Augmented Reality Based System for Determining SRC and Cognitive Performance

Adam Hooker, Kate Quinones, Justin Garcia, Kacey Pryor

University of Texas at San Antonio

UTSA
College of Engineering and Integrated Design

Introduction

Traumatic Brain Injury (TBI) is a medical diagnosis which is typically accompanied with many physical symptoms; yet there is no current method for consistent or dynamic detection. With up to 3.8 million Sports Related Concussions (SRC) and 22,000 military member TBI cases reported annually, we look to bridge the gap in early TBI detection, in soldiers and athletes, with Brain Augmented Reality Testing (BART). By consolidating research performed by the DoD, NCAA, and Texas State, BART will establish a highly desirable "Gold Standard" for dynamic TBI Testing and eliminate the need for large mobile scanners and inconsistent/subjective questionnaire testing methods.

Need for Product

- Reported $60 billion lost in medical benefits from misdiagnosed sports related concussion
- At least 5.3 million Americans are currently suffering from long-term effects of concussions
- 5% - 9% of reported concussions are sports related; this equates to roughly 1.6 - 3.8 million cases annually.
- Early detection of SRC related trauma decreases the occurrence of long-term neurological sequala
- Common diagnostic tactics for determining if an SRC has occurred includes widely subjective measures
- Quality health care should be provided for every division of sports, including low-income institutions
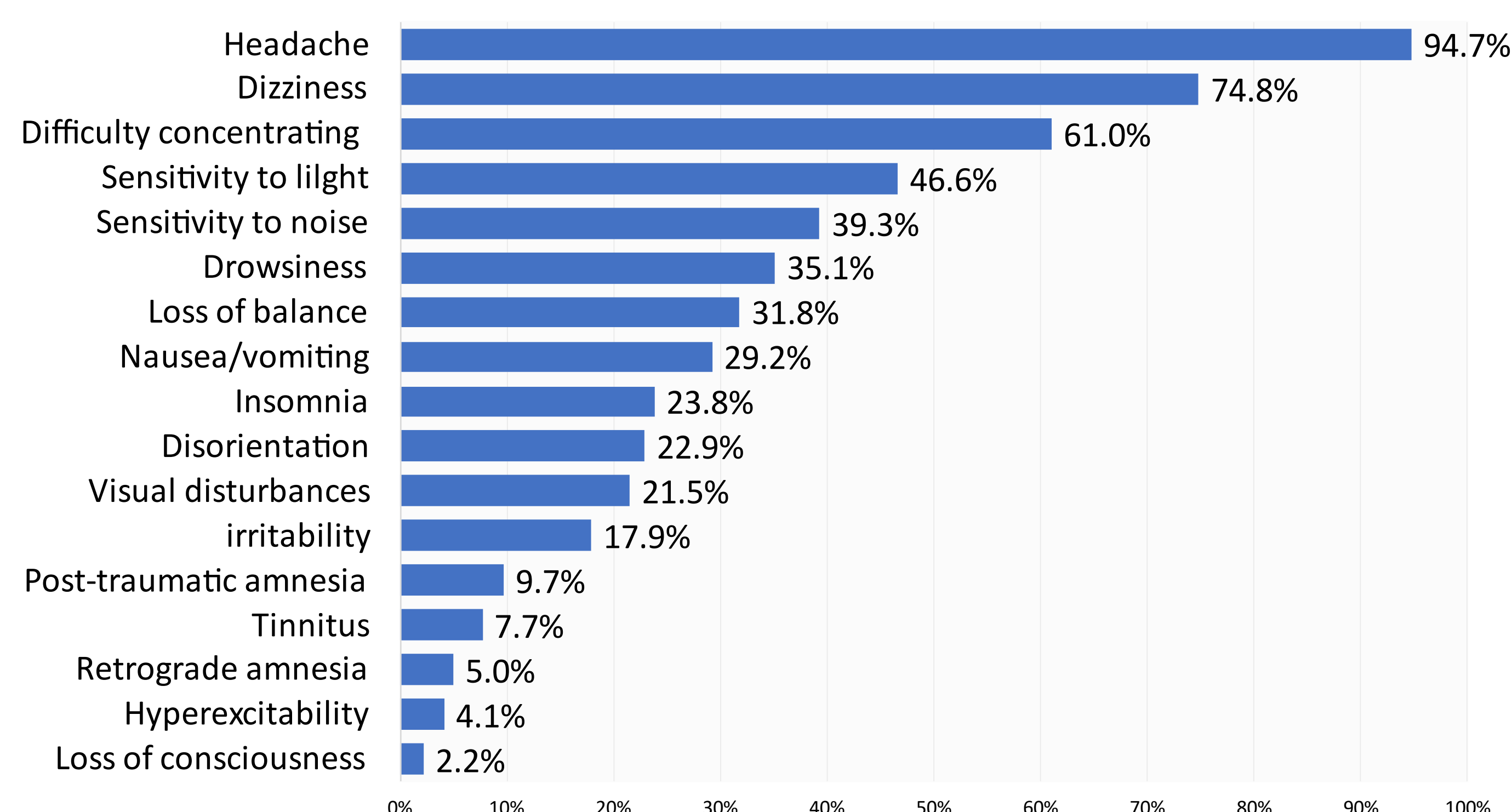
Reported Symptoms of Concussions (%)

Symptom	%
Headache	94.7%
Dizziness	74.8%
Difficulty concentrating	61.0%
Sensitivity to light	46.6%
Sensitivity to noise	39.3%
Drowsiness	35.1%
Loss of balance	31.8%
Nausea/vomiting	29.2%
Insomnia	23.8%
Disorientation	22.9%
Visual disturbances	21.5%
irritability	17.9%
Post-traumatic amnesia	9.7%
Tinnitus	7.7%
Retrograde amnesia	5.0%
Hyperexcitability	4.1%
Loss of consciousness	2.2%

Figure 1. Percent of reported concussion symptoms by type. cite:O'Connor et al., 2017, PMID 28387555

System Overview

The AR Traumatic Brain Injury Detection device would incorporate multiple traumatic brain injury (TBI) tests into one platform by utilizing Augmented Reality (AR) and Inertial Measurement Units (IMU). The suggested method for standardizing these tests will be to deploy an AR headset, specifically a HoloLens 2, where software development will be performed in Unreal Engine 4.

- Due to the inconsistent and time sensitive nature of determining TBI, our product will be highly desirable for the military and sport entities.
- Will make providing health accurate and consistent health assessments available to low-income institutions
- IMU data will be transmitted to the cloud (Azure) for processing
- Having a WIFI connection with an ESP32 microcontroller is the route we decided would benefit this project the most.
- Our product will create a new opportunity for collecting data to implement in learning algorithms
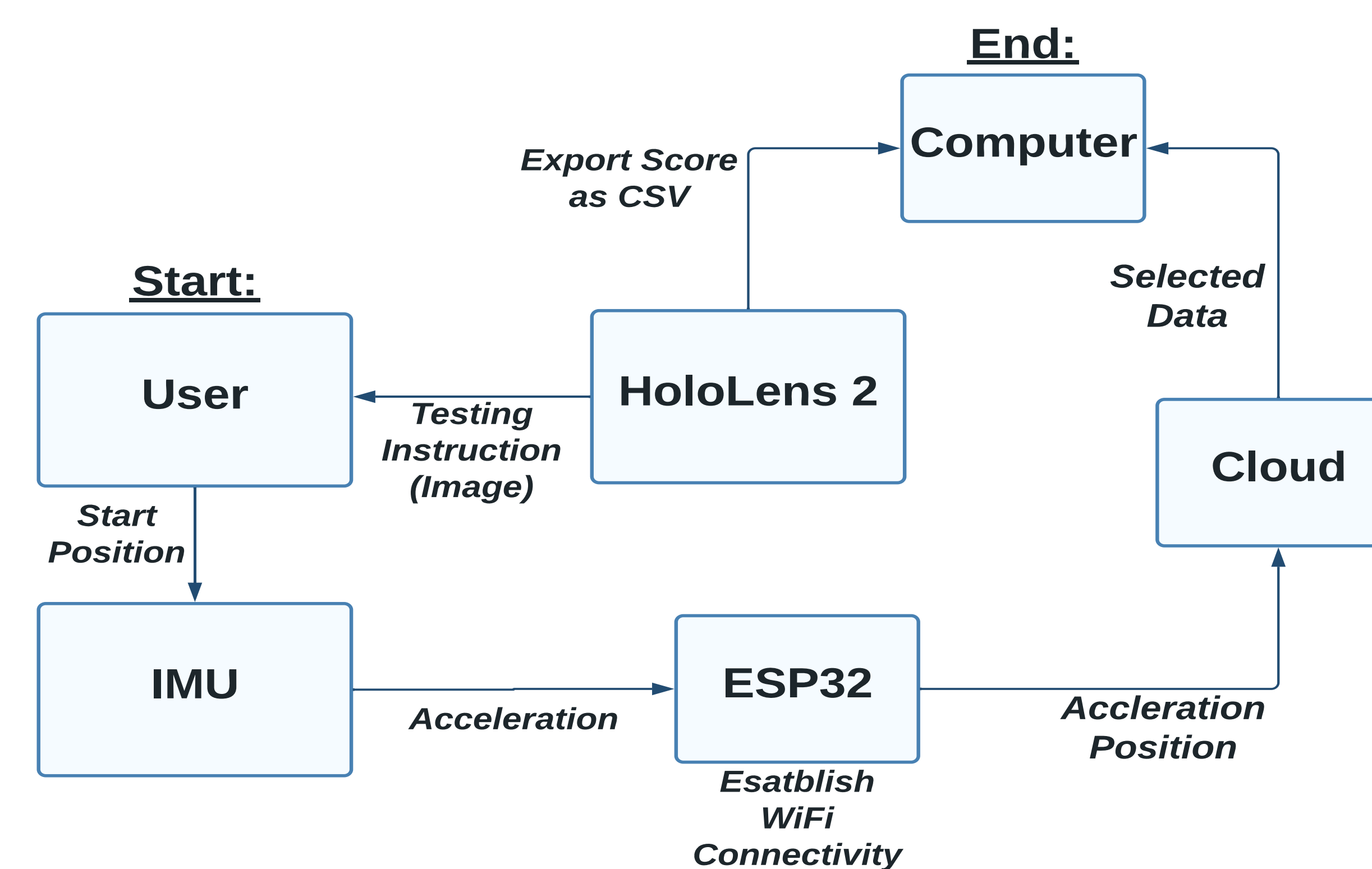
Data Flow

Figure 2. Concept art describing Green Dot Red Dot test. Source: TX State

HoloLens 2 will transmit image data via head mounted display. From testing environment, scoring will be sent to the computer in a .csv format. During Balance test IMU data will be sent from the ESP32 to the cloud, where it will be analyzed and sent to the computer for visualization.

Components

Figure 3. Hardware as seen from left to right: ESP 32 Microcontroller, Microsoft HoloLens 2, and IMU MPU 6050
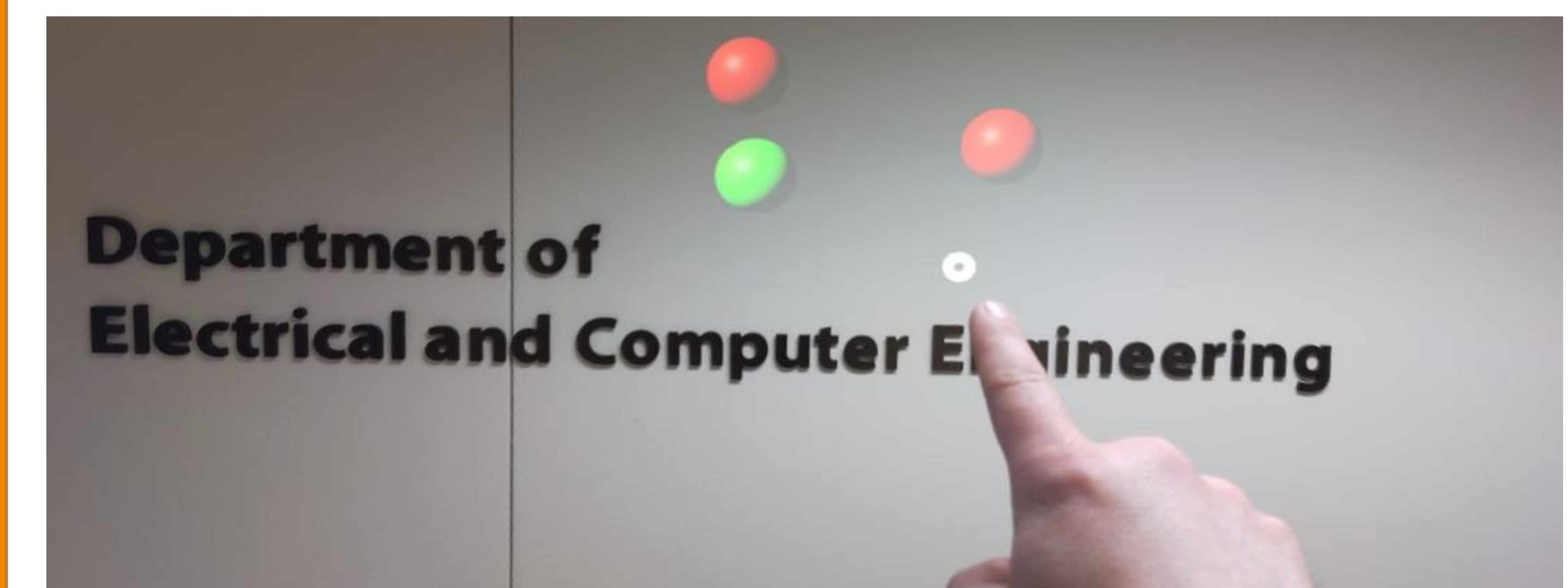
Development

Figure 4. End user view of Go/No-Go test. Source: Unreal Engine
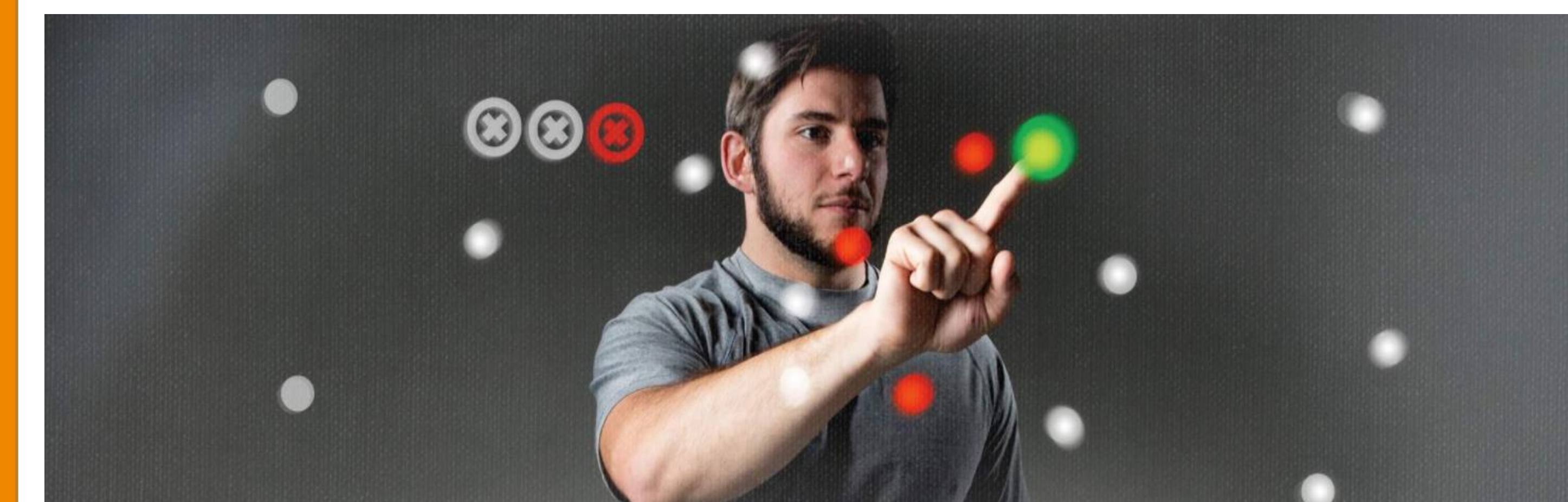

Figure 5. Concept art describing Green Dot Red Dot test. Source: TX State

Future Work

In the future we would like to see this technology mature in the following areas: human-machine interaction, adaptive learning algorithm deployment, and adoption by sports leagues. To achieve these developments, we intend to seek additional funding through start-up incubators and venture capital. We hope to see this technology improve the long-term health outcomes of athletes.

Acknowledgements