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Artificial Intelligence and Machine Learning in the Sentiment Recognition Based On Convolution Neural Network Model

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***Abstract*— In this paper, we propose an approach to understand situations in the real world with the sentiment analysis of Twitter data base on deep learning techniques. With the proposed method, it is possible to predict user satisfaction of a product, happiness with some particular environment or destroy situation after disasters. Recently, deep learning is able to solve problems in computer vision or voice recognition, and convolutional neural network (CNN) works good for image analysis and image classification. The biggest reason to adopt CNN in image analysis and classification is due to CNN can extract an area of features from global information, and it is able to consider the relationship among these features. The above solution can achieve a higher accuracy in analysis and classification. For natural language processing, texts data features also can be extracted piece by piece and to consider the relationship among these features, but without the consideration of context or whole sentence, the sentiment might be understood wrong. And currently, CNN is one of the most effective methods to do image classification, CNN has a convolutional layer to extract information by a larger piece of text, so we work for sentiment analysis with CNN, and we design a simple CNN model and test it on benchmark, the result shows that it achieves better accuracy performance in twitter sentiment classification than some of traditional method such as the SVM and Naive Bayes methods.**

Keywords*— *Machine learning, Supervised classification, Sentiment recognition, Convolution neural network (CNN), Accuracy, and Loss.

I. INTRODUCTION

Social media has become a source of varied kind of information, and the new type information could be harvested from social media. As one of the most popular social media, Twitter has at least 100 million active users, furthermore, 572,000 new accounts has been created on a single day (March 12, 2011, the day after the Sendai earthquake and resulting nuclear disaster), while an average of 140 million tweets are sent daily 14. Valuable knowledge is often hidden behind Twitter contents and cannot be easily processed through automation 12. Twitter is an ideal social media for the extraction of general public opinion on specific issues7. Twitter data is useful for sentiment analysis, such as opinion mining or natural language processing10. There are several approaches for sentiment analysis on Twitter, one of them is machine learning. Deep learning models have achieved great results in computer vision6 and speech recognition3 in recent years. To solve NLP (Natural Language Processing) problems, machine learning is also useful by using a general learning algorithm combined with a large sample of data to learn the classification rules. Human behavior analysis from big multimedia data has become a trending research area with applications to varied domains like surveillance, medical, sports, and entertainment. Facial expressions are employed by humans to convey various kinds of meaning in various contexts. The range of meanings spans basic possibly innate socio-emotional concepts like “surprise” to complex and culture specific concepts like “carelessly.” The range of contexts during which humans use facial expressions spans responses to events within the environment to particular linguistic constructions within sign languages. during this mini review we summarize findings on the use and acquisition of facial expressions by signers and present a unified account of the range of facial expressions employed by concerning three dimensions on which facial expressions vary: semantic, compositional, and iconic. Facial expression is one of the non-verbal communication methods between individuals and plays an important role as a communicative source to convey non-verbal cues [1, 2]. These cues can identify the mood/mental state of a private and convey a weighted mean of communication and spoken words. Behavior understanding through

countenance recognition could also be a natural way which performs a crucial role in meaningful conversation and social interaction [3].

Human behavior understanding has many lifestyle applications in various domains like entertainment, security, and healthcare. Researchers have presented various techniques for countenance recognition with considerable accuracy; however, it's still a challenging task to acknowledge countenance for faces captured from different angles and of varied nationalities [4]. Countenance is one of the beneficial sources for analyzing human attitude and behavior. A psychological study proved that features of facial expressions are located around mouth, nose, and eyes which are important for countenance recognition. The face is liable for communicating not only thoughts or ideas, but also emotions.

II. LITERATURE REVIEW

Dataset has taken from Amazon which contains reviews of Camera, Laptops, Mobile phones, tablets, TVs, video surveillance. After preprocessing they applied machine learning algorithms to classify reviews that are positive or negative. This paper concludes that, Machine Learning Techniques gives best results to classify the Products Reviews. Naïve Bayes got accuracy 98.17% and Support Vector machine got accuracy 93.54% for Camera Reviews. Face recognition has become one of the most frequently used topics in many areas, including the use of an alternative to the password in opening some applications and other applications. In this research work

A suggested algorithm was proposed to increase the efficiency of the Elman neural algorithm in face recognition. First step creates dataset of faces, second step convert color space to HSI and using saturation layer, image decomposition using curvelet transform, feature extraction using Principle component analysis, and final step face recognition using Elman neural network. after applying proposed algorithm, the rate of face recognition 94%. Human behavior analysis from big multimedia data has become a trending research area with applications to various domains such as surveillance, medical, sports, and entertainment. Facial expression analysis is one of the most prominent clues to determine the behavior of an individual, however, it is very challenging due to variations in face poses, illuminations, and different facial tones. In this research work

[3] they analyze human behavior using facial expressions by considering some famous TVseries videos. Firstly, they detect faces using Viola-jones algorithm followed by tracking through Kanade-Lucas-Tomasi (KLT) algorithm. Secondly, they use histogram of oriented gradients (HOG) features with support vector machine (SVM) classifier for facial recognition. Next, they recognize facial expressions using the proposed light-weight convolutional neural network (CNN). Various factors such as identity-specific attributes, pose, illumination and expression affect the appearance of face images. Disentangling the identity-specific factors is potentially beneficial for facial expression recognition (FER). Existing image-based FER systems either use hand-crafted or learned features to represent a single face image. In this research work.

[4] they propose a novel FER framework, named identity-disentangled facial expression recognition machine (IDFERM), in which they untangle the identity from a query sample by exploiting its difference from its references (e.g ., its mined or generated frontal and neutral normalized faces). They demonstrate a possible „recognition via generation‟ scheme which consists of a novel hard negative generation (HNG) network and a generalized radial metric learning (RML) network. Student attendance is essential in the learning process.

[5] proposed a web-based student attendance system that uses face recognition. In the proposed system, Convolutional Neural Network (CNN) is used to detect faces in images, deep metric learning is used to produce facial embedding, and K-NN is used to classify student's faces. Thus, the computer can recognize faces. Face plays a major role in social intercourse for conveying identity and feelings of a person. Human beings have not tremendous ability to identify different faces than machines. So, automatic face detection system plays an important role in face recognition, facial expression recognition, head-pose estimation, human–computer interaction etc. Face detection is a computer technology that determines the location and size of a human face in a digital image. Face detection has been a standout amongst topics in the computer vision literature. This research work presents.

[6] a comprehensive survey of various techniques explored for face detection in digital images. Different challenges and applications of face detection are also presented in this paper. At the end, different standard databases for face detection are also given with their features. Human computer interface is the methodology for providing interaction to the computer. For interaction human brain is to be responsible for providing connectivity. Machine learning focuses on computer program that learn from them. In this research work .

[7] they study how the machine learning technique used to provide analytical approach for developing human computer interface. Some of the methodologies used to analyze magnetic resonance images to find the interaction. There are different techniques like K-Nearest Neighbour, Support Vector Machine, and Artificial Neural Network that are used to analyze the human brain images. Facial expression recognition plays an important role in communicating the emotions and intentions of human beings. Facial expression recognition in uncontrolled environment is more difficult as compared to that in controlled environment due to change in occlusion, illumination, and noise. In this research work.

[8], present a new framework for effective facial expression recognition from real-time facial images. Unlike other methods which spend much time by dividing the image into blocks or whole face image, our method extracts the discriminative feature from salient face regions and then combine with texture and orientation features for better representation. As an emerging research topic for proximity service (ProSe), automatic emotion recognition enables the machines to understand the emotional changes

of human beings which can not only facilitate natural, effective, seamless, and advanced human robot interaction or human computer interface but also promote emotional health. Facial expression recognition (FER) is a vital task for emotion recognition. However, significant gap between human and machine exists in FER task. In this research work .

[9], present a conditional generative adversarial network-based approach to alleviate the intra-class variations by individually controlling the facial expressions and learning the generative and discriminative representations simultaneously. Facial expression recognition (FER) is a very challenging problem in computer vision. Although extensive research has been conducted to improve FER performance in recent years, there is still room for improvement. A common goal of FER is to classify a given face image into one of seven emotion categories: angry, disgust, fear, happy, neutral, sad, and surprise. In this research work .

[10] they propose to use a simple multi-layer perceptron (MLP) classifier that determines whether the current classification result is reliable or not. If the current classification result is determined as unreliable, we use the given face image as a query to search for similar images. In particular, facial action units are used to retrieve the images with a similar facial expression. Then, another MLP is trained to predict final emotion category by aggregating classification output vectors of the query image and its retrieved similar images.

A. Problem Statement

Sentiments are caused due to the emotions in human being. But, Expression and Emotion are not same. Emotion is relative in nature, for example expression laugh or smile to the emotion happiness. Expressions on face are not essentially being the outcome of human emotion too. If deliberately manipulated, expressions are just a physiological movement of different face parts, and these parts can be mouth, nose, eyes, eyebrows etc. To map Emotions to Expressions is a difficult area till date hence for now we can concentrate on Expressions only. For interactive human and computer interface (HCI) it is important that the computer understand facial expressions only as it is difficult to capture emotions. Human Face Detection and Facial Expression Identification can make this interaction with more efficiency under computer vision. This type of system can also be used in research in behavioral science and medicine. This work focuses on facial part moments based feature extraction method and identifying sentiments.

III. CHALLENGES IN FACE DETECTION

Challenges in face detection, are the reasons which reduce the accuracy and detection rate of face detection. These challenges are complex background, too many faces in images, odd expressions, illuminations, less resolution, face occlusion, skin color, distance and orientation etc.

- Odd expressions Human face in an image may have odd expressions unlike normal, which is challenge for face detection.
- Face occlusion Face occlusion is hiding face by any object. It may be glasses, scarf, hand, hairs, hats and any other object etc. It also reduces the face detection rate.
- Illuminations lighting effects may not be uniform in the image. Some part of the image may have very high illumination and other may have very low illumination.
- Complex background complex background means a lot of objects presents in the image, which reduces the accuracy and rate of face detection.
- Too many faces in the image it means image contains too many human faces, which is challenge for face detection.

Fig. 1: Various categories of challenges for face detection

IV. PROPOSED MODEL

A. Experimental Setup And Results

The Experimental Setup of proposed work has been implemented on a system having hardware capabilities to work with large dataset and good computational power. Systems with GPU or TPU are good to work with this as hardware requirement with minimum 8 GB random access memory. If program is being tested on system without GPU/TPU it will not be work properly or interrupted in middle without completion. For software requirement on anaconda distribution, Jupiter notebook is required on a static machine and as a background python is code implementation language.

Fig. 2 : Different expression of an image.

B. Neural Network

A Neural Net, a subset of Deep Learning, is a type of algorithm that has become wildly popular over the past couple of years. In addition to its uncanny ability to achieve higher than the formerly state-of-the-art accuracy for many classification tasks, Neural Nets have a critical benefit that‟s immensely helpful in emotion recognition: they do feature engineering automatically.

In a Neural Net, we can input the data we want to use (text, speech, etc.) and the data gets passed through different "layers" of the net. Each layer modifies the input values to try and morph it into something useful and predictive in the model. For our purposes, that means that we can input our data as is and tweak the model to output what we need. Getting even more specific, there are special types of Neutral Nets-called CNNs-that are very effective for the use of images as inputs. These networks further feature engineer the input images and can help achieve greater accuracy in emotion recognition. One of the cutting-edge algorithms in Affective Computing was developed by two professors from The Open University of Israel and uses CNNs.

C. Convolutional Neural Networks

A CNN is a neural network comprised of convolution layers which does computational heavy lifting by performing convolution. Convolution is a mathematical operation on two functions to produce a third function. It is to be noted that the image is not represented as pixels, but as numbers representing the pixel value. In terms of what the computer sees, there will simply just be a matrix of numbers. The convolution operation takes place on these numbers. Here utilize both fully-connected layers as well as convolutional layers. In a fully-connected layer, every node is connected to every other neuron. They are the layers used in standard feed-forward neural networks. Unlike the fully connected layers, convolutional layers are not connected to every neuron. Connections are made across localized regions. A sliding window is moved across the image. The size of this window is known as the kernel or the filter. They help recognize patterns in the data. For each filter, there are two main properties to consider - padding and stride. Stride represents the step of the convolution operation, that is, the number of pixels the window moves across. Padding is the addition of null pixels to increase the size of an image. Null pixels here refer to pixels with value of 0. If we have a 5x5 image and a window with a 3x3 filter, a stride of 1 and no padding, the output of the convolutional layer will be a 3x3 image. Convolution is very effective in image recognition and classification compared to a feed-forward neural network, architecture of convolution neural network is showing in Fig. 3 . This is because convolution allows reducing the number of parameters in a network and taking advantage of spatial locality.

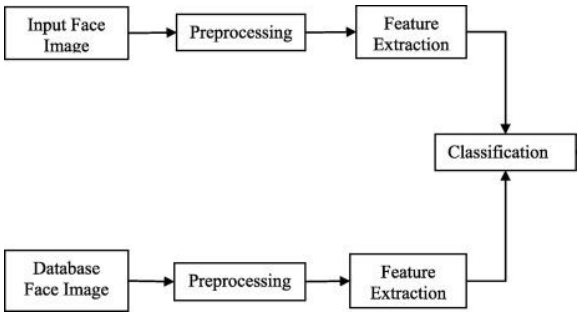

Fig. 3: An architecture of convolution neural network.

V. EXPERIMENTAL RESULT ANALYSIS

For performance testing of the phase-I framework in practical applications, the work has input images that include random images from an online platform and these input fed into the CNN model. These images have been predicted with seven emotions based on pre-trained model of CNN. Experiment has been carried out on kaggle platform on FER 2013 dataset (standard facial image data set available for experiments). The work includes the implementation of CNN model on python with learning library available with python named keras.

Fig. 4: Happy gesture image representation

Fig.5 represent happy gesture/sentiment for recognition in experimental work using convolution neural network model.

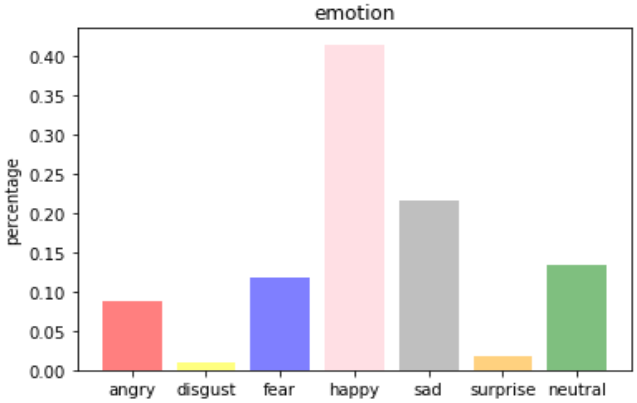

Fig.5: Happy gesture result graph representation.

Fig. 6 represent happy gesture/sentiment result graph with highest percentage for recognition in experimental work using convolution neural network model.

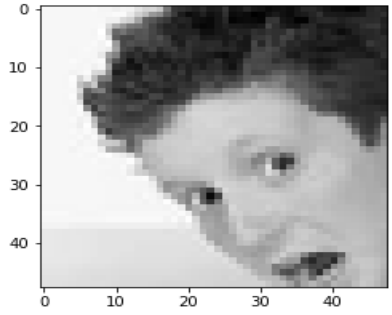

Fig. 6: Happy/surprise gesture image representation.

Fig. 7: represent happy/surprise gesture/sentiment for recognition in experimental work using convolution neural network model.

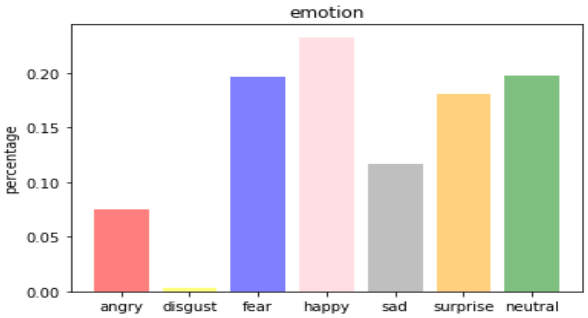

Fig. 7: Happy/surprise gesture result graph representation.

Fig. 8 represent happy/surprise gesture/sentiment result graph with highest percentage for recognition in experimental work using convolution neural network model.

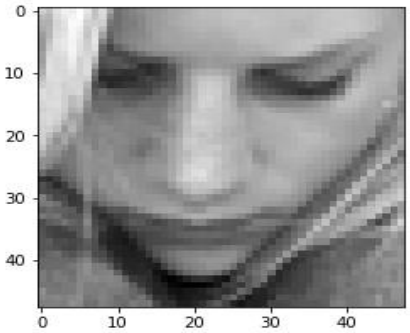

Fig. 8 : Sad gesture image representation.

Fig. 9 represent sad gesture/sentiment for recognition in experimental work using convolution neural network model.

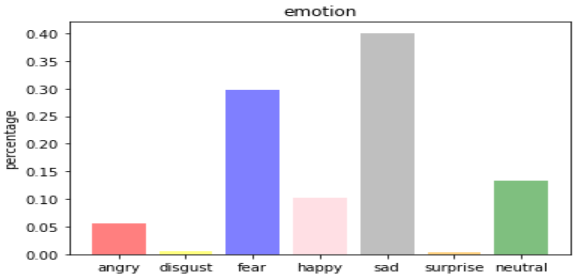

Fig. 9: Sad gesture result graph representation.

Fig. 10, represent sad gesture/sentiment result graph with highest percentage for recognition in experimental work using convolution neural network model.

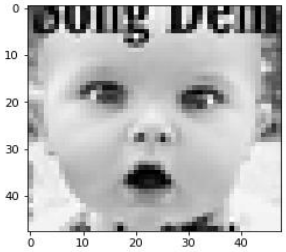

Fig. 10: Surprise gesture image representation.

Fig. 11 represent surprise gesture/sentiment for recognition in experimental work using convolution neural network model.

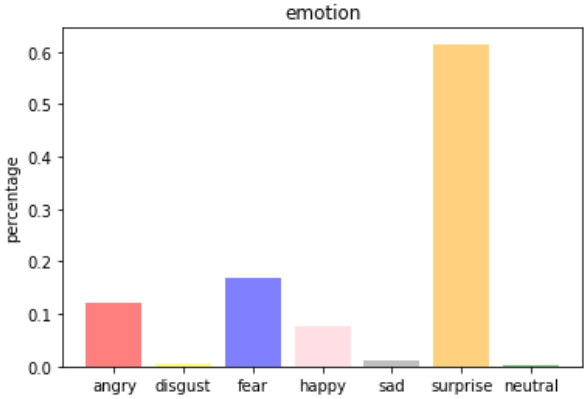

Fig. 11: Surprise gesture result graph representation.

All the faces were recognized and marked by the oblong outlines, and therefore the responding facial expressions were also labeled. Within the experiment of total of 25 faces, 22 marked by accurate, sentiments of the persons within the image. We weren't detected by the outlines precisely; the rationale could also be that the two face images are so incomplete that the features presented are too insufficient to acknowledge. it's worth noting that the probability of happiness is significantly above that of neutral during this figure, while the faces labeled "happy" are but "neutral" as exhibited in Fig.: 4, 6, 8, and 10. The difference is often explained as follows: there could also be features of multiple expressions on a face at an equivalent time; the expression presented on this face is going to be labeled consistent with the foremost likely expression decided by these features, but the general expression of a picture including multiple faces is set by the sum of varied expression features contained in each face.

Table I: Different no. of features and their training and testing dataset.

	Surprise	Fear	Angry	Neutral	Sad	Discussed	Happy
Train	3171	4097	3995	4965	4830	436	7215
Test	831	1024	958	1233	1247	111	1774

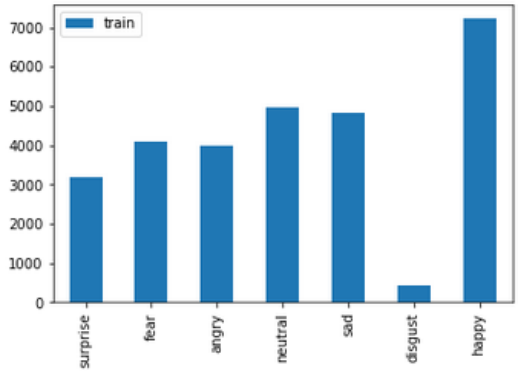

Fig.12: Classification of train datasets distribution.

Fig. 13 represent train data with dataset result graph for respective emotion with different values of each emotion.

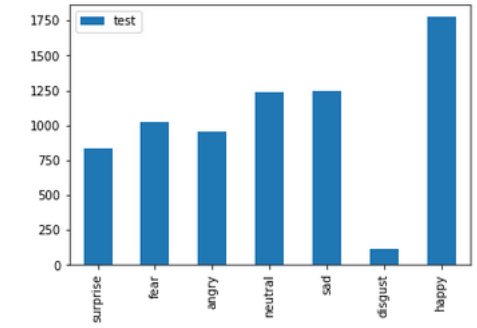

Fig. 13: Classification of test datasets distribution.

Fig. 13 represent test data with dataset result graph for respective emotion with different values of each emotion.

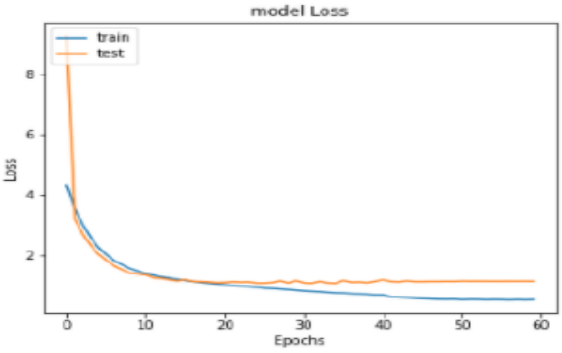

Fig.14: Model loss for train and test dataset.

Fig. 14 represent test data loss with number of epochs for train and test data based on convolution neural network model. Here two axes are defined (x & y), where x axis represent different number of epochs value for the train and test dataset with respective loss value which is mentioned in y axis.

Comparative Result Analysis

Table II: These tables represent comparative study for existing model and proposed model performance parameters evaluation.

Machine Learning Model	Accuracy
Existing Approach	72
Current Approach	86

In this table II current approach gives better results than existing approach, here accuracy is better than existing method. The performance parameters results i.e. accuracy.

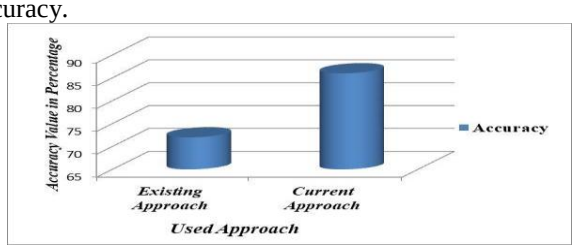

Fig. 14: Comparative study of between existing approach and current approach for performance parameter is accuracy.

VI. CONCLUSION AND FUTURE WORK

Facial Expression Recognition is a computer-based technology that uses mathematical algorithms to analyze faces in images or video. Facial emotion recognition and sentiment analysis by finding the knowledge from facial multimedia is helpful in many scenarios where the human skill effort can minimize at primary level while working with devices monitoring. Emotion recognition may be a method utilized in software that allows a program to "examine" the emotions on a person‟s face by utilizing sophisticated image dispensation. The present work has different sentiment analysis accuracy using convolution neural network for the respective images. At last the movement of facial features and classifies them into emotion or attitude categories, also taking the name of Facial Emotion Recognition, a topic of emotion recognition that involves the analysis of human facial expressions in multimodal forms. After performing experiment and result collection it has been found the proposed work using deep learning CNN model work optimally in related area. The prediction of appropriate region, finding its suitability for detection and report analysis has been completely done using proposed work. Accuracy over face selection help in minimizing the time, as it needs the selected area and working with the provided area features.

- Better face detection algorithm can helps in classifying the accurate sentiment class & expected with high accuracy.
- The proposed algorithm utilizes different part of segment of image and its analysis. Thus the observation of output of each stage provides good results.
- A feature extraction data processing helped in finding the desired feature by providing the input on demand.
- Data Augmentation helped in minimizing loss and improves accuracy of obtained results.
- A proper binaries approach and thresholding step minimized the pre-processing effort and thus saves time of usage.

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