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2015

## A device for the objective assessment of ADHD using eye movements

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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.<sup>[3]</sup> Proper diagnosis is critical in preventing unnecessary prescription of the powerful, habit-forming drugs used to manage ADHD, such as Adderall and Ritalin.<sup>[1][5]</sup> 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.<sup>[2][6][4]</sup> 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

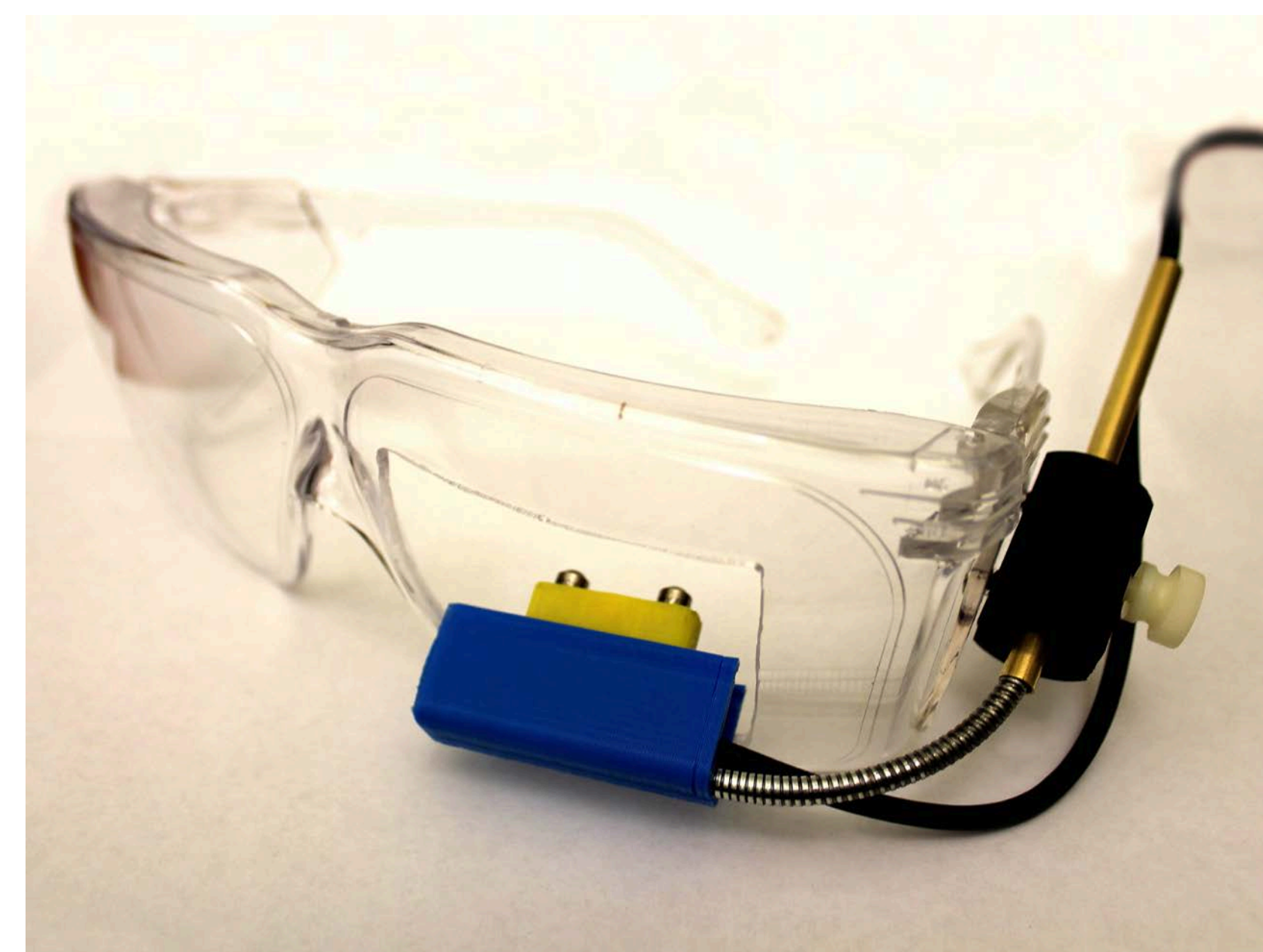


Figure 1: Eye tracking headgear with two degrees of rotation and translation.

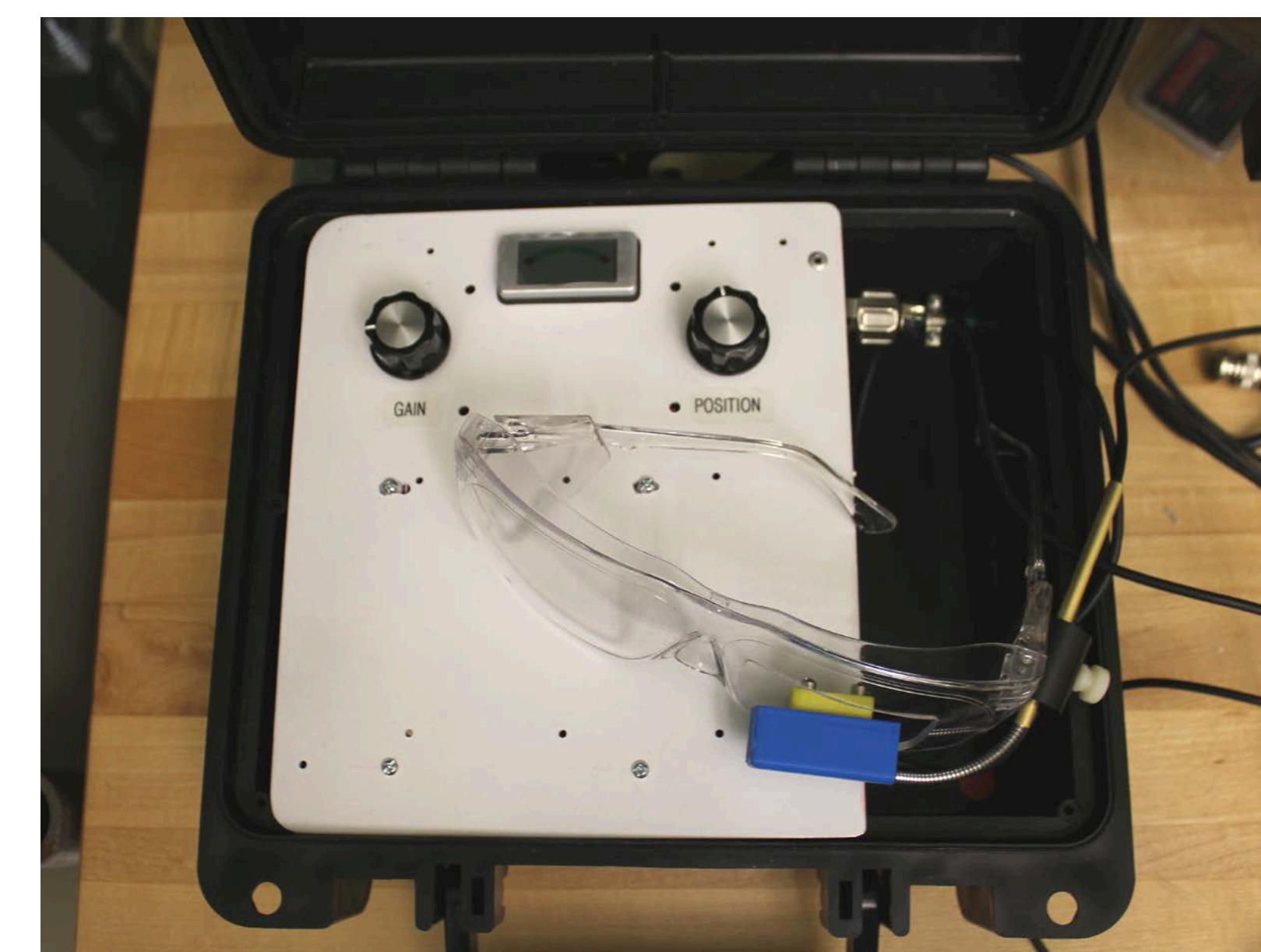
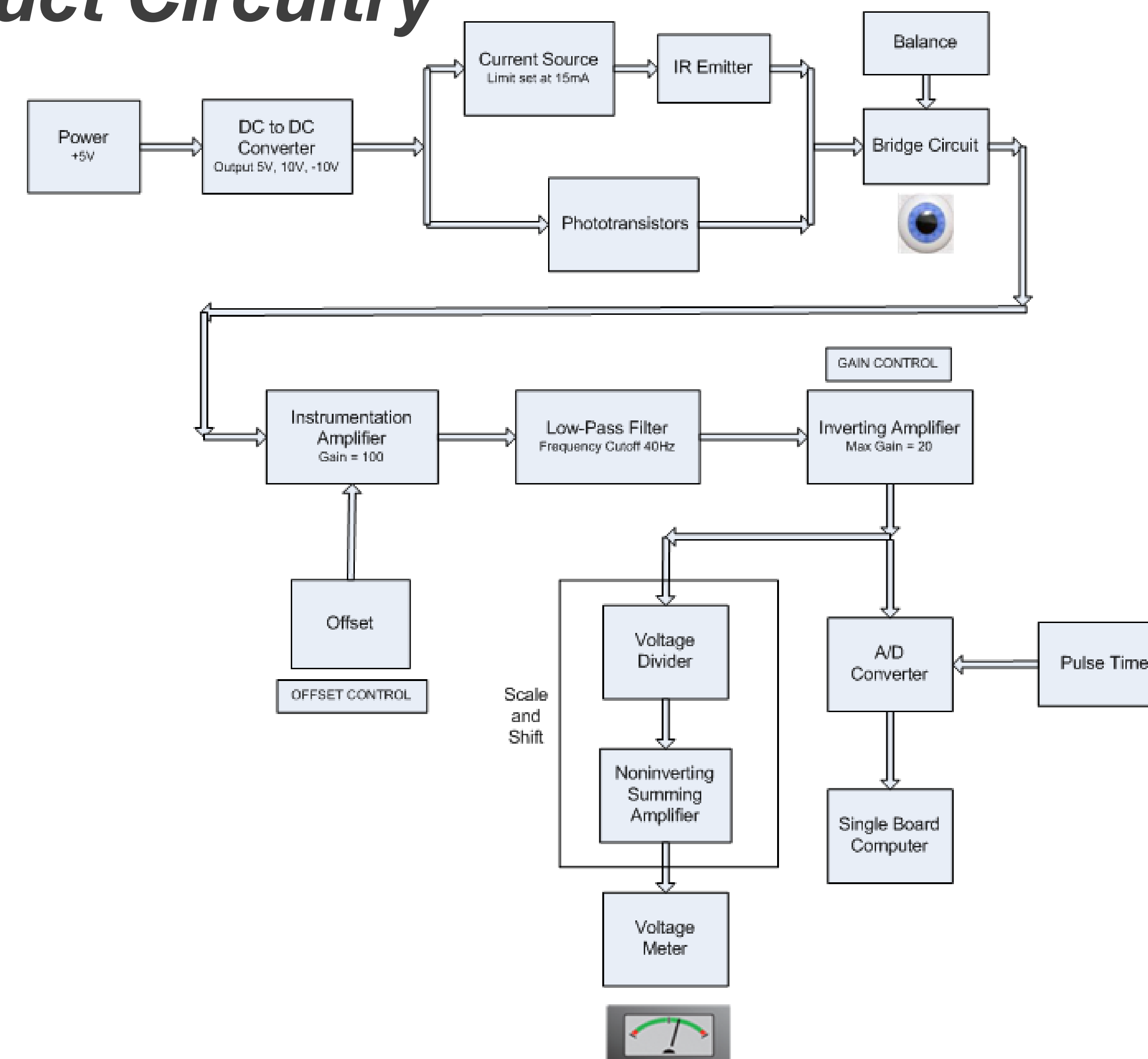


Figure 2: Overall casing includes single board computer, circuitry, and headgear.

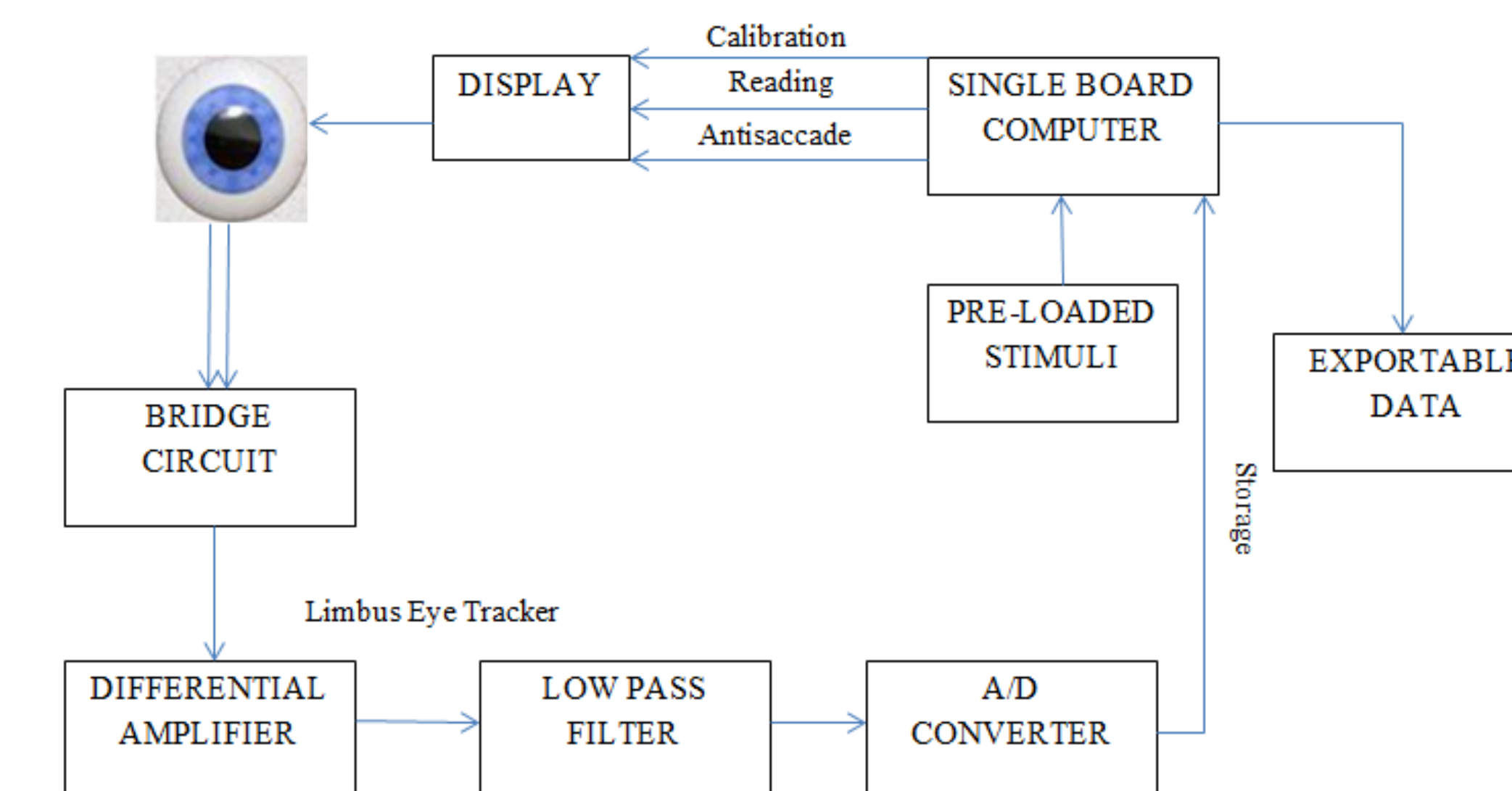
## Product Circuitry



## Acknowledgements

We would like to thank Dr. Wetzel for his advising, patience, and mentoring of this team, as well as the Sternheimer committee for additional funding which made this project possible.

## 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

## References

[1.] Attention Deficit Hyperactivity Disorder (ADHD). *National Institute of Mental Health* (n.d.). Retrieved September 8, 2014.

[2.] Deans, P., O'Laughlin, L., Brubaker, B., Gay, N., & Krug, D. (2010). Use of Eye Movement Tracking in the Differential Diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) and Reading Disability. *Psychology*, 1, 238-246. Retrieved September 11, 2014.

[3.] Gualtieri, C., & Johnson, L. (2005). ADHD: Is Objective Diagnosis Possible? *Psychiatry*, 2(11), 44-53. Retrieved September 11, 2014.

[4.] Munoz, D., Armstrong, I., Hampton, K., & Moore, K. (2003). Altered Control of Visual Fixation and Saccadic Eye Movements in Attention-Deficit Hyperactivity Disorder. *Journal of Neurophysiology*, 90(1), 503-514. Retrieved September 13, 2014.

[5.] Porter, E. (2012, December 17). Misdiagnosis: Conditions That Mimic ADHD. Retrieved September 14, 2014.

[6.] Schwerdtfeger, R., Alahyane, N., Brien, D., Coe, B., Stroman, P., & Munoz, D. (2012). Preparatory neural networks are impaired in adults with attention-deficit/hyperactivity disorder during the antisaccade task. *NeuroImage: Clinical*, 2(2), 63-78. Retrieved September 14, 2014.