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A Device for the Objective Assessment of ADHD Using Eye Movements



Abstract

Attention deficit hyperactivity disorder (ADHD) is a commonly diagnosed psychiatric disorder characterized by impulsive behavior, impaired focus, and hyperactivity. Current methods of pediatric diagnosis rely on subjective measures of activity and behavior relative to other children.^[3] Proper diagnosis is critical in preventing unnecessary prescription of the powerful, habit-forming drugs used to manage ADHD, such as Adderall and Ritalin.^{[1][5]} Research has shown that individuals with ADHD show abnormalities in reading and antisaccade tests, as these stimuli gauge ability to focus and suppress impulsive behavior, respectively.^{[2][6][4]} Our goal was to design and construct a dedicated eye tracking device capable of accurately and objectively screening children for ADHD. The device was to be both inexpensive and accessible by non-experts in eye tracking, such as school nurses, optometrists, and family physicians.

Clinical Need

- ADHD is frequently misdiagnosed
- Requires extensive diagnosis time and must be performed by a physician
- Current testing is subjective
- Affects child's academic and social development
- Treated with powerful drugs (Ritalin, Adderall)

Design Approach

- A dedicated device easily used by non-experts
- Durable, portable, non-threatening appearance
- Limbus system for single-plane, monocular tracking
- Export quantitative results after analysis

Headgear

- Accounts for adjustment around the eye with 3D printed holder and flexible tubing
- Adaptable for each patient

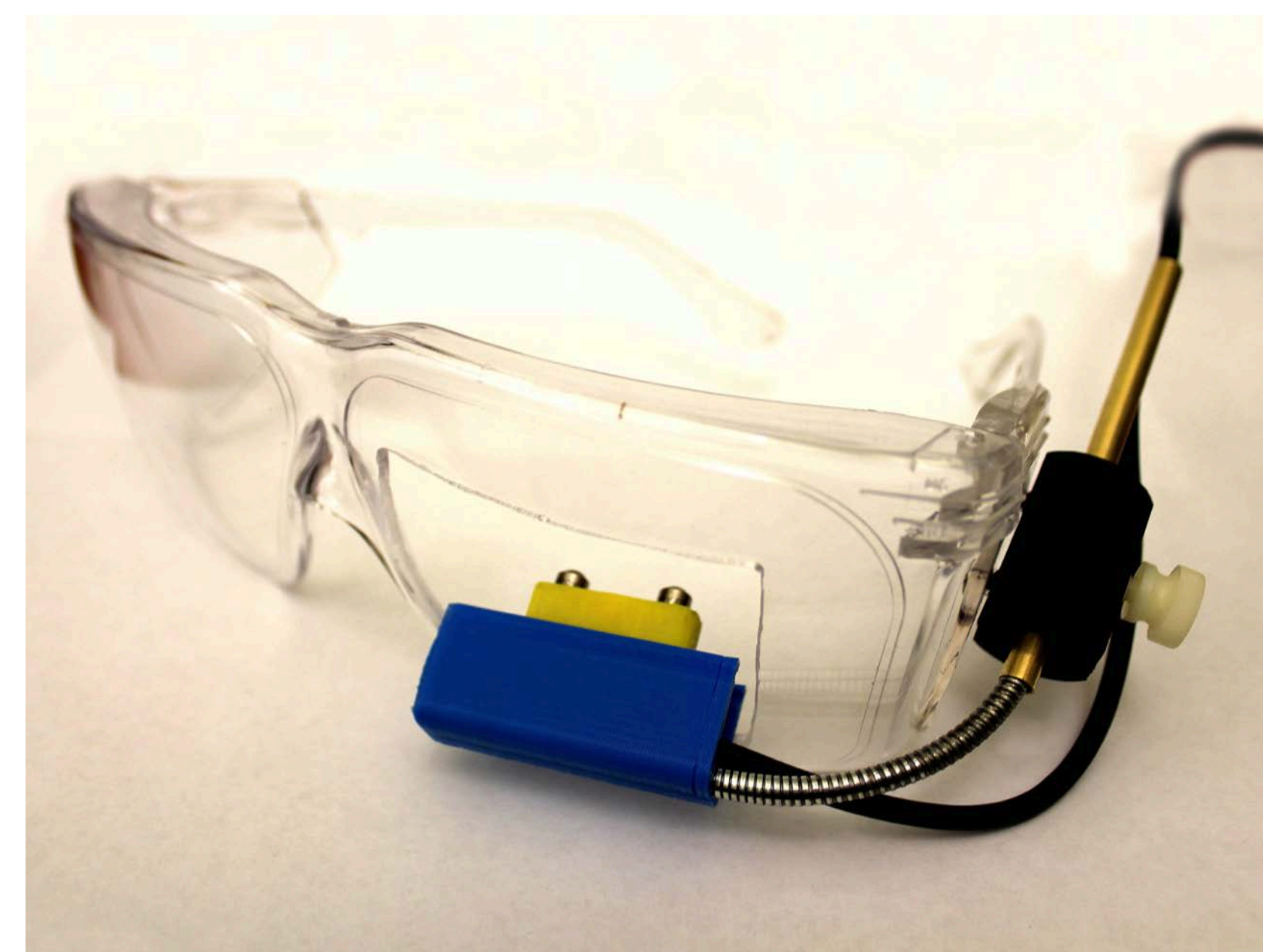


Figure 1: Eye tracking headgear with two degrees of rotation and translation.

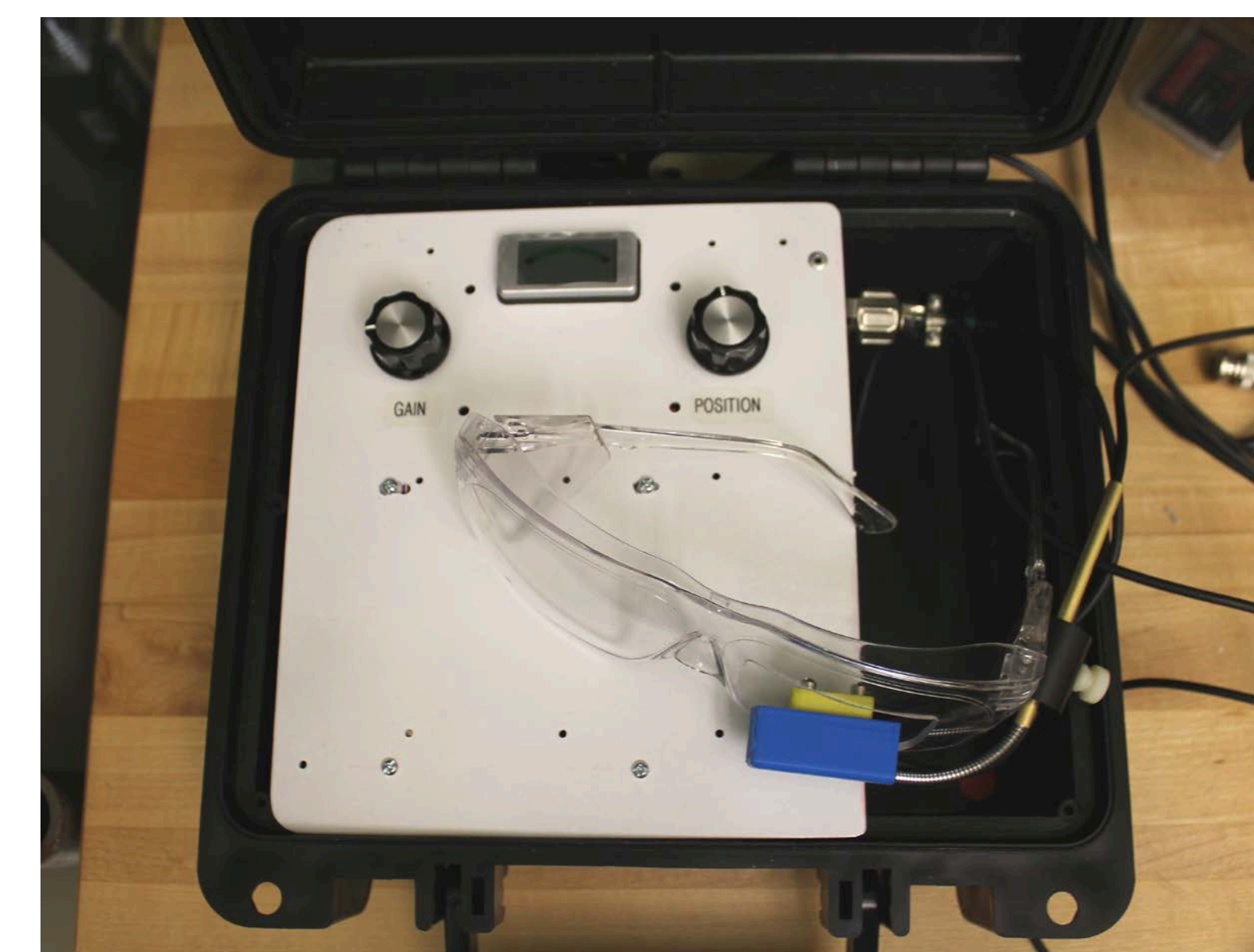
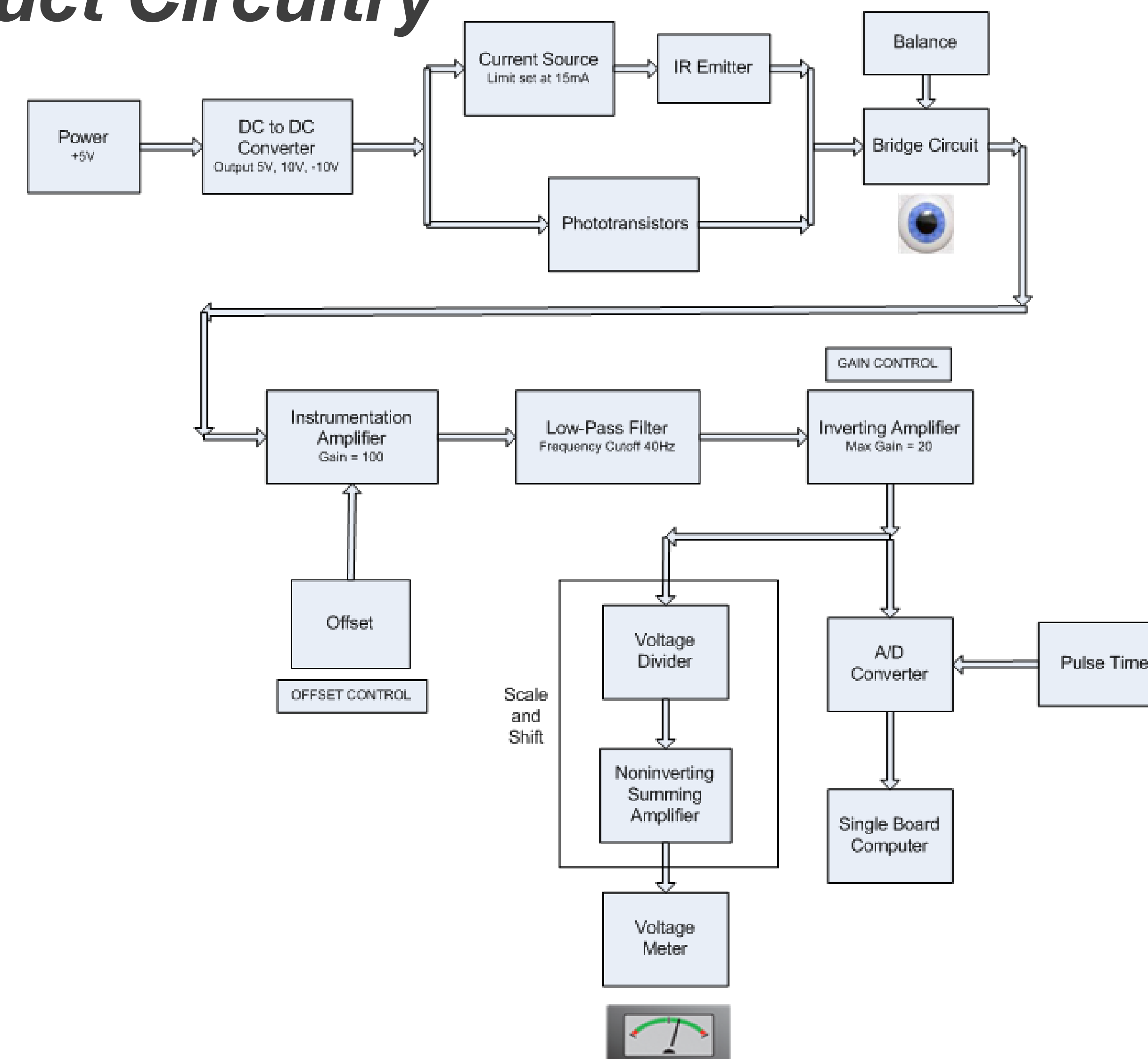


Figure 2: Overall casing includes single board computer, circuitry, and headgear.

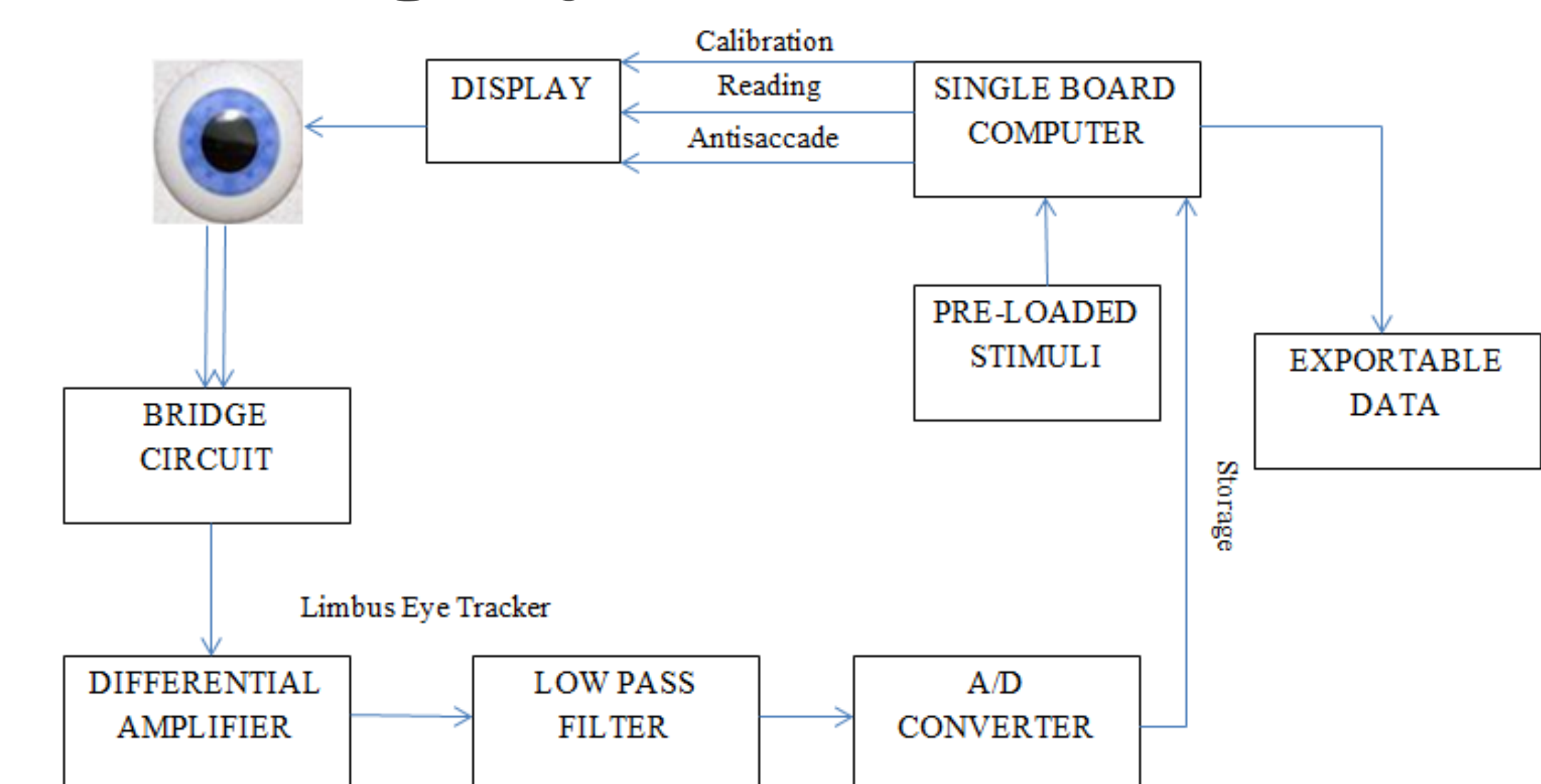
Product Circuitry



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Eye Tracking System



Visual Stimuli

- Reading Task
 - Uses Miller and Coleman reading passages
 - 5 passages of increasing difficulty in random order
 - Evaluates ability to focus on a task for an extended period
- Anti-saccadic Task
 - Uses horizontal step target motion
 - Subject eye movement must mirror target motion

Analysis

- Two-point central difference method used to determine velocity
- Velocity and acceleration thresholds set to identify saccades
- Time interval between saccades define fixation periods

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