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Efficient Detection Of Diabetic Retinopathy Using Deep Learning

[1]Mrs.L Naga Baby Jyotsna, [2]V.Durga Bhavani, [3]Shaik Arif, [4]B.Srikanth, [5]Y.Ram Sai, [6]B.Vishal Babu
[1]AssistantProfessor, [2,3,4,5,6]Students
Department of Computer Science & Engineering,
Dhanekula Institute of Engineering and Technology, Vijayawada, A.P, India

Abstract: Diabetic retinopathy is an eye condition caused by diabetes, where high blood sugar levels damage the blood vessels in the retina. Conventional detection techniques often require specialized equipment and can be time-consuming, limiting their accessibility. This project leverages MobileNet, a convolutional neural network (CNN)-based deep learning model, to classify diabetic retinopathy into five stages: No DR, Mild DR, Moderate DR, Severe DR, and Proliferative DR. A user-friendly web interface, developed using HTML, CSS, and JavaScript, is integrated with a Flask-based backend to facilitate user registration, image uploads, and stage predictions. By automating the diagnosis process, this system enhances efficiency, ensures early detection, and enables remote screening, ultimately improving patient care.

Index Terms- Diabetic Retinopathy, MobileNet, Convolutional Neural Networks, Deep Learning, Retinal Image Detection.

I. INTRODUCTION

Diabetic Retinopathy (DR) is a serious diabetes complication that damages retinal blood vessels, leading to vision impairment. Traditional diagnostic methods are inefficient, making early detection challenging. This study employs MobileNet architectures to classify DR stages using fundus images from the APTOS 2019 dataset collected from Aravind Eye Hospital. The dataset contains high-resolution images captured under varying conditions, aiding in accurate classification. Our MobileNet model, pre-trained on ImageNet, enhances detection accuracy across five DR stages: No DR, Mild DR, Moderate DR, Severe DR, and Proliferative DR. Deep learning-based automated DR detection supports clinicians in making timely decisions. This approach minimizes the risk of irreversible vision loss and improves patient care.

II. LITERATURE SURVEY

1. Varun Gulshan et al., "**Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs**," JAMA. 2016;316(22):2402-2410. doi:10.1001/jama.2016.17216. [15] This paper presents a deep learning algorithm for detecting diabetic retinopathy in retinal images. The model was evaluated based on sensitivity and specificity, with two operating points optimizing either high specificity or high sensitivity.
2. Kele Xu, Dawei Feng, and Haibo Mi, "**Deep Convolutional Neural Network-Based Early Automated Detection of Diabetic Retinopathy Using Fundus Image**," Received: 10 November 2017; Accepted: 22 November 2017; Published: 23 November 2017. [15] This paper focuses on the early detection of diabetic retinopathy using deep convolutional neural networks. The proposed model outperforms traditional feature-based methods in classifying retinal images. The approach achieved high accuracy, demonstrating its effectiveness for automated diabetic retinopathy detection.
3. Sheikh Muhammad Saiful Islam, Md Mahedi Hasan, and Sohaib Abdullah, "**Deep Learning based Early Detection and Grading of Diabetic Retinopathy Using Retinal Fundus Images**," arXiv:1812.10595v1 [cs.CV] 27 Dec 2018. [15] This paper presents a deep learning-based approach for early detection and grading of diabetic retinopathy. The model identifies microaneurysms, the first signs of DR, and classifies retinal

images into five severity levels. Tested on the Kaggle DR dataset, it achieved a 0.851 quadratic weighted kappa score and 98% sensitivity, demonstrating state-of-the-art performance.

4. Lam C, Yi D, Guo M, Lindsey T., "**Automated Detection of Diabetic Retinopathy using Deep Learning**," AMIA Jt Summits Transl Sci Proc. 2018 May 18;2017:147-155. PMID: 29888061; PMCID: PMC5961805. [15] This paper explores the use of convolutional neural networks (CNNs) for staging diabetic retinopathy using color fundus images. The model achieved a validation sensitivity of 95%, performing comparably to existing literature. Multinomial classification revealed misclassification challenges, particularly in distinguishing mild cases from normal due to subtle disease features.

5. Sara HosseinzadehKassani, Peyman HosseinzadehKassani, Reza Khazaeinezhad, Michal J. Wesolowski et al.,"**Diabetic Retinopathy Classification Using a Modified Xception Architecture**," 2019 IEEE International Symposium on Signal Processing and Information Technology (ISSPIT), 2019. [15] This paper proposes a modified Xception architecture for diabetic retinopathy classification using deep layer aggregation. The extracted features are processed by a multi-layer perceptron (MLP) for severity classification.The model, validated on the Kaggle APTOS 2019 dataset, achieved 83.09% accuracy, outperforming the original Xception architecture.

III. EXISTING SYSTEM

The current approach for diabetic retinopathy detection relies particularly on Artificial Neural Networks (ANN), which is a type of transfer learning method. While ANN helps in analyzing retinal images, it lacks the capability to extract deep hierarchical features effectively. The model struggles to achieve high accuracy due to its limitations in feature representation and classification. Additionally, the existing system heavily depends on manual feature extraction, making it less efficient in handling complex patterns in retinal fundus images.

Disadvantages:

1. **Less Feature Compatibility:** The model does not effectively extract crucial features from retinal images, leading to reduced performance in detecting diabetic retinopathy stages.
2. **Low Accuracy:** Due to inadequate feature extraction and learning capability, the system fails to provide highly accurate results, which may lead to incorrect diagnosis and delayed medical intervention.

IV. PROPOSED SYSTEM

To address the challenges of inaccurate and delayed diabetic retinopathy detection, our system employs MobileNet, a deep learning-based classification model. It enhances DR identification by efficiently analyzing retinal images with improved accuracy and reliability. The proposed approach enables early detection, ensuring timely medical intervention. This system assists clinicians in making informed decisions, ultimately leading to better patient outcomes.

Advantages:

1. **Accurate Classification:** The system utilizes MobileNet, a deep learning-based approach, ensuring precise identification of diabetic retinopathy stages.
2. **Less Complexity:** The lightweight architecture of MobileNet reduces computational complexity while maintaining efficiency.
3. **High Performance:** The model achieves superior accuracy and reliability compared to traditional machine learning methods, enhancing diagnostic effectiveness.

V.METHODOLOGY

5.1 DataSet Preparation

The dataset, sourced from the APTOS 2019 Kaggle repository, consists of 3,662 high-resolution fundus images categorized into five DR stages: No DR, Mild, Moderate, Severe, and Proliferative DR. Preprocessing includes scaling, translation, color variation, flipping, and contrast enhancement, with a 70%-20%-10% split for training, validation, and testing. MobileNet, pre-trained on ImageNet, is used for feature extraction and classification, aiding in early and accurate DR detection.

5.2 Model Description

The model utilized in this project is a deep learning-based approach for Diabetic Retinopathy (DR) detection, leveraging a pre-trained MobileNet architecture as a feature extractor. MobileNet, a lightweight and efficient convolutional neural network (CNN), is chosen for its capability to perform well on limited computational resources while maintaining high accuracy.

5.2.1 Preprocessing & Data Augmentation

1.The dataset consists of five DR severity classes: Mild, Moderate, No_DR, Proliferate_DR, and Severe.

2.Image data is preprocessed using ImageDataGenerator with rescaling (1./255) to normalize pixel values.

3.The dataset is split into training (506 images) and validation (217 images) sets, ensuring balanced class representation.

5.2.2 Model Architecture

The model follows a hybrid approach using MobileNet as the base model and additional fully connected layers to refine classification:

1.Base Model: Pre-trained MobileNet (with ImageNet weights) without the top layers.

2.Feature Extraction:

1.Global Average Pooling (GAP) layer to reduce dimensionality.

2.Fully connected Dense layer (64 neurons, ReLU activation) to learn deeper patterns.

3.Batch Normalization to stabilize training.

4.Dropout (0.2) to prevent overfitting.

3.Output Layer: Fully connected Dense layer (5 neurons, Sigmoid activation) for multi-class classification.

5.2.3 Compilation & Training

1.Loss Function: Categorical Crossentropy

2.Optimizer: Adam

3.Evaluation Metrics: Accuracy, Precision, Recall

4.Epochs: 20

5.Batch Size: 20

The model is trained using the fit_generator method, and performance metrics such as accuracy, precision, and recall are logged. During training, the validation loss and accuracy are monitored to detect overfitting.

5.2.4 Performance & Evaluation

The trained MobileNet model has undergone evaluation using a confusion matrix, which offers a detailed analysis of its performance across different classes. This evaluation helps in understanding how well the model distinguishes between various categories and identifies specific areas where misclassifications occur

5.2.5 Prediction & Visualization

A sample image is loaded, preprocessed, and fed into the trained model for classification.The highest probability class is selected as the predicted label.Training and validation metrics are plotted to analyze model convergence.This model provides a robust and efficient approach to Diabetic Retinopathy detection, with potential enhancements through fine-tuning and dataset augmentation.

.VI. RESULTS AND DISCUSSION

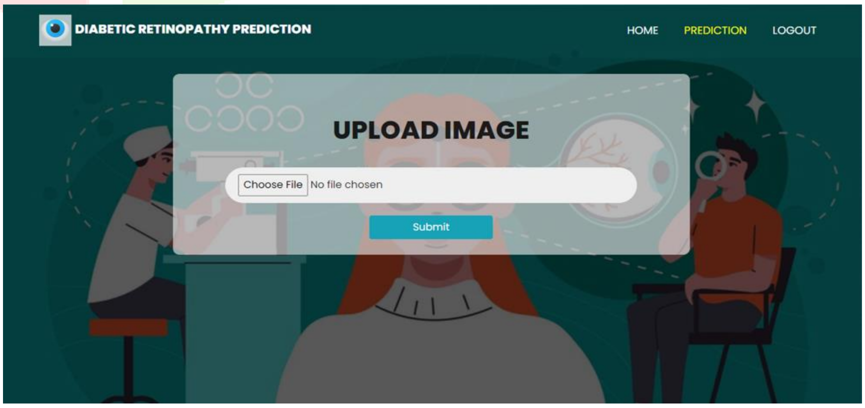

Fig 1. Shows the Page of Prediction

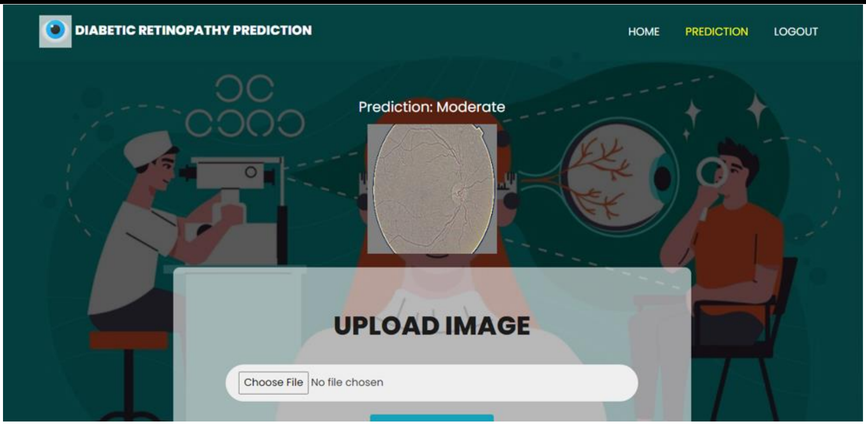

Fig 2. Prediction Stages of Diabetic Retinopathy

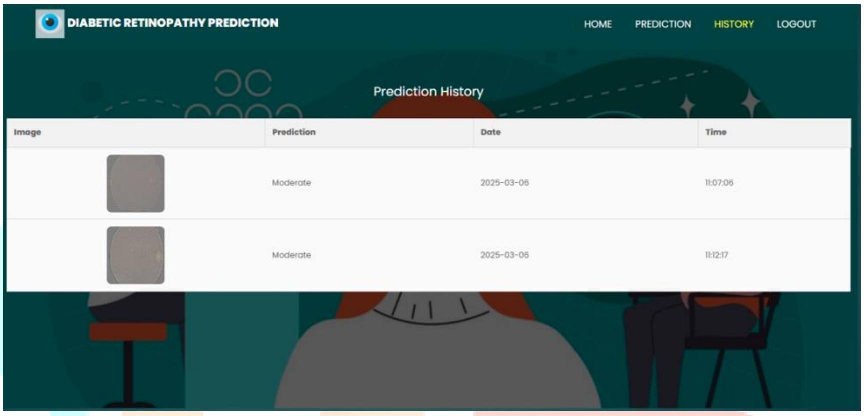

Fig 3. History of User

This project predicts different stages of diabetic retinopathy by allowing users to register, log in, and upload retinal images. A deep learning model analyzes the images and classifies them into stages like **No DR, Mild, Moderate, Severe, or Proliferative DR**. The predicted result is displayed on the screen for quick assessment. Users can track their past predictions through a history section that logs previous uploads with corresponding diagnoses, dates, and times. The interface provides a smooth experience with a simple upload process and clear result visualization. This system supports early detection and monitoring of diabetic retinopathy efficiently.

VII.ACKNOWLEGMENT

It is with great pleasure that I present this project titled "Efficient Detection of Diabetic Retinopathy using Deep Learning" I extend my heartfelt gratitude to the Dhanekula Institute of Engineering and Technology for providing the necessary facilities, web resources, and access to literature that were essential for the successful completion of this work.I am profoundly grateful to all the faculty and staff members, both teaching and non-teaching, of the Computer Science and Engineering Department at Dhanekula Institute of Engineering and Technology. Their invaluable support, guidance, and insightful feedback have been instrumental in shaping this project. I sincerely appreciate their time, expertise, and encouragement throughout this journey.Their contributions have significantly enriched the quality and depth of this work, and I am truly thankful for their unwavering assistance and motivation.

VIII. CONCLUSION

In this project we have successfully classified the images of Identification of diabetic retinopathy, are either affected with the diabetic retinopathy or not using the deep learning and machine learning. Here, we have considered the dataset of diabetic retinopathy images which will be of different types (healthy or unhealthy) and trained using MobileNet. After the training we have tested by uploading the image and classified it.

IX.REFERENCE

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