



Designing a Bodysuit to Counteract Wobbling in Cats with Cerebellar Hypoplasia

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BACKGROUND

Cerebellar Hypoplasia:

- Cerebellar hypoplasia (CH) is a **non-progressive** neurological condition
- Caused by **underdeveloped cerebellum**
 - Feline panleukopenia virus (FPV) (Kabir et al., 2023)
- Symptoms: **unpredictable** walking and stumbling, **uncoordinated** movement, and **lack of control** in balance.

Biomechanics:

- The cerebellum's role in the brain is that it has 'feedforward control'
 - The body is able to **predict** and **prepare** for **movement** based on previous experiences (Straulino et al., 2025).
- Underdeveloped cerebellum **compensates** to prevent the muscle contractions needed to stabilize movement
 - When the body **leans** one way, they attempt to **counteract** it by leaning the other way
 - Persistent** due to **lack of control**

Proprioceptive Feedback

- Proprioceptive feedback is the **neural representation** of the body's **movement** and **mechanics** to the central nervous system (Cleveland Clinic, 2025).
- Cats with CH may receive the body's feedback, but cannot do anything to respond to it due to their cerebellum.

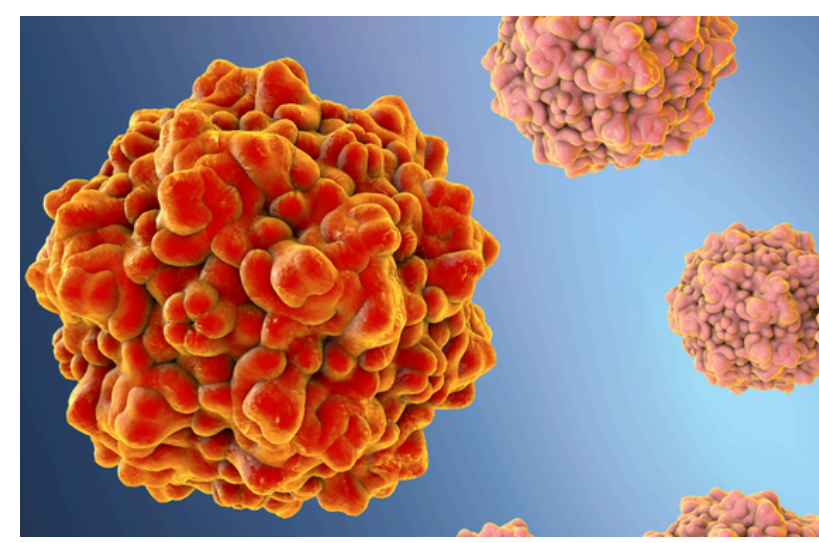


Figure 1: A visual image of the feline panleukopenia virus (The Native Antigen Company, 2025).

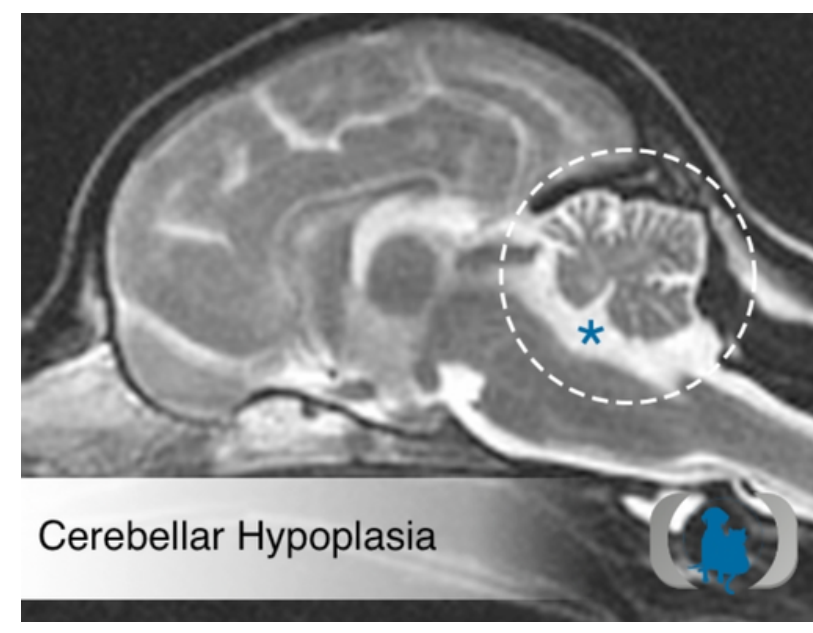


Figure 2: A visual image of the area affected by FPV, the cerebellum (Advanced Veterinary Medical Imaging, n.d.).

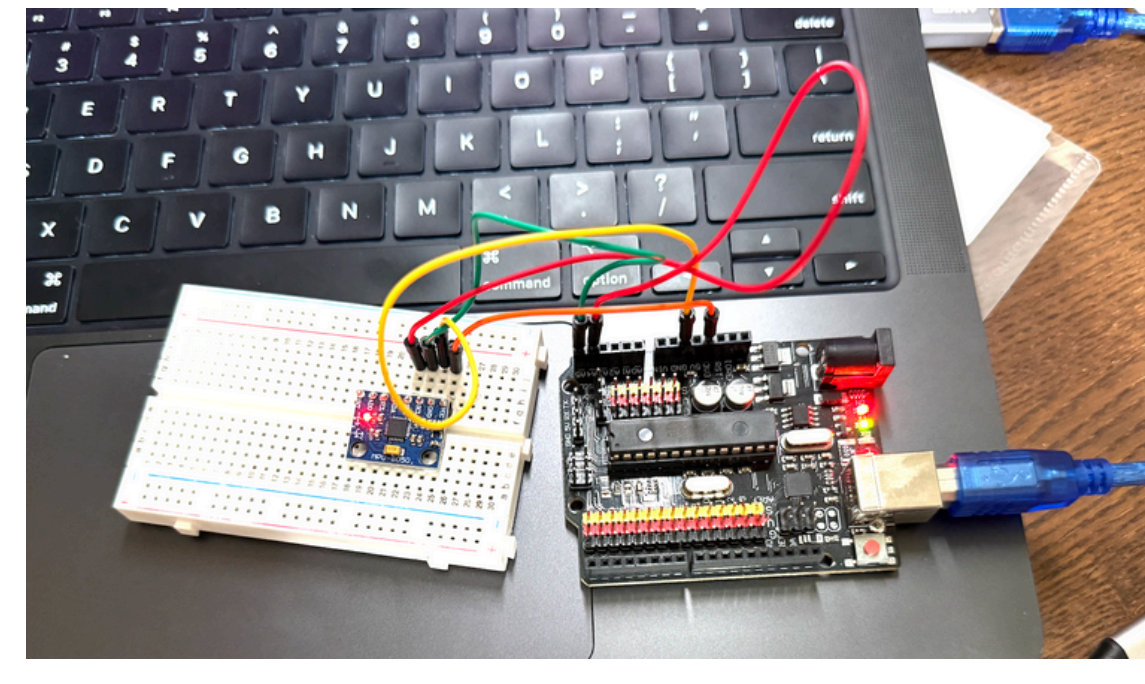
METHODOLOGY

Mass-Spring System



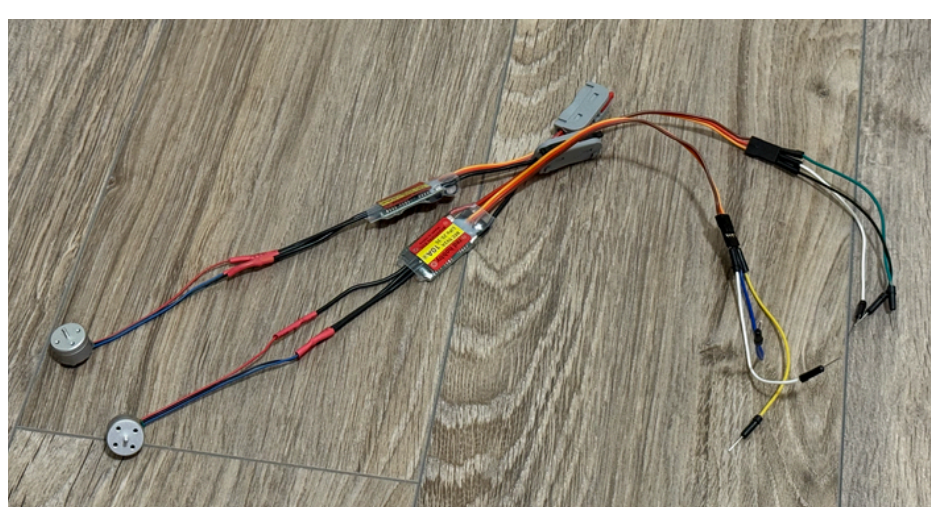
A vertical mass-spring system was set up to mimic the symptoms of a cat with cerebellar hypoplasia

Arduino Uno and MPU6050



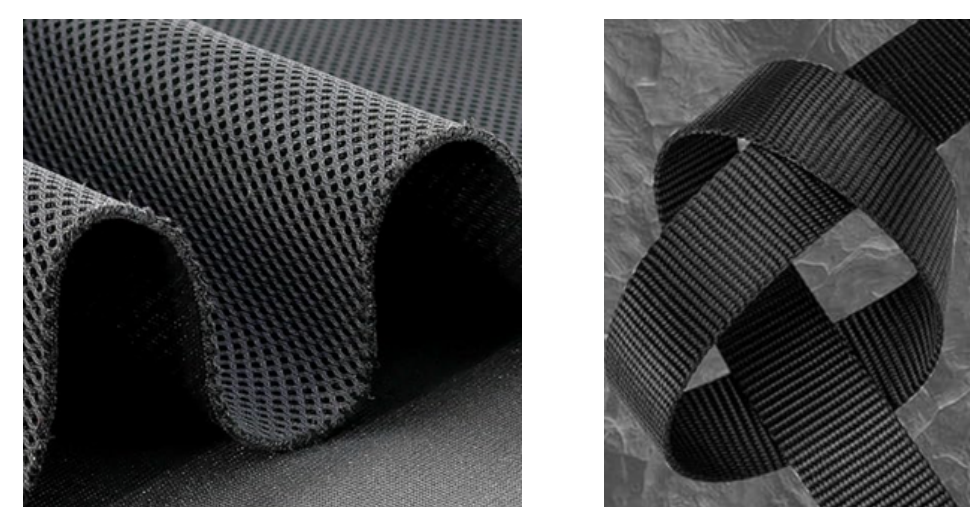
The MPU6050 was soldered to be attached to the breadboard, providing angular tilt and velocity through a 3-axis accelerometer and gyroscope

ESCs and Brushless Motors



The brushless motors and electronic speed controllers (ESCs) were connected via soldering, and a lever connector acts as a switch between the ESC and the power source.

Nylon Webbing and Air Mesh Fabric



Once the electrical components are completed, nylon webbing and air mesh fabric were used to create the outer layers of the bodysuit.

ENGINEERING PROBLEM

Cats with cerebellar hypoplasia (CH) often having **trouble walking**, coordinating **movement**, and controlling their **balance**. These factors can **limit stability** and increase the **risk of injury** during movement.

ENGINEERING OBJECTIVE

The objective is to **design** an assistive **bodysuit** that can **reduce wobbling** present in cats with CH. It will be tested on a vertical **mass-spring system** that **mimics** the **symptoms** of a cat with **CH**.

MAIN TAKEAWAYS

- Mass-spring system shows as mass **increases**, # of oscillations **decrease**
- Velocity vs. Time graph illustrates the baseline for the speed the device needs to **lower** in order to be **effective**
 - ~ **56% reduction** for velocity vs. time, **16 seconds** for prior, **7 seconds** to settle post
- Brushless motors prove to generate **enough countertorque** to gently **stabilize** a **cat** with CH

RESULTS

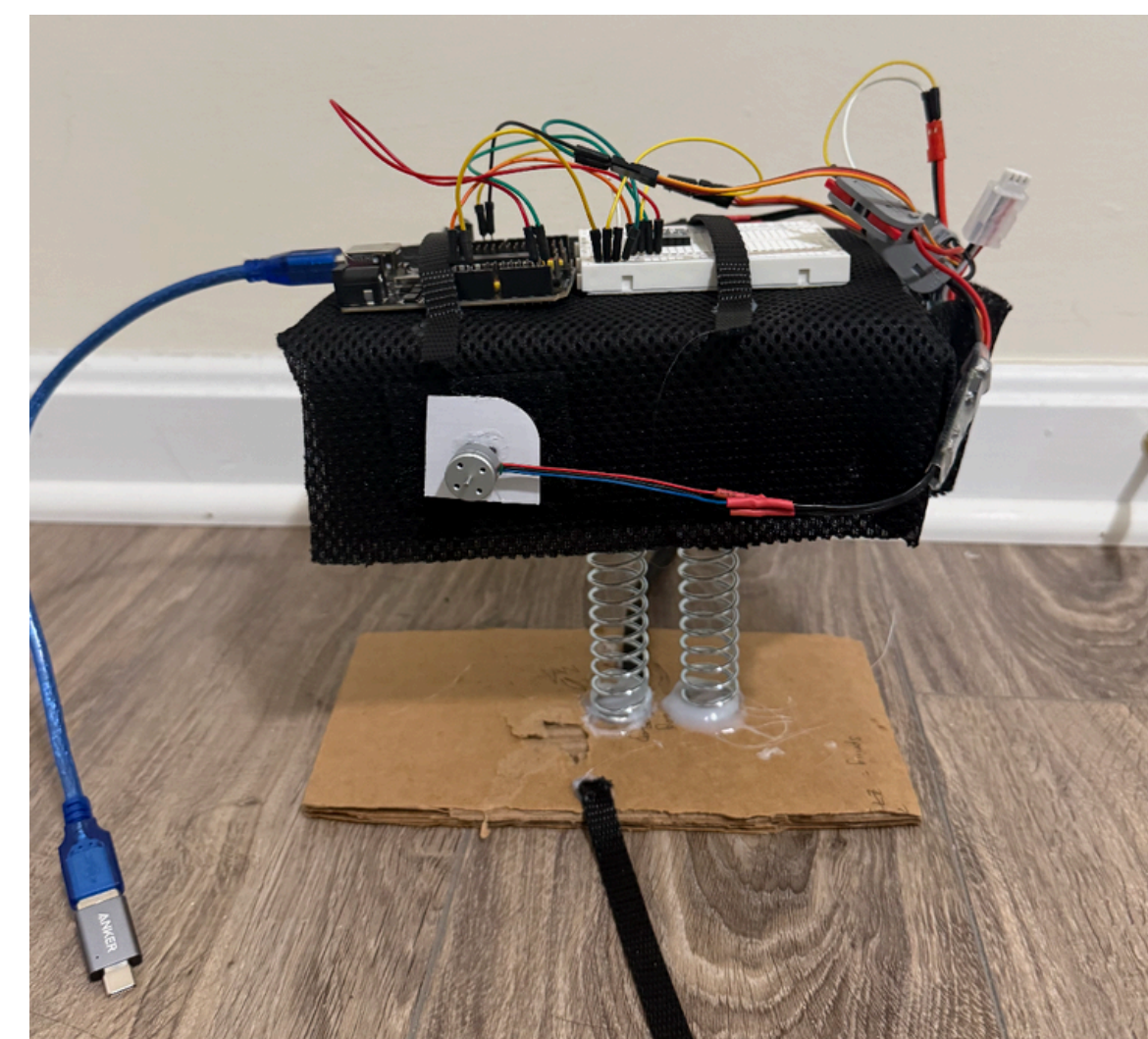


Figure 3: Side view of device on mass-spring system

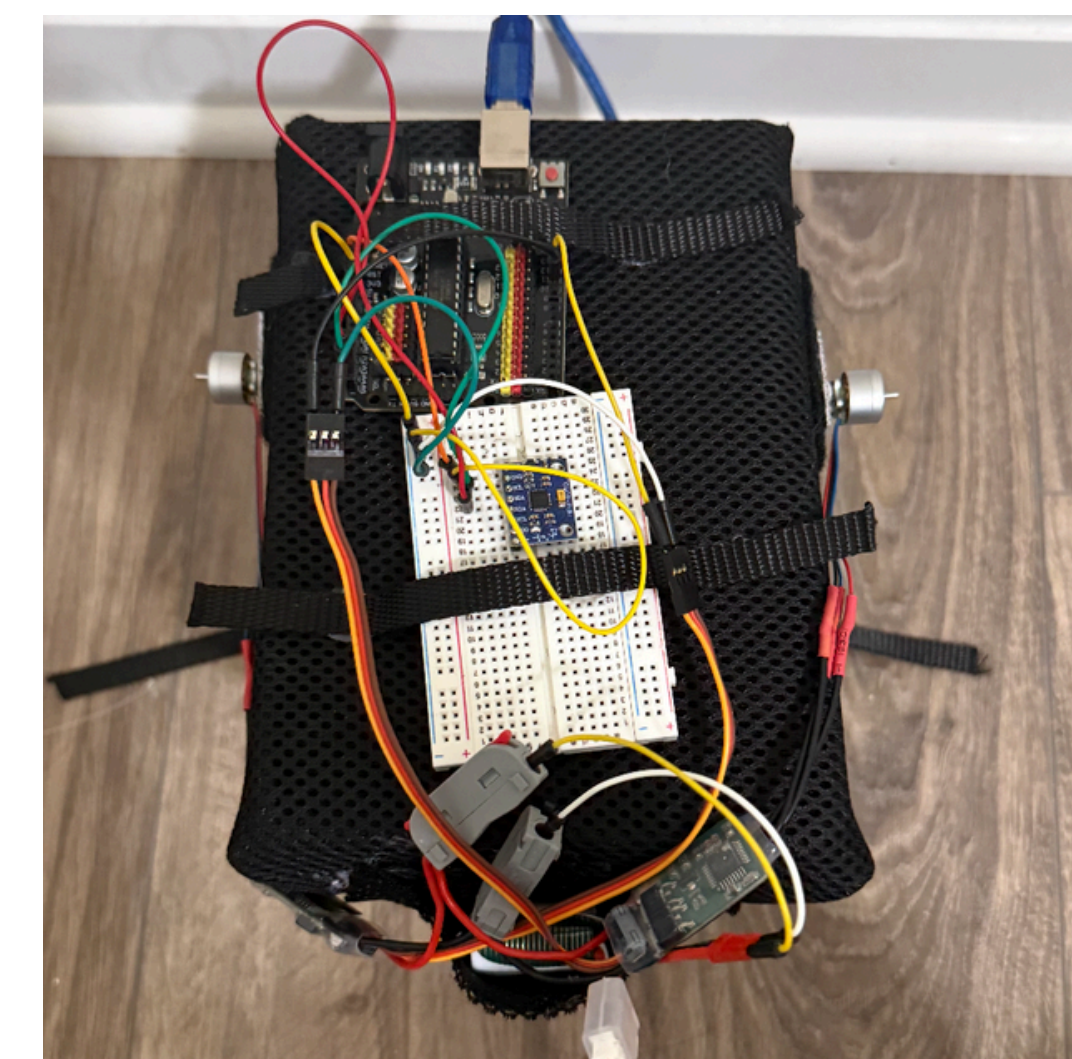


Figure 6: Bird's-eye view of device on mass-spring system

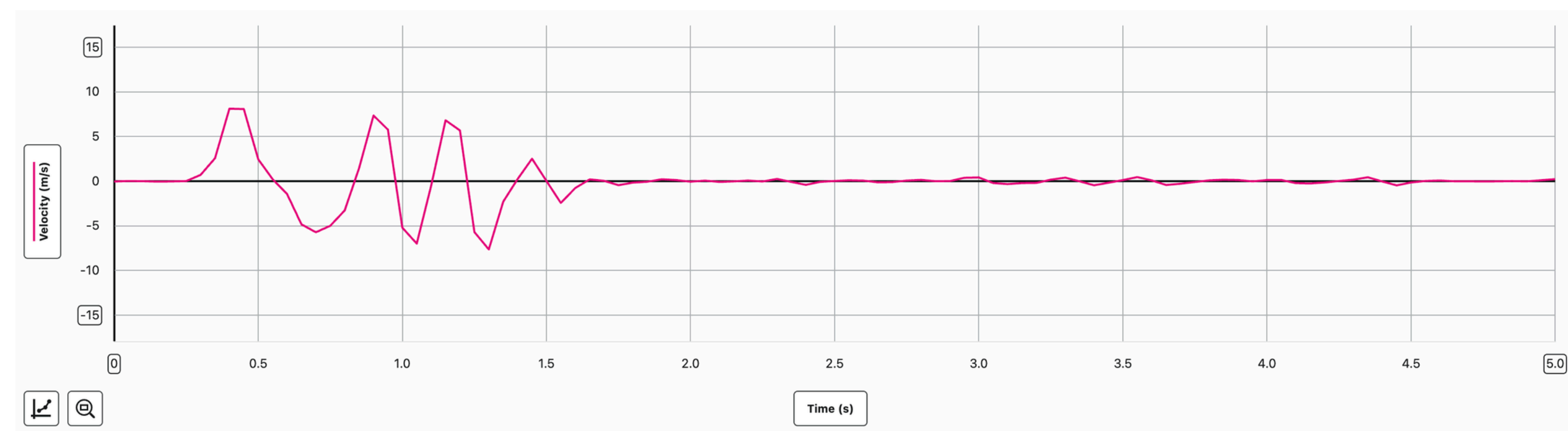


Figure 4: Velocity (m/s) vs. Time (seconds) prior to device

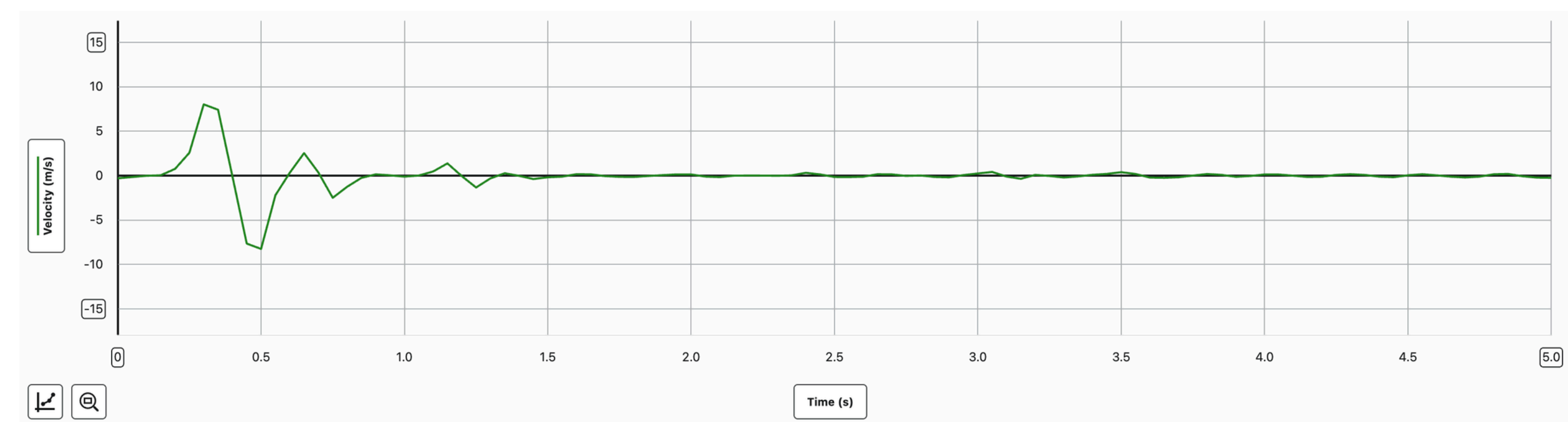


Figure 5: Velocity (m/s) vs. Time (seconds) after device

COMPETITOR ANALYSIS

Prior to this research project, engineers have designed **wheelchairs** to combat the mobility issues present in cats with CH. These wheelchair carts were fabricated using **PVC pipes** and joints, **neoprene**, a versatile **synthetic rubber**, and a **PLA filament** for 3D printed parts, and a **biodegradable thermoplastic** that is used in high detail 3d prints (Chang, 2024). Although this device allows for free movement while reducing wobbling in cats with CH, they are still dependent of their owners as they cannot go up stairs, eat, and drink alone.



Figure 6: A visual image of the competitor analysis (Chang, 2024).

ANALYSIS



Figure 7: A visual image of the wearable bodysuit on a cat-like model

The results from Figure 4 indicated that wobbling occurred consistently for **16 seconds**. But shortly after the device was turned on and applied, the number of oscillations **subdued to 7 seconds**, indicating the effectiveness in an IMU-based dampening system. Conceptual components gathered from a **self-balancing robot** were **successfully** reapplied to create feedback that **slowed down** the **impact wobbling** has on cats with cerebellar hypoplasia.

FUTURE WORKS

- This device will be most effective towards the walking movement in cats with cerebellar hypoplasia, but could potentially benefit cats who have issues with vertical movement.
 - Bodysuit could be tested how **jumping** impacts the **oscillations** and **gait** metrics
 - Ensure no **overcorrection** or **sudden torque spikes** when accelerating vertically
- Expand the investigation
 - Conduct testing on an authentic cat with CH, determine if their **gait** is affected the **same way** as the **mass-spring system**

CONCLUSION

- Essential in revolutionizing adoption for cats with CH
- Reduces constant checkups to the vet and healthcare expenses
- Increases overall health and well-being through constant movement
- Promotes quality of life through reducing the amount of dependency cats with CH rely on their owners
- Allows cat with CH to stand upright without the need to hold themselves constantly against a support pillar