AI-Based Vision Health Assistant for Eye Disease Detection

By: Retheck DJ

---

1. Problem Statement

Blindness and vision impairment affect millions worldwide, with a large portion being preventable or treatable if detected early. However, small clinics, rural healthcare providers, and NGOs lack the financial and technological resources to deploy advanced diagnostic tools for diseases like diabetic retinopathy, cataracts, and glaucoma. This gap often results in late diagnosis and worsening of patients' conditions.

---

2. Market/Customer/Business Need Assessment

Target Market:

- Small/medium-sized eye care clinics.
- Rural health centers.
- NGOs involved in affordable healthcare.

Customer Need:

- Affordable diagnostic solutions for common eye diseases.
- Portable and easy-to-use tools for non-specialist healthcare workers.
- Automated report generation to support under-resourced doctors.

Market Opportunity:

- Rapidly increasing diabetic population worldwide.
- Limited access to specialized eye care in rural areas.
- Cost-effective alternatives to expensive diagnostic devices for small-scale businesses.

---

3. Target Specifications and Customer Characteristics

End Users:

- Eye doctors in small clinics.
- Healthcare workers in NGOs conducting outreach programs.
- Patients benefiting from early detection at reduced costs.

Product Requirements:

- Portable hardware for retinal imaging.
- AI model for disease detection with a user-friendly interface.
- Compatibility with low-cost devices like Android smartphones.

---

4. External Search

- **References**:
    - Open-source retinal image datasets from Kaggle for training AI models.
    - Articles on AI-based healthcare solutions in rural markets.
    - Websites of existing AI tools like Eyenuk and Optos for comparison.

---

5. Benchmarking Alternate Products

Feature	Existing Products (Eyenuk, Optos)	Proposed Product
Cost	High (~₹5,00,000+)	Low (~₹10,000–₹15,000)
Portability	Limited (Bulky setups)	Portable (Handheld device)
Usability for Non-Experts	Low	High
Target Market	Large hospitals	Small clinics and NGOs

---

6. Applicable Patents

- **Patent US10314402B2**: Deep learning-based retinal disease detection.
- **Patent US10503814B2**: Portable imaging devices for eye screening.

---

7. Applicable Regulations

- **Healthcare Standards**: Compliance with HIPAA for patient data security.
- **Medical Device Certification**: Adherence to CE and ISO standards for medical devices.
- **Environmental Regulations**: Use of eco-friendly materials in hardware design to minimize environmental impact.

---

8. Applicable Constraints

- **Space**: Compact design to accommodate small clinics or outreach programs.
- **Budget**: Target hardware cost < ₹15,000.
- **Expertise**: Non-specialist healthcare workers should be able to operate the device.

---

9. Business Model (Monetization Idea)

Hardware Sales:

- Portable fundus camera priced at ₹10,000–₹15,000.

Subscription Services:

- **Basic Plan**: Free for NGOs (limited features).
- **Premium Plan**: ₹500/month with advanced diagnostics and teleconsultation.

Partnerships:

- Collaborate with insurance companies for bundled health plans.
- Partner with pharmaceutical companies for targeted treatments.

---

10. Concept Generation

Idea Origin:

Observing the challenges in diagnosing eye diseases in under-resourced clinics during health camps.

Inspiration:

Combining low-cost hardware with AI to provide scalable diagnostic tools.

---

11. Concept Development

The product is a combination of portable hardware and AI-powered software. The fundus camera captures retinal images, which are analyzed using an AI model. The app generates disease predictions and a diagnostic report, providing affordable and accurate eye care solutions.

---

12. Final Product Prototype

Schematic Diagram:

Hardware:

- Portable Fundus Camera.
- Smartphone/PC Connection (via USB/Bluetooth).

Software:

- AI Model for Retinal Analysis.
- Report Generation Module.

Workflow:

1. Capture retinal images using the fundus camera.
2. Upload images to the mobile app.
3. The AI model processes images and provides disease predictions.
4. Generate diagnostic reports for doctors or direct teleconsultation.

---

13. Product Details

How It Works:

- Users capture images using the fundus camera.

- Images are processed locally or on the cloud by the AI model.
- Diagnostic results are displayed, and reports are generated.

Data Sources:

- Retinal image datasets from Kaggle.
- Feedback data from clinics for model improvement.

Algorithms/Frameworks:

- CNN-based models (e.g., ResNet, EfficientNet).
- Flask for backend API.

Team Requirements:

- 2 Data Scientists (Model Development).
- 1 Hardware Engineer.
- 1 Frontend Developer (App UI).

Costs:

- Hardware development: ₹8,00,000 for initial prototypes.
- AI model training and app development: ₹5,00,000.

---

14. Code Implementation/Validation on Small Scale

- I have attached the sample code implementation on a small scale using a small dataset.

---

15. Conclusion

The AI-Based Vision Health Assistant addresses a critical gap in affordable and accessible eye care. By combining low-cost hardware with AI-driven diagnostics, this product empowers small clinics and NGOs to detect and manage common eye diseases effectively.