Project Statement and Specifications
Auditory and Visual Stimuli System for Fast Eye Movement Analysis

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Statement of Need

The client is in need of a system that displays visual and auditory stimuli as input for a fast eye movement analysis system. The device will need to record eye movements using an EOG signal. The system will need to perform tests on subjects who have experienced a significant blow to the head in order to determine whether or not the subject has experienced any type of brain trauma. The device will need to use a combination of visual and auditory stimuli in order to test the subject’s eye movements to form a proper diagnosis.

Introduction and Overview

In the United States alone, around one million people suffer at least one concussion every year. In today’s society, many people are at risk for concussions including people who partake in popular contact sports such as football and hockey, as well as active members of the military. If ignored or treated improperly, concussions can lead to very serious long term traumatic brain injuries and even death.

Dr. John Enderle has been researching rapid eye movements and their respective neuronal activities for the past thirty years. His research has led to the belief that there is a way to determine whether or not a person has suffered mild traumatic brain injury based on their results from a visual/auditory combination eye movement test.

The design for an auditory and visual stimuli system for fast eye movement analysis is necessary in order to achieve a way to safely, efficiently, and accurately diagnose a patient with mild brain trauma. Designing a device that is able to record the subject’s eye movements in response to visual and auditory stimuli will allow for a diagnosis based on the subject’s ability to follow the stimuli with their eyes.

The device will be made so that the auditory and visual stimuli sources are activated in a randomized fashion so that the subject does not know the location of the stimuli before testing. This will assure that the recorded response of the subject’s eye movements are an accurate portrayal of the subject’s ability to react to the stimuli. The client has asked that the device have a large amount of possible stimuli locations spread out so that several different eye movements can be tested. The device will have several LED lights each with a small speaker in the same location.

During the test, the patient will be asked to focus on the location of the visual and auditory stimuli and their eye movements will be recorded. The client has also specified that the device must be able to use a signal from an EOG. The device will be able to record eye movements using an EOG signal and using LabView, the movements will be displayed in a way that can be interpreted to determine the patient’s diagnosis.

Realistic Constraints

Health and Safety: This device will be used on patients who are potentially suffering from head trauma so it essential that the patient’s safety is not compromised during the use of the device. It is important that device can be utilized on a patient who is seated during examination. The patients should be seated during the testing because it is possible that they are light headed or dizzy from the injury. It is also important that the
device will cause as little discomfort as possible to the patient. The device will utilize an EOG electrode system which will be used to capture eye movements. This is a lightweight system and will cause little to no discomfort to the patient during testing.

**Manufacturability:** The device will require very intricate and complex wiring due to the very large amount of auditory and visual stimuli sources. This will make it hard to mass produce the device and will also potentially cause a delay in manufacturing. The device will need to be able to accommodate patients of all sizes so it is important that the device is adjustable or manufactured to be able to be used on all patients.

**Economical:** The device will feature a very large amount of speakers and visual stimuli sources. This can cause a potential problem concerning budgeting.

**Environmental:** There will be no significant negative effects on the environment due to the device.

**Sustainability:** The device is meant to be reusable for a great number of patients so it is very important the device to be durable. All materials used in the making of the device should be wear resistant and functional after several uses.

**Social/Political:** In general, athletes are not accepting of the idea of a prolonged absence from their sport. Although, the device will be beneficial to the health of athletes, many athletes would rather risk further injury as opposed to not participating in their sport for a prolonged period of time. Many athletes would be opposed to the idea of the device and this is a very important social constraint that must be considered. It will be beneficial to offer an education program in order to enlighten these about the risks and long term effects of mistreating concussions.

**Questions**
- How do we make the device adjustable for subjects of different heights?
- Can the device be used on patients who are at risk for seizures?
- How much will each examination cost?
- Will people with contacts or glasses be able to use the device?
- Will people with hearing aids be able to use the device?
- How can the device be made sterile for multiple uses?
- Will the device need to be calibrated before each individual subject is examined?

**Other Information**
Previous senior design project teams have worked on this project and have developed a preliminary design for the auditory and visual stimuli system. The preliminary design involves a curved black board with LED lights used as the visual stimuli source. The goal is to implement small speakers behind each LED light in order to
have auditory and visual stimuli at each LED location. A LabView program has already been developed by the previous senior design team.

**Technical Specifications**

**Maintenance**

The device has very complex and intricate wiring and may break down due to excessive use. Because of this, the device should be maintained under proper care and maintenance in order to ensure that the device is always functioning properly.