Cable-Actuated Locking Mechanism (CALM)

An Ergonomic Monitor Solution for Central Vision Loss

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THE FOUNDRY

Problem Statement

Individuals with Central Vision Loss (abbreviated as CVL, visual example provided in fig. 1), caused by conditions such as Leber Hereditary Optic Neuropathy (LHON) and macular degeneration, struggle to use traditional computer monitors. Because they must rely on peripheral vision, users often lean or hunch to view screens, causing chronic neck and back strain(fig. 2). Based on focus group interviews, current on-market monitor arms sag over time or are too complex to operate for people with limited vision.

Fig. 2 **LHON Collective.** (n.d.). *Home.* Retrieved from https://www.lhon.org

Fig. 1 *The problem with depicting Central Vision Loss.* ericatandori.com. (2016, November 18). https://www.ericatandori.com/researching-vision-loss/the-problem-with-depicting-central-vision-loss/

Motivation & Exigency

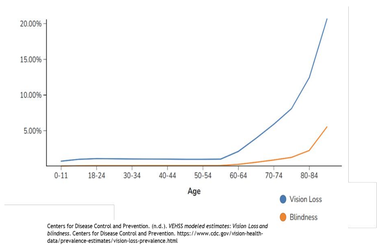
For people with CVL:

- Computers are essential for work and social connection
- Their setups tether them to desks, leading to isolation and pain.

Our client, Dr. Amie Koch of Duke University's School of Nursing, emphasized the need for a mechanical solution that **restores comfort, posture, and independence at an affordable cost.**

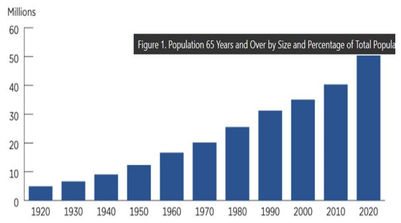
The project's societal importance also increases as the U.S. population ages, expanding the number of people with vision-related disabilities as shown in Fig. 3 and Fig. 4.

Figure 3. Prevalence (Percentage of US Resident Population) with Vision Loss or Blindness (Best Corrected Visual Acuity 20/40 or Worse), by Age Group (in years)



Centers for Disease Control and Prevention. (n.d.). *VEHIS modeled estimates: Vision Loss and blindness.* Centers for Disease Control and Prevention. https://www.cdc.gov/vision-health-data/prevalence-estimates/vision-loss-prevalence.html

Figure 4. Population 65 years and Over by SIze and Percentage of Total Population 1920 to 2020



Caplan, Z. (2023, May 25). *U.S. older population grew from 2010 to 2020 at fastest rate since 1880 to 1890.* Census.gov. https://www.census.gov/library/stories/2023/05/2020-census-united-states-older-population-grew.html

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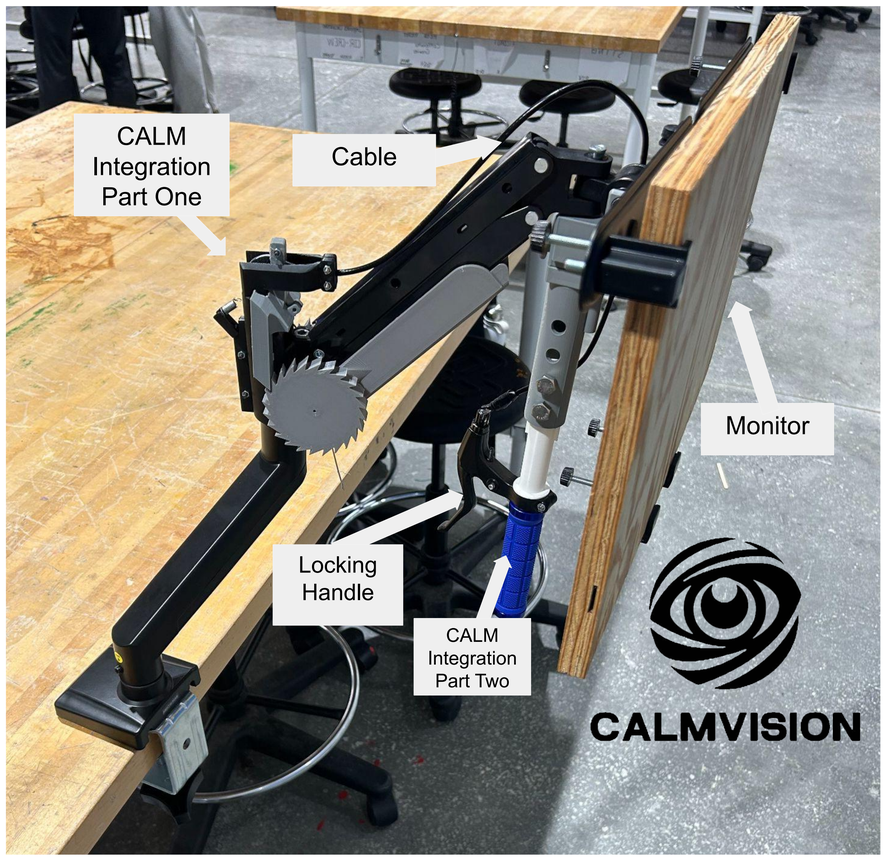
Hannah Stark	Teaching Assistant

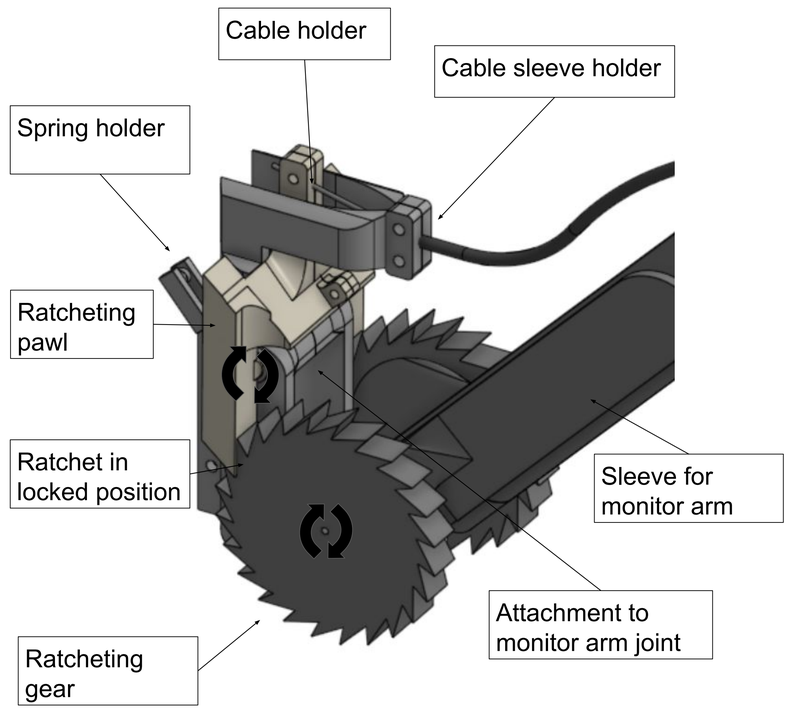
Design Criteria and Testing

1. Holding Capacity (Structural Integrity)	Ensure the ratcheting joint can reliably hold monitor weight and prevent sagging over time.	Support ≥ 25 lb at all operating angles (-45˚ to 45˚).	Incrementally load up to 35 lb; record weight at which arm begins to sag. Repeat for each 20* angles.
2. Locking Mechanism Usability	Verify that users with limited vision and strength can unlock the joint easily using the cable-actuated handle.	Unlocking requires less force than a standard bike brake; achieve average user rating ≤ 1.5 (on 1–3 ease scale).	Participants depress handle 10 times and rate ease vs. a bike brake (1 = easy, 3 = difficult).
3. Durability / Lifespan	Demonstrate that CALM withstands repeated daily use without failure or degradation.	Complete ≥ 100 full z-axis move ment cycles without failure .	Manual cyclic testing of joint until noticeable wear or failure; run 5–10 replications.
4. Ease of Use & Setup	Verify system can be installed and adjusted intuitively by people unfamiliar with device.	80 % participants rate usability as "Easy" (≤ 2 on 1–5 scale); setup < 5 min.	Users perform setup and navigation tasks (e.g., spreadsheet editing) within 15 min; score 1–5 (1 = very easy).
5. Integrability (Compatibility)	Confirm design attaches to existing commercial monitor arms without custom monitors or tools.	Universal VESA and c lamp compatibility achieved; secure fit on > 90 % t ested arms.	Attach CALM to commercial arm, record gaps and stability.
6. Weight & Porta bility (Constraint)	Maintain lightweight system manageable for users with limited stren gth.	≤ 25 lb total assembl y weight	Measured using digital scale post-a ssembly.

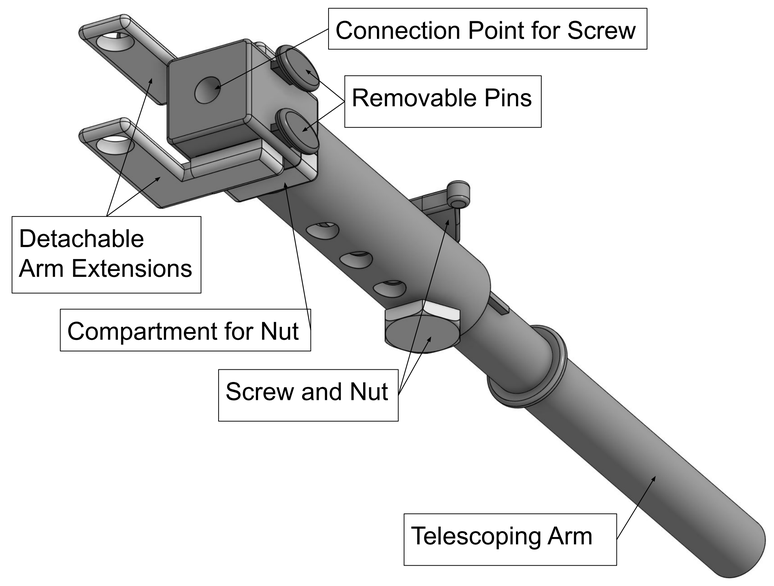
CALM Final Design



CALM Integration Part One



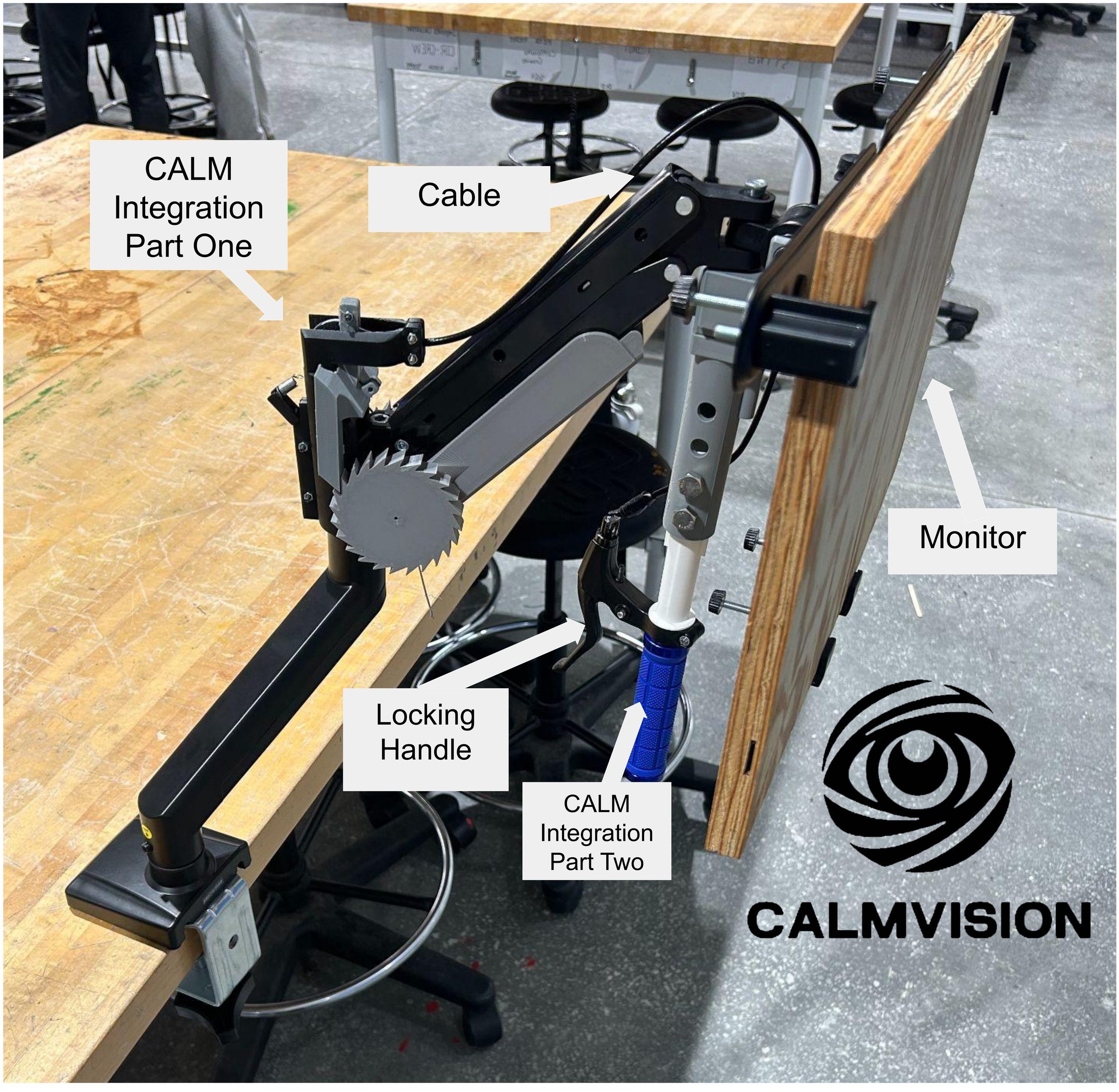
CALM Integration Part Two



Conclusion and Future Work

CALM achieves the project goal of providing a mechanically simple, ergonomic, and affordable monitor adjustment system for individuals with Central Vision Loss. The cable-triggered locking mechanism eliminates posture-induced pain by reducing monitor sagging over time, improves daily accessibility with an easy-to-use monitor handle, and retains compatibility.

This design fulfills the client's vision of bringing the able-bodied workspace to the user, fostering autonomy and quality of life. Future work on this project may involve shrinking the size of the CALM attachments to be more visually appealing, reducing setup time, and utilizing more durable materials such as metal.


CALM
Integration
Part One
Cable
Monitor
Locking
Handle
CALM
Integration
Part Two
CALMVISION