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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (Data Science)

DS705PC Project Stage - II

REVIEW-I

TITLE: VISION GUARD: AI- BASED EYE DEFECT DETECTION AND SIGHT CORRECTION

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ABSTRACT

Vision Guard is an AI-powered system designed to detect eye defects and suggest sight correction in a simple, reliable way. By analyzing high-resolution eye images with deep learning and computer vision. it can identify common problems like cataracts, Glaucoma, kertoconus, corneal Defects and using datasets we find myopia, hypermetropia while recommending the right lens power. The system focuses on early detection, reducing human error and making eye care accessible even in remote areas. If we have any doubts about the defects or language that tough to pronounce we have chat bolt to clarify. Affordable and efficient, it offers a modern solution to improve vision and support healthcare providers.

Keywords: Ophthalmic Image Analysis, Artificial Intelligence in Healthcare, Eye Defect Detection, Computer Vision, Sight Correction Recommendation.

OBJECTIVE AND SCOPE

- Image Acquisition - Collecting high-resolution ophthalmic images like corneal images, retinal fundus
- Images, etc. using cameras or data sets.
- Deep Learning Model(CNN) - Convolutional Neural Network for classification of eye images into healthy vs defective
- Regression Models - To predict the lens power needed for myopia /hypermetropia
- Sight Correction Recommendation - Estimation lens power for refractive errors using Regression models and providing personalized recommendations for treatment.

INTRODUCTION

Scans the real time eye and scans the defect of the eye using the camera

- ❖ Upload the file of dataset which is innerness of an eye
- ❖ The system uses computer vision and deep learning techniques to analize images of the eye.
- ❖ By combining image preprocessing, CNN and lightweight model architectures
- ❖ Give the reports of the defected eye in a first section.
- ❖ Suggests the surgeries and precautions in an another section.
- ❖ We can download the report of the interface of defected eye and can upload in a chat bolt for any queries.
- ❖ the vision guard provides fast, affordable, and accessible solution for early eye disease detection

JUSTIFICATION

- Today, many people face eye problems because of long screen time, pollution, and lifestyle changes.
- Detecting these eye defects early can help prevent serious vision loss, but the normal process of testing eyes takes time and needs experts.
- Vision Guard was created to make this process easier and smarter.
- It uses artificial intelligence (AI) to scan and study eye images or medical data to find any signs of vision problems. The system can automatically detect defects like short-sightedness, cataracts, or retinal issues without needing a full manual checkup.
- helping users understand what steps they can take next. This makes eye checkups faster, more accurate, and accessible for everyone, even in areas where eye specialists aren’t easily available.
- Vision Guard aims to use AI to protect people’s vision by making eye health detection and correction simple, quick, and reliable for everyone.
- User data and medical information are safely managed within the platform, ensuring privacy and confidentiality.
- Once a defect is found, Vision Guard provides personalized sight correction guidance. This may include tips like eye care routines, lens recommendations, or lifestyle improvements. It saves time for users and gives them clear next steps toward better eye health.
- The website includes a smart dashboard where users can view their reports, progress, and history in one place. It allows users to track changes in their eye health over time easily.
- A built-in information section explains common eye diseases, prevention tips, and eye care practices. This helps users learn about maintaining healthy vision in everyday life.

MOTIVATION OF THE PROJECT

- Eye-related diseases such as cataracts, glaucoma, diabetic retinopathy, and refractive errors are among the leading causes of vision loss worldwide.
- Most of these conditions can be prevented or treated if detected early, but lack of awareness and limited access to ophthalmologists delay diagnosis.
- The motivation behind the Vision Guard project is to create a smart and accessible system that helps in early detection and monitoring of eye diseases using technology.
- By combining image processing and machine learning, the system can analyze eye images and identify potential abnormalities automatically.
- This not only assists doctors in making faster decisions but also helps common users, especially in rural or underdeveloped areas, to check their eye health without visiting hospitals frequently.
- The project aims to contribute toward reducing preventable blindness and promoting public health awareness through innovation

BASIC CONCEPTS RELATED TO THE TITLE

1. Computer Vision
Computer vision is a field of artificial intelligence that enables computers to understand and interpret visual information from images or videos. In this project, it helps the system to analyze images of the human eye and detect any signs of diseases or abnormalities.

2. Image Processing
Image processing involves enhancing and analyzing images to extract useful information. Techniques such as noise removal, contrast adjustment, and edge detection help prepare eye images for further analysis.

3. Machine Learning / Deep Learning
These are subsets of artificial intelligence where models are trained using datasets. In this project, algorithms (like Convolutional Neural Networks - CNN) learn to identify patterns in eye images and classify diseases such as cataract, glaucoma, or diabetic retinopathy.

4. Feature Extraction
This refers to identifying and extracting key characteristics from the eye image (like color, texture, and shape of the retina or pupil) that help in detecting abnormalities.

5. Automation in Healthcare
The project supports the idea of automating basic eye health checkups, which reduces manual effort, increases accuracy, and provides a faster diagnosis — especially useful in rural areas with limited medical access.

TIMELINE OF THE PROJECT

Sprint 1

- Requirement Analysis & Literature Review
- Studied the importance of early eye defect detection and the challenges in traditional eye checkups.
- Collected reference materials, datasets, and research papers related to AI-based medical detection systems.
- Defined the project’s main goals, scope, and user requirements.

Sprint 2

- Designed the structure and flow of the website including homepage, dashboard, reports, and settings sections.
- Created the user interface layout using HTML and CSS.
- Planned data flow between the upload, detection, and report sections.

Sprint 3

- Built the front-end components using HTML and CSS (and optionally AI backend simulation).
- Added sections like dataset upload, report generation, and settings.
- Designed dark and light modes for user comfort.

Sprint 4

- Integrated AI or simulated AI model to detect eye defects from uploaded images or datasets.
- Tested the detection accuracy with sample datasets
- Improved the performance and responsiveness of the web interface.

Sprint 5

- Added automated report generation and download options.
- Designed an easy-to-read report layout summarizing eye health, detected defects, and correction tips..
- Collected user feedback to enhance the interface and readability.

Sprint 6

- Compiled full project documentation, including aim, justification, features, results, and future enhancements.
- Conducted final testing to ensure all features work properly.
- Prepared the system for presentation and deployment.

Analysis and Explanation of the Identified Problem

- Many people today face vision issues due to long screen time, pollution, and unhealthy lifestyles.
- Eye problems like strain, dryness, or blurred vision are becoming more common.
- Most people realize they have eye issues only after the problem becomes serious.
- Early signs such as headaches or blurry vision are often ignored or unnoticed.
- Regular eye tests require visiting hospitals or clinics, which can be costly and time-consuming.
- In rural or remote areas, proper eye specialists and testing equipment are often unavailable.
- Traditional eye testing methods are manual and slow.
- There is no simple, technology-based platform that allows quick and accurate detection of eye problems.
- Artificial Intelligence (AI) can help detect eye defects early by analyzing images or datasets.
- AI-based systems can identify even small changes in the eye that humans might miss.
- Vision Guard is designed to solve these problems using AI for early defect detection and sight correction.

Literature Review

Author / Year	Title / Focus of Study	Key Findings	Identified Gap / Limitation	Relevance to Your Project
Gulshan V. / ().2016	*Development and validation of a deep learning algorithm for detection of diabetic retinopathy in retinal fundus photography*	Development a CNN model that accurately detected diabetic retinopathy from retinal images with performance similar to ophthalmogists	Focused only on diabetic retinopathy;didn't include other eye disease or real-time detection	Demonstrates the potential of CNN's for automated disease detection;helps vision guard apply similar techniuqes for multiple disease
Pratt et /2016	*CNN for diabetic retinopathy classification*	Proposed a CNN model for image-based classification of retinal disease with high accuracy	Model performance reduced with low-quality or blurred images	Support vision guard's idea using preprocessing to enhance image clarity before prediction
Abbas / 2017	*Automatic cataract detection using deep learning and image analysis techniqes*	Introduced an algorithm using texture and color features to identify cataracts automatically	Datasets size was small and not diverse; lacked generalization	Encourages vision guard to use a larger and more varied datasets for improved accuaracy
Raghavendra/2018	*Deep CNN for glaucoma diagnosis using digital fundus images*	Designed a deep learning system that successfully detected glaucoma with over 90% accuracy	High computational cost; required large GPU resource	Suggests optimizing vision performance on low-power devices

Agarwal / 2020	*AI-based screening for multiple ocular disease using retinal images*	Demonstrate that multi-disease detection models can identify several conditions in one system.	Complex architecture; required a large labeled datasets	Inspires vision guard's goal of multi-disease detection (eg.,cataract, glaucoma,diabetic,retinopathy)
Who, 2023	*World Report on vision*	Highlighted global rise in vision impairment and lack of early diagnosis tools, especially in rural areas.	Non-technical; did not propose a technological solution	Strenghtens the motivation behind vision guard as a cost-effective early detection tool for underserved areas
kalla Bharath Vardhan , mandava nidhish, surya kiran C, 2025	Eye desease detection using deep learning models with transfer learning techniques	Eye desease detection using deep learning models with transfer learning techniques	Complex model; limited to small dataset and single disease	Helps vision guard extend detection beyond a single disease , building a multi-disease recognition system
Md zahan mutaqim, tangan amir smrity 2024	Eye desease detection enhancement using a multi-satge deep learning approach	Eye Disease Detection Enhancement Using a Multi-Stage Deep Learning	Required large dataset lacked real time implementation	Vision guard uses optimized model and transfer learning for faster, efficient real-time detection
Mr. Langade Umesh, Ms. Malkar Mrunalini 2016	Glaucoma-Deep: Detection of Glaucoma Eye Disease on Retinal Fundus Images using Deep Learning	Eye disease detection using deep learning on retinal fundus images	Targeted only glaucoma, did not integrate with other disease	Vision guard intergrates glaucoma, cataract, and diabetic into a unified system
Abbas 2017	CNN for diabetic retinopathy classification	Proposed a CNN model for image-based classification of retinal disease with high accuracy	Focused only on diabetic retinopathy,not on multiple eye disease.	Vision guard improves scalability and multi-class detection through enhanced datasets

Data Collection

DATA SOURCES: Kaggle diabetic retinopathy datasets – large labeled fundus images for DR.

- Fundus images useful for vessel/segmentation tasks and smaller-scale experiments

MINIMUM SAMPLE SIZE SUGGESTIONS: Ensures images have labels (diagnosis and severity when possible), relevant metadata, and quality control for training robust deep learning models.

Inclusion/Exclusion critereia: confirmed clincal diagnosis or consensus label from >1 ophthalmologist.

- Several blurred or obscured images and duplicate images.

FILE FORMATS & STORGAE : Storage images in lossless or high- quality JPG/PNG. For medical use prefer png or high-quality JPEG

- Use consistent file:naming: VG_001_left_2025.png

TRAIN: typical split 70% train/ 15%validation /15%test (or80/100)

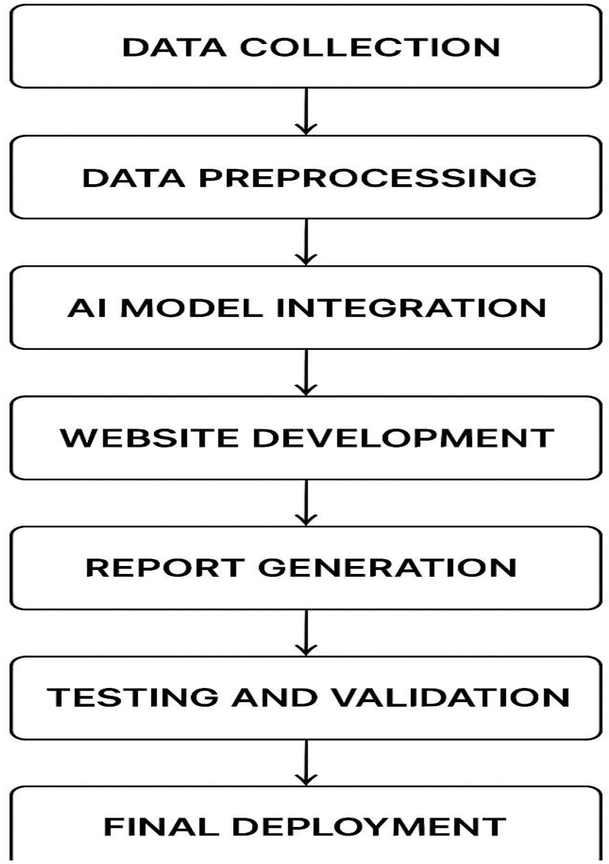
- Straify splits by disease class and device to avoid bias.

GOALS: collects a diverse set of retinal images covering the target classes: heatlhy diabetic retinopathy, cataract, glaucoma and other common retinal conditions.

Methodology

Vision Guard focuses on using AI to detect eye defects and provide sight correction guidance. The system is designed to be simple, fast, and user-friendly while maintaining accuracy and privacy.

1. Data Collection:
Collected eye datasets from trusted sources like Kaggle, including images of eyes with conditions such as diabetic retinopathy, glaucoma, and cataracts.



2. Data Preprocessing:
Resized and standardized images for uniformity.

3. AI Model Integration:
Used a trained AI or simulated model to analyze the eye images.

4. Website Development:
Built the frontend using HTML and CSS for a clean and interactive user interface.

5. Report Generation:
After analysis, the system generates a detailed report summarizing detected eye de

6.Testing and Validation:
Ensemble improves detection accuracy and generalization to unseen .

7.**Final Deployment:**
The complete system, including AI detection and user-friendly interface, was prepared for demonstration.

SYSTEM DESIGN

- **Image Upload Layer:**

  Allows users to upload retinal eye images through a web interface.
- **Preprocessing Layer:**

  Resizes and normalizes images to make them suitable for CNN analysis.
- **CNN Classification Layer:**

  A trained CNN model extracts features and classifies eye diseases such as **Normal, Cataract, Glaucoma, and Retina Disease**.
- **Backend Processing Layer:**

  Flask backend manages image handling, model inference, and result generation.
- **Result Display Layer:**

  Displays the predicted disease and confidence score on the webpage.

FUTURE SCOPE

Advanced Disease Detection:

The app can be expanded to detect a wider range of eye diseases such as cataracts, diabetic retinopathy, glaucoma, and macular degeneration with higher accuracy using larger and more diverse datasets.

Integration with Smart Devices:

Vision Guard can be connected with smart glasses or wearable devices to provide continuous visual assistance and health monitoring.

Voice and Gesture Control:

Adding voice commands and gesture-based controls can make the app even more accessible for users with complete or partial vision loss.

Cloud-based Data Storage and Analytics:

Implementing cloud services can help store user data securely, track changes in vision over time, and provide personalized health reports.

Multilingual Support and Localization:

The app can be made available in multiple languages to reach users in different regions, promoting wider accessibility.

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