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Emotion Detection using Machine Learning

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Abstract - As we all know the human trait, we can guess the emotion of a human just by looking at the nature of their face, have you ever wondered what it would be like if a computer can do the same. Changes in the position of the muscles which are under the skin in the face of a person is called facial expression. These expressions convey the exact mood of the person in a non-verbal form. Since machine learning is training the machine to act like humans; we can do the same and teach the computer to recognize human emotions.; what if it turns out better than we can perceive the emotions of others. The computer if first trained with 20,000 images, then the computer gains the capacity to classify the input images according to different. The main components of Emotion Detection are Image pre-processing, feature extraction and feature classification. First, we'll consider the face detection basically. We'll eliminate the part of the face which are trivial. The second part will be facial landmarks, these are a set of key points on human face images. These points are defined by the coordinates on the image. It pinpoints the important regions of the face which contributes to the emotion such as eyes, eyebrows, nose, mouth and the jawline. To differentiate between the emotions of the person we can concentrate on the mouth and the eyes which are more specific. KNN, CNN and MLP are the algorithms which are used in the project. Emotion Detection is used to detect the reaction of the customers to check if they are happy with the service or not. The main aim of the project is to perform real time prediction and get to the conclusion.

Key Words: KNN, CNN, MLP, Emotion Detection, Image preprocessing, Machine Learning.

1.INTRODUCTION

Emotion detection is the process in which the persons mood can be found without any actual conversation. There are many ways in which the emotion can be detected, facial recognition, speech recognition, bio signals, body movements and gestures and many more. We have used Facial recognition technique using machine learning to find the emotion of the person. This is a technique which is very useful. In this technique the unwanted area of the face is first eliminated, this process is called face detection. Next is facial landmarks, these are a set of key points on the image of a person's face. These points are defined by their coordinates on the image. These points are on the necessary regions of the face such as eyes, nose, mouth, eyebrows and jawline. The main emotions are angry, happy, sad, surprise and neutral. KNN, CNN and MLP are the algorithms used.The man aim is to perform real time application. It is used for helping children with autism, it helps visually challenged people to read the facial expression. It is very much used for security purposes and also used by robots to increase social interaction.

Fig. 1 Emotions of humans using Emotion Detection

2. PREVIOUS WORK

"Emotion Recognition using Various Methods" by **Reeshad Khan & Omar Shari** [15] published in 2016. This paper talks about Human Emotions being a natural instinctive state of mind. The mind is not capable of knowing the current state of mood being positive, negative and neutral it depends on the state of where the person is and the relationship with other people. This is also carried out as important information to understand emotion as an intelligent agent. Imagine a world where the machine can be as strong as the human brain and carry out the nuances of emotions. Particularly, emotion recognition through deep learning has become an intriguing research in the upcoming days. Firstly, the machine can understand emotions using vocal sounds. Secondly, there are multimodal systems that can use more than one feature to

understand and predict the emotions with more accuracy. It makes use of a combination of audio-visual expressions, EEG and body gestures. Thirdly, the use of deep neural networks can be used for speech and language processing, as well as emotion recognition tasks. In conclusion we arrive to the point that amongst all these methods the most efficient turns out to be the EEG signal and audiovisual signals has the highest recognition rate and has highest performance.

"Mood Detection System" by **Rajneesh Singla** [16] published in 2016. Mood detection is a difficult way to be recognized due to the variation of physical expression amongst people and variations among the same individual. Detecting mood has several implications in forensic, bioinformatics and physiological applications. There is always a need for developing an expression-based profile and above application in real time and on the real time database. There are three new methods for mood detection recognizing facial expressions effectively LDA, ICA and PCA technique. The mail goal of it is to find the rate of mood detection successfully. This method can be useful for human-computer interface. In conclusion, mood detection is a challenging problem in the field of image processing and computer vision. This method has gained a lot of researchers because of it being used widely. The aim is to find the mood using audio visual mood detection technique. The algorithm is being successfully used in real-time technique and has proved to be efficient.

"Multi-label Emotion Detection from Text" by **Kalyani Vishwakarma and Prof. Pushpak Bhattacharya** [17] published in 2018. At this moment of time, where there is vast availability and accessibility to online data, it has become an intriguing topic to research about sentimental and emotion analysis. It can be used in various domains like marketing, pervasive computing, recommendation systems, political science. The research work has been done through the technique of Affective Computing where the main focus was on the investigation of cognition, psychology and behaviors of humans. This mode captures the body gestures, posture and speech to detect the emotion and to detect the emotion through online making use of the data which includes short forms of the words, emoticons, emojis, and the colloquial language. The recent technique includes the use of techniques like deep learning, LSTM, Convolutional Neural Networks, Attention Models, etc. along with exploring semantics, syntactic, ontology, etc. In conclusion, the methods that have been proved more efficient and useful are traditional approaches like SVM and Naive Bayes in comparison to the latest methods of neural networks.

"A Survey Paper on Emotion Recognition and Depression Detection using Machine Learning Algorithms" by **Keerthana S Kumar, Neha S, Nivya, Pooja HC Shekar, Asha VG** [18] published in 2020. Depression being one of the main mental health issues pertaining to a large population of the world, this method can be useful for detecting the mental health of a person. Depression can interfere in day to day simpler activities which can require minimal effort, basically it kills a person inside making them eliminate the joys of life. To avoid this mental illness for a longer period of time, it would be beneficial to detect it at the earlier stage would help to lower its effect. The survey is to detect depression at the earlier stage to see if the person is sad throughout the day and according to the guidelines by American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders (DSM-5 criteria) and to see if they have the symptoms. If it is found out by continuous evaluation, then it can be detected through the method of MTCNN and Keras Libraries through the aid of chatbot. In conclusion, using the method of MTCNN which uses the method of 3 modules face detection and emotion recognition through Keras Libraries the accuracy is high through chat bot which can differentiate between sadness and depression and help the person to a greater extent.

"Recognition of Emotion intensity Using Machine Learning Algorithms: A comparative study" by **Ahmad Y. Javaid, Dhwani Mehta and Mohammad Faridul Haque Siddiqui** [1] on 21st April 2019.The need for human-machine interaction and behavioral biometric system has been increasing at a rapid rate. Due to this increasing need, Automatic facial recognition has gained a lot of attention. The algorithms which are used for feature extraction are Local Binary Pattern, a Histogram of Oriented Gradients and Gabor filters. k-Nearest algorithm, Support Vector Machine and Random Forest are the algorithms which are used for the purpose of classification. The works which are already in existence do not find the intensity of the emotion whereas here we the facial emotion is recognized along with the intensity of that particular emotion. The emotion's intensity is most of the time associated directly with the facial muscle movement's intensity. This helps in finding the emotional state of the person. During the study in the field of detecting the intensity of emotions, it related to three areas. Firstly, it related to the cross-cultural character where, for the same emotion, it predicted the intensity for two different expression. Secondly, gender causes major difference in signs which are not verbal. Final conclusion is that, people with diseases such as autism, schizophrenia etc. do no have an emotional pattern similar to normal people. And their emotional intensity also differs.

"Facial Emotion Recognition Using Machine Learning" by **Nitisha Raut** [13] in May 2018.Facial emotion recognition and detection is becoming famous day by day. It is very easy for a human being to find the emotion of another person but it difficult for a machine to do the same task. In order to help the machine to the mentioned task, the machine has to be trained. They must then be tested using different datasets. The machines use a lot of algorithms for the training process. The basic human emotions are classified into a few basic categories, happy, sad, anger, disgust, contempt, surprise and neutral. The above-mentioned emotions are very subtle. Minute changes in facial muscles leads to a different emotion. Features such as the nose, eyes and the jaws are mainly taken under consideration for detecting the different emotions. Expression for the same

emotion can be different for different people. Pattern recognition and classification is done mainly by machine learning algorithms. The different steps to detect an emotion are: dataset processing, face detection, feature detection and classification into different emotion according to the features detected.

"Facial geometric feature extraction based emotional expression classification using machine learning algorithms", **Murugappan M.** [14] on 18 February 2021. Emotion detection has played a very vital role. Emotion plays a very important role in interpersonal communication and in improving the quality of social life. There are many ways to detect emotions such as speech, signal, gesture ect. Emotions are classified into six major groups namely sad, happy, surprise, anger, sad and disgust. The face of the image which is inputted is recognized using a Haar-like features. Then the virtual markers are positioned in different locations of the face. Using an algorithm called Lucas Kannade the features are detected, and the emotion are recognized. The recognition is automatic. Facial expressions are a very potential nonverbal communication medium. Facial expressions detection and recognition are used in clinical analysis, 3D-modelling, human-machine interaction, etc. Databases such as Japanese Female Facial Expression Database, Cohn-Kanade extended database etc. are used for facial emotion detection. Many still images were inputted and tested using the above-mentioned algorithms several times. Most of them did not work properly in offline mode, it could not detect macro expressions and are not fit for emotion detection in real time. Actions units(AU's) or Facial action units(FAU) are manipulated by the facial models that are fully controllable.

3.METHODOLOGY

There are many ways to detect emotions, the different approaches are facial expressions, hand gestures, body languages etc. The main emotions detected are anger, sad, disgust, happy, surprise and fear. In order to fine the emotion of the image, which is inputted, a set of data must be fed and trained. The input image is then classified into their respective groups are the features of the input image is compared with the trained set of data. Taking a dataset of 20000 images which are divided into five emotions. The images are 48*48 grayscale cropped images. First is the face detection process where we detect the face in the images and eliminate the regions which are not necessary in it. Next is the facial landmarks, they are basically a set of key points on the face. These points are mainly defined by their coordinates (x, y) to locate regions of the face like the eyes, jaw, eyebrows etc. These are the most salient features of the face where different emotions can be distinguished. We can find the Euclidian distance between the points to know the emotions. After loading the dataset, we will split the data into training set and trained set. Now using the models like linear models and non-linear models we can classify the images into emotions. The algorithms used are KNN for linear model where we use the Euclidean distance between the points to find the accuracy of the model. Similarly, we will use MLP where there maybe hidden layers and finally output layers and next we use CNN to improve the performance of accuracy.

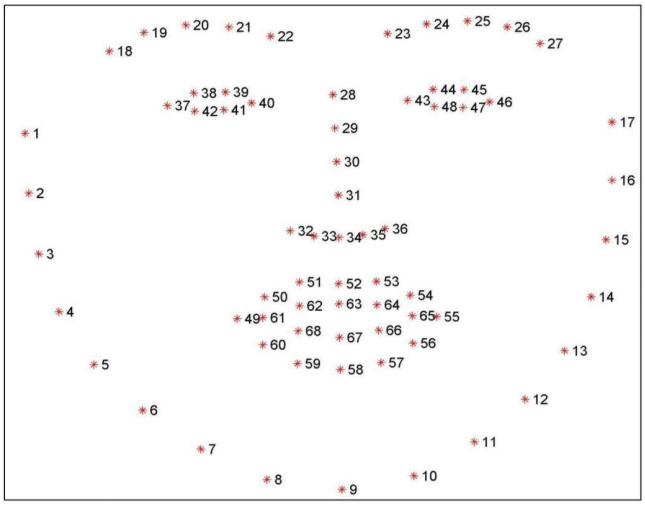

Fig. 2 Landmarks to be marked on Face

WORKFLOW

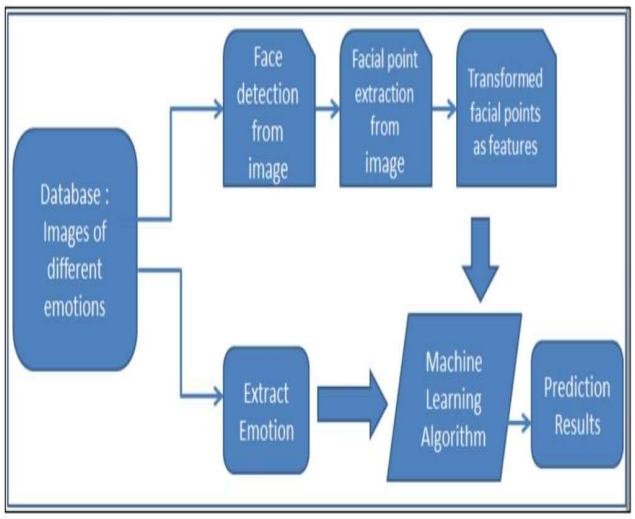

Fig. 3 Process of how it works.

1. K-NEAREST NEIGHBOURS ALGORITHM

KNN algorithm is a non-parametric classification method. K-NN is one of the easiest machine learning algorithms which is based on Supervised Learning Techniques. This algorithm assumes the similarities between the new data or case and the data or case which is already available and the put the new case or data into the category which is most similar to the available categories This method is used for both regression and classification. This algorithm is mostly used for classifications. In both the mentioned cases, the input consists the k closest

training example in the data set. Whereas the output always depends upon whether k-NN is used for regression or for classification. This algorithm is also called lazy learner algorithm.

k-NN regression: The output of k-NN regression is always the property value of the objects. The output value is the average of the values of the k-NN.

k-NN classification: The output of k-NN classification is always a class membership, the object is always classified by the plural vote of its neighbor. The object is assigned to the class of the class which is the most common amongst its k-NN (if k is a typically small positive integer). If k is equal to 1, then the object is directly assigned to the class of that single nearest neighbor which is the nearest.

For k-NN the neighbors are taken from a set of objects for which the class (in case of k-NN classification) or the property value of the object (in case of regression) is known. There is no explicit training step required but this can be thought as the training set for the algorithm.

The specialty of k-NN algorithm is that it is very sensitive to all the local structures of the data.

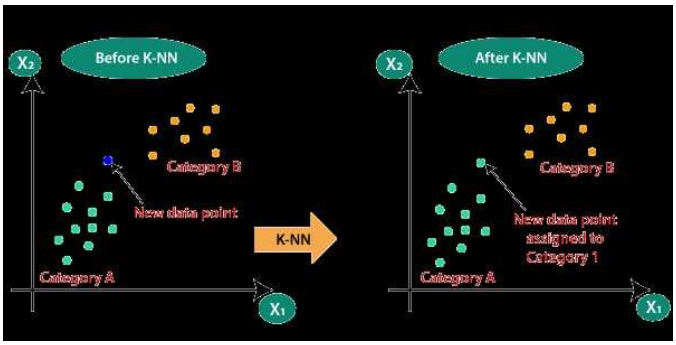

Fig. 4 Comparison of how KNN works

KNN WORKING

STEP 1: Select the k value.

STEP 2: Then the Euclidean distance using the Euclidean formula has to be calculated.

STEP 3: The k nearest neighbor as the calculated Euclidean distance has to be taken.

STEP 4: Count the number of data points in each of the categories amongst the k neighbor.

STEP 5: Then assign the new data point to the category which has the maximum number of neighbors.

HOW TO SELECT THE VALUE OD K IN THE K-NN ALGORITHM

There is no one such method to determine the value of K. Trial and error method is the best.

The most preferred values of K is 5.

A value which is very low can be noisy.

Large values for K is preferred but it sometimes may lead to difficulties.

STEPS TO IMPLEMENT THE KNN ALGORITHM

STEP 1: Data pre processing

STEP 2: The KNN algorithm to the training data set has to be fitted.

STEP 3: Test result has to be predicted.

STEP 4: The accuracy of the result is tested.

STEP 5: The test set result is then visualized.

ADVANTAGES OF KNN METHOD

It is an algorithm which is very easy to understand.

It is very easy for interpretation.

The accuracy of the output is very high.

This algorithm can be used for both regression and classification.

It is very efficient for noisy and large training data.

DISADVANTAGES OF KNN METHOD

The value of K must always be determined which at times is a very tedious process

The distance between the data points for all the training samples must be found which leads to high computational cost.

The prediction is very slow when it comes to the nig N.

The memory storage which is required is very high when compared to other algorithms.

2. CONVOLUTIONAL NEURAL NETWORK ALGORITHM

The Convolutional Neural Network is a classification of deep neural network. This is mostly used to analyze visual images. The CNN can recognize and classify different features form an image. They are then classified accordingly. The term convolution means the mathematical function of convolution .It is a linear operation which is a special kind. In order to get the third function, two functions are multiplied. The third function shows how the shape of one function is modified by the other

function. In order to extract features from the image two images which are represented in the form of matrices are multiplied.

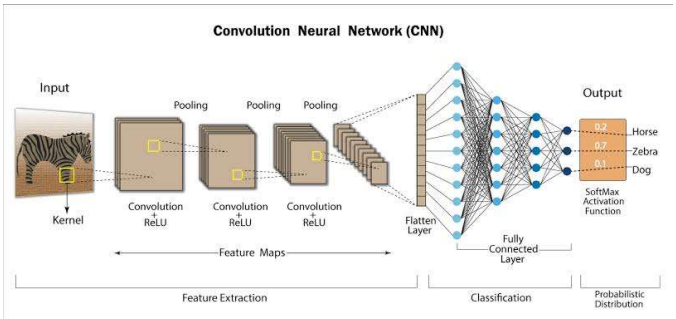

Fig. 5 Convolutional Neural Network

The CNN architecture has two main parts.

The convolution tool is used to separates and identify the different features of the image. This image is then analyzed in a process known as feature extraction.

The output of the convolution process is used by the fully connected layer. The class of the image which is based on the features which are extracted in the previous stages is then predicted.

CONVOLUTION LAYER

It is used to extract the various features from the image which is inputted. The mathematical operation of convolution is performed in this layer. It is then filtered to a particular size of MXM. The filter is slid over the input image. The dot product between the filter and parts of the input image is then taken. The size (MXM) is maintained. The dotted output image is called the Feature map. This map gives the information about the image such as the edges and the corners. In order to learn other several features this feature map is then fed to the other layers.

POOLING LAYER

This layer is after the convolutional layer. The main aim of this layer is to reduce the size of the convoluted feature map. This is done to reduce the cost of computation. The reduction of the size of the image is done by decreasing the connections between the layers. It is independently operated on the feature map. There are many types of pooling operations.

Only the largest element is taken from the feature map in Max Pooling. The average of the elements in a predefined size is calculated in Average Pooling. In between the Convoluted Layer and the Fully Connected Layer the Pooling Layer acts as a bridge.

FULLY CONNECTED LAYER

The weights and biases along with the neutrons is consisted in the Fully Connected Layer. The neurons between the two layers is connected. These are the layers which are placed before the output layer. In the CNN Architecture they form the last few layers. In this layer the images which are inputted from the previous layers are flattened and then they are fed into the Fully connected layer. These flattened vectors layers go through a few more Fully Connected layers .It is where the mathematical functions operations are taken place. The classification process begins to take place in this layer.

DROPOUT

Overfitting in the training data set can be caused when all the features are connected to the Fully connected layer. When a particular model works so well on the training data, it causes a negative impact on the performance of the model when it is used on the new data, this in turn is the reason for overfitting. A dropout layer is used in order to overcome this problem. The size of the model is reduced by dropped from the neural network during the process of training. About thirty percentage of the nodes are dropped out randomly from the neural network.

ACTIVATION LAYER

The Activation Layer is the most important parameter of the Convoluted Neural Network model. This is used to learn and to approximate complex and continuous relationships between the variables of the network. This decides to which information should fire in the front direction and which one should not at the end of the network.

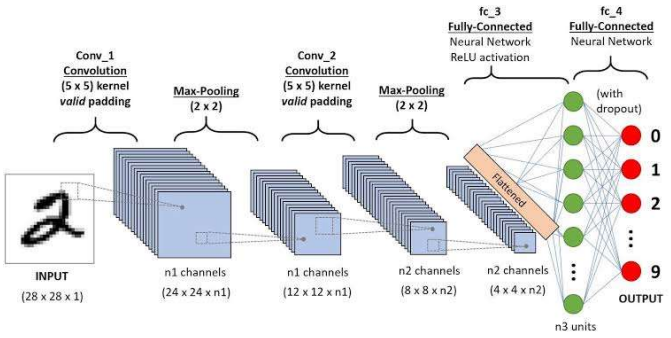

Fig. 6 Different types in CNN

3. Multilayer Perceptron

MLP is a class of artificial neural network which is of the feedforward type. When a set of inputs is given, the MLP generates a set of outputs. This term MLP is used to any kind of Artificial Neural Network. At times it is very much strictly referred to multiple layers of perceptron. The MLPs are also called “vanilla” neural networks. It is mostly called “Vanilla” neural networks when they have only a single hidden layer. The multilayer perceptron (MLP) consists of three layers of nodes namely an input node, an output node and a hidden layer. Every and every node is a neuron, it uses an activation function that is non-linear. The MLP uses a technique which is called

backpropagation. This technique is used for training. It is a supervised learning technique. Multilayer perceptron is distinguished from a linear perceptron by their multiple layers and non-linear activation. It can also differentiate all the data that are non-linearly separable. The approximation of continuous function is done by Multilayer Perceptron with one hidden layer. The MLP can also be used for the process of regression. In the regression prediction problem, the quantity which is real valued is predicted when a set of inputs is given.

4.RESULT

The results found here are angry and happy based on the expression of the people we have used. We have taken a set of images to find out the emotion of the image. The image has been first tracked down into coordinates and using the algorithm we have successfully got the results which are displayed in the images below. The distance between the coordinates are considered to find out how the jaw, the eyebrows, the lips are the vital parts of the image.

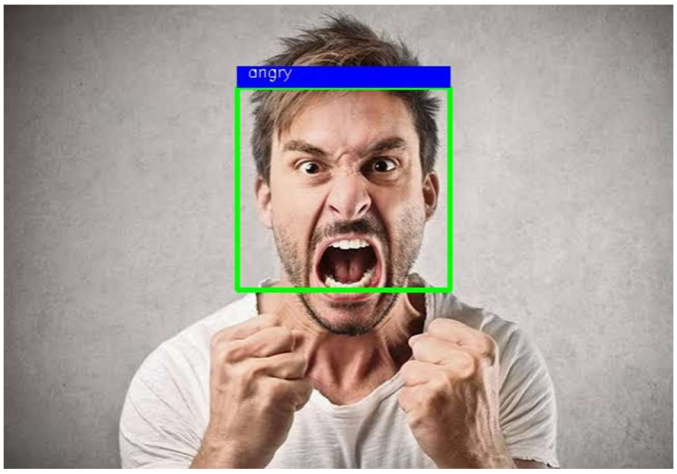

Fig. 7 Finding out the emotion Angry

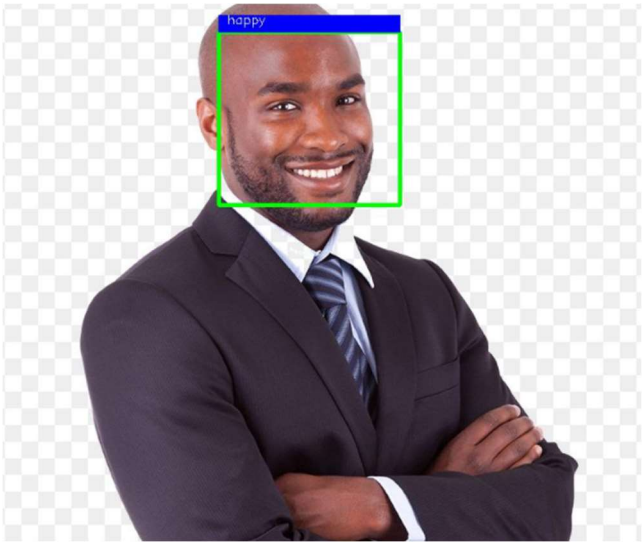

Fig. 8 Finding out the emotion Happy

5.CONCLUSION

The main objective of this paper is to find the emotion of a person automatically. The computer has been trained using machine learning. The algorithms used are KNN,CNN and MLP. These algorithms are very efficient and the output is very accurate. The different emotions detected are anger, sad, happy, disgust and neutral. This is used for many real time applications such as for security purposes, it is used by doctors to find the emotion of a deaf person, it is used by robots to socialize with common people and by people with autism. It can also be used in the field of VFX animations where we are required to capture the emotions of humans and apply it accordingly to the animations we are using in the movies. VFX animations have taken place in the brands like Pixar and Disney. For making movies which are of the genre science fiction VFX plays and important role and the emotion detection can be used. The next usage of this will be in the field of Recruitment, where we are not knowing how the candidate is acting while giving an online exam or the interviewer wants to judge the interviewee's mood at that point of time. Finally, using KNN, CNN and Multilayer Perceptron we arrive at the conclusion that the emotion has been identified accurately and with most precision.

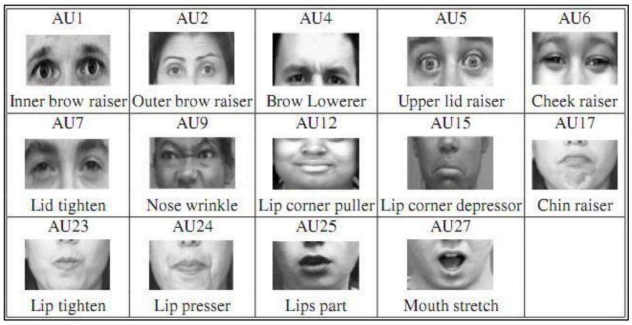

Fig. 9 Different Expressions

REFERENCES

[1] Ahmad Y. Javaid, Dhwani Mehta and Mohammad Faridul Haque Siddiqui, "Recognition of Emotion intensity Using Machine Learning Algorithms: A comparative study", 21st April 2019.

[2] Hossain, Mohammad Shahadat, et al. "A belief rule-based expert system to assess suspicion of the acute coronary syndrome (ACS) under uncertainty." Soft Computing 22.22 (2018): 7571-7586.

[3] Inamura, T. and Nakadai, K. (2019). "The 27th IEEE International Symposium on Robot and Human Interactive Communication (ROMAN 2018)." Journal of the Robotics Society of Japan, 37(1), pp.69-69.

[4] Jalali, Mehrdad, et al. "WebPUM: A Webbased recommendation system to predict user future movements." Expert Systems with Applications 37.9 (2010): 6201-6212.

[5] Grundland, Mark, and N. Dodgson. "Decolorize: fast, contrast-enhancing, colour to grayscale conversion." Color Research and Application 16.6 (2009): 385-393.

[6] Jain, Deepak Kumar, Pourya Shamsolmoali, and Paramjit Sehdev. "Extended deep neural network for facial emotion recognition." Pattern Recognition Letters 120 (2019): 69-74

[7] Pantic, Maja, and Leon J. M. Roth Krantz. "Automatic analysis of facial expressions: The state of the art." IEEE Transactions on pattern analysis and machine intelligence 22.12 (2000): 1424-1445.

[8] Mukherjee, Sohom, et al. "Fingertip detection and tracking for recognition of airwriting in videos." Expert Systems with Applications 136 (2019): 217-229.

[9] Baig, Faisal, Muhammad Fahad Khan, and Saira Beg. "Text writing in the air." Journal of Information Display 14.4 (2013): 137-148.

[10]. Oka, Kenji, Yoichi Sato, and Hideki Koike. "Real-time fingertip tracking and gesture recognition." IEEE Computer graphics and Applications 22.6 (2002): 64-71.

[11] Xu, D., Liu, J., Yang, J., Liu, G., Wang, J., Jenkinson, I. and Ren, J. (2007). Inference and learning methodology of a belief-rule-based expert system for pipeline leak detection. Expert Systems with Applications, 32(1), pp.103-113.

[12] Wu, Yuwen, Hong Liu, and Hongbin Zha. "Modeling facial expression space for recognition." 2005 IEEE/RSJ International Conference on Intelligent Robots and Systems. IEEE, 2005.

[13] Nitisha Raut, “Facial Emotion Recognition Using Machine Learning”, IEEE transactions on pattern analysis and machine intelligence May 2018.

[14] Murugappan M, “Facial geometric feature extraction based emotional expression classification using machine learning algorithms”, May 2018.

[15] Reeshad Khan. Omar Shari, “Emotion Recognition using Various Methods", August 2016.

[16] Rajneesh Singla, “Mood Detection System”, September 2019.

[17] Kalyani Vishwakarma, Prof. Pushpak Bhattacharya, “Multi-label Emotion Detection from Text”, January 2018.

[18] Keerthana S Kumar, Neha S, Nivya, Pooja HC Shekar, Asha VG, “A Survey Paper on Emotion Recognition and Depression Detection using Machine Learning Algorithms”, April 2020.