.

Because the application is designed for a mobile device, it takes concussion monitoring and testing directly to the athlete whether on the sideline or at home instead of taking the athlete to a hospital or testing center. Safety BLITS allows for monitoring of an athlete who is recovering from a head injury and can oversee the number of flagged tests and concussions an athlete has over their career. More importantly, it helps the treating physician answer the question, “When can the athlete safely return to play?” by monitoring the injured player to ensure their performance returns to their baseline levels.

Problem Need

Each year in the United States, millions of children and adults step on to local fields, arenas, and gyms to play sports. Their reasons for doing so may include healthy exercise, the
thrill of competition, or for the love of the game. Whatever the reason, none include playing sports to sustain physical injury. In recent years, shocking stories of mental illness, depression, and suicide from former National Football League (NFL) players have drawn intense spotlight from the media, sports governing bodies and medical community on the subject of concussions and head injuries in not only football, but all sports.

A concussion is defined by the American Association of Neurological Surgeons (AANS) as “a clinical syndrome characterized by immediate and transient alteration in brain function, including alteration of mental status and level of consciousness, resulting from mechanical force or trauma” (5). Sometimes a person who has just sustained a concussion show typical symptoms such as a loss of memory, loss of consciousness, slurred speech, dilated pupils, poor balance or a headache. Often, they will show no immediate or visible signs that there is something wrong (10).

The heightened concern about concussions in sports has raised many questions such as “Is football safe for my children?”, “What are the long term effects from getting one or more concussions?”, or “How much contact is too much?”. One question that is asked by more and more parents, family members, coaches and trainers is “How can I tell if someone has a concussion?” Typically, concussions are diagnosed by a doctor after a head injury occurs. Sometimes this diagnosis is given in the emergency room or by the family doctor and is often done subjectively without any real data that compares the patient in their normal functioning state to their injured state.

According to the Mayo Clinic, “Timely diagnosis and prompt treatment can help prevent more-serious concussion complications. Obtaining pre-injury baseline data on athletes who engage in contact sports can make the sideline assessment more accurate” (6). Many hospitals
and medical centers offer pre-injury baseline testing. The Mayo Clinic recommends that this baseline test include “a brief cognitive test and a computer-based neuropsychological test” (6). While the Mayo Clinic does free pre-injury baseline concussion test at no cost to high school athletes in Arizona (6), many medical providers offer similar services starting at $20.00 for a baseline cognitive screening to several hundred dollars for both a cognitive and neurological screenings.

**Solution**

With the spotlight still glaring on the issue of concussions in sports, there is a need for a broad, affordable, and accessible solution to screen athletes. That solution needs to provide parents, coaches and trainers the ability to collect pre and post-injury data on athletes throughout their entire life. Additionally, the solution should be portable with idea of taking the test directly to the athletes instead of taking the athletes to hospital or medical center. Lastly, the solution needs to be able to provide meaningful data to physicians and medical professionals for their consideration and analyzation in the diagnosis of a concussion.

This project addresses this problem with a mobile application called Safety Base Line Injury Testing System (BLITS). Safety BLITS will be initially developed for Apple’s iPad mobile tablet. It combines both a cognitive and neurological test on one platform. The cognitive test will implement a series of questions in which the device will measure the user’s accuracy of answer, as well as response time. The neurological test will function and feel like a game to the user. It will require the user to place a random object on the screen and move it into a holding area by tilting the device. Once the object is inside the holding area, the gyro hardware in the device will measure the X, Y and Z-axis movements of the device.
When comparing a baseline and post-injury test, the device will measure the variance and deferential between the two tests and deliver the information onto a report that provides meaningful data about both tests. This report will be able to be printed or emailed, so a physician can use the data as metrics that show valuable information about the patient pre and post-injury.

**User Profile and Design Protocol**

Safety BLITS will incorporate several design protocols as defined within the *iOS Human Interface Guidelines* published by Apple. The design goal is give the user a traditional iOS look and feel that many Apple users are accustomed to. This will be done by using Table View Controllers and Navigation Controllers as the primary User Interface (UI) elements. There will also be other UI elements developed from JavaScript to help with reporting and displaying the data in a meaningful way. A logo concept and sample splash screen for Safety BLITS is on display in Exhibit 1.0 and 1.1. (See Exhibit 1.0, 1.1)

The project will be developed around three user profiles and use cases. Case number one includes a parent or adult administering the tests to a child or other family members. Case number two involves a trainer administering the tests to a player. Case number three has a trainer administering the tests to an entire team. As shown in Figure 1.0, the results of the test include an examination by a physician on a test that yields a positive differential.
Technical Elements

The application could be developed on several platforms, including Android, Windows, or Apple’s iOS. A large part of the success of this project would hinge on selecting the best possible platform to develop it on (9). The platform that was chosen for this platform was iOS by Apple. The results of the platform analysis are listed in Platform Analysis for Safety BLITS.
Platform Analysis for Safety BLITS

Platform Analysis – Safety BLITS

Primary Target Platform: iPad Air, 4th Gen, 3rd Gen, iPad2
Possible Secondary Target: iPhone 5C, 5S, 4S, 4, iPad Mini
Software: iOS7

Consumer Target: Athletic Departments (college level and below), sports teams, parents, sports organizations and governing bodies.

The Apple iOS Platform is being recommended for the following reasons:

1. **Single Hardware Manufacturer:** By focusing on a device by a single hardware manufacturer, iPad and iOS7 are ideal for an application in which testing data that is measured by internal device hardware. This is supported in the most basics concepts of the scientific method; that being if one can compare two sets of data derived from the same hardware and the same software, it will be far more accurate than data derived from two different kinds of hardware and same software. Less ideal in terms of accuracy, but preferred over multiple manufactures and multiple devices, would be comparing data derived from different devices but made by the same manufacturer. For example, development and testing can be focused on particular device by the same manufacturer. Whereas development and testing for other platforms such as Android and Windows RT
would require significant development and testing considerations to account for multiple hardware devices produced multiple manufacturers. (see Figure 1.2)

2. **Apple’s Current Presence in Football and Professional Sports:** Beginning in 2012, the Cincinnati Bengals became one of eight teams in the NFL to adopt the use of iPad playbooks. Starting in 2013, All 32 NFL teams have adopted the use of iPads on the enterprise level. This trend has now filtered down into the college football ranks where top college programs are using the same technology as well as major league baseball. iPads are preferred for the ease of use, but mainly because of the tools that Apple provides for enterprise wide deployment where data can be pushed to an entire football team or organization by a single application.

3. **Apple’s Current Presence in Education:** Historically, Apple has had a strong footprint in education at all levels. Since the Consumer Target includes schools, using the iOS platform would be an asset due to not only its immense popularity in schools and on campuses, but its familiar UI and navigation design.

4. **Revenue Generation:** Despite the world’s most popular mobile operating system, I am not sure Android and the Google Play Store would lead to the strongest revenues in terms of monetizing the application. According to Ditismo (8), a firm specializing in mobile application analytics, the Apple App Store generates significantly higher revenues from app purchase compared to Google Play (see Figure 1.1). This would lend me to make a broad, general conclusion that iOS users are more accustomed to purchasing applications. As a result are more likely to buy my app.

5. **80/20 Rule:** During my time in business, the 80/20 rule proved critical to improving capacity and driving sales. As a start-up, it is even more critical to try and not be
everything to everyone and focus one doing a few things well. Cross platform design comes into play especially with the 80/20 rule. As the rule states, 20% of the client base will drive 80% of revenues. In the case of this application, Apple is firmly entrenched in my consumer target market. At this point in the development life cycle, cross platform or a different platform than iOS is not practical.

![Total Revenue Per Country](image)

*Figure 1.1 (8)*
Figure 1.2
Budget

The initial budget for Safety BLITS is $3731.94 (See Figure 1.3). This includes hardware acquisition cost, development cost, domain and hosting, licenses, marketing and legal costs. Hardware was needed for iOS development and testing. Legal costs and incorporation are to protect personal assets. Beginning January 1, 2014, the intellectual property for this project will fall under the ownership of Redan Technologies, LLC.

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**Total** $3731.94

Figure 1.3

Timeline

The project’s development timeline is illustrated with Gant Chart in Figure 1.4. (See Figure 1.4) The timeline includes critical thresholds for testing and submission to the Apple App Store, with public release scheduled for April 15, 2014 at the University of Cincinnati Tech Expo. Additional task breakdown of the Software Development Plan is shown in Figure 1.5. (See Figure 1.5)
SOFTWARE DEVELOPMENT PLAN

Gant Chart
Figure 1.4

Software Development Plan
Figure 1.5
Conclusion

Traditionally, brain injuries such as concussions have traditionally been a subjective diagnosis. Safety BLITS by design, tries to quantify the critical aspects of this diagnosis. By engaging the ocular capabilities of the user in concert with their fine motor skills, it is possible to test the neurological system using a video game-like obstacle. By measuring the user’s performance on both two and three dimensional levels and comparing the user’s baseline performance to a post-injury test, it is possible to see performance trends that indicate a brain injury such as a concussion.
Exhibit 1.0
Exhibit 1.1
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