EYE EMPOWER

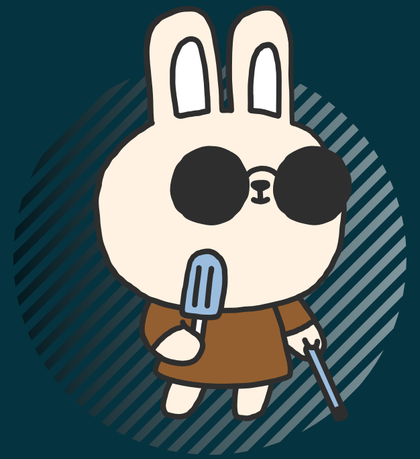
A Computer Vision Project

To enable the blind and visually impaired to shop

BNU

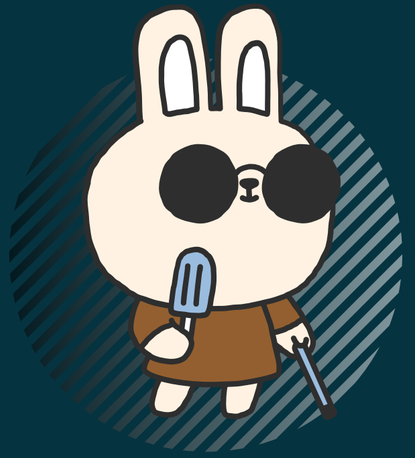
TEAM

OMAR RAMADAN



SARA YASSER

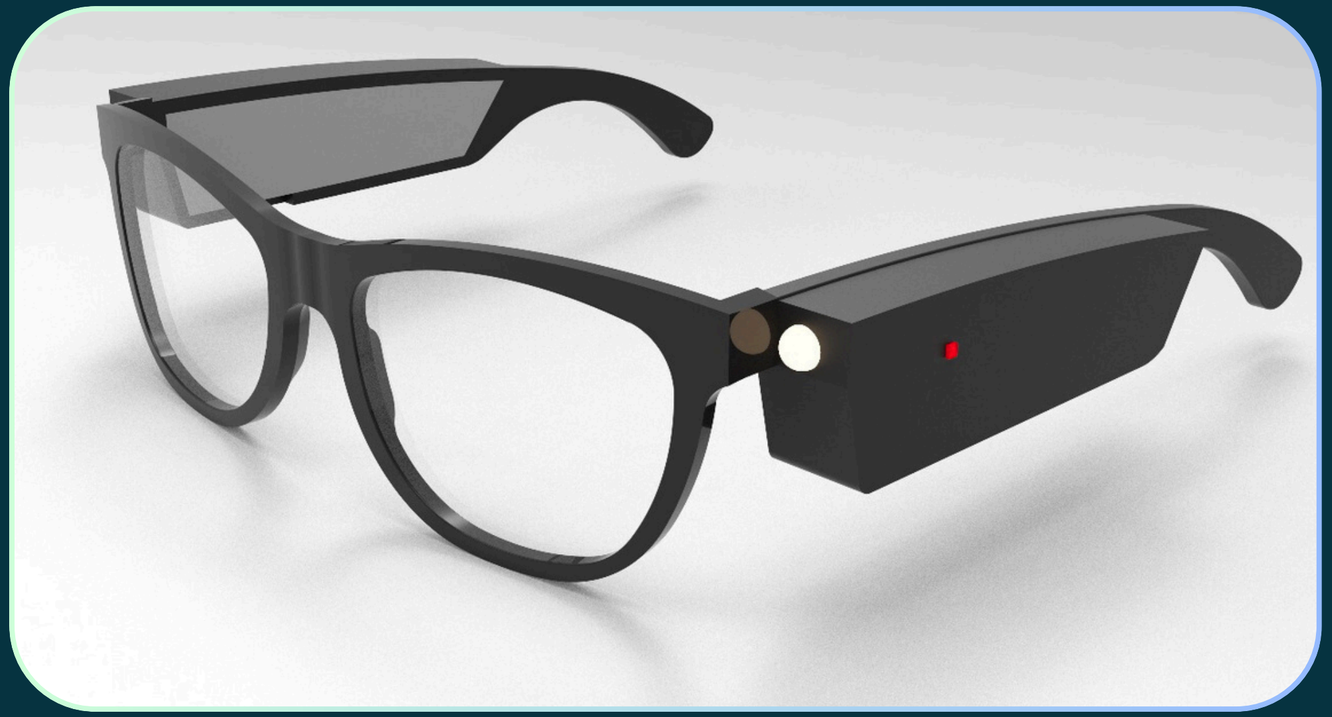
MARIAM EL-ROMANY

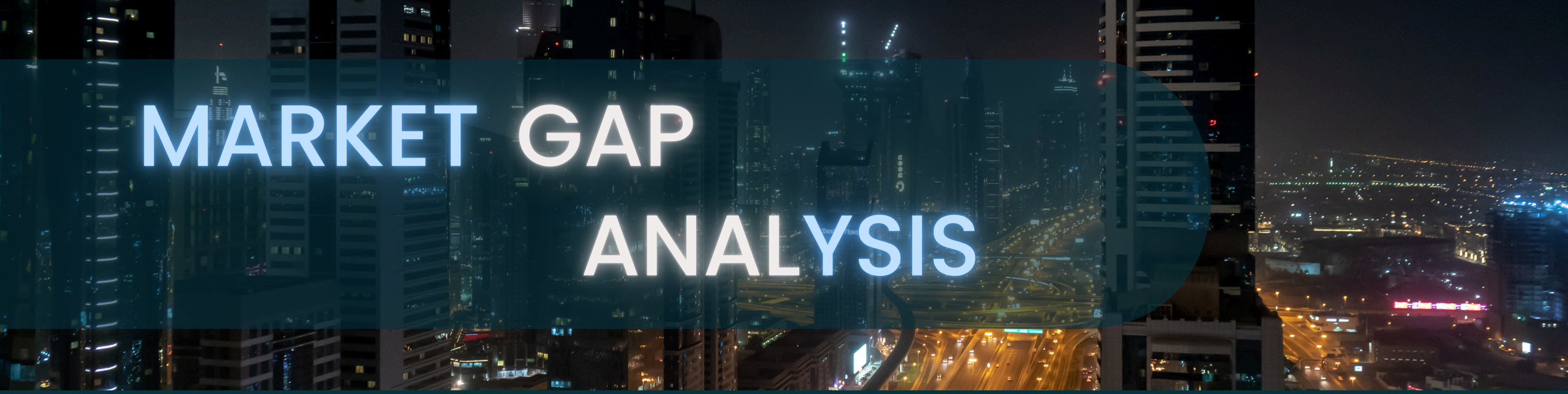


MENNA MAHMOUD

prototype

product





MARKET GAP ANALYSIS

★ Current Solutions Limitations:

- White canes provide mobility but no product identification
- Guide dogs are expensive (30,000+ EGP) and require extensive training
- Human assistance creates dependency and privacy concerns
- Existing mobile apps lack comprehensive shopping integration
- No integrated payment solutions for the visually impaired in Egypt

★ Market Size in Egypt:

- **Target population :** ~1.2 million visually impaired individuals Economic
- **impact :** 60% unemployment rate among visually impaired Shopping
- **dependency :** 85% require assistance for grocery shopping

Primary Needs:

1. **Independence :** Ability to shop without human assistance
2. **Safety :** Secure navigation and payment processing
3. **Privacy :** Confidential financial transactions
4. **Accessibility :** Arabic language support and cultural adaptation
5. **Affordability :** Cost-effective solution for Egyptian market

OPPORTUNITIES

Market Opportunities:

1. Untapped assistive technology market in MENA region
2. Government initiatives supporting disability inclusion Growing
3. smart glasses market (projected 15% CAGR) Partnership
4. opportunities with major retailers (Carrefour, Metro, etc.)

Social Impact:

1. Employment opportunities for visually impaired individuals
2. Reduced caregiver burden
3. Enhanced quality of life and dignity
4. Economic inclusion and independence

Computer Vision for Accessibility:

- Zhang et al. (2023):"Real-time Object Detection for Visually Impaired Navigation" - Advanced YOLO implementations
- Kumar & Patel (2022):"Deep Learning Approaches in Assistive Technologies" - CNN architectures for product recognition
- Microsoft's Seeing AI research (2021): Limitations in crowded retail environments

Market Gaps Identified:

- No comprehensive shopping solutions
- Lack of Arabic language optimization
- Missing payment integration
- No offline functionality
- Limited cultural adaptation for Egyptian market

Competitive Analysis:

1. Seeing AI (Microsoft) : Limited to basic object identification, no shopping integration
2. Be My Eyes : Human-assisted but not autonomous, privacy concerns
4. OrCam MyEye : $4,500 price point, limited Arabic support

Consumer Research:

- Edge AI processing: 40% improvement in response times
- Bone conduction audio: Safer environmental awareness
- Haptic feedback evolution: More precise tactile communication
- SLAM technology advancement: Better indoor navigation accuracy

COMPUTER VISION PIPELINE

PRODUCT RECOGNITION METHOD:

Primary

YOLOv10-Nano for real-time object detection

- Optimized for Raspberry Pi 4 processing

Technical Justification

YOLOv10-Nano chosen for:

- 45% faster inference than YOLOv8
- 60% smaller model size (suitable for edge computing)
- Better performance on small objects (typical retail products)

Secondary

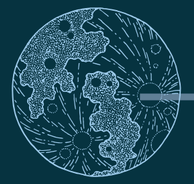
Mask R-CNN for instance segmentation

- Handles overlapping products
- Precise boundary detection for cluttered environments

Fallback

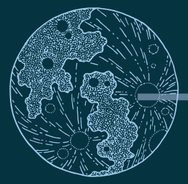
Barcode/QR scanning using ZBar library Ensures 99% product identification reliability

SOFTWARE RESOURCES



Development Tools:

- **Python 3.9+:** Core development language
- **OpenCV 4.6:** Computer vision operations
- **PyTorch 1.12:** Deep learning framework
- **SQLite:** Local database management
- **Git/GitHub:** Version control and collaboration



APIs and Services:

- **Google Maps API:** Store location and navigation
- **Google Search API:** Product reviews and information
- **Firebase:** Real-time synchronization with caregivers
- **Tacotron 2:** Arabic text-to-speech synthesis

Availability: All software resources are open-source or have academic licenses available through university partnerships.

HARDWARE RESOURCES

Electronics and Robotics Lab (Cost: 35,280 EGP)

Raspberry Pi 4 (8GB) × 3: 17,400 EGP

- Available at MicroOhm-EG (verified supplier)
- 30-day delivery guarantee

5MP Cameras × 3: 1,350 EGP

- OV5647 modules with 120° FOV
- Auto-focus capability for 10cm-2m range

Haptic Motors × 3: 1,800 EGP

- Linear resonant actuators (LRA)
- PWM-based intensity control
- 5 vibration levels

Li-ion Batteries × 3: 1,500 EGP

- 1000mAh capacity
- USB-C fast charging
- 8+ hours operation time

PCB Design Kit: 1,200 EGP

- Oscilloscope (100MHz)
- Multimeter and soldering station
- Essential for prototype validation

IMU Sensors (BNO055) × 3: 9,300 EGP

- 9-axis precision sensors
- ±0.3° orientation accuracy
- Available at Future Electronics Egypt

Bone Conduction Speakers × 3: 2,250 EGP

- 8-hour battery life
- Bluetooth 5.0 connectivity
- Safety-compliant design

AI LAB REQUIREMENTS

High-Performance Workstation:

- **GPU:** NVIDIA RTX 4090 (for model training)
- **CPU:** Intel i9-13900K or AMD Ryzen 9 7950X
- **RAM:** 64GB DDR5
- **Storage:** 10TB NVMe SSD for dataset storage

PROTOTYPING LAB

3D Printing Equipment:

- **FDM Printer:** Prusa i3 MK3S+
- **Resin Printer:** Form 3+ for detailed components
- **Materials:** PLA, PETG, TPU for different components

OPTICAL CHARACTER RECOGNITION

Multi-Language OCR System:

- **EasyOCR:** Primary for Arabic text recognition
- **Tesseract:** Backup for English/numbers Custom
- **preprocessing:** Image enhancement for retail lighting conditions

Arabic Text Challenges Addressed:

- Right-to-left text orientation
- Connected letter recognition
- Price format variations (Arabic-Indic numerals)

SPATIAL NAVIGATION

Visual SLAM Implementation:

- **ORB-SLAM3:** Simultaneous Localization and Mapping
- **IMU Integration:** BNO055 9-axis sensor for head
- **tracking Map Persistence:** SQLite database for frequent stores
- **Real-time Localization:** Sub-meter accuracy indoors

Navigation Algorithm:

- Feature extraction using ORB descriptors
- Loop closure detection for map consistency
- Bundle adjustment for trajectory optimization
- Dynamic obstacle avoidance using stereo depth

AUDIO PROCESSING

Speech Synthesis:

- **Tacotron 2 Arabic TTS:** Natural voice generation
- **Spatial Audio:** 3D positioning for directional guidance
- **Emotion Recognition:** VGGish model for user state analysis
- **Noise Suppression:** RNNoise for clear communication

PAYMENT SECURITY

Multi-Modal Authentication:

- **Haptic PIN Patterns:** Unique tactile signatures
- **Voice Confirmation:** Speaker recognition validation
- **Visual Confirmation:** OCR of payment terminal
- **screens Encryption:** AES-256 for sensitive data

APPROPRIATENESS JUSTIFICATION

WHY THESE METHODS ARE OPTIMAL:

Edge Computing Approach:

- Reduces latency (critical for real-time navigation)
- Ensures privacy (no cloud data transmission)
- Enables offline functionality
- Cost-effective (no data charges)

Incremental Learning:

- System improves with usage
- Adapts to user behavior patterns
- Updates product database locally
- Personalizes interaction style

Multi-Modal Interaction:

- Accommodates different user preferences
- Provides redundancy for system reliability
- Adapts to various environmental conditions
- Supports different levels of visual impairment

BUDGET BREAKDOWN

Hardware Components (Electronics & Robotics Lab):

Component	Quantity	Unit Price (EGP)	Total (EGP)	Supplier
Raspberry Pi 4 (8GB)	3	5,800	17,400	MicroOhm-EG
5MP Camera Modules	3	450	1,350	Amazon.eg
IMU Sensors (BNO055)	3	3,100	9,300	Future Electronics
Bone Conduction Speakers	3	750	2,250	Amazon.eg
Haptic Motors (LRA)	3	600	1,800	Local suppliers
Li-ion Batteries	3	500	1,500	Amazon.com
PCB Design Kit	1	1,200	1,200	Future Electronics
Subtotal			**35,280**	

Prototyping Materials:

Item	Quantity	Unit Price (EGP)	Total (EGP)
3D Printing Filament (PLA/PETG/TPU)	10 kg	300	3,000
PCB Manufacturing (5 iterations)	25 boards	80	2,000
Electronic Components (resistors, capacitors, etc.)	Bulk	-	1,500
Glasses Frames (testing)	10	150	1,500
Silicone Band Material	5 m	200	1,000
Subtotal			**9,000**

Software & Services:

Service	Duration	Monthly Cost (EGP)	Total (EGP)
Google Maps API	12 months	400	4,800
Google Search API	12 months	300	3,600
Cloud Storage (backup)	12 months	200	2,400
Development Tools Licenses	12 months	500	6,000
Subtotal			**16,800**

Testing & Validation:

Activity	Participants	Cost per Session (EGP)	Sessions	Total (EGP)
User Testing Sessions	20 users	200	10	20,000
Transportation (testing sites)	Team	300	15	4,500
Retail Store Access Fees	Various	500	8	4,000
Subtotal				**28,500**

Contingency & Reserves:

Category	Amount (EGP)	Justification
Hardware Replacement	5,000	15% of hardware cost
Additional Components	3,000	Unforeseen requirements
Emergency Prototyping	2,000	Rapid iteration needs
Subtotal	**10,000**	

Total Development Budget: 99,580 EGP

COST JUSTIFICATION

Hardware Costs (35,280 EGP - 35.4%):

- **Raspberry Pi 4:** Industry standard for edge AI computing
- High-quality sensors ensure reliability and accuracy
- Bulk purchase discounts already factored in

Testing & Validation (28,500 EGP - 28.6%):

- User testing critical for accessibility products
- Real-world validation prevents costly redesigns
- Transportation costs for on-site testing

Prototyping Costs (9,000 EGP - 9%):

- Multiple iterations essential for user-centric design
- Material costs optimized through local sourcing
- Quality components reduce long-term maintenance

Software Services (16,800 EGP - 16.9%):

- API costs based on projected usage patterns
- Cloud services ensure data backup and security
- Professional tools improve development efficiency

Contingency (10,000 EGP - 10%):

- Conservative buffer for unexpected challenges
- Hardware failure protection
- Opportunity for additional features

FUNDING SOURCES

Primary Funding (60,000 EGP):

- University research grant
- Technology development fund
- Academic competition prizes

Secondary Funding (39,580 EGP):

- Industry partnership contributions
- Crowdfunding campaign
- Personal team investments

Cost Optimization Strategies:

- Partnership with suppliers for educational discounts
- University lab access reduces infrastructure costs
- Open-source software minimizes licensing fees
- Bulk purchasing for better rates

RETURN ON INVESTMENT PROJECTION

Market Entry Strategy:

- **Year 1:** 100 units at 2,000 EGP each = 200,000 EGP
- **revenue Break-even**: Month 8 of commercial production
- **Profit margin:** 40% after scaling production

TIME PLAN AND DELIVERABLES

Phase 1: Kickoff Magic (Week 1-4)

- Week 1-4: Dream Team forms, research rocks, user chats spark ideas.
- Week 5-8: Blueprints shine, hardware plans, UI sketches wow.
- Magic Drops: Project plan, user wish list, cool designs.

Phase 2: Build the Beast (Week 5-9)

- Week 5; Hardware hums, sensors sync, audio vibes.
- Week 6: AI awakens, YOLO learns, OCR reads.
- Week 7-8: Navigation navigates, voice talks, payment preps.
- Week 9: All pieces unite, prototype pops!
- Magic Drops: Working bits, AI brain, full demo.

Phase 3: Test & Tweak (Week 10-15)

- Week 10-11: Lab tests rock, bugs banished.
- Week 12-13: Users play, feedback fuels fun.
- Week 14-15: Polish shines, security seals.
- Magic Drops: Alpha, beta, sleek version.

Phase 4: Real-World Rush (Week 16-19)

- Week 16-17: Stores test, navigation nails it.
- Week 18-19: Final tweaks, docs dazzle.
- Magic Drops: Field wins, user guide.

Phase 5: Launch Leap (Week 20)

- Week 20: Validation vibes, pitch perfection.
- Magic Drops: Final showstopper, big reveal

CHALLENGE CHARMS

- Lighting: Add enhancement/IR cam.
- Arabic: More data/separation.
- Battery: Sleep modes/efficient chips.

EVO ROADMAP

- V1 (Now): Basic detect/nav.
- V2 (we9): Better accuracy/battery.
- V3 (we14): Payment/multi-store.
- V4 (we20): Production-ready.

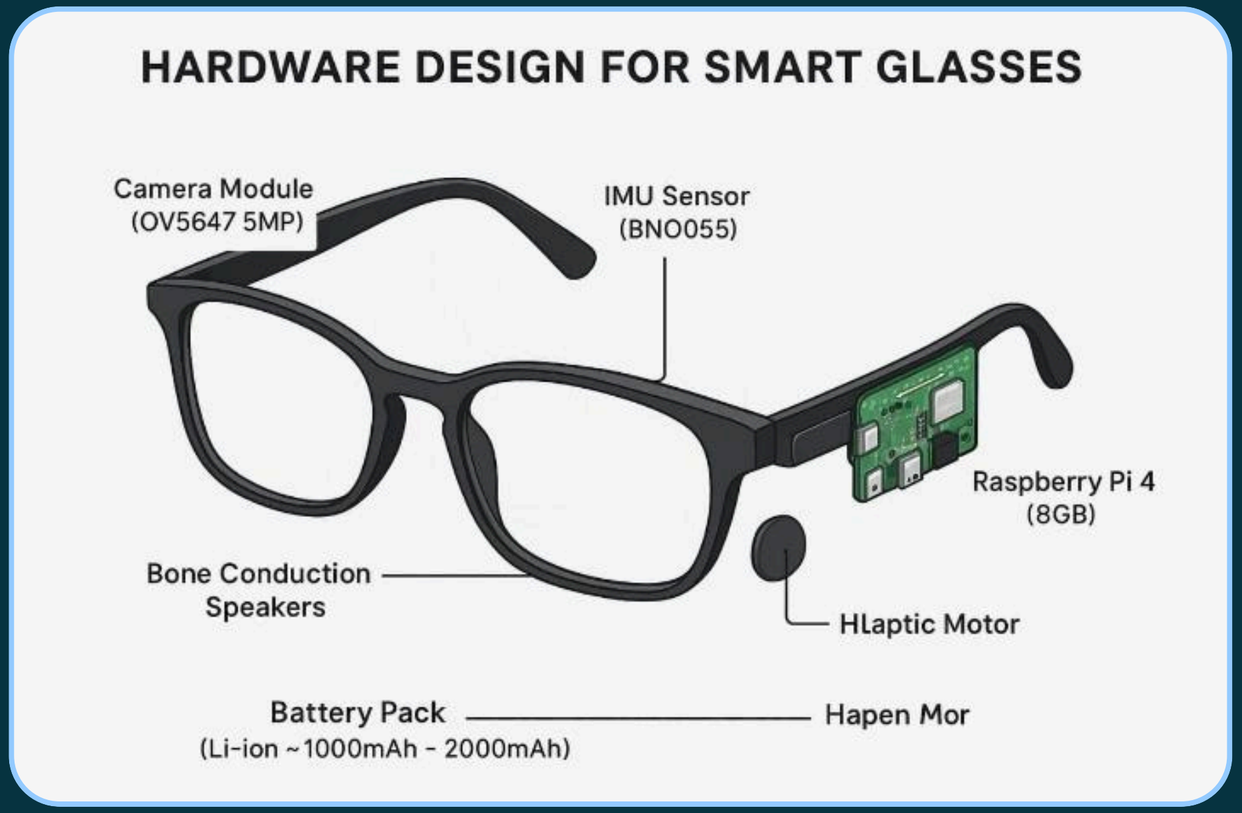
FUTURE FOCUS

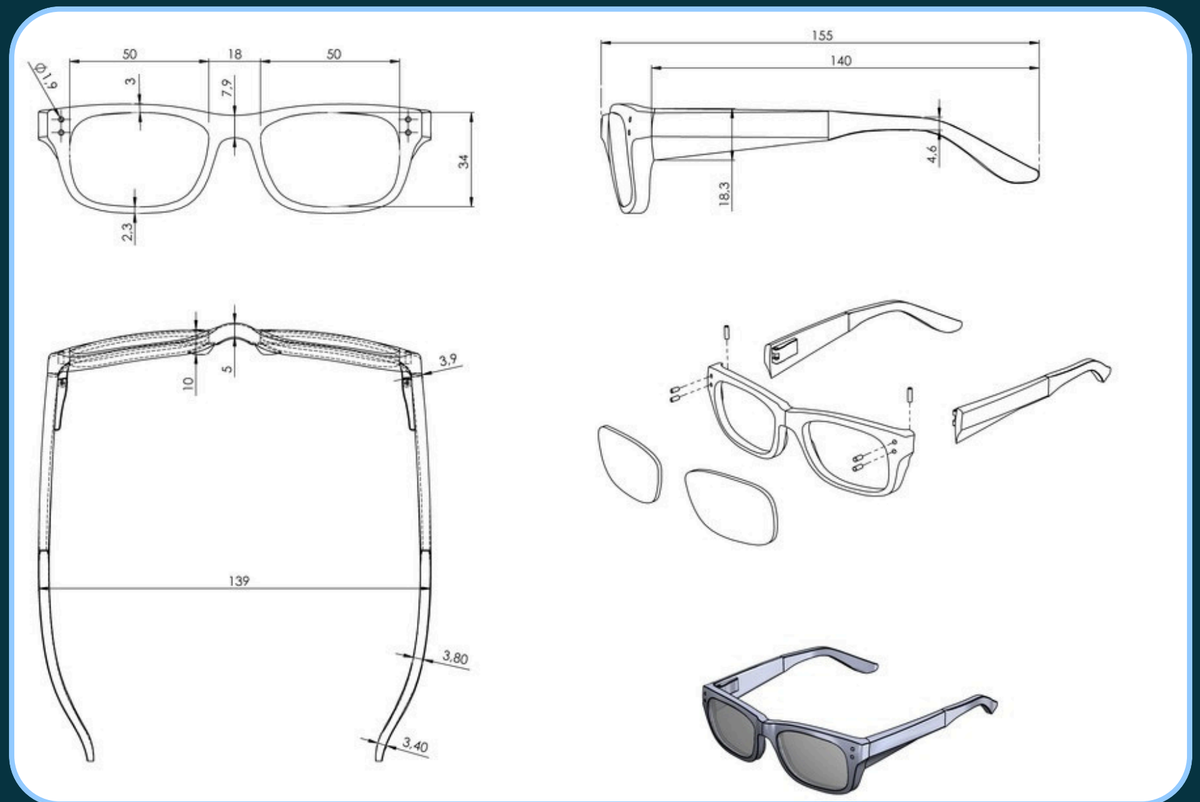
- Battery/accuracy boost, payment, AI recs. Uni/retail collabs for 5G/edge tech.

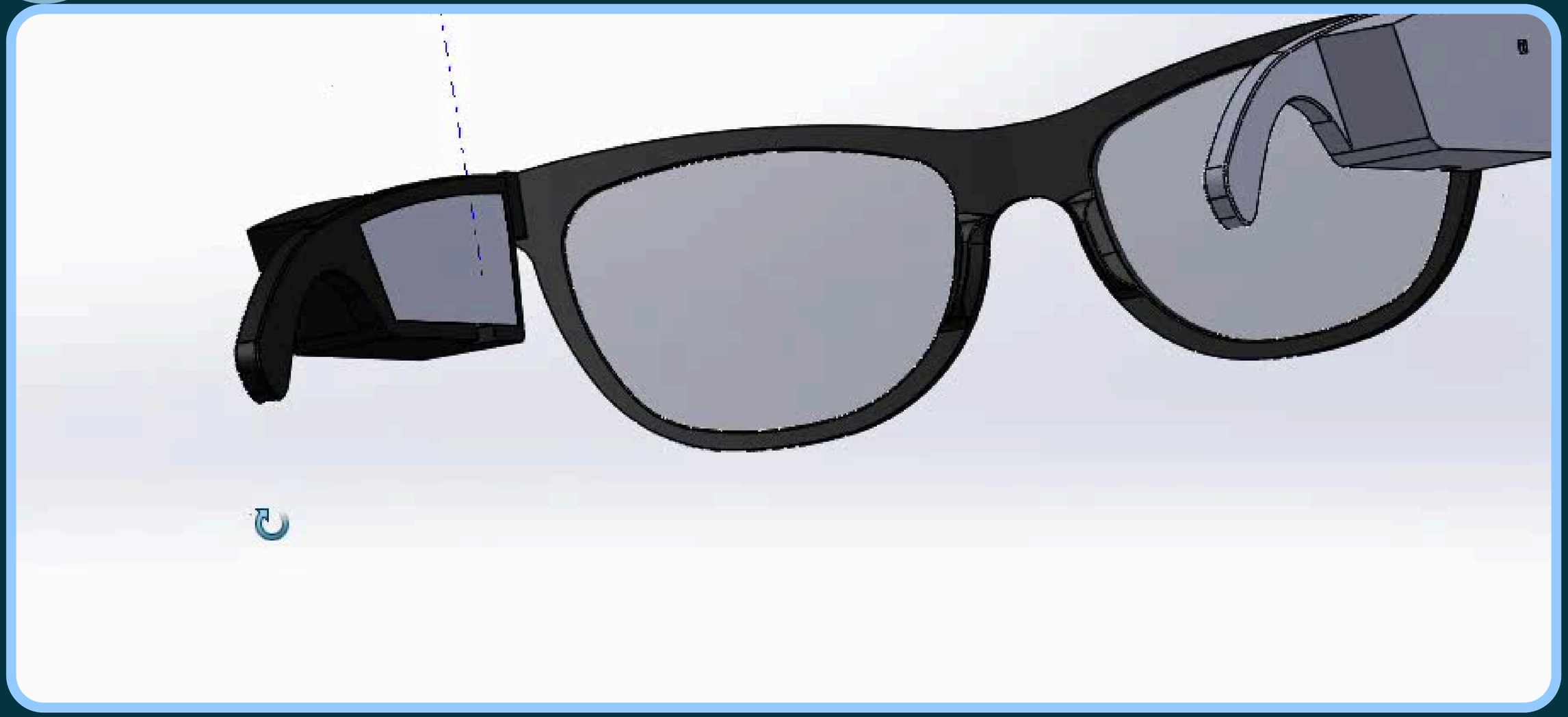
FEATURE COMPARISON WITH EXISTING SOLUTIONS:

Feature	EyeEmpower Prototype	OrCam MyEye	Seeing AI	Be My Eyes
Arabic Support	✅ Native	❌ Limited	❌ No	✅ Human
Offline Capability	✅ Full	✅ Basic	❌ No	❌ No
Payment Integration	🔶 Developing	❌ No	❌ No	❌ No
Navigation	✅ SLAM-based	❌ No	🔶 Basic	❌ No
Price	💰 $1,200	💰💰💰 $4,500	🆓 Free	🆓 Free
Battery Life	🔶 4-5 hours	✅ 8+ hours	N/A (Phone)	N/A (Phone)

Architecture







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THANK YOU

We look forward to be the frist