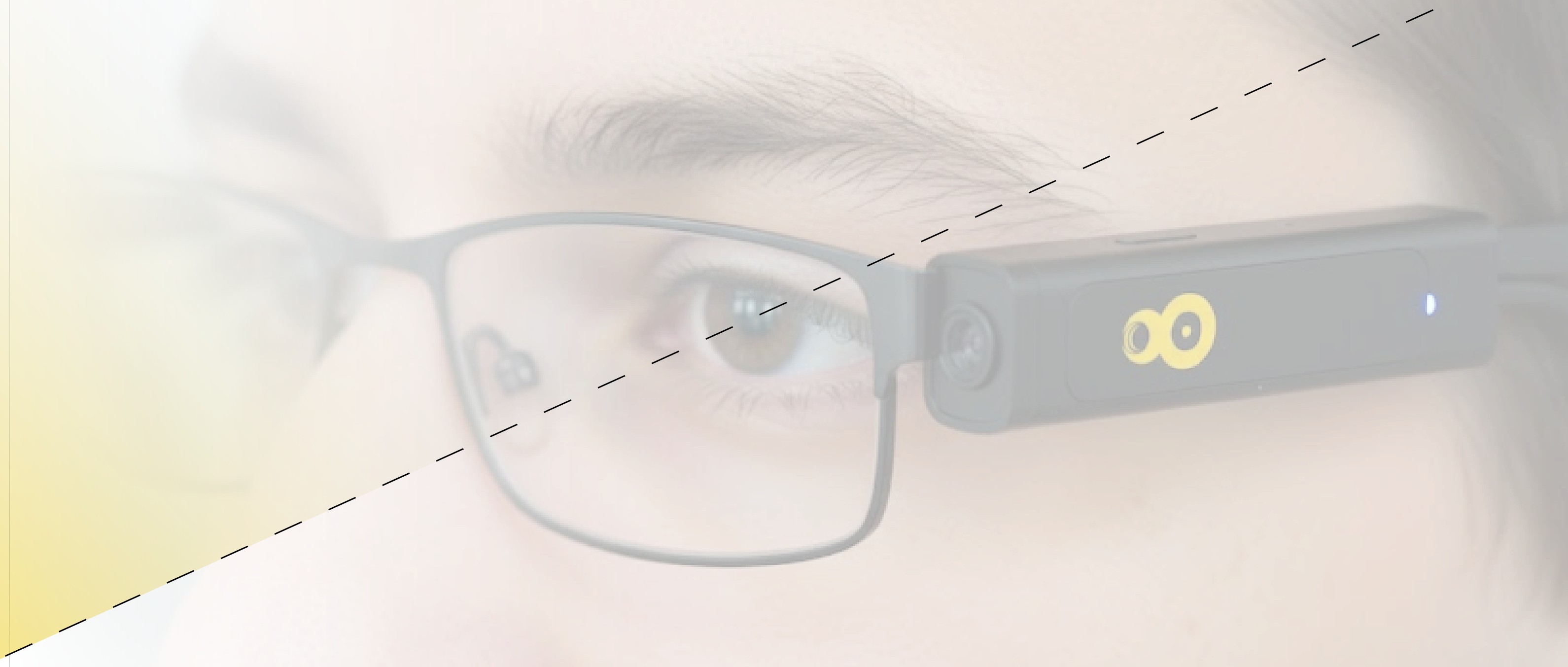

Sanket Eye

Project Created and Documentation by: Yash Nadkarni

Research Project Documentation

B.Des User Experience Design

December 2025

Accessibility is not a problem to be solved.
Accessibility is a culture to be built

~ Sheri Byrne-Haber

Sanket Wearable Ecosystem

Research project submitted by

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Academic Year 2025-2026

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Faculty of Arts, Design and Humanities

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This Research project titled **“Sanket Wearable Ecosystem”**
by Mr. Yash Rajesh Nadkarni is approved.

Name of the Jury Member (External Examiner)	*Signature, Date*
Name of the Jury Member (Supervisor)	*Signature, Date*
Program Coordinator *B.Des. (User Experience Design)*	*Signature, Date*
Dean, School of Design	*Signature, Date*

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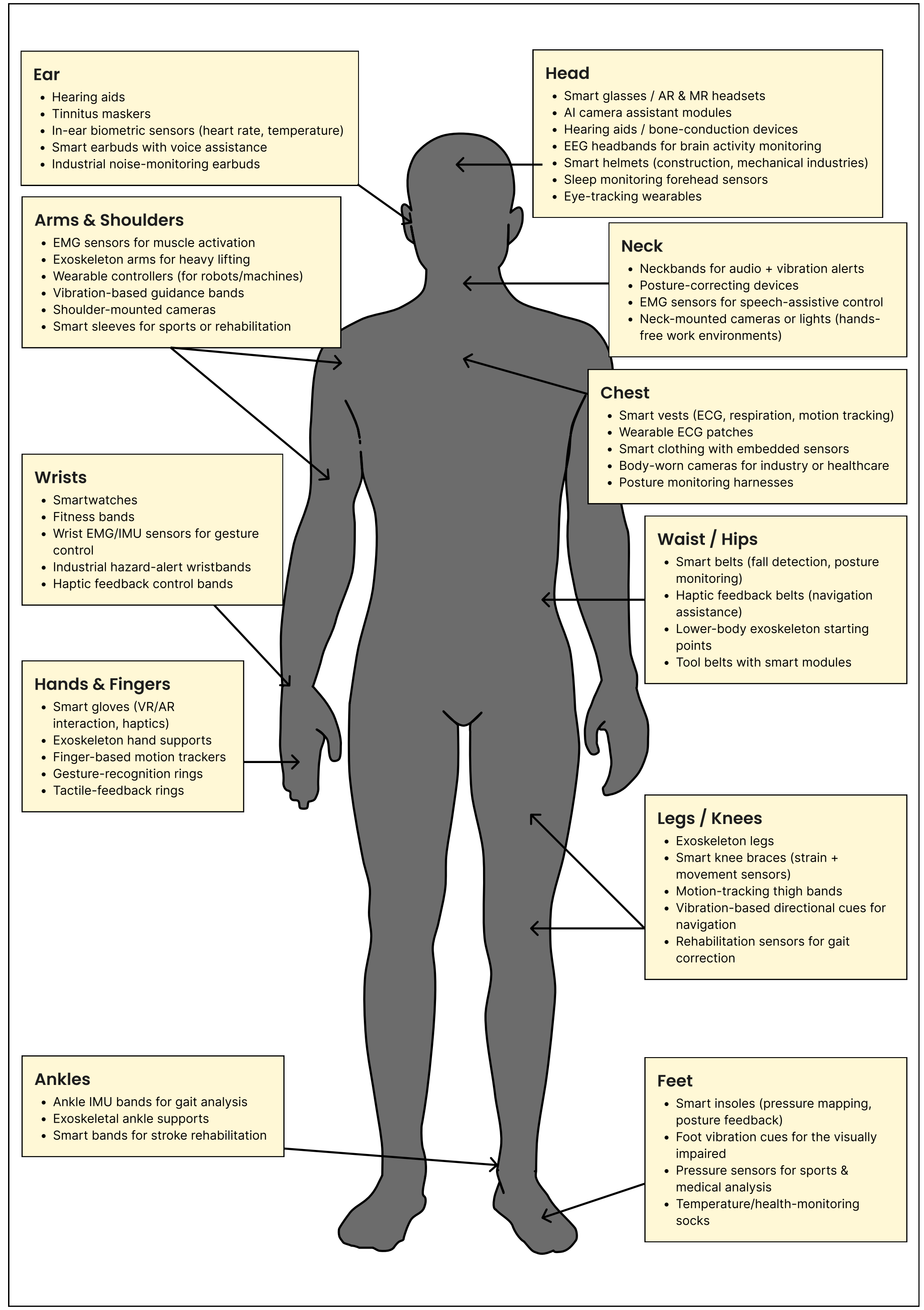
Synopsis

1. Synopsis

1.1 Introduction

Sanket Eye is a camera-enabled assistive device (physical product + app) designed to attach to existing wearables such as glasses or pendants, transforming them into accessible, multipurpose tools. As a key component of a broader accessibility ecosystem, it functions as an external “eye,” capturing information from the user’s environment, processing it, and delivering personalized outputs. These include understanding surroundings, reading text, identifying people, recognizing objects, and managing schedules—ultimately reducing cognitive load and minimizing the need for constant assistance.



Parts of the body where assistive wearables can be integrated

1.2 About my Users

1. Blind and Visually Impaired Individuals (Core User Group)

Sanket Eye directly supports:

- Blind users
- Low-vision users
- Users with progressive vision loss (glaucoma, cataract, macular degeneration)

Why it fits them:

- Enhances navigation, environment awareness, and safety
- Provides audio or haptic feedback
- Improves daily independence and reduces caregiver reliance

Age range:

- Teens to older adults (13–80+)
  Vision loss occurs at all ages, but functional decline is highest in senior populations.

2. Aging Adults & Elderly Individuals

Useful for:

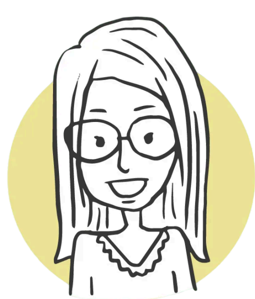
- Seniors with mild vision decline
- Seniors needing support for memory, safety, orientation
- Older adults living independently

Why it fits them:

- Prevents accidents (fall prevention, obstacle detection)
- Reduces stress and confusion
- Supports healthy, independent living
- Enhances cognitive engagement

Age range:

- 55+, especially 65+



3. People With Cognitive or Memory-Related Challenges

Includes:

- Mild cognitive impairment (MCI)
- Early-stage dementia
- ADHD or attention-related challenges
- Individuals with short-term memory difficulties

Why it fits them:

- Provides reminders, orientation cues, daily task assistance
- Reduces cognitive load and stress
- Supports safe routines and independence

Age range:

- 18–70+

1. Synopsis | 1.2 About my Users

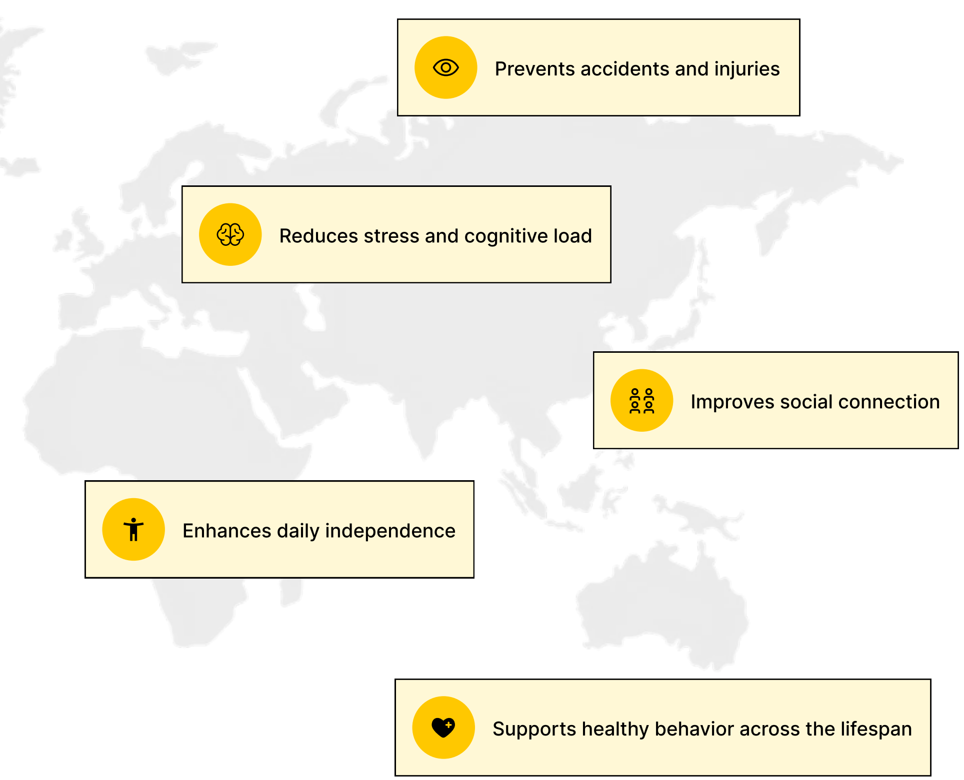
4. General Public (Universal Design Group)

Includes:
- Students
- Professionals
- Travelers
- Busy individuals
- Anyone needing support to track tasks, find items, receive notifications discreetly

Why it fits them:
- The design is not disability-coded
- Provides everyday assistance:
  - Item recall
  - Environmental awareness
  - Subtle notifications
  - Safety cues
- Aligns with preventive health & well-being

Age range:
- 15–60

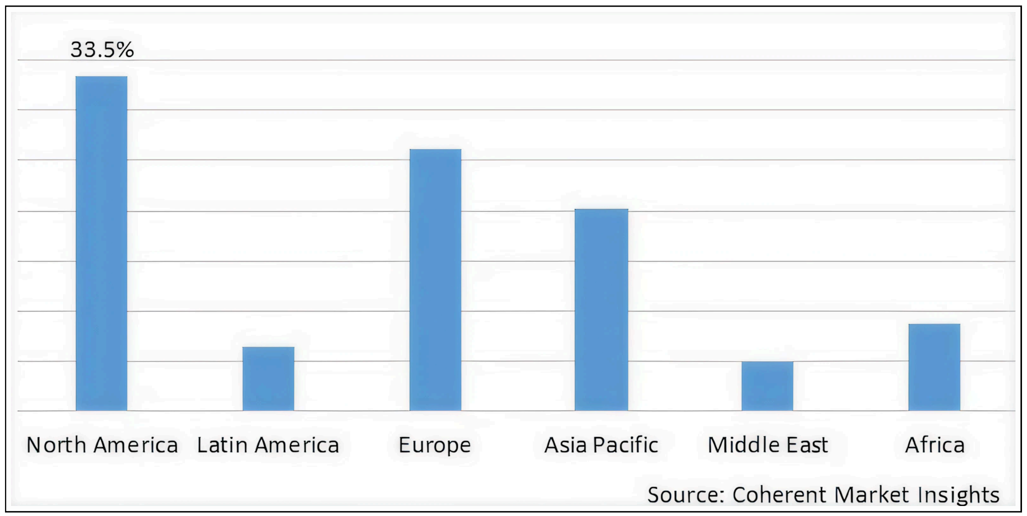
The present research therefore proposes the development of a modular, ecosystem-based wearable platform that can seamlessly integrate with common personal accessories such as glasses and rings. By enabling adaptive customization based on individual needs, this system aims to foster inclusivity and universal usability, ensuring that assistive devices are not perceived as markers of difference but as extensions of everyday living. The ultimate goal is to bridge the divide between assistive and non-assistive technology, thereby creating an equitable design framework that benefits both users with disabilities and the general population, with particular emphasis on enhancing the independence and interaction of individuals who are blind or visually impaired.



1.3 Current Market

The Assistive Technology Market is projected to be worth $25.34 billion by 2025 and is anticipated to grow to $35.66 billion by 2032, reflecting a compound annual growth rate (CAGR) of 5% during this period. This growth is driven by the rising number of individuals with disabilities, an aging population, and advancements in assistive technology devices.

North America will lead the assistive technology market in 2025 with 35.2%, driven by high disability rates (61 million adults in the U.S.). Europe will be second with 27.3%, supported by strong innovation such as advanced hearing-aid SoCs. Asia-Pacific will grow the fastest (5.2% CAGR) due to its rising elderly population and increasing awareness in China, India, and Japan.

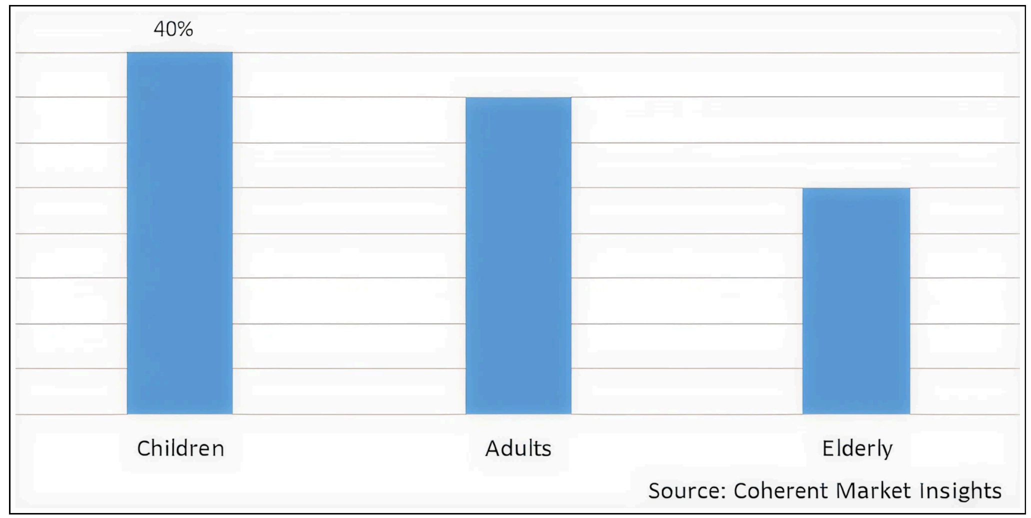


Global Assistive Technology Market Share (%), By Region, 2025

The market is segmented into product type, disability type, age group, end user, and region. By product type, the market is segmented into mobility impairment devices, visual impairment devices, hearing impairment devices, and other product types.

Global Assistive Technology Market Drivers

- Aging population: Growing elderly demographics increase demand for mobility aids, hearing aids, and vision-support devices to maintain independence.
- Rising disability rates: More disabilities caused by chronic conditions, accidents, and injuries (e.g., 5 million injured in 2019 road accidents in UNECE region) drive the need for assistive tools.
- Technological advancements: AI, sensors, robotics, and wearable tech enable smarter, more usable assistive devices.
- Government support: Policies, funding, and subsidies worldwide are accelerating the development and adoption of assistive technologies.



Global Assistive Technology Market Share (%), By Age group, 2025

Reference

https://www.coherentmarketinsights.com/market-insight/assistive-technology-market-5911

1.4 Why this topic

The estimated world population for 2025 is approximately 8.23 billion people. The global population is currently growing at an annual rate of around 0.85%, a decrease from previous years.

Population growth is slowing down.

We are still increasing in number, but the speed at which the world adds new people is decreasing.
It takes more years to add each new billion.

- Earlier: Adding 1 billion people took ~12 years.
- Now: It takes much longer.

This shows fewer births and aging populations worldwide.

Population will still grow—but only up to a point.
The world population is projected to:

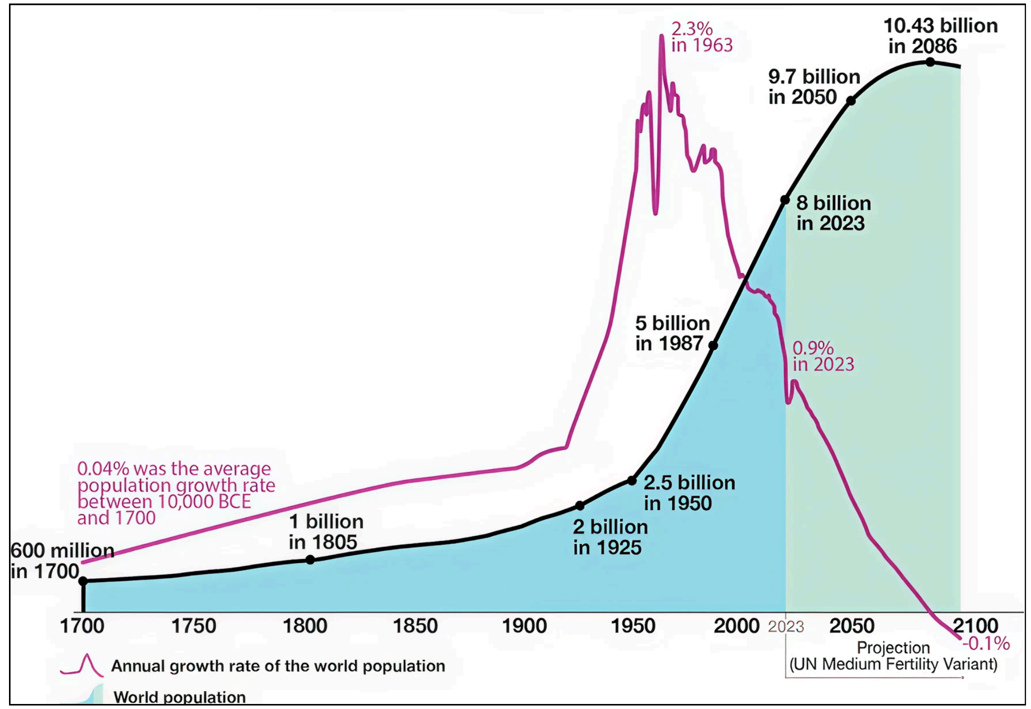
- Reach 9 billion by 2037
- Peak at around 10.3 billion in the 2080s

After this peak, growth may flatten or decline.

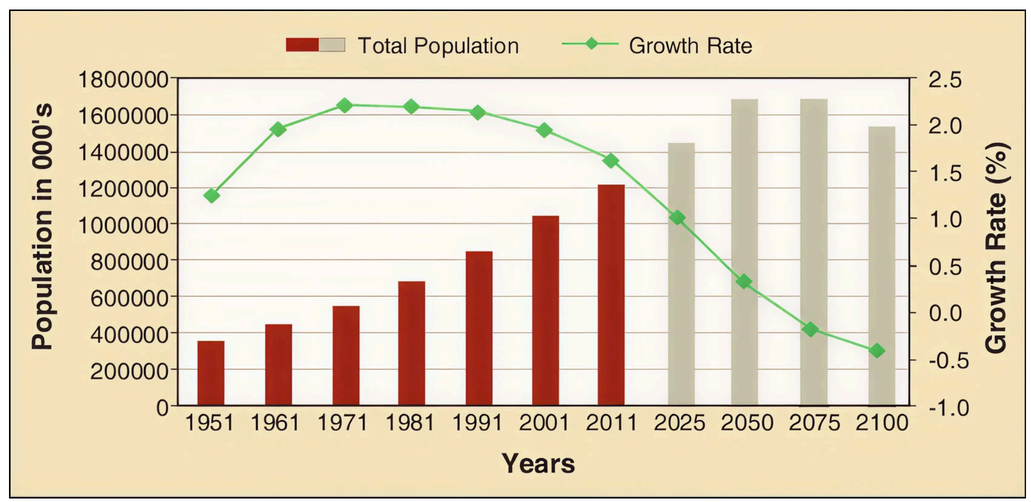
Aging becomes the dominant global demographic trend.
With fewer births and longer lifespans:

- There will be more elderly people
- Fewer young people
- Higher demand for healthcare and assistive technologies

Despite the global slowdown in population growth, it remains essential to develop solutions that enable people with vision loss and other disabilities to lead independent, inclusive, and fully participatory lives comparable to those of non-disabled individuals.



World Population Growth, 1700 - 2100



Population size and its annual growth rate in India for 1951-2100

1.5 Aim, Objective and constraints

Aim of the project:

This project focuses on integrating assistive technology into everyday wearable accessories, turning them into smart, functional tools that enhance accessibility. We aim to create a modular assistive wearable system called Sanket Eye, which will work with common accessories to improve independence, safety, communication, and overall well-being for individuals who are visually impaired, elderly, or cognitively challenged, while also being usable by the general public. However, our thorough research and user-centered approach revealed that the challenges in the assistive technology field are complex and cannot be solved through standalone product development.

This aim reflects:

- Universal design
- Preventive health
- Lifespan inclusivity
- Assistive intelligence integrated into daily life

Objective of the project:

1. To create a universally accessible assistive wearable that blends into daily life.

- Design a clip-on system that attaches to common accessories such as glasses and rings.
- Reduce stigma by making the device aesthetically neutral and mainstream.
- Ensure it supports both disabled and non-disabled users.

2. To enhance independence and safety for visually impaired and aging populations.

- Provide navigation and environment awareness through audio or haptic feedback.
- Assist users in avoiding obstacles and improving mobility confidence.
- Minimize dependency on caregivers and reduce risk of accidents.

3. To support preventive health through cognitive and behavioral assistance.

- Reduce cognitive load by offering reminders, task assistance, and orientation cues.
- Support early aging and mild cognitive impairment with daily living guidance.
- Promote healthier routines and safer engagement with the environment.

4. To integrate smart sensing, AI-based interpretation, and wearable interaction.

- Utilize sensors (camera, IMU, etc.) and onboard intelligence for real-time assistance.
- Enable multimodal feedback: haptic, audio, and visual.
- Experiment with ESP32-CAM and other hardware platforms for functional prototyping.

5. To ensure adaptability for users with diverse needs and disabilities.
- Enable modularity so users can customize which functions they require.
- Support multiple disability profiles: blindness, low vision, cognitive challenges, dual sensory needs.
- Create a scalable ecosystem that expands beyond a single device.

6. To conduct user-centered design research for solution validation.
- Perform interviews, usability tests, and contextual inquiry with visually impaired users, elderly individuals, and caregivers.
- Evaluate comfort, usability, and perceived usefulness of physical prototypes.
- Iterate design decisions based on real user needs, not assumptions.

7. To reduce barriers to assistive technology adoption.
- Offer a cost-effective, modular alternative to high-priced assistive devices.
- Build a system that works with existing accessories to avoid specialized hardware.
- Encourage everyday use by making the device unobtrusive and easy to adopt.

8. To contribute toward inclusive design and longevity innovation.
- Align with global longevity trends that demand tools for healthier, longer lives.
- Support users across life stages—from teenagers with vision impairments to seniors seeking independence.
- Promote societal inclusion and well-being through technology-driven empowerment.

1. Synopsis | 1.5 Aim, Objective and constraints

Constraints of the project:

1. High Development Costs
Developing compact, sensor-based wearables with AI capabilities can be expensive, increasing prototype and production costs.

2. Affordability for Users
Visually impaired and aging users may not be able to afford advanced assistive devices unless pricing is kept low and subsidy options exist.

3. Limited Awareness and Adoption
Many potential users are unaware of emerging assistive technologies, which may limit initial adoption and real-world testing.

4. Hardware Limitations
Small, modular devices restrict battery size, processing power, and sensor capabilities.

5. Technology Reliability
Camera-based assistance and AI interpretation may not perform consistently in low light, crowded areas, or unpredictable environments.

6. Lack of Standardization
Assistive tech ecosystems lack universal standards, making interoperability with other devices or apps difficult.

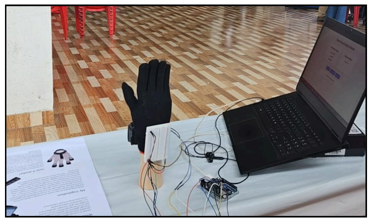
7. Research and Testing Constraints
Access to visually impaired and elderly users for usability studies may be limited, slowing refinement and validation.

8. Manufacturing & Scalability Challenges
Designing a modular system that is durable, safe, and manufacturable at scale is technically challenging.

9. Privacy & Ethical Concerns
Camera-based sensing and environmental scanning raise data privacy considerations, especially for public use.

10. Dependency on External Devices
The wearable relies on a companion smartphone app, which may limit use for individuals without smartphones.

1.6 Timeline and Product Evolution

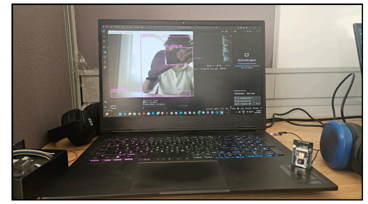


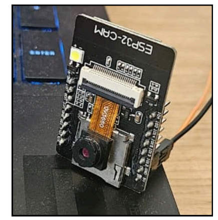
Started with a reason to make an assistive device for James Dyson Product Design competition

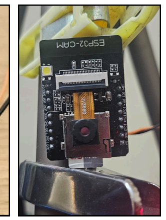
Presentation at Startup Expo
August 5, 2025 → August 10, 2025
I created a prototype to present, with features like, Speech to braille, Sign language to text

September 10, 2025

Visited Badhir Mukh Shikshan Kendra to get insights on what product to build, and then understood building gloves is not the ideal solution

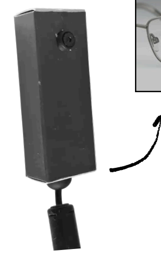


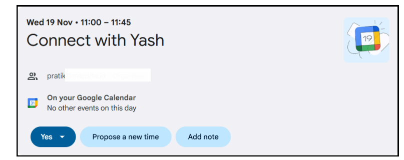




October 22, 2025 → November 10, 2025

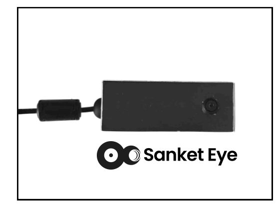
Created a Prototype of what i want to build, so that i can show and get more clear insights form people.

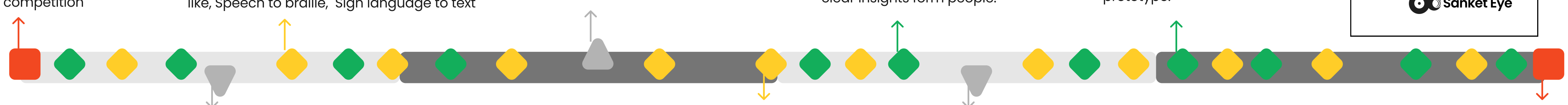




November 10, 2025 → November 30, 2025

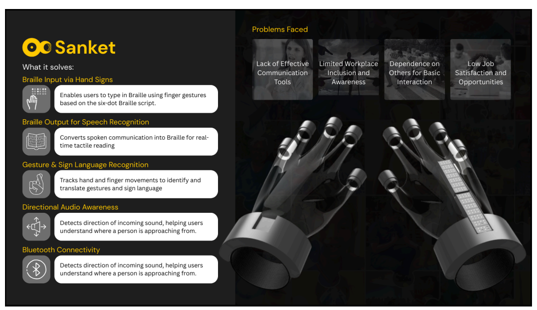
I interviewed product designers focused on accessibility and worked on improving the prototype.

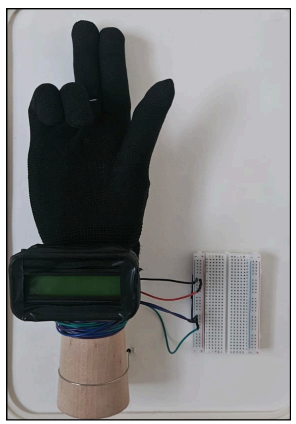




July 10, 2025 → July 17, 2025

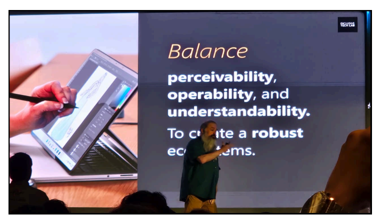
Created Initial Visual Ideation



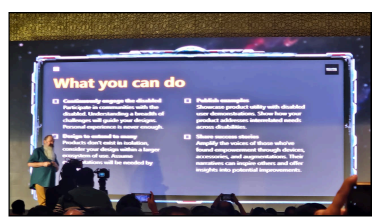


September 4, 2025 → October 21, 2025

Researched about wearables and the current gaps in Assistive Technology

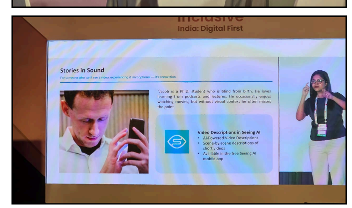


September 19, 2025 Attended UX India and met people working in the same domain



November 10, 2025

I participated in the Inclusive India Digital First event, where I had the opportunity to connect with individuals with physical disabilities and network with professionals dedicated to supporting them.



December 1, 2025 → December 5, 2025

Working on UI Screens and more user validation

Identification and Research

2. Identification and Research

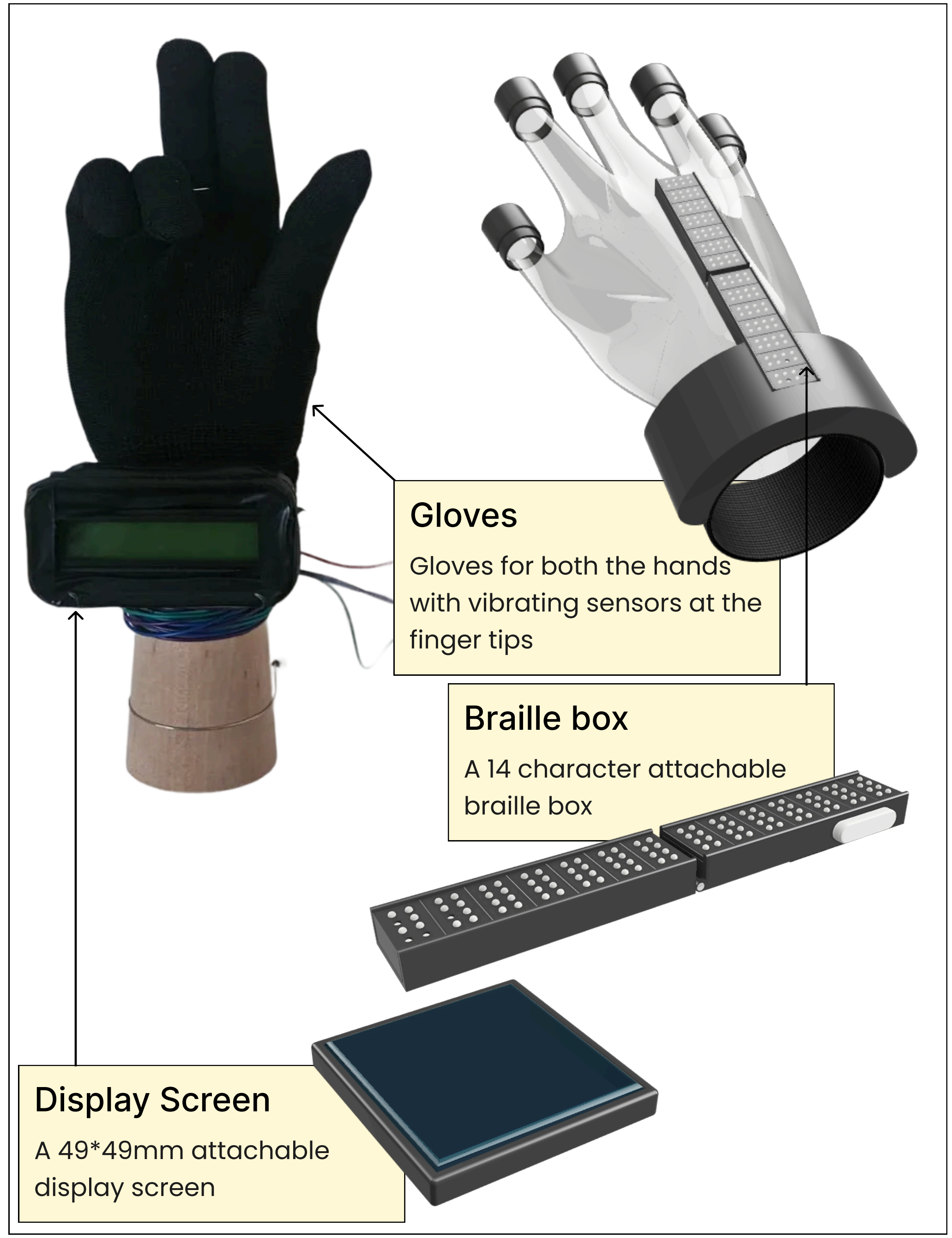
2.1 Primary Research phase 1

About Sanket Gloves

A smart assistive device designed to support individuals with visual, auditory, and speech disabilities in their work environment.

1. What it does

- Enables users to type in Braille using finger gestures based on the six-dot Braille script.
- Converts spoken communication into Braille for real-time tactile reading
- Tracks hand and finger movements to identify and translate gestures and sign language
- Detects direction of incoming sound, helping users understand where a person is approaching from.
- Connects via Bluetooth to an app



2. What inspired me to design it

- In rural areas, the number of differently-abled individuals exceeds 18 million, while urban areas account for just 8.1 million.
- Many disabled workers are experiencing low job satisfaction due to various challenges they encounter.
- Miscommunication often occurs between disabled and non-disabled individuals, particularly affecting those with hearing impairments.
- Everyone deserves equal opportunity at work. Sanket bridges the communication gap between disabled and non-disabled individuals —enabling seamless, independent interaction without external support.

2. Identification and Research | 2.1 Primary Research phase 1

3. Presenting this gloves to an Audience

I brought these gloves to a Startup Expo Event, thanks to my professor, Vatsala Sutar. Over 100 people stopped by my booth, offering a variety of suggestions and ideas. Since my target audience includes individuals with visual, auditory, and vocal disabilities, I had the chance to connect with someone who works closely with children with disabilities.

4. Gaining insights from educational institutions for children with special needs.

I brought these gloves to a Startup Expo Event, thanks to my professor, Vatsala Sutar. Over 100 people stopped by my booth, offering a variety of suggestions and ideas. Since my target audience includes individuals with visual, auditory, and vocal disabilities, I had the chance to connect with someone who works closely with children with disabilities.

Badhir Mukh Shikshan Kendra, Pune

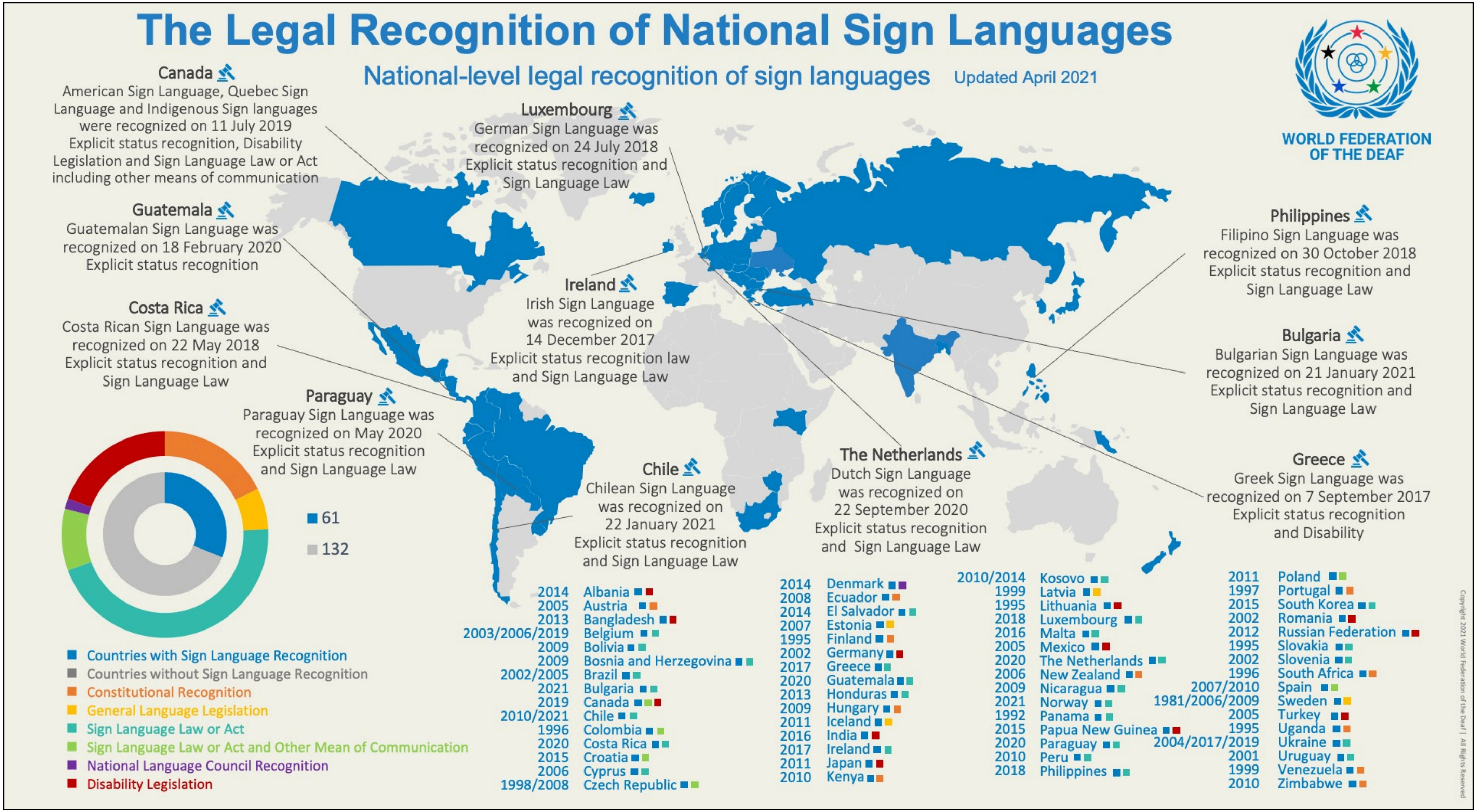
Insights from the visit

1. There are a lot of people building hand gloves that translate gestures into texts and audios
2. The Students who are unable to hear shift to sign language eventually as they cannot speak.
3. Some Students have Residual Hearing
4. They cannot hear to normal music or tunes or lyrics, they catch beats and vibe to that
5. They are a government funded organization and the students there are economically backward
6. Their education depends mostly on learning various ways to communicate themselves.
7. There are mobile apps that transcript and translate speech for these students, which they can then read.
8. The voice they hear and feel soothing can be disturbing to us.
9. These students are mentally stable but the only thing they lag are ways to communicate to the normal people.
10. Sign language changes from region to region, but common actions remain constant.

These insights led me to realize that while there is a demand for wearables, this particular device isn't the answer. Attempting to cram multiple features into one gadget makes it impractical for users. My product currently ignored my target audience who are deaf, blind, or have vocal impairments. Although several innovators have created sign language translating gloves, there isn't a single product that is widely recognized and available on the market.

5. A major reason this product isn't on the market.

Sign Language exhibits significant diversity among individuals and across different regions. The task of developing a universal system or comprehensive dataset that accurately captures every gesture utilized by people in various localities presents a considerable challenge. This complexity arises from the unique cultural contexts and personal expressions inherent in each sign language.



Legal Recognition of National Sign languages in the whole world

2. Identification and Research | 2.1 Primary Research phase 1

6. Photos from the Startup Expo presentation.

Held at Muktangan English School & Jr College Sivadarshan Poorgrasta Vasahat, Parvati Paytha, Pune, Maharashtra 411009

7. Outcome of Primary Research

This outcome was crucial for me to evolve my project into a more practical and functional device that people would genuinely use.

1. Focus on one target group

To develop a successful product, start by addressing the needs of a specific target audience, then work on reaching a broader public.

2. Enhance the product

With so many individuals developing similar products, it's essential to differentiate yours by enhancing its features and ensuring high quality.

3. Consider Real problems

It's not ideal to assume that a product automatically addresses the needs of disabled users. Their requirements are unique, and they process information differently than the general public.

4. Wearables are the future

While there are several apps available, the institution emphasizes activities and devices such as hearing aids and glasses.

5. Sign Language is subjective

Various gestures can be used to identify or classify items, but establishing a one-size-fits-all solution isn't the best approach.

6. General Public like anything

When a device designed for disabilities is shown to an audience unfamiliar with the challenges faced by a specific group, they often acknowledge the effort but struggle to provide meaningful feedback.

7. Teaching kids about wearables early is essential.

Raising awareness about wearable technology early on is crucial, as young people have a natural curiosity to learn. In contrast, encouraging older generations to embrace these devices can be quite challenging.

8. There is a need for more specialized products

The market offers various standard products, but there is a clear demand for a diverse range that meets the functional, emotional, and assistive needs of individuals.

But did the project fail?

No, What we actually accomplished was establishing a solid foundation to launch our project on a larger scale. We gained insights into initial user needs and pain points, which will guide the development of a different product tailored for the same audience, while adopting a new approach to ideation.

2.2 Primary Research phase 2

About Sanket Eye

A device equipped with a camera was developed, drawing inspiration from various online products. Initially, it was designed in a very basic electronic format, featuring only the ability to identify objects.

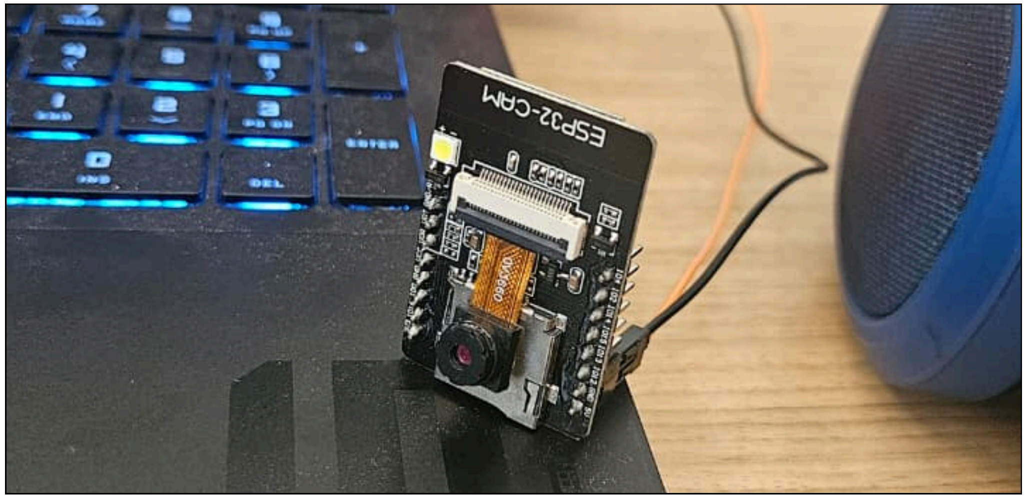
1. What it helped me with

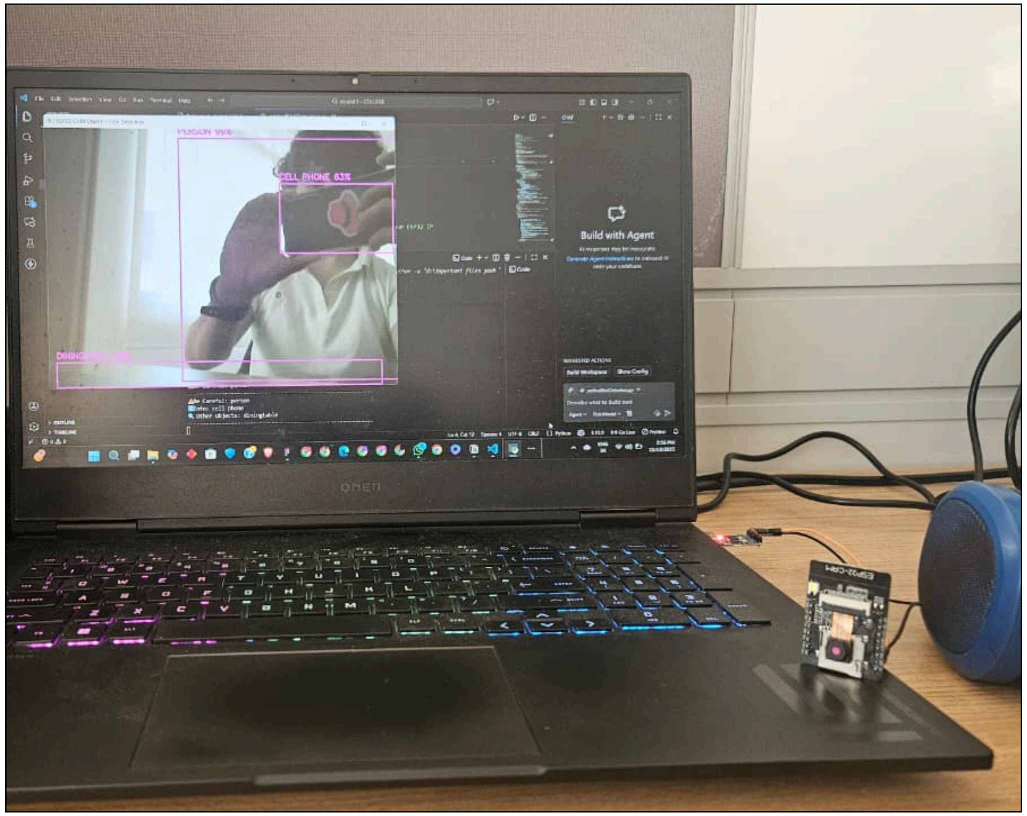
Creating an actual product helped me to start a conversation in detail.

Understood what are the technical limitations and basic hardware costs

Points to identify from this phase

1. Is this product accepted?
2. What features are required?
3. Is the device usable?
4. Who are my potential customers?

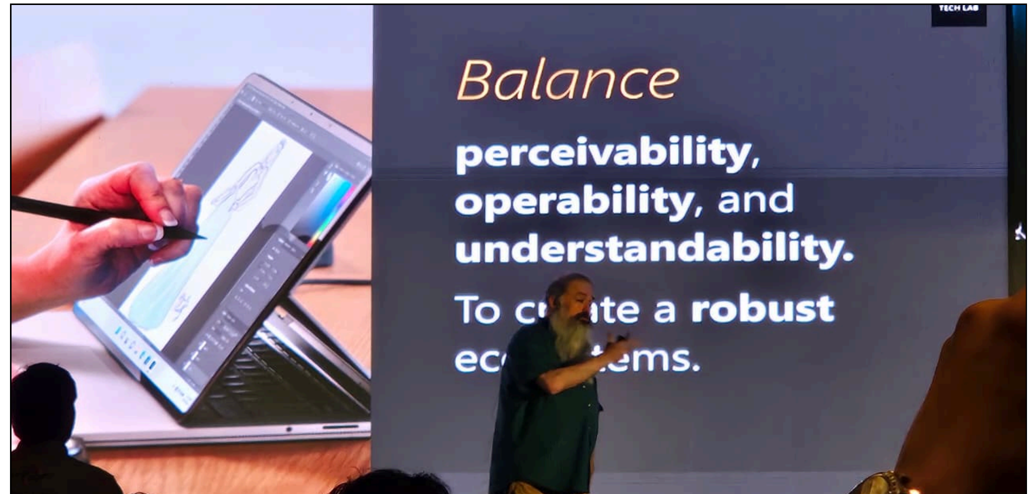




2. Identification and Research | 2.2 Primary Research phase 2

2. Who did i meet in this Phase

Name of the Person interviewed
Bryce Johnson (Co founder of Xbox)
Rtn. Srinivasu Chakravartula (Director of Accessibility Design Freshworks)
Ketan Kothari (XRCVC LABS)
Priti Rohra (Chief Accessibility officer at Barrier Break)
Pratik Shah (Senior Director Of Product design)



3. Classification of Functional, Emotional, Assistive needs

Functional Needs

1. Safe & Independent Mobility

Users need:
- Smooth, continuous, non-slippery walking surfaces
- Ramps with correct slopes (1:12), width, and handrails
- Clear, obstacle-free pathways
- Proper signage for navigation
- Tactile cues for visually impaired users

2. Accessible Entry & Exit Points

Users need:
- Entrances without level differences
- Dropped kerbs to transition between road and platforms
- Doors wide enough (≥900 mm) for wheelchair entry
- Automatic or easy-to-open doors

3. Functional Navigation Aids

Users need:
- Clear, visible, and tactile signage
- Logical route planning
- Audio cues to locate spaces (toilets, ramps, lifts)
- Well-lit corridors and pathways

4. Safe Vertical Movement

Users need:
- Ramps with landings
- Accessible lifts (size ≥ 2000 × 1100 mm)
- Audible lift indicators
- Properly designed staircases with tactile warnings

5. Access to Basic Facilities

Users need:
- Toilets with correct dimensions (2200 × 1750 mm)
- Grab rails inside toilets
- Accessible washbasins
- Emergency call buttons

6. Safe Interaction with Crowds & Vehicles

Users need:
- Separation between pedestrian and vehicular paths
- Clear crossings
- No encroachment of walkways
- Marked bus entry/exit points

7. Organized Parking & Drop-off Points

Users need:
- Accessible parking close to entrances
- Proper kerb ramps connecting parking to pathways
- Smooth surfaces without slopes or loose stones

8. Emotional & Social Needs
- Confidence while walking independently
- Reduced fear, anxiety, and stress
- Feeling included rather than dependent
- Maintaining dignity without needing visible “medical devices”

9. Independence in Daily Activities
- Managing errands without requiring a guide
- Accessing government buildings, hospitals, banks, schools
- Reading labels, boards, and instructions
- Performing everyday tasks confidently

10. Cognitive Support
- Reminders for tasks, items, or routines
- Reduced mental load in navigating daily life
- Assistance for memory-related difficulties (common in aging adults)
- Predictive cues to prevent accidents or confusion

3. Classification of Functional, Emotional, Assistive needs

Emotional Needs

1. Safety and Security
People with both conditions experience heightened anxiety and fear due to their inability to visually assess their surroundings while simultaneously struggling with cognitive confusion.

2. Connection and Human Presence
Visual impairment combined with dementia creates profound isolation

3. Dignity and Respect
Despite significant impairments, these individuals remain full persons deserving of respect.

4. Validation of Feelings and Experiences
Their emotional responses, confusion, and perceptions need acknowledgment rather than correction.

5. Comfort and Reassurance
The world can feel chaotic and frightening.

6. Sensory Engagement
With vision compromised, other senses become crucial pathways to emotional comfort and connection.

7. Purpose and Meaningful Engagement
Even with significant impairment, people need to feel useful and engaged.

8. Patience and Unhurried Time
Processing information and responding takes significantly longer.

3. Classification of Functional, Emotional, Assistive needs

Assistive Needs

1. Navigating the Physical Environment
Individuals with visual impairments encounter challenges when navigating through crowds, discovering new locations, and traveling.

2. Reading Text
Individuals with visual impairments encounter challenges when reading text, especially if it's not presented in a language they can understand.

3. Accessing Digital Media
When websites aren't designed to be accessible for people with disabilities, they encounter difficulties in accessing and comprehending the content. This includes factors like color choices, ARIA text, and text size.

4. Communication
It's essential to be patient and understanding towards individuals with disabilities, as they may require extra time to grasp certain information.

5. Daily Living Accessibility
Navigating daily life requires an awareness of your surroundings and familiarity with the people around you to feel secure.

3. What are the expectations to meet these needs?

Overcoming Functional Needs

White Canes
- Detect ground-level obstacles through tactile feedback
- Require training to use effectively
- Miss head-height hazards

Guide Dogs
- Provide intelligent obstacle navigation
- Offer emotional support and companionship
- Very limited availability in India

Human Assistance
- Family members or paid attendants guide the person
- Most common solution in India
- Limits independence and spontaneity

GPS Tracking Devices
- Worn as watches, pendants, or shoe inserts
- Allow caregivers to locate wandering patients

Door Alarms
- Alert when exterior doors are opened
- Simple sensor systems
- Can be disruptive for entire household

Visual Cues
- STOP signs on do
- Photos of destina on doors
- Floor markings ar colored tape

Physical Modifications
- Grab bars in bathrooms
- Walk-in showers with seats
- Non-slip mats and surfaces

Assistive Tools
- Long-handled brushes and sponges
- Talking thermometers for water temperature
- Electric razors instead of manual

Reminders
- Caregiver prompts and supervision
- Simple written or pictorial schedules
- Apps that send reminders to caregivers

Adaptive Clothing
- Elastic waistbands instead of zippers
- Slip-on shoes instead of laces
- Clothing with tactile markers (front/back, inside/outside)

Kitchen Safety Devices
- Stove auto-shutoff systems
- Talking timers
- Speaking thermometers
- Color-changing heat indicators

Organizational Aids
- Braille or large pr labels on contain
- Tactile markings appliances
- Raised dots on microwave butto

Adaptive Equipment
- High-contrast plates (dark food on light plate)
- Cups with lids and large handles
- Plate guards to prevent food spillage

Pill Organizers
- Daily or weekly compartment boxes
- Large print labels
- Color-coded for different times
- Braille labels available

Large Print & Braille
- Large print books and documents
- Braille books and labels
- Refreshable braille displays
- Electronic magnifiers

Communication Boards
- Picture boards for pointing
- Yes/no cards
- Alphabet boards
- Topic cards (food, bathroom, pain)

Overcoming Emotional Needs

Their choices honored whenever safely possible

Treatment as adults, never as children

Privacy maintained during personal care

Consistent reassurance through familiar voices and gentle touch
Regular physical presence of caregivers and loved ones

Predictable daily routines that provide structure

Clear verbal communication abou what is happening a them

Recognition of their life history, accomplishments, and identity

Simple, achievable activities adapted to their current abilities

Opportunities to help with basic tasks (folding, sorting, holding)

A safe physical environment free from hazards

Immediate response to expressions of fear or distress
Reassurance that they are not alone and will not be abandoned

Close proximity duri interactions (sitting them, not across fro them)

Minimize background noise and confusion

Maintain consistent lighting (avoiding harsh shadows)

Use tactile markers to identify important items

Gentle, appropriate touch such as hand-holding or shoulder patting

Warm, engaging conversation even when responses are limited

Direct communicatio addressed to them, over them or about t

Overcoming Assistive Needs

Provide consistent, even lighting throughout all spaces (150-200 lux minimum)

Eliminate shadows and dark corners that increase confusion

Paint door frames in contrasting colors to walls (dark frames, light walls or vice versa)

Use contrasting colors for handrails against walls
Install continuous handrails on both sides of all hallways

Mark stair edges with high-contrast tape or paint

Install light switches doorknobs in contra colors

Add tactile markers (raised dots, different textures) on important doors

Use brailled or large-print room labels (even if reading ability is declining)

Create tactile pathways using carpet runners or textured mats

Maintain consistent furniture placement (never rearrange without necessity)
Keep pathways clear and at least 36 inches wide
Remove unnecessary furniture and clutter

Install large, simple signs with both words and pictures
Use symbols and icons alongside text

Add tactile elements important signs
Include color coding different areas (kitchen=blue, bedroom=green)

Always announce your presence before touching or entering personal space

Identify yourself by name each time ("It's Sarah, your daughter")

Face the person when speaking, even if they cannot see you clearly
Speak clearly at moderate volume without shouting
Use short, simple sentences with one idea at a time

Allow extra processing time before expecting responses

Regularly state the time of day ("It's morning, time for breakfast")
Mention the location ("We're in your bedroom")

Use talking clocks th announce time on re
Install voice-activate assistants for remind and information
Use audio labels on medication bottles (recording devices)

Employ audio books and radio for entertainment and engagement

Create texture boards for different activities
Use touch to guide movement (hand-under-hand technique)
Label clothing with tactile tags to identify items

Large-button telephones with photo memory buttons
Voice-activated smart home systems (lights, thermostats)
GPS tracking devices for wandering prevention

Video monitoring systems with two-way communication
Medication dispensers with audio and visual alarms

Remove unnecessary features and buttons from devices
Use devices with high-contrast displays
Enable voice feedback on all electronic devices

2.3 Secondary Research

Approach

To begin designing a product ecosystem, we must grasp the fundamentals of Braille and sign language, explore various teaching methods, and understand how individuals with these disabilities perceive information.
I've identified several key points from my primary research phase 1 to inform my secondary research.

1. Key points

Braille Fundamentals	Sign Language Systems	Teaching Methodologies	Information Perception	Cross-Disability Solutions
How blind individuals read and learn tactile information	How deaf-blind individuals communicate	Proven methods for skill development	How people with disabilities process and understand information	Multi-modal approaches for various impairments

Process

Here's how the secondary research process works.

Identify Domains → **Collect Data from credible sources** → **Extract UX insights using frameworks** → **Organize findings in tables** → **Synthesize insights**

1. Braille Fundamentals

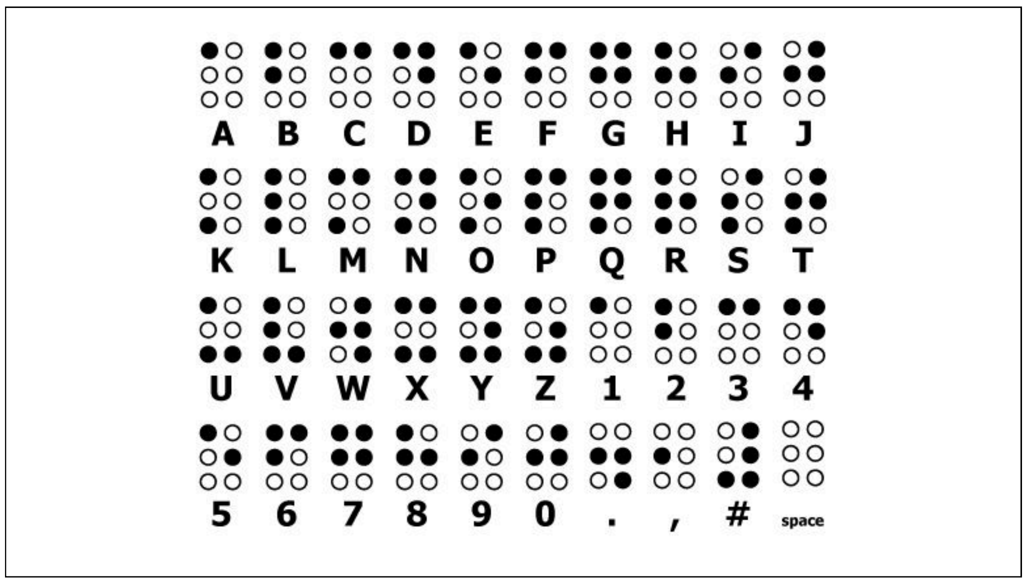
History & Development

Origins

- Invented by Louis Braille in 1824 (France)
- Based on 6-dot cell system
- Modified from military "night writing" system
- Standardized internationally in 1932

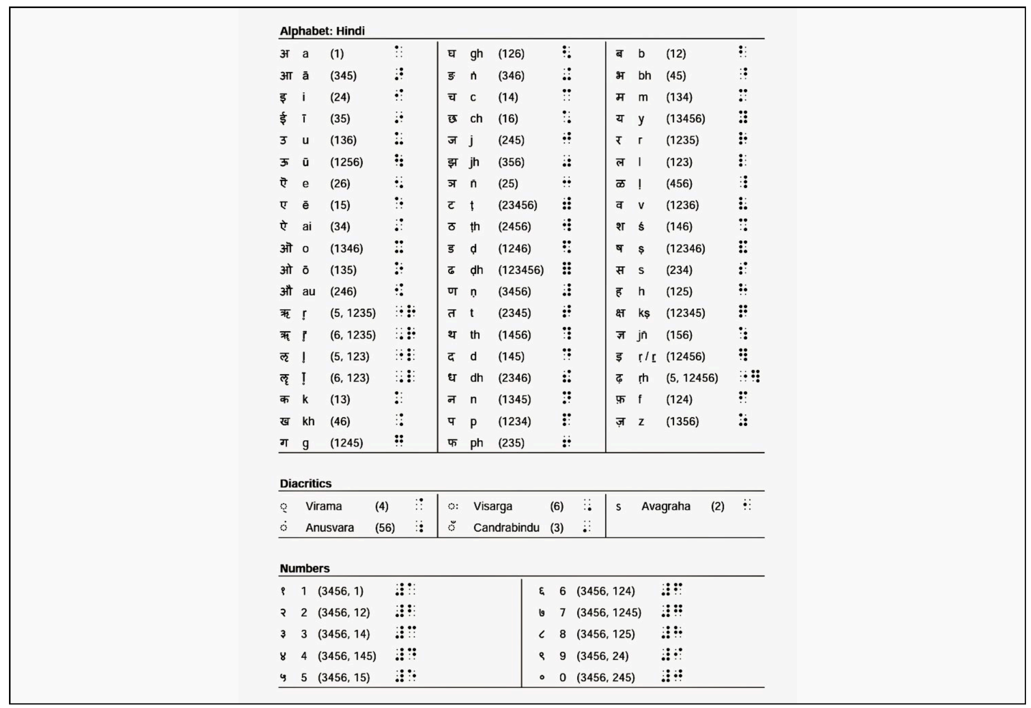
Braille Codes

- Grade 1: Letter-by-letter transcription (basic)
- Grade 2: Contracted braille with abbreviations (most common)
- Grade 3: Personal shorthand (highly abbreviated)
- Bharati Braille: Unified system for Indian languages



Braille script grade 1

Braille script grade 2



Bharati Braille

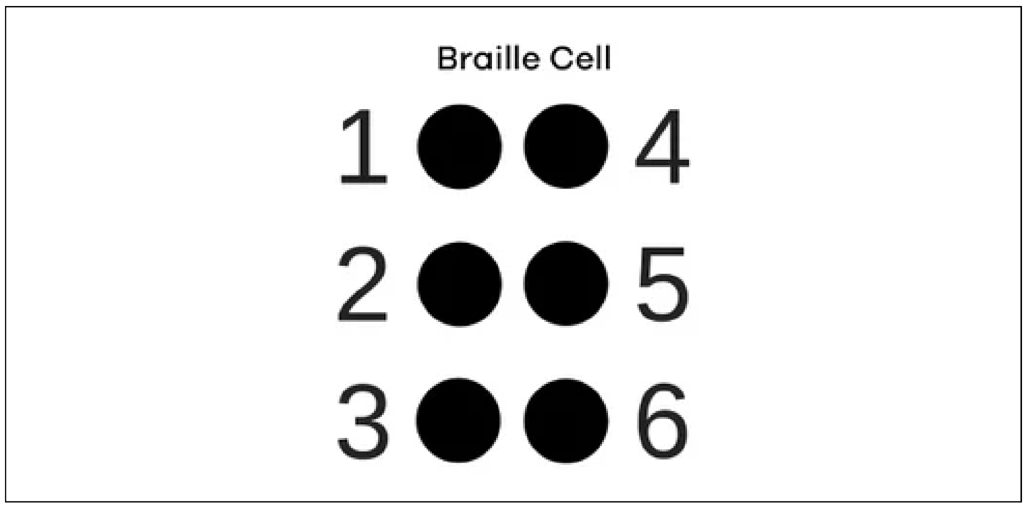
Braille Reading Mechanics

Physical Process

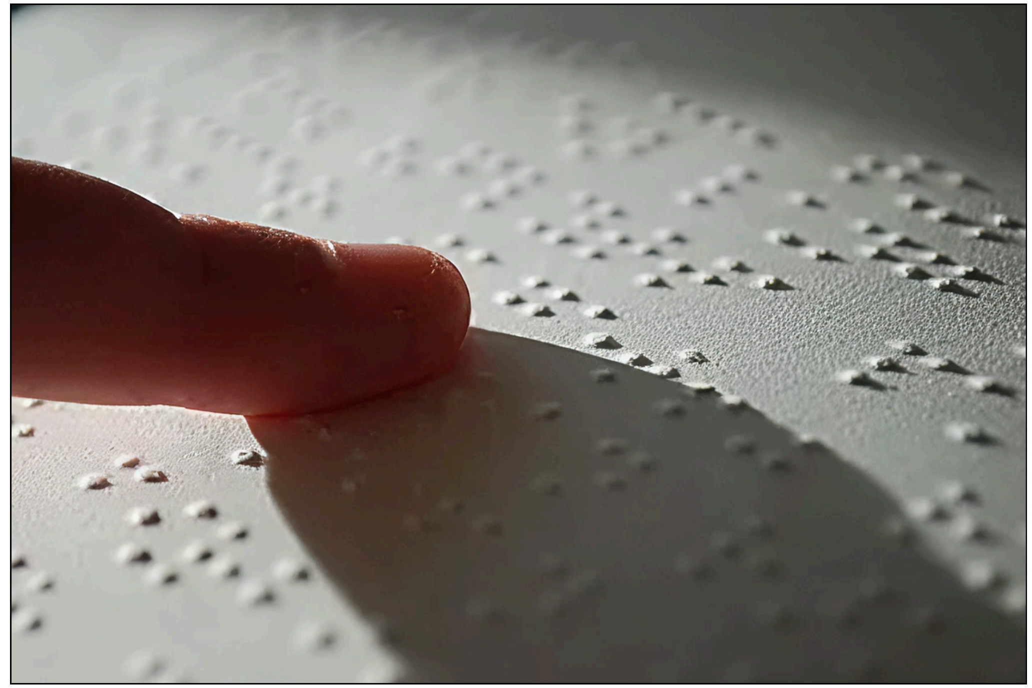
- Fingers scan raised dots from left to right
- Index fingers do most reading (most sensitive)
- Reading speed: 125 words/minute (average), 200+ (advanced)
- Two-handed reading is most efficient

Tactile Sensitivity

- Fingertip sensitivity: 0.02mm dot height minimum
- Optimal dot spacing: 2.3-2.5mm center-to-center
- Raised dots: 0.5-0.6mm height
- Reading requires fine motor skills and tactile discrimination



Braille alphabet letters. Alphabet for the blind. Tactile writing system used by people who are visually impaired.



Braille alphabet letters. Alphabet for the blind. Tactile writing system used by people who are visually impaired.

Learning Curve

- Basic literacy: 6-12 months with regular practice
- Fluency: 2-3 years
- Best learned in childhood (higher neuroplasticity)
- Adult learners face greater challenges

Braille Literacy Statistics

Usage Rates

- Only 10-15% of blind children in developed countries learn Braille
- Less than 5% in developing countries like India
- Declining due to audio technology preference
- Critical for deaf-blind population (no audio alternative)

Barriers to Adoption

- Limited availability of Braille materials
- Shortage of trained teachers
- High cost of Braille production
- Preference for audio alternatives (easier to learn)

Manufacturing Braille Appliances(MBA)

Government organizations developing accessible materials for the visually impaired.

- National Institute for the Empowerment of Persons with Visual Impairment (NIEPVD): This institute, under the Department of Empowerment of Persons with Disabilities (DEPwD), works for the education, training, and empowerment of visually impaired persons since 1943. It houses a Braille Development Unit and a Central Braille Press.
- Department of Empowerment of Persons with Disabilities (DEPwD): This department under the Ministry of Social Justice and Empowerment runs a scheme to provide financial assistance for the establishment, modernization, and capacity augmentation of Braille presses, which has supported 25 presses across India.
- Bharati Braille: The Government of India, through NIEPVD, has standardized "Bharati Braille" codes across different Indian languages to ensure uniformity. A manual on Bharati Braille is also in development.

Manufacturing Braille Appliances(MBA)

2. Identification and Research | 2.3 Secondary Research

2. Sign Language Systems

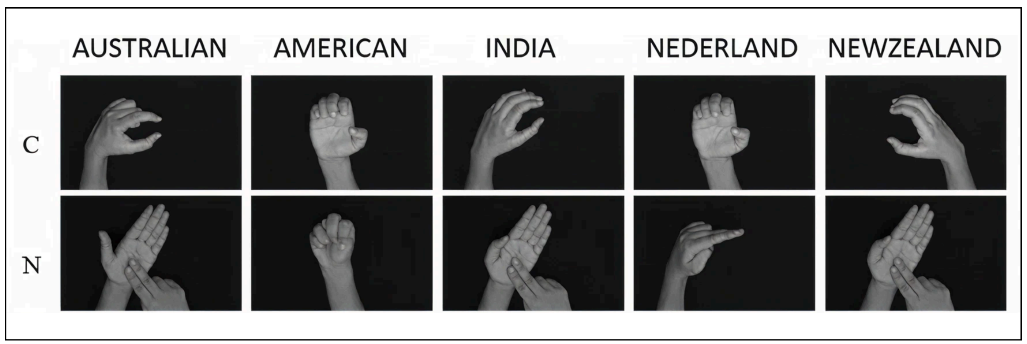
Overview of Sign Languages

Major Sign Languages

- American Sign Language (ASL) - USA, Canada
- British Sign Language (BSL) - UK
- Indian Sign Language (ISL) - India
- International Sign (IS) - International communication
- Note: Each country has distinct sign language, not universal

Structure

- Complete languages with grammar and syntax
- Rely on hand shapes, movements, facial expressions, body language
- Spatial grammar (location indicates meaning)
- Not direct translation of spoken language



For visual verification between sign languages of five different countries

Indian Sign Language (ISL)

Characteristics

- Recognized as official language in India (2023)
- Used by 5-7 million deaf Indians
- Regional variations exist
- Influenced by BSL (British colonial history)

Components

- Hand shapes (configurations)
- Hand movements (directions)
- Location (where sign is made)
- Orientation (palm direction)
- Non-manual markers (facial expressions, head movements)

For visual verification between sign languages of five different countries

3. Teaching Methodologies

Braille Instruction Methods

Traditional Approach
- Tactile exploration of Braille cell
- Letter-by-letter recognition
- Progressive complexity (words, sentences, paragraphs)
- Use of Braille slate and stylus

Modern Approaches
- Technology-integrated learning (apps, audio feedback)
- Whole-word recognition method
- Multi-sensory instruction (touch, audio, kinesthetic)
- Games and interactive activities

Best Practices
- Early intervention (age 3-5 optimal)
- Consistent daily practice (20-30 minutes minimum)
- Meaningful reading material (not just exercises)
- Integration with regular curriculum
- Parent involvement and home practice

For visual verification between sign languages of five different countries

India's first Braille Smart Class - Thinkerbell Labs

Thinkerbell Labs Revolutionizes Braille Literacy with Annie

Thinkerbell labs blogs

Student Education problem identification

- The Government school for the visually impaired in Ranchi has 24 students aged 6 to 18. With only 2 teachers, each student gets just 5 minutes of personal attention during their 60-minute lessons, which is insufficient for mastering Braille. The poor student-to-teacher ratio results in inadequate supervision, and the absence of engaging content fails to capture the students' interest. Consequently, they are taking longer to learn Braille.

Solution

- To tackle the challenges faced by teachers and students alike, India launched its inaugural Braille smart class in Ranchi. A total of 20 Annie devices were installed to assist 24 visually impaired students in learning braille.

Result

- The feedback from the 24 students has been incredibly positive, particularly from the younger ones who are excited about using the devices for learning. Teachers can now authenticate students and monitor their progress effectively. Annie has been warmly welcomed by the teachers, allowing them to oversee all 24 students simultaneously and meet their learning goals.

Understanding

While a solution exists to address the teacher-to-student ratio, gaps remain in the process that hinder individual students from voicing their personal doubts or feedback.

A physical product is a stationary device located in one place. To access information, the user must visit the device.

4. Information Perception

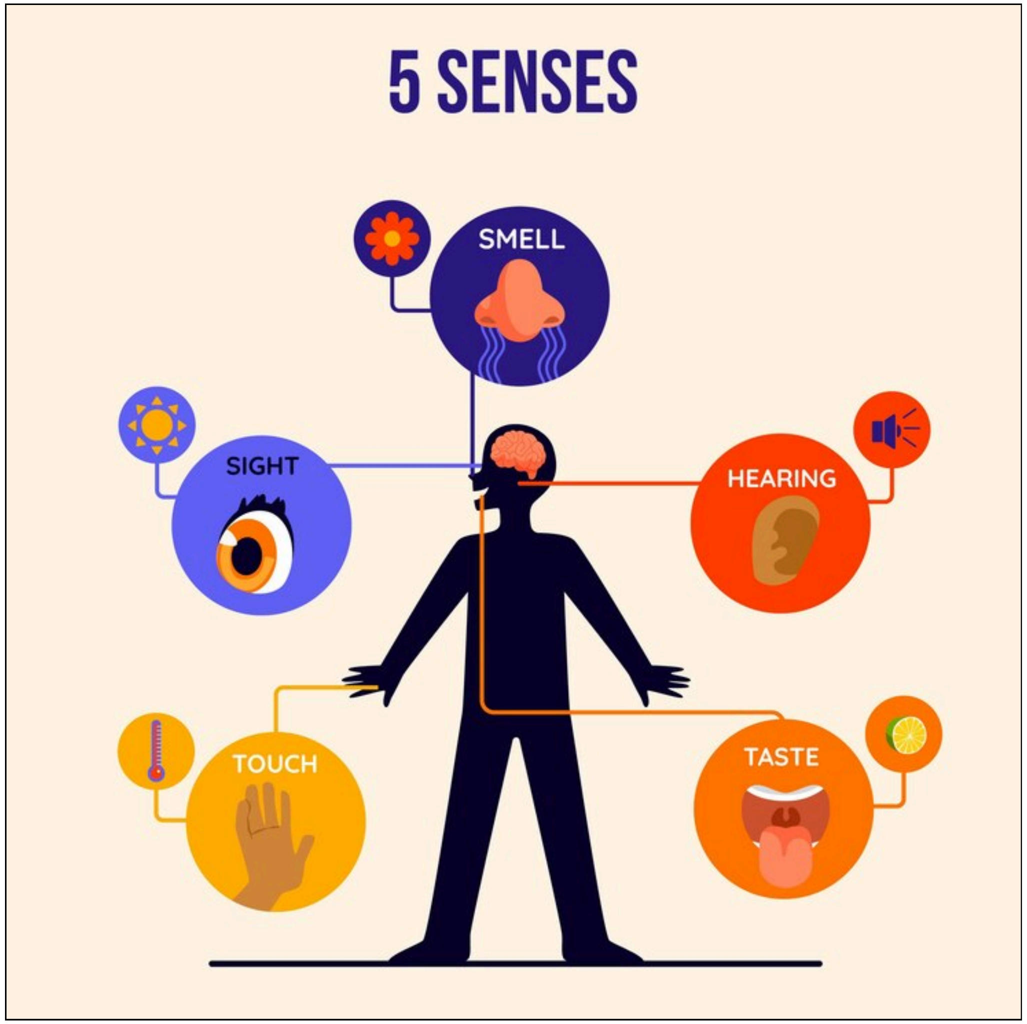
Sensory Compensation

Enhanced Senses
- Hearing becomes more acute (attention, not physiology)
- Touch sensitivity increases with practice
- Spatial awareness develops through sound and movement
- Olfactory cues become more significant

Perceptual Learning
- Brain reorganizes to process remaining senses more effectively
- Visual cortex repurposed for tactile and auditory processing
- Cross-modal plasticity strongest in congenitally blind
- Adventitiously blind (lost sight later) retain visual memory

Spatial Understanding

Mental Mapping
- Blind individuals create cognitive maps of environments
- Based on auditory landmarks, tactile cues, movement memory
- Route knowledge (sequence of turns) vs. survey knowledge (overall layout)
- Requires explicit teaching and practice



5 human senses

Information Processing Preferences

Auditory Information

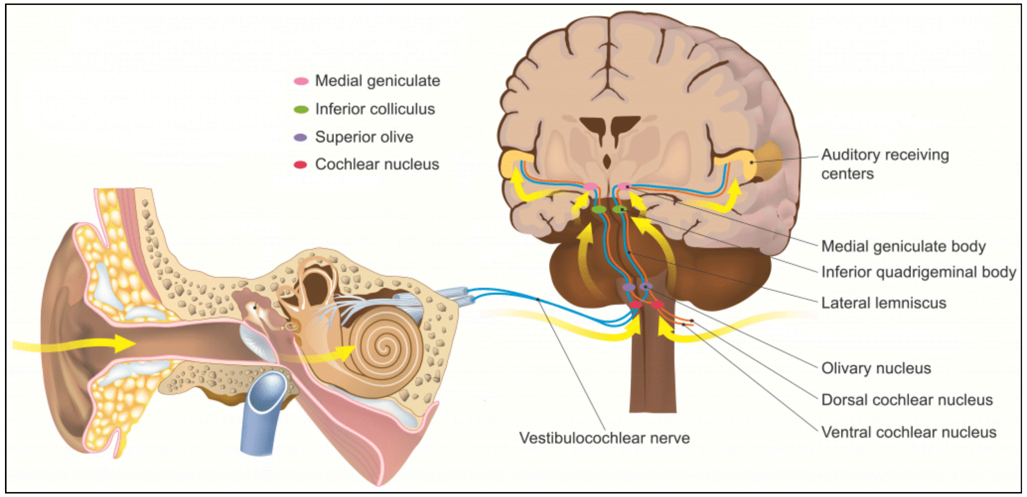
- Preferred by majority of blind individuals
- Faster to consume than Braille
- Allows multitasking
- Screen readers read at 300-400 words/minute (advanced users)

Tactile Information

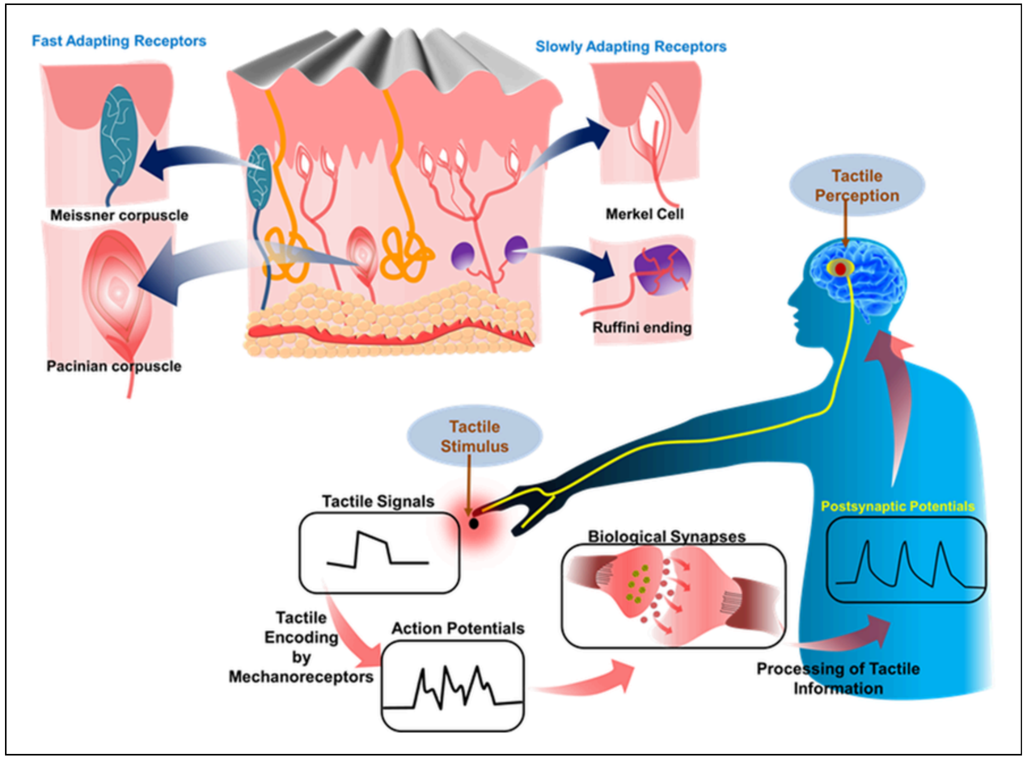
- Critical for literacy and education
- Provides spelling verification
- Necessary for deaf-blind individuals
- Enables private reading

Multimodal Approach

- Combination of audio and tactile most effective
- Audio for quick information
- Braille for detailed reading and learning
- Tactile graphics for spatial concepts



The Auditory Pathway



The Auditory Pathway

How visual deprivation affects auditory processing and multisensory integration

PART 1: AUDITORY PROCESSING IN BLIND PEOPLE

Criteria	Outcome	Superior Performance in	Impaired Performance:	Neural Mechanism:	Key Findings
1. Basic Auditory Perception	ENHANCED	✅ Pitch discrimination - Blind people perform better ✅ Absolute pitch - Higher prevalence in blind musicians ✅ Temporal resolution - Better at detecting gaps between sounds ✅ Duration discrimination - More accurate time interval		• Faster processing: Auditory N1 brain response occurs earlier (~100ms) • Higher excitability: Auditory cortex recovers faster between stimuli • Reorganization:	Blind people process basic auditory features (pitch, timing, duration) faster and more accurately due to auditory cortex reorganization.

PART 1: AUDITORY PROCESSING IN BLIND PEOPLE

Criteria	Experiment
1. Multisensory Illusion Study	Experiment: Touch + Sound Integration • Present 1 tactile stimulus with 2-4 tones • Sighted people: Tones create illusion of extra touches (even when told to ignore tones) • Blind people: Markedly reduced illusion - less influenced by tones Interpretation: • Blind people have more precise tactile perception alone • Lower likelihood of cross-modal integration because individual senses are stronger • Follows "inverse efficiency principle": Weak senses integrate more; strong senses stay independent
2. Cross-Modal Spatial Attention	Experiment: Attention Sharing Between Touch and Sound Sighted people: • Attending to sound at one location → automatically enhances touch at that location • Early brain response (100ms): Spatial attention automatically "links" across modalities • Cannot easily split attention to different locations for touch vs. sound

5. Cognitive Aspects

Memory Strategies

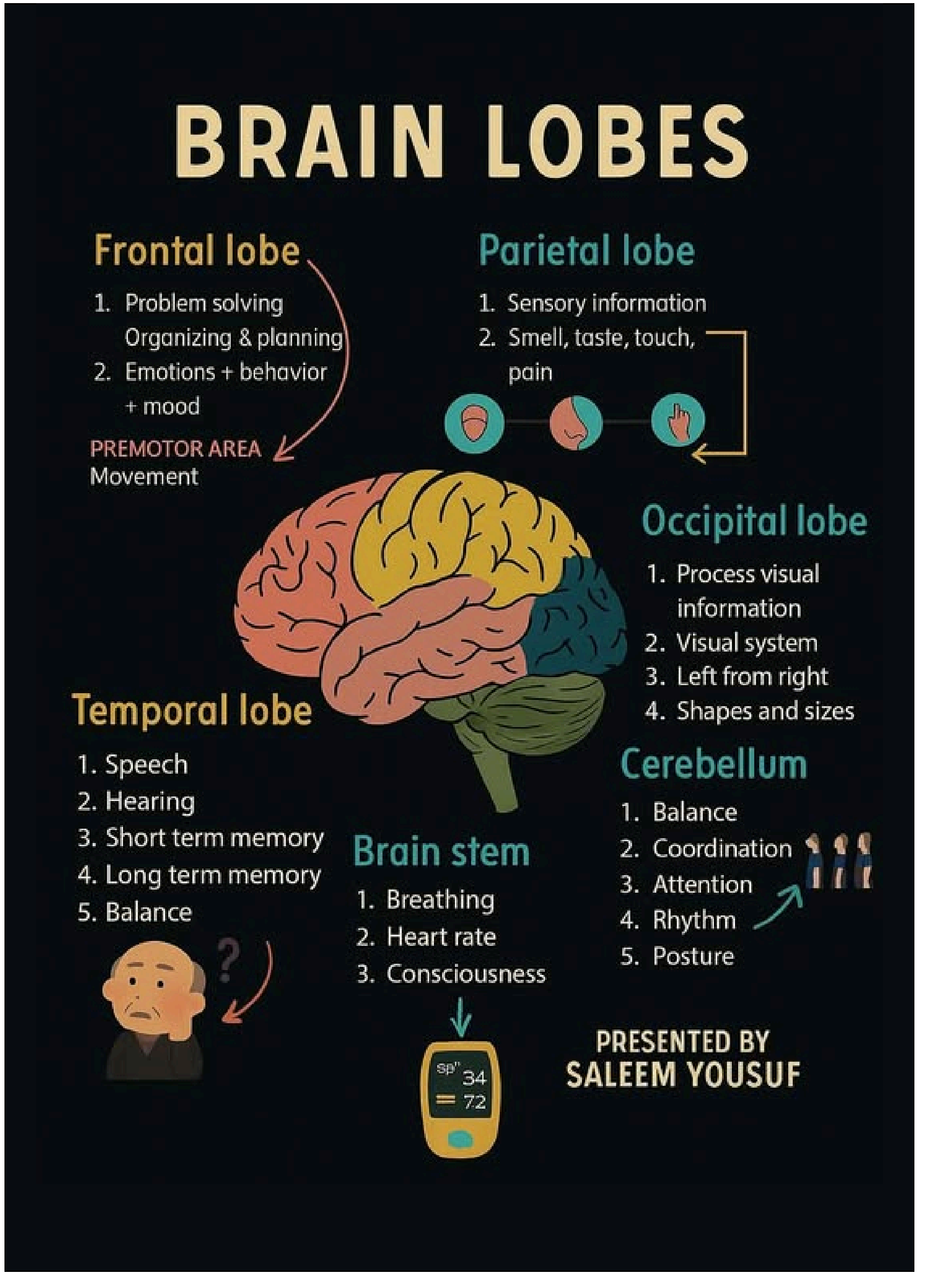
Compensatory Techniques
- Verbal labeling of locations and objects
- Routine establishment for consistency
- Organizational systems (labeled storage)
- Mnemonic devices and mental landmarks

Challenges with Dementia
- Spatial memory particularly vulnerable
- Difficulty forming new cognitive maps
- Familiar routes forgotten
- Compensatory strategies less effective

Attention & Focus

Cognitive Load
- Navigating while blind requires significant mental resources
- Listening to environment while processing speech is challenging
- Multitasking is more difficult without vision
- Fatigue sets in faster during navigation

For Dementia Patients
- Reduced attention span
- Difficulty filtering relevant from irrelevant information
- Easily distracted by sensory input
- Require simpler, clearer information delivery



Parts of the brain and their functions

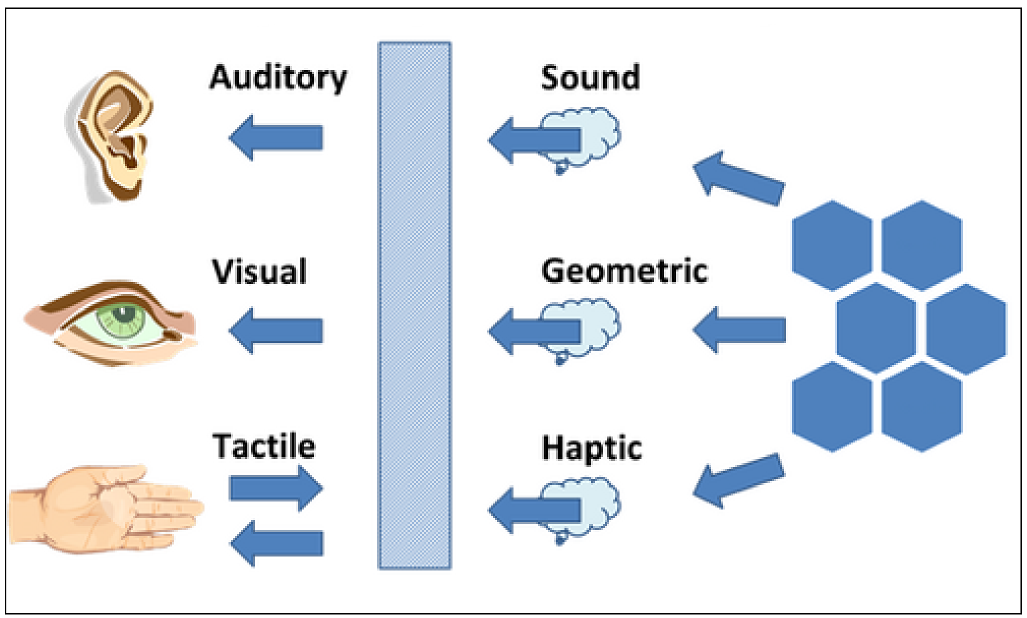
6. Cross-Disability Solution

Universal Design Principles

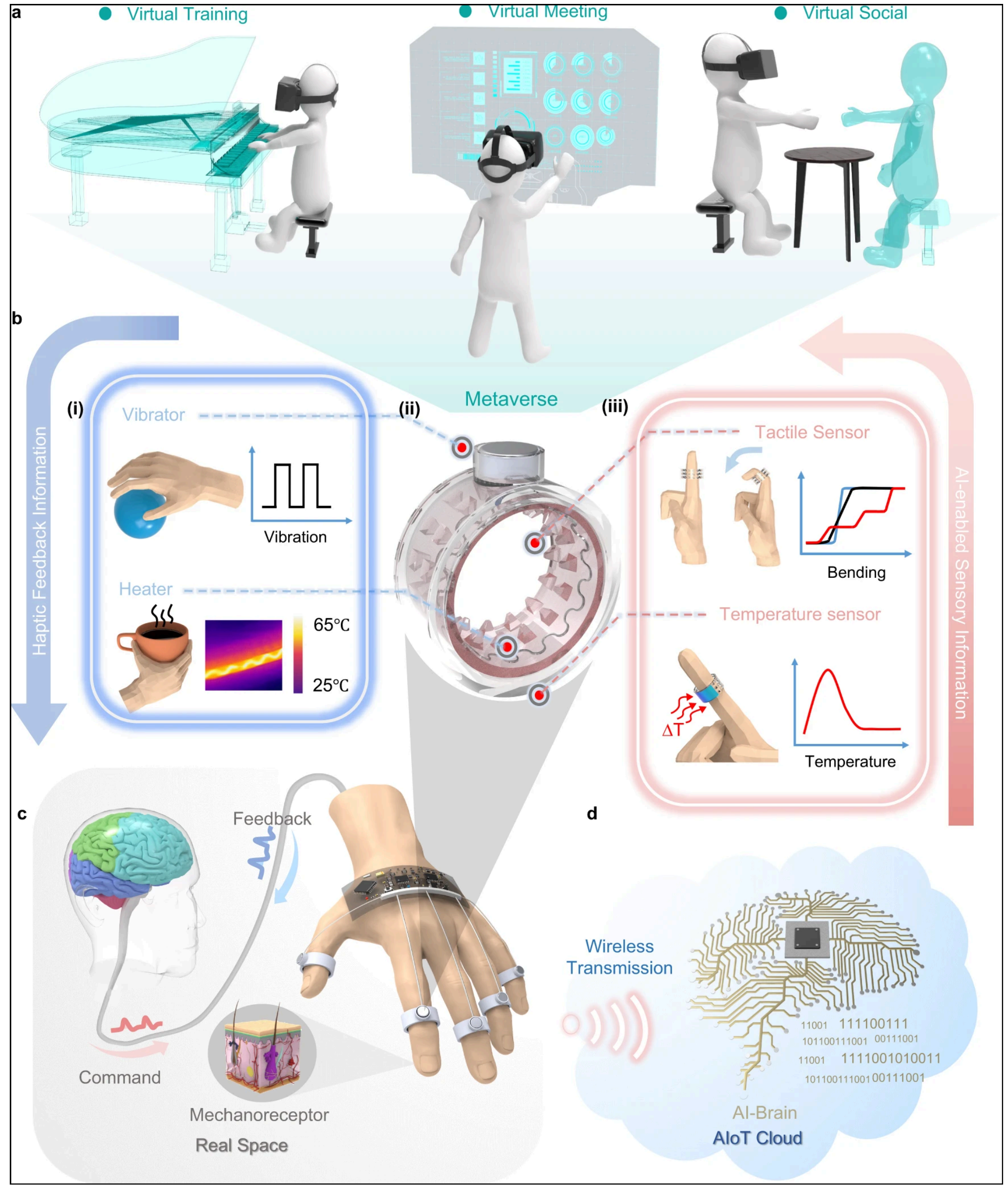
Multiple Means of Representation
- Present information in multiple formats (audio, tactile, visual)
- Offer choices in how to access content
- Provide redundant cueing

Multiple Means of Action & Expression
- Allow various input methods (voice, touch, gesture)
- Flexible timing and pacing
- Support different communication modes

Multiple Means of Engagement
- Personalization and customization
- Motivating and relevant content
- Minimize distractions and support focus



Parts of the brain and their functions



Parts of the brain and their functions

7. Aesthetic Wearable Tech for Dementia Care

Key Problem Identified

Despite growing interest in wearable technologies for dementia care, adoption rates remain very low. The study identifies that poor aesthetic design and insufficient consideration of user experience are major barriers to acceptance.

1. Aesthetic Experience (Sensory Appeal)

Preferred designs: Watch-like, jewelry-like, lightweight (<100g), small (50×50×20mm)

Material preferences: Soft, waterproof, hypoallergenic, varied colors, comfortable straps

Common complaints:

- Devices too tight, bulky, uncomfortable (e.g., Empatica E4)
- VR headsets cause heaviness and nausea
- Need personalization options

2. Experience of Meaning (Symbolic Value)

Preferred designs: Watch-like, jewelry-like, lightweight (<100g), small (50×50×20mm)

Material preferences: Soft, waterproof, hypoallergenic, varied colors, comfortable straps

Common complaints:

- Devices too tight, bulky, uncomfortable (e.g., Empatica E4)
- VR headsets cause heaviness and nausea
- Need personalization options

3. Emotional Experience (Personal Connection)

Negative emotions from current devices:

- Feelings of incapacity, frustration, anxiety
- Fear of stigma and surveillance
- Reduced confidence in social settings

Positive emotions from well-designed devices:

- Jewelry (rings): Increased grace, beauty, confidence, dignity
- Personalized items: Emotional attachment, empowerment
- VR experiences: Relaxation, happiness, self-expression
- Soft textiles: Comfort, affection, emotional connection

Critical Gap Identified

Most wearable devices prioritize function over design, resulting in:

Stigmatizing appearance (look like medical equipment)

Lack of personalization

No consideration for self-image and identity

Focus on monitoring rather than empowerment

2.4 Competitive Analysis

Meta Ray-Ban Smart Glasses (Gen 2)	Envision Glasses (Powered by Google Glass Enterprise Edition 2)	OrCam MyEye Pro	Solos AirGo Vision Smart Glasses	NuEyes Pro 4 LV (Low Vision Glasses)	SHG Smart Vision Glasses (Made in India)	Free Smartphone Apps (Be My Eyes, Seeing AI, Google Lookout)
Gen 1: ₹29,900 - ₹35,700	Not officially sold in India	OrCam MyEye Pro: ₹3,10,	AirGo Vision: ₹25,878 (₹26,	Not officially available in	Subsidized/ Free: Distributed	100% Free: No cost for download or use

Key features

Meta	Envis	OrCa	Solos	NuE	SHG	Free Smartphone Apps (Be

• Camera: 12MP ultra-wide camera (Gen 1), 3K Ultra HD video (Gen 2)	• Camera: 8MP with wide field of view
	• Text Recognition: Instant Text, Scan Text
		• Clip-On Design: Attaches magnetically to any eyeglasses frame
		• Camera: 13M
			• Camera: Front-facing camera for visual AI (Vision model only)
			• AI Inte
				• Magnification: 1x to 12x variable digital magnification
				• Display: High-resolut
					• Object Identification: Recognizes outdoor objects (roads, lamp posts, tre	• Be My Eyes:
						  • Volunteer Network: 8.3+ million volunteers, 750,000 blind users
						  • Live Video Assistance: Real-time help from sighted volunteers
						  • Be My AI: GPT-4 powered AI image description
						  • 185 Languages: Global language support
						  • Company Support: Direct access to company representatives
						  • 24/7 Availability: Round-the-clock volunteer access
						  • Partnership Integration: Works with Hilton, Tesco, Microsoft, Meta Ray-Ban

Strengths and Weaknesses

Meta	Envis	OrCa	Solos	NuE	SHG	Free Smartphone Apps (Be
• Stylish Design: Looks like regular Ray-Ban glasses, not overtly "tech" • Brand Recognition: Combination of Ray-Ban and Meta credibility • Mainstream	• Purpose-Built for Blind Users: Designed specifically for visual impairment • Comprehensive Feature Set: Most complete assistive technology	• Discrete Design: Small, lightweight clip-on doesn't require dedicated glasses • Works Offline: No internet required for core functions • Excell	• Highly Affordable: Lowest price among camera-equipped smart glasses • Privacy-Focused Design: Option for camera-free frames • Multi-	• Purpose-Built for Low Vision: Specifically designed for magnification needs • Excellent Magnification: Up to 12x zoom with high quality • Medical-Grade Devi	• Made in India: Local manufacturing and support • Affordable: Much lower cost than international alternatives • NGO Distribution: Free or subsidized for	• Zero Cost: Completely free, no subscription • High Accessibility: Anyone with smartphone can access • Regular Updates: Continuous improvements and new features • No Special Hardware: Uses existing smartphone camera • Proven Technology: Millions of active users • Multiple Options: Different apps for different needs • Community Support: Large volunteer networks (Be My Eyes) • AI Integration: Latest GPT-4, Gemini technology • Offline Capability: Some features work without internet (Lookout) • Inclusive Design: Built with blind community input • Indian Currency Support: Google Lookout recognizes INR • Local Language Support: Multiple Indian languages (varies by app) • No Learning Curve: Easy to use with screen readers

Strengths and Weaknesses






Meta	Envis	OrCa	Solos	NuE	SHG	Free Smartphone Apps (Be
Official: https://www.meta.com/in/ai-glasses/ Ray-Ban India: https://india.ray-	Official: https://www.letsenvision.com/ Purchase: https://shop.letsenvision.com/	Official: https://www.orcam.com India Purchase: Available via Amazon.in, IndiaMART, specia	Official: https://solosglasses.com/	Official: https://www.nueyes.com/	Vision-Aid partnership: https://visionaid.org/about-smart-vision-glasses/	Be My Eyes: https://www.bemyeyes.com/ Seeing AI: https://www.seeingai.com/ Google Lookout: Google Play Store

2.5 5 W's 1H

1. WHAT — What is the project?

Sanket Eye is a smart, modular assistive wearable that clips onto everyday accessories (such as glasses or pendants) to provide real-time navigation, environmental awareness, safety alerts, and cognitive support for visually impaired, aging, and cognitively challenged individuals.
It blends assistive intelligence into daily life without stigma or complexity.

2. WHO — Who is it for?

Primary Users:
- Blind individuals
- Low-vision users
- Elderly adults experiencing declining senses
- People with mild cognitive impairments or memory issues

Secondary Users:
- Caregivers
- Students, professionals, or travelers needing everyday assistance
- Anyone seeking safer, more efficient mobility and awareness

3. WHY — Why does this project exist?

Individuals with visual or cognitive challenges face:
- Unsafe and inaccessible environments
- Lack of real-time environmental awareness
- Expensive, stigmatizing assistive devices
- Social isolation, stress, and dependence on others
- Poor public infrastructure and inconsistent accessibility

We need an affordable, discreet wearable that enhances independence and well-being.

4. WHERE — Where will it be used?

- Indoors: homes, workplaces, malls, hospitals, schools, government buildings
- Outdoors: roads, crossings, transit systems, markets
- Semi-structured environments: campuses, parking areas, public spaces

Sanket Eye is designed for everyday environments where accessibility is unreliable.

5. WHEN — When is it needed?

During navigation (walking, commuting, unfamiliar places)
During daily tasks requiring awareness (finding doors, avoiding obstacles)
When infrastructure fails (lack of ramps, signage, tactile pathways)
When cognitive load or memory fatigue occurs
As people age and experience declining sensory abilities
Anytime a user wants hands-free guidance and safety

6. HOW — How does it work?

Sanket Eye works through:
- Clip-on wearable hardware with sensors and/or camera
- AI-based interpretation of surroundings
- Real-time haptic, audio, or visual feedback
- Smartphone integration for configuration and extended processing
- Modular ecosystem design, allowing other devices (ring, clip, etc.) to connect

The system enhances awareness, supports navigation, and provides preventive assistance.

2.6 Storyboarding

Arnav's Day

Aarav, a 26-year-old visually impaired individual, begins his day attempting to leave his apartment, already struggling with dim corridors and unexpected obstacles. As he navigates familiar spaces, he faces broken tactile paths and cluttered walkways that force him to move cautiously.
When he reaches a government building, the absence of ramps, poor signage, and dense crowds make him hesitant and disoriented. Inside, he must rely on hurried strangers for directions, leading to embarrassment and loss of independence. A near accident with a misplaced object further heightens his anxiety, and by the time he exits the building, he feels exhausted, stressed, and defeated.
This journey illustrates how inaccessible infrastructure, missing cues, and lack of real-time guidance create daily barriers for visually impaired users—barriers that Sanket Eye is designed to solve. By providing continuous environmental awareness, navigation support, safety alerts, and independence through a discreet wearable ecosystem, Sanket Eye addresses these exact moments of confusion, danger, and emotional strain, empowering users like Aarav to move confidently through their world.

Define and Validate

3. Define and Validate

3.1 Problem statement

1. Critical Affordability Gap in Assistive Technology

Reality: 99.98% of India's visually impaired population cannot afford existing smart assistive devices.

Market Gap: No comprehensive assistive wearable exists in the ₹6,000-₹20,000 range that addresses the specific needs of visually impaired individuals with cognitive impairment.

Device	Price in India	Adoption Rate
OrCam MyEye Pro	₹3,10,000 - ₹3,50,000	<2,000 users
Envision Glasses	₹1,32,000 - ₹2,73,000	<500 users
NuEyes Pro 4 LV	₹4,13,000 - ₹4,96,000	<50 users
Meta Ray-Ban	₹30,000 - ₹40,000	Not designed for assistive use

3. Fragmented Assistive Technology Ecosystem

Users must carry and manage multiple devices:

- White cane for ground-level obstacles
- GPS tracker for wandering prevention
- Medication reminder system
- Emergency alert button
- Smartphone with multiple apps for different tasks
- Separate devices for text reading, object identification, navigation

Problems with fragmentation:

- Cognitive burden: Remembering which device does what
- Physical burden: Carrying/wearing multiple devices
- Cost accumulation: Each device costs separately (total: ₹50,000-₹1,50,000+)
- Inconsistent interfaces: Different interaction methods for each device
- No integration: Devices don't communicate or work together
- Battery management: Multiple devices to charge daily

2. Inadequate Solutions for Dual Diagnosis (Vision Loss + Dementia/ Alzheimer's)

Mobility & Safety:

- Cannot see obstacles + forget routes = high fall risk (elderly falls cause 6.8M injuries/year in India)
- Wandering behavior + inability to navigate = safety emergencies
- Disorientation in familiar spaces = complete dependence on caregivers

Communication & Independence:

- Cannot read labels/signs + forget verbal instructions = medication errors
- Cannot recognize faces visually + forget who people are = social isolation
- Cannot use traditional aids (white cane) effectively + forget how to use complex devices = loss of autonomy

Cognitive Overload:

- Navigation requires intense mental effort when blind
- Dementia reduces cognitive capacity
- Combined effect: Current solutions demand cognitive resources that dual-diagnosis users don't have

4. Poor Infrastructure Compounds Technology Need

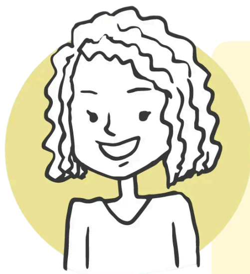
India's accessibility infrastructure gaps:

- 70% of cities lack continuous, accessible sidewalks
- Minimal tactile paving for blind navigation
- Few audio crossing signals at traffic lights
- Open manholes and unmarked construction sites
- Unpredictable obstacles: Street vendors, parked vehicles, flooding

Problem Statement

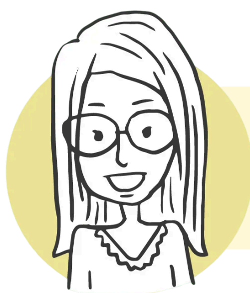
Individuals with combined visual impairment and dementia/Alzheimer's disease in India face a critical gap in accessible assistive technology. Existing solutions are either prohibitively expensive (₹1.3-5 lakhs), designed for single conditions only, stigmatizing in appearance, fragmented across multiple devices, or require cognitive abilities that dual-diagnosis users lack. With 99.98% of India's 62 million visually impaired unable to afford smart assistive devices, and a growing elderly population experiencing both vision loss and cognitive decline, there is an urgent need for an affordable (₹20,000-₹60,000), comprehensive, aesthetically acceptable, easy-to-use wearable ecosystem that provides proactive safety assistance, reduces caregiver burden, and respects user dignity while accounting for the unique sensory processing differences in blind individuals.

3.2 User Interviews and Persona Mapping



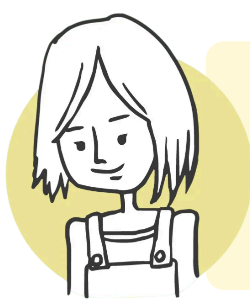
My son has autism, and my friend's son has Down syndrome. This device would be incredibly useful for them as a personal assistant. Additionally, it would be fantastic if the device could provide location hints or track their whereabouts.

The device must be budget-friendly, ideally priced under 10,000 rs, making it accessible for individuals from low-income backgrounds and those with permanent disabilities. Let's concentrate on the essential features for now.



She struggles to grasp concepts unless they are audio-enabled, and she finds it challenging to navigate open spaces without help from others.

The device must be budget-friendly, ideally priced under 10,000 rs, making it accessible for individuals from low-income backgrounds and those with permanent disabilities. Let's concentrate on the essential features for now.



I struggle with recognizing people and engaging in conversations. Moving around can be challenging for me. While I use smart glasses and various disability-related apps that help simplify my tasks, I still require physical support.

Designing for accessibility requires a focus on user needs rather than unfounded assumptions that could hinder usability. Users will actively seek solutions to navigate challenges.

3.3 Stake Holder Mapping

Power

HIGH POWER, HIGH INTEREST

- Family Caregivers
- Primary Users - Visually Impaired + Dementia Patients
- Government - DEPwD (Disability Dept)
- Major NGOs
- Ophthalmologists & Eye Hospitals
- Investors & VCs

LOW POWER, HIGH INTEREST

- Disability Rights Advocates
- Professional Caregivers
- Occupational Therapists
- Media & Tech Reviewers

HIGH POWER, LOW INTEREST

- Regulatory Bodies
- Component Suppliers
- Contract Manufacturers

LOW POWER, LOW INTEREST

- General Public
- Indirect Competitors

Interest

ADDITIONAL KEY STAKEHOLDERS

FINANCIAL SUPPORT

CSR Partners (High Power, Medium Interest)
- Who: TCS, Infosys, Apollo, Lenskart, insurance companies
- Power: ₹25K+ crore annual CSR spend in India (2% profit mandate)
- Need: Measurable impact, brand association
- Strategy: Co-branded programs, subsidized distribution, impact reporting

Grant Organizations (Medium Power, Medium Interest)
- Gates Foundation, USAID, Atal Innovation Mission, NIDHI Prayas
- Strategy: Apply for non-dilutive funding (₹50L-₹2 crore)

DISTRIBUTION CHANNELS

Senior Living Facilities (Medium Power, Medium Interest)
- Primus, Antara, Columbia Pacific
- Opportunity: B2B bulk sales, 10+ residents per facility
- Strategy: Facility-wide pilots, institutional pricing

Rehabilitation Centers (Medium Power, High Interest)
- NIVH, state institutes
- Opportunity: Training adoption, user skill-building
- Strategy: Educational pricing, training tool integration

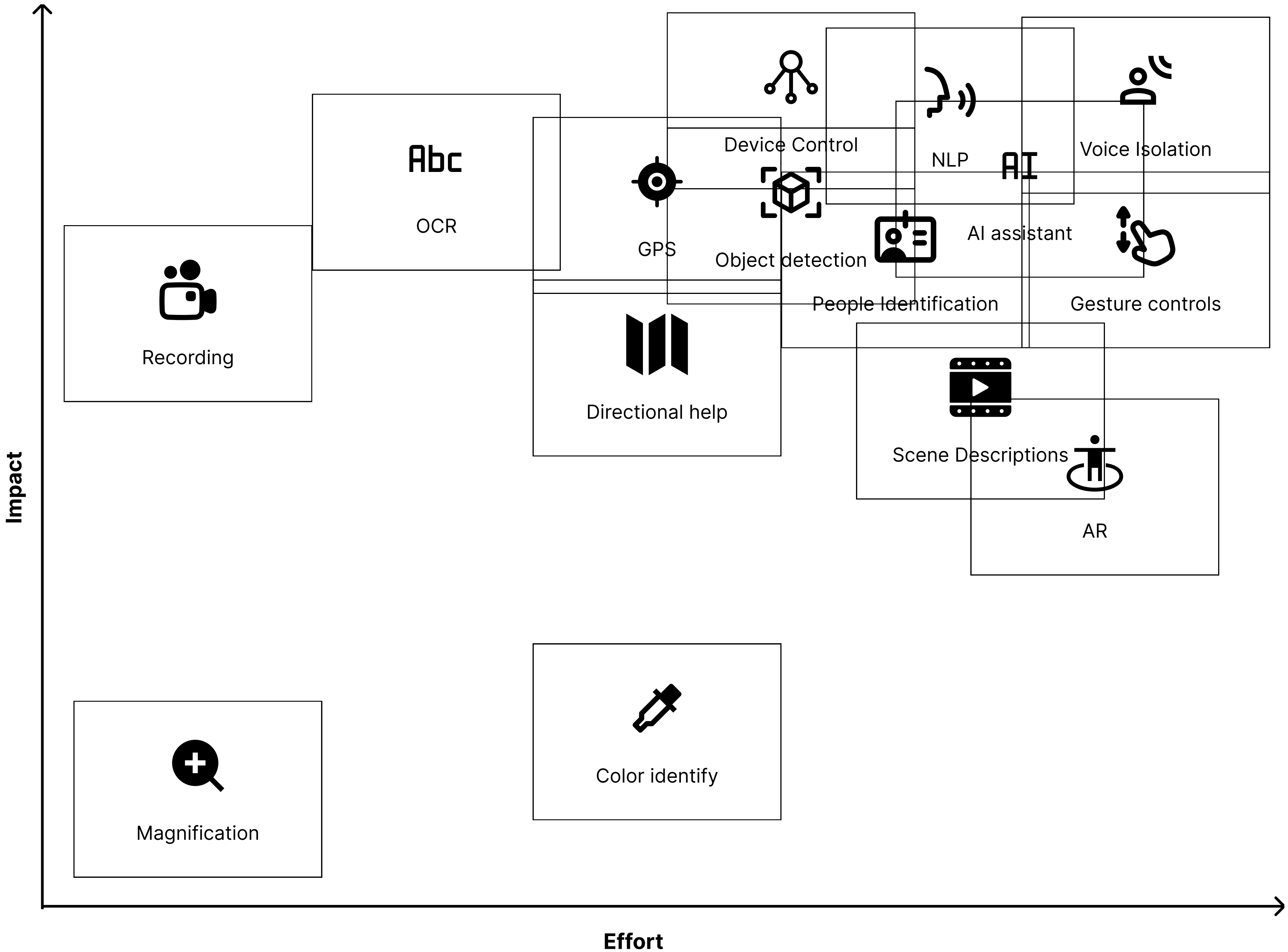
E-commerce & Retail (Medium Power, Low Interest)
- Amazon.in, Flipkart, optical stores
- Strategy: Multi-channel distribution, sales training

VALIDATORS

Academic Institutions (Low Power, Medium Interest)
- IITs, IISc, Stanford
- Value: Research validation, credibility
- Strategy: Collaborative studies, publications, conference presentations

Dementia Care Organizations (Medium Power, High Interest)
- ARDSI, Dementia India Alliance
- Value: Community reach, dual-diagnosis expertise
- Strategy: Co-develop dementia-specific features, advocacy partnership

3.4 Impact vs. Effort Mapping

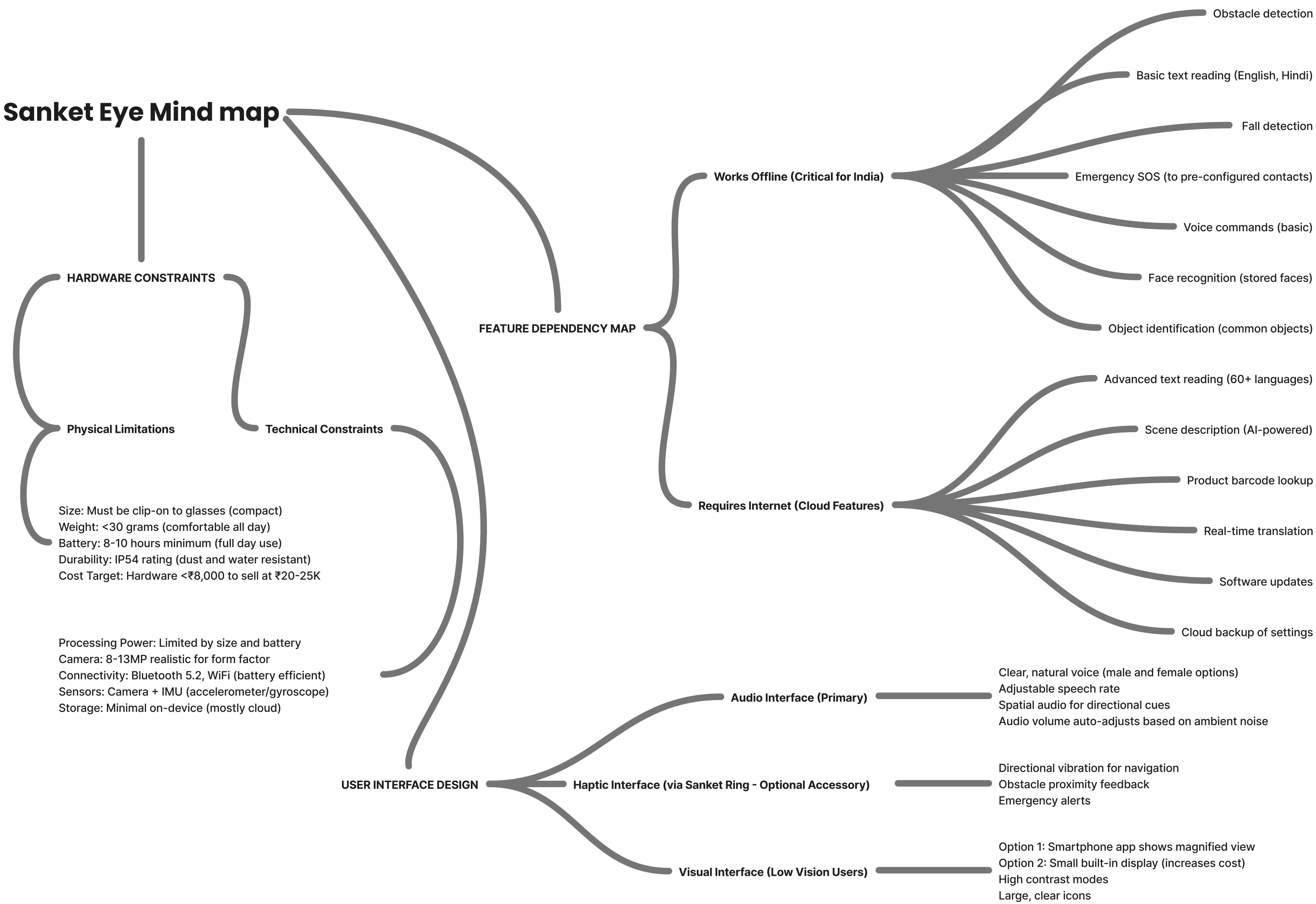


3.5 Mind Mapping

Sanket Eye Mind map

- USER NEEDS ANALYSIS
  - PRIMARY USER GROUPS
    - 1. Visually Impaired (Blind/Low Vision)
      - Core Needs:
        - Independent mobility and navigation
        - Text reading (signs, documents, labels)
        - Object and obstacle identification
        - Social interaction support (face recognition)
        - Currency and product identification
      - Pain Points:
        - Existing solutions too expensive (₹3-5L)
        - Need hands-free operation
        - Require offline functionality (not always have internet)
        - Need reliability for safety
    - 2. Dementia & Alzheimer's Patients
      - Core Needs:
        - Orientation and location awareness
        - Face recognition (family members)
        - Routine and medication reminders
        - Wandering prevention and safety
        - Reduced cognitive load (simple interface)
      - Pain Points:
        - Forget how to use complex devices
        - Get confused in familiar places
        - Difficulty recognizing loved ones
        - Need caregiver monitoring
        - Require proactive assistance
  - 3. Elderly Users (General Safety)
    - Core Needs:
      - Fall prevention and detection
      - Emergency assistance
      - Navigation in unfamiliar places
      - Reading assistance (small text)
      - Independence at home
    - Pain Points:
      - Fear of falling (limits activity)
      - Family worries about safety
      - Difficulty with technology
      - Pride/stigma about "disability devices"
  - 4. General Users (Preventive Safety)
    - Core Needs:
      - Enhanced situational awareness
      - Hands-free information access
      - Navigation assistance
      - Safety in urban environments
    - Pain Points:
      - Distraction from smartphones
      - Want discrete assistance
      - Don't want "medical looking" device

3. Define and Validate | 3.5 Mind Mapping



Sanket Eye Mind map

FEATURE PRIORITIZATION FRAMEWORK

TIER 1: CRITICAL - Must Have for Launch
Without these features, device has no value

OBSTACLE DETECTION & COLLISION AVOIDANCE

Why Critical:
- Primary safety feature for blind users
- Prevents injuries and accidents
- Core value proposition
- Must work offline (no internet dependency)

Implementation:
- Real-time object detection (YOLO algorithm)
- Distance measurement (up to 10 meters)
- Audio alerts: "Obstacle 2 meters ahead, center"
- Adjustable sensitivity based on walking speed
- Works on-device (edge AI processing)

Technical Specs:
- Detection range: 0.5m - 10m
- Update rate: 10 fps minimum
- Accuracy target: 95%+ in good lighting, 85%+ in low light
- Latency: <200ms from detection to alert

TEXT-TO-SPEECH (OCR)

Why Critical:
- Essential for independence (read signs, labels, documents)
- High user demand (most requested feature)
- Competitive necessity (all competitors have this)

Implementation:
- Instant Text: Automatic detection and reading
- Scan Text: Full document reading
- Smart Reading: Extract specific info ("find price", "find date")
- Offline basic text (English, Hindi)
- Cloud-enhanced for complex text and 60+ languages

Technical Specs:
- Text detection: <1 second
- Languages: 6+ Indian languages + English (offline), 60+ (online)
- Accuracy: 95%+ for printed text, 80%+ handwritten

BASIC NAVIGATION ASSISTANCE

Why Critical:
- Enables independent movement
- Differentiates from smartphone apps (hands-free)
- Essential for dementia patients (orientation)

Implementation:
- GPS-based turn-by-turn directions
- Audio guidance: "Turn left in 50 meters"
- Indoor navigation (with optional beacons)
- Landmark identification
- "Where am I?" location announcement

Technical Specs:
- GPS accuracy: 3-5 meters
- Offline maps: Major cities pre-downloaded
- Voice guidance in 6+ languages

VOICE COMMANDS & CONTROL

Why Critical:
- Hands-free operation (blind users can't use touch screen)
- Essential for elderly/dementia (simple interaction)
- Reduces cognitive load

Implementation:
- "Hey Sanket" wake word
- Natural language commands (not rigid phrases)
- Multi-language support (English, Hindi, Tamil, Telugu, Bengali, Marathi, Gujarati)
- Offline command recognition for basic functions
- Cloud-enhanced for complex queries

Common Commands:
- "What's in front of me?"
- "Read this"
- "Where am I?"
- "Find [object]"
- "Call [contact]"
- "Emergency"

EMERGENCY SOS & FALL DETECTION

Why Critical:
- Life-saving feature
- Family peace of mind (increases adoption)
- Differentiator vs. competitors

Implementation:
- Fall Detection: IMU sensors detect sudden fall
- Emergency Activation: Voice command "Emergency" or manual trigger
- Auto-Response: Sends location + alert to emergency contacts
- Photo Capture: Takes photo of surroundings on fall/emergency
- Auto-Call: Initiates call to primary emergency contact

Technical Specs:
- Fall detection accuracy: 90%+ (minimize false positives)
- Emergency response time: <5 seconds
- Works offline (pre-configured contacts)

Sanket Eye Mind map

FEATURE PRIORITIZATION FRAMEWORK

TIER 2: IMPORTANT - High Value, Include if Possible
Significantly enhance product; strong user demand

FACE RECOGNITION

Why Important:
- Critical for dementia patients (recognize family)
- Social confidence for blind users
- Emotional connection (seeing loved ones)

Implementation:
- User trains device with photos of family/friends
- Device announces: "Your daughter Sarah is approaching"
- Stores up to 100 faces locally
- Privacy controls: Off by default, explicit consent required

Considerations:
- Privacy concerns: Clear opt-in, local processing
- Accuracy needed: 95%+ (false positives cause confusion)

SCENE DESCRIPTION (AI-POWERED)

Why Important:
- Provides environmental awareness
- Competitor feature (Envision, Meta Ray-Ban have this)
- Enables independence in new places

Implementation:
- AI describes surroundings on request
- "You're in a kitchen. There's a refrigerator on your left, a stove ahead, and a dining table to your right."
- Multi-AI support (GPT-4, Gemini, Claude)
- Cloud-based (requires internet)

Usage:
- On-demand: "Describe what's around me"
- Proactive: Announces significant changes
- Context-aware: Adjusts detail level

OBJECT & PRODUCT IDENTIFICATION

Why Important:
- Daily living independence
- Shopping assistance
- Medication identification (safety)

Implementation:
- General Objects: "This is a cup", "This is a phone"
- Barcode Scanning: Identifies packaged products
- Color Detection: "This shirt is blue"
- Currency Recognition: Indian rupees (notes and coins)
  - Bonus: Authenticity check (fake note detection)

Technical Approach:
- Object detection: On-device (common objects)
- Barcode: Cloud API (product database)
- Currency: On-device + cloud verification

LIGHT & HAZARD DETECTION

Technical Approach:
- Camera-based detection
- Thermal sensor (optional, for heat detection)

Implementation:
- Light level detection: "Room is dark, consider turning on light"
- Specific hazards:
  - Water on floor (slip hazard)
  - Staircase detection (up/down)
  - Open doors/windows
  - Hot surfaces (stove, heater)

Why Important:
- Safety for blind users
- Elderly fall prevention
- Simple to implement

MAGNIFICATION MODE (Low Vision)

Consideration:
- Requires display OR sends to smartphone app
- If clip-on device → App shows magnified view
- Trade-off: Battery usage

Implementation:
- Digital zoom: 2x, 4x, 6x, 8x
- High contrast modes: Black/white, inverted, color filters
- Mode switching: "Reading mode" (magnify) vs. "Walking mode" (navigate)
- Picture-in-picture: Magnified text with obstacle alerts

Why Important:
- 62M visually impaired in India (not all blind)
- Low vision users are large market segment
- Competitor feature (NuEyes specializes in this)

3.6 SWOT Analysis

STRENGHTS

1. Universal & Inclusive Design Philosophy
Competitive Advantage: Unlike OrCam MyEye Pro (₹3.1-3.5L) and Envision Glasses (₹1.3-2.7L) which look like obvious medical devices, Sanket Eye's

Stigma Elimination: Works for disabled AND non-disabled users, similar to Meta Ray-Ban's approach but with assistive feature:
Mainstream Aesthetics: Avoids the "medical device" look that

Market Positioning: This positions Sanket Eye between Meta Ray-Ban (fashion-first, ₹30-40K) and purpose-built assistive devices (functionality-first, ₹1.3-5L), creating a unique

Feature	Sanket Eye	Meta Ray-Ban	Envision	OrCam	Free Apps
Obstacle Detection	Yes	No	Limited	No	No
Navigation Aid	Yes	Basic	Beta	No	Requires separate app
Hazard Alerts	Yes	No	Limited	No	No
Emergency SOS	Yes	No	No	No	Depends on phone
Always-On Monitoring	Yes	No	Yes	Yes	No (must open app)
Hands-Free Operation	Yes	Yes	Yes	Yes	No

2. Modular Ecosystem Architecture
Competitive Differentiation: No current competitor offers a truly modular, multi-device ecosystem for assistive technology. This is Sanke

Ecosystem Components:
- Sanket Eye: Primary wearable clip-on for glasses
- Sanket Ring: Haptic feedback and gesture control
- Sanket App: Central

Strategic Benefits:
- Scalable Revenue: Multiple products unde brand (vs. single-product competitors)
- User Customization: Users buy only what need (unlike all-in-one expensive devices
- Upgrade Path: Users can start with basic module and add features over time
- Market Segmentation: Different modules

Comparison to Competitors:
- OrCam MyEye: Single device, one purchase, ₹3.1L+ upfront
- Envision: Three editions but no mix-and-match modularity

Core Capabilities:
- Real-time Environmental Awareness: Continuous monitoring vs. on-demand (OrCam, smartphone apps)
- Obstacle Detection: Critical for mobility, missing from Meta Ray-Ban
- Navigation Assistance: Built-in vs. requiring separate app
- Hazard Alerts: Proactive warnings (stairs, vehicles, obstacles)
- Fall Detection: Preventive health feature missing from competitors
- Emergency Response: Direct SOS capability

Market Opportunity:
- 8 million blind people i India
- 62 million with visual impairment
- Only estimated 1,000-2,000 using premium devices

Accessibility Beyond Disability:
- Elderly Population: 104 million people age 60+ in India (2022), projected 319 million 2050
- Safety-Conscious Urban Professionals: Ta market of 50M+ in metro cities
- Parents of Young Children: 26 million birtl year in India

Sanket Eye Clip-On:
- Attaches to existing prescription glasses (60% of Indians need vision correction)
- No need to buy specia frames
- Works with sunglasses

Sanket Ring:
- Discrete haptic feedback
- No visible device at all
- Works independently or with Sanket Eye
- Gesture control for navigation and

Mental Health Benefits:
- Reduced Anxiety: Constant environmenta awareness reduces stress for visually imp users
- Increased Confidence: Safe navigation bu independence
- Social Inclusion: Mainstream design encourages social participation
- Reduced Cognitive Load: Device handles spatial awareness, freeing mental resourc

Physical Health Benefits:
- Fall Prevention: Critical for elderly (6.8 mil fall-related injuries in India annually)
- Mobility Maintenance: Encourages independent walking and exercise
- Injury Prevention: Obstacle detection prev collisions and accidents
- Faster Emergency Response: SOS feature reduce response time

Aging Population Focus:
- India's 65+ population: 91 million (2021) → 230 million (2050)
- Age-related vision impairment affects 76% of people 80+
- Falls are leading cause of injury-related death in elderly
- Sanket Eye positions as "aging independence technology" not just "disability device"

3. Define and Validate | 3.6 SWOT Analysis

WEAKNESS

Battery Life Challenges:
Wearable Size Constraint:
- Small form factor = limited battery capaci
- Competitor Comparison:
  - Meta Ray-Ban Gen 2: 8 hours continuc use, 48 hours with charging case
  - OrCam MyEye Pro: ~4-8 hours depenc on usage

Sanket Eye Challenge:
- Clip-on design limits battery size vs. full glasses frame
- Always-on monitoring consumes more powe than on-demand systems

Processing Power Limitations:
Edge Computing Constraints:
- Limited CPU/GPU in small form factor
- Complex AI models require cloud

Field of View:
- Limited camera FOV vs. human peripheral vision
- May miss obstacles at edges
- Requires head-mounted position vs.

;amera & Sensor :hallenges:
ow Light Performance:
- Small wearable = smaller camera senso
- Reduced performance in evening, indoor, shadowy environment

Crowded Environment Detection:
- Complex scenes difficult to process in real-time
- Distinguishing between relevant and irrelevant obstacles

Weather Resistance:
- Rain, fog, dust affect camera clarity
- Must be IP54 minimum (like Solos AirGo) for India
- Monsoon season creates 4-month

Hardware Development Expenses:
Prototyping Costs:
- Industrial Design: ₹10-20 lakhs for multipl iterations
- Electronics Design: ₹15-30 lakhs (PCB, sensors, integration)
- Camera Module: ₹5-10 lakhs (custom lens housing)

AI & Software Development:
Core Technology Stack:
- Computer Vision Models: ₹20-40 lakhs (training, optimization)
- Object Detection: ₹15-25 lakhs (custom dataset, India-specific objects)
- Navigation Algorithms: ₹10-20 lakhs (patl planning, spatial mapping)

User Testing & Validation:
Clinical & Field Testing:
- Blind/Low Vision Testing: ₹10-20 lakhs (recruiting, compensation, analysis)
- Safety Validation: ₹15-25 lakhs (must pro device doesn't cause accidents)
- Elderly User Testing: ₹5-10 lakhs
- General Public Testing: ₹5-10 lakhs

Multiple SKUs:
- Sanket Eye: Different colors, attachment types
- Sanket Ring: Multiple sizes, materials

Regulatory & Compliance:
- Medical Device Certification: ₹10-20 lakhs (if classified as assistive medical device)
- BIS Certification: ₹2-5 lakhs (mandatory for

Bluetooth & App Requirements:
Functionality Split:
Device-Only (No Phone):
- Basic obstacle detection
- Haptic/audio alerts
- Simple navigation cues
- Emergency detection (falls, hazards)

Requires Smartphone:
- Advanced AI processing (scene descripti complex text reading)
- Navigation with maps

Market Limitation:
- Smartphone Penetration in India: 54% (20 46% of population lacks smartphone
- Target Users Without Smartphones:
  - Elderly (lowest smartphone adoption): 30-40% in 60+ age group
  - Rural population: Lower penetration in villages
  - Low-income blind i afford ₹15K phone

Learning Required:
- Understanding voice commands and thei variations
- Interpreting audio/haptic feedback correc
- Calibrating expectations (what device ca cannot do)
- Trusting device for safety-critical decisio
- Troubleshooting common issues

Software Compatibility:
- Firmware updates across all devices simultaneously
- Testing inter-device communication
- Backward compatibility as new modules launch
- ...pan

Supply Chain Complexity:
- Multiple component suppliers
- Quality control across different products
- Assembly and testing procedures for each
- Packaging and distribution logistics

Public Perception Issues:
- Recording Anxiety: People uncomfortable being recorded withou consent
- Similar to initial Google Glass backlash (2013-2014)
- "Glasshole" phenomenon - social stigma
- Restaurants, theaters,

Privacy Regulations:
- DPDP Act (India): Digital Personal Data Protection Act 2023
- GDPR (Europe): If considering export
- Consent Requirements: Recording others in public spaces
- Data Storage: Where is video/photo data stored, for how long?
- Third-Party Access: Who can access recorded data?

Customer Support Complexity:
- oubleshooting issue ross multiple nnected devices
- entifying which odule is causing oblem
- anaging returns and irranties for osystem
- odating user owledge as they add odules

False Sense of Security:
- Device limitations may not be fully understoo by users
- Over-confidence coul lead to dangerous situations
- Device failure in critica moment could cause accidents

Cultural Sensitivity:
- Western-designed AI may not understand Indian contexts
- Object recognition trained on Western datasets
- Navigation assumptions based on developed world infrastructure

OPPORTUNITIES

Market Size & Growth:
- 2024 Market Size: $4.2 - $6.34 billion (assistive tech for visually impaired)
- 2030 Projection: $10.68 - $11.20 billion
- 2035 Projection: $13.2 - $16.3 billion
- CAGR: 10.2% - 16.3% depending on segm
- Smart Glasses Segment: Growing fastest within market (AI-driven)

Asia-Pacific Leadership:
- Fastest Growing Region: 17.67% CAGR
- India Contribution: Largest visually impair population globally
- Digital Adoption: 900M+ internet users, 5 smartphone penetration growing rapidly
- Middle Class Growth: 400M+ middle clas 2030, increasing purchasing power

Demographic Drivers:
Visual Impairment Statistics:
- Global: 2.2 billion people with vision impairment
- India:
  - 8 million blind individuals
  - 62 million visually impaired
  - 78% of visual impairment preventable treatable (but often not treated)
  - Population Impact:

The Affordability Gap Analysis:
Willingness vs. Ability to Pay:
- Indian Middle Class Income: ₹25,000 - ₹75,000/month
- Affordable Technology

ee:
Products: Be My Eyes, Seeing AI, Google Lookout
Strength: High adoption (millions of users)
Limitation: Requires

Massive Market Opportunity:
- Only 1,000-2,000 Indians using premium assistive devices (OrCam, Envision)
- 99.98% of visually impaired Indians lack access to smart assistive tech
- If 1% of India's 62M visually impaired adop 620,000 users
- At ₹30,000 average → ₹1,860 crore marke opportunity
- Adding elderly safety market → 10M pote users → ₹30,000 crore opportunity

Inaccessible Built Environment:
- Sidewalks: 70% of Indian cities lack continuous, accessible sidewalks
- Tactile Paving: Minimal tactile paving for b navigation in public spaces
- Audio Signals: Few traffic lights have audi crossing signals
- Public Transport: Limited accessibility fea in metros, buses
- Building Access: Inconsistent ramps, elev and signage

DEPwD (Department of Empowerment of Persons with Disabilities):
- Research Grants: Funding for assistive technology development
- Opportunity: ₹50 lakh - ₹2 crore grants for R&D
- STRIDE Scheme: Science and Technology Research Initiative
- NEAT Initiative: National Educational Alliance for Technology

Comparative Market Context:
- Developed Countries: Better infrastructure ...duces need for constant assistance tech
- ...veloping Countries: Poor infrastructure ...akes assistive tech MORE valuable
- ...dia Advantage for Sanket Eye: Higher value ...oposition due to infrastructure gaps

...ssible India Campaign:
- ...vernment Initiative: Making India accessible ... 2024 (now 2025)
- Budget: ₹100 crores+ annual allocation
- Partnership Opportunity: Pilot programs with government institutions
- Credibility: Government endorsement aids market acceptance

- Envision Professional (₹2.7L), NuEyes (₹4.1-5L)
- Market Size: 1,000-2,000 users in India (0.002% penetration)
- Limitation: Completely

- Market Size: Additiona 1,000-3,000 potential users
- Limitation: Still beyonc reach of middle-class India

AirGo (₹26K)
- Limitation: Not purpose-built for blindness, limited assistive features
- Opportunity: Price point accessible but functionality gap

Market
- If 5% of India's visually impaired adopt at ₹35 average → 3.1M users → ₹10,850 crore market
- Expanding to elderly safety → 10M users →

Investment:
- Accessible India Campaign (Sugamya Bharat Abhiyan) progress is slow
- Full infrastructure accessibility decades

Navigation Complexity:
- Unstructured Roads: Many areas lack clea pedestrian pathways
- Mixed Traffic: Pedestrians, bikes, vehicles sharing space
- Inconsistent Signage: Poor or missing directional signage
- Rapidly Changing Environment: Construct pop-up vendors, parked vehicles

Compensating for Infrastructure Gaps:
Technology can provide assistance that phys infrastructure lacks:
- Real-time Obstacle Detection: Identifies hazards infrastructure doesn't mark
- Dynamic Hazard Alerts: Warns about temporary obstacles (vehicles, constructi
- Navigation Assistance: Provides guidance where signage and tactile paving absent
- Elevation Detection: Identifies steps, curb holes where markings missing

Affordable (₹15-25K):
- Products: SHG Smart Vision (NGO-subsidized only)
- Gap: No commercially available comprehensive solution in this range
- SANKET EYE OPPORTUNITY: Fill thi massive gap

ADIP (Assistance to Disabled Persons):
- Scheme: Provides subsidies for assistive devices
- Budget: ₹500+ crores annually across India
- Subsidy: Up to 50% cost coverage for BPL, up to ₹20,000 for others
- Opportunity: Sanket Eye could be approved device, government subsidizes purchase
- Impact: Could reduce user cost to ₹15,000-25,000 with subsidy

...dous Conditions:
...en Manholes: ...equent hazard, ...using injuries and ...aths
...nstruction Sites: ...ten poorly marked or ...rricaded
...eet Vendors: ...predictable ...stacles on sidewalks
- Parked Vehicles:

3. Define and Validate | 3.6 SWOT Analysis

THREATS

1. Intense Competition from Established Brands
Big Tech Entry Risk:

Google Glass Lessons:
2013 Google Glass Backlash:
- "Glasshole" Phenomenon: Social stigma against Glass wearers
- Privacy Outrage: Recording concerns in restaurants, theaters, bathrooms
- Business Bans: Many establishments ban Google Glass
- Consumer Rejection: Product failed in consumer market
- Cost: Google pivoted to enterprise only

Sanket Eye Risk:
Similar Concerns:
- Small camera on glasses recording public spaces
- People uncomfortable being filmed without consent

Regulatory Threats:
Digital Personal Data Protection Act 2023 (India):
- Consent Requirements: Must obtain consent before collecting personal data

Fast-Paced AI Development:
- GPT-3 to GPT-4: 18 months, 10x improvement
- GPT-4 to GPT-5: Expected 2025, another leap forward

Sanket Eye Challenge:
- Hardware Lifespan: 3-5 years typical
- AI Advancement: Every 18-24 months
- Risk: Device AI becomes outdated before hardware EOL

Potential Regulations:
- Mandatory Visual Indicators: LED must be clearly visible when camera active
- No-Camera Zones: Banned in certain locations (changing rooms, bathrooms)
- Age Restrictions: Cannot record minors

Legal Liability:
Product Liability Law:
- Duty of Care: Must ensure device is reasonably safe
- Defect Types:
  - Manufacturing Defect: Individual unit malfunction
  - Design Defect: Fundamental design flaw
  - Failure to Warn: Inadequate instructions or warnings
- Strict Liability: Liable for injuries even without negligence

Class Action Risk:
- Scenario: Multiple users injured due to same defect
- Lawsuit: Consolidated class action for ₹100s of crores
- Impact: Bankruptcy risk for startup
- Insurance: Product liability insurance essential but expensive

Regulatory Penalties:
- Medical Device Violations: ₹10 lakhs - ₹5 crores per violation
- Consumer Protection Act: Compensation for defective products
- Criminal Liability: Potential jail time for gross negligence

...tive Technology
...ledge Gap:
- ...ost visually impaired ...dians unaware smart ...asses exist
- ...liance on traditional ...ls (white cane, guide ...gs)

...tics:
- ...ly 20-30% of blind ...dians use white ...nes
- ...% aware of OrCam, ...vision, or similar ...vices
- ...% rely on human

...ce:
- ...ser trusts device completely, stops
- ... has limitations (low light, crowded ...tery)
- ...injured in situation device can't
- ...ce created false sense of security

Hardware Obsolescence:
Camera Technology:
- Sensor Improvements: Higher resolution, better low-light every year
- Computational Photography: Software compensating for hardware limits
- Risk: Sanket Eye camera outdated within 2 years

Processor Advancement:
- Mobile SoCs: Qualcomm, MediaTek releas... faster chips annually
- AI Accelerators: Dedicated neural process... units improving
- Power Efficiency: Better performance per...

...uter Vision ...vements:
- ...ject Detection: ...LO v5 → v8 in 2 ...ars, significant ...curacy gains
- ...ene Understanding: better at complex

Software Bug:
- Scenario: Firmware update introduces bug causing system freezes
- Impact: Thousands of users lose device functionality simultaneously
- Consequences: Users stranded without assistance, injuries occur
- Reputation: Trust in brand destroyed

Connectivity Evolution:
- 5G Adoption: Faster, lower latency connectivity
- WiFi 7: 2-4x faster than WiFi 6
- Bluetooth LE Audio: Better audio quality, l... power

Marketing Challenge:
Reaching Target Users:
- Limited Digital Presence: Many blind user... active on social media
- Traditional Media: Radio, word-of-mouth ...ective than ads
- ...mmunity-Based: Trust community ...commendations over advertising
- ...monstration Needed: Must try device t... ...lieve effectiveness

...ation Required:
- ...hat is it?: Concept of "smart glasses" ne... ...planation
- ...w does it work?: AI and computer vision are ...stract concepts
- Why is it better?: Advantages over current solutions unclear
- Is it safe?: Overcoming fear and skepticism

Competitor Advantages:
- Meta Ray-Ban: Massive marketing budget, mainstream awareness

Critica... device...
- Ob... or l...
- Fal... to s...
- Nav... situ...
- Dev... mic...
- Co... leg...

Ideation and design

4.1 Basic Idea Overview

Camera fitted device that views from the persons POV

Lets users click images and record videos

This device identifies objects

What is Sanket Eye

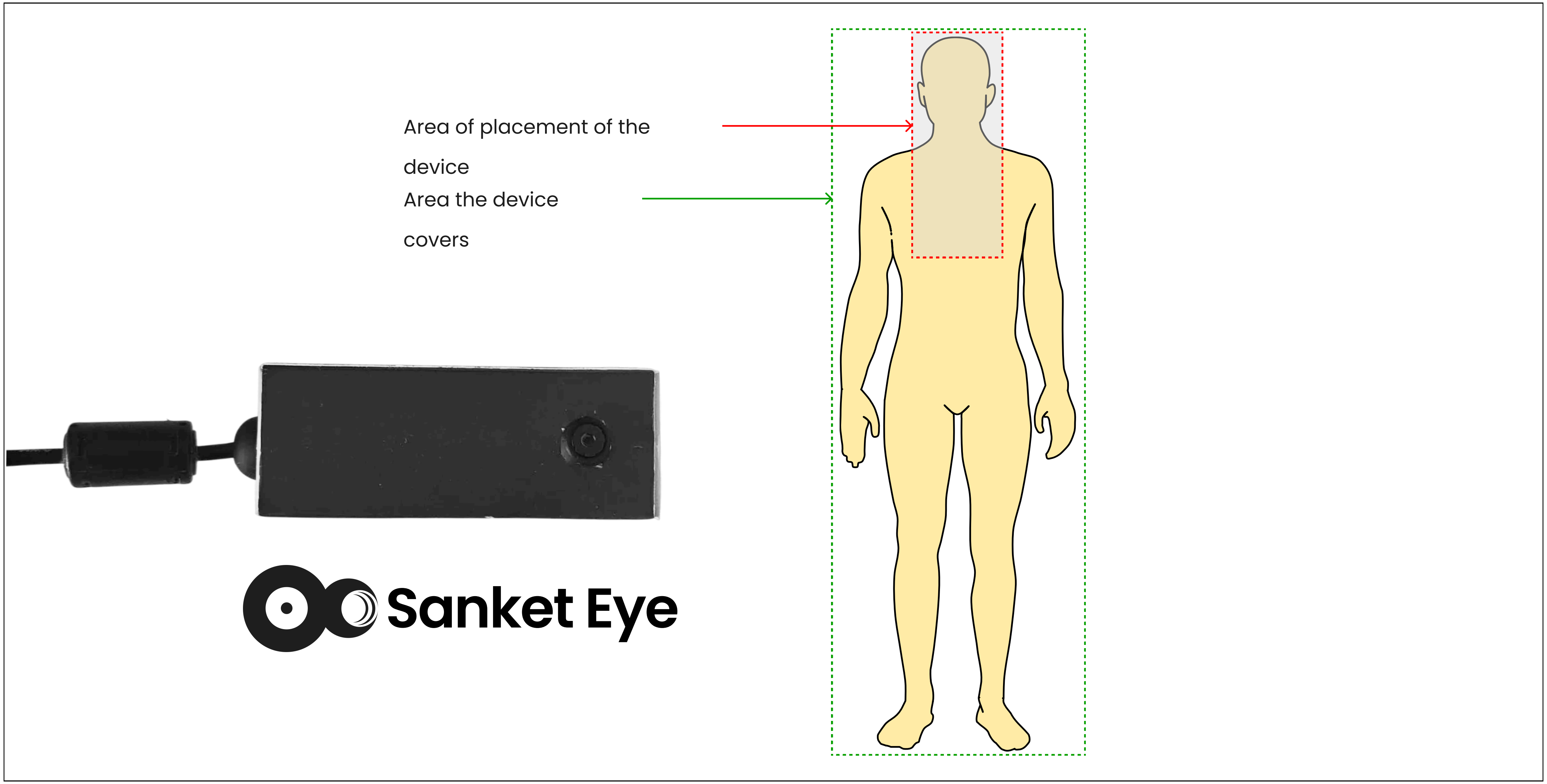
It is just a part of the Ecosystem of assistive devices i aim to build

Clicks a last seen image before turning off so that the whereabouts of the person are known

Lets you add image of a person name it. the device then identifies the person

Lets you add a event to the schedule and then it notifies you before the event

4. Ideation and Design | 4.1 Basic Idea Overview



What will be Sanket Eye

- Sanket Eye will be a Wearable clip-on device + a mobile app
- Users will have their individual login ID's
- The device Should perceive Visual Information and convey in an effective manner to reach to the User

What will be My goals

- Create a straightforward product that effectively communicates my concept to the audience.
- Study the basics of electronics and how they work.
- Grasp the principles of product design and ergonomics.
- Aim for cost-effective production to meet budget goals.

4.2 SCAMPER METHOD

Substitute

1. Replace Paid Subscription Models with One-Time Purchase
   - Current: Envision requires ongoing subscriptions for some features
   - Substitute: Lifetime access to core features with one-time purchase
   - Benefit: More affordable for Indian market, no recurring costs
   - Implementation: Core AI features included; optional premium cloud services

2. Replace Complex Touch Controls with Simp Voice + Haptic
   - Current: Solos AirGo uses complex touch gestures; OrCam uses pointing gestures
   - Substitute: Primary voice commands + hap feedback (via Sanket Ring)
   - Benefit: Easier for elderly and dementia patients; no learning curve
   - Implementation: "Hey Sanket" activation + simple vibration patterns

3. Replace Cloud-Only Processing with Hybrid Edge-Cloud
   - Current: Meta Ray-Ban and Solos heavily cloud-dependent
   - Substitute: Critical safety functions on-device; complex AI on cloud when available
   - Benefit: Works in low connectivity; faster response for safety alerts
   - Implementation:
     - On-Device: Obstacle detection, fall detection, basic navigation
     - Cloud: Advanced scene description, complex text reading, real-time translation

4. Replace Single-Language AI with Multilingu Support
   - Current: Most devices English-focused; lin Indian language support
   - Substitute: Hindi, Tamil, Telugu, Bengali, Marathi, Gujarati support from launch
   - Benefit: Accessible to 80%+ of Indian user
   - Implementation: Pre-trained models in 6+ Indian languages + English

5. Replace Separate Devices with Modular Ecosystem
   - Current: Users must buy complete new device for different features
   - Substitute: Modular components (Eye, Ring, Clip) that work independently or together
   - Benefit: Users pay only for what they need; upgrade incrementally
   - Implementation: Bluetooth mesh network connecting all Sanket devices

Combine

1. Combine Meta Ray-Ban's Mainstream Design + Envision's Assistive Features
   - From Meta Ray-Ban: Stylish, socially acceptable design; voice AI integration
   - From Envision: Comprehensive assistive features (text reading, scene description, face recognition)
   - Sanket Eye: Fashion-forward wearable with purpose-built assistive technology
   - Implementation: Clip-on design works with any glasses; discrete form factor

2. Combine OrCam's Offline Capability + Cloud AI Power
   - From OrCam: Works without internet; instant text-to-speech
   - From Envision/Meta: Advanced GPT-powered scene understanding
   - Sanket Eye: Basic features offline; enhanced features online
   - Implementation:
     - Offline: Text reading, obstacle detection, stored face recognition
     - Online: Ask questions, complex scene description, real-time translation

3. Combine Be My Eyes' Human Assistance + AI Automation
   - From Be My Eyes: Live video call with human volunteers
   - From Seeing AI/Lookout: Automated AI descriptions
   - Sanket Eye: AI handles routine tasks; human assistance for complex situations
   - Implementation:
     - Built-in "Call Assistant" feature (video call to caregiver/volunteer)
     - AI attempts first; escalates to human if uncertain
     - Integration with Be My Eyes network as backup

4. Combine NuEyes' Magnification + Environmental Awareness
   - From NuEyes: 12x digital magnification for low vision users
   - From Envision: Real-time object and scene detection
   - Sanket Eye: Magnification mode for reading + navigation mode for walking
   - Implementation:
     - Switch modes via voice: "Reading mode" (magnify text), "Walking mode" (detect obstacles)
     - Picture-in-picture: Magnified view with obstacle alerts overlay

5. Combine Multiple AI Models (GPT-4, Gemini, Claude)
   - From Solos: Multi-AI platform support
   - From Envision: GPT-5 integration
   - Sanket Eye: Best-in-class AI for each task type
   - Implementation:

6. Combine Wearable + Smartphone + Home Beacons
   - From Various: Standalone devices OR phone-dependent
   - Sanket Eye Ecosystem:
     - Sanket Eye: Primary wearab

4. Ideation and Design | 4.2 SCAMPER METHOD

Adapt

1. Adapt Automotive Collision Detection for Pedestrian Safety
- From: Car collision warning systems (radar, lidar, cameras)
- Adapt To: Pedestrian obstacle detection and collision avoidance
- Sanket Eye Feature:
  - Real-time obstacle detection with distance measurement
  - Audio alerts: "Object 2 meters ahead, left side"
  - Haptic alerts: Vibration intensity increases as object gets closer
  - Visual alerts (for low vision): Red warning on display

2. Adapt Gaming Controllers' Haptic Feedbac
- From: PlayStation DualSense adaptive trig and haptic patterns
- Adapt To: Navigation and environmental awareness through touch
- Sanket Ring Feature:
  - Different vibration patterns for differen alerts:
    - Obstacle ahead: Pulsing vibration
    - Turn left/right: Directional vibration right side of ring)
    - Stairs up/down: Ascending/descend vibration pattern
    - Emergency: Strong, continuous vibr
  - Replaces audio when discretion neede hearing impaired users

3. Adapt Smart Home's Room-by-Room Automation
- From: Google Home, Alexa room-specific automation
- Adapt To: Context-aware feature activation based on location
- Sanket Eye Feature:
  - Kitchen: Automatically activate stove/ appliance detection, timer alerts
  - Bathroom: Activate water/heat detection, slip hazard warnings
  - Bedroom: Sleep mode (reduced alerts, fall detection only)
  - Outdoors: Full navigation mode, traffic awareness
  - Public transport: Transit mode (announcement reading, stop alerts)

4. Adapt Fitness Trackers' Activity Recognitio
- From: Apple Watch, Fitbit automatic worko detection
- Adapt To: Automatic context detection an feature adjustment
- Sanket Eye Feature:
  - Detects: Walking, sitting, lying down, climbing stairs, in vehicle
  - Adjusts:
    - Walking: Obstacle detection active
    - Sitting: Reading mode suggested
    - Vehicle: Motion reduced, audio enhanced
    - Lying down: Fall detection sensitivit adjusted

5. Adapt Video Games' Mini-Map Navigation
- From: Radar/mini-map in games showing relative positions
- Adapt To: Spatial audio map of surroundings
- Sanket Eye Feature:
  - 3D audio representation of environment

6. Adapt Airline Pilot Checklists for Daily Rout
- From: Aviation pre-flight checklists
- Adapt To: Daily routine assistance for dementia patients
- Sanket Eye Feature:
  - Morning routine checklist: "Have you tak

Modify

1. Modify OrCam's "Point and Read" to "Look and Hear"
- Original: OrCam requires deliberate pointing gesture at text
- Modified: Sanket Eye automatically detects text in field of view
- Benefit: More natural for users; better for dementia patients who may forget gestures
- Implementation:
  - Always-scanning mode: Announces text when detected
  - User can say "Read this" to read detected text
  - Or: "Find price", "Find expiration date" for specific info extraction

2. Modify Envision's Face Recognition for Emotion Detection
- Original: Envision recognizes and names familiar faces
- Modified: Also detects and reports emotional expressions
- Benefit: Critical for dementia patients who struggle reading social cues
- Sanket Eye Feature:
  - "Your daughter Sarah is smiling at you"
  - "The person speaking seems upset"
  - Helps users respond appropriately in social situations
  - Privacy controls: User must explicitly enable emotion detection

3. Modify Google Lookout's Currency Detection for Indian Context
- Original: Lookout recognizes US Dollars, Euros, INR
- Modified: Recognize INR notes AND verify authenticity
- Benefit: Protect blind users from counterfeit currency
- Sanket Eye Feature:
  - Identifies denomination: "500 rupees"
  - Verifies security features: "Genuine note" or "Possible fake - check with another person"
  - Also recognizes: Coins, transit cards, coupons

4. Modify Meta Ray-Ban's Social Sharing to Safety Sharing
- Original: Meta Ray-Ban shares photos/videos to Instagram, Facebook
- Modified: Shares location and safety status with caregivers
- Benefit: Family peace of mind; quick emergency response
- Sanket App Feature:
  - Real-time location sharing with selected contacts
  - "Safe arrival" notifications when reaching destination
  - Emergency photo/video: If user says "Help" or falls, captures and sends to emergency contacts
  - Geofencing: Alerts if dementia patient leaves safe zone

5. Modify Seeing AI's Scene Description to Predictive Warnings
- Original: Seeing AI describes scene upon request
- Modified: Proactively warns about upcoming hazards

6. Modify NuEyes' TV Viewing Mode to Shared Activity Mode
- Original: NuEyes magnifies TV f viewing
- Modified: Enhances shared acti family/friends

4. Ideation and Design | 4.2 SCAMPER METHOD

Put to other uses

1. Repurpose for Industrial Safety
- Original Use: Assistive device for blind users
- New Use: Safety device for factory/ construction workers
- Sanket Eye Industrial Edition:
  - Hard-hat mounted version
  - Detects: Overhead hazards, moving vehicles, unsafe zones
  - Compliance tracking: Ensures workers wearing PPE (detected via computer vision)
  - Hands-free communication with team
  - Market: 500M+ industrial workers globally

2. Repurpose for Elderly Fall Prevention
- Original Use: Navigation for blind
- New Use: Fall prevention for elderly at hon
- Sanket Eye Home Safety:
  - Detects: Loose rugs, spills, uneven surfaces, poor lighting
  - Gait analysis: Warns if walking pattern indicates fall risk
  - Instant fall detection: Alerts emergency contacts immediately
  - Night mode: Enhanced detection durin bathroom trips (highest fall risk time)
  - Market: 104M elderly in India, 319M by 2050

3. Repurpose for Parents with Young Children
- Original Use: Assist visually impaired adults
- New Use: Enhanced situational awareness for busy parents
- Sanket Eye Parenting Mode:
  - Detects child wandering out of sight
  - Identifies hazards in environment (sharp objects, choking hazards, water hazards)
  - Hands-free photo/video capture of child's activities
  - Reminder system: "Time for Rohan's medicine"
  - Market: 26M births/year in India

4. Repurpose for Drivers and Cyclists
- Original Use: Pedestrian navigation
- New Use: Enhanced awareness while drivi cycling
- Sanket Eye Transit Edition:
  - Blind spot detection
  - Collision warnings
  - Traffic sign reading
  - Fatigue detection (alerts if drowsy)
  - Navigation without looking at screen
  - Market: 300M+ drivers and cyclists in I

5. Repurpose for Tourists and Travelers
- Original Use: Daily navigation for locals
- New Use: Travel assistance in unfamiliar places
- Sanket Eye Travel Mode:
  - Real-time translation of signs and menus (60+ languages)
  - Currency identification and conversion
  - Landmark identification and historical info
  - Navigation in foreign countries
  - Emergency assistance in local language
  - Market: Global travel market (1.5B

6. Repurpose for Students with Learning Disabilities
- Original Use: Assist blind students
- New Use: Learning support for dyslexia, A processing disorders
- Sanket Eye Learning Mode:
  - Text-to-speech for reading difficulties
  - Organize and structure information visu
  - Note-taking assistance (voice recording transcription)
  - Focus mode: Blocks distractions, highligl important text

Eliminate

1. Eliminate Meta Ray-Ban's Social Media Integration
- Remove: Direct Instagram/Facebook Live streaming
- Reason: Privacy concerns; not relevant for assistive use; adds complexity
- Keep Instead: Share to family/caregivers only (closed group)
- Benefit: Simpler interface; better privacy; lower data usage

2. Eliminate Envision's Multiple Editions
- Remove: Read, Home, Professional tiers requiring separate purchases
- Reason: Confusing for users; locks features behind high prices
- Replace With: Single device with software-unlocked features
- Benefit: Simpler product line; users upgrade via app purchases not hardware

3. Eliminate Complex Multi-Gesture Controls
- Remove: Solos' complicated touch patterns; OrCam's precise pointing
- Reason: Difficult for elderly, dementia patients, and first-time users
- Replace With: Voice-first interface + simple one-button operation
- Benefit: Faster learning; better accessibility; lower cognitive load

4. Eliminate Video Recording and Storage
- Remove: Ability to record and save video (unlike Meta Ray-Ban)
- Reason: Privacy concerns; storage requirements; legal liability
- Keep Instead: Real-time analysis only; no recording unless emergency
- Benefit: Addresses privacy backlash; reduces data/storage costs; social acceptance

5. Eliminate Dependency on Specific Eyeglass Frames
- Remove: Integrated glasses design (like Meta Ray-Ban, NuEyes)
- Reason: Users already have prescription glasses; added cost
- Keep Instead: Universal clip-on design (like OrCam but affordable)
- Benefit: Works with any eyewear; lower cost; users keep existing glasses

6. Eliminate Always-On Camera LED (Optional)
- Remove: Constant LED indicator when device powered on
- Reason: Draws attention; stigmatizing; battery drain
- Keep Instead: LED only when camera actively analyzing (not just powered on)
- Benefit: Discrete; less social stigma; better battery life
- Note: User-configurable for transparency vs. discretion preference

7. Eliminate Separate Accounts for Family Members
- Remove: One device = one account (OrCam, Envision model)
- Reason: Families may share device; caregivers need access
- Replace With: Multi-user profiles with family

4. Ideation and Design | 4.2 SCAMPER METHOD

Rearrange/ Reverse

1. Reverse: Instead of User Asking Device, Device Offers Help
- Traditional: User must request information ("What's in front of me?")
- Reversed: Device proactively offers assistance based on context
- Sanket Eye Proactive Mode:
  - Detects user stopped in front of sign → Automatically reads it
  - Detects user at crosswalk → "Light is red, 15 seconds remaining"
  - Detects person approaching → "Someone approaching from your right"
  - Detects confusion behavior → "Would you like navigation assistance?"
- Benefit: Reduces cognitive load; critical for dementia patients who forget to ask

2. Rearrange: Start with Audio, Escalate to Visual, Then Human
- Traditional: All information via same channel (audio OR visual)
- Rearranged: Multi-modal progression based on urgency and complexity
- Sanket Eye Escalation:
  a. Audio Alert: Simple spoken warning (obstacle ahead)
  b. Haptic Alert: Vibration if audio missed or hearing impaired
  c. Visual Alert (low vision users): Screen flash or visual indicator
  d. Human Assistance: If situation complex, connect to caregiver/volunteer
- Benefit: Redundancy for safety; accommodates different disabilities

3. Reverse: Instead of Device on User, Beacons in Environment
- Traditional: Camera on user's glasses observing environment
- Reversed: Environmental beacons communicating with user's device
- Sanket Home Beacon System:
  - Small Bluetooth beacons placed in home
  - Transmit information to Sanket Eye/Ring
  - Kitchen beacon: "You're in the kitchen. Stove is on the left."
  - Bathroom beacon: "Toilet is ahead. Shower on your right."
  - Doorway beacons: "Entering bedroom" (orientation for dementia patients)
- Benefit: Works without camera; indoor navigation; privacy-friendly; aids dementia orientation

4. Rearrange: Family App as Primary Interface, Device as Sensor
- Traditional: User interacts with device; family gets notifications
- Rearranged: Family uses app to configure and monitor; device runs automatically
- Sanket Family Dashboard:
  - Caregivers customize settings remotely
  - Receive real-time updates on user's activities
  - Proactive alerts: "Mom hasn't left bedroom in 3 hours" (potential issue)
  - Two-way video call initiation
  - Medication reminders sent from family app
- Benefit: Empowers caregivers; critical for dementia care; reduces user complexity

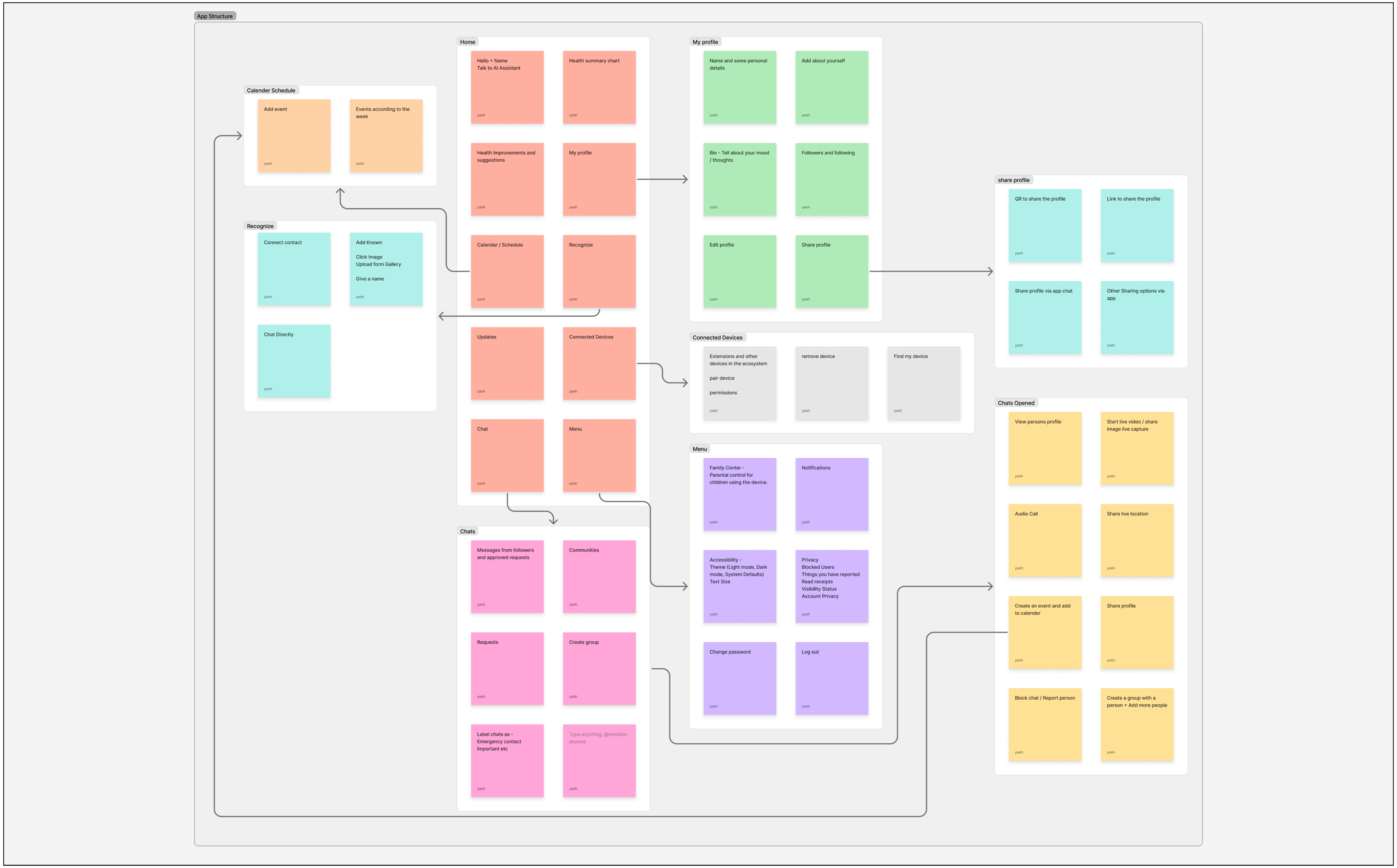
5. Reverse: Instead of Describing Scene, Describe Changes
- Traditional: Full scene description on request
- Reversed: Announce only what changed since last scan
- Sanket Eye Change Detection:
  - "New person entered room"
  - "Door opened behind you"
  - "Object moved into your path"
  - "Light level decreased" (potential hazard)
- Benefit: Reduces information overload; focuses attention on relevant updates; critical for dementia patients

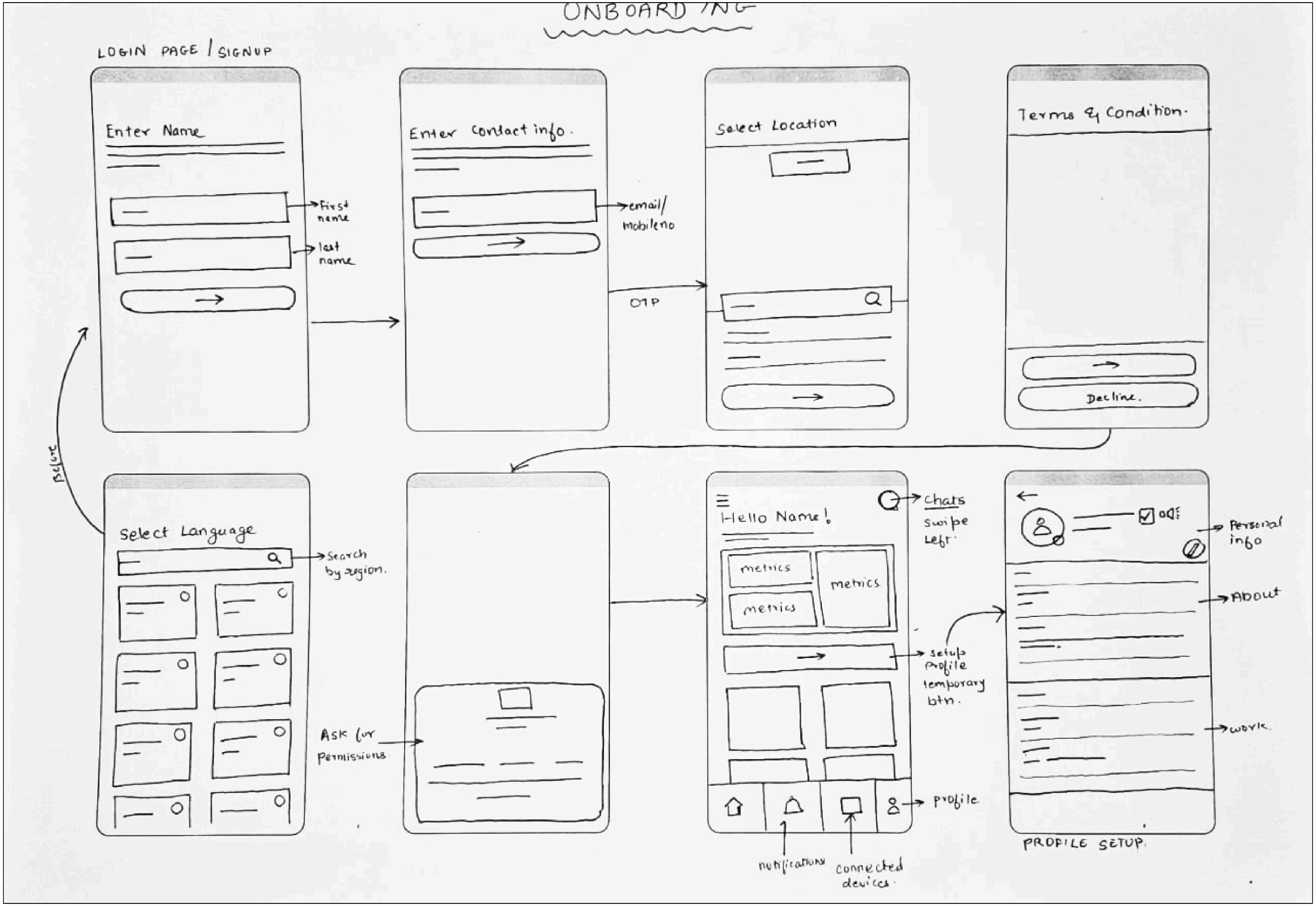
6. Rearrange: Community Data Before Individual AI
- Traditional: Each device independently analyzes environment
- Rearranged: Device first checks if other users reported this location
- Sanket Crowd-Sourced Intelligence:
  - User A encounters obstacle → Marks on map
  - User B approaching same spot → Proactive warning before camera even sees it
  - Community reports: "Open manhole reported at this location"
  - Real-time hazard database updated by user community
- Benefit: Anticipatory warnings; community safety; faster than AI processing

7. Reverse: Free Hardware, Paid Software (Printer Model)
- Traditional: Expensive hardware (₹1-5 lakhs), free software
- Reversed: Affordable/subsidized hardware, optional paid features
- Sanket Eye Pricing Model:
  - Hardware: ₹15,000 - ₹25,000 (near cost; low margin)
  - Software: Free basic features; ₹299/month premium OR pay-per-use
  - Goal: Maximize hardware adoption; revenue from software/services
- Benefit: Lower entry barrier; recurring revenue stream; affordable for more users

4. Ideation and Design

4.3 App structure and Low fidelity

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LOGIN PAGE / SIGNUP
Enter Name
First name
last name
Enter contact info.
email/ mobileno
OTP
Select Location
Terms & Condition.
Decline.
before
Select Language
Search by region.
Ask for Permissions
Hello Name!
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About
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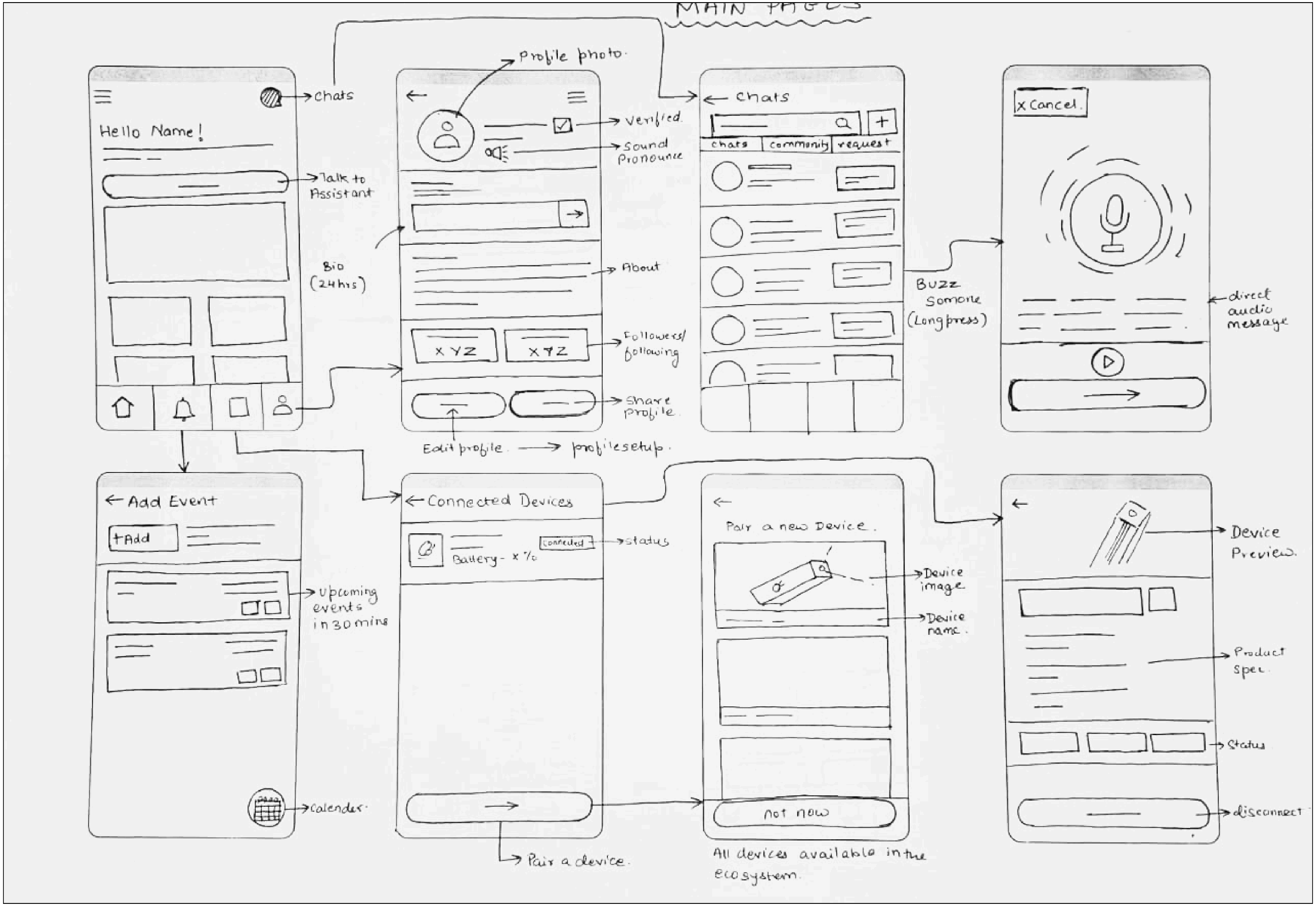
PROFILE SETUP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Chats
Talk to Assistant
Bio (24hrs)
Profile photo.
Verified
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About
Followers/ following
Share profile
XYZ
XYZ
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Chats
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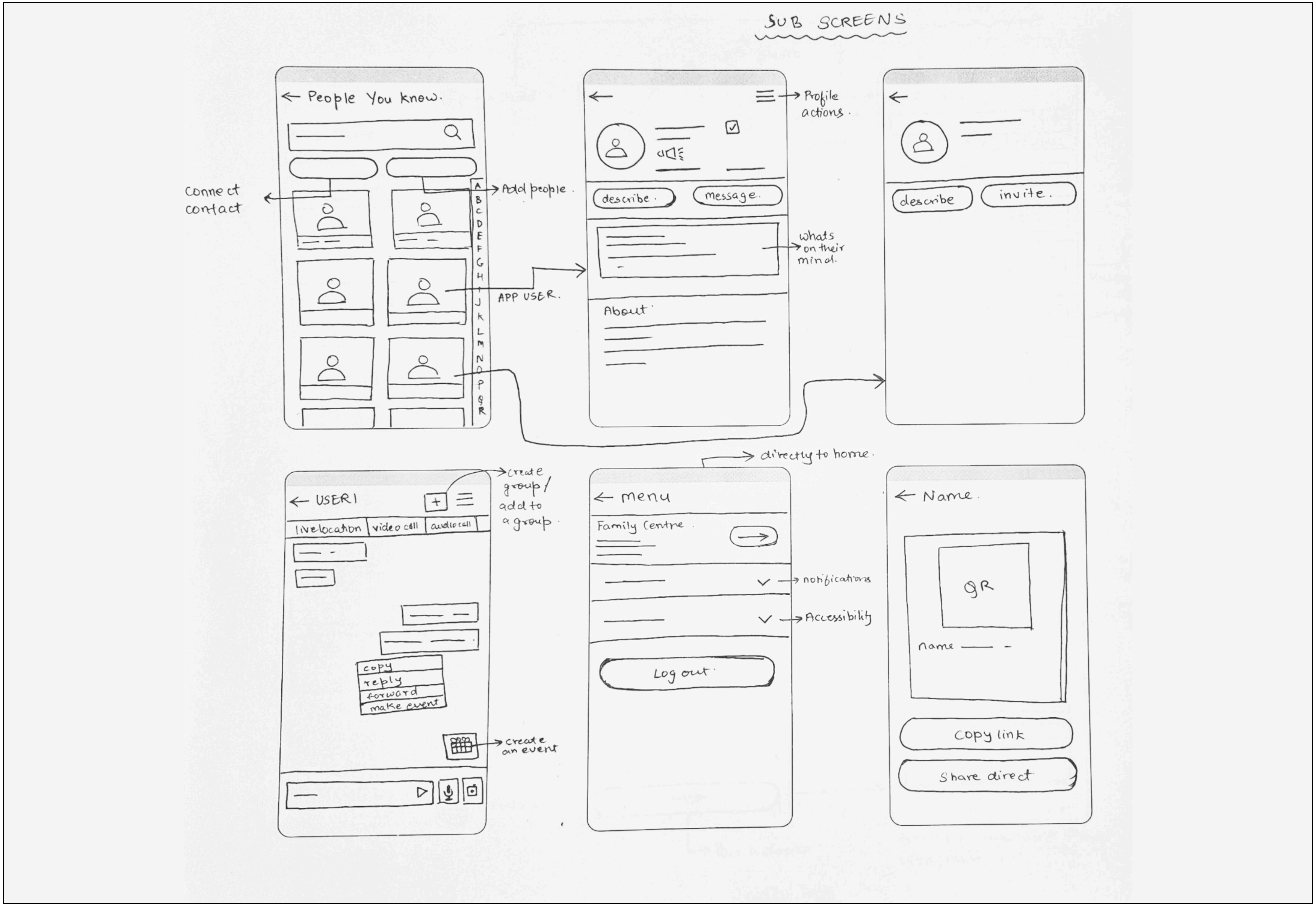
request
Buzz Somone (Long press)
X Cancel.
direct audio message
Add Event
+Add
Upcoming events in 30 mins
Calender.
Connected Devices
Battery - x %
connected
Status
Pair a device.
Pair a new Device.
Device image
Device name.
not now
All devices available in the ecosystem.
Device Preview.
Product Spec.
Status
disconnect


SUB SCREENS
People You know.
connect contact
Add people.
APP USER.
Profile actions.
describe.
message.
whats on their mind.
About
describe
invite.
directly to home.
USER1
create group/ add to a group.
livelocation
video call
audio call
copy
reply
forward
make event
create an event
menu
Family Centre
notifications
Accessibility
Log out
Name.
QR
name
copy link
Share direct

4.4 UI Design System

4.1.1 Logo

Considering Sanket as a brand and the centerpoint of the entire ecosystem, the logo must express not only the diversity of products and users we serve, but also the core idea of translation and connection that defines our technology. The visual identity should be inclusive—using colors and forms that remain clear and distinguishable for users with low vision, blurry vision, or colorblindness. Additionally, the logo should be flexible and scalable, able to represent every new product added to the Sanket ecosystem while maintaining a cohesive and recognizable brand presence.

1. Overview

- The Sanket Eye logo represents the core philosophy of the project: translating the world into accessible information, empowering users with clarity, independence, and safety.
  It reflects Sanket as the center of an assistive ecosystem, seamlessly blending technology, inclusivity, and human-centered design.

2. Logo Concept

The visual symbol is composed of two circular forms, symbolizing:

2.1 The Larger Circle

- Represents the primary lens of vision and perception.
- Symbolizes support, guidance, and widening awareness for visually impaired and aging users.
- The distributed concentric rings echo focus, clarity, and signal detection.

2.2 The Smaller Circle

- Represents the wearable module—smart, compact, and adaptive.
- Positioned beside the larger circle to indicate the connection between user and technology.
- The internal layered arcs depict translation, signal processing, and assistive cues.

2.3 Combined Meaning

- The merging of circles signifies:
  - Ecosystem connectivity
  - Assistive augmentation
  - Human + technology partnership
  - Seamless integration into everyday life
- The icon is balanced, minimal, and inclusive, ensuring recognizability even for users with blurry or low vision.

3. Typography

Primary Font: Poppins

The logotype “Sanket Eye” uses clean, geometric, rounded typography to reflect:

- Approachability
- Clarity
- Modernity
- Universality

Rounded letterforms are intentionally selected to maintain friendliness and accessibility, avoiding sharp edges that may strain visibility or readability.

4. Color Psychology & Accessibility

Primary Color: Yellow (#FFC800-Range)

Yellow is chosen intentionally because:

- It is one of the most visible and high-contrast colors for users with low vision.
- It is distinguishable for most forms of colorblindness (including Deuteranopia and Protanopia).
- Symbolically, yellow communicates guidance, illumination, optimism, and clarity—all core values of Sanket Eye.

The bold yellow ensures:

- Strong visibility at small sizes
- Excellent contrast against dark backgrounds
- Universality across diverse viewing conditions

Original Logo

Normal vision

Greyscale (1 in 30 000 have achromatopsia)

Green weak (1 in 20 men, 1 in 1000 women have deuteranomaly

Red/green (1 in 100 men, 1 in 300 women have deuteranopia)

Red/green (1 in 100 men have protanopia)

Red/green (1 in 100 men have protanomaly)

Blue/yellow (1 in 1000 have tritanopia)

Blue/yellow (1 in 1000 have tritanomaly)

5. Accessibility Design Principles

The logo adheres to these accessibility standards:

5.1 High Contrast
The golden yellow on dark background maintains a contrast ratio suitable for visually impaired users.

5.2 Strong Silhouette
Even when blurred or reduced to a basic outline, the icon remains identifiable.

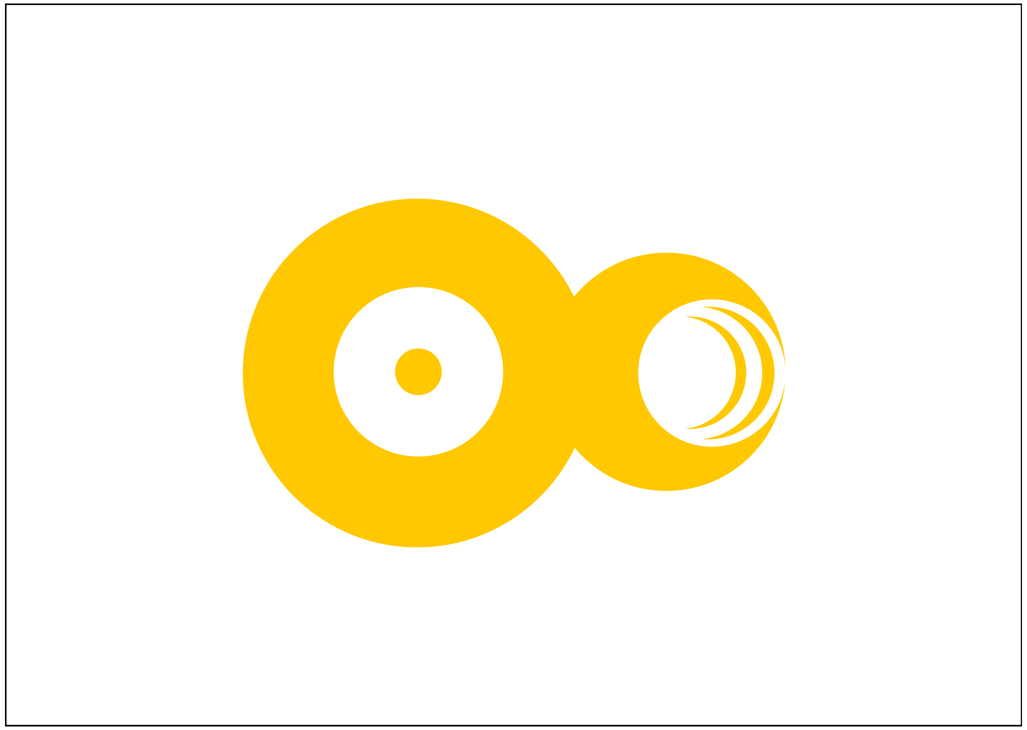
5.3 Minimal Structure
Avoids complex details that may disappear in small sizes or for low-vision users.

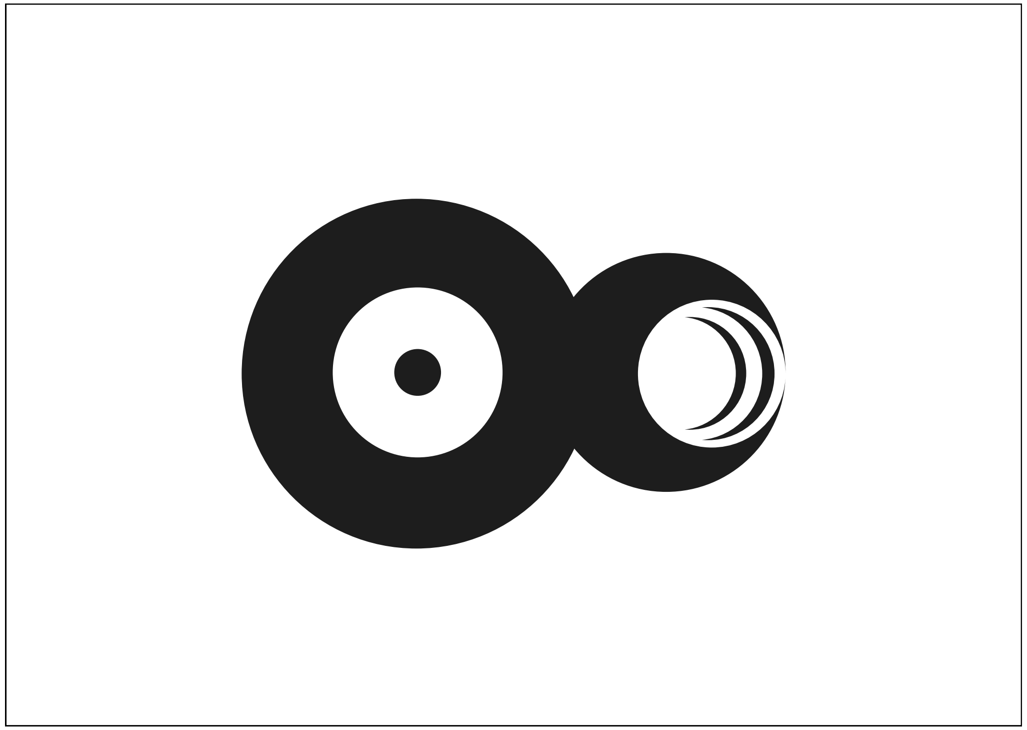
5.4 Colorblind Safety
No elements rely solely on hue; shape communicates identity.

6. Symbolism Summary

Element	Meaning
Large circle	Vision, awareness, guidance
Small circle	Assistive module, intelligence
Arcs inside small circle	Translation, processing, communication
Color yellow	Visibility, safety, clarity
Two circles together	User + technology partnership
Overall form	Assistive ecosystem & inclusivity

It perfectly embodies the mission to “empower every sense through intelligent, inclusive design.”





4.1.2 Font and Typeface

Poppins

Modern, clean, friendly

ABCDEFGHIJKLMNOPQRSTUVWXYZ

abcdefghijklmnopqrstuvwxyz

1234567890

Poppins-Light	300	The quick brown fox jumps over the lazy dog.
Poppins-LightItalic	300 Italic	*The quick brown fox jumps over the lazy dog.*
Poppins-Regular	400	The quick brown fox jumps over the lazy dog.
Poppins-Italic	400 Italic	*The quick brown fox jumps over the lazy dog.*
Poppins-Medium	500	The quick brown fox jumps over the lazy dog.
Poppins-MediumItalic	500 Italic	*The quick brown fox jumps over the lazy dog.*
Poppins-SemiBold	600	**The quick brown fox jumps over the lazy dog.**
Poppins-SemiBoldItalic	600 Italic	***The quick brown fox jumps over the lazy dog.***
Poppins-Bold	700	**The quick brown fox jumps over the lazy dog.**
Poppins-BoldItalic	700 Italic	***The quick brown fox jumps over the lazy dog.***
Poppins-ExtraBold	800	**The quick brown fox jumps over the lazy dog.**
Poppins-ExtraBoldItalic	800 Italic	***The quick brown fox jumps over the lazy dog.***
Poppins-Black	900	**The quick brown fox jumps over the lazy dog.**
Poppins-BlackItalic	900 Italic	***The quick brown fox jumps over the lazy dog.***

4.1.3 Colors used in the UI Screens

Design System

Background Tokens

Tag	Code	Color
$background-light	#FAFAFA	
$background-primary	#FAFAFA	
$background-primary-light	#F4F6FC	
$background-primary-1	#0084FF	
$background-primary-1-light	#FFF5C2	

Design System

Layer Tokens

Tag	Code	Color
$layer-01	#f4f4f4	
$layer-02	#ffffff	
$layer-03	#f4f4f4	
$layer-inverse	#1E1E1E	

Design System

Button Tokens

Tag	Code	Color
$button-primary-default	#1E1E1E	
$button-primary-hovered	#373737	
$button-primary-active	#1E1E1E	
$button-secondary-default	#FFC800	
$button-secondary-hovered	#FFDA53	
$button-secondary-active	#FFC800	
$button-danger-default	#DA1E28	
$button-disabled	#C6C6C6	

Design System

Text Tokens

Tag	Code	Color
$text-primary	#1E1E1E	
$text-secondary	#464646	
$text-placeholder	#a8a8a8	
$text-on-color	#ffffff	
$text-helper	#6f6f6f	
$text-error	#da1e28	
$text-inverse	#ffffff	
$text-highlight	#FCD980	

Design System

Border Tokens

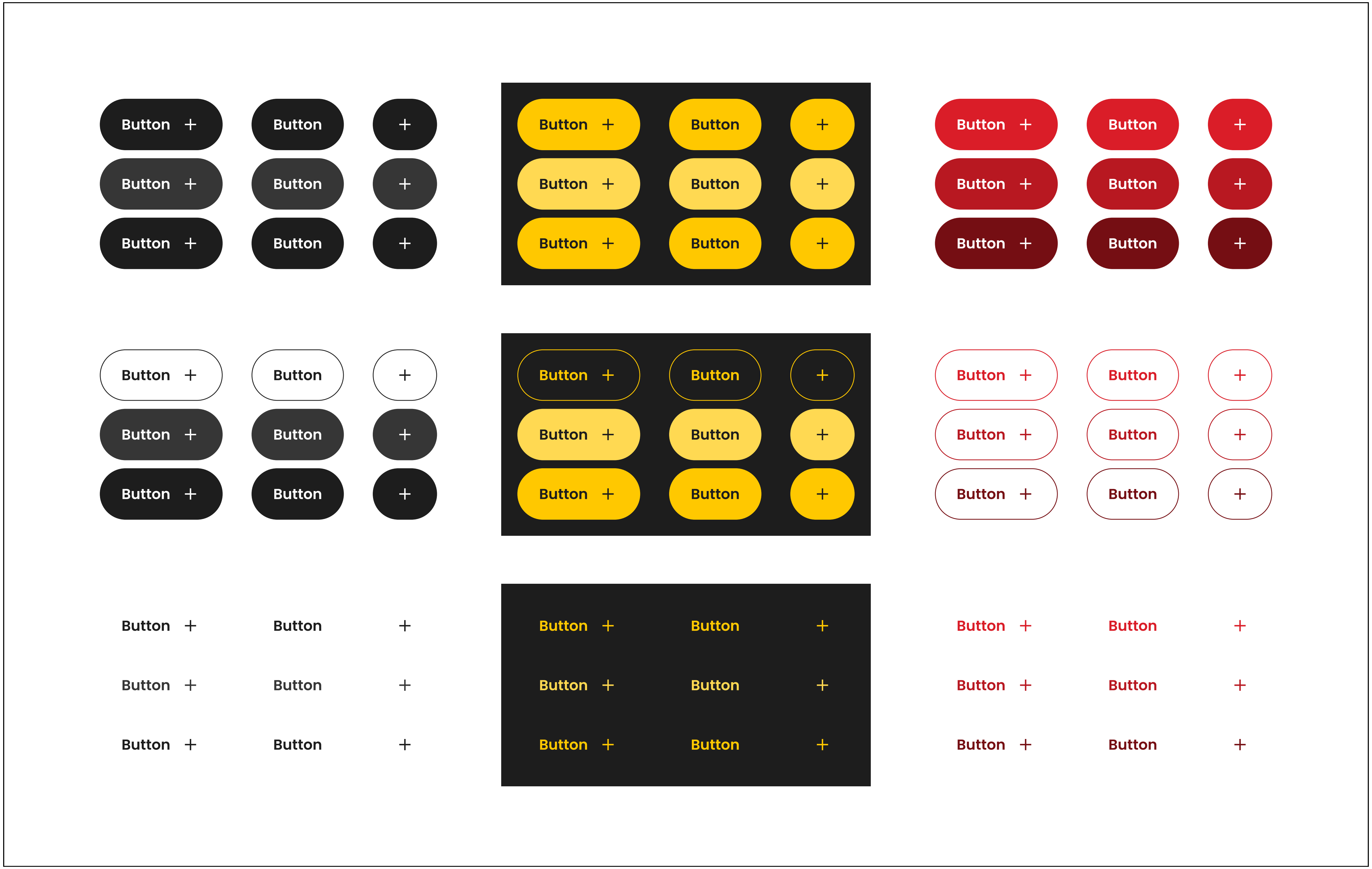
Tag	Code	Color
$border-interactive	#FFC800	
$border-subtle	#C6C6C6	
$border-strong	#1E1E1E	
$border-subtle	#B8B8B8	

Design System

Icon Tokens

Tag	Code	Color
$icon-primary	#1E1E1E	
$icon-secondary	#1E1E1E	
$icon-inverse	#fffff	
$icon-disabled	#161616	

4.1.4 Buttons


Button + Button + Button Button + Button +
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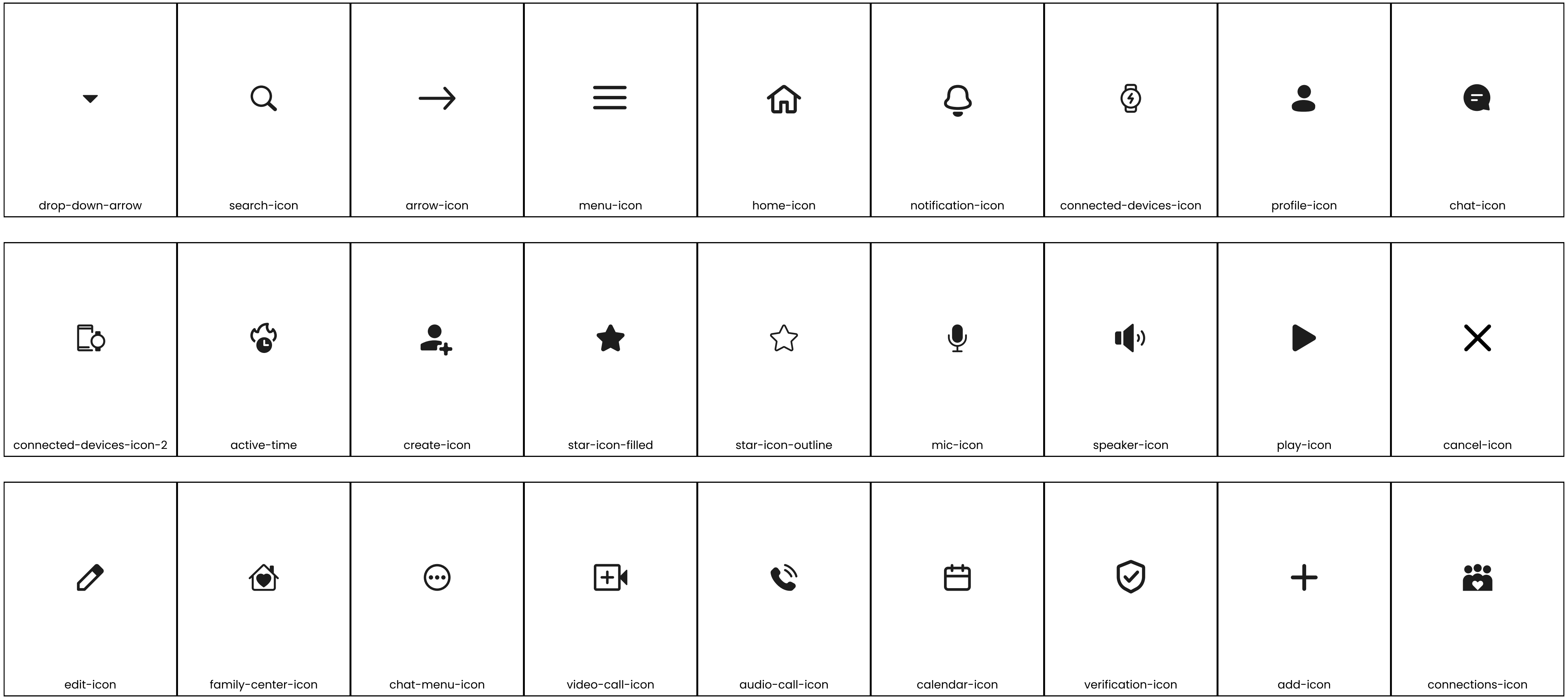
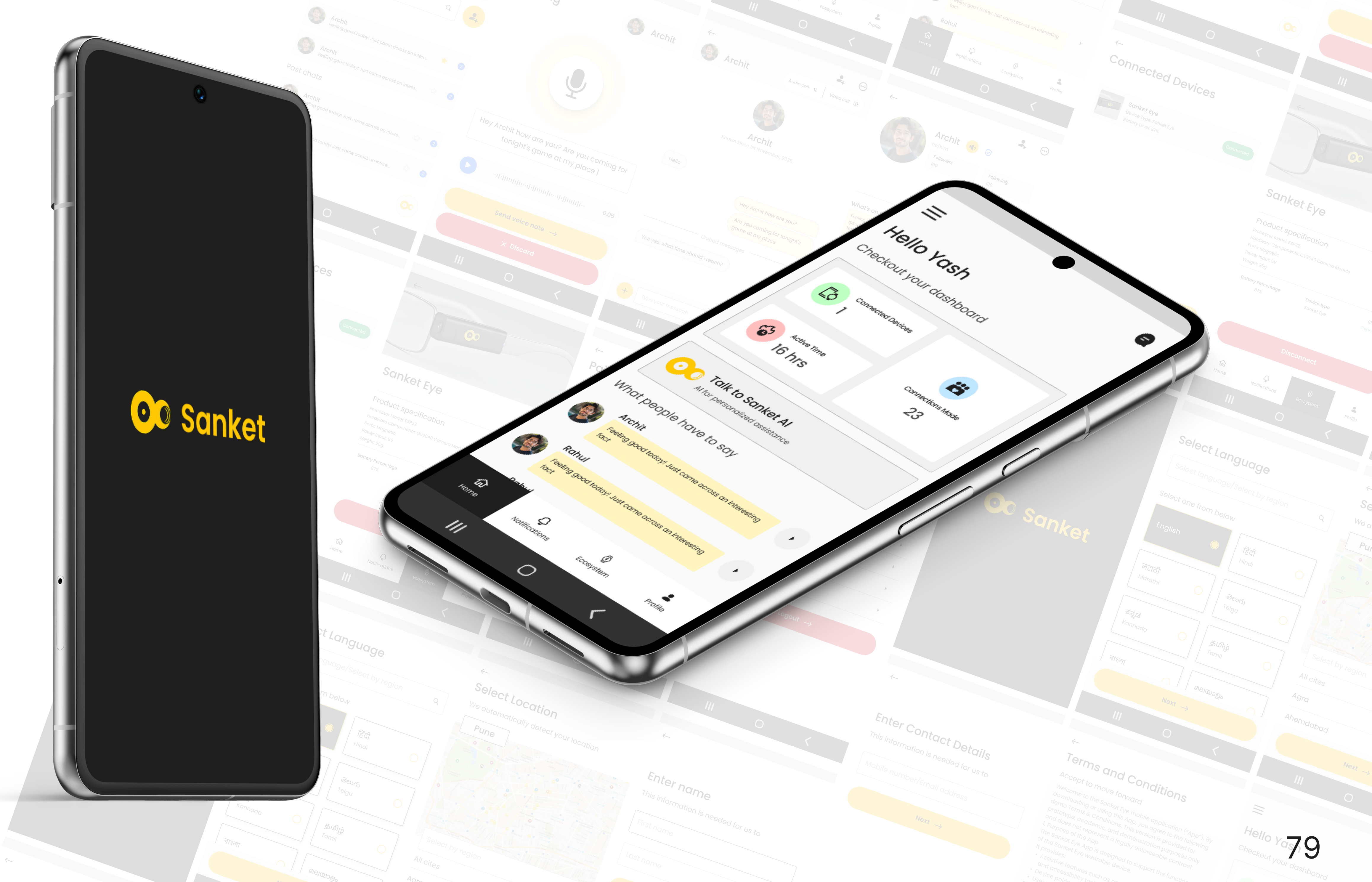
4. Ideation and Design | 4.4 UI Design System

4.1.5 Icons in the UI Screens



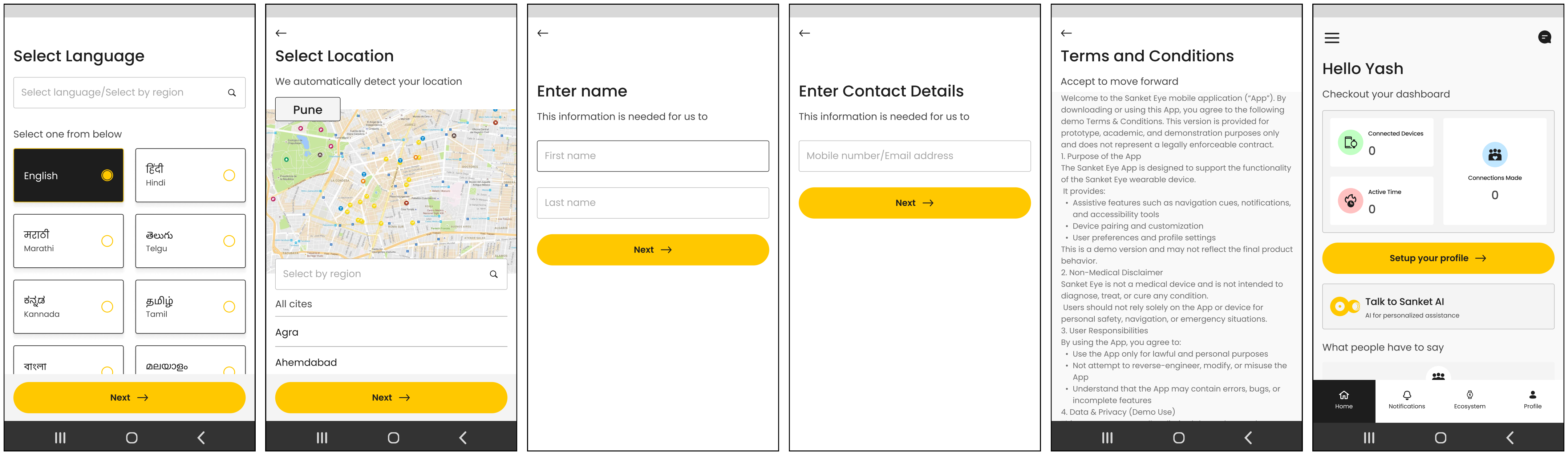
4. Ideation and Design

4.5 UI Design



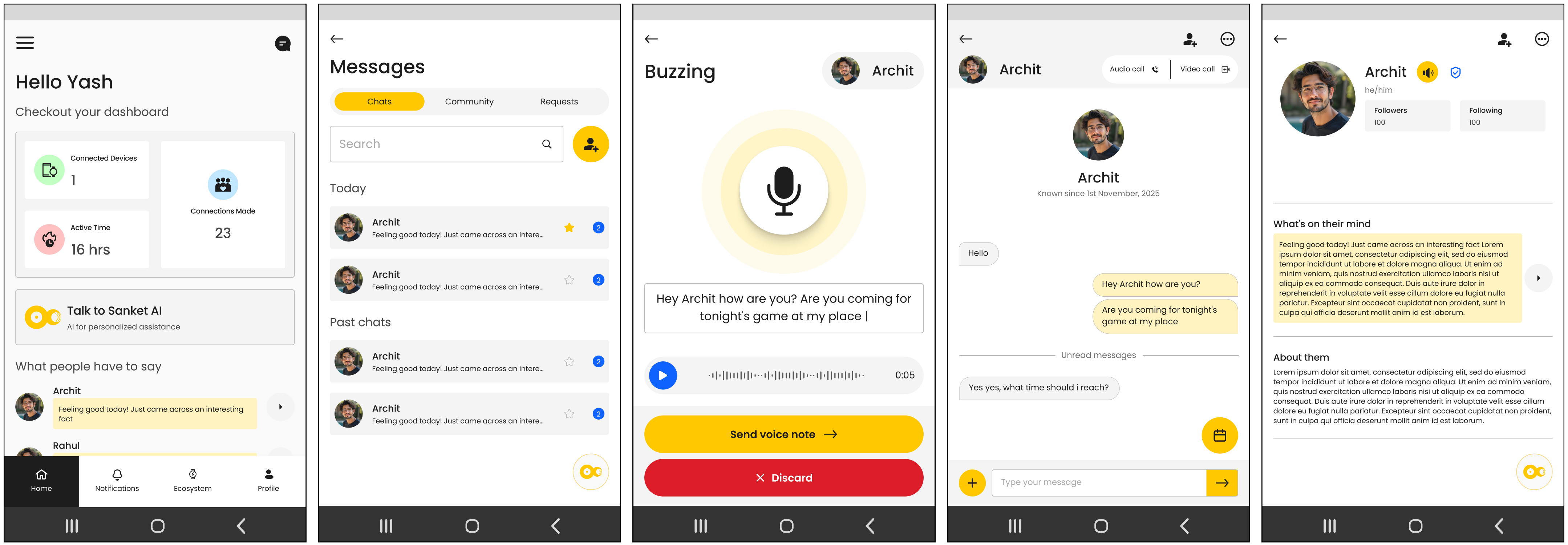
4. Ideation and Design | 4.5 UI Design

Login/signup flow



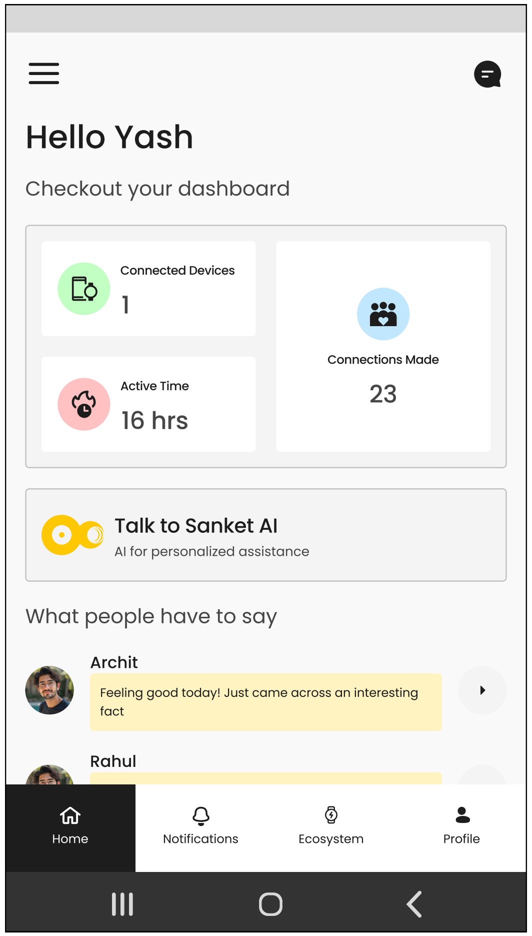
4. Ideation and Design | 4.5 UI Design

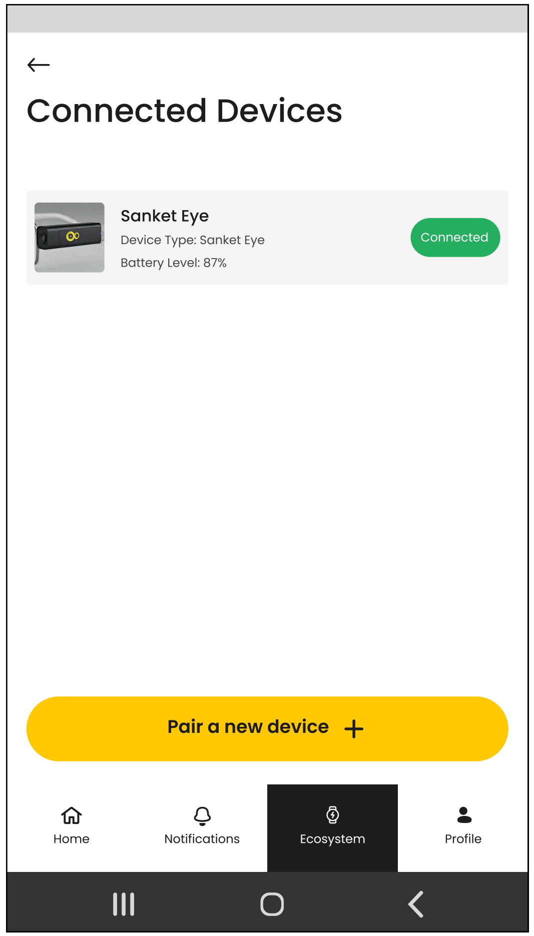
Chat to user profile flow

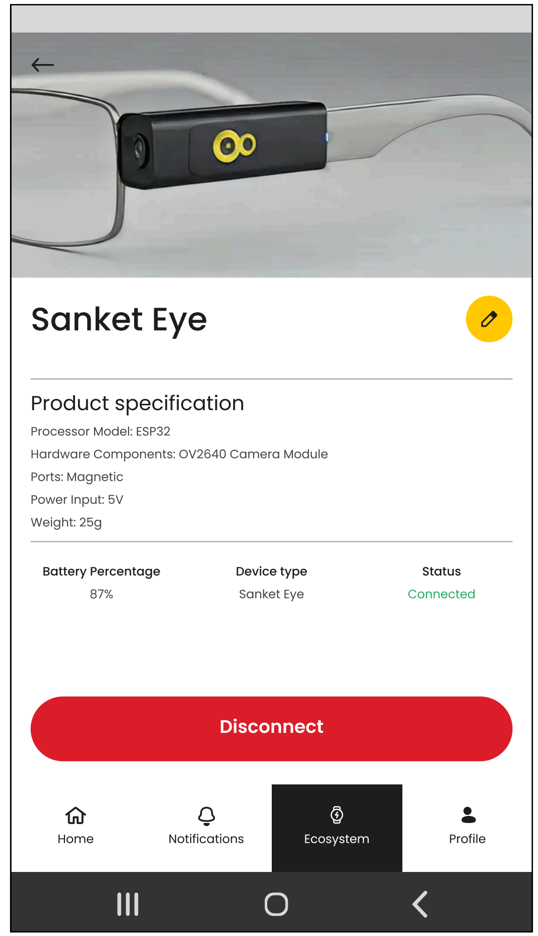


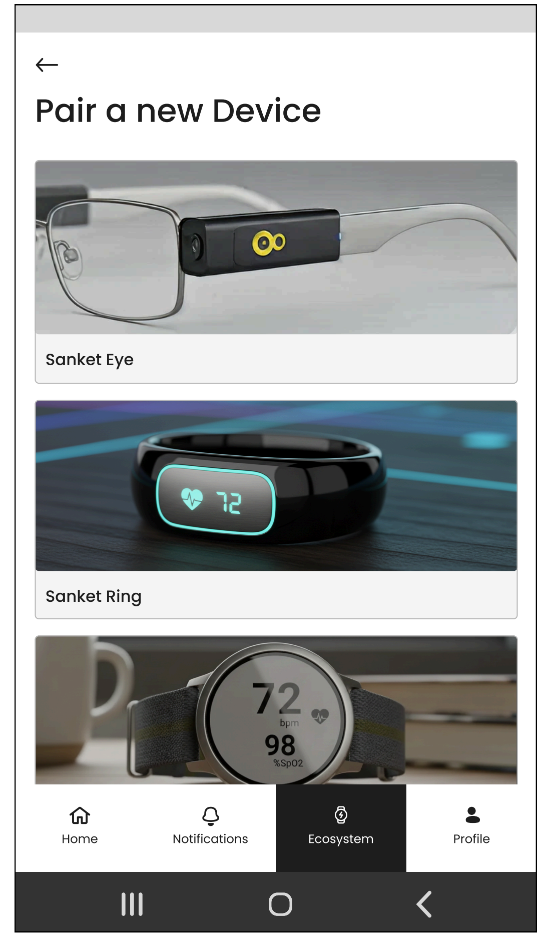
4. Ideation and Design | 4.5 UI Design

Chat to user profile flow



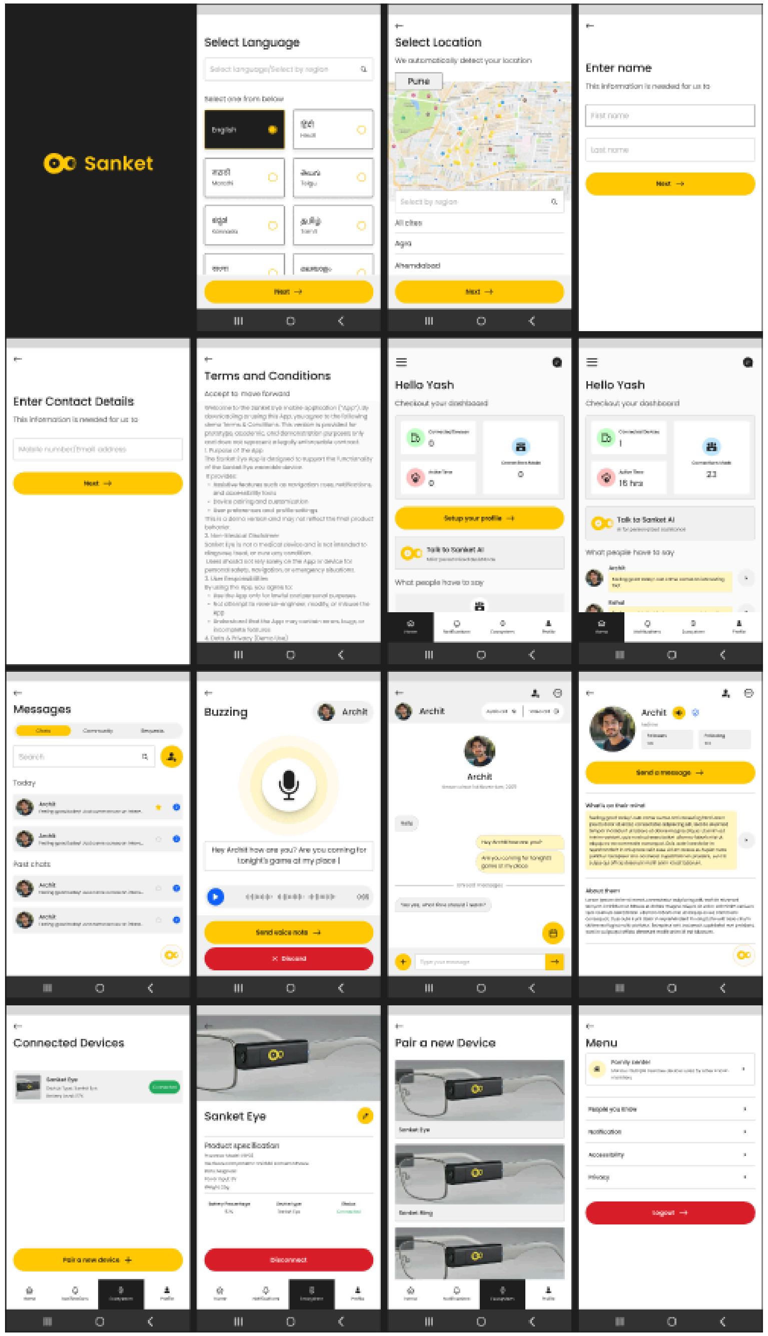




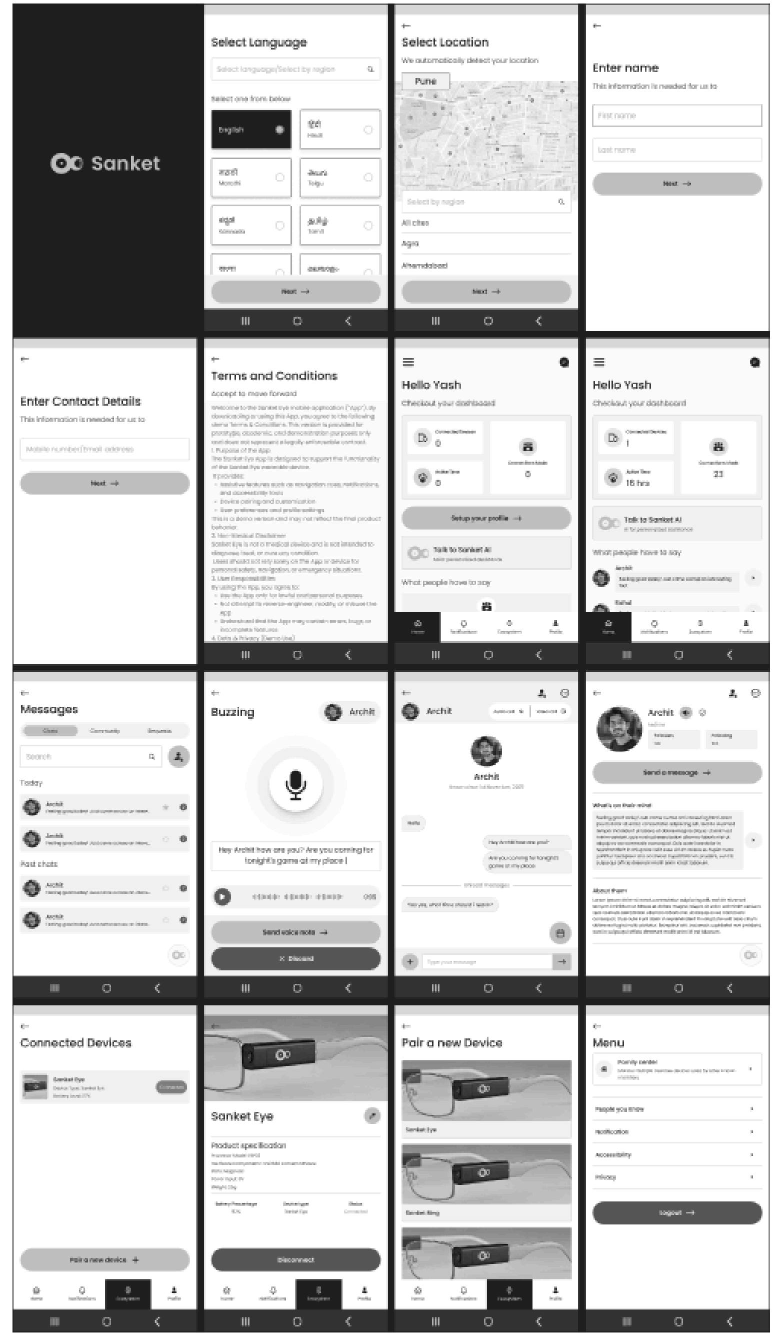


4. Ideation and Design | 4.5 UI Design

UI design as viewed by color-blind users

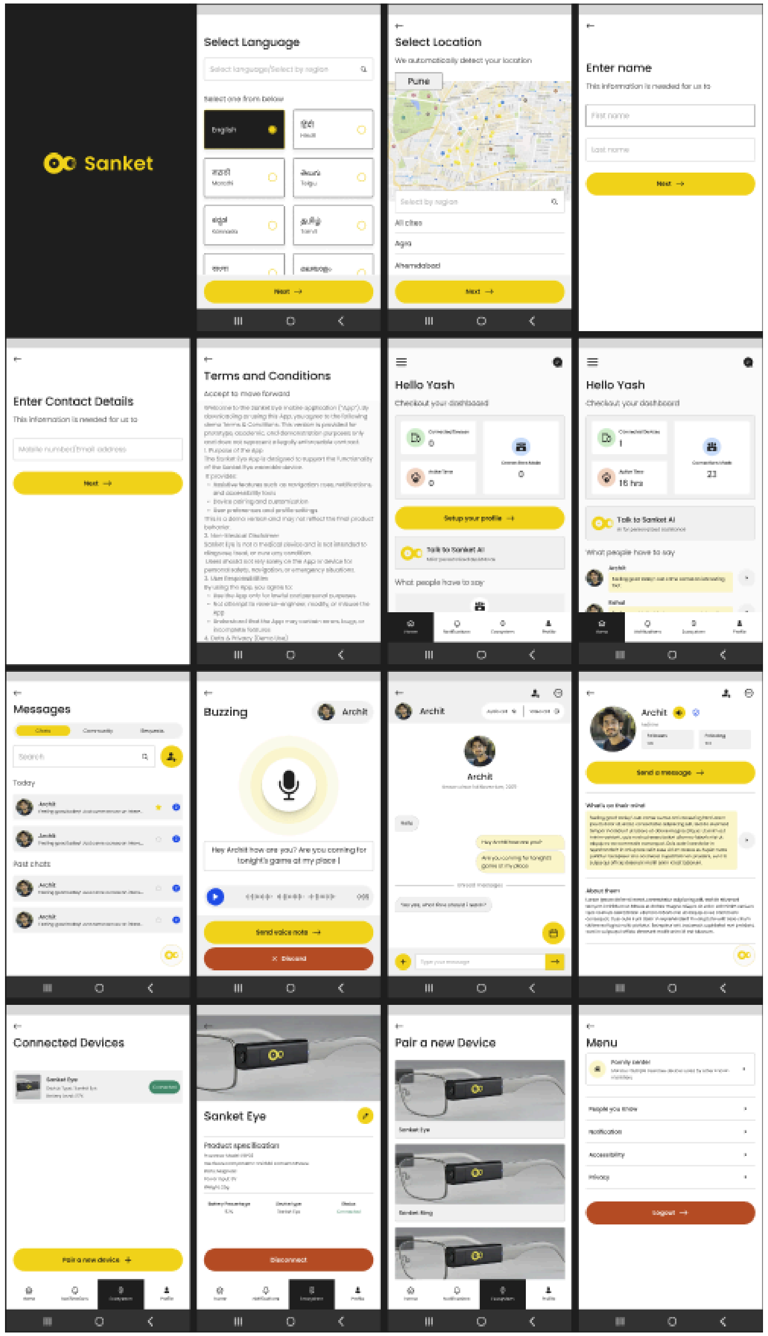


Normal vision

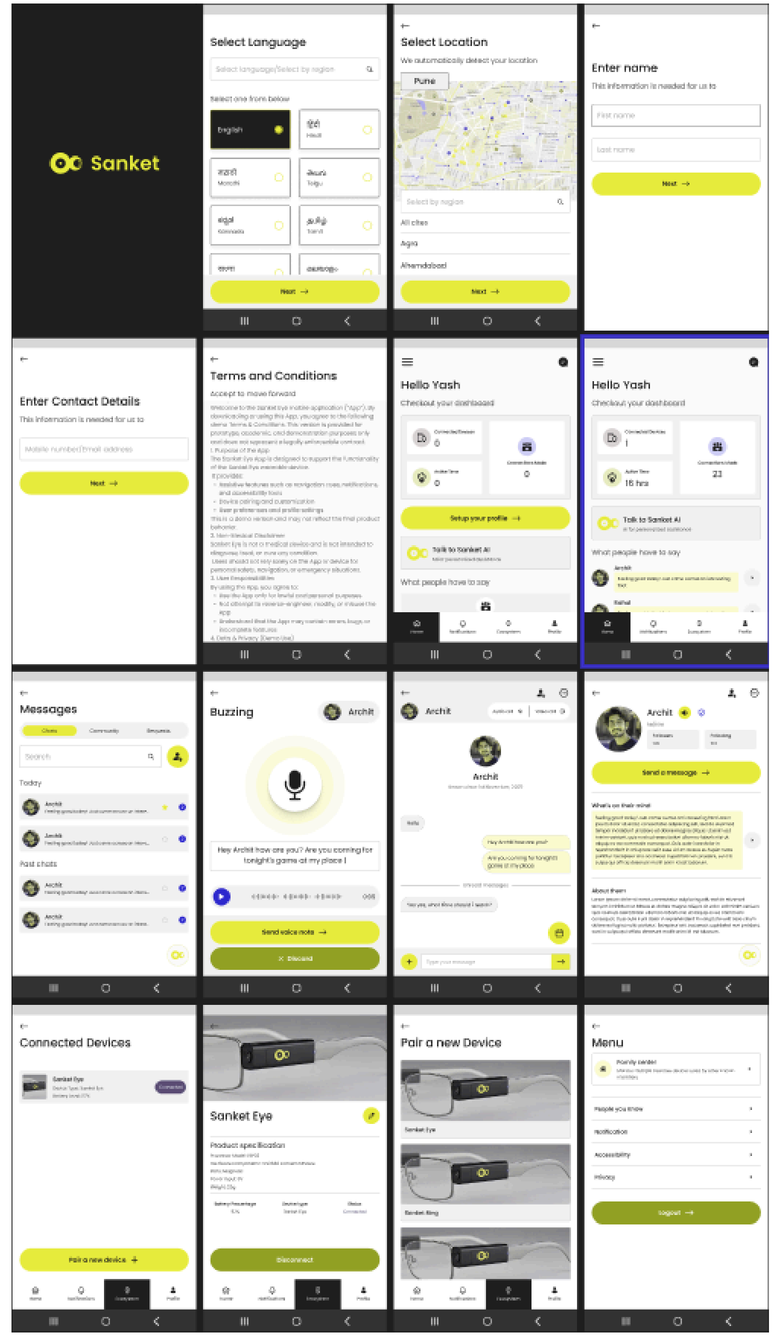


Greyscale (1 in 30 000 have achromatopsia)

4. Ideation and Design | 4.5 UI Design

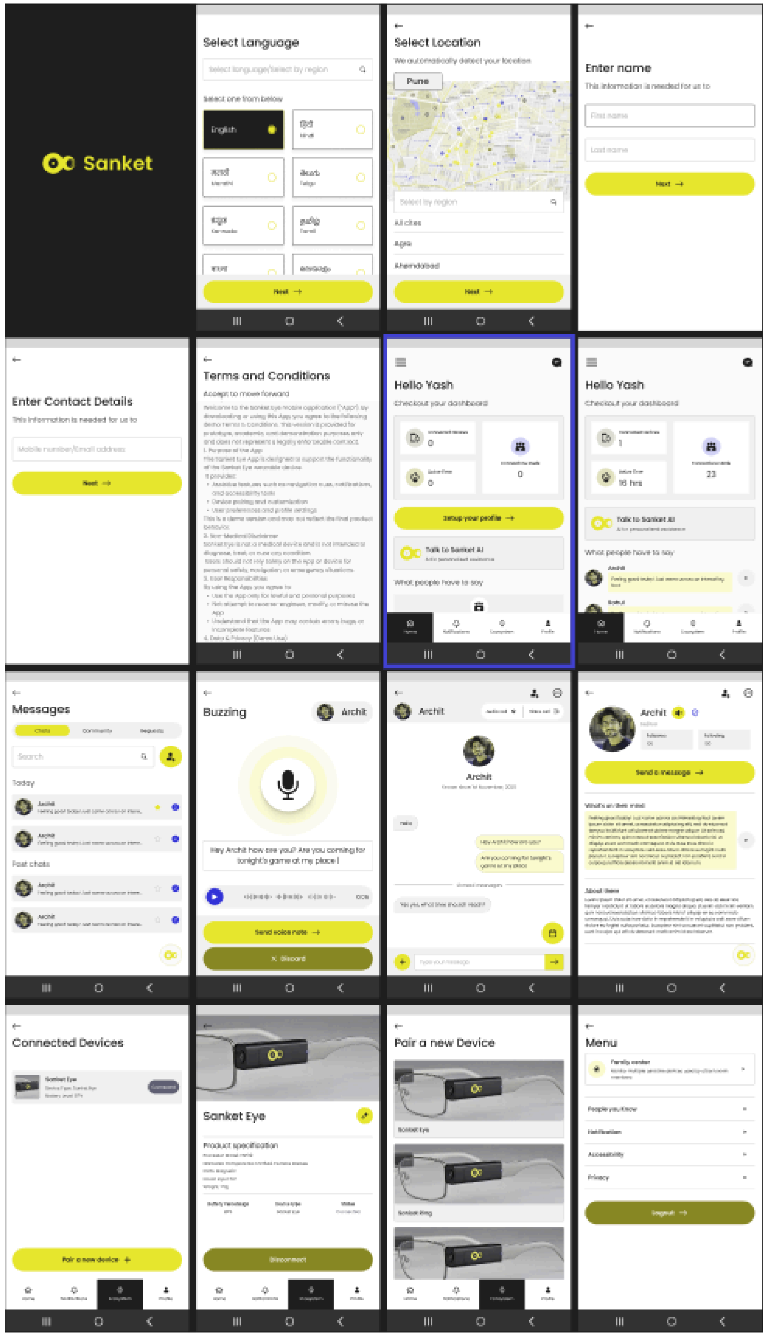


Green weak (1 in 20 men, 1 in 1000 women have deuteranomaly

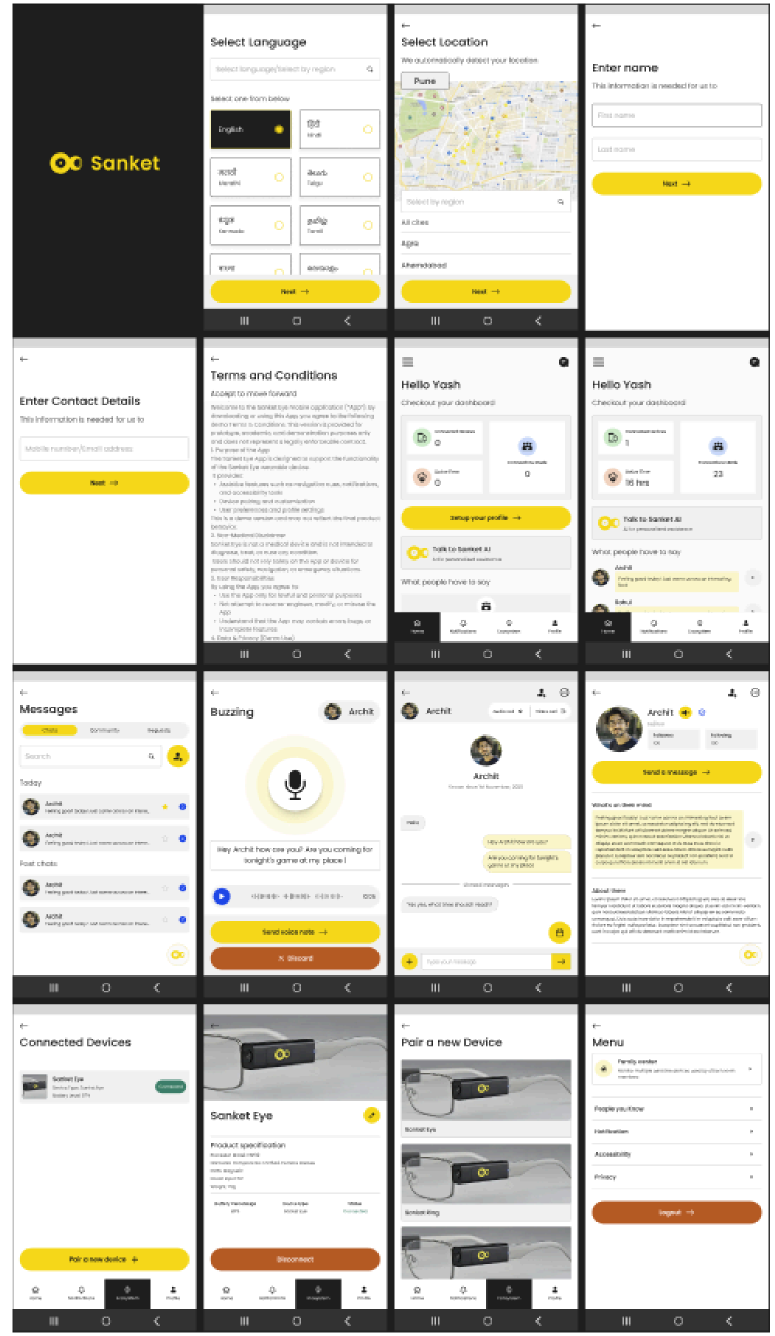


Red/green (1 in 100 men, 1 in 300 women have deuteranopia)

4. Ideation and Design | 4.5 UI Design

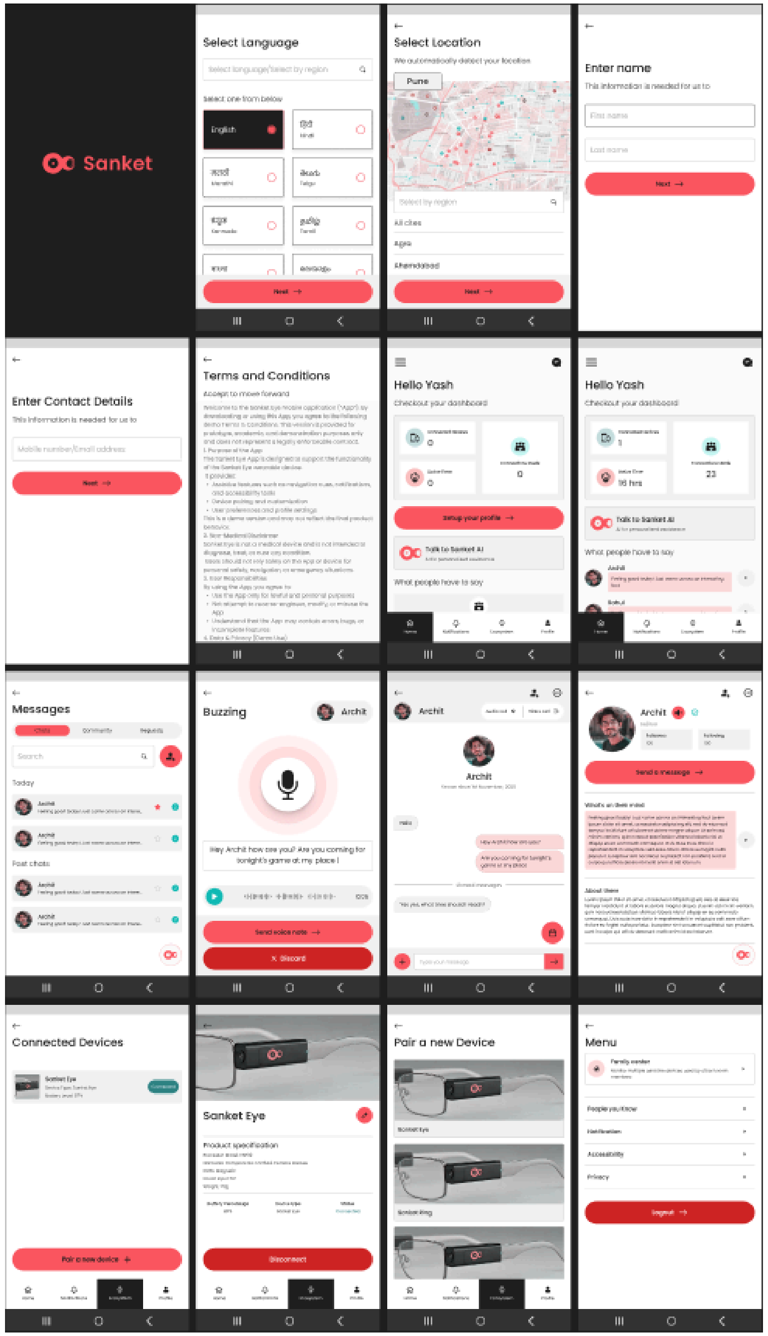


Red/green (1 in 100 men have protanopia)

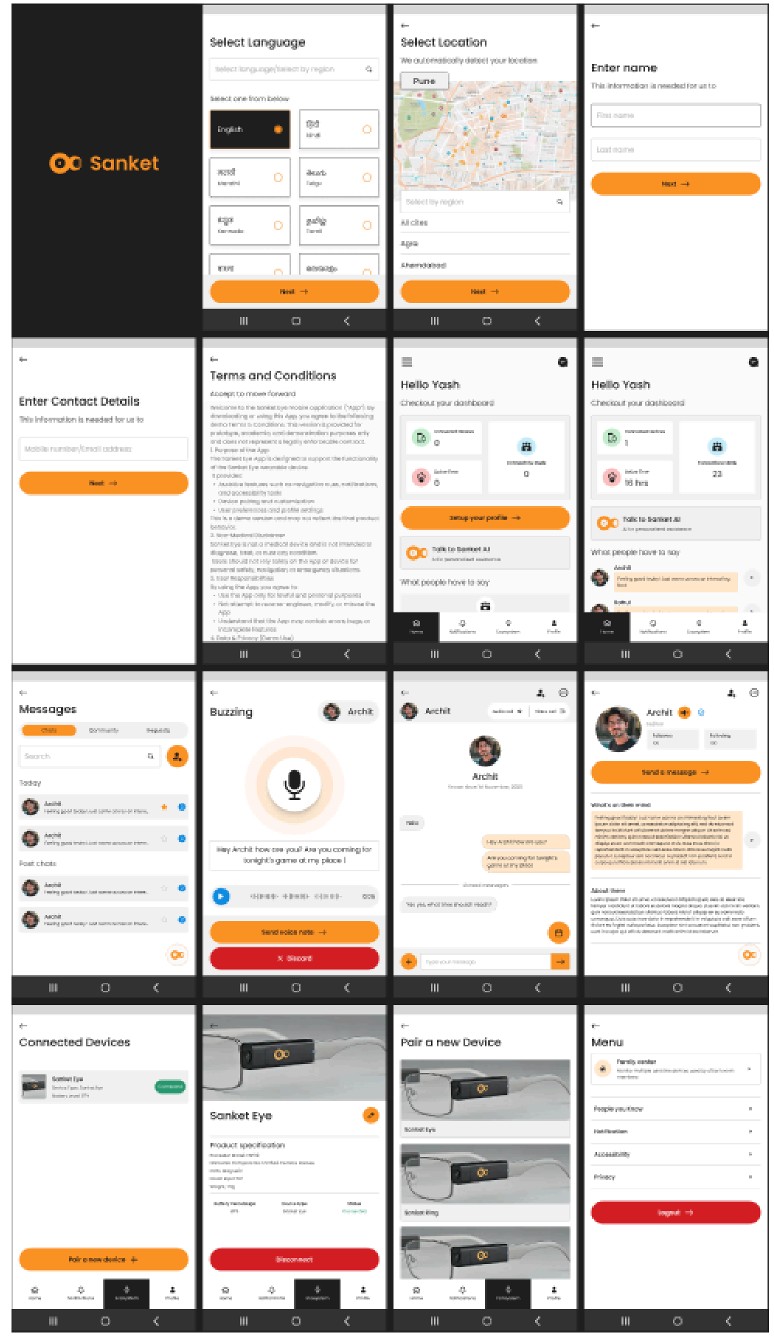


Red/green (1 in 100 men have protanomaly)

4. Ideation and Design | 4.5 UI Design



Blue/yellow (1 in 1000 have tritanopia)



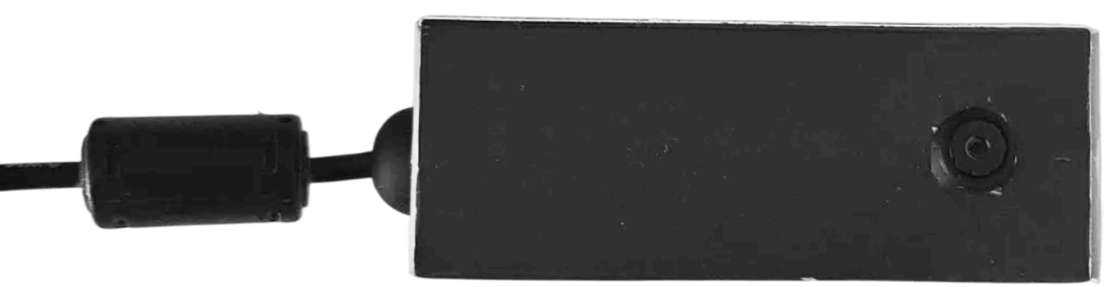
Blue/yellow (1 in 1000 have tritanomaly)

Product and Development

5.1 Technology Used

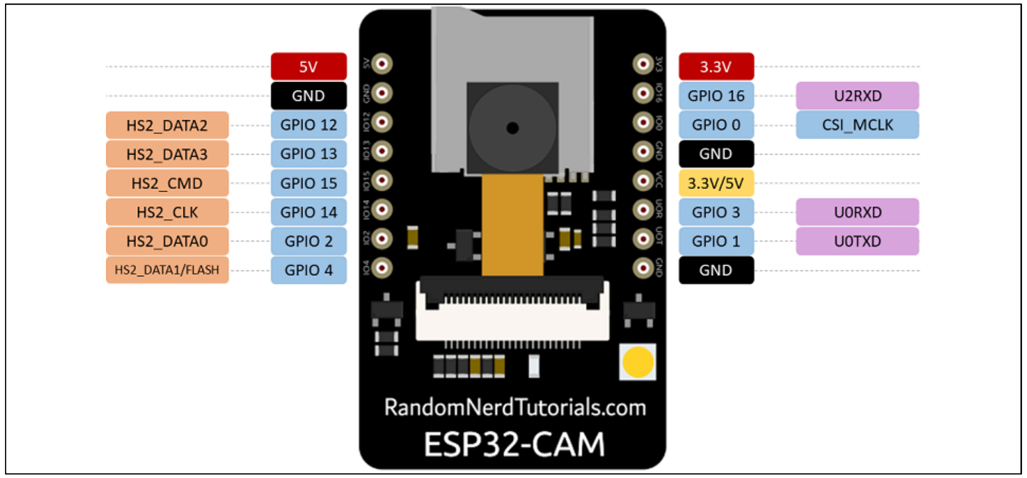
Highlights of this phase

This phase documents my journey of building a simple working prototype from scratch. Coming from a design background, I had to step into the role of a developer for the first time and translate my concept into an MVP with basic functional features. The process involved a steep learning curve—understanding microcontrollers, sensors, and coding while troubleshooting frequent errors. I relied on tools like ChatGPT and Cursor AI, and learned through YouTube tutorials and short-format content to understand technical requirements. Despite the challenges, this phase helped me validate the feasibility of my idea and lay the foundation for the future development of the Sanket ecosystem.



5.1.1 Hardware Overview

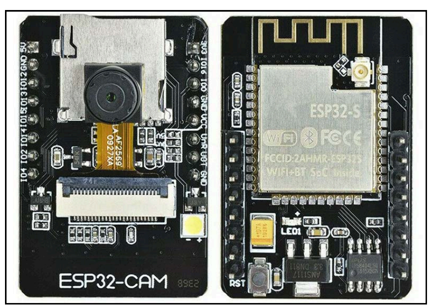
5.1.1.1 ESP32-CAM Module



ESP 32 CAM Module pins

The ESP32-CAM is a small, low-power camera board widely used for IoT, robotics, and surveillance applications. It integrates:

- ESP32-S MCU (dual-core processor running up to 240 MHz)
- OV2640 camera sensor for image capture
- Wi-Fi 802.11 b/g/n support
- MicroSD card slot
- GPIO pins for extensions



ESP 32 CAM Module

Component	Specification
Processor	Tensilica LX6 Dual-Core (240 MHz)
RAM	~520 KB SRAM, PSRAM supported
Storage	MicroSD slot (up to 4–8 GB)
Camera	OV2640 module, 2MP sensor
Wi-Fi	802.11 b/g/n
Image Resolution	160×120 → 1600×1200
Interfaces	UART, SPI, I2C, PWM, ADC
Power Requirements	5V (via USB/FTDI or 5V pin)

5.1.1.2 Why ESP32-CAM is used in this research

Requirement	ESP32-CAM Strength
Low cost	Extremely affordable for assistive devices (Prototype)
Built-in camera	Removes need for external imaging hardware
Wi-Fi capability	Enables real-time image streaming to Flask server
Compact size	Ideal for wearable assistive technology (Prototype)
Open-source ecosystem	Large community support

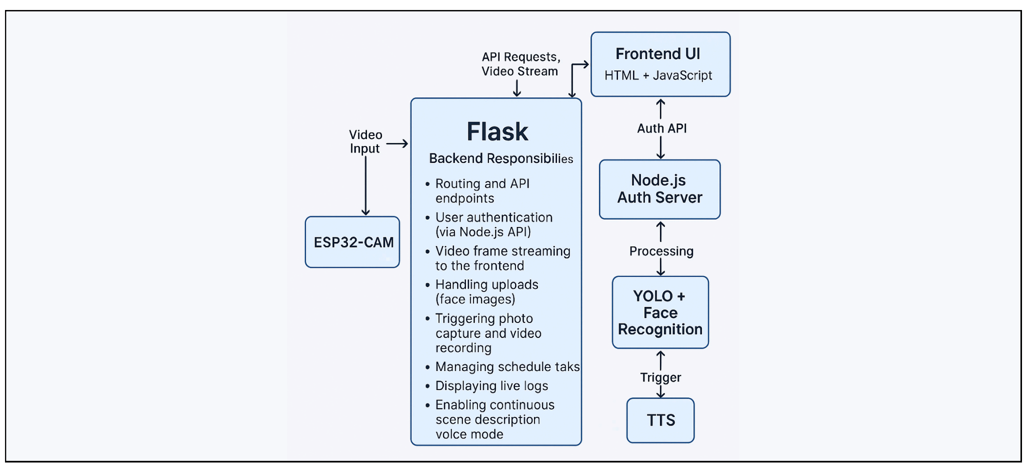
5.1.2 Backend Framework

5.1.2.1 Flask Framework

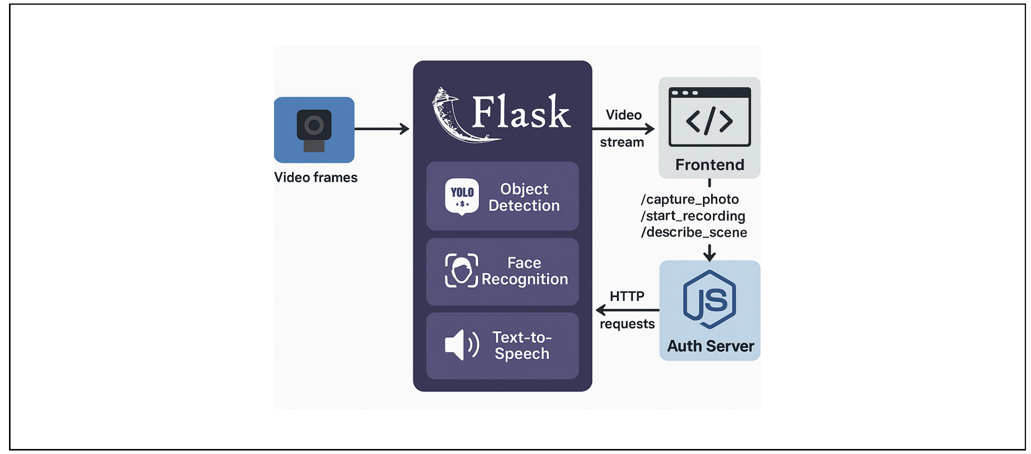
Flask is a lightweight Python web framework that handles:

Key Backend Responsibilities
- Routing and API endpoints
- User authentication (via Node.js API)
- Video frame streaming to the frontend
- Handling uploads (face images)
- Triggering photo capture and video recording
- Managing schedule tasks
- Displaying live logs
- Enabling continuous scene description voice mode

Why Flask is used
- Extremely fast for prototyping
- Easy integration with OpenCV and Python ML models
- Simple structure for building UI + API in one application
- Supports threading, essential for running detection in the background



ESP32-CAM AI System Architecture Diagram



ESP32-CAM → Flask (Detection + TTS + API) → Frontend → Node.js Auth Server

5.1.2.2 Real-Time Detection Loop

A dedicated background thread continuously:
1. Fetches frames from ESP32-CAM using urllib.request
2. Converts them into NumPy arrays
3. Passes them to:
   - YOLOv3 object detection
   - Face Recognition
4. Updates:
   - Frames used in streaming
   - Clean frames for recording
5. Triggers TTS output if continuous voice mode is enabled

Why a background thread?
Because:
- Flask must remain responsive
- Real-time detection cannot block UI requests
- Parallel processing improves UX responsiveness

5.1.3 Computer Vision Technologies Used

5.1.3.1 YOLOv3 Object Detection

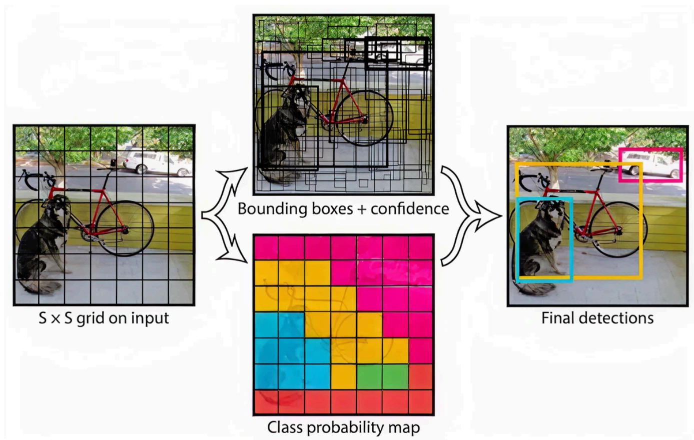
Uses **yolov3.cfg, yolov3.weights, coco.names**
Detects 80+ classes (person, car, bottle, dog, chair, etc.)
Performs:

- Bounding box prediction
- Object categorization
- Confidence scoring
- Non-Max Suppression

Role in UX

- Helps users understand objects around them
- Enables verbal guidance:
  - “I see a person in front of you”
  - “Be careful, there is a chair on your right”

Improves situational awareness for visually impaired users.



YOLO object detection with OpenCV

5.1.3.2 Face Recognition

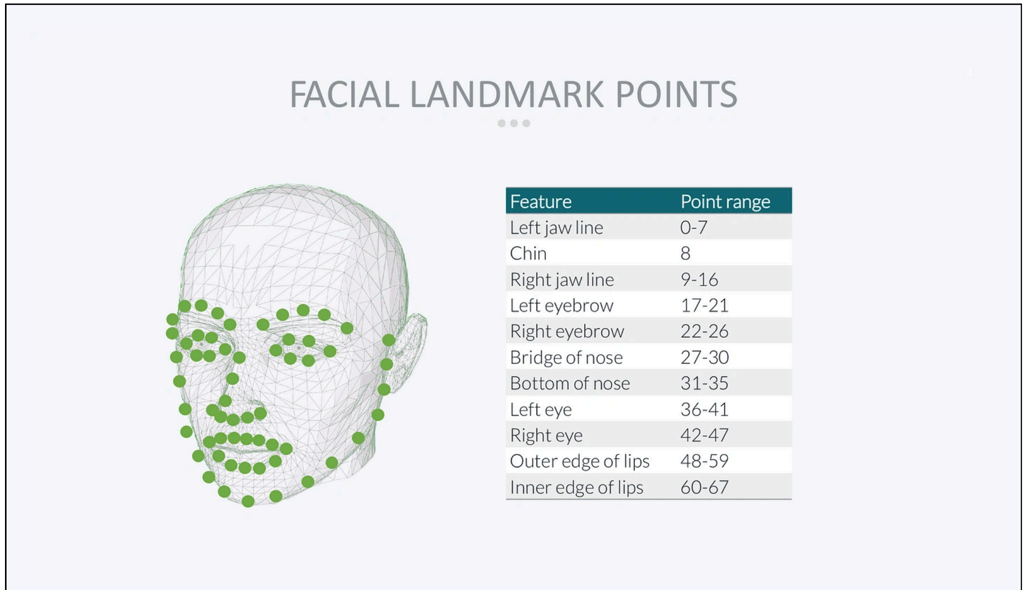
Powered by the face_recognition library:

- Encodes facial embeddings
- Compares them with the stored known faces
- Tells the user:
  - “I see Rohan”
  - “I see your mother”

Why this matters for UX

- Personalized interaction
- Emotional security
- Knowing who is around them improves trust and usability

Users can upload faces directly through the UI.



Feature	Point range
Left jaw line	0-7
Chin	8
Right jaw line	9-16
Left eyebrow	17-21
Right eyebrow	22-26
Bridge of nose	27-30
Bottom of nose	31-35
Left eye	36-41
Right eye	42-47
Outer edge of lips	48-59
Inner edge of lips	60-67

Face Recognition System Using Python

5.1.4 Text-to-Speech System

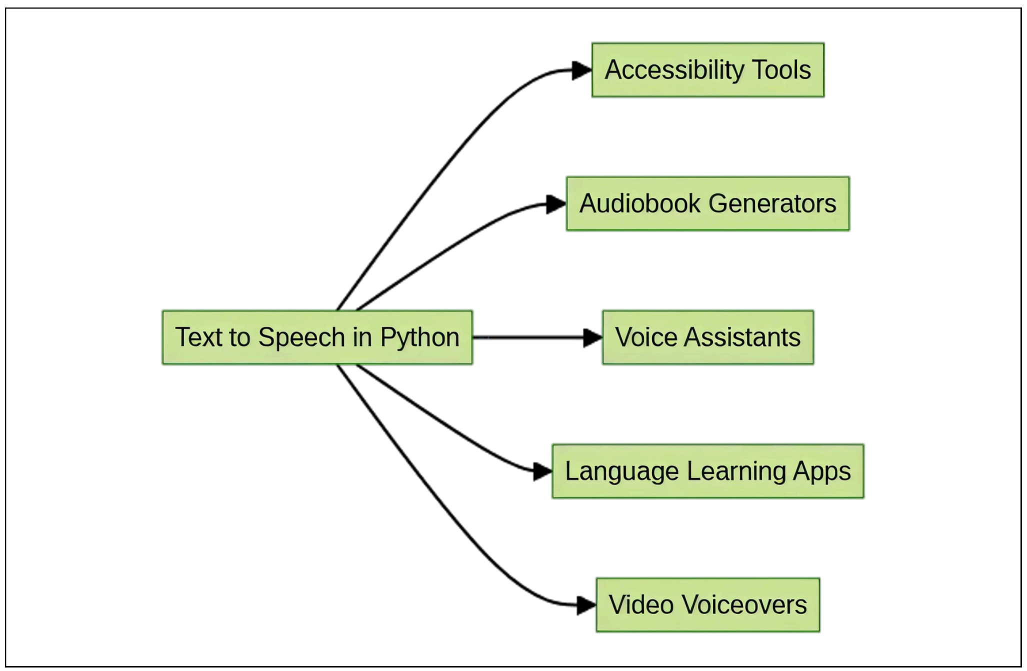
Using pyttsx3:

- Provides offline speech
- Announces:
  - Detected objects
  - Recognized people
  - Task reminders
  - Scene descriptions

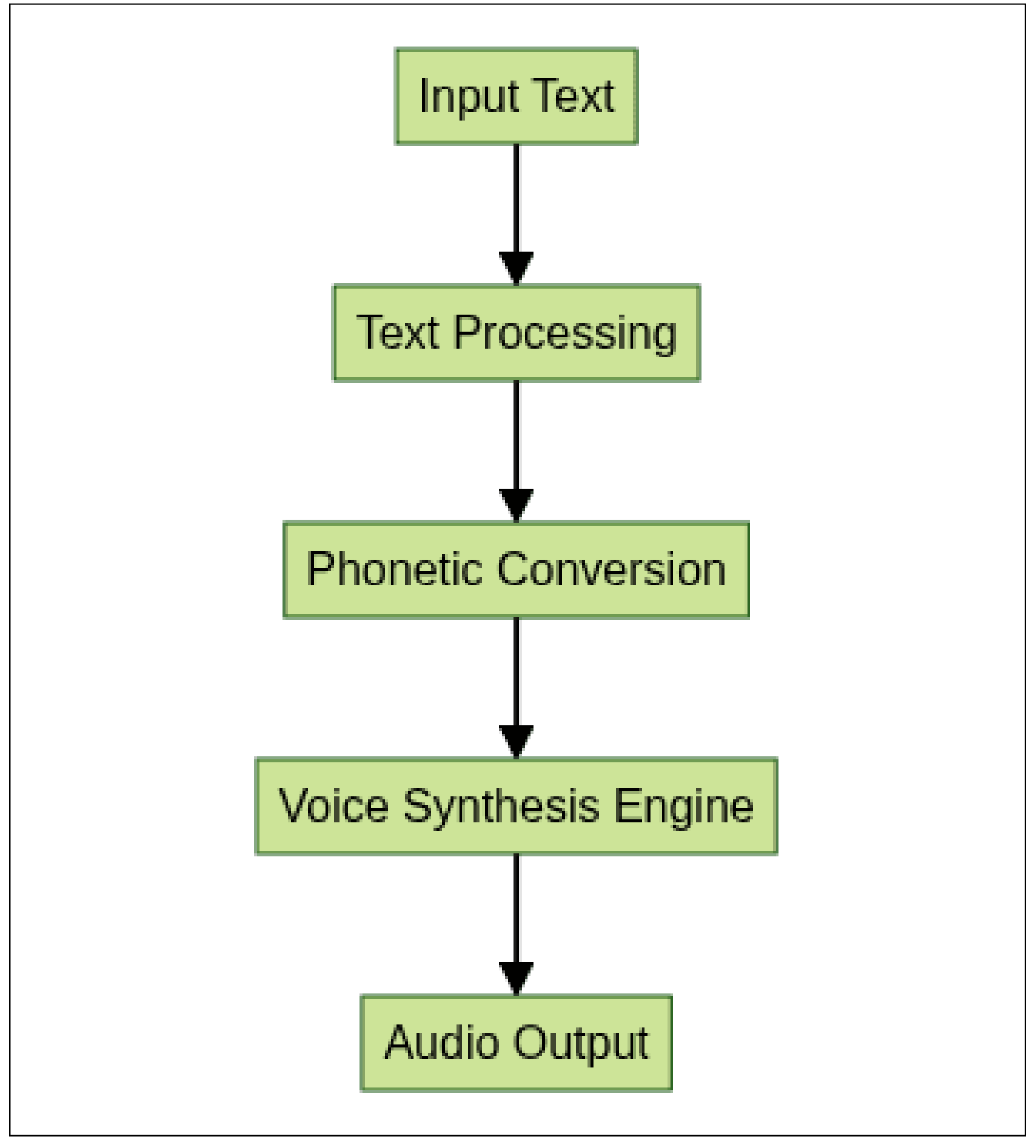
The backend manages speech queueing to avoid overlapping voices, ensuring clean, understandable audio output.

TTS enhances UX by:

- Allowing hands-free interaction
- Supporting real-time auditory feedback
- Reducing cognitive load for visually impaired users



TTS application ecosystem



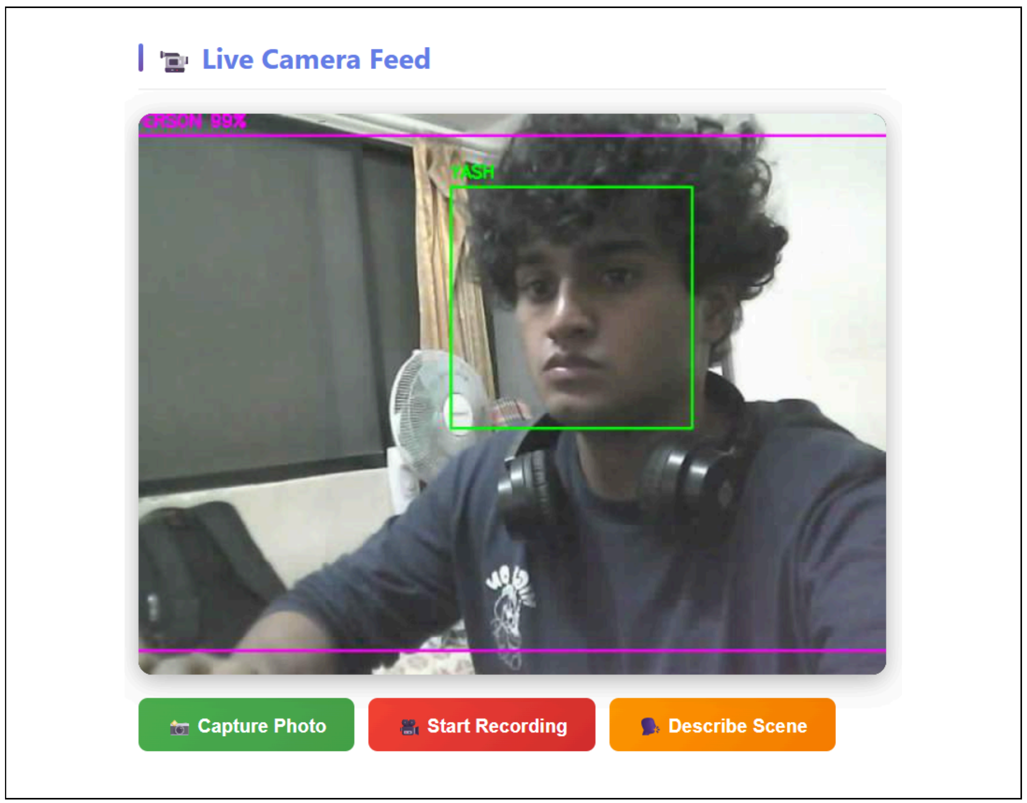
TTS process flow

5.1.5 Video & Photo Management

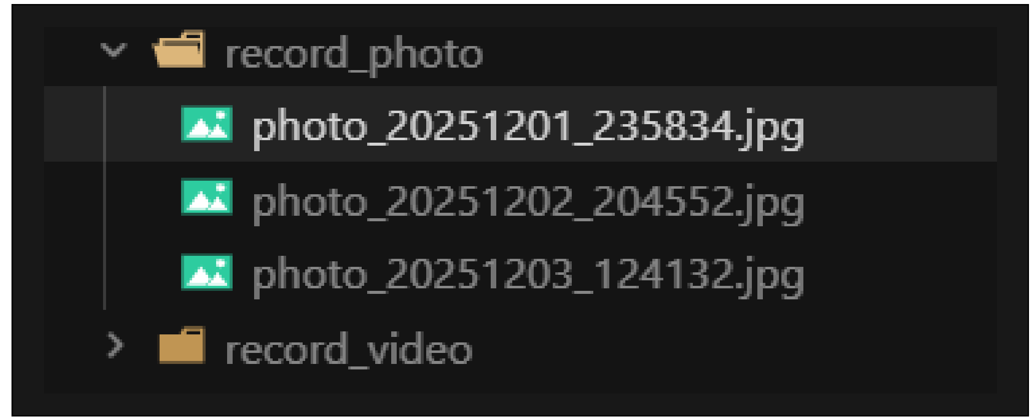
Clean Frame vs Processed Frame
- clean_frame: no bounding boxes → saved to gallery
- current_frame: detection overlays → used for live stream

Features
- Capture still photo
- Start/stop MP4 video recording
- Save to structured folders

These features allow the user to capture important moments or evidence during navigation.



Frontend UI (Proto)



Backend Files where the images and the videos are stored

5.2 Frontend System (HTML + CSS + JavaScript)

The frontend is designed to give users a simple, accessible, and human-friendly interface for managing the device.

Live Camera Feed
Streams real-time video from Flask using MJPEG.

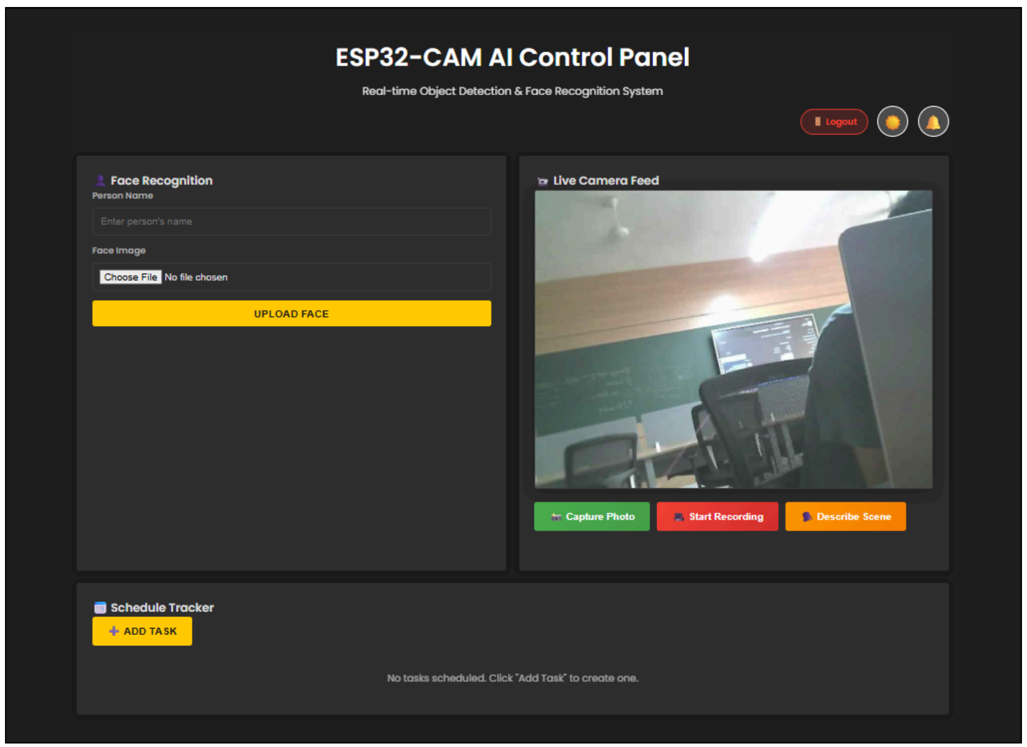
Face Upload Form
Allows users to register known faces.

Video Control Panel
Buttons for: Capture photo, Start/stop recording, Continuous describe scene toggle

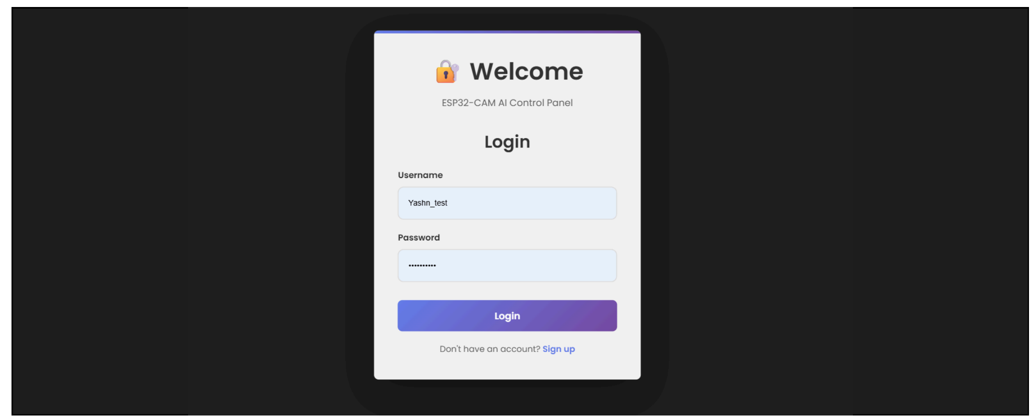
Notifications Panel
Shows scheduled tasks with time-based filtering.

Real-Time Logs Display
Shows detections in real time for transparency and debugging.

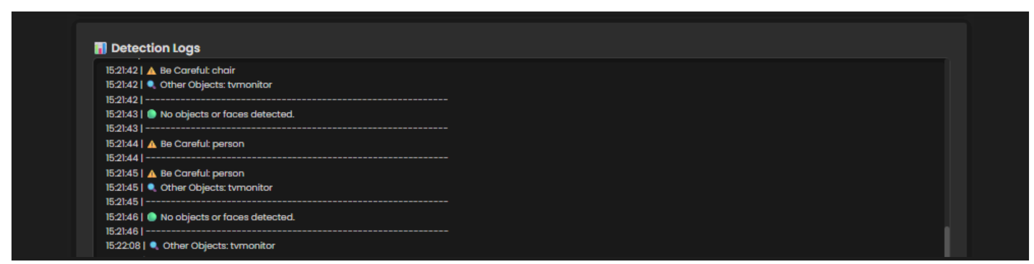
Schedule Management Modal
Add/edit tasks with: Date, Time, Repeat type, Repeat count



App UI (Prototype early stage)

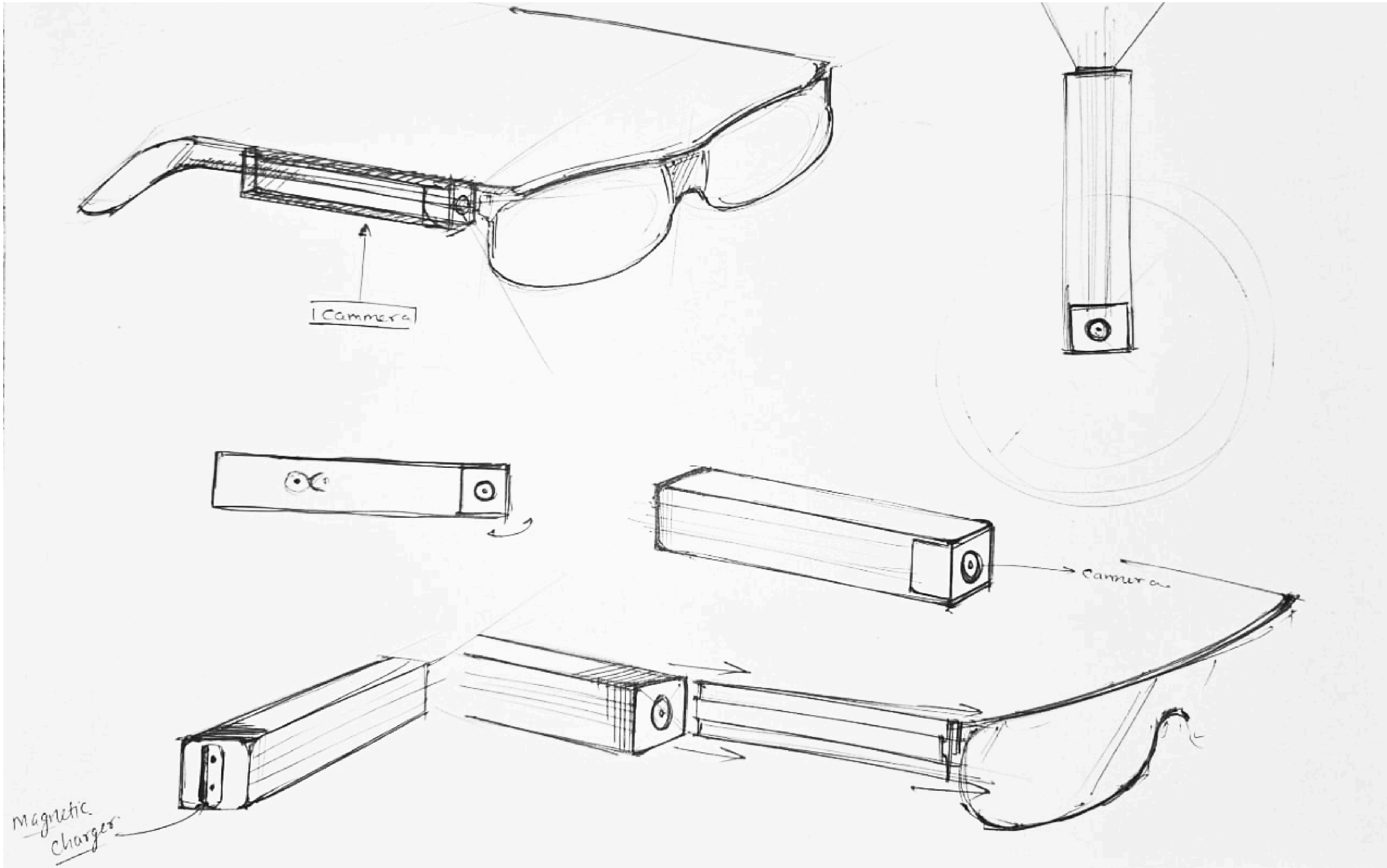


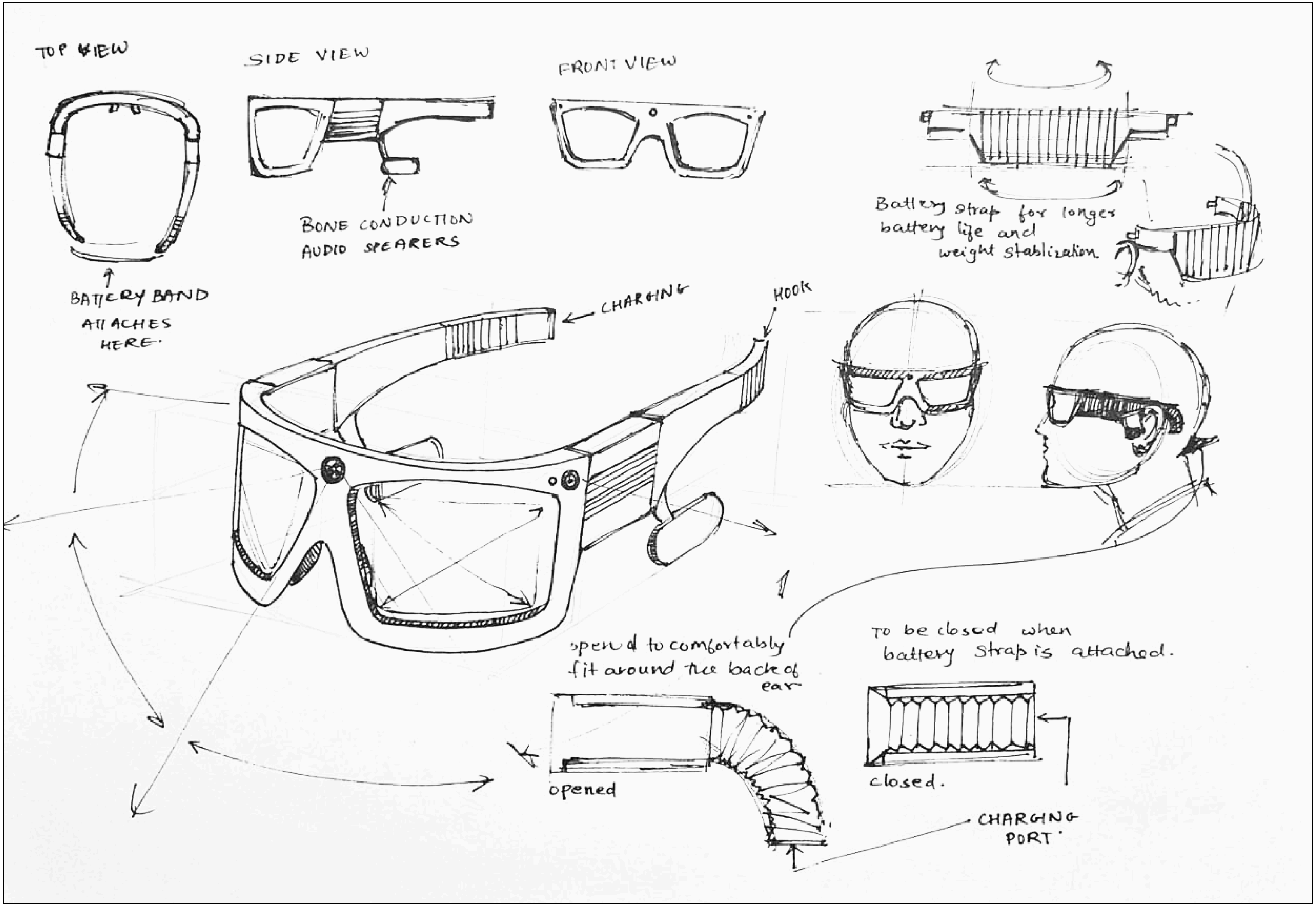
Login UI (Prototype early stage)



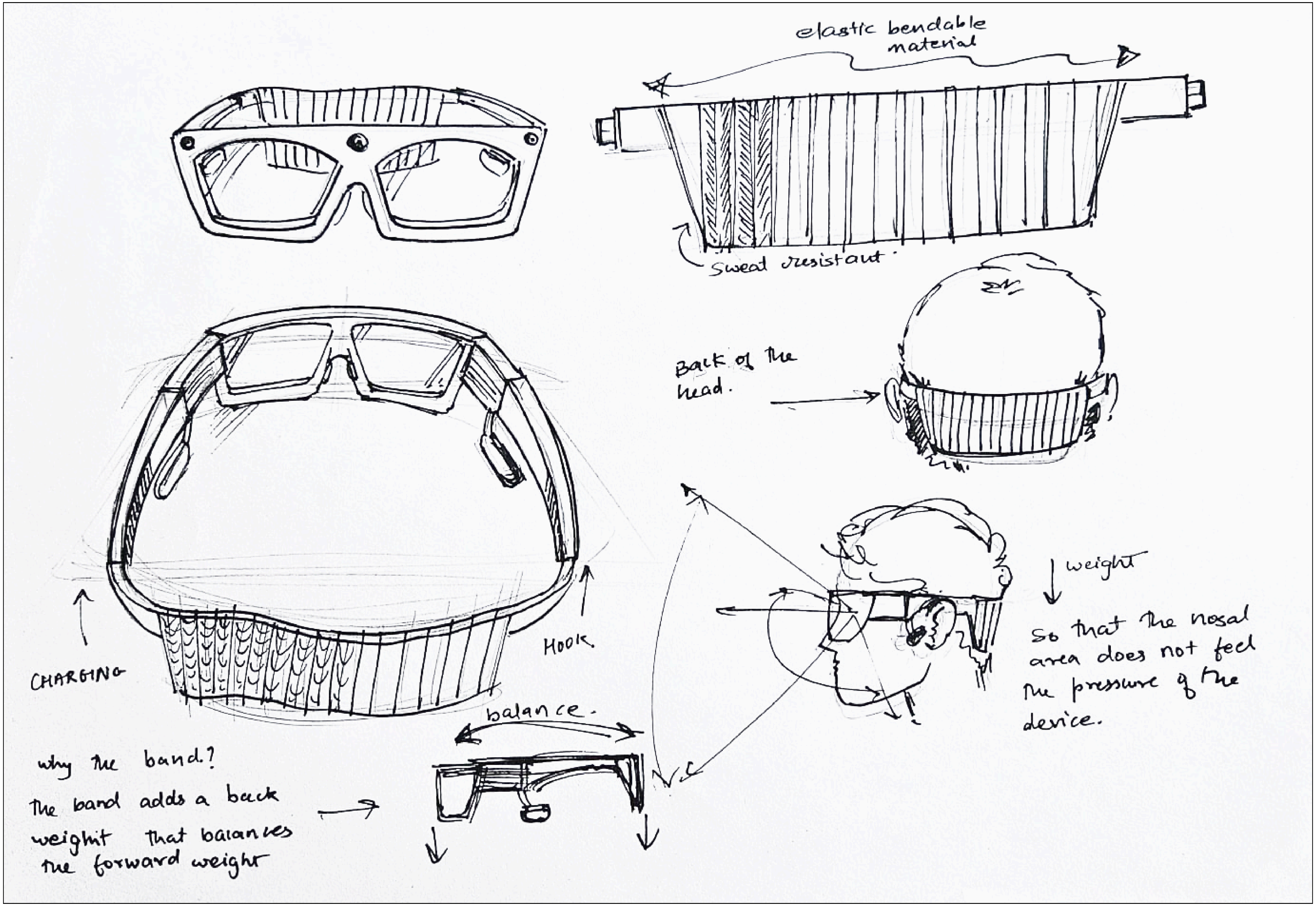
Detection Logs (Just for reference)

5.3 Product Sketches

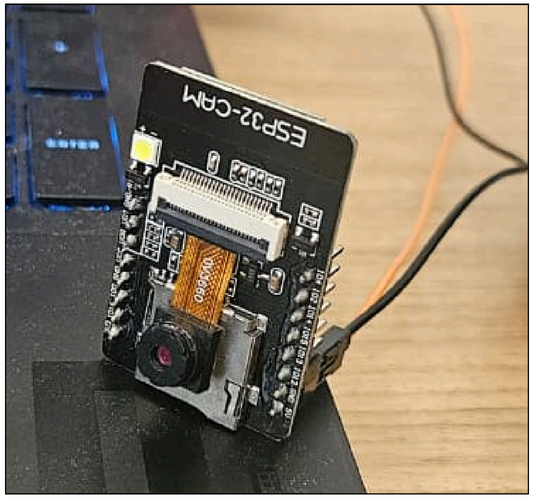




TOP VIEW
SIDE VIEW
FRONT VIEW
BONE CONDUCTION AUDIO SPEARERS
BATTERY BAND ATTACHES HERE.
Battery strap for longer battery life and weight stablization.
CHARGING
HOOK
opened to comfortably fit around the back of ear
To be closed when battery strap is attached.
opened
closed.
CHARGING PORT.

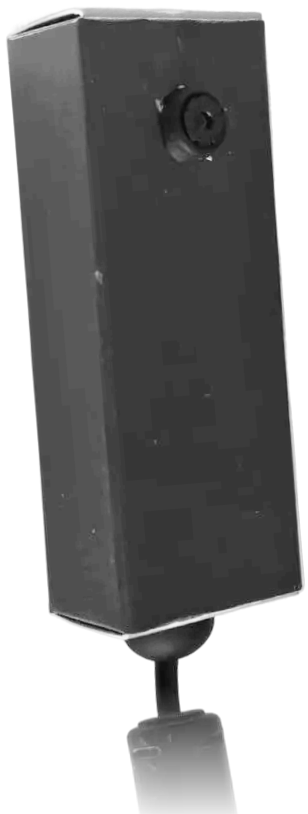

elastic bendable material
Sweat resistant.
Back of the head.
HOOK
CHARGING
balance.
weight
So that the nasal area does not feel the pressure of the device.
why the band?
The band adds a back weight that balances the forward weight

5.4 Physical Product Making



How the Product initially looked?

It was just basic hardware(ESP32). Which I then enclosed in a box, to make it feel like a durable product, and to get a basic shape.



How the Product should actually look?

The end result must be sleek, stylish, lightweight, and easily attachable to accessories like glasses or pendants.

Testing and Future opportunities

6. Testing and Future Opportunities

6.1 Usability Testing

Highlights of this phase

During this phase, I visited the Poona School and Home for the Blind Trust in Pune. There, I had the opportunity to meet Amrut Lokhande, the administrative officer. After some thoughtful discussions, I gathered valuable insights about a device similar to mine that they are currently using in their educational classroom.

Results of this phase

Make the device wireless
Think about lowering the weight before enhancing its appeal.
Constant noise frustrates students, leading to a negative perception of the device. It's beneficial for the device to utilize natural communication methods, as most information is absorbed through touch and sound.
Most information is received through touch and sound, so it's beneficial for the device to utilize natural communication methods.

6.2 Market Scope

Total Addressable Market

Global Market

Visual Impairment
- 2.2 billion people with vision impairment worldwide
- 43 million completely blind globally
- Aging population: 771M (65+) in 2022 → 1.6B by 2050
- Age-related vision loss: 80% of visual impairment in people 50+

Dementia/Alzheimer's
- 55 million people living with dementia globally (2024)
- Projected: 139 million by 2050
- 10 million new cases annually

Assistive Technology Market Size
- 2024: $4.2-6.34 billion (visually impaired assistive tech)
- 2030: $10.68-11.20 billion
- 2035: $13.2-16.3 billion
- CAGR: 10.2-16.3%
- Smart glasses segment: Fastest growing (AI-driven)

TAM = $16+ billion by 2035 globally

India Market (Primary Focus)

1. Visual Impairment
- 62 million visually impaired
- 8 million completely blind
- Congenital/early blind: ~3 million
- Age-related vision loss: ~59 million

2. Dementia/Alzheimer's
- 5.4 million currently (2024)
- Projected: 14 million by 2050
- Annual new cases: ~500,000

3. Dual Diagnosis (Vision Loss + Dementia)
- Estimated 2-3 million people (overlap of elderly with both conditions)
- Highest need, most underserved

4. Elderly (General Safety)
- 104 million people aged 60+ (2022)
- Projected: 319 million by 2050 (tripling in 30 years)
- Fall risk: 6.8 million fall-related injuries annually in India

Current served market: <₹500 crores (99% unserved)

Serviceable Obtainable Market (SOM)

Year 1-2: Early Adoption Phase

Target: 500-2,000 users
Channels:
- NGO partnerships (50% of sales)
- Direct sales through website (20%)
- Eye hospital referrals (20%)
- Retail/Amazon (10%)

Revenue: ₹1.75-7 crores

Market Share: 0.001% of SAM

Year 3-4: Growth Phase

Target: 10,000-30,000 users
Expansion:
- ADIP subsidy inclusion (government support)
- 20+ NGO partnerships
- 100+ hospital referral network
- Amazon, Flipkart, retail presence (10 cities)
- 3-5 CSR partnerships

Revenue: ₹35-120 crores

Market Share: 0.07-0.2% of SAM

Year 5: Scale Phase

Target: 50,000-100,000 users
Maturity:
- Pan-India distribution
- Insurance reimbursement
- Institutional sales (100+ senior living facilities)
- International expansion begins (Southeast Asia)

Revenue: ₹175-400 crores

Market Share: 0.4-0.8% of SAM

Sanket Eye Market Position

Price-Performance Sweet Spot:

Above: Affordable alternatives (₹0-15K) with limited features
Below: Premium devices (₹1.3-5L) that are unaffordable
Sanket Eye: ₹10-60K with comprehensive features

Competitive Advantages:

1. Only device designed for dual diagnosis (vision + dementia)
2. Only modular ecosystem (customize based on needs)
3. Only India-focused (local languages, currency, support)
4. Only aesthetic-first assistive device (non-stigmatizing)
5. Price: 60-85% cheaper than premium alternatives

Market Growth Drivers

1. Aging Population (Massive)
   - 104M elderly (60+) → 319M by 2050 (3x growth in 30 years)
   - Every year: +7-8 million elderly Indians
   - 76% of 80+ have vision impairment
2. Dementia Epidemic
   - 5.4M → 14M by 2050 (2.6x growth)
   - +500K new cases annually
   - Increasing awareness and diagnosis
3. Diabetes-Related Vision Loss
   - 77 million diabetics in India (2nd highest globally)
   - Diabetic retinopathy: Leading cause of blindness
   - Growing epidemic
4. Rising Middle Class
   - 400M+ middle class by 2030
   - Increasing healthcare spending
   - Tech adoption accelerating

Market Barriers

1. 1. Affordability (Even at ₹20-40K)
    - Median household income: ₹31,000/month
    - Still 1-2 months salary
    - Need subsidies/financing for mass adoption
2. 2. Awareness Gap
    - 80% of visually impaired unaware smart assistive tech exists
    - Low digital literacy in target demographic
    - Need extensive education
3. 3. Distribution Challenges
    - Tier 2/3 cities harder to reach
    - Retail infrastructure limited for assistive tech
    - After-sales support network needs building
4. 4. Stigma & Adoption
    - Cultural resistance to assistive devices
    - Family decision-making complexity
    - Trust in new brands/technology
5. 5. Regulatory Uncertainty
    - Medical device vs. consumer electronics classification unclear
    - Privacy regulations evolving (DPDP Act 2023)
    - Standards for assistive tech not well-defined

6.3 Conclusion

In conclusion, Sanket Eye represents a meaningful step toward bridging the accessibility gap for visually impaired and aging individuals by integrating intelligent assistance into everyday wearables. Through research, prototyping, and iterative design, the project demonstrates how discreet, affordable, and modular technology can support independence, safety, and confidence in environments that are often inaccessible or unpredictable. While still in its early stages, the concept establishes a foundation for a broader assistive ecosystem that empowers users without stigma and adapts to diverse needs. Sanket Eye not only addresses immediate mobility and awareness challenges but also contributes to a more inclusive future where assistive support is seamlessly woven into daily life for everyone.

6.4 The Video

Scan The QR code to see the product function

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