Comparison between SVM and CNN models through deployment in the Face Recognition System using real time dataset

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ABSTRACT

The modern era is encountering several challenges in the field of computer vision. Image processing applications are extensively used across several domains, such as face recognition, object identification, criminal identification cases, medical imaging technology, traffic control systems, machine vision, and other related fields. With continuous changes in the instincts of human beings, features, and patterns of living activity for this reason it is quite hard to positively identify particular humans. Presently, the classification algorithms that have the highest level of popularity are Convolutional Neural Networks (CNN) and Support Vector Machines (SVM). This study employs a diverse range of facial images from various age groups and nations to analyze the performance of both these higher-quality models in facial recognition. The predictions are visualized including the features from various datasets. The results analyses show the classification prediction accuracy at 99%, run time, f1- score, and support, precision, and recall values using both the SVM and CNN algorithms implemented in the Python platform.

***Keywords*:** Face recognition, image classification, feature detection, SVM, CNN

Introduction

Image classification is a versatile and critical technology that has a wide range of applications across various industries, enhancing automation, decision-making, and our understanding of the visual world. It plays a pivotal role in enabling machines to interpret and interact with visual information, making it a valuable tool in today's digital age [1]. Different organizations and industries face various challenges when it comes to image classification, depending on their specific use cases and requirements. The researcher has taken a number of steps to identify and create new tools, technologies, and algorithms to solve these image classification problems [2]. Due to frequent changes in objects to objects, it is difficult to control classify, and detect objects as every object has its own nature and structural differences, and making decisions based on the classification is time-consuming. The ascendancy of this image classification algorithm [3] has a life-changing impact on everyday life. Deep learning (DL) methods due to good performance in the last few years have become more popular for Image classification. Many researchers have analyzed different aspects of image classification using Convolutional Neural Network (CNN) [4] and Support Vector Machine (SVM) [5] techniques. Among these, CNN gained significant attention in robust feature extraction and information mining. Its robust feature extraction and learning mechanisms paved its usefulness in various types of applications such as object identification, image super-resolution, semantic segmentation, etc [6]. CNN integrated with several methods, can extract features without using handcrafted models, and eventually, show better accuracy in IPS. There are many studies on image classification that found efficient outcomes using these techniques. For example, in the medical field, image

processing plays an important role [7]. Here, many diseases are detected or pre-detected using these modern IPS. Authors in [8] proposed an automatic Image Processing System (IPS) to identify different types of tumors by deploying SVM and CNN simultaneously. Some authors [9] developed IPS using hybrid CNN and SVM. There, the efficacy of these techniques is assessed to identify cancer cells in the lungs. Research in this field shows that CNN is easier to train and has fewer parameters compared to a fully connected network with the same number of hidden units [10]. Along with, the authors [11] used face recognition for the advanced attendance system. Moreover, authors in [11] presented the high accuracy rate of CNN when compared to SVM for the same dataset. A hybrid model combining CNN and SVM for classification and threshold-based detection is proposed in [12]. In [13], a deep learning method is proposed for extracting features and classification for the follow-up treatment of the retina. In the field of remote sensing, research on deep learning has gained successful validation and applications. In [14], a seven-layer CNN technique is used for sensing images remotely. Several Machine-Learning algorithms [15] have been utilized for remote sensing as well. Authors in used SVM and CNN for crop image classification analysis. The image classification comparison was made among four crops (paddy rice, potatoes, cabbages, and peanuts), roads, and structures.

Methodology of the Work

In this work, two high-level classification algorithms are used, namely Convolutional Neural Network (CNN) and Support Vector Machine (SVM) to determine the performance parameters in the facial recognition system. The comparative study for both algorithms based on their accuracy scores, error rate, precision, recall, f1-score, Support, and runtime are carried out as well. The confusion matrices of both these models are predicted and evaluated based on the random image datasets. The following section provides a detailed explanation of the workflow process, accompanied by illustrations, for each particular algorithm.

3. Results and Observations

3.1 Real-time image dataset:

In this work, real-time datasets have been assembled from unprecedented people. Thereafter, a final dataset is reformed from a few people's image data. The images are collected from every possible angle and put together for further analyses. These image datasets are utilized extensively to conduct a comparative analysis between CNN and SVM models respectively. The following are the work steps referred from the pseudocodes mentioned in Section 2.

- **Data pre-processing stage**: The images are collected from individuals, and then merged for reconstructing the final datasets. In this stage, the data pre-possessing is done to clean the noisy data and resize all data. In the forecasting part, the data set has been divided into two different sections, male and female. The data set is then separated with respect to different aspects and unnecessary data are removed from the final data set. The data set is then separated manually based on the gender diversity.
- **Training and testing stage**: From the final dataset, the first 80% data are considered as training data and the rest as 20% testing set.

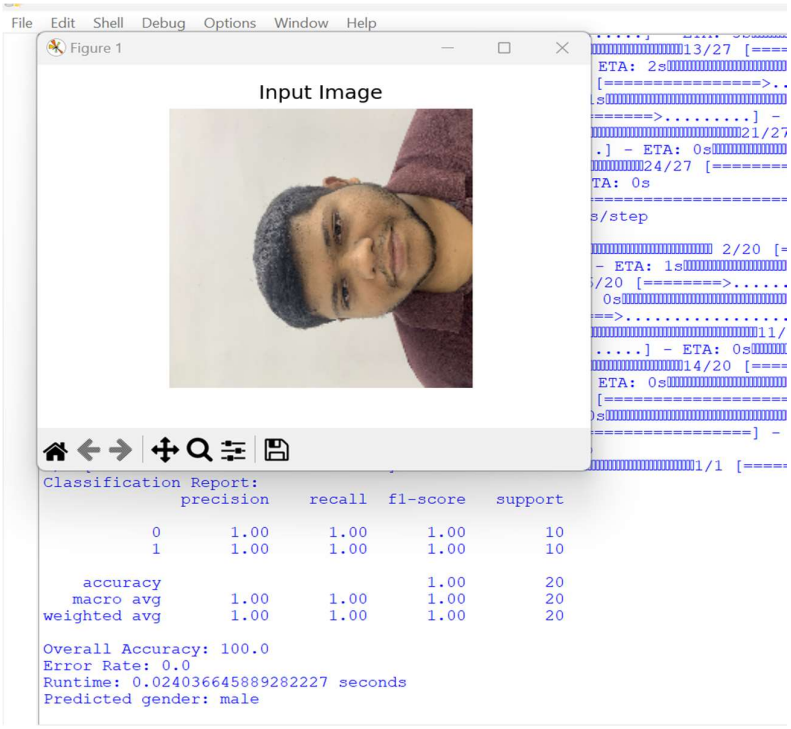

Fig.4 Data processing and result evaluation with the CNN model.

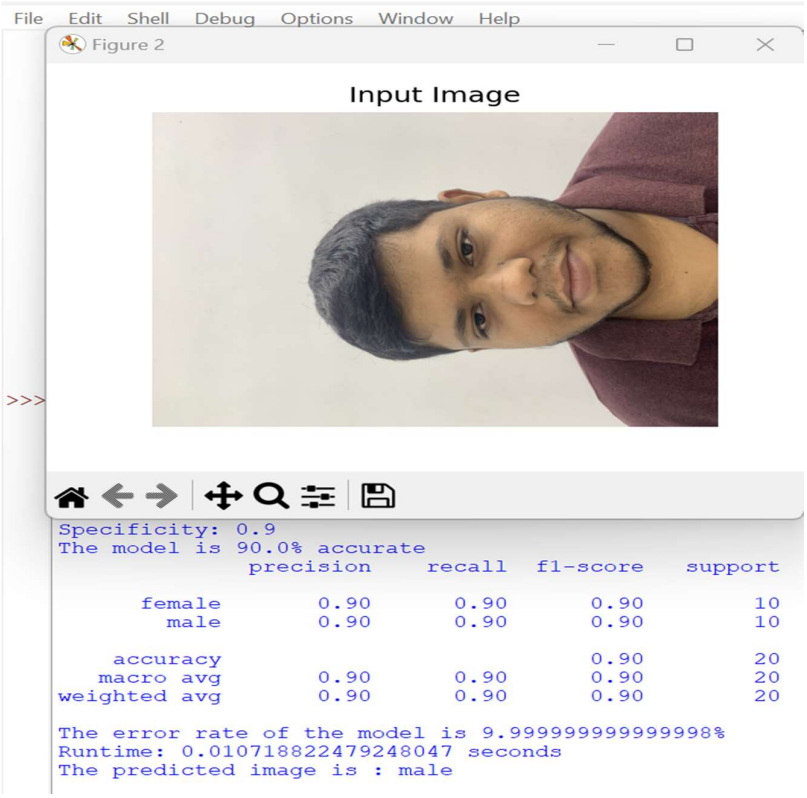

Fig.5 Data processing and result evaluation with the SVM model.

From Fig.4 and Fig.5**,** it can be seen that the accuracy of the CNN model is better than that of the SVM model. Consequently, the precision, recall, f1-score, and support all correctly denote a better-quality classifier than the SVM model. Here, precision represents the positive predictions, it is visible that CNN's precision is higher with a precision value of 1 for the female class and for the male 1.00. Similarly, here the recall represents the proportion of the actual positives identified correctly for females which is more than SVM and equal for males. F1-score made a correct prediction with an accuracy of 1.0 for both female and male classes better than that of SVM with a f1-score of 0.90. The support values indicate the number of actual datasets in each class. It is evident from the figure that the error rate is 0.00% whereas the SVM carried out approximately 9.99% of the error rate. However, for the runtime evaluation, it is seen that the SVM model takes less execution time than the CNN model.

Conclusion

To conclude, in this work, a comparative assessment between two classification algorithms i.e., the CNN model and SVM model is conducted. Here, it is found that the CNN model is more efficient with respect to its accuracy, error rate, specificity, precision, support, and f1-score. On the other hand, SVM takes much less time to execute the prediction process because of the datasets. As CNN is well known for larger datasets, it works well in the work but takes much more time than the SVM model. In feature analysis, CNN operates its execution based on the image-feature pixel-wise correctly, and during prediction, it predicts accurately with an accuracy of 1. To the best of the present work analysis, the CNN model performs better than the SVM model in face recognition systems. Researchers are incessantly trying to invent the best algorithm for classification, it seems that more work progress can be done on this part as well. Data visualization shows that the same input image prediction accuracy is different. Though CNN took more time for prediction than SVM for the taken datasets, it can be said that the CNN predictions are more reliable than the SVM. The main purpose of this research is clear visualization of accuracy, precision, recall, f1 score, support, and error occurrence, and the performance measurement individually for both SVM and CNN models. The effect of CNN model in face detection is considerable effective and the range of prediction results is noticeable.

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