**Title page:**

OpenCV Algorithm Compared with Skin Texture Analysis Algorithm for Accurate Smart Attendance Face Recognition System

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**Keywords:** Education, Face Recognition, Image Processing, Machine Learning Novel OpenCV, Novel Skin Texture Analysis, Smart Attendance.

**ABSTRACT**

**Aim:** The objective of this project is to enhance the accuracy of a smart attendance system based on face recognition, by comparing the performance of OpenCV-based face recognition with a skin texture analysis algorithm. **Materials and Methods:** To enhance the accuracy of face recognition of a person is implemented by using the OpenCV algorithm with sample size of (N=10) and Skin texture analysis algorithm (N=10) with G power of 80%. **Results:** The face recognition based smart attendance system through OpenCV gained accuracy of 93.67% whereas skin texture analysis algorithm obtained accuracy of 84.90% respectively. There is a statistically significant difference between OpenCV and the Skin Texture Analysis algorithm with (p=0.000) (p<0.05). **Conclusion:** The face recognition based smart attendance system is implemented using OpenCV and compared with accuracy of Skin Texture Analysis algorithm. From findings, it is evident that OpenCV appears to be better than skin texture analysis.

**Keywords:** Education, Face Recognition, Image Processing, Machine Learning Novel OpenCV, Novel Skin Texture Analysis, Smart Attendance.

**INTRODUCTION**

Every Institution requires a dependable method for monitoring student attendance.Each uses a unique method to track attendance. During lecture hours, some call names by hand on a piece of paper, while others employ biometric devices like fingerprint, RFID, and iris scanners. College attendance is a powerful predictor of student education outcomes. It takes a long time to call out each student's name individually as is customary[(Subhash et al. 2016)](https://paperpile.com/c/fKjNc0/2aQb). According to the RFID card system [(Paret and Riesco 2005)](https://paperpile.com/c/fKjNc0/uQr1), Each student is given a card that corresponds to their identification, but there is a danger that the card may get lost or that someone else will use it to pretend to be absent. Other biometrics, such as voice, iris, or fingerprint identification, have their own drawbacks and are not entirely reliable. [(Paret and Riesco 2005)](https://paperpile.com/c/fKjNc0/uQr1) . Face recognition is a clever way for the education attendance management system to track attendance because it is more precise and quick than other methods, which lowers the possibility of proxy attendance. [(Kuo and Nevatia 2011)](https://paperpile.com/c/fKjNc0/0wQ6). Face recognition can be used in many smartphones and tablets to unlock the device, making it a more convenient and secure method of access compared to traditional passwords. This has been identified as an application for this project [(Huang, Xiong, and Zhang, n.d.; Alfalou and Brosseau 2010a)](https://paperpile.com/c/fKjNc0/Quuf1+u2Jpt), with improved accuracy and the elimination of manual errors.[(Noyes, Hill, and O’Toole 2018)](https://paperpile.com/c/fKjNc0/jThQ).

Several face recognition-based attendance management systems have been introduced in recent years to improve student performance in various organizations.. In [(Mishra 2012)](https://paperpile.com/c/fKjNc0/tf84) Jomon Joseph, K. P. Zacharia proposed a system using image processing, PCA, Eigen faces [(Vidya 2016)](https://paperpile.com/c/fKjNc0/53H3) that works with the orientation of the system. Ajinkya Patil [(Amarapur and Patil 2006)](https://paperpile.com/c/fKjNc0/QzW2) proposed a face recognition approach for attendance marking using the Viola-Jones algorithm. Haar cascades are used to detect faces in images, and recognition is performed through the Eigenface method. A skin texture analysis approach for an attendance management system was proposed by Muthu Kalyani, Veera Muthu, and others [(M et al. 2015)](https://paperpile.com/c/fKjNc0/7DW9), who marked attendance with the monthly progress of each student. There is a need for an alternative algorithm that can enhance the recognition of oriented faces. The Efficient Attendance Management system is designed with the help of the PCA algorithm [(Jain et al. 2018)](https://paperpile.com/c/fKjNc0/e8oE). They have achieved accuracy up to 83%, but their system performance decreases due to slight changes in light conditions.

The fact that the daily attendance of students' education is manually recorded and saved subject-by-subject in the past study work reveals a research gap. In the proposed system, facial traits of students are computed and compared to identify them using deep learning, while faces in photographs are detected using a skin texture analysis method. Our system is able to recognise several faces simultaneously. [(Li 2010)](https://paperpile.com/c/fKjNc0/noL9). The primary objective of the study is to evaluate the accuracy of smart attendance systems based on face recognition, by comparing the performance of OpenCV-based face recognition with a skin texture analysis algorithm.

**MATERIALS AND METHODS**

The training and testing of face recognition studies are performed in the Open Source Laboratory, Saveetha School of Engineering, and Saveetha Institute of Medical and Technical Sciences. The groups used in this study are two. The first group is OpenCV, and the second group is skin texture analysis. Sample size was calculated using previous study results [(Kane, Phar, and BCPS n.d.)](https://paperpile.com/c/fKjNc0/auGM)) by keeping the threshold at 0.05, G power at 80%, and the confidence interval at 95%.

The research work used an HP PAVILION 15 EC0001NX computer with a Ryzen 7 9th gen processor, 16GB RAM, 1TB storage, and Windows 11 operating system for the testing setup. The dataset used was the Smart Attendance Facial Detection dataset obtained from Kaggle [(Tiwari 2020)](https://paperpile.com/c/fKjNc0/efQRE), consisting of 166 images of different people's faces and with a size of 59.7 MB. The dataset was divided into a training set of 136 images and a test set of 30 images. Additionally, the dataset for the Face Recognition Smart Attendance System was sourced from [(Tiwari 2020)](https://paperpile.com/c/fKjNc0/efQRE) and stored in .csv format. To determine the accuracy of both methods, an independent T-test analysis was conducted.

**OpenCV**

A cross-platform library called OpenCV, which focuses mostly on real-time computer vision, provides programming functions [(Tan et al. 2021)](https://paperpile.com/c/fKjNc0/QdLBc). It is specifically put into use to address issues with real-time image processing models. This library was created in C, making it appropriate for use with digital signal processors [(Bansal and Garg 2016)](https://paperpile.com/c/fKjNc0/RTQa5). OpenCV may be used to recognise faces, objects, and handwritten alphabets.

**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.

**Skin Texture Analysis Face Recognition**

Skin texture analysis [(Singh, Shah, and Bagade 2016)](https://paperpile.com/c/fKjNc0/VlES) has been an active area of research in pattern recognition. A variety of techniques have been used for measuring textural similarity. In 1973, Haralick et al. proposed a co-occurrence matrix (GLCM) representation of texture features to mathematically represent the gray level spatial dependence of texture in an image [(Goryachev et al. 2022)](https://paperpile.com/c/fKjNc0/AYSg) . In this method, the co-occurrence matrix [(Seck, Dee, and Tiddeman 2014)](https://paperpile.com/c/fKjNc0/9uRS)is constructed based on the orientation and distance between image pixels. Meaningful statistics are extracted from this co-occurrence matrix, as the representation of texture. Since basic texture patterns are governed by periodic occurrence of certain gray levels, co-occurrence of gray levels at predefined relative positions can be a reasonable measure of the presence of texture and periodicity of the patterns. Several texture features such as entropy, energy, contrast, and homogeneity, can be extracted from the co-occurrence matrix of gray levels of an image.

**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**

Statistical Package for the Social Sciences (SPSS) version 26 was used to do the statistical calculations. SPSS was developed to undertake statistical analysis for the data collected. 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 [(Huang, Xiong, and Zhang, n.d.; Alfalou and Brosseau 2010b)](https://paperpile.com/c/fKjNc0/7sHE+pRVK). In this study, a set of facial images is chosen, and the facial form and texture are extracted from them to be utilized as an independent variable to improve the accuracy of recognition. The increase in accuracy is considered as the dependent variable in this study.

**RESULTS**

In comparison to skin texture analysis, the OpenCV face recognition system performs more effectively in identifying human faces from a dataset for the purpose of smart attendance recognition.

**Table 1.** Improved accuracy for predicting Accuracy of Face Recognition Smart Attendance System usinG OpenCV (93.67%) compared with Skin Texture Analysis (84.90%)

**Table 2** defines the mean and standard deviation of the group and accuracy of the OpenCV and Skin texture analysis were 93.67% and 1.66517, 84.90% and 2.49417 respectively. In comparison to the skin texture analysis 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.

**Figure 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 96%.

**DISCUSSION**

The primary goal of the project is to implement a face recognition-based algorithm to provide attendance to students, with the aim of creating a more effective attendance system. OpenCV gained accuracy of 93.67% whereas Skin Texture Analysis Algorithm obtained accuracy of 84.90% respectively. There is a statistically significant difference between OpenCV and Skin Texture Analysis with p=0.000 (p>0.05).

This proposed work, OpenCV is a mass open source library for computational vision [(Jain et al. 2018)](https://paperpile.com/c/fKjNc0/e8oE), Machine learning (ML) and Image processing [(Singh, Shah, and Bagade 2016)](https://paperpile.com/c/fKjNc0/VlES); recently it is widely used in real time applications and it occupies an important role in growing technologies. The applications of OpenCV [(Srikantaswamy and Sudhaker Samuel 2006)](https://paperpile.com/c/fKjNc0/xm1qd) is to identify objects, faces and handwritten alphabets. Skin Texture Analysis [(D’Souza, Jothi, and Chandrasekar 2019)](https://paperpile.com/c/fKjNc0/7rV9k) 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 [(Zhao, Zhao, and Qu 2022)](https://paperpile.com/c/fKjNc0/qR0ZK). When compared to earlier study publications, [(Wahab et al. 2022)](https://paperpile.com/c/fKjNc0/g11E) OpenCV looks to be more accurate.

The real time dataset, kaggle dataset for face recognition is utilized to achieve an efficient education attendance system. The limitation of the research work is that it is not supported for larger datasets, 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. Future work could be used in universities, colleges, and online course platforms to provide students accurate attendance.

**CONCLUSION**

The study presents a face recognition based smart attendance system and compares the accuracy of algorithms. The findings suggest that OpenCV (93.67%) is a better choice for a face recognition system compared to skin texture analysis (84.90%).

**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.

**Acknowledgments**

The authors would like to express their gratitude to Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (Formerly Saveetha University) for providing the necessary support to complete this work effectively.

**Funding:**

The financial support provided by the following organizations was instrumental in the successful execution of this study. Their contributions are greatly appreciated.

1. Qbec Infosol, Chennai
2. Saveetha School of Engineering.
3. Saveetha Institute of Medical and Technical Sciences
4. Saveetha University

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**TABLES AND FIGURES**

**Table 1.** Improved accuracy for predicting Accuracy of Face Recognition Smart Attendance System using OpenCV (93.67%) compared with Skin Texture Analysis (84.90%)

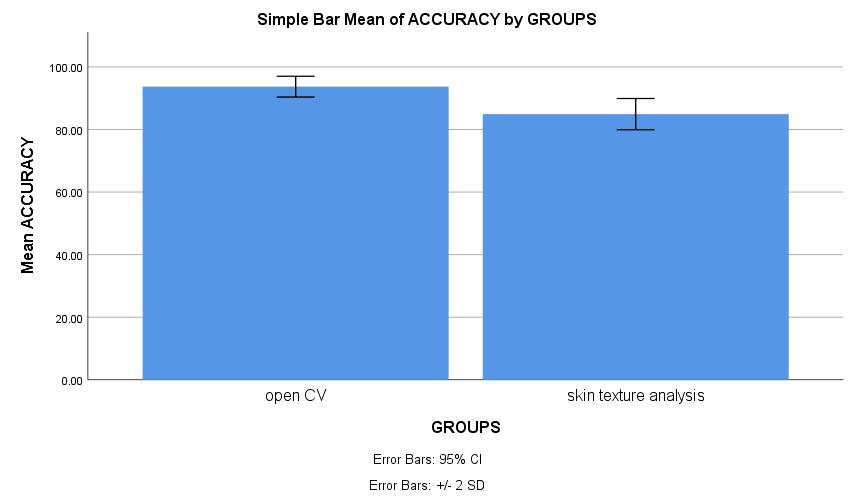
| **Iteration No** | **OpenCV** | **Skin texture analysis** |
| --- | --- | --- |
| 1 | 95.47 | 83 |
| 2 | 93.99 | 84.97 |
| 3 | 90.34 | 85.10 |
| 4 | 91.68 | 85.37 |
| 5 | 92.43 | 87.00 |
| 6 | 93.88 | 87.95 |
| 7 | 94.24 | 88.64 |
| 8 | 94.74 | 84 |
| 9 | 94.97 | 82 |
| 10 | 95.02 | 81 |

**Table 2.** The mean and standard deviation of the group and accuracy of the OpenCV and 3d recognition were 93.67% and 1.66517, 84.90% and 2.49417, respectively. In comparison to the 3d recognition approach, the OpenCV had a lower standard error of .90973.

| **Group Statistics** | | | | | |
| --- | --- | --- | --- | --- | --- |
|  | **GROUP NAME** | **N** | **Mean** | **Standard Deviation** | **Standard Error Mean** |
| **Accuracy** | **OpenCV** | 10 | 93.67 | 1.66517 | .90973 |
| **Skin texture analysis** | 10 | 84.90 | 2.49417 | 1.17410 |

**Table 3.** Performing calculations of statistics for independent samples that are tested between the Novel OpenCV and the Skin texture analysis algorithms. The df (Document-Frequency) value for equal variances assumed is more than not assumed equal variances in accuracy. The significant value of 0.000 (p<0.05) for equal variances assumed.

| **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** | 1.24 | .280 | 9.25 | 18 | .000 | 8.77 | .94845 | 6.78 | 10.765 |
| **Equal Variances not assumed** |  |  | 9.25 | 15.69 | .000 | 8.77 | .94845 | 6.75 | 10.786 |

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**Fig. 1.** Mean accuracy comparison of OpenCV method with skin texture analysis. The proposed method attained a mean accuracy of 93.67%, which is greater than the conventional method of 84.90%. X-axis represents accuracy of OpenCV and Skin texture analysis; Y-axis represents mean accuracy ± 2SD.