1. Introduction

Human communication has two principle viewpoints; verbal (sound-related) and non-verbal (visual). Outward appearances are a vital segment of interpersonal correspondence. Regardless of their non-verbal nature, they pass on a great deal of data about the individual and the individual’s full of feeling state, expectation and identity. Especially for the acknowledgment of the full of feeling state, people depend vigorously on investigating outward appearances. Figure 1 describes the flow of the facial expression recognition.

![Figure 1](image-url)  
Figure 1. Facial expression recognition.

Face Detection is one of the essential qualifying technologies for many of human-computer interaction applications. It is a necessary pre-processing step for: Facial expression and face recognition, head pose estimation and tracking, face modeling and normalization. The objective of the face detection is to isolate human faces in an image regardless of their position, scale, in-plane rotation, pose, illumination, and facial expressions. Face location is a beginner’s way of face detection. The objective is to describe the position of a face in an image where there is only one image. But facial featuredetection concerns detecting and locating some significant components, such as eyes, lips etc.

Depending on the state of affairs different face detection approaches are needed. i.e., in controlled environment, color images, images in motion. In controlled - environment, photographs are taken under controlled light, background, etc. For the color images, the major variance lies between their intensity. Localize the faces from motion detection i.e., face localization in videos.

1.1 Face Detection Techniques

There are various types of algorithms for detecting face is found by the researchers and all these procedures have its dignities and shortcomings. The mechanism of face detection system has to think about the changes affected by
the surroundings such as viewing geometry, shadowing, resolution, lighting, imaging noise, scaling etc. Based on the literature, these algorithms can be categorized into four types. There are four types of face detection methods described as follows: Knowledge-based, Feature-invariant, Template matching, Appearance-based.

1.1.1 Knowledge based
Knowledge-based techniques use the basic facial knowledge (such as elliptic shape and the triangle feature) to obtain the final region of the face. It can be categorized into hierarchical and vertical/horizontal classifications. They apply rules to label the features of a face and their relations. In presented an algorithm for rule based face detection in frontal views for multi resolution image.

1.1.2 Feature-Invariant
Feature-invariant algorithms aim to find structural features that exist even when the pose, viewpoint, or lighting conditions, skin, edges. Skin-color based technique and color space models were described using fuzzy techniques and L*a*b color model respectively. Edge represents a margin between two regions which are identical in some sense. In edge detection, we attempt to identify the sharp discontinuities in an image. Boundaries in objects of the scene can be distinguished by the detection of edges. The canny edge detection technique was explained to detect eye regions with glasses. The Gabor feature mechanism was to extract the features in diverse orientation and scales. The neighborhood pixel may be described by these different frequencies and directions which have a reference to the exact pixel.

1.1.3 Template Matching
Template matching is a technique for identifying areas of an image that comparable (are similar) to a template image (patch). The targeted area of the image is known as template image and that image is searched in the source image. The matching area is determined by the correlation values. The Active Shape Model, the Active Appearance Model (AAM), deformable templates techniques used under Template matching.

1.1.4 Appearance based Method
Contrary to template matching technique, the inconsistency of the outward appearance of the faces should be confined by the training dataset. In appearance-based method, local approaches includes interest point detection, corners and global method utilizes whole image (i.e., mean of the image). The Eigen face algorithm is the best example for global approach. The merits and demerits of these techniques are discussed in Table 1.

<table>
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<tr>
<th>Table 1. Merits and demerits of the techniques</th>
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<td>Method</td>
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| Knowledge-based | Easy and simple procedures | i) Hard to decode human knowledge into rules precisely  
| | | ii) Difficult to extend this approach to detect faces in diverse poses. |
| Feature-Invariant | Features are invariant to pose and orientation change. | Difficult to discover facial features due to several corruptions (illumination, noise, and occlusion) and also challenging to detect faces in complex background. |
| Template Matching | Simple | i) Initialization of the template should adjacent to the face images.  
| | | ii) It is tough to compute templates for dissimilar poses. |
| Appearance-Based | Use powerful machine learning algorithms.  
| | b) Has demonstrated good empirical results.  
| | c) Fast and fairly robust. | i) Essential to examine over space and scale.  
| | | ii) Need lots of positive and negative illustrations. |

The paper is organized as follows. The second section describes the detection of faces using image processing techniques implemented in MATLAB, and third section concludes the paper.

2. Methodology
The technique to detect faces in the emotional system is presented in this paper. The flowchart for the face detection system is shown in Figure 2.
2.1 Reading an Input Image
The still RGB frontal face images are taken as an input. The input image information is passed to the detector with the utilization of the imread command. Then, RGB image is converted into grayscale image to improve the performance of the integral image in the algorithm.

2.2 Face Detection
The face detection system is fit for preparing pictures to a great degree quickly while accomplishing high discovery rates. The method is described below:

- The Integral Image is used for calculating the sum of values (pixel values) in a rectangular subset of a grid (the given image). It is utilized for calculating the average intensity within a given image. Summed Area Table at \((p,q)\) is computed as follows:
  \[
  S(p, q) = i(p, q) + S(p-1, q) + S(p, q-1) - S(p-1, q-1)
  \]

- Adaboost is one of the prevalent boosting techniques. The objective of the boosting algorithm is to construct the strong classifier as the combination of weak classifiers. The mathematical definition of classifier is as follows:
  \[
  h(x; f, p, \theta) = \begin{cases} 
  1 & \text{if } pf(x) > p\theta \\
  0 & \text{otherwise}
  \end{cases}
  \]

  Where \(x = 24*24\) pixel sub-window, \(f\) is applied frame, \(p\) the polarity and \(\theta\) the threshold that decides whether \(x\) should be classified as a positive or a negative. The boosting algorithm was used to train a classifier which is capable of processing images rapidly while having high detection rates.

- The present location of the sub window is identified by the classifier label. That may be either true or false. If any features of face region is detected, the classifier allowed it to the next stage i.e., face is detected otherwise it slides to the next location. The classifier flow diagram described in Figure 3. The experimental results are shown in the Figure 4.

Figure 3. Classifier flowchart.

3. Conclusion
In this paper, face detection method is suitable for the detection of face in the frontal view images only. In the future work, we plan to address the following problems:

- To identify dark faces (Figure 5).
- To detect various (Figure 6) rotated images.
An Analysis of Adaboost Algorithm for Face Detection

Figure 5. Dark faces are not detected.

Figure 6. Side-view of the face is not detected.

4. References