**Title page:**

Accurate Smart Attendance Face Recognition System using OpenCV Algorithm Compared with Sparse Network of Winnows

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**Keywords:** Education, Face Recognition, Image Processing, Machine Learning, Novel OpenCV, Smart Attendance, Sparse Network Of Winnows(SNOWs).

**ABSTRACT**

**Aim:** This study aims to enhance the accuracy of face recognition for a smart attendance system using OpenCV, by comparing it with a sparse network of winnows (SNOWs). **Materials and Methods:** OpenCV and Sparse Network of Winnows are the two groups in this study. For the datasets with a sample size of N =10, accuracy was calculated with G power of 80%. **Results:** The face recognition based smart attendance system through OpenCV gained accuracy of 92.67% whereas Sparse Network of Winnows obtained accuracy of 87.68% respectively. There is a statistical significant difference between OpenCV and Sparse Network of Winnows with p=0.001 (p<0.05). Independent sample T-test values state that the results in the study are statistically significant between two groups. **Conclusion:** This paper implements and compares two methodologies, namely OpenCV and Sparse Network of Winnows, for developing a smart attendance system based on face recognition. By succeeding the current research experiment, it is found that the OpenCV (92.67%) appears to be better than a sparse network of winnows (87.68%).

**Keywords:** Education, Face Recognition, Image Processing, Machine Learning, Novel OpenCV, Smart Attendance, Sparse Network Of Winnows.

**INTRODUCTION**

College attendance is a powerful predictor of student education outcomes. There is an inherent positive relationship between students’ attendance education in schools and colleges and their academic performance, according to research [(Liang et al. 2022)](https://paperpile.com/c/ZKCgCe/eQKa). And, in order to maintain this relationship, it is necessary to encourage their presence and performance in the classrooms, so that students are motivated to keep up with the progress of the subjects being taught in class, thereby increasing their participation in school/college. There are numerous approaches used to deploy attendance education management systems in schools, colleges, and institutions around the globe. These systems are very usable, yet there are some legitimate concerns about their usefulness. One system of this type that has lately gained popularity is the face recognition-based attendance system. Face recognition is a method for recognising, validating, or differentiating a subject from other subjects based on an image or video of the subject's face. It makes use of a biometric identification technique to measure the head and face of a person and confirm their identity. [(Lang and Gu 2009)](https://paperpile.com/c/ZKCgCe/3KaL). Face recognition biometric systems employ computer algorithms to identify particular, distinctive characteristics of a person's face, including the distance between their eyes or their facial structure. These traits are transformed into a mathematical form, like an array or matrix, then contrasted with those of other faces in a face recognition database. A face encoding is information about a particular face that differs from a picture in that it is intended to only contain certain information that can be used to recognise one face from another. [(Luh 2014)](https://paperpile.com/c/ZKCgCe/3SQ0). For the purposes of creating and storing the biometric facial pattern, this system requires any device having digital photographic technology, such as a webcam or a CCTV camera. The facial recognition systems are used by Security and access control, law enforcement, border control mobile devices for better accuracy in threat detection by the Border Security Force [(Fullerton and Widding 2000)](https://paperpile.com/c/ZKCgCe/qiVH)).

In 2017 [(Srikantaswamy and Sudhaker Samuel 2006)](https://paperpile.com/c/ZKCgCe/Hlbb) Samuel John presented a Face Recognition Attendance System with GSM Notification. This system uses the ViolaJones algorithm. This algorithm is used for detecting faces. Also, the Fisher faces method was used to generate patterns from the captured faces. This produced templates that were saved in the database. To construct the graphical user interface for this system, Software Development Kit (SDK) was utilized in conjunction with the OpenCV library.. In [(D’Souza, Jothi, and Chandrasekar 2019)](https://paperpile.com/c/ZKCgCe/iUq1) another paper, Using facial recognition, Jenif D'Souza introduces an Automated Attendance Marking and Management System by Facial Recognition. This system marks students' attendance automatically by the camera which captures the photo of students in the class. This system uses the algorithm called Histogram.The histogram technique is used to identify faces. The face image is transformed into a matrix in this approach. For precise facial identification, histograms are employed. With this technique, the issue is time-consuming. In [(Yadav et al. 2020)](https://paperpile.com/c/ZKCgCe/FMM6) introduced an Attendance System based on face recognition. This system captures the video of the students, converts it into frames and stores it in the database. Also, The Convolution Neural Network (CNN) algorithm is used to find faces. Accuracy and speed are improved because of this system. developed Real Time Smart Attendance Management System Using Face Recognition Techniques in. In this system, two cameras are used along with a convolution neural network and principal component analysis (PCA) approach for face detection and recognition. At the classroom door and inside the classroom, some cameras are employed for facial recognition and proxy attendance monitoring.. In [(Zhao, Zhao, and Qu 2022)](https://paperpile.com/c/ZKCgCe/9Z0A) 2016, S.Jeevitha introduced Automatic Attendance Management System Using Face Recognition. In this system the use Eigen Faces, Eigen Weight method for face detection this system the camera detention the image and then system crop the faces of student and tie the faces with student database.

The results of earlier education studies point to a research gap where students' attendance can be properly marked manually with the aid of facial recognition. Faces are spotted, recognised, and attendance is updated while contending with obstacles including poor lighting and image orientation. The study's main goal is that without losing any data, this system is able to identify and recognise any face that is provided as input using OpenCV algorithm.

**MATERIALS AND METHODS**

The planned study was carried out for face recognition studies in the Open Source Laboratory, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences. The study comprises two groups, where the first group uses OpenCV and the second group uses SNOWs.[(Zhao, Zhao, and Qu 2022)](https://paperpile.com/c/ZKCgCe/9Z0A). For the provided data samples, alpha was fixed at 0.05 and the G-power was calculated to be 80%. These aforementioned algorithms were used to run the experiment over ten iterations [(Zhao, Zhao, and Qu 2022)](https://paperpile.com/c/ZKCgCe/9Z0A).

The experiment was conducted on an HP PAVILION 15 EC0001NX laptop with a Ryzen 7 9th gen processor, 16GB RAM, 1 TB storage, and Windows 11 operating system. The researchers used the Smart Attendance Facial Detection dataset, which is an open source dataset from www.kaggle.com [(Tiwari 2020)](https://paperpile.com/c/ZKCgCe/O8Nx8), and contains images of different people's faces. The dataset has a size of 59.7 MB and includes 166 images, which were divided into training and testing sets. The training set contained 136 images, and the test set contained 30 images. The dataset for the Face Recognition Smart Attendance System was obtained from [(Tiwari 2020)](https://paperpile.com/c/ZKCgCe/O8Nx8), and was stored in .csv format. The accuracy of both methods was calculated using an independent T-test analysis.

**OpenCV**

OpenCV is a library that can be used across multiple platforms and provides programming functions that primarily focus on real-time computer vision [(Tan et al. 2021)](https://paperpile.com/c/ZKCgCe/Sb8iI). It is often used to tackle issues related to real-time image processing. Due to its development in the C language, it is suitable for use with digital signal processors [(Bansal and Garg 2016)](https://paperpile.com/c/ZKCgCe/XsDx2). OpenCV has a wide range of applications, including object and face recognition as well as recognizing handwritten letters.

**Algorithm**

Step 1: Input is taken from data.world website which is a group of face images.

Step 2: In this step, Pre-processing is done.

Step 3: After that, image post-processing will take place.

Step 4: The processing of the recommended algorithm takes place.

Step 5: The pre-processed images are taken into action to improve the detection of the human face.

Step 6: This is the step where the face of an individual is identified with accuracy and time taken by the selected algorithm is visualized.

**Sparse network of Winnows (SNOWs)**

SNOWs is a learning architecture that is specifically tailored for learning in the presence of a very large number of features. and can be used as a general purpose multi-class classifier. The current release of the SNOWs architecture is the second generation of the original SNOWs learning architecture developed by Dan Roth. SNOWs stands for Sparse Network of Winnows. The Learning architecture is a sparse network of sparse linear functions over a predefined or incrementally acquired feature space; several update rules may be used - sparse variations of the Winnow Update rule, the Perceptron, or naive Bayes. SNOWs is a multi class learner, where each class is represented as a single target node, learned as a linear function over the feature space or as a combination of several of those, organized into clouds. Each of these representations is learned from labeled data in an incremental fashion. Both The representation architecture (i.e., which \features" are important) and the features' weight are determined by SNOWs. Decisions made by SNOWs are either binary indicating which of the labels is predicted for a given example, or continuous indicating a condence in the prediction. Several other output modes are available.

**Algorithm**

Step 1: Loading of dataset is the initial stage.

Step 2: Obtaining noise free facial regions.

Step 3: Processing of feature extraction using noise removed data.

Step 4: Recognition of facial image has to be done.

**STATISTICAL ANALYSIS**

The Statistical analysis was calculated using SPSS Version 26 (Statistical Package for the Social Sciences). Its development stage provides advanced factual analysis, a sizable library of AI calculations, text analysis, open source extensibility, and the ability to compare algorithms' mean accuracy. Using the Python compiler, a smart attendance system using face recognition in real time is analyzed and performed, and accuracy values are obtained with key characteristics. The Python compiler's output is statistically analyzed using IBM SPSS version 26 software [(Nisbet, Miner, and Yale 2017)](https://paperpile.com/c/ZKCgCe/o3iX). In this study, a set of face images of individuals has been chosen, and from these images, the structure and features of a person's face are isolated and utilized as a distinct parameter to enhance their recognition. The improvement in accuracy is considered as the dependent variable in this study.

**RESULTS**

The OpenCV face recognition to perform smart attendance recognition of the human face from a collection of dataset performs well when compared to skin texture analysis.

**Table 1.** Improved accuracy for predicting Accuracy of Face Recognition Smart Attendance System usinG OpenCV (92.67%) compared with SNOWs (87.68%)

**Table 2** defines the mean and standard deviation of the group and accuracy of the OpenCV and SNOWs were 92.67% and 2.87683, 87.68% and 3.71285, respectively. In comparison to the SNOWs approach, the OpenCV had a lower standard error of .90973.

**Table 3** involves the independent sample test that revealed a substantial variation in accuracy among the suggested two stages and the standard single stage. Since p<0.05, there is a substantial variation between the two methods.

**Fig. 1.** represents the accuracy and mean accuracy calculation of the conventional method and the proposed over selected input. The proposed method attained a mean accuracy of 92.67%, which is greater than the conventional method of 87.68%. X-axis represents accuracy of OpenCV and Sparse Network of Winnows algorithm; Y-axis represents mean accuracy ± 2 SD.

**DISCUSSION**

The proposed system aims to improve the efficiency of smart attendance systems by utilizing face recognition algorithms to assign attendance to students. OpenCV achieved an accuracy of 92.67%, while the Sparse Network of Winnows (SNOWs) Algorithm attained an accuracy of 87.68%. There is a statistically significant difference between OpenCV and SNOW's algorithm, with a p-value of 0.001 (p<0.05)..

This proposed work, OpenCV is a mass open source library for computational vision [(Srikantaswamy and Sudhaker Samuel 2006)](https://paperpile.com/c/ZKCgCe/Hlbb), Machine learning (ML) and Image processing; recently it is widely used in real time applications [(D’Souza, Jothi, and Chandrasekar 2019)](https://paperpile.com/c/ZKCgCe/iUq1) and it occupies an important role in growing technologies. The applications of OpenCV is to identify objects, faces and handwritten alphabets [(Yadav et al. 2020)](https://paperpile.com/c/ZKCgCe/FMM6). Sparse Network of Winnows (SNOWs) replaces difficulties in two dimensional recognition and it is mainly used in face recognition systems to recognize the face of a person even without bright light effect and facial expression. When compared to earlier study publications, OpenCV looks to be more accurate [(Zhao, Zhao, and Qu 2022)](https://paperpile.com/c/ZKCgCe/9Z0A). The real time dataset, Kaggle dataset for face recognition is utilized to achieve an efficient attendance system.

The limitation of the research work is that it is not supported for larger datasets [(Liang et al. 2022)](https://paperpile.com/c/ZKCgCe/eQKa), which is a restriction of the proposed work. If the dataset contains other parameters like facial changes due to the aging factor, there may be a potential to forecast a more accurate face recognition attendance system [(Lang and Gu 2009)](https://paperpile.com/c/ZKCgCe/3KaL). Future work could be used in universities, colleges, and online course platforms to provide students accurate attendance.

**CONCLUSION**

The face recognition based smart attendance system is presented and compared accuracy of recommended algorithms. From findings, it is evident that OpenCV (92.67%) is the right choice for a face recognition system better than SNOWs(87.68%)

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**DECLARATION**

**Conflicts of Interest**

The submission has no potential conflicts.

**Author Contributions**

Author ST was in charge of data collection, data analysis, and manuscript writing. The manuscript's conceptualization, data validation, and critical review were all done by author KSR.

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**TABLES AND FIGURES**

**Table 1.** Improved accuracy for predicting Accuracy of Face Recognition Smart Attendance System using OpenCV (92.67%) compared with Sparse Network of Winnows (87.68%).

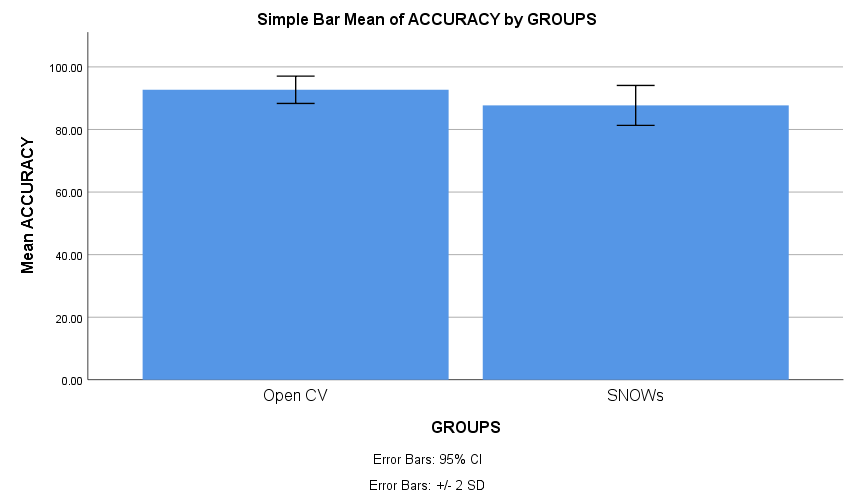
| **Iteration No** | **OpenCV** | **SNOWs** |
| --- | --- | --- |
| 1 | 89.47 | 83 |
| 2 | 89.99 | 84.97 |
| 3 | 90.34 | 85.10 |
| 4 | 91.68 | 85.37 |
| 5 | 92.43 | 87.00 |
| 6 | 93.88 | 87.95 |
| 7 | 94.24 | 88.64 |
| 8 | 94.74 | 90.47 |
| 9 | 94.97 | 91.63 |
| 10 | 95.02 | 92.74 |

**Table 2.** The mean and standard deviation of the group and accuracy of the OpenCV and Sparse Network of Winnows were 92.67% and 2.18365, 87.68% and 3.19175, respectively. In comparison to the SNOWs approach, the OpenCV had a lower standard error of .90973.

| **Group Statistics** | | | | | |
| --- | --- | --- | --- | --- | --- |
|  | **GROUP NAME** | **N** | **Mean** | **Standard Deviation** | **Standard Error Mean** |
| **Accuracy** | **OpenCV** | 10 | 92.67 | 2.18365 | .69053 |
| **SNOWs** | 10 | 87.68 | 3.19175 | 1.00932 |

**Table 3.** The independent sample test revealed a substantial variation in accuracy among the suggested two stages and the standard single stage. Since p<0.05, there is a substantial variation among two methods.

| **Independent Sample Test** | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Levene’s Test for Equality of Variances** | | | | **T-test for Equality of Means** | | | | | | |
|  | | **F** | **Sig.** | **T** | **Df** | **Sig. (2-tailed)** | **Mean Difference** | **Std. Error Differences** | **95% Confidence Interval of the Difference** | |
| **Lower** | **Upper** |
| **Accuracy** | **Equal Variances assumed** | 1.435 | .247 | 4.08 | 18 | .001 | 4.98 | 1.22 | 2.41 | 7.558 |
| **Equal Variances not assumed** |  |  | 4.08 | 15.911 | .001 | 4.98 | 1.22 | 2.39 | 7.582 |



**Fig. 1.** Mean accuracy comparison of OpenCV method with SNOWs. The proposed method attained a mean accuracy of 92.67%, which is greater than the conventional method of 87.68%. X-axis represents accuracy of OpenCV and SNOWs; Y-axis represents mean accuracy ± 2SD.