**Title Page:**

Accurate Analysis of Face Recognition Smart Attendance System using

OpenCV in comparison with Elastic Bunch Graph Matching Algorithm

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**Keywords**: Education, Elastic Bunch Group Matching. Face Recognition, Image Processing, Machine Learning, Novel OpenCV, Smart Attendance.

**ABSTRACT**

**Aim:** The project's goal is to compare an Elastic Bunch Group Matching (EBGM) algorithm with OpenCV algorithm for smart attendance system to improve accuracy. **Materials and Methods:** The Novel OpenCV algorithm with (N=10) and EBGM (N=10) are used to identify face recognition of a person. To perform accuracy prediction SPSS software is used, with G power of 80% and CI of 95%. **Results:** The smart attendance system that uses face recognition technology using Novel OpenCV achieved an accuracy rate of 93.67%, while the accuracy rate of EBGM was 85.55%. There exists a statistical significant difference between Novel OpenCV and Elastic Bunch Graph Matching with p=0.000 (p<0.05). **Conclusion:** The smart attendance system is based on face recognition, and the accuracy of OpenCV and EBGM algorithms are compared. Based on the findings, it is clear that Novel OpenCV is a better choice for a face recognition system when compared to EBGM.

**Keywords**: Education, Elastic Bunch Group Matching. Face Recognition, Image Processing, Machine Learning, Novel OpenCV, Smart Attendance.

**INTRODUCTION**

The most important thing in the classroom is attendance which is directly linked to the educational academic performance of the students [(G. Fu et al. 2022)](https://paperpile.com/c/wWFlz0/4j06). The smart attendance represents making attendance digitally and storing the collected data in a safe medium called cloud storage system [(Fullerton and Widding 2000)](https://paperpile.com/c/wWFlz0/of2NB). College attendance is a powerful predictor of student education outcomes. The storage system can be easily accessed by the user admin and refer to it if any clarification is required. The facial recognition based attendance system is recommended by the research undergoing research on attendance management system. [(Kong, You, and Lv 2022)](https://paperpile.com/c/wWFlz0/YkSA). This project's main focus will be on acquiring digital photographs and then using programmes and algorithms to extract relevant information from them,[(Malathi and Manimekalai 2020)](https://paperpile.com/c/wWFlz0/INinU). As the visual data is fed in, image processing works on it to make it relevant for human comprehension [(Papatheodorou and Rueckert 2007)](https://paperpile.com/c/wWFlz0/ygnV). That image processing information will be quite useful and useful in a variety of [(Luh 2014)](https://paperpile.com/c/wWFlz0/v8pP) fields where it might be implemented. [(Huang, Xiong, and Zhang, n.d.; Alfalou and Brosseau 2010a)](https://paperpile.com/c/wWFlz0/Ig6eX+OP3ry). Airports and train stations use facial recognition technology to verify passenger identities, making the check-in process faster and more efficient [(Huang, Xiong, and Zhang, n.d.; Alfalou and Brosseau 2010a)](https://paperpile.com/c/wWFlz0/Ig6eX+OP3ry).

Between 2011 and 2023, 1800 papers were reviewed, including 940 from IEEE Xplore, 620 from Researchgate, 100 from Elsiver, and 140 from Springer[(R. Fu et al. 2017)](https://paperpile.com/c/wWFlz0/o3Zp4) using multitask cascade convolutional neural network and center-face recognition. The purpose of neural networks is to perform face detection center face recognition and attendance management. [(Al-Habeeb et al. 2020)](https://paperpile.com/c/wWFlz0/XUjHd) represented mobile application to conduct election during COVID-19 pandemic situation in accordance with the situation of Iraq. [(BalaMurali, Sravanthi, and Rupa 2020)](https://paperpile.com/c/wWFlz0/6BoxU) conducted research and made a solid security system recommendation that can identify if a voter is eligible to cast a ballot or not. This system identified the authorized person using biometric data. The biometric system can detect attempts to cast a false ballot. If somebody tries to steal the voting machine, the GPS position finder built into the machine will be able to find it. [(Arsenovic et al. 2017)](https://paperpile.com/c/wWFlz0/F48Ge)l features. The CNN classifier takes features as input source and performs classification. [(Patil and Shukla 2014)](https://paperpile.com/c/wWFlz0/NkYY9) chose viola-jones classifier to perform facial recognition based attendance system. In that Haar cascade to detect faces on testing images and Eigenface method performed recognition. Previous research has revealed a research gap in that the existing manual attendance system is time intensive and difficult to maintain. And there may be chances of proxy attendance. This Novel OpenCV is divided into four stages: database building, face detection, face recognition, and attendance updating. The research's primary objective is to determine the Elastic Bunch Group Matching (EBGM) algorithm with OpenCV algorithm for smart attendance system to improve accuracy.

**MATERIALS AND METHODS**

The proposed research was conducted in the Open Source Lab at the Saveetha School of Engineering and Saveetha Institute of Medical and Technical Sciences. Two groups are involved in the proposed work, the first group is Novel OpenCV Algorithm, and the second group is Elastic Bunch Graph Matching classifiers. Identification of a person is developed by the Novel OpenCV algorithm and Elastic Bunch Graph Matching Algorithm with sample size of (N=10) ([(Zhao, Zhao, and Qu 2022a)](https://paperpile.com/c/wWFlz0/gOg9) threshold fixed with 0.05, G power 80%, and confidence interval 95%.

The proposed work was tested on an HP PAVILION 15 EC0001NX laptop with a Ryzen 7 9th generation processor, 16GB RAM, 1TB storage, and Windows 11 operating system. The research work utilized the Smart Attendance Facial Detection using OpenCV dataset, which is an open-source dataset available on Kaggle [(Tiwari 2020)](https://paperpile.com/c/wWFlz0/7vsvZ) and contains images of different individuals' faces. The dataset size is 59.7 MB, comprising 166 images split into a train set of 136 images and a test set of 30 images. Face recognition smart attendance system data was obtained from the same source and stored in .csv format[(Tiwari 2020)](https://paperpile.com/c/wWFlz0/7vsvZ). The accuracy of both methods was calculated using an independent t-test analysis.

**OpenCV**

The Novel OpenCV is an open-source computer vision library that can be used across multiple platforms [(Magomedova 2020)](https://paperpile.com/c/wWFlz0/kyquA). It provides programming functions that primarily focus on real-time computer vision and is often used to address issues related to real-time image processing [(Wang et al. 2022)](https://paperpile.com/c/wWFlz0/WNMuQ). As it was developed using the C language, it is well-suited for use with digital signal processors. Novel OpenCV has a variety of applications, including the recognition of objects, faces, and handwritten letters [(Lai 2003)](https://paperpile.com/c/wWFlz0/RIQnD).

**Pseudocode**

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.

**Elastic Bunch Group Matching (EBGM)**

The EBGM algorithm in image processing and computer vision uses a graph representation taken from other related images to identify object classes or individual objects in an image. [(Hanmandlu, Gupta, and Vasikarla 2013)](https://paperpile.com/c/wWFlz0/urVg). A face is represented by a face graph in EBGM. The goal of EBGM is to create an algorithm that can compare two photos and calculate how similar they are on a quantitative level. In order to identify only the skin region of the face region, it is expected that the facial picture in each bounding box is thresholded by skin segmentation. It has been utilized regularly for gesture-related purposes as well as face verification, face recognition, and face analysis.

**Pseudocode**

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**

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 (Statistical Package for the Social Sciences) version 26 software. In this study, a set of facial images is chosen, and the facial form and texture are extracted from them to be utilized as independent variables to improve the recognition of faces[(Nisbet, Miner, and Yale 2017)](https://paperpile.com/c/wWFlz0/qjDFh) .The enhanced 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 EBGM.

**Table 1.** Improved accuracy for predicting Accuracy of Face Recognition Smart Attendance System using OpenCV(93.67%) compared with Elastic Bunch Graph Matching (EBGM) Algorithm (85.55%)

**Table 2.** The mean and standard deviation of the group and accuracy of the OpenCV and EGBM were 93.67% and 1.73146, 85.55% and 2.96640, respectively. In comparison to the Elastic Bunch Graph Matching (EBGM) Algorithm 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. 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 93.6%, which is greater than the conventional method of 85.5%. X-axis represents accuracy of OpenCV and Elastic Bunch Graph Matching Algorithm; Y-axis represents mean accuracy ± 2 SD.

**DISCUSSION**

The primary goal of the suggested system is to create an effective attendance system by allocating attendance to the students using face recognition-based algorithms. OpenCV proved with better accuracy of 93.67% whereas Elastic Bunch Graph Matching (EBGM) Algorithm obtained accuracy of 85.55% respectively [(Zhao, Zhao, and Qu 2022a)](https://paperpile.com/c/wWFlz0/gOg9). There exists a statistical significant difference between OpenCV and Elastic Bunch Graph Matching p=0.000 (p<0.05).

This proposed work adds to this rich legal system. OpenCV is a mass open source library for computational vision [(Srikantaswamy and Sudhaker Samuel 2006)](https://paperpile.com/c/wWFlz0/U5I4x), Machine learning (ML) and Image processing; recently it is widely used in real time applications and it occupies an important role in growing technologies [(Singh, Shah, and Bagade 2016)](https://paperpile.com/c/wWFlz0/2lPRh).The K-nearest neighbors (KNN) algorithm had a competence rate of 95 percent, an artificial neural network algorithm had a success rate of 93 percent, and the Naive Bayes algorithm had a result rate of 92% The applications of OpenCV [(Magamedova 2020)](https://paperpile.com/c/wWFlz0/kyquA) is to identify objects, faces and handwritten alphabets [(Candra et al. 2016)](https://paperpile.com/c/wWFlz0/gYb1). Elastic Bunch Graph Matching (EBGM) Algorithm 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 2022b)](https://paperpile.com/c/wWFlz0/au9VQ). When compared to earlier study publications [(Wahab et al. 2022)](https://paperpile.com/c/wWFlz0/pfyhX), OpenCV looks to be more accurate.

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, 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 potential of EBGM in the future is bright, as improvements in computer vision and machine learning are raising the need for accurate and effective object recognition algorithms. As technology advances quickly, EBGM is anticipated to be incorporated into a variety of applications, such as autonomous vehicles, smart homes, and security systems.

**CONCLUSION**

The study introduces a smart attendance system based on face recognition and compares the accuracy of algorithms. The results indicate that OpenCV (93.67%) is a more effective option for a face recognition system when compared to EBGM (85.55%).

**DECLARATION**

**Conflicts of Interest**

The submission has no possible conflicts.

**Author Contributions**

Data collection, analysis, and manuscript writing were the responsibility of author ST. Author KSR was responsible for the conceptualization, data validation, and critical evaluation of the text.

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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 Elastic Bunch Graph Matching (EBGM) Algorithm (85.55%)

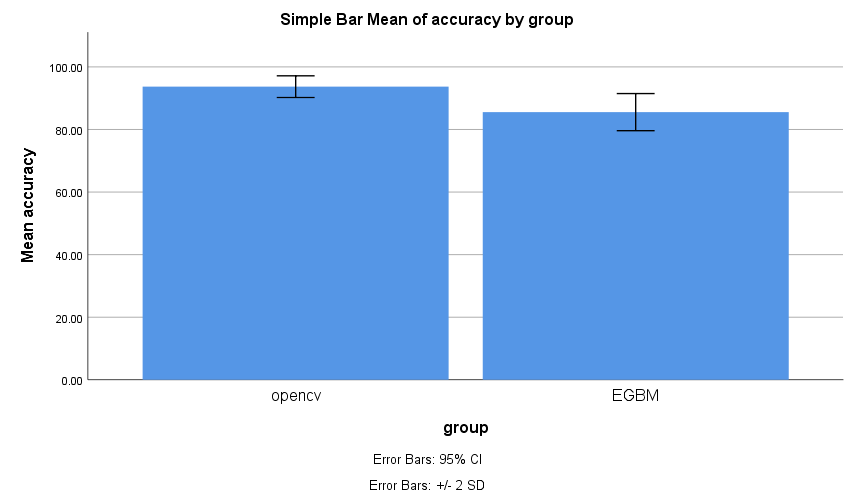
| **Iteration No** | **OpenCV** | **EBGM** |
| --- | --- | --- |
| 1 | 93.47 | 83 |
| 2 | 95.99 | 84.97 |
| 3 | 90.34 | 88.10 |
| 4 | 91.68 | 85.37 |
| 5 | 92.43 | 82.00 |
| 6 | 93.88 | 87.95 |
| 7 | 94.24 | 88.64 |
| 8 | 94.74 | 80.47 |
| 9 | 94.97 | 89 |
| 10 | 95 | 86 |

**Table 2.** The mean and standard deviation of the group and accuracy of the OpenCV and EGBM were 93.67% and 1.73146, 85.55% and 2.96640, respectively. In comparison to the EGBM approach, the OpenCV had a lower standard error of .90973.

| **Group Statistics** | | | | | |
| --- | --- | --- | --- | --- | --- |
|
|  | **GROUP NAME** | **N** | **Mean** | **Standard Deviation** | **Standard Error Mean** |
| **Accuracy** | **OpenCV** | 10 | 93.6740 | 1.73146 | .54754 |
| **EBGM** | 10 | 85.5500 | 2.96640 | .93806 |

**Table 3.** Performing calculations of statistics for independent samples that are tested between the Novel OpenCV and the EBGM 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** | 3.118 | .094 | 7.480 | 18 | .000 | 8.12400 | 1.08616 | 5.8420 | 10.40 |
| **Equal Variances not assumed** |  |  | 7.480 | 14.495 | .000 | 8.12400 | 1.08616 | 5.8018 | 10.44 |

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**Fig. 1.** Mean accuracy comparison of OpenCV method with EBGM. The proposed method attained a mean accuracy of 93.67%, which is greater than the conventional method of 85.55%. X-axis represents accuracy of OpenCV and EBGM; Y-axis represents mean accuracy ± 2SD.