Comparative Evaluation of Machine Learning Techniques for the Detection of Diabetic Retinopathy

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***Abstract*—Diabetic Retinopathy (DR) is a common diabetes disorder that attacks blood vessels in the light-sensitive tissue known as the retina. It is among the most common causes of loss of vision among patients with diabetes, and it is the leading cause of reduced vision and blindness even among aged adults. Naturally, this occurrence begins with no apparent change in vision. For the identification of DR, ophthalmologists use the retinal image of a patient known as the fundus image, and the blood vessels may also be captured explicitly from the retina. This paper presents a comparative study of five commonly used machine learning techniques: K-Nearest Neighbor, Support Vector Machine and Discriminant Analysis, Naïve Bayes, and Ensembles. The texture characteristics of the fundus image were extracted using the Local Binary Pattern (LBP) descriptor. And this feature extracted using LBP was used to train the classifiers. The proposed method classifies the retina's fundus pictures as "no DR" or "current DR." The Ensemble Classifier (EC) technique generated a better DR detection accuracy of 98.31% than the other four classifiers and existing works based on the classifiers' comparative analysis.**

Keywords— Diabetic Retinopathy, Classification, Feature Extraction, Ensemble Classifier, Machine Learning

I. INTRODUCTION

Diabetes is the most common condition in the human body that causes many complications worldwide [1]. According to estimates from 2014, this disease's incidence rose from one hundred million patients in 1980 to four hundred and twenty-two million patients, with a global prevalence of 4.7% to 8.5% [2]. Patients with a history of diabetes are more prone to diabetic retinopathy [1]. Diabetic retinopathy (DR) is a disease that tends to worsen and is one of the critical causes of blindness and vision loss [3]. DR is a diabetes-related eye condition that arises when the retina's blood vessels swell and leak fluid, leading gradually to vision impairment [4]. Diabetes causes high blood sugar levels that accumulate in the blood vessels, causing damage that impedes or inhibits blood flow to the body's organs, including the eyes, affecting up to 80% of all patients with diabetes for ten years or longer [5]. This assumption facilitates the application of automated diagnostic screening methods to larger populations. DR symptoms include blurred vision, eyespots, and night vision difficulties [6].

The minor disparity between different grades and the existence of many small essential characteristics renders the task of identification very difficult [7]. However, the current approach to detecting DR is a very laborious and time-consuming task that relies heavily on a doctor's capacity [8]. DR automatic detection is necessary to solve these problems. Early-stage identification of DR, which can prevent blindness with appropriate care, is also crucial for diagnosis [9]. The creation of intelligent systems to assist ophthalmologists' decision-making has attracted the scientific community's attention in various works concerning incorrect diagnosis [10][11].

This paper aims to conduct a comparative evaluation of five machine learning methods, namely: Discriminant Analysis Classifier (DAC), Support Vector Machine (SVM), K-Nearest Neighbor (KNN), Ensemble Classifier (EC), and Naïve Bayes (NB) classifier utilized for Diabetic Retinopathy (DR) detection and classification. Hence, the significant contributions of this paper include:

1. Classification of retinal fundus images into No DR or Present DR
2. Comparative experimentation of five different classifiers on the features obtained using the LBP feature descriptor.

The rest of this research is structured as follows: a description of related works is given in Section II. Section III explains the methods used for conducting the research. Section IV describes the findings obtained during the experiment and addresses the results presented. In Section V, conclusions have been drawn, and possible studies are presented in Section VI.

II. RELATED WORKS

In the field of computer vision, the task of detecting DR early is a challenging issue. Diagnostic clarity criteria aim to identify clinical characteristics of Diabetic Retinopathy such as haemorrhages, microaneurysms, soft exudates, and hard exudates. It is an essential issue for a proper diagnosis to