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DEVELOPMENT OF BIOMETRIC EXAM FRAUD DETECTION SYSTEM USING ARTIFICIAL INTELLIGENCE TECHNIQUE

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Abstract

This paper presents the development of biometric exam fraud detection system using artificial intelligence technique. This aim is to employ facial recognition to detect exam fraud in tertiary institutions. This was achieved using research methods such as data collection, computer vision, face detection, data processing, Machine Learning (ML) and facial recognition. The system was designed using mathematical equations, pseudopodia and universal modeling diagram which presented the modeling of the face detection system. The ML algorithm used is the K-Nearest Neighbor (K-NN) and was trained with clusters of the data collected to generate the facial recognition algorithm used to build the exam fraud detections system. The performance of the K-NN when evaluated showed classification area under curve result of 0.83. Fraud detection system was tested with 30 self volunteered student faces and 24 were correctly classified leaving an accuracy of 80%.

Keywords: Fraud, Biometric, Exam, Artificial Intelligence, Impersonation, Facial Recognition

1. INTRODUCITON

According to Emaikwu (2012), examination is the process of evaluation in an academic environment to ascertain the intellectual capacity and capability of a student; however the best method to main the integrity of exam process has remained a topic for debate over the years. There are many forms of examinations such as external, internal, oral or both, but the most common is the internal examination form in which students within an academic institution are evaluated under the supervision of lecturers or internal examiners. Today, the limited number of examiners or supervisors compared to the large number of students gives room for many examination misconducts acts like malpractice.

According to Akani and Odofin (2015), exam malpractice is process which involves the use of unauthorized documented or material, having the capacity to provide answers during exam or other forms of assessments, and has remained a major challenge. To solve this problem, many administrative measures have been put in place over the years such as the use of question types (a case where questions are randomly arranged per student), strict rules and regulations as penalties, the use of identity cards, among others. These measures have impacted greatly on the institutions by reducing the rate of exam malpractices to some extent, but have not

been able to completely solve the problem of exam impersonation (Oduwaiye, 2014; Uzochukwu, 2015; Oduwaiye, 2014).

Impersonation is an unauthorized employment of external person by student for representation in an exam hall (Oduwaiye, 2014). This practice has gained attention in many institutions today and has dominated all types of exams at all levels even outside academic domains. This is a very big problem today and needs urgent attention. To solve this problem, the use of manual verification system such as class albums was introduces to check and confirm student identity, however this approach can only be reliable where few student are involved, hence there is need for urgent automated biometric solution to the problem.

According to Uzoigwe (2018), the use of biometric technology is a reliable means for person identification which engaged biological traits such as voice, face, finger print, signature, iris among other to verify identify. Nevertheless, they all have their advantages and disadvantages, but the use of facial recognition system provided better performance compared to the rest due to its ability for contactless person verification, accuracy, reliability, hygienic, cost effective among others as discussed in (Chioma et al., 2018).

Nawaf (2016) researched on face Recognition system using Eigen-Face implemented on Digital Signal Processor (DSP) Processor. The work focused on the development of an automatic face t digital signal processor as a classifier can help recognize a face. Recording 95% accuracy from 10 tested AT&T database images. However, the recognition result for RGB images (i.e colored and unfiltered images) was poor. Yang et al. (2017) presented a student information management

According to Ituma and Asogwa (2018), facial recognition is the holy grail of biometric technology and has found its way in numerous applications over the years due to its efficiency and high success rate. This will be employed to address this problem of impersonation in this research using Artificial Intelligence (AI) Technique. AI is set of algorithms which can learn based on set of rules and training dataset to make accurate decision (Olofin, 2014). They are classified as fuzzy logic, genetic algorithm, expert systems and machine learning. The use of Machine Learning (ML) however supersedes other AI types due to their effectiveness in many areas in terms of accuracy. According to Asogwa and Ituma (2018) ML is a set of mathematical algorithms which have the ability to learn from training dataset to solve regression or classification problems. These set of algorithms includes clustering, support vector machine, K-Nearest Neighbor (K-NN) among other. This research employed K-NN as clustering algorithms which can extract clusters of the training faces to verify the identity of students during examinations and detect impersonations. This when achieved will go a long way to solve the problem of impersonation in the Nigerian academic institutions among other regions and help restore integrity of the universities.

2. LITERATURE

recognition system using holistic features extraction that is based on global features represented by low frequency data from the face image. The researcher concluded tha

system for finger identification and data security transmission. The study used finger image as input to verify the identity of individual, however fingerprint suffers mutation problem with time. Urvashi and Rohit (2014) surveyed face detection methods and feature extraction techniques;

the work identified template based method of face recognition system as an easy approach to implement but suffer rejection in the global face structure. Color segmentation based result can be affected by different color model and illumination variation, Appearance based method represents optical feature points which can represent global face structure and finally, the Geometric based method provides stability and scale invariant features. The study never considered A.I. Deepesh (2011) researched on real time face recognition system using Principal Component Analysis (PCA) and various distance classifiers. The paper employed PCA for feature extraction and various distance classifiers such as the Eucledian distance, Manhattan distance and Mahalanobis distance. The researcher posited that the techniques all employed `eigen faces,' then projecting training data into face-space to be used with a predetermined classification method and evaluation of a projected test element by To develop the fraud detection system, data was collected from the Enugu state university of Science and Technology (ESUT). The sample size of the data collected is 1020 faces from the

Dimension	80 x 60
Pixel Height	80
Pixel Weight	60

The table 1 presented the properties of the data collected and then stored as the training dataset.

Data Acquisition: This process involves the use of camera to capture the students face before entering the examination hall for verification. The camera specifications are already reported in table 1. **Computer Vision:** This is a process where the camera is incorporated with artificial intelligence which enables it derives useful information from a digital image before capturing them. There are various computer vision algorithms in Ituma and Asogwa (2018) projecting it into face space and comparing to training data. Andrew (2015) studied a combinational approach to face recognition system. The main purpose of their research project was to develop a face recognition system capable of outperforming existing solutions in terms of accuracy using PCA and Gabor appearance-based recognition approaches. The performance when evaluated was better than the heuristic approach. Vimal and Virender (2015) studied the implementation and performance analysis of face recognition using Matlab. The work analyzed face recognition using edge detection method which gives a binary image in which the white pixels closely approximate the true edges of the original image. The paper concluded that Edge detection technique gives more accuracy due to it less sensitivity noise.

3. METHODS OF DATA COLLECTION

departmental class album. The data properties are provided in the table 1;

Table 1: Data properties

Image parameters	Values
Resolution	480 dpi
Bit depth	24
Size	5.6kb

which can achieve these objectives. This study adopted the Viola Jones algorithm which enables camera to detect and track face in real time. **Data Processing:** One of the main problems with facial recognition system over the year is noise. Noise has remained the main stumbling block which affects the reliability of existing recognition techniques and was addressed using Gaussian filter which processes and remove every unnecessary frequencies attribute with the image data (Ituma and Asogwa, 2018). **Normalization:** This was used to vary the changes of pixel intensity values in the

images captured. The aim was to convert the image into a range of pixels values which are familiar to ensure that striped noise is removed. **Feature extraction:** This process involves the drilling of clusters representing various pixels of the image. The feature extraction method used here is the statistical method based on histogram oriented gradients technique adopted from (Ituma and Asogwa, 2018). **Machine learning:** In Machine learning, the K-NN algorithm is a non parametric technique which is employed in solving problem of classification and regression. This technique determines the distance between the query data and the samples in the training dataset. This was employed in this research using the K-NN technique which computes the distance between clusters of extracted features to check similarity distance and label the closest with respect with the query extracted clusters as result. Unlike the other hierarchical clustering techniques, the K-NN uses the actual observation to create clusters based on their location in space and then find a partition which relates the closest clusters possible based on Euclidean distance.

4. MODELING

This section presents the modeling of the computer vision algorithm used for face detection and also the K-NN algorithm used to develop the face recognition algorithm. The algorithm adopted for the face detection is the Viola and Jones which used Haar features and adabost techniques to search and detect facial features until the face is captured. The pseudocode of the viola jones algorithm is presented as;

Pseudopodia of Viola Jones Algorithm

1. *Start*
2. *Read input image from camera as y*
3. *Normalize (y)*
4. *Format (y) to 80 x 60 pixels*
5. *Convert (y) into an integral image*
6. *Apply Haar features*
7. *Extract features of (y) with adaboast*
8. *Search for Haar like features which are facial features*
9. *If*
10. *Features are identified as true*
11. *Then*
12. *Face detected*
13. *Else*
14. *Return to search Haar features*
15. *End*

The pseudocode to develop the face detection system which used the computer vision algorithm to capture and detect student face was presented as;

Face Detection Algorithm

1. *Start*
2. *Begin data acquisition*
3. *Activate viola jones algorithm*
4. *Initialize Haar features*
5. *Initialize adaboast search*
6. *Search for facial features*
7. *If*
8. *Features searched is the same as Haar features*
9. *Label as fudicial point (p+1)*
10. *Continue and increment (p +n) until n is equal or greater than 10*
11. *Stop search and capture the face*
12. *Else*
13. *Continue search for p*
14. *Return*
15. *End*

MODELING OF THE FACE RECOGNITON ALGORITHM

Clustering technique is preferred to model similarity pattern recognition problems like the case study facial recognition system where most of the facial feature vectors have similar identities. The clustering algorithm employed for the solution is the K-NN which is a ML algorithm that identifies the feature vectors extracted from the data set

and training images as X_A and X_B and then use the equidistance model in equation 1 to compute the nearest points for the features and classify as the matched student.

$$D = \sqrt{\sum_{i=1}^{x}(X_A - X_B)^2} \quad 1.0$$

Where X_A is training features

X_B is testing features

x is the number of features extracted

D is distance between nearest point.

The model in equation 1 was used to show how the KNN algorithm operates by identifying data from the input source as k and then dimension into space for computation of similarity match based on equidistance model. This was used to determine the closest feature points between the query and training data to determine similarity measures. The flow chart of the face detection was presented in figure 1 while the flow chart of the K-NN algorithm is presented in figure 2.

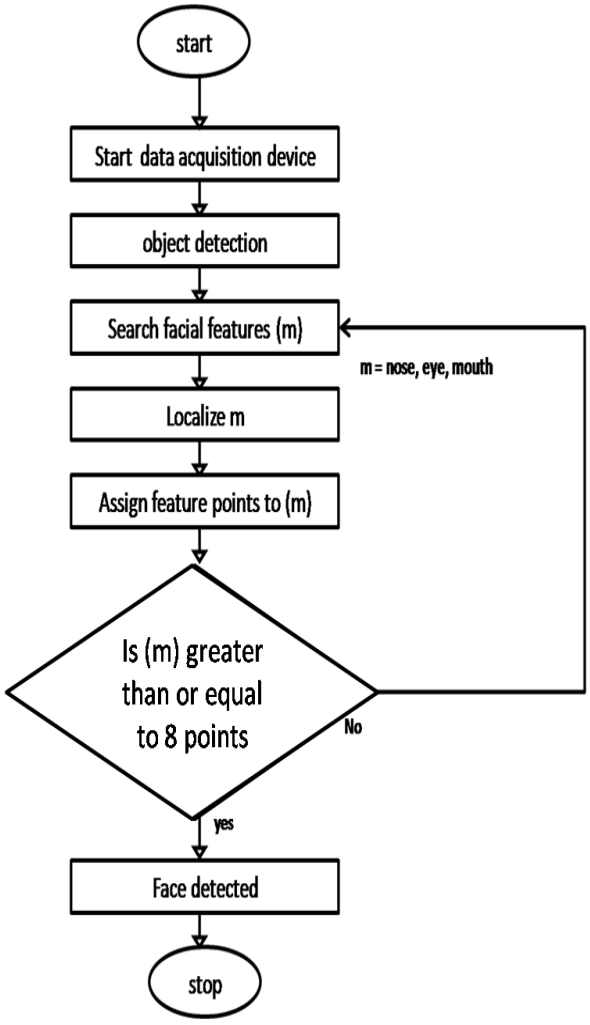

Figure 1: Flow chart of face detection

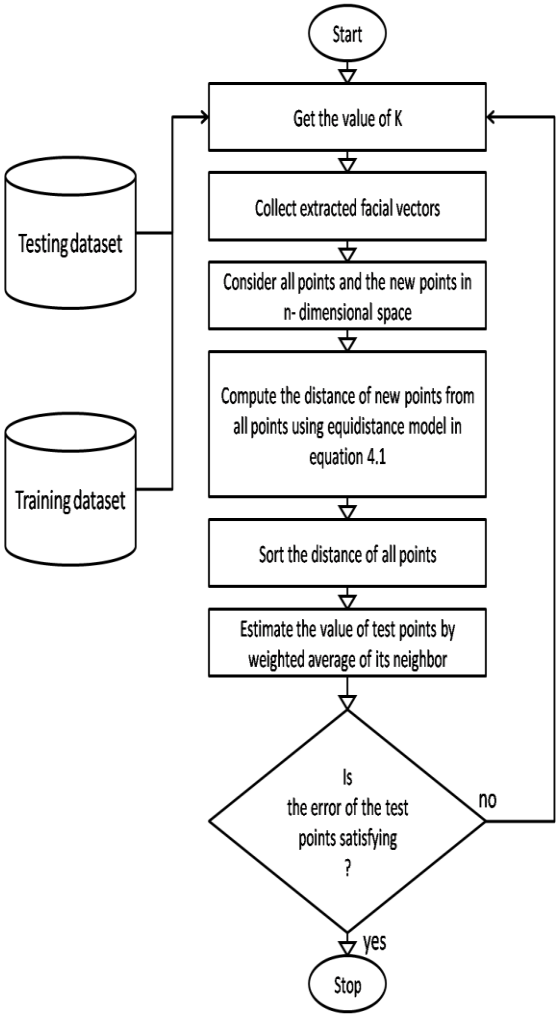

Figure 2: Flow chart of K-NN algorithm

The figure 1 presented the flow chart of the face detection algorithm which was used to intelligently detect the student face. The figure 2 on the other hand showed how the K-NN algorithm used the equidistance model to classify the clusters via the computation of features neighbors and then match the closest as the recognition result.

5. SYSTEM IMPLEMENTATION

The system was implemented with Matlab programming environment. In the programming platform classification learner application software was used to import the data collected and then trained with the K-NN algorithm developed to generate the face recognition algorithm which was used to develop the fraud detection system. The fraud detection system collected data of the test sample and then process with the Guassian filter to remove noise. The output was classified with the face recognition algorithm to detect the student identity. The implemented fraud detection system was presented in figure 3;

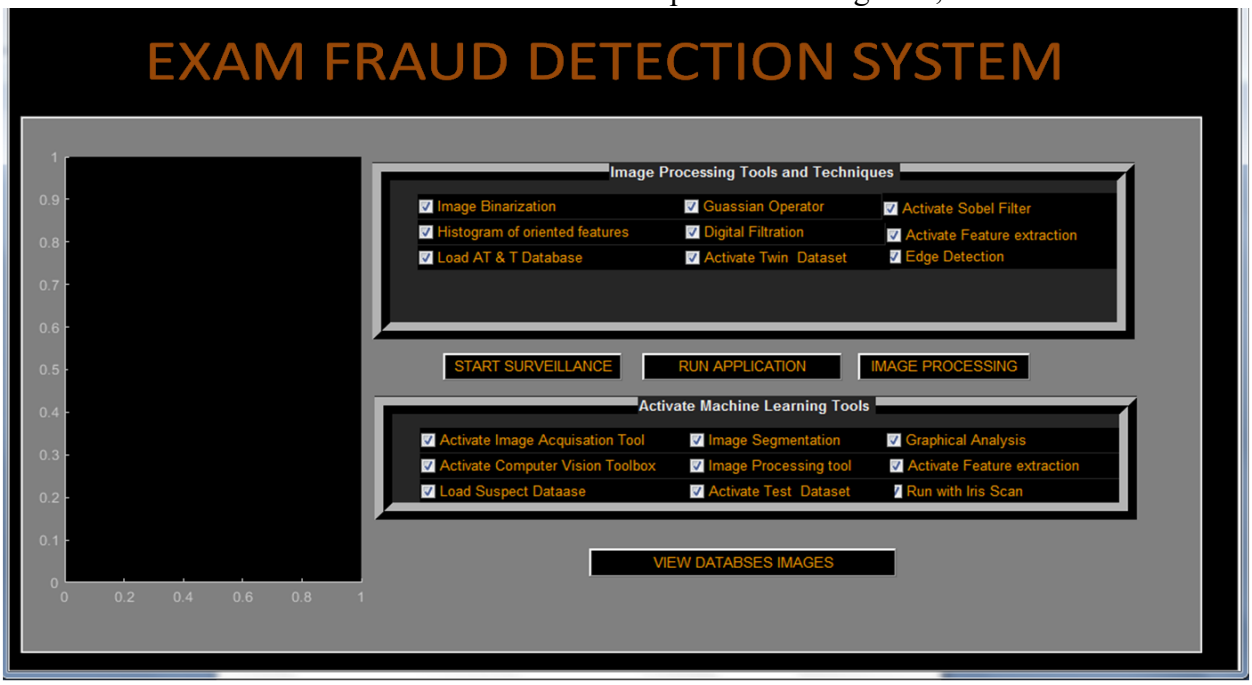

Figure 3: The fraud detection system

6. RESULTS AND DISCUSISON

The performance of the KNN algorithm developed with the face training dataset and also the fraud detection system developed was evaluated using the Area under Curve (AUC) analyzer and sample faces of students. The AUC used the relations between the true positive rate and false positive rate performance of the test data to evaluate the correct classification rate of the algorithm as shown in the figure 4;

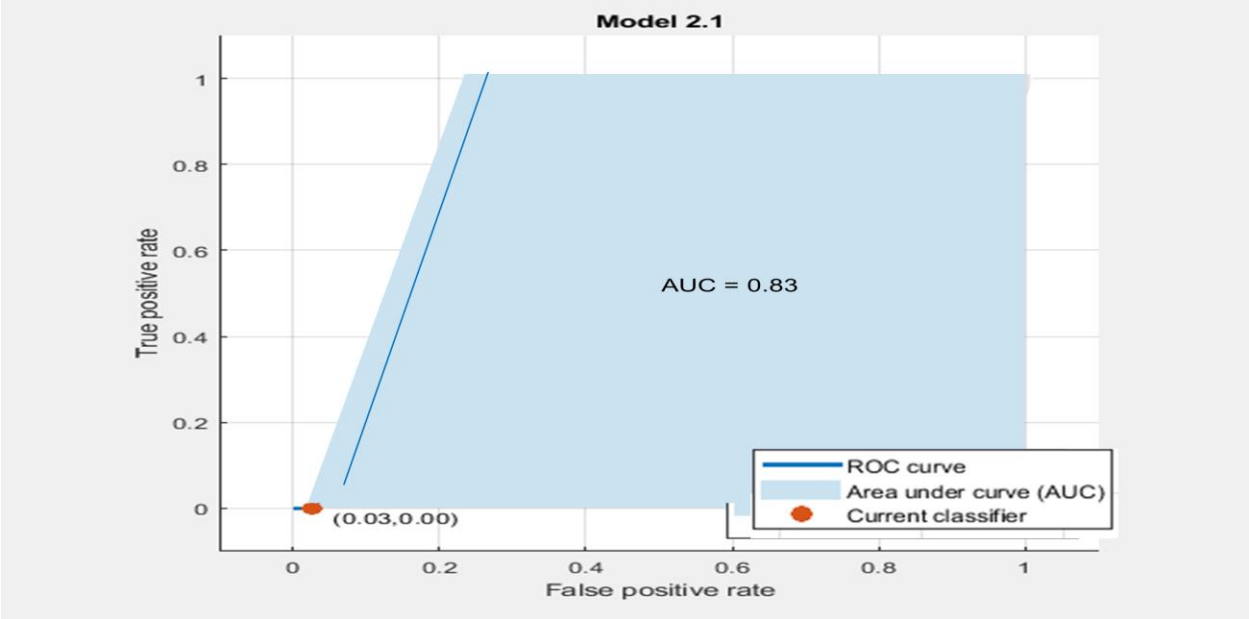

Figure 4: Area under curve performance

The figure 4 presented the AUC performance of the K-NN algorithm with the aim of achieving AUC equal or approximately one. From the result, it was observed that the K-NN was able to correctly classify students face at a AUC of 0.83 which is approximately one as desired. This algorithm when used to develop the fraud detection system and tested with student face presented the result in figure 5;

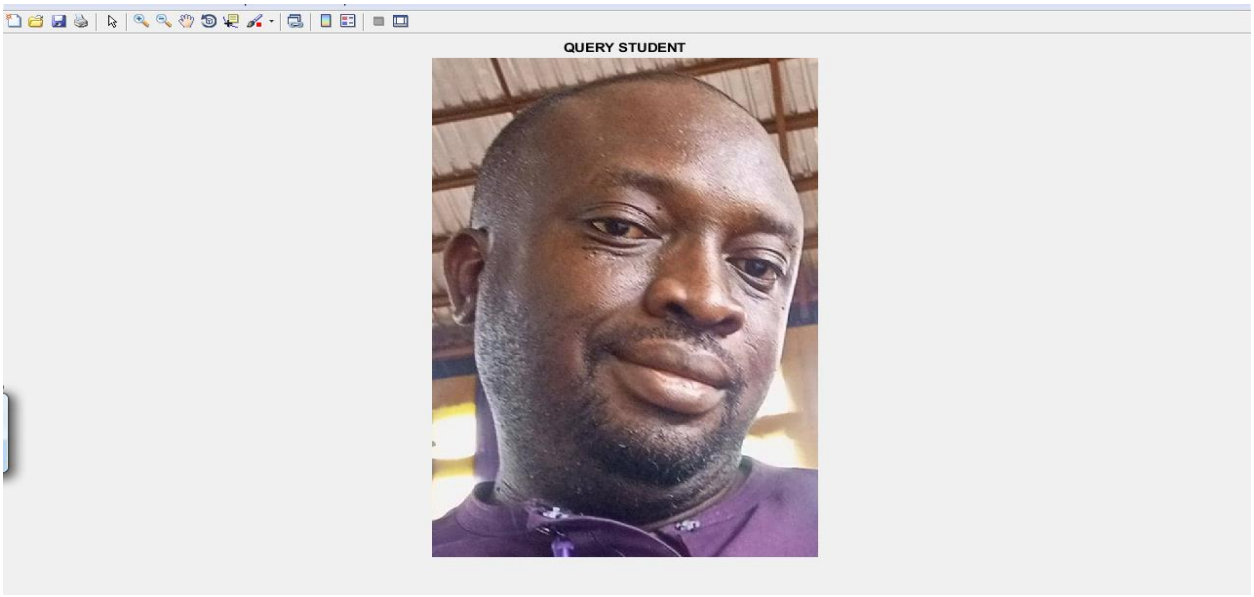

Figure 5: Query student

The figure 5 showed the query student face identified as X_A in equation 1. The features were processed using the Gabor filter as shown in the filter output in figure 6;

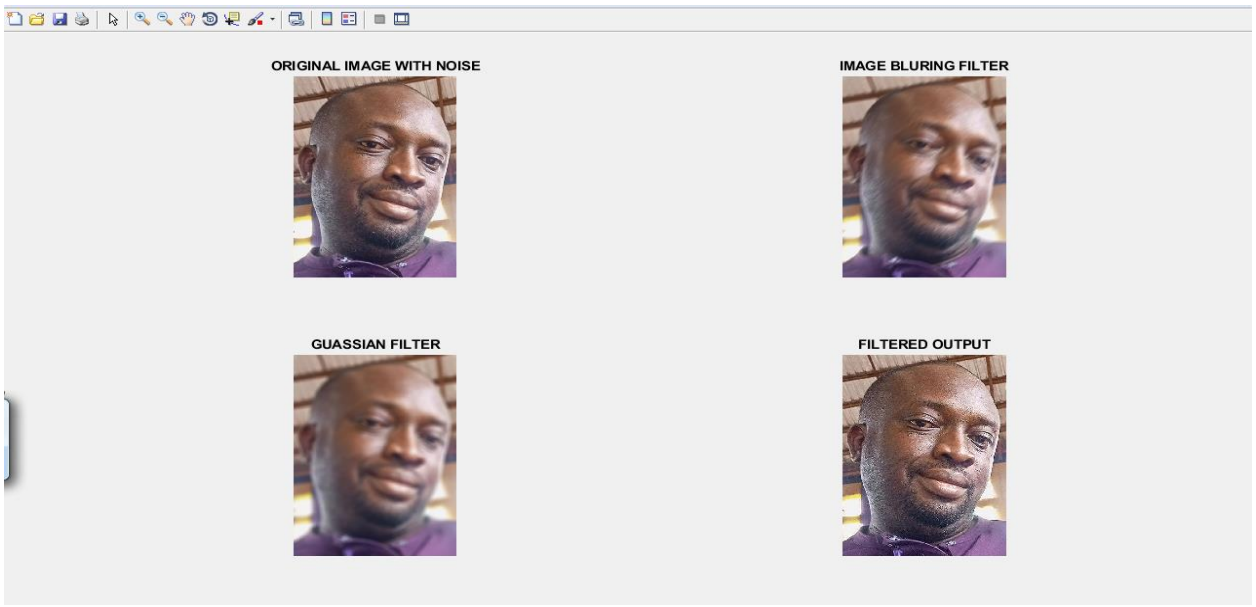

Figure 6: Data processing result

The figure 6 presented the performance of the data processing which removes noises capable of degrading the integrity of the facial recognition performance. The Gaussian filter adopted was used to process the image via decomposition of the features and remove excess frequency which induces lightening intensity to degrade the quality. The result of the feature extraction of the data clusters are presented in figure 7;

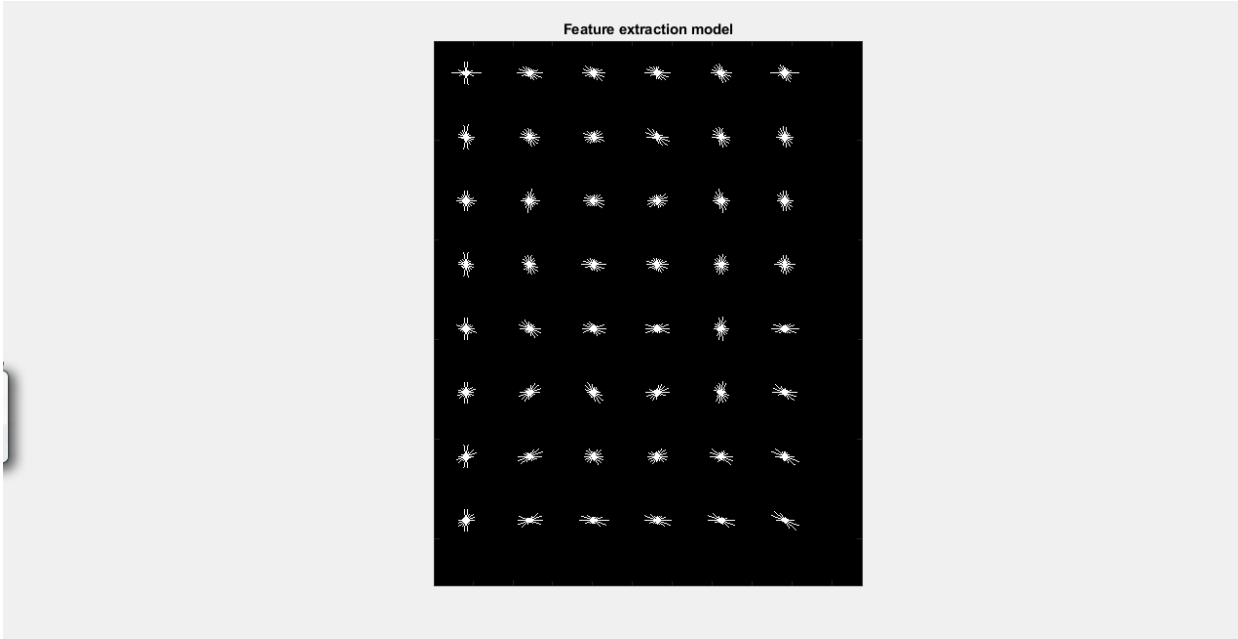

Figure 7: Feature extraction

This feature extraction was used to extract the cluster of the test image and then compared with the cluster of the training images in the K-NN algorithm and then find the nearest neighbor based on similarity distance as in equation 1. The output

presented the identified face as shown in figure 8;

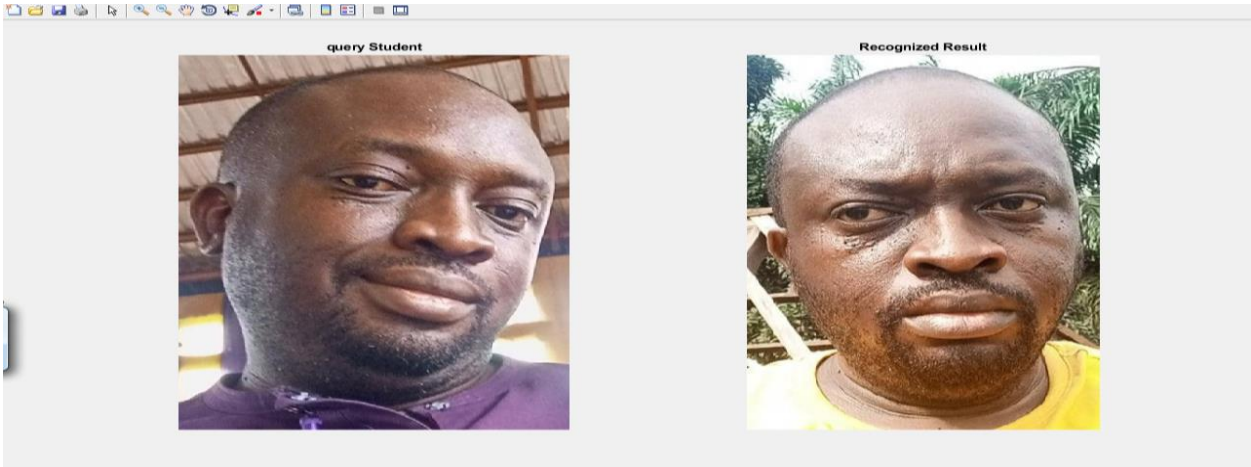

Figure 8: Student verification result

The figure 8 presented the verification result which proves that the student is a member of the class. To validate the result, 10 sampled facial data was used to test the software and the result was recorded and presented in the table 2 while the result was computed using the cross validation model in equation 2;

$$CVA = \frac{1}{30} \sum_{1}^{10} Ai \qquad 2.0$$

Where CVA stands for Cross Validation Accuracy, Ai is the recognition result measure for each fold;

Table 2: validation result

Student Face ID	Recognition Result	Conclusions
1	True	Student verified
2	True	Student verified
3	True	Student verified
4	True	Student verified
5	False	Student verified
6	True	Student verified
7	True	Student verified
8	True	Student verified
9	True	Student verified
10	False	Impersonator

From the result it was observed that the facial recognition system was able to recognize student face with accuracy of 80%. The implication of this result showed that the new system developed is very good and can be use to solve the problem of exam impersonation and other types of fraud in the academic institutions.

7. CONCLUSION

Face detection and recognition system is not a new idea in the human vision domain. It represents a physiological biometric identifier that is widely used in person recognition. During the past decades, face recognition has become a well-known computer vision research field and represents a computer-driven application for automatically authenticating a person from a digital image or a video sequence. It

performs the recognition by comparing selected facial characteristics in the input image with a face database. This was achieved in the research using KNN algorithm and deployed as exam fraud detection system. When tested the result showed that the new system was able to correctly match students face with accuracy of 80%.

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