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REVIEW OF FACIAL EXPRESSION RECOGNITION SYSTEM AND USED DATASETS

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Abstract: *The human face is main part to recognize the individuals as well as provides the important information, current state of user behavior through their different expressions. Therefore, in biometric area of the research, automatically face & face expression recognition attracts researcher's interest. The other areas which use such technique are computer science medicine, psychology etc. Usually face recognition system is consisting of many internal tasks. Face detection is thefirst task of such systems. Due to different variations across the human faces, the process of detecting face becomes complex. But with help of different modeling methods, it becomes possible to recognize the face and hence different face expressions. This paperpresents a literature review over the techniques and methods used for facial expression recognition. Also, different facial expression datasets available for the research or testing of existing methods of facial expression recognition are discussed.*

Keywords: *Facial Expression, Face Detection, Features Extraction, Recognition, datasets.*

I.INTRODUCTION

Now days, the task of face recognition is widely used application of image analysis as well aspattern recognition. This process has been taken the significant attention during the last decade.At least two reasons account for this trend: Wide range of first commercial and law enforcementapplications, and the second after 30 years of research is the availability of viable technologies.Increase and rising security concerns and face recognition of practical life force received a facial recognition and face SatyaHydro system automatically to identify a person or a digital image as much as processing digital, still face picture is carried out to verify a computer application can beconsidered as facial expression recognition [19].The system was introduced in 1978 by Suwa et. Al. creating a facial expression recognition system the main point of face detection and feature extraction and image alignment, normalization, categorization. There are techniques that are usedto identify the facial expression number [2].

In human-to-human conversation, the articulation and perception of facial expressions form a communication channel in addition to voice which carries vital information about the mental, emotional, and even physical state of the persons in conversation. A person's facial expressions in its simplest form is a more subtle happy or angry thoughts, feelings or understanding of the speaker expected or unexpected response from listeners, sympathy, or even what the speaker is saying no signal can provide to computing background, brings our everyday human user to remain atthe forefront in the fabric will move to absorb. This set up a generally prediction, pervasive computing and ambient intelligence such as needed to achieve the next generation ofcomputing [22]. it's easy to naturally occurring multimodal human-human communication focused response to the user interface will need to be developed to identify such interfaces and intentions and as expressed by feelings of social and emotional indicators will need to have the ability. This vision of the future motivates the research for automated recognition of nonverbal actions and expression. Facial expression recognition, computer vision, pattern recognition and human-computer interaction research has attracted increasing attention in communities. Automatic recognition of facial expressions is so affective computing technologies, intelligent tutoring systems, including various forms the essence of the next generation computing equipment, patient monitoring systems, and etc. personal wellness profiled [13]. Human face other gender, different age groups and other physical characteristics of a person varies.

Figure1 below showing the general framework of automatic facial expression recognition. Fromthe figure, there are three important phases of overall system. First is face detection task in which first prominent features are extracted and then face is identified. The second step is where the facial feature extraction and recognition of facial expressions to the overall features are removed at the end of the last step in classification. Facial expressions of input image are then recognized. In this paper, facial expression recognition system is introduced, that is, the various stages of the various methods used for.

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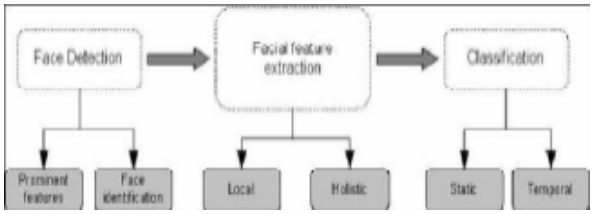

Fig-1: Generalized Framework for Automatic Facial Expression System

II. RELATED WORK

In [1], a new method is proposed on the basis of novel encoding scheme named as Local Directional Number Pattern. It extracts local information from image and encodes it using coding scheme in a compact form to distinguish between similar structure patterns indicating different intensity variations. Zhang et al. [2] produced better results than Local Binary Pattern using higher order Local Derivative Pattern. LDeP uses (n-1)thorder derivative direction variations based on binary coding functions and contains detailed discriminative features that cannot be obtained by Local Binary Pattern (LBP). To overcome noise and illumination variation problems, other information have been used by duo methods. Facial Expression Recognition using Support Vector Machines [3] presents a methodology to recognize facial expressions using Support Vector Machine (SVM) classifier. It is mainly used for the purpose of classifying data as per the requirement of the proposed technique. SVM Classifier generally uses support vectors which are separated by a hyperplane, a maximal margin mainly classifies different pixel values that represents top directional information of local features. Local Directional Pattern (LDiP) [4,5] proposes a method which represents a pattern which encodes the directional information in the neighbourhood, instead of the intensity. It uses an eight bit binary code which can be assigned to each and every pixel of an input image. LDiP is calculated by comparing a pixel values in different directions and produces pattern with more stability even in the presence of noise. The reason behind gaining popularity extensively by LBP is its better performance than previous existing methods. There were many newer methods that tried to overcome the disadvantages of LBP are like Local Ternary Pattern (LTP) [6, 7]. This is proved as an extension of the LBP features which were designed originally for descripting textures applied for the purpose of face recognition. Local Binary Pattern (LBP) [8], a paper that represents feature descriptor designed for mainly for texture analysis. LBP is actually defined as a tool which models texture images and a grey scale invariant measure. LBP analyses facial expressions, background modeling, recognize face images and it can be viewed as a collection of micro patterns. First order derivative pattern of images are also represented by LBP and binary gradient directions are concatenated to generate micro patterns.Elastic Bunch Graph Matching [9], a methodology represented in a paper represents a face by a topological graph where each node represents a bunch of coefficients called as Gabor coefficients also known as jet. Gabor features [10], is a method uses Gabor wavelet which is a sinusoidal plane with particular frequency and orientation modulated by a Gaussian envelope.Linear Discriminant Analysis [11] and most recent 2D PCA [12] are the examples considered under holistic methods. These methods have been widely studied because of local descriptors as they had gained attention because of their robust nature against illumination and pose variations. Heisele*et al.* showed that component-based methods are more valid as compare to holistic methods. The methods using local feature computes the descriptor from different areas of the face, and then collects the information into one descriptor. Amongthese different methods is a Local Features Analysis (LFA) which is a purely second order derivative method. The methods forholistic class are Eigenfaces and Fisherfaces [13], which are actually based on Principal Component Analysis (PCA); it uses PCA for dimensionality reduction and also yields projection directions for maximization of total scattering over each and every class i.e., across all of the facial images. An unwanted variation due to lighting and facial expression is actually retained by PCA.

III. FACIAL EXPRESSION RECOGNITION SYSTEM

Human facial expression recognition problem of three problem areas (fig.1) also includes: (1)finding faces view, (2) extracting facial features and/or facial features change as the speed of analysis, and some facial expression interpretations categories (for example, emotions, facialmuscle actions to classify this information found in the facial area), (3) `. Face the problem of finding a division problem (machine vision) or (pattern recognition) is a problem in locating, it can be seen as a human face identification of all areas in the view refers to the head in pretend occlusions and variations. Clutter, and Regardless of lighting conditions face (face localization, face detection) should solve the problem of non-rigid movements. Facial expression and facial shape,color & texture are presence of a high degree of variability in this problem even more difficult. Many techniques to detect faces in still images have been developed. However, most of them only honest face frontal or near frontal view can detect faces arguably the most employed detector automatically. Facial expression analysis in real-time is proposed by Viola and Jones face detector. Feature extraction of problem a dimensionality reduction problem (in machine vision and pattern recognition) as can be seen it referenced that input data to encode features relevant information from a low-to change the input data set represented.

Main problem of the facial feature extraction from input images may be divided into at least three dimensions:

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(1) Are the features holistic (spanning the whole face) or analytic (spanning subparts of the face)? (2) Is temporal information used? (3) Are the features view- or volume based (2-D/3-D)?

This glossary, facial expression recognition, analytical approach proposed for the most stable, 2-d face feature extraction is directed toward. Derived facial features generally too geometric features such as facial components (eyes, mouth, etc) shapes and Facial fiducially points (corners of the eyes, mouth, etc.) locations, or the presence of specific facial wrinkles, bulges, and thetexture of the facial skin in areas including furrows are represented. Appearance-based independent component analysis filter features learned image (ICA), principal component analysis (PCA), local feature analysis (LFA), Gabor filters, integral image filters (also known as box-like filters and defeat filter) are based on the age-oriented, histograms, etc features. Several attempts have also reported using both geometric and presence features (e.g., [3]). Automatic facial expression analysis of these methods are referred to as hybrid methods, although it has been reported that based on geometric features based on those methods often are outperformed by, for example, by using Gabor wavelets or eigenfaces, recent studies have shown that in some cases the presence of geometric characteristics can outperform. Yet, it seems that both use geometric and presencefeatures some of the best choices in terms of facial expressions.

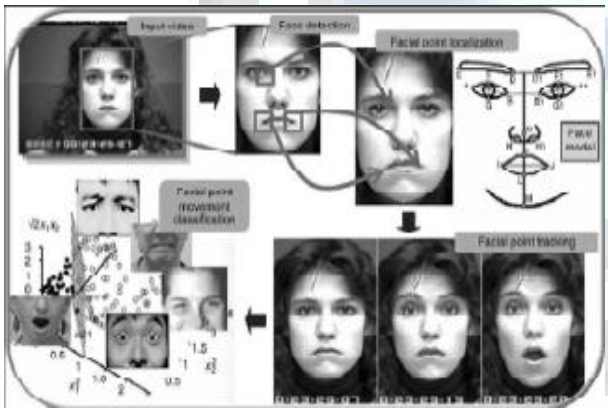

Fig-2: Detailed process of facial expression recognition based on geometric-features-based

The muscles of the face, causing contractions that produce facial expressions, movements offacial skin and change the location and/or the presence of facial features (e.g., brings a frown muscle contractions, Corrugators and move toward each other to produce wrinkles between eyebrows usually causes eyebrows fig. 3). Such a change optical flow, facial-point-or facial constituent contour-tracking results, can be detected by analyzing or changes (for example, whether or not the deep nasolabial furrow) to make decisions about the appearance of the ensemble classifiers trained by using an optical flow based on attendance pass features. Main approaches face to describe the required processing of facial feature extraction of phase. Dense flow information throughout the whole facial area, smooth texture, such as cheek and forehead areas regardless of the existence of facial components results and visible optical flow movement velocity is expressed in terms of, because it's straight face expressions can be used to represent this approach [2,3] by many researchers. Until recently, the most commonly used standard optical flow technology arguably, facial feature points and shape as was used to track.

Error and noise, occlusion, clutter and sensitivity to changes in the accumulation of illuminationsuch as optical flow techniques to address the limitations inherent in the recent efforts of automatic facial expression recognition in sequential State estimation techniques (such as Kalman and particle filters) image sequences to track facial feature points. Finally, dense flow information, tracked the movements of facial feature points, tracked changes in the shape of facial components, and/or appearance features displayed facial expression are translated into a description of the extracted (facial expression interpretation) is usually shown affective states (emotions) is either given or facial muscles underlying displayed facial expression as active. It stems from two major approaches in psychological research to measure facial expression: the message and the signature decision estimated what a displayed facial expression, such as impact or personality, shown underlies behavior, such as the surface of facial movement or facial components.Shape description is the purpose of the decision to sign, while thepurpose of this decision is the message type, a decision a message ' anger ' brow frown and a facial movement that lowers and pulls close together eyebrows in a sign-decisions can be judged as approach while explaining the decision message. The conclusions conveyed messages, leaving higher-order objective decision to be about to sign judgment is all about effort.

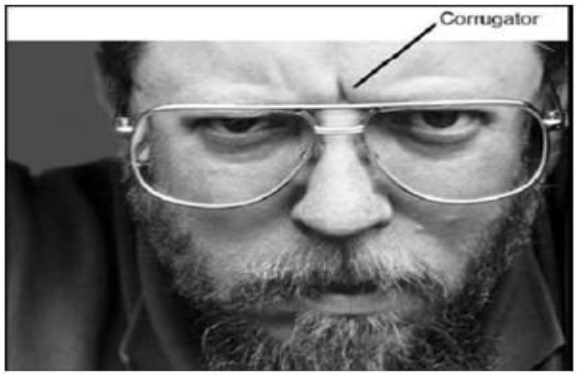

Fig-3: Facial appearance of the Corrugators muscle contraction

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Most commonly used facial expression descriptors in message judgment approaches are the sixbasic emotions (fear, sadness, happiness, anger, disgust & surprise; look Fig. 4) Ekman and discrete emotion theorists who suggest that universally these emotions and facial expressions are recognized by the signature decision approaches proposed. Commonly used facial action coding system defined face battle action descriptors units such as AUs, most facial expressions developed analyzers, yet, the goal of human facial impact analysis and a small set of joy and anger as prototypic emotional facial expressions to identify attempted however, you can identify systems that were deliberately reported many promising prototype produced in face images and effortlessly display AUs validation side also has some recent efforts have been reported as well. While the expert rules and methods such as simple approach Ntrika network, including machine learning are the old ways to employ some of the relevant information from the input data to the facial expression interpretations categories, and recently (and often more) methods to classify jobs in probabilistic, statistical, and ensemble techniques, especially face image automatic facial expression recognition seem to be suitable for learning sequences.

Fig-4: Prototypic facial expressions of six basic emotions (left-to-right from top row): disgust,happiness, sadness, anger, fear, and surprise.

III. PROPOSED FRAMEWORK

The proposed methodology for face and expression recognition will be a flow depicted in figure below. The first stage of this system is image acquisition in which the input image is obtained as per the requirement of the system. The images used for the purpose of face and expression recognition can be acquired from standard databases depicting various facial expressions indicating anger, joy, disgust, fear, sad and happiness and for this purpose standard JAFFE database has been used and further pre-processing techniques are applied. After this, various local features from an image are extracted using different coding schemes and edges are detected using Gaussian Derivative and Kirsch Masking. Extracted local features are normalized and classified using Support Vector Machine (SVM) Classifier. Finally, obtained results are analysed and compared with the other existing methods.

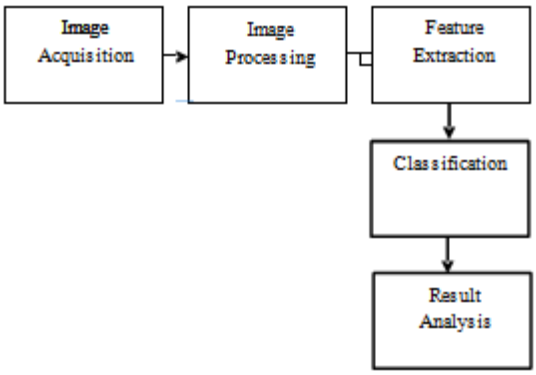

Figure 5. Flow of Proposed Work

A. Image Acquisition

The JAFFE Dataset images are used as input for processing is taken from web available sources. The dataset images depict different facial expressions reflecting various emotions like anger, joy, disgust, sad, fear and happiness. Figure 6 shows instances of input images.

Figure 6. JAFFE Dataset

B. Image Processing

Input images are used for further processing techniques. Different compass masking schemes can be used for computing edge responses i.e., mainly Kirsch masking. Kirsch masking is basically used to extract edge responses and is rotated 45° apart to obtain mask in eight different directions. Further, Gaussian smoothing is used to stabilize the code using derivative Gaussian mask. This mask overcomes noise and illumination changes resulting into strong edge responses .Input images are decomposed

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resulting into directional templates. Figure 7 and 8 below shows the pre-processed images showing eight directional templates obtained after applying kirsch masking and derivative Gaussian mask.

Figure 7.Compass Masked Images (Kirsch Masking)

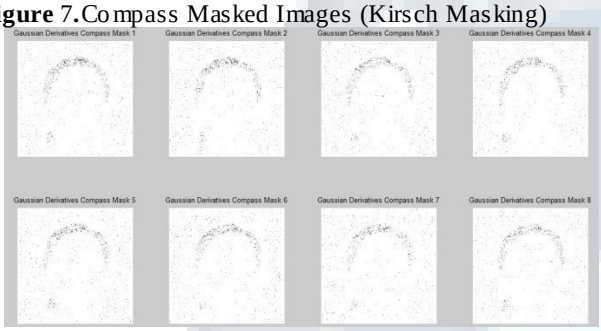

Figure 8.Compass Masked Images (Derivative Gaussian Masking)

C. Feature Extraction

Local Directional Number Pattern methodology is used for extracting features from pre-processed images. The proposed Local Directional Number Pattern (LDN) represents a six bit binary code which can be assigned to each and every pixel of an input image representing the texture structures and intensity transitions.
Numbers (coded with binary value 0-9);

0 - 00- 0 0 0 0 0 0
1 - 01- 0 0 0 0 0 1
2 - 02- 0 0 0 0 1 0
3 - 03- 0 0 0 0 1 1
4 - 04- 0 0 0 1 0 0
5 - 05- 0 0 0 1 0 1
6 - 06- 0 0 0 1 1 0
7 - 07- 0 0 0 1 1 1
8 - 10- 0 0 1 0 0 0
9 - 11- 0 0 1 0 0 1

This coding scheme is actually based on directional numbers, rather than bit strings encoding information related to the neighbourhood in a more efficient way. The implicit utilization of sign information encodes more information in comparison to the previous directional and derivative methods in less space as well as simultaneously discriminating more textures. The method is actually more robust against illumination changes and noise due to the use of gradient information.
In a coding scheme, LDN code is generated by analyzing the edge response of each mask, {M0. . . M7}, that represents the edge significance using its respective direction and by combining the dominant directional numbers. Since, the edge responses are not equally important therefore the presence of the highest positive or negative value indicates prominent darkor bright area. Hence, to encode these prominent regions, the sign information is used and a fixed position for the top positive directionalnumber is assigned as the mostsignificant bits of the code as wellas the top negative directionalnumber is assigned as the three least significant bits.

Therefore, the code is defined as,

$LDN(x, y) = 8i_{x,y} + j_{x,y}(1)$ Where,
(x, y) = the central pixel of the neighbourhood being coded, $i_{x,y}$ = directional number of the maximum positive response, $i_{x,y}$=directional number of the minimum negative response.

Figure below shows an LDN code result.

Figure 9.LDN Code Result

D. Face Recognition

LDN: A Face Descriptor:
LDN acts as a face descriptor and every face is represented by an LDN histogram (LH) which contains information of an image including edges, spots, corners, etc. and other local textures. Without using any location information, the occurrence of certain micro-patterns can be encoded. The location information is aggregated to the descriptor by dividing the face image into small regions $\{R^1, \ldots\ldots, R^N\}$ and a histogram H^i is extracted from each region R^i. Finally,

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all the histograms obtained for different spots, edges, corners and other local textures due to different intensity variations are concatenated for the purpose of face recognition. Theface can be recognised using both LH and MLH during the face recognition process and its main objective is to compare an encoded feature vector of a subjective person with other persons feature using chi-square dissimilarity measure.

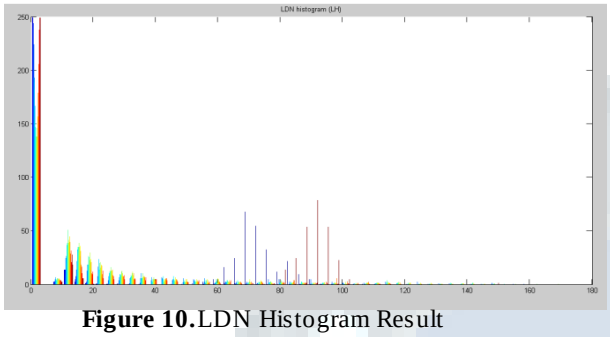


Figure 10.LDN Histogram Result

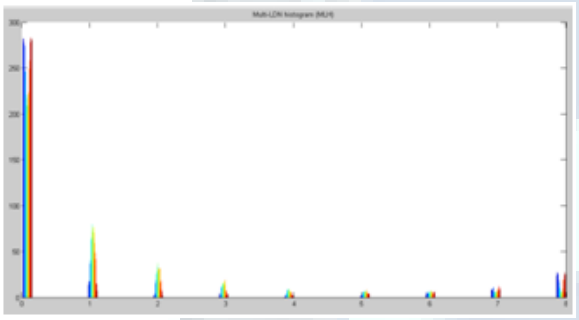
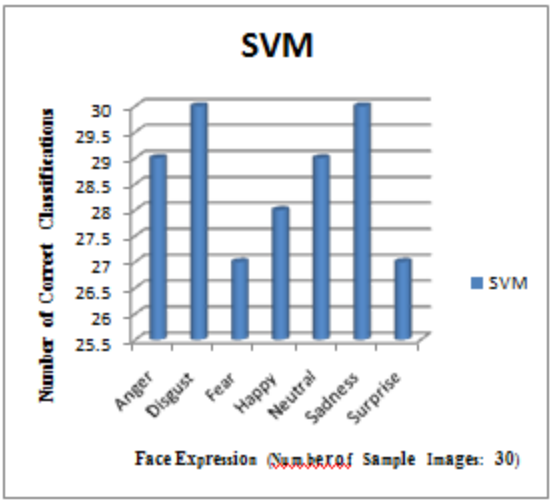


Figure 11. Multi-LDN Histogram Result

Figure 12. Resultant Recognized Face

E. *Expression Recognition*

Facial Expressions can be recognized using Support Vector Machines (SVM). SVM is basically used to evaluate the performance of the proposed method.SVM is a supervised machine learning technique that not only makes binary decisions but also maps the data; multi-class classification can be achieved by adoptingthe one- against-one or one-against-all techniques. By using SVM, for facial expression recognition the accuracy of object can be maximized. Figure below shows graph in which number of correct classification is performed for recognizing accuracy using maximum number of sampled images approximately 30 for each facial expressions.



V. CONCLUSION

In this paper, the review of framework of facial expression recognition has been highlighted. In this, the different components and phases required for facial expression recognition have been discussed. Local Directional Number Pattern Method is used as a novel encoding scheme that uses directional information to code different patterns from face textures. It is basically analyzed on two compass masking schemes such as Kirsch Masking and derivative Gaussian masking. It also uses Support Vector Machine (SVM) mainly used to classify data for the purpose of expression recognition. LDN is a good face descriptor which effectively performs per pixel computation. It overcomes noise and illumination problems and produces better results than other existing methods.

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