ISSN: 0974-5823 Vol. 7 (Special Issue, Jan.-Mar. 2022)

*International Journal of Mechanical Engineering*

# Improving the Efficiency of Fingerprint Verification Using Support Vector Machine (SVM) in Comparison with Naïve Bayes Classifier

**R. Sravanthi[1], R. Sabitha[2]**

[1]Research Scholar, Department of Computer Science and Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamilnadu. India. Pincode:602105

[2]Project Guide, Corresponding Author, Department of Computer Science and Engineering , Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamilnadu. India. Pincode:602105

## ABSTRACT

**Aim:** Perfecting the effectiveness of Fingerprint Verification using Support Vector Machine and in comparison with Novel Naïve Bayes classifier.**Materials and Methods:**The Novel Naïve Bayes Method is compared with a Support Vector Machine. The total number of samples that are evaluated on the proposed methodology is 15 in each of 2 groups and G power value is 80%. **Results:** Novel Naïve Bayes Method algorithm has biometrics predicted with accuracy of 87% which is more compared with Support Vector Machine algorithm which is having the accuracy 83% in detecting the biometrics. Here the pretest power analysis was carried out at 85% and sample size for one group is 15 and total sample size is 30, Novel Naïve Bayes (87.28%) and SVM algorithms (83.01%) in terms of mean accuracy and the standard deviation of Novel Naïve Bayes Method (1.27323) is slightly better than SVM (1.83456) Novel Naïve Bayes Method (87.28%) and SVM algorithms (83.01%) in terms of mean accuracy and the standard deviation of Novel Naïve Bayes Method (1.27323) is slightly better than SVM (1.83456) to attain the significance value is 0.031 ($p<0.05$). **Conclusion:** In this study it is found that the Novel Naïve Bayes Classifier Algorithm is significantly better for the prediction of biometrics compared to SVM algorithm.

**Keywords:** Fingerprint Classification, Support Vector Machine, Fingerprint, Novel Naive Bayes Classifier, Classifier, Biometric Recognition, Machine Learning.

## INTRODUCTION

The research is about the detection of Fingerprint Classification using machine learning ([1]. Point bracket means that assignment of every Point to an order in a harmonious and dependable system, similar to an unknown point to be searched, has to be compared only to the set of fingerprints within the Information belonging to an analogous class ([2]). The performance of the classifier is Essential for good decision timber. But the performance of The classifier depends greatly on the individuality of data to Be distributed ([3]).

A total of 35 articles in IEEE and 15 articles in google scholar have been published. Whereas point Matching is generally performed according to point Micro-features, like crest terminations and bifurcations, point bracket is generally grounded on macro-features, like global creststructure.The recognition of an individual Needs the comparison of his/her point with all the Fingerprint Classification during a database. A typical strategy to reduce the Number of comparisons throughout point reclamation and, Accordingly, to enhance the time interval of the recognition system, is to divide the fingerprints into some predefined orders. Biometrics [1] can not be fluently stolen, faked, or participated. Hence, this system is more dependable and safer for feting people than the traditional knowledge or possession grounded system. Still, these physical and behavioral features must satisfy several constraints for a high trustability of the biometric recognition systems. Indeed, the objects of biometric recognition [2] are the ease of use by a recognition without card or Leg, the increased security which is restated by the difficulty to circumvent the access control as well as the lesser performance with the perfection and the speed of processing. The factual control of mortal ideas is grounded on Feting patterns. The enhanced computers get Pattern recognition [3]. Bracket is an illustration of pattern Recognition [4] which assigns each input value to one of The individual classes. Its final goal is to optimally prize Pattern support on certain conditions and to separate one Class from the others.Previously our team has a rich experience in working on various research projects across multiple disciplines [5]–[15]

Based on the literature survey the accuracy and Fingerprint [16] Classification is less when using Machine Learning algorithms like Support Vector Machine[17]. So focussing on this, the proposed work is used for better accuracy and precision. Thus the aim of this research is to Verify Fingerprint Classification by using the Novel Naïve Bayes[18] Method and the data of the patient by comparison of two Machine Learning algorithms.

## MATERIALS AND METHODS

The research is done in the Department of Computer Science and Engineering of Saveetha School of Engineering. There are two groups in this study namely group 1 is the Improved Novel Naïve Bayes [19] method and group 2 is the Support Vector Machine [17], [20]. The total number of samples that are evaluated on the proposed methodology is 15 samples in each of 2 groups [3]. The sample estimation is done using the G Power statistical software has achieved actual power of 80% statistical difference between means, a-0.05, G power-0.80, effect size-0.679345, mean for c-means Novel Naïve Bayes-0.87, mean for Support Vector Machine-0.83, standard deviation-0.51218 .

### Data Preparation

A dataset was collected from the Kaggle website and has been used in which there was data for fingerprint recognition. It contains a total of 100 images of fingerprint data which is used for disease identification (https://www.kaggle.com/ruizgara/socofing). In the data collection procedure, the various images of the fingerprint are collected based on the fingerprint recognition and are stored in a file. The data is collected from the different data sets and stored which is easier to analyze.

### Naive Bayes Algorithm

The Novel Naïve Bayes Classifier algorithm is one of the simplest and most effective Fingerprint Classification ML algorithms which helps in building the fast machine learning models that can make quick predictions. Novel

Naïve Bayes[21] is one of the fast and easy ML algorithms to predict a class of dataset images and removes the edges of the image preserving the structural properties of any image as below.

Input: Image

Output: After removing the edges of the image

Step 1 : Get the image

Step 2 : Remove the noise from the image to get clear image

Step 3 : Remove the edges from the image and use the gaussian blur

Step 4 : Calculate the gradient and gray scale of the image

Step 5 : Get the image after removing the edges

**Support Vector Machine (SVM) Algorithm**

Support Vector Machine (SVM) is the technique of fingerprint classification that separates the values of the data by the creation of hyperplanes. Hyperplanes can be of different shapes based on the spread of data but just the points that help in distinguishing between the classes are considered for the classification.

Step 1 : Import the matplotlib.pyplot

Step 2 : Get the image from the data set

Step 3 : Import svc to the program

Step 4 : Use else if condition for the image

Step 5 : Check the image and predict it

Step 6 : Get the accuracy score of the prediction

The whole process of data training and testing is done in the process as Fig. 1. Training data is the process of making the Novel Naïve Bayes to understand the data of the symptoms and to perform the difference in the dataset by making the model to get trained in an effective manner. Images are collected and trained to get the Fingerprint Classification analysis path. The testing setup of the proposed system is Hardware-Desktop with 64-bit, 4GB RAM and Software-Windows 10, Python 3.8, Jupyter Notebook.Now split the collected data into two different datasets,one is training dataset and one testing dataset. So that performs the analysis of data used for model building  and predictive modeling that is used for the prediction of the Fingerprint.

**Fig. 1.** Sample dataset images along with its actual images.

Step : 1 Split the images differently based on the identifications.

Step : 2 70% of the dataset is used for training and building the model.

Step : 3 30% of the data is used for testing and removing the outliers of the model.

Step : 4 Fit the model within the data,where the model should not overlap.

Step : 5 Improved Logistic Regressions are applied to the data entered.

Step : 6 Fingerprint recognition is done.

This data is used for the verification purpose and to check whether the data is trained properly or not. This can be an analyzing factor which is used to determine the accuracy of the identification and prediction of disease through the trained values of the data like in Table 1.

**Table I.** Performance measure of Support Vector Machine (Accuracy-83.01) and Naive Bayes (Accuracy-87.28)

| Algorithm | Accuracy | F1-score |
|---|---|---|
| Support Vector Machine | 83.01 | 82.44 |
| Naive Bayes | 87.28 | 85.33 |

**Statistical Analysis**

The analysis is done through SPSS Software using Innovative Novel Naïve Bayes Detection and Support Vector Machine [20], [22] Algorithms. Dependent variables are persons and fingerprints. The independent variables are Accessing time, recognition of images, Actions of a person, Object Recognition.

**RESULTS**

After the data collection is carried out the analysis can be done using an UI or can be done using the python compiler for execution of result and accuracy of the particular ML algorithm. Fig.1 shows the data set of different Biometric recognition images[23]. Here in this proposed work the Improved Novel Naïve Bayes Classifier [19], [24] algorithm has achieved a result of 87.28% accuracy. The accuracy has been improved a lot compared to the Support Vector Machine[25] algorithm which only produced 83.01% accuracy. The final Biometric Verification can be done using the images of the biometric recognition.

**Table II.** Group statistics of Support Vector Machine (mean accuracy 83.01%) and Naive Bayes(mean accuracy 87.28)

| Algorithm | N | Mean | Std.Deviation | Std.Error mean |
|---|---|---|---|---|
| SVM | 15 | 83.01 | 1.83456 | 0.58014 |
| Naive Bayes | 15 | 87.28 | 1.27323 | 0.40263 |

**Table III.** Independent Sample Test T test is applied for the data set fixing confidence interval as 87.28% and level of significance as 0.0031

| Accuracy | Levene's test for equality of variances | | T-Test for equality of means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | t | df | sig.(2-tailed) | Mean difference | Std.error difference | 95% confidence interval of the difference | |
| | | | | | | | | Lower | Upper |
| Equal Variances assumed | 1.081 | 0.0031 | -6.054 | 18 | .445 | -4.27500 | 0.70617 | -2.79140 | -5.75860 |
| Equal variances not assumed | | | -6.054 | 16.037 | .447 | -4.27500 | 0.70617 | -2.77828 | -5.77172 |

In SPSS software a sample size of 15 data is used for analysis of Novel Naïve Bayes Classifier [21] and Support Vector Machine algorithms. These 15 data samples for each algorithm are used to calculate the different statistical values of accuracy and F1 score that can be used for comparison as in Table 1. Here are the statistics of the ML algorithms comparison of Support Vector Machine[17] and Innovative Novel Naïve Bayes[26] Method Algorithm in which the various stats of Mean Accuracy, Standard Deviation and Standard Error Mean of the two algorithms that are taken for the comparison as in the Table 2 in the Fingerprint verification system. These stats can be used to differentiate the efficiency between the two algorithms. In Table 3 independent samples of significance, mean difference, standard error difference and confidence interval of the difference of both ML algorithms have been compared. Fig. 2 shows the Comparison of Novel Naïve Bayes Method (87.28%) and SVM algorithms (83.01%) in terms of mean accuracy and the standard deviation of Novel Naïve Bayes Method (1.27323) is slightly better than SVM (1.83456) to attain the significance value is 0.031 ($p<0.05$).[17], [19]

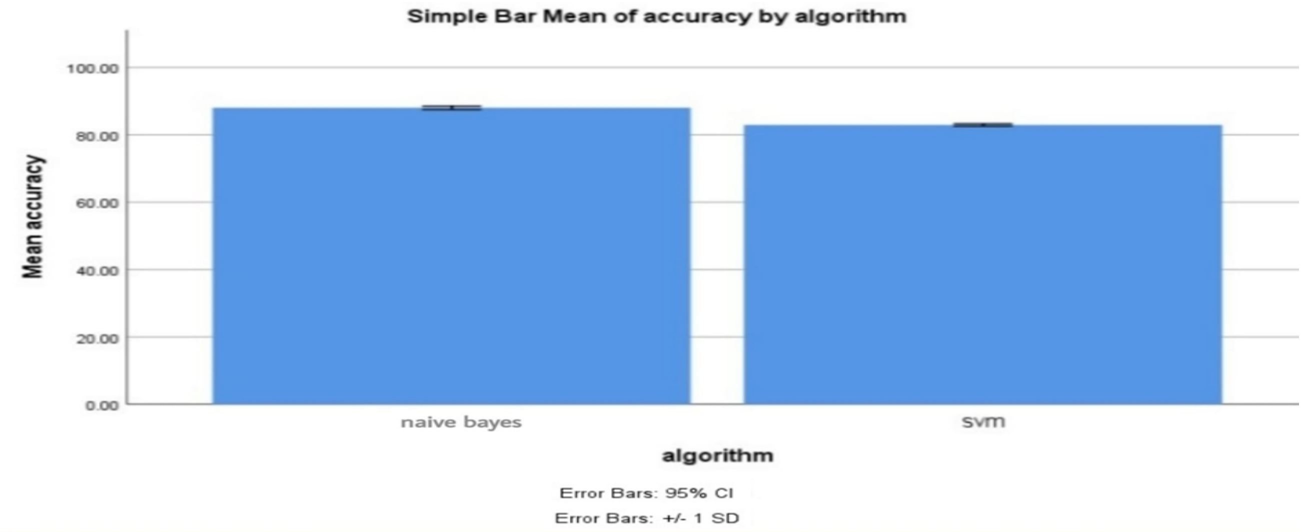


**Fig. 2.** Comparison of Novel Naïve Bayes Method and SVM algorithms in terms of mean accuracy. The mean accuracy of Novel Naïve Bayes Method is better than SVM and the standard deviation of Novel Naïve Bayes Method is slightly better than SVM with error bar +/-1 SD.

**Table II.** Group statistics of Support Vector Machine (mean accuracy 83.01%) and Naive Bayes(mean accuracy 87.28)

| Algorithm | N | Mean | Std.Deviation | Std.Error mean |
|---|---|---|---|---|
| SVM | 15 | 83.01 | 1.83456 | 0.58014 |
| Naive Bayes | 15 | 87.28 | 1.27323 | 0.40263 |

**Table III.** Independent Sample Test T test is applied for the data set fixing confidence interval as 87.28% and level of significance as 0.0031

| Accuracy | Levene's test for equality of variances | | T-Test for equality of means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | t | df | sig.(2-tailed) | Mean difference | Std.error difference | 95% confidence interval of the difference | |
| | | | | | | | | Lower | Upper |
| Equal Variances assumed | 1.081 | 0.0031 | -6.054 | 18 | .445 | -4.27500 | 0.70617 | -2.79140 | -5.75860 |
| Equal variances not assumed | | | -6.054 | 16.037 | .447 | -4.27500 | 0.70617 | -2.77828 | -5.77172 |

## DISCUSSION

Based on the above study it is observed that the Novel Naïve Bayes[20] Method algorithm has better accuracy 87.28% then the Support Vector Machine[27] algorithm which has 83.01% in the prediction of Fingerprint.

In the work they have acquired an accuracy of 79% by using the Support Vector Machine but Novel Naïve Bayes has obtained an accuracy percentage of 85%. This study is a comparison between segmentation (Accuracy=80%). Random forest (Accuracy=82%). The Classifier is found by the conventional neural network used in Fingerprint prediction systems. This process is not observed in the proposed work. overcome the problem by using the deep learning ML algorithm [24] that identifies the pattern and classifies the biometric recognition image for finding Fingerprint Recognition. In the above study the data has shown that the Novel Naïve Bayes [28] Method algorithm has better accuracy than the ML algorithms like Segmentation[2], [29], Random forest and Support Vector Machine[30] but lacks in the detection of the Fingerprint that are based on the user specific needs, which is hard to achieve through this method.[2][17] [2], [29]

The limitations of this proposed work is that the normal biometric recognition image is not able to recognize the Fingerprint images used and also most of these examinations reflect negative cases and many have poor image quality. In future various applications can be made by working together with professions of creating applications for predicting Biometric recognition [31]. Even the medical health records can be uploaded on the cloud platform for the future reference and availability of the data through which more users can access the data [29] [23]

## CONCLUSION

In this research Fingerprint Verification systems using datasets have been observed that the Novel Naive Bayes Method algorithm [24] has obtained a better accuracy of 87.28% than the Support Vector Machine [32] algorithm which only has an accuracy of 83.01%. The precision of the Fingerprint Verification has been significantly increased.

## DECLARATION

### Conflict of Interest

No conflict of Interest in this manuscript.

### Authors Contribution

Author SR was involved in data collection, data analysis, and manuscript writing. Author RS was involved in conceptualization, data validation, and critical review of manuscript.

### Acknowledgement

The authors would like to express their gratitude towards Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (Formerly known as Saveetha University) for providing the necessary infrastructure to carry out this work successfully.

**Funding:** We thank the following organizations for providing financial support that enabled us to complete the study.

1. Mass Datta Developers
2. Saveetha University
3. Saveetha Institute of Medical and Technical Sciences
4. Saveetha School of Engineering.

## REFERENCES

[1] L. Wang and X. Geng, *Behavioral Biometrics for Human Identification: Intelligent Applications: Intelligent Applications*. IGI Global, 2009.
[2] J.-K. Chiu, C.-S. Chang, and S.-C. Wu, "ECG-based Biometric Recognition without QRS Segmentation: A Deep Learning-Based Approach," *Conf. Proc. IEEE Eng. Med. Biol. Soc.*, vol. 2021, pp. 88–91, Nov. 2021.
[3] C. M. Bishop, *Neural Networks for Pattern Recognition*. Oxford University Press, 1995.
[4] C. M. Bishop, *Pattern Recognition and Machine Learning*. Springer, 2016.
[5] D. Ezhilarasan, T. Lakshmi, M. Subha, V. Deepak Nallasamy, and S. Raghunandhakumar, "The ambiguous role of sirtuins in head and neck squamous cell carcinoma," *Oral Dis.*, Feb. 2021, doi: 10.1111/odi.13798.
[6] R. Balachandar *et al.*, "Enriched pressmud vermicompost production with green manure plants using Eudrilus eugeniae," *Bioresour. Technol.*, vol. 299, p. 122578, Mar. 2020.
[7] S. Muthukrishnan, H. Krishnaswamy, S. Thanikodi, D. Sundaresan, and V. Venkatraman, "Support vector machine for modelling and simulation of heat exchangers," *Therm. Sci.*, vol. 24, no. 1 Part B, pp. 499–503, 2020.
[8] A. Kavarthapu and K. Gurumoorthy, "Linking chronic periodontitis and oral cancer: A review," *Oral Oncol.*, p. 105375, Jun. 2021.
[9] S. C. Sarode, S. Gondivkar, G. S. Sarode, A. Gadbail, and M. Yuwanati, "Hybrid oral potentially malignant disorder: A neglected fact in oral submucous fibrosis," *Oral Oncol.*, p. 105390, Jun. 2021.
[10] Hannah R, P. Ramani, WM Tilakaratne, G. Sukumaran, A. Ramasubramanian, and R. P. Krishnan, "Author response for 'Critical appraisal of different triggering pathways for the pathobiology of pemphigus vulgaris—A review.'" Wiley, May 07, 2021. doi: 10.1111/odi.13937/v2/response1.
[11] D. Sekar, D. Nallaswamy, and G. Lakshmanan, "Decoding the functional role of long noncoding RNAs (lncRNAs) in hypertension progression," *Hypertension research: official journal of the Japanese Society of Hypertension*, vol. 43, no. 7. pp. 724–725, Jul. 2020.
[12] P. Appavu, V. Ramanan M, J. Jayaraman, and H. Venu, "NOx emission reduction techniques in biodiesel-fuelled CI engine: a review," *Australian Journal of Mechanical Engineering*, vol. 19, no. 2, pp. 210–220, Mar. 2021.
[13] S. Menon, H. Agarwal, S. Rajeshkumar, P. Jacquline Rosy, and V. K. Shanmugam, "Investigating the Antimicrobial Activities of the Biosynthesized Selenium Nanoparticles and Its Statistical Analysis," *Bionanoscience*, vol. 10, no. 1, pp. 122–135, Mar. 2020.
[14] R. Gopalakrishnan, V. M. Sounthararajan, A. Mohan, and M. Tholkapiyan, "The strength and durability of fly ash and quarry dust light weight foam concrete," *Materials Today: Proceedings*, vol. 22, pp. 1117–1124, Jan. 2020.
[15] V. R. Arun Prakash, J. F. Xavier, G. Ramesh, T. Maridurai, K. S. Kumar, and R. B. S. Raj, "Mechanical, thermal and fatigue behaviour of surface-treated novel Caryota urens fibre–reinforced epoxy composite," *Biomass Conversion and Biorefinery*, Aug. 2020, doi: 10.1007/s13399-020-00938-0.
[16] D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, *Handbook of Fingerprint Recognition*. Springer Science & Business Media, 2006.
[17] N. Cristianini, J. Shawe-Taylor, and Department of Computer Science Royal Holloway John Shawe-Taylor, *An Introduction to Support Vector Machines and Other Kernel-based Learning Methods*. Cambridge University Press, 2000.
[18] A. Jayant, *Data Science and Machine Learning Series: Bayes Theorem and the Naive Bayes Classifier*.

2020.
[19] M. Parsian, *Data Algorithms: Recipes for Scaling Up with Hadoop and Spark*. "O'Reilly Media, Inc.," 2015.
[20] J. Liu and M. Shi, "A Hybrid Feature Selection and Ensemble Approach to Identify Depressed Users in Online Social Media," *Front. Psychol.*, vol. 12, p. 802821, 2021.
[21] M. Kirk, *Thoughtful Machine Learning: A Test-Driven Approach*. "O'Reilly Media, Inc.," 2014.
[22] X. Wang *et al.*, "Joint efficacy of the three biomarkers SNCA, GYPB and HBG1 for atrial fibrillation and stroke: Analysis via the support vector machine neural network," *J. Cell. Mol. Med.*, Feb. 2022, doi: 10.1111/jcmm.17224.
[23] D. Zhang, X. Jing, and J. Yang, *Biometric Image Discrimination Technologies*. IGI Global, 2006.
[24] A. Jayant, *Data Science and Machine Learning Series: Naive Bayes Classifier Advanced Concepts*. 2020.
[25] D. Kumar, *Machine Learning Series: The Support Vector Machine (SVM) in Python*. 2019.
[26] H. A. Rahman *et al.*, "Prediction Modeling of Mental Well-Being Using Health Behavior Data of College Students," *Res Sq*, Feb. 2022, doi: 10.21203/rs.3.rs-1281305/v1.
[27] Y. Ma and G. Guo, *Support Vector Machines Applications*. Springer Science & Business Media, 2014.
[28] C.-Y. Lin, T.-W. Chien, Y.-H. Chen, Y.-L. Lee, and S.-B. Su, "An app to classify a 5-year survival in patients with breast cancer using the convolutional neural networks (CNN) in Microsoft Excel: Development and usability study," *Medicine* , vol. 101, no. 4, p. e28697, Jan. 2022.
[29] V. Lakshmanan, *Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines: From Ingest to Machine Learning*. "O'Reilly Media, Inc.," 2017.
[30] M. N. Murty and R. Raghava, *Support Vector Machines and Perceptrons: Learning, Optimization, Classification, and Application to Social Networks*. Springer, 2016.
[31] A. Cavoukian and A. Stoianov, "Biometric encryption," *Biometric Technology Today*, vol. 15, no. 3. p. 11, 2007. doi: 10.1016/s0969-4765(07)70084-x.
[32] M. Kheirandish, D. Catanzaro, V. Crudu, and S. Zhang, "Integrating landmark modeling framework and machine learning algorithms for dynamic prediction of tuberculosis treatment outcomes," *J. Am. Med. Inform. Assoc.*, Feb. 2022, doi: 10.1093/jamia/ocac003.