1. INTRODUCTION

Glaucoma, which is typically characterized by optic nerve damage, can be related to increased pressure in the eyeball. Patients with glaucoma can experience headaches, eye pain, redness, nausea, and vomiting. Glaucoma sufferers may also experience visual abnormalities that develop to progressive blindness if the disease is not treated appropriately. Visual disturbances in patients with this disease cannot be cured in any way, even with surgery, because the damage occurs in the optic nerve. The thing that can damage the optic nerve in this disease is the pressure that prevent the entry of the nutrient fluid needed in the eye components to cause nerve cell death in the eye.

Until now, the only option to prevent the occurrence of this disease has been through routine screening or early identification of the retina of the eye, this is essential because, in the early stages of glaucoma, patients commonly show no symptoms. One of the most often used methods for detecting retinal diseases is to evaluate the fundus image (fundus copy), which would be obtained using the ophthalmoscope method to examine the back and interior of the eye. This procedure is time-consuming because the doctor should inspect the fundus of the eye through the ophthalmoscope's small lens to diagnose abnormalities in the eye's retina. As a solution, numerous studies have attempted to automate the diagnostic process by combining computer vision and machine learning methods. Typically, evaluation of the optical disc, optical cup, and blood vessel anatomy can be employed to determine cardiovascular disease in the eye's retina [1][2].

The easiest thing to analyze in detecting glaucoma is to measure the diameter ratio between the optical disc and the optical cup (cup-to-disc ratio). This ratio measurement method is widely used because glaucoma patients' pressure has a significant effect on the shape of the two objects. The greater the pressure, the more significant the change in the object's diameter, particularly in the optical cup diameter ratio. The research [3], attempted to build a system for early detection of glaucoma by calculating the ratio of the optical disc and optical cup obtained through experiments on the combination of red and green channels on several labeled image samples and succeeded in demonstrating that both channels were successful—proven in obtaining the segmentation of the optical disc and optical cup in order to calculate the ratio to detect glaucoma.

Karmawat R et al. (2019) proposes a glaucoma diagnosis system based on the fuzzy c-means (FCM) algorithm for segmenting the optical cup into normal and glaucoma categories. Then the results of the segmentation will be extracted using the CDR, ISNT rule, and DDLS methods. HOG

and 2D-DWT. This study obtained system performance accuracy of 80.20% and 82.20% for the Support Vector Machine (SVM) model and ensemble classifier, respectively [4].

Salam et al. (2017) proposed a glaucoma detection system which by calculating the ratio of the optical disc to the optical cup. The procedure of optical disc segmentation starts with the selection of the HSV plane on the image. It will be segmented using Otsu Thresholding, and then the image's edges will be retrieved and smoothed using the ellipse fitting method. Meanwhile, the contrast in the green channel is enhanced to obtain optical cup segmentation, and blood vessels are removed first using opening and closing morphological operations, followed by the canny edge detector method to acquire the optical cup's surface. This study succeeded in obtaining an average accumulation of accuracy, specificity, and sensitivity of 88.5%, 85.25%, and 93.75, respectively [5].

Dutta et al. (2018) proposed a system that created to automates the optical cup area segmentation process in RGB-channel images in order to predict glaucoma. This system's classification approach is pixel-based feature classification, which analyses the feature set of each pixel with a numerical value in the image. While the optical cup segmentation process is carried out by calculating the average threshold value in the image, the accuracy attained in this system is 83.168% whenever 84 photos from 101 images in the dataset were collected from Arvind Eye Hospital in Madurai with IIIT Hyderabad are classified [6].

Joshi et al. (2018) proposed a system by focusing on extracting features from the optical disc segmentation obtained using the level set method and the Local Binary Pattern (LBP) method, which leverages the average, median, standard deviation, entropy, and skewness characteristics. Besides that, the kurtosis will be examined using a Support Vector Machine model. The final result of the performance evaluation of the system obtained accuracy, sensitivity, specificity, and F1-score values of 78.57%, 83.33%, 75%, and 76.92 %, respectively [7].

According to previous research, the optical disc and optical cup play an essential role in diagnosing glaucoma through fundus images. However, only a few studies use blood vessel segmentation to detect glaucoma. Blood vessels in the retina also have an important role in detecting the disease because the pressure on the eyeball can also affect the shape, structure, and thickness of the blood vessels. Even so, this study employs Invariant Moment to extract form, dimension, and rotational features from the optical cup and blood vessel segmentation of the eye's retina. Then, the method's feature extraction vectors will be examined using multiple machine

learning techniques to decide which classifier model produces the most significant system performance on the used dataset. The primary reason we use the Random Forest model is that it is well-suited for classifying data with a significant level of randomness, as our feature extraction method generates multiple features with random values. While K-Nearest Neighbor was chosen as another comparison model because the results of image segmentation will have adjacent pixel distances, this method is suitable for calculating the image matrix value in the surrounding neighbors.