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# DISTINGUISH BETWEEN NORMAL FACE FROM DEFORMED FACE TOWARDS FACE RECOGNITION PROCESS

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*ABSTRACT*
*Face recognition system is the most crucial work in today's world. It plays an essential role for a variety of reasons, including 1) searching for a person, 2) matching a person who committed a crime, 3) various cosmetologically processes, and many others. Throughout all of humanity's organs, a person's face is particularly important. Human personalities can be altered by even minor changes in facial shape. As a result of genetic mutations, severe injuries, or strong medication, a human face can develop a variety of deformities, which may have the largest influence on individuals. As a result, the rapid change may damage the recognition process in the future. In the present environment, where an epidemic-like state has already materialized, grave health issues are persistently impacting the entire population. Thus, using substantial quantities of medication is solely one method of treating these medical conditions. For this reason, taking large amounts of medication may be a contributing factor to a number of facial abnormalities. In order to evaluate these human facial imperfections computer vision with human interaction was chosen for this investigation. This research examines an input image of a human's frontal face and employs a segregation approach to distinguish the deformed faces. To identify those facial images, this strategy first implemented the Viola-Jones face detection algorithm, then Fast Fourier Transformation (FFT) and Discrete Cosine Transformation analysis for feature extraction, and finally Euclidean distance measurement techniques to analyze the input faces.*

**Keyword:** Viola-Jones Algorithm, Fast Fourier Transformation (FFT), Euclidean Distance Measurement, Discrete Cosine Transformation (DCT).

## I. INTRODUCTION

People always concerned about their health, especially at a time when fatal diseases are sweeping all over the globe. The continued health status all around the globe is deteriorating

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day by day [1]. In this context, the use of powerful medications is being considered in order to avert these conditions. However, the continuous use of these medications may gradually harm diverse portions of the human body. Human face is a most important body part among all because this part helps to identify a human primarily. Therefore, any damage of this part due to injuries or drugs can affect the primary identification process. Even slight physical defects have an impact on the personality. As the face is the vital for recognizing a person, defects in its shape cannot be concealed. Most abnormalities have their origins in the human skeleton [2]. A chromosomal issue, several traumas, and severe medication can all be causes of facial abnormalities. Face injuries and diseases can cause discomfort and alter one's appearance. In serious conditions, it can impair the vision, voice, respiration, and swallowing capacity. Deformation or shattered bones, particularly in the nose, cheekbone, and jaw, are common facial injuries. As a result, it is necessary to identify the abnormal regions on the face as well as to determine the cause of the deformities. With today's superior research technology, it is possible to discover this face condition using a variety of approaches.

Various approaches [3] for identifying a face and its facial components are developed and investigated. The major goal of this investigation is to determine whether or not a face is typical. If not, identify the altered facial areas. In order to accomplish this method, a first face and facial detection system are built in this study. The detecting mechanism is then built depending on the distance and breadth of the face and all facial parts. This study is an improving innovation with a high degree of accuracy. For the exact detection of normal and anomalous individuals, the FFT and DCT have been used. The study's conclusions showed that the suggested method is helpful in this area of investigation and may eventually result in more practical exploration.

## II. LITERATURE SURVEY

Numerous classification methods have been employed by researchers to develop a variety of face recognition systems. They accomplish this by using multiple models or a single categorization system. Neural network models are used by researchers to assess whether or not a face was fabricated [4]. In their investigations, some scientists address the person with Down syndrome (DS) condition and detail various categorization techniques, detection of faces, and the collection of features. [5]. In their investigation, researchers employed Haar-Cascade likes and Euclidean distance measurement to detect a face. They found that the experiment had a 91.1 percent recognition rate [6]. The researchers suggested a universal approach for detecting visually visible illnesses on faces. They employed a semi-supervised learning model with various classification strategy algorithms for this aim [7]. Other researchers developed an enhanced face recognition technique based on PCA and the FFT algorithm in their research report. To create the model, they used the well popular database and a series of tests [8]. Cardiovascular disease is one of the most frequent and lethal diseases in today's world. Using machine learning algorithms, researchers devised a strategy for detecting this disease [9]. The authors presented an artificial intelligence with voice-based email system to connect with people in a secure manner. The authors introduce an artificial intelligence with voice-based email system to connect with people in a secure manner. This approach is effective for visually impaired people as well as society [10]. After dealing with fatalities and multiple morbidities, the authors suggested a method for producing and administering vaccines. staff. The primary goal of this study is to examine the immunization campaign in India. The findings of the study will assist the government in making critical decisions in the event of a pandemic in the future [11]. Understanding the patients' well-being in a timely manner is a difficult endeavour. To carry out this research, a DL face image analysis is required. The authors undertake a comprehensive study to investigate the characteristics and consequences of deep learning-based face image analysis in medical research to fill this gap. They apply deep learning-based facial image analysis to detection of diseases [12]. With the constant advancement of networking technologies, numerous types of efficient computer networks have emerged, and human reliance on network technology has progressively expanded. The author offers a new computer vision-based method based on face detection and identification technologies. They show that under any condition, such as occlusion or side face detection, the suggested technique provides the highest accuracy [13].

## III. BACKGROUND DETAILS

### A) Human Facial Structure

Every human face has distinct traits that distinguish each individual. It is the most important bodily component for identifying an individual. The human face [14,15] is split into three major parts in anatomy: 1) Upper Face, 2) Middle Face, and 3) Lower Face. A human face begins just below the scalp and extends all the way to the lower jaw line. The three face regions are described in detail below. Figure 1 depicts the ideal facial structure of a normal individual.

#### *A.1) Upper Facial Region*

The upper face is defined as the area prior to the hairline and ending just under the lower eyelid. The upper face's peripheral boundaries end near the temporal area. This region is split into two sections.

**Forehead.** It is the biggest and most noticeable feature. This area started right below the scalp. The forehead is the most prominent feature on the upper face.

**Eyes.** The eyes are located in the upper facial region at the semi-circular orbital hole. It is the other superior part of the upper face. This has two eyelids, upper and lower eyelids, and brows. The human eye is a sensory organ that responds to light and allows the human to see.

### *A.2) Middle Facial Region*

The middle face extended from the lower eyelid to just above the top lip. This is the most prominent feature of a person's face. It is broken into three sections. 1) The nose, 2) the cheek, and 3) the ear.

**Nose.** It is the construction of the center line that extends to the face area. The nose is the most protuberant feature of the human face. It also serves as the key organ in the sensory organs. The nasal region is divided into two parts in this experiment: 1) tip of nose and 2) the region just below the nose tip.

**Cheeks.** This area is located lateral to the nose. It is made up of skin and fat pads. The cheeks are the part of the face between the nose and the left or right ear, located below the eyes.

**Ears.** Humans utilize their ears to hear sounds in their surroundings. This section is the external shape of the nasal section.

### *A.3) Lower Facial Region*

The lower facial region begins at the upper lip and extends to the chin. This section is divided into 4 parts. 1) Upper Lip, 2) Lip, 3) Chin, and 4) Jawline

**Upper Lip Area.** This area extended from the below nostril region to just above the lip region. It is the area between the nose and the mouth. It has a thick muscle that allows the lip region to move easily.

**Lip Area.** This region extends from just below the upper lip to just above the chin area. It is also referred to as the mouth. It is a prominent feature of the lower face.

**Chin Province.** This area extended from the bottom of the lip area to the end of the bottom jawline area. This is the enlarged area of the cheeks.

**Jawline.** This section begins with the parallel to the nose tip point. The jawbone is the biggest and most powerful bone structure in the human facial skeleton, according to anatomy. It is the only bone in the skull that can move.

Figure 1 depicts the ideal facial structure of a normal individual. The major 8 points of a face are all yellow with red surrounded, while others are utilized to specify those areas further thoroughly.

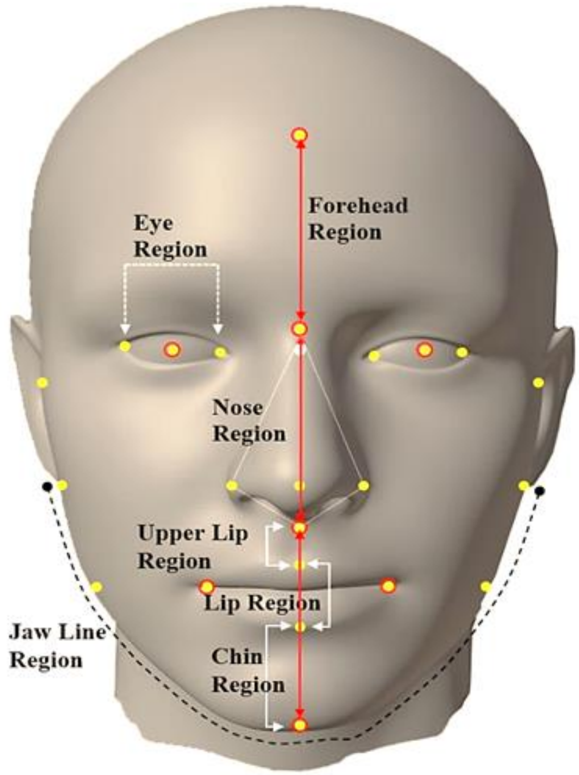


**Fig. 1.** Human Face Structure

### B. Machine Learning for Face and Facial Part Detection

Machine learning (ML) is a type of machine intelligence application [16]. It could acquire up new skills and change on its own with no needing much scripting. The goal of machine learning is to develop automated systems that can collect data and use it to learn for itself. The machine learning approach begins with data evaluations to look for patterns in the data. This technique helps in making better selections in the future based on the instances. Due to the security concerns, facial recognition technology is quickly expanding in today's society. This process is made easier with the use of AI, ML, and DL. Facial recognition is a system that can recognize a person depending on the structure of their face. It uses several learning algorithms to detect, collect, store, and examine facial characteristics in order to match them with images of people in a pre-existing database. Face-detection and recognition technology has progressed significantly in recent years. In this discipline, the viola-jones algorithm was a huge success. This algorithm is used in this study to detect faces and facial features.

### C. Viola-Jones face and Facial Parts Detection Algorithm

Paul Viola and Michael Jones devised this method in 2001 [17,18]. It is highly powerful and stands out in real-time facial identification. This system takes a long time to train but can recognize faces in real time with a magnificent speed. This procedure consists of four steps. 1) Identifying Haar-like features, 2) Creating an integral image, 3) Apply AdaBoost training, 4) Create and apply cascade classifier.

**Haar-Like Feature.** The human face has several distinguishing features such as eyes, brows, nose, lips, and so on. Some of the locations are darker than their neighbors. The Haar Wavelet idea is employed in this approach to detect these locations. It adds and compares the pixel values from both regions in order to identify the darker or lighter one. The total pixel values in the lighter section will exceed the total pixel values in the darker zone. Any facial feature, including the brows or eyes, could have an edge if one side is paler than the other. The edge and line features are then utilized to detect edges and lines, and the four-sided features are used to find diagonal characteristics from the lighter and darker sections.

**The Integral Image.** After selecting the features in the haar-like feature phase, the pixel values of those features must be computed. The integral image performs those operations and generates a final set of characteristics. In order to achieve this, each input pixel must equal the sum of all its neighboring pixels from top to bottom and left to right.

**Apply AdaBoost Training and Cascade Classifier.** Reducing the number of falsely accepted results is the main objective of the proposal. It reduces the number of regions in the image that are mistakenly recognized as faces. The Viola-Jones object detection algorithm's training method use AdaBoost to choose a subset of features and construct the classifier. The most effective outcomes are obtained with this strategy, which takes inadequate classifiers and turns them into powerful ones based on bias inaccuracy. The fundamental idea behind the Viola-Jones technique is to continuously scan the detector over the same image until the desired outcome is achieved but with a different size every time. Every round the adaboost algorithm is used to find the best classifier. This is really a time-consuming process. A Cascade Classifier is a multi-stage classifier that detects objects rapidly and reliably. Every round is comprised of a powerful classifier generated by the AdaBoost Algorithm. If all classifiers agree, the image is finally categorized as a face image.

## D. Fast Fourier Transformation (FFT) and Discrete Cosine Transformation (DCT)

### *D.1) Fast Fourier Transformation*

The fast Fourier analysis (FFT) [19,20] is an effective way to determine a sequence's discrete Fourier transform (DFT). This algorithm transfers a signal from its temporal or spatial domain to a frequency domain and vice versa. This approach is commonly used to minimize the number of evaluations for N points. In the present experiment, this method is utilized to convert the spatial domain pixel values of the input image into the frequency domain. One advantage of using FFT is that it helps convert the time domain to frequency domain, which speeds up calculations. Its ability to transform individual information into a continuous information type that can be accessed at an extensive bandwidth.

### D.2) Discrete Cosine Transformation

Discrete cosine transforms (DCT) [21, 22] represents a predetermined sequence of data points as a combination of cosine functions vibrating at various frequencies. The majority of digital material, including digital photographs, use it to compress images. A wide range of additional industrial applications can benefit from the usage of DCTs. The benefits of employing the discrete cosine transform are as follows: 1) it is a quick transform, 2) it has great compression for closely correlated data, and 3) it fixed basis images and strikes a fine balance between information compressing capability and computational complexity. Two wavelet processing approaches were utilized in this investigation to extract features from identified regions and construct feature matrices for the following phase. It is the first principal technique used to carry out this investigation.

### D.3) Euclidean Distance Calculation

Fundamentally, the Euclidean distance measurement technique [22] is used to compute the distance between two points. This approach measures the distance and the length between two points in the three-dimensional space which is also known as Euclidean space. The basic composition of a human face and the distance estimation between its constituent parts are shown in Figure 1. The key features of the human face anatomy are shown in Figure 2 as yellow dots surrounded by red circles. The full facial geometry is defined by the additional yellow spots. The nose tip is represented by the yellow points with the white border. This circle represents the human face's highest point. The Euclidean distance between various facial parts is specified by the lengths $d_0$ *to* $d_{10}$, which are listed in table 1. The Euclidean distance between various facial components, as described in table 1, was studied in this research to identify whether a face is normal or not. This is the second principal technique used to carry out this experiment.

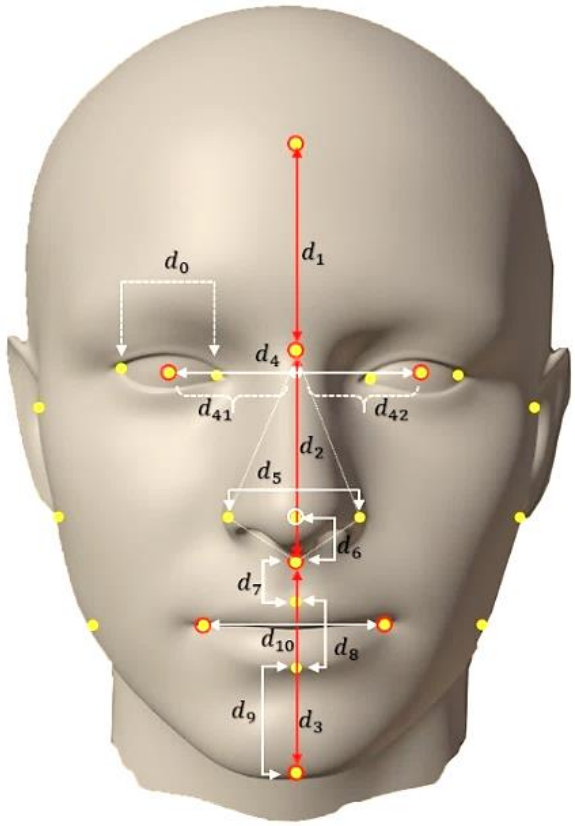


**Fig. 2.** The Basic Schematic of the Human Face and Its Distinct Facial Features

## IV. PROPOSED METHODOLOGY

The purpose of this study is to create a method to detect whether a human face is normal or aberrant. The faces deformed by heavy medication or other causes associated to Covid-19 or other disorders are primarily investigated in the present study. A machine learning model is established in this context. First, this model is capable of accurately detecting the face and facial parts [23-25]. Then it used the distance matrices technique in conjunction with two separate Fourier transformation techniques, FFT and DCT to determine whether the face is normal or deformed. Figure 3 illustrates the proposed method's fundamental sequence diagram.

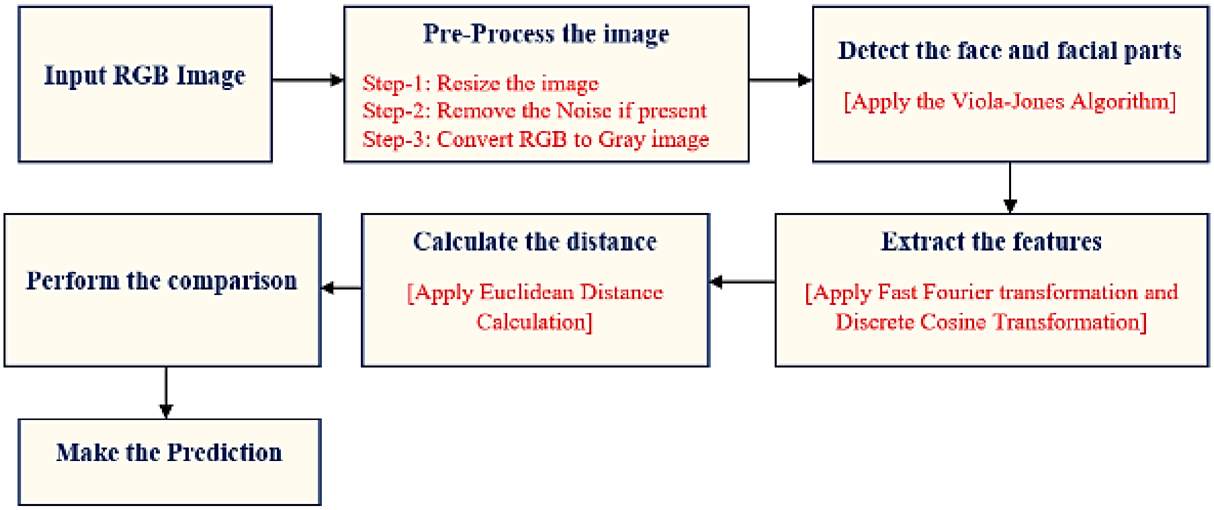


**Fig. 3.** Sequence diagram

## V. PROPOSED METHODOLOGY

### *A.1) Dataset details*

This investigation's input dataset includes over 2000 images of male and female persons of different ages. We created the majority of the data in this dataset. The images were collected from Kaggle repository [26]. All the images are in RGB format and feature both male and female figures. Figure 4 shows some samples of normal and aberrant face images.


**Fig. 4.** Sample images of Normal and Deformed Faces

### *A.2) Results*

The experimental result depicted in Figure 5 and 6. Figure 5 depicts the preprocessing result of the human face. Figure 6 represents the different facial parts detection and its measurement using viola-jones algorithm and Euclidean distance measurements.

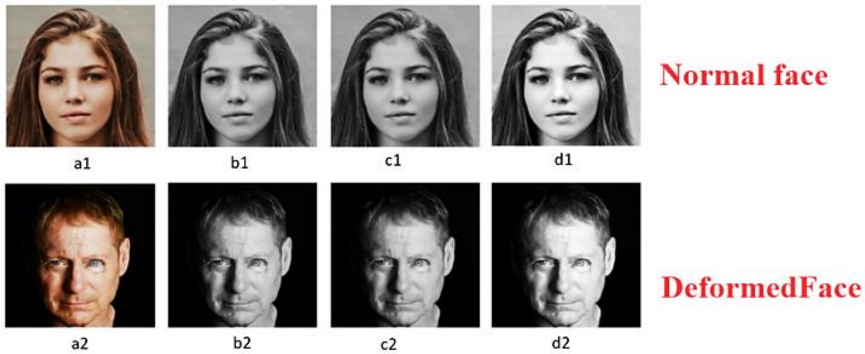


**Fig. 5.** Sample images of Normal and Deformed Faces

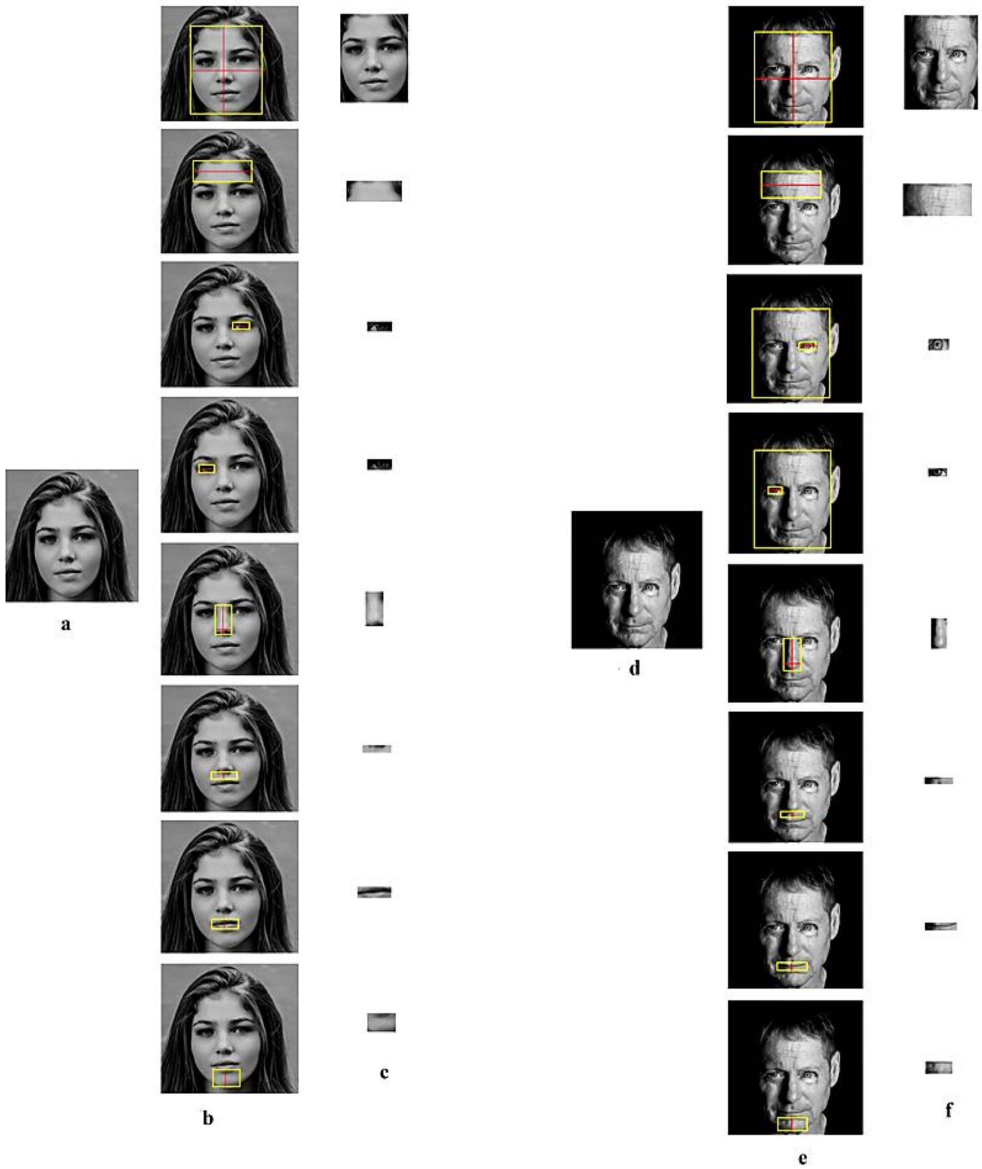


**Fig. 6.** Recognition of Distinct Facial Parts and the Area for Calculating Their Euclidean Distance [(a, d) Original Pre-processed image, (b, e) Detected Facial Parts Region, (c, f) Different Facial Parts]

### *A.3) Discussions*

Among all body parts, the human face is the most important. This section primarily aids in the identification of a person. As a result, the face and facial parts are crucial in terms of surveillance. Sometimes the face deforms on a small to large scale due to several reasons, like chromosome disorders, heavy medicinal drugs, heavy injuries, or surgical issues, etc. As a result, with the identification of faces, it is necessary to detect whether a face is normal or deformed. In this paper, a paradigm for dealing with this issue is proposed. The Viola-Jones method is used to recognize faces and facial areas. This method distinguishes and categorizes a face from a non-facial component in an image accurately and at a significantly faster rate. The following are the benefits of employing this algorithm:

1. This method can distinguish between a face and a non-face in an arbitrary image.
2. It produces findings with a larger proportion of true positives and a lower proportion of false positives.
3. It has numerous uses in real-time systems.

The second phase is to select features from the input images. In this phase, two wavelet transformation approaches were used: FFT and DCT. Both transformation strategies were capable of efficiently selecting and extracting features from the input photos.

FFT helps convert time domain to frequency domain, which makes computations easier because multiple frequency bands are always involved in communications networks. This is one of the key advantages of FFT. Its ability to transform discrete data into a continuous data format that is accessible at various frequencies is an additional noteworthy benefit. On the other hand, the benefits of employing DCT include the fact that it is a highly efficient and faster algorithm for computing, as well as being simple to implement and build a compressed data set. The human face is made up of various facial parts. When all of these facial elements are combined, they form a complete and normal face structure. If any of these elements is absent or distorted, the facial structure is said to be Deformed. In facial anatomy, the entire face structure is made up by right and left sections, each of which contains half of the facial features. When the length, width and distance between two parts from each side of these facial elements differ from one another, or when the position is incorrect, the facial structure becomes unbalanced. This approach is used in this investigation at the final phase. The Euclidean distance technique was used to estimate the breath and size of each facial part, as well as the distance between two facial parts. Finally, a final prediction is made based on these measurements.

## VI. CONCLUSION

The most significant part of the body of an individual is the face. The reason it important is due to the fact that a person's face can reveal a lot about them, including their gender, identity, intentions, feelings, appearance, age, and ethnicity. One can tell whether a face is normal or abnormal just by looking at it. Still, it may have difficulty in explaining what distinguishes a normal and abnormal face. This face may be distorted for a variety of reasons. The face deformity can occur as a result of a number of accidents, as well as some medications or a genetic condition. The Covid-19 pandemic crisis has significantly altered human living style over the last two years. Heavy medicine for covid patients, as well as other emergency injuries from post-operative procedures or other genetic reasons, may cause harm to the human facial structure. Numerous research projects have been started on this subject. In this work, an effective method for determining if a face is normal or deformed is established. This study included a thorough analysis of abnormal facial recognition in humans. One of the intermediate steps of human identification is the detection of normal and deformed human faces. Using facial feature analysis, the proposed method in this study determines a person's normalcy. For this investigation, a two-stage approach has been selected and implemented. In the initial step, this system was able to correctly identify the human face and facial features from the input photographs. In the second phase, two wavelet transformation approaches, FFT and DCT, were applied for feature identification and extraction. Finally, the Euclidean distance technique was employed to determine if the face is normal or aberrant based on its length and width.

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