**Title Page:**

Smart Attendance Face Recognition System using OpenCV Algorithm and Comparing the Accuracy with Three Dimensional Facial Recognition Algorithm Shaik Thabrez 1 K.Sashi Rekha 2

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**Keywords**: Education, Face Recognition, Image Processing, Machine Learning, Novel OpenCV, Smart Attendance, Three Dimensional Facial Recognition

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**ABSTRACT**

**Aim:** The goal of this study is to perform a face recognition-based smart attendance system using Novel OpenCV in comparison with three-dimensional recognition to improve accuracy. **Materials and Methods:** A Novel OpenCV algorithm is compared with the three-dimensional facial recognition algorithm to improve the accuracy of the system by considering a total of 20 sample sets with G power of 80%. **Results:** There was a statistically significant difference between Novel OpenCV and Three Dimensional Facial Recognition with p=0.000 (p<0.05). The face recognition based smart attendance system through Novel OpenCV gained accuracy of 94.27% whereas three dimensional recognition attained accuracy of 83.87% respectively. **Conclusion**: A comparison was performed between the accuracy of an OpenCV-based face recognition system and a three-dimensional facial recognition system in a smart attendance system. After performing the current research experiment, Novel OpenCV is the better choice for a face recognition system than three dimensional recognition.

**Keywords**: Education, Face Recognition, Image Processing, Machine Learning, Novel OpenCV, Smart Attendance, Three Dimensional Facial Recognition.

**INTRODUCTION**

In most cases, the professors manually took attendance at the start and end of class. College attendance is a powerful predictor of student education outcomes. This education method has the drawback of taking more time because it is a manual procedure and will almost always have room for error. RFID (Radio Frequency Identification) was established in recent years to help solve this issue [(Nekoogar and Dowla 2011)](https://paperpile.com/c/LT6Ji8/tO8D). But it also provides a procedure for failing to prove attendance. The proposed work is to offer the idea of an attendance system based on face recognition. The major goal of the suggested system is to create an effective education attendance system by allocating attendance to the students using face recognition-based algorithms [(Tistarelli and Grosso 1998)](https://paperpile.com/c/LT6Ji8/NWJ0). Face recognition attendance marking at schools, colleges, and universities has been highlighted as one of the applications for this research [(Q. Wang et al. 2018)](https://paperpile.com/c/LT6Ji8/k5HX) with better accuracy avoiding manual mistakes [(Alfalou and Brosseau 2010)](https://paperpile.com/c/LT6Ji8/FkTL).

There have been 20 publications debating the causes, effects, and trends of face recognition smart attendance accuracy [(Zhao, Zhao, and Qu 2022)](https://paperpile.com/c/LT6Ji8/ORxP). Mishra Using Matlab-based microcontrollers, Eigen faces, PCA, and image processing, Jomon Joseph and K. P. Zacharia suggested a system. Only front face photographs can be used by their system, so an appropriate technique that takes into account the system's orientation is required. Ajinkya Patil and his colleagues suggested a face recognition method for recording attendance using the Viola Jones algorithm [(Jeena Jacob et al. 2021)](https://paperpile.com/c/LT6Ji8/JWFy). Faces are detected in images using Haar cascades, and recognition is carried out using the Eigenface method. The author developed a system using artificial neural networks as another method of making attendance systems simple and safe. They used PCA to extract facial photos, neural networks for testing and training, and their system functions in a variety of orientations[(Veeramuthu 1994)](https://paperpile.com/c/LT6Ji8/B6GF). A suggested a 3D face recognition method for an attendance management system, marking attendance with monthly progress of each student. An alternate approach is required in order to improve the recognition of orientated faces [(Kumar, Kaur, and Kumar 2019)](https://paperpile.com/c/LT6Ji8/KPil).

Since it is a manual education attendance method and will almost certainly make mistakes, the prior research reveals a research gap. The suggested algorithm assists in avoiding the fail-safe attendance system, and this system serves as a replacement for all currently in use systems, including Radio Frequency Identification and all other biometric systems. In terms of keeping track of attendance, it saves time and effort. Face recognition-based automated attendance systems have shown to be more secure and time-efficient. Whether a person is connected to the company or not, this system can be used to identify them. The primary purpose of the work is to perform a face recognition-based smart attendance system using Novel OpenCV in comparison with three-dimensional recognition to improve accuracy.

**MATERIALS AND METHODS**

The suggested work was accomplished in Open Source Lab, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai. For the investigation, a total of two groups have been identified. The first group is Novel OpenCV, and the second group is Three-Dimensional Recognition. Sample size was calculated by using previous study results, by keeping threshold 0.05, G power 80%, confidence interval 95 %. Identification of a person is developed by the Novel OpenCV algorithm and three-dimensional recognition with sample size of (N=10) ([(Zhao, Zhao, and Qu 2022)](https://paperpile.com/c/LT6Ji8/ORxP).

The testing set up for the proposed work was done in HP PAVILION 15 EC0001NX with 16GB RAM, Ryzen 7 9th gen processor, 1 TB storage and Windows 11 Operating System. Dataset used in this research work is smart attendance facial detection using OpenCV which is an open source dataset obtained from kaggle [(Tiwari 2020)](https://paperpile.com/c/LT6Ji8/JfPd). This dataset includes several images of different persons' faces. The size of the dataset is 59.7 MB which consists of a total number of 166 images. The dataset was split into Train and Test. The train dataset consists of 136 images and the test dataset consists of 30 images. Dataset for Face Recognition Smart Attendance System are taken from [(Tiwari 2020)](https://paperpile.com/c/LT6Ji8/JfPd)which was stored in .csv format. Independent T-test analysis is carried out to calculate the accuracy of both methods.

**OpenCV**

The Open Source Computer Vision Library [(Magomedova 2020)](https://paperpile.com/c/LT6Ji8/taAP) is a cross-platform library with programming functions that are primarily focused on real-time computer vision [(S. Wang et al. 2022)](https://paperpile.com/c/LT6Ji8/sPTE). It is primarily used to solve problems in the modeling of real-time image processing. This library was created in C, making it suitable for digital signal processors [(Lai 2003)](https://paperpile.com/c/LT6Ji8/c4gX). OpenCV is used to recognise objects, faces, and handwritten alphabets [(Nixon and Aguado 2019)](https://paperpile.com/c/LT6Ji8/VqRc).

**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.

**Three Dimensional Facial Recognition**

Face recognition in three dimensions is important because it reduces the difficulties that face recognition techniques face. When the internal characteristics of the face are used, face recognition is simple. Most recognition fails when external factors such as pose and lighting are used as sources.The primary cause of this problem is that recognition occurs in the natural environment. The Three Dimensional Facial Recognition method can detect identical twins [(Mpiperis, Malassiotis, and Strintzis 2008)](https://paperpile.com/c/LT6Ji8/GkJz). It has primarily been used in a wide range of industrial applications in recent years.

**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**

A smart attendance system using face recognition in real time is analyzed and performed using the Python compiler, and accuracy values are obtained with key characteristics. The Python compiler's output is statistically analyzed using IBM SPSS (Statistical Package for the Social Sciences) version 26 software [(Huang, Xiong, and Zhang, n.d.; Alfalou and Brosseau 2010; “SPSS Software” n.d.)](https://paperpile.com/c/LT6Ji8/sIer+FkTL+pGkf). The collection of face images of people is selected, and from those, the form and texture of a person's face are extracted and used as an independent variable with the aim of better recognising it in this study. The increase in accuracy is considered the dependent variable, and an independent sample T-test was carried out to analyze the results.

**RESULTS**

**Table 1** demonstrates the accuracy of the Face Recognition Smart Attendance System using OpenCV compared with Three Dimensional Facial Recognition Algorithm which were run in Google collab with a sample size of 20 at different times. The Three Dimensional Facial Recognition Technique algorithm appears to be less accurate than OpenCV.

**Table 2** shows the results of the statistical analysis of ten samples yielded a standard deviation of 2.87 and a standard error of .0.909 for OpenCV. Three Dimensional Facial Recognition methods yielded a standard deviation of 3.7 and a standard error of 1.174.. The related output values (dependent variables) varied in response to changes in the input values (independent variables).

**Table 3**, Independent sample T-test is used to compare the accuracy of OpenCV and Three Dimensional Facial Recognition Algorithms, and observed a statistically significant difference (p=0.321) with a 95 percent confidence interval, showing that our hypothesis is valid.

**Figure. 1** depicts a bar graph analysis based on two algorithms' accuracy. The OpenCV algorithm and the Three Dimensional Facial Recognition algorithm's mean accuracies.

**DISCUSSION**

The primary objective of the proposed system is to establish an efficient attendance system by utilizing face recognition-based algorithms to mark student’s attendance. Three-dimensional recognition achieved an accuracy of 83.8%, while OpenCV achieved an accuracy of 94.2%. A statistically significant difference was observed between Novel OpenCV and Three Dimensional Facial Recognition, with a p-value of 0.000 (p<0.05).

It is suggested that the suggested effort will enrich this sophisticated legal system. OpenCV [(Fan 2022)](https://paperpile.com/c/LT6Ji8/BZ3E) is a popular open source library for computational vision, machine learning [(Al-Shabandar et al. 2019)](https://paperpile.com/c/LT6Ji8/lshE), and image processing; recently, it has gained significant traction in real-time applications and plays a significant role in developing technologies. OpenCV [(K. Wang 2021)](https://paperpile.com/c/LT6Ji8/Xft3) may be used to recognize faces, objects, and handwritten alphabets. In order to recognize a person's face even when there is no intense light effect or facial emotion, three-dimensional recognition eliminates the challenges of two-dimensional recognition. OpenCV [(Shuaishuai and Chen 2019)](https://paperpile.com/c/LT6Ji8/kbxO) appears to be more accurate as compared to earlier study articles.

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.The proposed effort will contribute to the advancement of this sophisticated legal system. OpenCV is a popular open source library for computational vision, machine learning (ML), and image processing; it has recently gained traction in real-time applications and plays an important role in technology development. [https://www.kaggle.com/](https://www.kaggle.com/datasets/salmakouhou/restaurant-revenue-prediction) used for data sets. Faces, objects, and handwritten alphabets can all be recognized using OpenCV. Three-dimensional recognition eliminates the challenges of two-dimensional recognition by allowing recognition of a person's face even when there is no intense light effect or facial emotion. When compared to previous research articles, OpenCV appears to be more accurate.

**CONCLUSION**

The study implements a face recognition-based smart attendance system and compares its accuracy with algorithms. The results show that OpenCV (94.27%) is a better option for a face recognition system than three-dimensional recognition (83.87%).

**DECLARATIONS**

**Conflicts of Interest**

No conflict of interest in this manuscript.

**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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**References**

[Alfalou, A., and C. Brosseau. 2010. “Understanding Correlation Techniques for Face Recognition: From Basics to Applications.” *Face Recognition*. https://doi.org/](http://paperpile.com/b/LT6Ji8/FkTL)[10.5772/8935](http://dx.doi.org/10.5772/8935)[.](http://paperpile.com/b/LT6Ji8/FkTL)

[Al-Shabandar, Raghad, Abir Jaafar Hussain, Panos Liatsis, and Robert Keight. 2019. “Detecting At-Risk Students With Early Interventions Using Machine Learning Techniques.” *IEEE Access*. https://doi.org/](http://paperpile.com/b/LT6Ji8/lshE)[10.1109/access.2019.2943351](http://dx.doi.org/10.1109/access.2019.2943351)[.](http://paperpile.com/b/LT6Ji8/lshE)

[Fan, Jiangtao. 2022. “Performance of COVID Face Mask Detection Based on SVM Algorithm Using OpenCV DNN as Preprocessing Model.” *International Conference on Automation Control, Algorithm, and Intelligent Bionics (ACAIB 2022)*. https://doi.org/](http://paperpile.com/b/LT6Ji8/BZ3E)[10.1117/12.2639377](http://dx.doi.org/10.1117/12.2639377)[.](http://paperpile.com/b/LT6Ji8/BZ3E)

[Huang, Thomas, Ziyou Xiong, and Zhenqiu Zhang. n.d. “Face Recognition Applications.” *Handbook of Face Recognition*. https://doi.org/](http://paperpile.com/b/LT6Ji8/sIer)[10.1007/0-387-27257-7\_17](http://dx.doi.org/10.1007/0-387-27257-7_17)[.](http://paperpile.com/b/LT6Ji8/sIer)

[Jeena Jacob, I., Francisco M. Gonzalez-Longatt, Selvanayaki Kolandapalayam Shanmugam, and Ivan Izonin. 2021. *Expert Clouds and Applications: Proceedings of ICOECA 2021*. Springer Nature.](http://paperpile.com/b/LT6Ji8/JWFy)

[Kumar, Ashu, Amandeep Kaur, and Munish Kumar. 2019. “Face Detection Techniques: A Review.” *Artificial Intelligence Review*. https://doi.org/](http://paperpile.com/b/LT6Ji8/KPil)[10.1007/s10462-018-9650-2](http://dx.doi.org/10.1007/s10462-018-9650-2)[.](http://paperpile.com/b/LT6Ji8/KPil)

[Lai, Edmund. 2003. “Digital Signal Processors.” *Practical Digital Signal Processing*. https://doi.org/](http://paperpile.com/b/LT6Ji8/c4gX)[10.1016/b978-075065798-3/50009-6](http://dx.doi.org/10.1016/b978-075065798-3/50009-6)[.](http://paperpile.com/b/LT6Ji8/c4gX)

[Magamedova, D. M. 2020. “OpenCV - Computer Vision Tool.” *TRENDS IN THE DEVELOPMENT OF SCIENCE AND EDUCATION*. https://doi.org/](http://paperpile.com/b/LT6Ji8/taAP)[10.18411/lj-07-2020-68](http://dx.doi.org/10.18411/lj-07-2020-68)[.](http://paperpile.com/b/LT6Ji8/taAP)

[Mpiperis, Iordanis, Sotiris Malassiotis, and Michael G. Strintzis. 2008. “Face and Facial Expression Recognition Using Three Dimensional Data.” *Encyclopedia of Multimedia*. https://doi.org/](http://paperpile.com/b/LT6Ji8/GkJz)[10.1007/978-0-387-78414-4\_21](http://dx.doi.org/10.1007/978-0-387-78414-4_21)[.](http://paperpile.com/b/LT6Ji8/GkJz)

[Nekoogar, Faranak, and Farid Dowla. 2011. “Basics of Radio Frequency Identification (RFID) Systems.” *Ultra-Wideband Radio Frequency Identification Systems*. https://doi.org/](http://paperpile.com/b/LT6Ji8/tO8D)[10.1007/978-1-4419-9701-2\_1](http://dx.doi.org/10.1007/978-1-4419-9701-2_1)[.](http://paperpile.com/b/LT6Ji8/tO8D)

[Nixon, Mark, and Alberto Aguado. 2019. *Feature Extraction and Image Processing for Computer Vision*. Academic Press.](http://paperpile.com/b/LT6Ji8/VqRc)

[Shuaishuai, Zhang, and Peng Chen. 2019. “Research on License Plate Recognition Algorithm Based on OpenCV.” *2019 Chinese Automation Congress (CAC)*. https://doi.org/](http://paperpile.com/b/LT6Ji8/kbxO)[10.1109/cac48633.2019.8996599](http://dx.doi.org/10.1109/cac48633.2019.8996599)[.](http://paperpile.com/b/LT6Ji8/kbxO)

[“SPSS Software.” n.d. Accessed March 28, 2021.](http://paperpile.com/b/LT6Ji8/pGkf) <https://www.ibm.com/analytics/spss-statistics-software>[.](http://paperpile.com/b/LT6Ji8/pGkf)

[Tistarelli, Massimo, and Enrico Grosso. 1998. “Active Vision-Based Face Recognition: Issues, Applications and Techniques.” *Face Recognition*. https://doi.org/](http://paperpile.com/b/LT6Ji8/NWJ0)[10.1007/978-3-642-72201-1\_14](http://dx.doi.org/10.1007/978-3-642-72201-1_14)[.](http://paperpile.com/b/LT6Ji8/NWJ0)

[Tiwari, Yashesh. 2020. “Face Recognition Attendance System- Yashesh Tiwari.”](http://paperpile.com/b/LT6Ji8/JfPd) <https://www.kaggle.com/yasheshtiwari/face-recognition-attendance-system-yashesh-tiwari>[.](http://paperpile.com/b/LT6Ji8/JfPd)

[Veeramuthu, Giridaran Jolarpettai. 1994. *The Influences of Rigor Mortis Acceleration and Fiber Type on Calpain and Calpastatin Activities and Myofibrillar Fragmentation in Broiler Chicken Muscle*.](http://paperpile.com/b/LT6Ji8/B6GF)

[Wang, Kun. 2021. “A Solution for Metropolis: Autonomous Transportation Hub System Using OpenCV Algorithm.” *2021 IEEE International Conference on Computer Science, Artificial Intelligence and Electronic Engineering (CSAIEE)*. https://doi.org/](http://paperpile.com/b/LT6Ji8/Xft3)[10.1109/csaiee54046.2021.9543152](http://dx.doi.org/10.1109/csaiee54046.2021.9543152)[.](http://paperpile.com/b/LT6Ji8/Xft3)

[Wang, Q., D. Xiong, A. Alfalou, and C. Brosseau. 2018. “Optical Image Encryption Method Based on Incoherent Imaging and Polarized Light Encoding.” *Optics Communications*. https://doi.org/](http://paperpile.com/b/LT6Ji8/k5HX)[10.1016/j.optcom.2018.01.018](http://dx.doi.org/10.1016/j.optcom.2018.01.018)[.](http://paperpile.com/b/LT6Ji8/k5HX)

[Wang, Shuo, Jingjing Zheng, Ziwei Huang, Xiaoqin Zhang, Vinicius Prado da Fonseca, Bin Zheng, and Xianta Jiang. 2022. “Integrating Computer Vision to Prosthetic Hand Control with sEMG: Preliminary Results in Grasp Classification.” *Frontiers in Robotics and AI* 9 (September): 948238.](http://paperpile.com/b/LT6Ji8/sPTE)

[Zhao, Mingtao, Gang Zhao, and Meihong Qu. 2022. “College Smart Classroom Attendance Management System Based on Internet of Things.” *Computational Intelligence and Neuroscience* 2022 (July): 4953721.](http://paperpile.com/b/LT6Ji8/ORxP)

**TABLES AND FIGURES**

**Table 1.** Improved accuracy for predicting Accuracy of Face Recognition Smart Attendance System using OpenCV (94.27%) compared with Three Dimensional Facial Recognition Algorithm (83.87%)

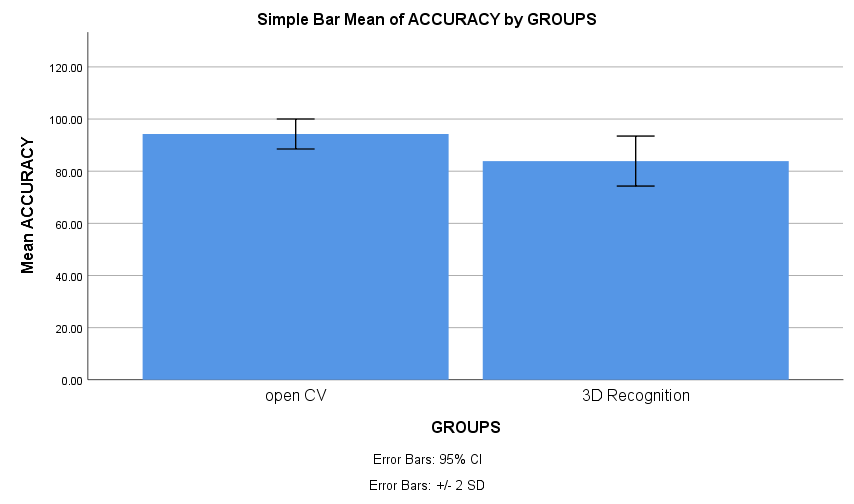
| **Iteration No** | **OpenCV** | **Three Dimensional Recognition** |
| --- | --- | --- |
| 1 | 90.47 | 80.47 |
| 2 | 91.05 | 81.05 |
| 3 | 91.69 | 86.69 |
| 4 | 93.00 | 73.00 |
| 5 | 93.75 | 83.75 |
| 6 | 94.06 | 84.06 |
| 7 | 95.11 | 85.11 |
| 8 | 96.79 | 86.79 |
| 9 | 98.34 | 88.34 |
| 10 | 98.45 | 89.45 |

**Table 2.** The mean and standard deviation of the OpenCV and Three Dimension Recognition were 2.87683, 4.79413 and 94.2710, 83.8710 respectively. In comparison to the 3D recognition approach, OpenCV had a lower standard error of 0.90973.

|  | **Group Name** | **N** | **Mean** | **Standard Deviation** | **Standard Error Mean** |
| --- | --- | --- | --- | --- | --- |
| **Accuracy** | **OpenCV** | 10 | 94.2710 | 2.87683 | .90973 |
| **Three Dimensional Recognition** | 10 | 83.8710 | 4.79413 | 1.51604 |

**Table 3.** Performing calculations of statistics for independent samples that are tested between the Novel OpenCV and the Three Dimension Recognition 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.

| **Levene’s Test for Equality of Variances** | | | | **T-test for Equality of Means** | | | | | **95% Confidence Interval of the Difference** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Lower** | **Upper** |
|  | | **F** | **Sig.** | **T** | **Df** | **Sig.(2-tailed)** | **Mean Differences** | **Std.Error Differences** |  |  |
| **Accuracy** | **Equal Variances assumed** | 1.03 | .321 | 5.882 | 18 | .000 | 10.4000 | 1.7680 | 6.68547 | 14.114 |
|  | **Equal Variances not assumed** |  |  | 5.882 | 14.73 | .000 | 10.7680 | 1.7680 | 6.62565 | 14.174 |



**Fig. 1.** Mean accuracy comparison of the OpenCV method with three dimensional recognition. The proposed method attained a mean accuracy of 94.27%, which is greater than the conventional method's 83.87%. X-axis represents accuracy of OpenCV and three dimensional recognition; Y-axis represents mean accuracy ± 2SD.