Title Page:

Enhancing Glaucoma Diagnosis with Artificial Intelligence through Comparative Study of Support vector machine algorithm and Gaussian Naive Bayes Algorithm in Retinal Fundus Image Analysis.

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Keywords:Support Vector Machine, Gaussian Naive Bayes algorithm, eye treatment, glaucoma, detection.

ABSTRACT

Aim: The accuracy of glaucoma detection in this work is assessed using the machine learning methods Gaussian Naive Bayes (GNB) and Support Vector Machine (SVM). **Materials and Methods:** 145461 records make up the glaucoma detection dataset, on which the SVM is deployed. This study presents and develops a standard module for glaucoma detection that contrasts the machine learning techniques SVM and GNB. 1010 sample records from each group were collected for assessment. Clinical analysis was used to measure the sample records; the evaluation's enrollment ratio is 1, the percentage of confidence is 95, the percentage of pretest power is 80, and the values of alpha and beta are 0.05 and 0.5, respectively. The acquired significance value (p), which is less than 0.05, is 0.001 for accuracy. Both methods' final accuracy were computed and reported. **Results:** The machine learning algorithm SVM classifier predicts glaucoma detection on the used dataset with 97.00% accuracy, while the Naïve Bayes classifier predicts the same event with 50.00% accuracy.**Conclusion:** According to the study, the Support Vector Machine (SVM) algorithm predicts glaucoma detection more accurately than the Gaussian Naïve Bayes(GNB) method.

Keywords:Support Vector Machine, Gaussian Naive Bayes algorithm, eye treatment, glaucoma, detection.

INTRODUCTION:

Given that glaucoma is one of the main causes of vision loss, ophthalmologists consider it to be a serious issue. An early and precise diagnosis is essential to preventing permanent damage. In order to better understand the potential of artificial intelligence (AI) in glaucoma diagnosis, this study analyzes two machine learning techniques: Support Vector Machine (SVM) and Gaussian Naive Bayes (GNB). Retinal fundus imaging, a non-invasive technique that takes pictures of the back of the eye, provides crucial information about the detection of glaucoma. Artificial intelligence (AI) algorithms are able to recognize minute details from these photos that may not be visible to the human eye but are indicative of the illness.The effectiveness of SVM and GNB in differentiating between retinal fundus images from healthy and glaucomatous eyes is investigated in this comparative study. The research attempts to determine which algorithm is most appropriate for assisting ophthalmologists in the diagnosis of glaucoma by assessing their performance indicators. Through examining the advantages and disadvantages of SVM and GNB, this study seeks to provide important new understandings into the use of AI for glaucoma diagnosis. The results can guide the creation of strong and trustworthy AI-powered instruments to assist ophthalmologists in accurately and promptly diagnosing glaucoma, which would eventually improve patient outcomes.

There are 105 research articles published on the glaucoma detection in the IEEE xplore, 165 research papers on google scholar and 34 articles were found in sciencedirect. The Bayes technique offers an additional method for incorporating past knowledge into detection models because it is frequently challenging to outperform the best representation of glaucoma detection. predicting circumstances in cases where prior knowledge is either unavailable or unhelpful. It seems that things are stable as a result. This study investigates how artificial intelligence (AI) might enhance glaucoma diagnosis by contrasting two machine learning techniques, Support Vector Machine (SVM) and Gaussian Naive Bayes (GNB). By looking at retinal fundus images, we aim to evaluate how well these algorithms differentiate between eyes that are healthy and those that have glaucoma.

The research gap identified from the survey is that there are many methods proposed for glaucoma detection but most of those methods have less accuracy rate. Several works have demonstrated that the performance of gaussian naïve bayes(GNB) is poor and provides less accuracy in glaucoma detection. The best way to determine which classification algorithm provides the best accuracy is to analyse and compare them. Therefore, this research paper compares the precision and the accuracy of Support Vector Machine (SVM) and Gaussian Naive Bayes (GNB) algorithm for accuracy.

MATERIALS AND METHODS

This research was performed at the Data Analytics lab, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, in which the lab provides extremely superior configured systems which help to get accurate results. Total no.of groups considered for the research were two, group1 consists of 10 sample sizes and group 2 consists of 10 sample sizes. The calculation is done with G-power 0.95, alpha value 0.005, beta value 0.95 and confidence interval 95%. The dataset used for the research was downloaded from Kaggle website (kerneler 2019).

Pseudocode for Support Vector Machine(SVM) Algorithm:

Step 1: Preparing the data

1.1 Load the collection of fundus pictures 1.2 Prepare the photos (resize, normalize, sharpen contrast, etc.)

1.3 Take relevant features (such as texture, optic disc, and cup-to-disc ratio) and extract them from photos.

Step 2: Divide Information

2.1 Separate the dataset into testing and training sets (for example, 30% testing and 70% training).

Step 3: SVM Model Training

3.1 Initialize the SVM model using the preferred kernel (radial, polynomial, or linear basis function, for example).

3.2 Use the training dataset to train the SVM model.

3.2.1 Feed the SVM with the retrieved features and the associated labels (glaucoma positive or negative).

3.2.2 If necessary, use cross-validation to modify model parameters (such as kernel parameters and regularization parameter C).

Step 4: Model Evaluation

4.1 Predict labels for the test dataset using the trained SVM model

4.2 Utilizing the proper metrics (such as accuracy,precision,recall,F1-score)

4.3 Visualize the results (e.g., confusion matrix, ROC curve)

Step 5: Fine-tuning (optional)

5.1 If performance is not satisfactory, fine-tune the model by adjusting parameters or exploring different kernels

5.2 Re-train and evaluate the model iteratively until desired performance is achieved

Step 6: Deployment (optional)

6.1 Once satisfied with the model's performance, deploy it for glaucoma detection in real-world scenarios

6.2 Implement necessary integration with existing healthcare systems if applicable

Support vector machine:

The SVM class's sklearn.linear_model library was utilized in this study's data training. Open the Glaucoma Detection.csv file and read it. The dataset's data records are dispersed at random, with 80% of the dataset being used for training and the remaining 20% being used for testing. After defining the output variable, the training dataset is used to create three out of ten SVM classifiers. Training dataset is used to estimate the testing dataset. After testing the SVM classification design, accuracy is obtained.

Pseudocode for Gaussian Naive Bayes(GNB) Algorithm:

Step 1: Preparing the Data

Launch the Fundus Image Dataset.

- Prepare fundus images by resizing, normalizing, and denoising them.

Step 2:Feature Extraction

Take preprocessed photographs and extract pertinent features.

Step 3: Dataset Splitting

Create training and testing sets from the dataset (e.g., 70-30 split).

Step 4: Model Training

Using the training data, instantiate and train the Gaussian Naive Bayes classifier.

Step 5: Prognosis and Assessment

Estimate the risk of glaucoma for the testing set's cases.

- Utilize metrics such as F1-score, recall, accuracy, and precision to evaluate the classifier's performance.

Step 6: Deployment and Iterative Improvement

Refine the model iteratively in light of performance assessment.

- If necessary, change the parameters or take into account other feature extraction techniques.

- Use the learned classifier for glaucoma detection tasks in real-world scenarios if performance is adequate.

Gaussian Naive Bayes (GNB) :

The data in this study were trained using the Gaussian Naive Bayes (GNB) class from the sklearn ensemble package. The dataset's data records are dispersed at random, with 80% of the dataset being used for training and the remaining 20% being used for testing. It selects samples at random from the dataset, and decision trees are assembled to forecast the result. All possible outcomes were put to a vote, and the winner was determined by selecting the most votes. It employs a Gaussian Naive Bayes (GNB) algorithm.

This study was implemented using Google collab and SPSS software, and hardware specifications needed in a system for evaluation is an intel i3 processor, 50GB Hard Disk Drive, 4GB and Random Access Memory (RAM) and software specifications needed is a windows operating system.

STATISTICAL ANALYSIS

The SPSS tool is used to statistically assess the work in addition to experimental analysis. The mean, standard deviation, accuracy, and standard error mean were the research objectives. The SVM and GNB algorithms were compared using an independent sample T-Test.

RESULTS

Table 1:The accuracy results obtained from comparing the Gaussian Naive Bayes (GNB) and Support Vector Machine (SVM) for analysis with different iterations are displayed in Table 1.
Table 2: The different parameters for both groups are shown in Table 2. For SVM and GNB, the accuracy, recall, F1 Score, and support have been computed. SVM outperforms Gaussian Naïve Bayes (GNB) in terms of accuracy (97.00%), according to a comparison of two groups.
Table 3 shows the statistical analysis of Support Vector Machine (SVM) and Gaussian Naive Bayes (GNB) with different test datasets. The table depicts Support Vector Machine (SVM) produces better accuracy compared with Gaussian Naive Bayes (GNB).
Table 4 depicts the statistical analysis of Significant levels for both groups. There is a negligible Significant difference 0.001 for accuracy among the two groups. Hence Support Vector Machine (SVM) is better than Gaussian Naive Bayes (GNB).

Figure. 1 inferred the mean accuracy of Support Vector Machine (SVM) and Gaussian Naive Bayes (GNB). The results showed that the SVM has better accuracy (97.00%) compared to the accuracy of GNB.

DISCUSSION:

By changing the test size, two groups of people conducted experiments: Support Vector Machine (SVM) and Gaussian Naive Bayes (GNB). According to the SPSS testing data (Figure 3), SVM has an accuracy of 97.00%, while GNB offers an accuracy of 50%. This illustrates why Gaussian Naive Bayes (GNB) is inferior than Support Vector Machine (SVM). According to the SPSS, the constructed SVM algorithmic classification model outperformed the GNB in terms of comparison accuracy (97.00%).

There are still certain study restrictions even though the suggested methodology produced results that were satisfactory. When evaluating accuracy on large datasets, the results might not be adequate. Additionally, the mean error in SVM is larger than in GNB, which is not what is wanted.

final result. The current study effort is greatly enhanced by lowering the mean error. Applying optimization algorithmic techniques to the algorithms is one potential method to improve accuracy and decrease mean error. Using feature selection methods prior to dataset classification is another option for increasing classifier accuracy and achieving desired results.

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CONCLUSION:

A machine learning classifier called Support Vector Machine (SVM) maximizes accuracy by using decision trees. As opposed to Gaussian Naive Bayes (GNB), the research study demonstrates that the Support Vector Machine (SVM) algorithm appears to have a higher accuracy in glaucoma detection. For the detection of glaucoma, SVM is proven to perform noticeably better than GNB. The study came to the conclusion that the Support Vector Machine (SVM) algorithm yields higher accuracy (97.00%) than the Gaussian Naive Bayes (GNB) approach (50.00%).

DECLARATION:

Conflicts of Interests:

No conflicts of interest in this manuscript.

Author Contributions:

Author Y. Yamini Reddy played a key role in collecting and analysing data as well as writing the manuscript. Additionally, Y. Yamini Reddy contributed significantly to conceptualization, data validation and providing critical feedback during manuscript reviews.

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TABLES AND FIGURES

Table 1: Accuracy values of SVM and GNB algorithms obtained for each iteration while evaluating the dataset for various test sizes.

GROUP	ACCURACY
SVM	97
SVM	96
SVM	98
SVM	99
SVM	95
SVM	97
SVM	98
SVM	95
SVM	96

SVM	97
GNB	50
GNB	52
GNB	49
GNB	51
GNB	48
GNB	47
GNB	50
GNB	48
GNB	52
GNB	47

GROUP STATISTICS

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
ACCURACY	SVM	20	95.9500	1.70062	.38027
	GNB	20	55.3000	2.63778	.58983

Table 2: Group Statistics Results-SVM and GAUSSIAN NAIVE BAYES algorithm

Independent Samples Test

Levene's Test for Equality of Variances		t-test for Equality of Means					
F	Sig.	t	df	Sig. (2-	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference

						tailed)			Lower	Upper
ACCURACY	Equal variances assumed	5.673	.022	57.924	38	.000	40.65000	.70178	39.22931	42.07069
	Equal variances not assumed			57.924	32.468	.000	40.65000	.70178	39.22132	42.07868

Table 3:Independent sample test for significance and standard error determination. P-value is less than 0.00 considered to be statistically significant and 95% confidence intervals were calculated.

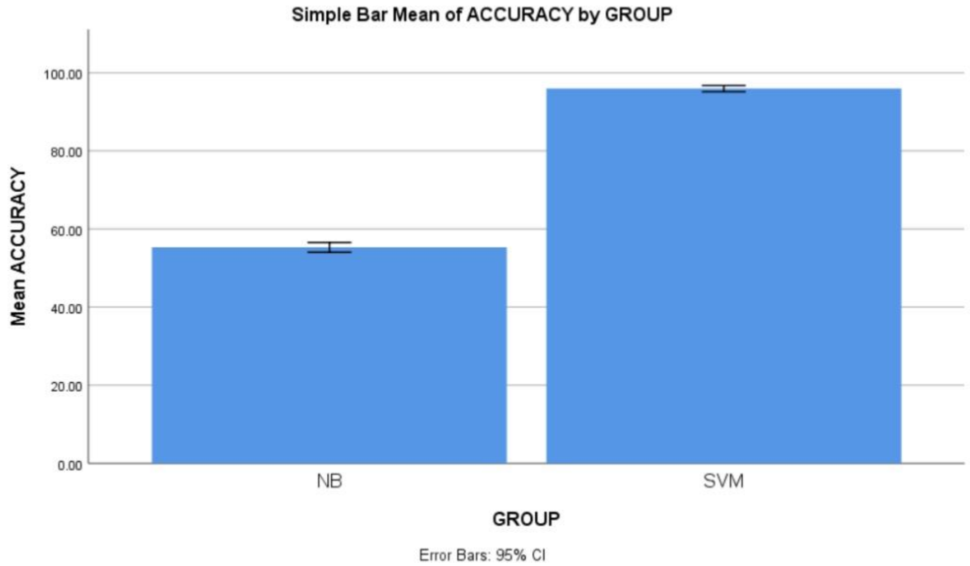

Fig.1. These results underscore SVM superior predictive performance and its potential to enhance traffic evaluation.This comparison is graphically represented with the X-axis denoting "SVM vs GNB algorithm," while the Y-axis represents "Mean Accuracy."The Error bar is represented by ± 2.