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Early detection and management
using AI and image processing

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HEXART.IN INNOVATION COHORT PROGRAM

Diabetic Retinopathy

Diabetes Retinopathy (DR)

Definition

- Progressive dysfunction of the retinal blood vessels caused by chronic hyperglycemia.
- DR can be a complication of diabetes type 1 or diabetes type 2.
- Initially, DR is asymptomatic, if not treated though it can cause low vision and blindness.

Diabetes Mellitus

Diabetes Mellitus is a group of diseases characterized by high blood glucose levels. Diabetes results from defects in the body's ability to produce and/or use insulin.

- **Type 1 diabetes** is usually diagnosed in children and young adults, and was previously known as juvenile diabetes. In type 1 diabetes, the body does not produce insulin. 5% of people with diabetes have this form of the disease.
- **In Type 2 diabetes**, either the body does not produce enough insulin or the cells ignore the insulin. This is the most common form of diabetes.

- Recognize the importance of diabetic retinopathy as a public health problem
- Discuss diabetic retinopathy as a leading cause of blindness in developed countries
- Identify the risk factors for diabetic retinopathy
- Describe and distinguish between the stages of diabetic retinopathy
- Understand the role of risk factor control and annual dilated eye exams in the prevention of vision loss

Learning Objectives

ABSTRACT

High blood sugar in diabetes can damage tiny blood vessels in your eyes, leading to diabetic retinopathy, a big cause of blindness. This project explains how

- Diabetes affects your eyes, like bad plumbing making it hard for blood to flow.
- It also lists things that can raise your risk, like high sugar levels for a long time.

But there's good news! By checking your eyes every year and keeping your blood sugar in check, you can stop retinopathy before it steals your sight. This project shows you

- The different stages of retinopathy, from mild blurry vision to serious problems, and helps you understand how important early detection is. Remember, taking care of your diabetes also means taking care of your eyes.
- This project gives you the tools to keep your vision bright, even with diabetes!
- This simplified version uses relatable language and avoids technical terms to make the information accessible to a broader audience.
- It still conveys the key points about the significance, risks, and prevention of diabetic retinopathy.

Duration of diabetes is a major risk factor associated with the development of diabetic retinopathy

Risk factors

The severity of hyperglycemia is the key alterable risk factor associated with the development of diabetic retinopathy

Risk factors

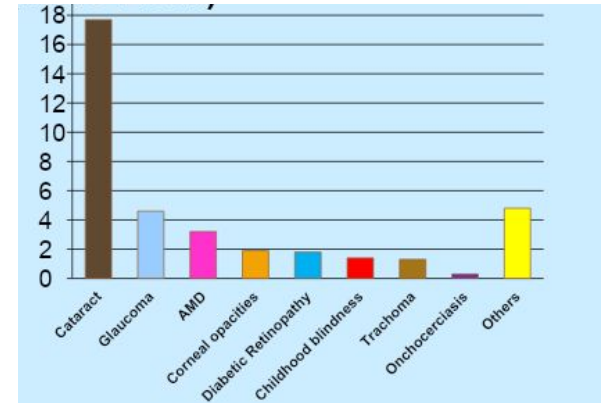
INTRODUCTION

Diabetic retinopathy, a consequence of prolonged high blood sugar levels in diabetes, damages the tiny blood vessels in the eye, potentially leading to blindness if left untreated.

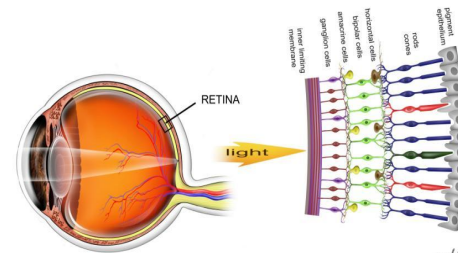
- Initially causing minor vision impairments such as blurry spots, it can progress to severe loss of central vision, color perception issues, and eventual complete sight loss due to bleeding and scarring of weak blood vessels in the eye.
- Unfortunately, it's a leading cause of blindness among working-age adults in developed nations and is worsening annually.

However, there's hope through early detection via regular eye check-ups and managing blood sugar levels and other risk factors.

- This project aims not only to raise awareness but also to prompt action in combating diabetic retinopathy by understanding its progression, identifying warning signs, and emphasizing preventive measures to preserve vision and maintain eye health.



Causes for global blindness in millions of people (WHO 2022)



Retina

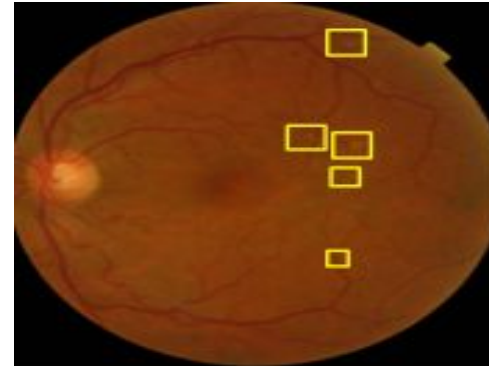
PROPOSED SYSTEM

The analysis began with the collection of diverse datasets related to diabetic retinopathy from Kaggle.

- Pre-processing followed, involving data cleaning, segmentation, and augmentation to prepare the images for analysis, ensuring relevance and quality.
- Model training utilized Convolutional Neural Networks (CNNs) with Softmax activation functions, known for their effectiveness in image-related tasks.
- Finally, the trained model provided outputs indicating the presence or absence of diabetic retinopathy based on probability distributions over classes.
- This comprehensive pipeline aimed to leverage machine learning techniques for effective detection and classification of diabetic retinopathy in retinal images.



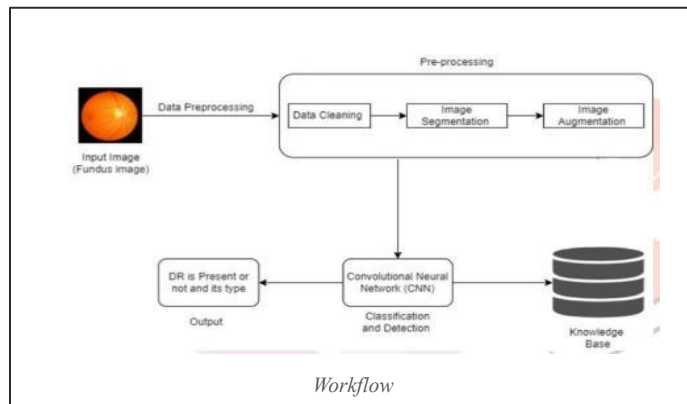
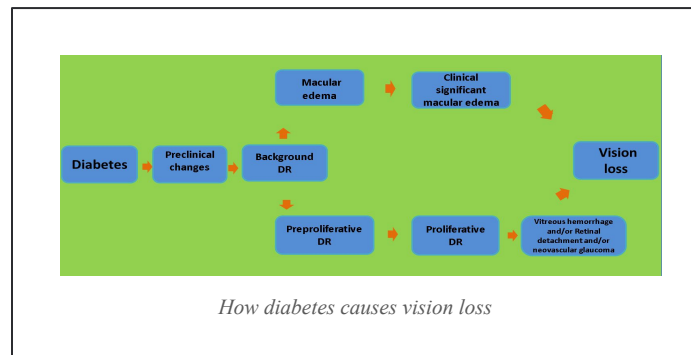
Healthy Retina



Diabetic Retinopathy

WORKFLOW

1. **Data Collection and Annotation:** A diverse dataset of eye images is gathered, comprising diabetic retinopathy at different stages as well as images from individuals without the condition.
2. **Data Preprocessing and Augmentation:** The collected images undergo cleaning and preprocessing to ensure consistency and quality, including tasks like noise removal and standardization.
3. **Feature Extraction:** Computer vision techniques are utilized to extract relevant features from the eye images. These techniques focus on identifying key aspects such as blood vessels, retinal structure, and any abnormalities indicative of diabetic retinopathy, providing the model with meaningful information for classification.
4. **Model Selection and Training:** A suitable machine learning model, typically Convolutional Neural Networks (CNNs) for image classification tasks, is selected. The dataset is split into training and validation sets, and the chosen model is trained using the training data while adjusting parameters to optimize performance.
5. **Model Evaluation and Performance Metrics:** The model's performance is evaluated using standard metrics such as accuracy, precision, recall, and F1 score. Additionally, a confusion matrix is employed to gain insights into the model's strengths and weaknesses, particularly regarding its ability to correctly classify diabetic retinopathy at different stages.

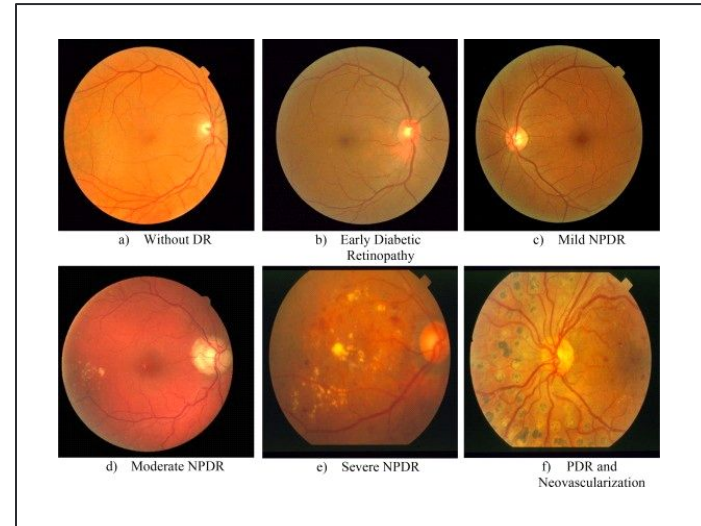


TECHNICAL STACK USED

- Programming Languages
- Machine Learning Frameworks
- Computer Vision Libraries
- Model Interpretability

RESULT

1. **Accuracy Assessment:** Model accuracy is evaluated to determine its proficiency in correctly classifying images as either having diabetic retinopathy or being healthy. A high accuracy signifies the model's capability to make accurate predictions.
2. **Precision, Recall, and F1 Score Analysis:** Precision, recall, and F1 score are critical metrics used to understand the trade-off between correctly identifying positive cases (sensitivity) and avoiding false positives (precision). Achieving a balanced F1 score is essential for ensuring a reliable and well-rounded model.
3. **Confusion Matrix Examination:** The confusion matrix is analyzed to gain insights into the model's performance. By identifying false positives and false negatives, areas where the model excels and areas requiring fine-tuning for improved accuracy can be pinpointed.
4. **Early Detection Rate Evaluation:** Assessing the model's capability in early detection involves measuring its performance in identifying mild symptoms or early signs of diabetic retinopathy. Early detection is crucial for effective intervention and management.



OUTCOME

```
from google.colab import drive
drive.mount('/content/drive')

Mounted at /content/drive

[2] !pwd

/content

[3] !pip install kaggle

Requirement already satisfied: kaggle in /usr/local/lib/python3.10/dist-packages (1.5.16)
Requirement already satisfied: six>1.10 in /usr/local/lib/python3.10/dist-packages (from kaggle) (1.16.0)
Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-packages (from kaggle) (2024.2.2)
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.8.2)
Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.31.0)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from kaggle) (4.66.2)
Requirement already satisfied: python-slugify in /usr/local/lib/python3.10/dist-packages (from kaggle) (8.0.4)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-packages (from kaggle) (2.0.7)
Requirement already satisfied: bleach in /usr/local/lib/python3.10/dist-packages (from kaggle) (6.1.0)
Requirement already satisfied: webcodings in /usr/local/lib/python3.10/dist-packages (from bleach->kaggle) (0.5.1)
Requirement already satisfied: text-unidecode>1.3 in /usr/local/lib/python3.10/dist-packages (from python-slugify->kaggle) (1.3)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle) (3.6)

[5] import os
import shutil

# Check the current working directory
current_directory = os.getcwd()
print("Current working directory:", current_directory)
```

34.56 GB available

Connected to Python 3 Google Compute Engine backend (GPU)

Thank You

Hexart.In...an opportunity like never before!



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