Senior Design Project

Ahmad Shah, Neeti Mistry, Sara Gaber &

Sohan Chatterjee

Background and Problem

- 39 million blind people worldwide
- 65% experience at least 1 collision per week, causing injuries, medical bills, and loss of independence
- 70% of visually impaired people are unemployed because of these physical and emotional barriers
- Everyday navigation presents major challenges:
  - Avoiding obstacles, following routes, and staying safe
  - Existing aids (white canes, guide dogs) have limitations

What is C-ALL?

- **Objective:** Develop an affordable, real-time navigation system for visually impaired individuals
  - Leverages LiDAR technology integrated into newer iPhone Pro 12+ models to detect surroundings and guide users safely
- **Technology Stack:** LiDAR, Swift, Geographical ARKit, Bluetooth, Raspberry Pi, Mobile Application (iOS), SolidWorks
- **Key Features:**
  - Real-time obstacle detection and path guidance
  - Seamless integration between hardware and software
  - Mapping and navigation on sidewalks rather than roads for improved pedestrian safety
- **Impact:** Enhances mobility, independence, and accessibility for users

How It Works

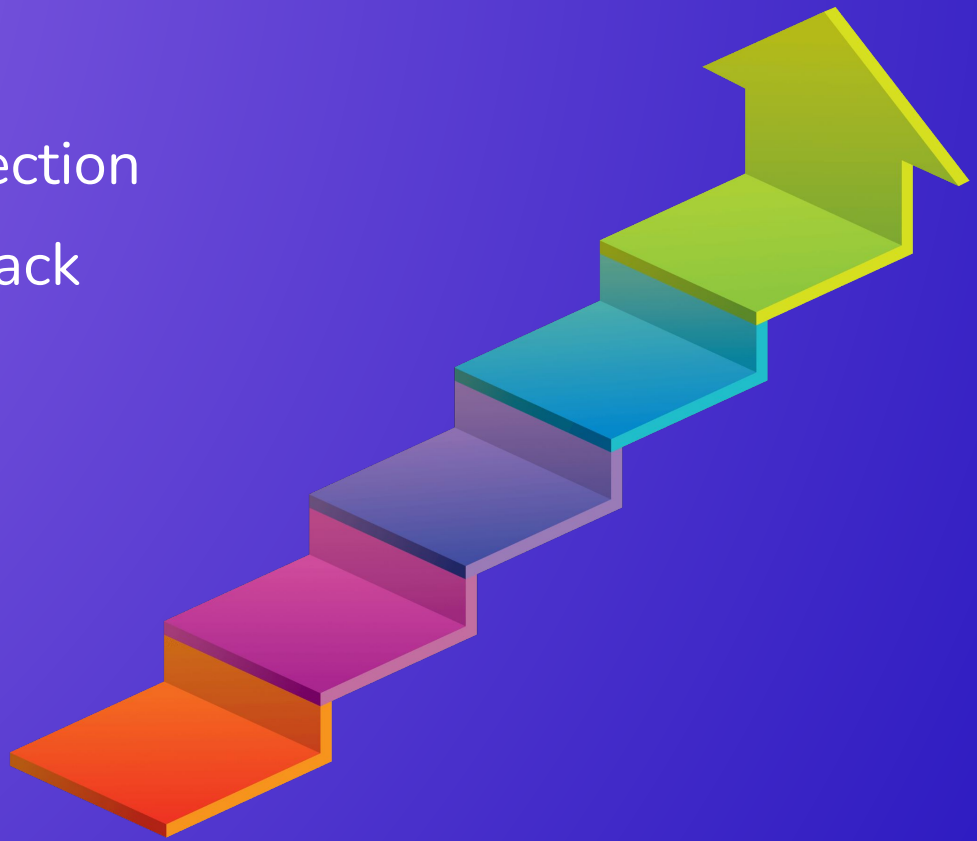
- **LiDAR Sensor (iPhone)** - Detects nearby obstacles and scans surroundings in real time
- **Navigation Engine (Our iOS App)** - Processes Apple Maps sidewalk data + ARKit to create safe walking routes
- **Haptic Feedback (Smart Gloves)** - Converts digital directions into physical sensations (pointers on the back of the hand) → Users feel where to go without relying on sight or sound
- **Hardware–Software Integration** - iPhone connects via Bluetooth to the glove's Raspberry Pi system for instant haptic feedback

Business Objectives

1. Offer an alternative assistive device for the visually impaired to guide dogs and canes
2. Enhance the independence and mobility of visually impaired individuals
3. Increase market penetration in assistive technologies

Success Criteria

- Accuracy in Obstacle Detection
- User Adoption and Feedback
- System Reliability
- Cost-Effectiveness



Stakeholders

- Project Sponsor
- Project Managers
- Developers
- Manufacturers
- Visually Impaired Clients
- Healthcare Providers
- Insurance Companies
- Nonprofit Organizations
- Rehabilitation Facilities

Competitive Advantage

- Current Solutions Fall Short
- Guide dogs → Cost up to $50,000 + limited access
- White canes → Offer minimal environmental awareness + large and highly visible, many (especially younger users) find stigmatizing
- Realistically, users are stuck between two extremes:
    - One that's super expensive, and one that's embarrassing
    - C-ALL provides another option

Use Cases

Use Case	Requirements	Name and Description
UC_1	$reqkFunctional_1$, $reqkInterface_4$, $reqkQuality_1$, $reqkQuality_2$, $reqkBusiness_1$,	ucNavigate Give directions to the User to navigate to their desired destination
UC_2	$reqkFunctional_2$, $reqkFunctional_3$, $reqkInterface_4$, $reqkQuality_1$, $reqkQuality_2$, $reqkBusiness_1$,	ucObstacleAvoid Give directions to the User to avoid obstacles
UC_3	$reqkFunctional_3$, $reqkInterface_1$, $reqkInterface_3$,	ucHandleErrors Notify the User of a system failure if directions can no longer be given reliably
UC_4	$reqkInterface_2$, $reqkInterface_3$, $reqkInterface_4$, $reqkConstraint_1$, $reqkConstraint_2$, $reqkBusiness_1$, $reqkBusiness_2$,	ucSetup Set up and calibrate the system for each user
UC_5	$reqkBusiness_2$, $reqkInterface_4$, $reqkQuality_1$, $reqkFunctional_3$,	ucUpdateSoftware Allow users to download and install software updates to improve performance, add new features, and fix potential issues

Use Case Interviews

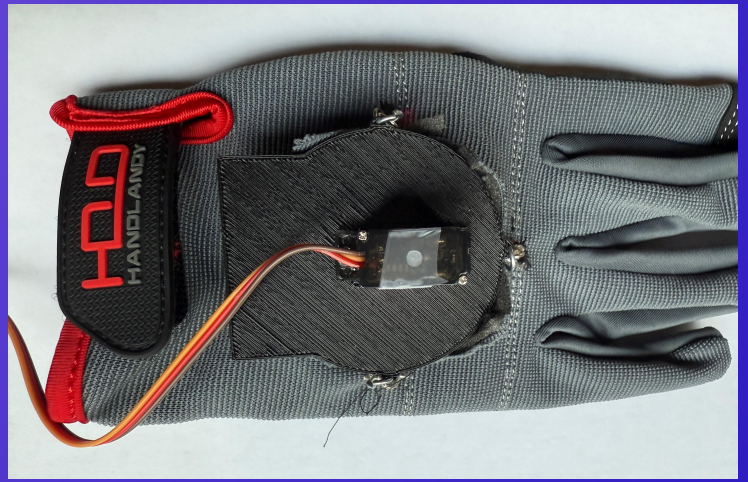
- We spoke with Jules Jaworowski, a 20-year-old blind student & teacher for visually impaired students, prior to development — her insights shaped our entire project.
- Helped us understand key needs + gaps in the market
- Originally, we planned to build on a past LiDAR-based project with audio cues
    - Auditory overload → Audio cues were overstimulating in real-world use
    - Prioritized info → She doesn't need all visual details, just critical obstacles

Key Takeaways

- **Dogs vs. Canes** → Dogs offer full awareness; canes are limited + require hitting obstacles
- **Stigma** → Young people want discreet aids
- **Openness to Tech** → Younger users are eager to try customizable tech
- **Apple Ecosystem** → Strong trust + reliance on Apple's accessibility tools
- Tech aids relying on audio cues can be overwhelming or impractical in noisy environments

How This Shaped C-ALL?

- We’re building a discreet, wearable device that avoids the embarrassment factor
- We focus on major hazards, not irrelevant details — delivering useful, actionable guidance
- By leveraging Apple integration, we tap into familiar, trusted accessibility features
- We offer a third option beyond dogs or canes, expanding user choice and independence



Business Model

- Costs of Production
  - Overhead: $4,570
  - COGS: $180/model
- Revenue Strategy
  - Price: $250 for entire kit
  - Direct-to-consumer sales
  - Future plans to secure insurance coverage and successful market adoption
- Value Proposition: Independence, Safety, Affordability

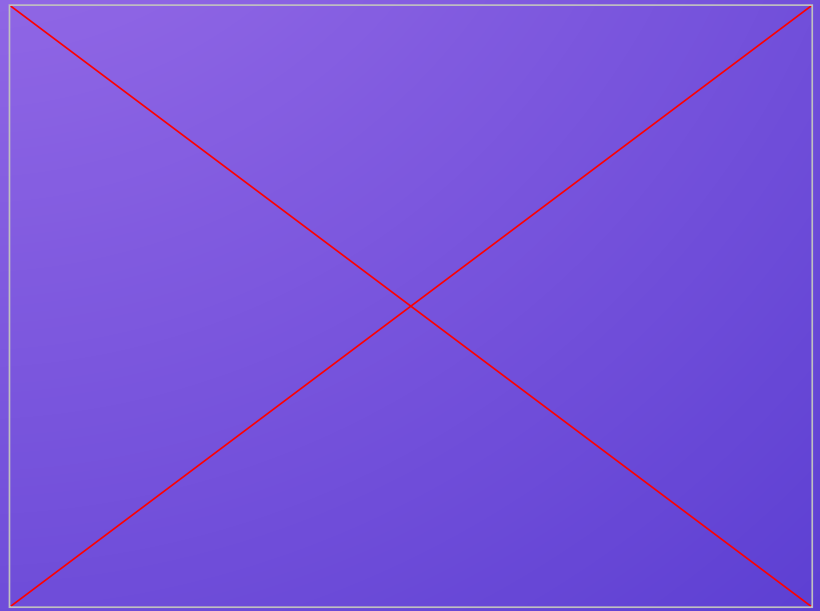
Constraints & Risks

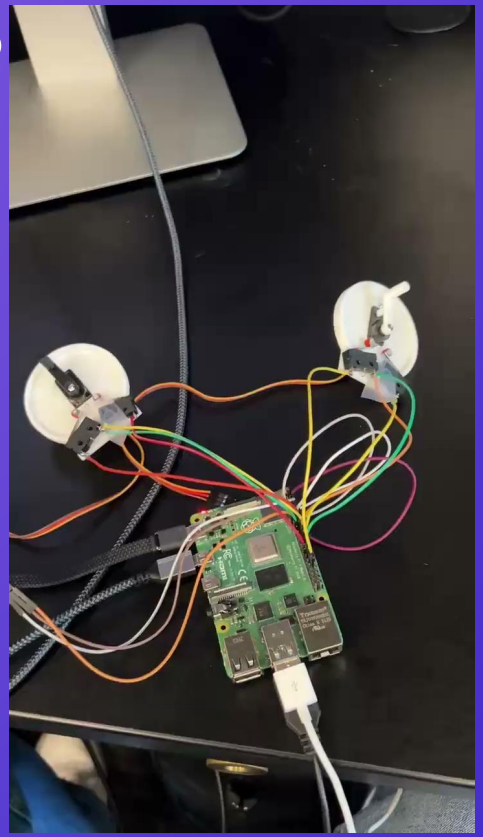
- Application only accessible on iOS-enabled devices.
- Obstacle detection only functional on devices with LiDAR sensors.
- Marketplace competition and regulatory compliance.
- Delays in hardware and software development.
- User acceptance and feedback.

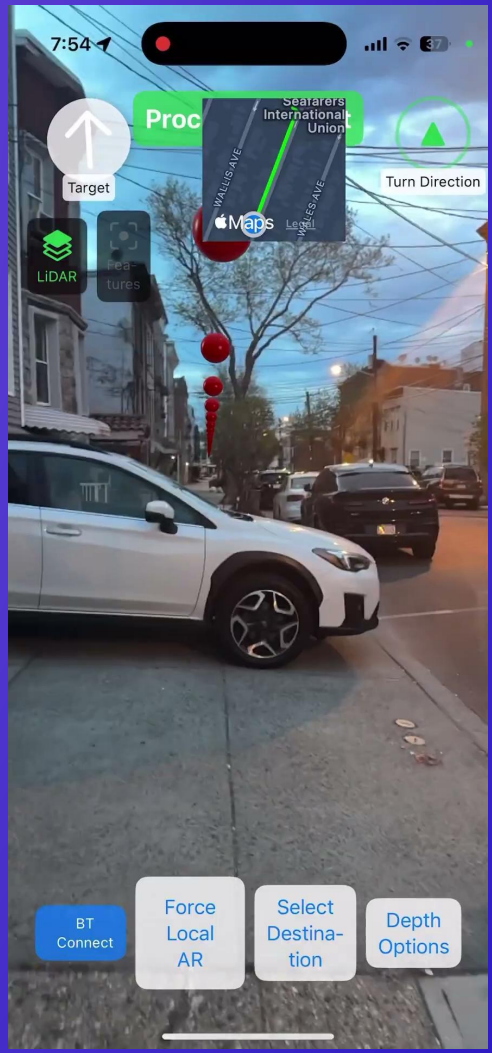
Target Market & Impact

- Visually impaired individuals, rehabilitation centers, and healthcare organizations.
- Turn C-ALL into a global accessibility solution.
- Enhance mobility, promote inclusivity, and improve quality of life.
- Rework core technology for future uses.

Working Prototype Demos







User Manual

A User Manual was created to:

- Guides setup & use for smooth experience
- Troubleshooting tips for common issues
- Instructions for updates & maintenance to keep C-ALL running at its best

6.2 Troubleshooting Common Issues

Issue	Possible Cause	Solution
The device does not turn on	Low battery	Charge or replace the battery
No haptic feedback	Loose wiring or disconnected servo motor	Check wiring connections and restart
The app does not detect the device	Bluetooth is off or not paired	Enable Bluetooth and reconnect via settings
Inaccurate pointer movements	Misalignment during calibration	Recalibrate using the app

Table 6.1: Common Issues and Solutions for the C-ALL Device

Disclaimer: **Due to the technical nature of the setup process, visually impaired users may require assistance during the initial installation and calibration of the C-ALL system. It is recommended to have a sighted assistant help with assembling the hardware, pairing the device, and performing the first-time calibration.**

Future Potential and Reach

- C-ALL's 360° haptic LiDAR feedback has wide applications:
  - Firefighting → Navigate through smoke
  - Military → Stealth in low-visibility missions
  - Exploration → Cave and underwater navigation without GPS
- C-ALL's intuitive, tactile system can enhance human vision across high-risk environments—technology that starts with accessibility and scales for all.

What’s Next for C-ALL?

- Publish the **C-ALL app** on the **App Store** for wider accessibility
- Continue gathering **user feedback** and conducting **pilot testing** to refine features and **improve usability** for software updates
- **Partner** with **accessibility** and **mobility organizations** for **outreach** and **collaboration**
- Explore **multilingual** support to reach more users **globally**
- As an early-stage product, **durability** and **weather resistance** can be **improved** in future iterations
- Implement **emergency location sharing** feature to enhance user safety

Ask for the Board

- We are looking for **advice**, **introductions**, and potential **partnerships**, particularly in:
  - Navigating the **regulatory process**
  - **Connecting** with **manufacturing** or **supply chain experts**
  - **Identifying industry contacts** in **healthcare**, **accessibility technology**, or **first responder technology**
- We would like to discuss strategies for the Ansary Entrepreneurship Competition in navigating unfamiliar topics (revenue streams, regulations, etc.)

Thank you!

Any Questions?