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A NOVEL FACIAL EXPRESSION RECOGNITION SYSTEM TO RATE RESTAURAENT FACILITIES THROUGH DEEP LEARNING

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ABSTRACT: Now-a-days in advance countries automated unmanned restaurants are more popular as this restaurant will not have any human power to take customer feedbacks about food quality and service. The state of mind of a person can be easily understood from the human face. Facial expression recognition technology has been more and more in demand in security, entertainment, education, medical, and other domains as artificial intelligence has advanced. Facial expression recognition (FER) plays a key role in conveying human emotions and feelings. Automated FER systems enable different machines to recognize emotions without the help of humans; this is considered as a very challenging problem in machine learning. Over the years there has been a considerable progress in this field. Face expression recognition technology based on deep learning has become one of the research hotspots. Hence in this work, a novel facial expression recognition system to rate restaurant facilities through deep learning is presented. This work presents a restaurant rating system based on facial expression recognition using pre-trained convolutional neural network (CNN) models for this purpose. It is made up of a Web app, a web server, and a pre-trained AI-server. Food and the environment are both supposed to be rated. The scoring system currently provides three expressions (satisfied, neutral, and disappointed).

KEYWORDS: Facial Recognition, Deep Learning, Convolutional Neural Network (CNN).

I. INTRODUCTION

There are many ways for people to communicate with each other: language, text, action, etc., and expression is also one of the important ways. Emotions are psychological states based on individual thoughts, behaviours and actions. They are mainly conspicuous methods used for conveying purpose and internal feelings.

They can be a verbal or non-verbal representations. Facial Emotion is nonverbal representation and scientists are doing research to discover a new and efficient way to predict facial emotions. Facial expression recognition technology has broad application scenarios in psychological guidance, entertainment, security, online education, and intelligent medical care [1].

Facial emotions and their analysis play a vital role in non-verbal communication. It makes oral communication more efficient and conducive to understanding the concepts. It is also conducive to detecting human attention, such as behavior, mental state, personality, crime tendency, lies, etc. Regardless of gender, nationality, culture and race, most people can recognize facial emotions easily. Emotions can be used for rating customers' impression for the environment in restaurants. However, a challenging task is the automation of facial emotion detection and classification.

Facial expression is one of the most important aspects of biometry; it has been regarded as a fresh and active research field in the last decade due to its importance in translating the emotional state of people. Even though this latter analysis can be done through other features such as: voice, body gestures, social and contextual parameters of the situation among others facial expression remains to

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be the most expressive way through which human beings can display their emotions because it has a high level of directness, friendliness, convenience and robustness [2]. Facial expression recognition is utilized in a variety of applications, including the identification of mental disorders, depression analysis, and health forecasting and criminal detection. The seven universal facial expressions that are recognized in humans are "Happy, Sad, Fear, Anger, Surprise, Disgust, and Neutral."

Automated Facial Expression Recognition (FER) has remained a challenging and interesting problem in computer vision. Despite efforts made in developing various methods for FER, existing approaches lack generalizability when applied to unseen images or those that are captured in wild setting (i.e. the results are not significant). Most of the existing approaches are based on engineered features where the classifier's hyper-parameters are tuned to give best recognition accuracies across a single database, or a small collection of similar databases.

The traditional face expression recognition method is to capture the image and extract the image features first and then use the machine learning method to recognize the image, but this method has certain limitations, the feature extraction process is complicated, and the recognition performance is easily disturbed by the external environment and the face action. In recent years, with the development of deep learning, convolutional neural networks are gradually applied to the image processing field and have high accuracy.

With the rapid development of artificial intelligence, how to achieve the detection and accurate recognition of human face expressions has become a hot research topic in artificial intelligence nowadays. In recent time, several techniques have been devised for automatic facial expression recognition with the help of deep neural networks. Deep neural networks are the subfield of machine learning that involve neural networks for figuring out solutions for the problems dealing with artificial intelligence.

Hence in this work, a novel facial expression recognition system to rate restaurant facilities through deep learning is presented. This work is focused on the classification of aforementioned facial expression with the help of deep learning techniques. The rest of the work is organized as follows: The section II describes the literature survey. The section III presents a novel facial expression recognition system to rate restaurant facilities through deep learning. The section IV evaluates the result analysis of presented approach. Finally the work is concluded in section V.

II. LITERATURE SURVEY

Udaya Dampage, D. A. Egodagamage , A. U. Waidyaratne , D. A. W. Dissanayaka and A. G. N. M. Senarathne et. al., [3] presents Spatial Augmented Reality Based Customer Satisfaction Enhancement and Monitoring System. The customer-satisfaction analytical-model provides environmental knowledge-based dynamic capabilities to the human-centered dining environment. The dishes are being portrayed in three-dimensional (3D) virtual menu also, adding SAR features in a special angle creating a 3D illusion to the naked eye. The performance was analyzed with numerous experimental evaluations with ambient light levels and desired viewing angles, where they found optimal angle values for spatial augmented reality applications. The results revealed 87.5% of responders were very satisfied with the 3D virtual experience. 79.2% indicated rareness of feedback on food and service

and more than 50% liked a system that will automatically measure their satisfaction.

Mohammad Farukh Hashmi, B. Kiran Kumar Ashish, Vivek Sharma, Avinash G. Keskar, Neeraj Dhanraj Bokde, Jin Hee Yoon and Zong Woo Geem et. al., [4] presents LARNet: Real-Time Detection of Facial Micro Expression Using Lossless Attention Residual Network. The aim and motivation of this work is to provide an end-to-end architecture that accurately detects the actual expressions at the micro-scale features. The spatial and temporal information extracted from the face is encoded in LARNet (Lossless Attention Residual Network) for a feature fusion extraction on specific crucial locations, such as nose, cheeks, mouth, and eyes regions. LARNet outperforms the state-of-the-art methods with a slight margin by accurately detecting facial micro expressions in real-time.

W. Wu, Y. Yin, X. Wang, and D. Xu et. al., [5] Face detection with different scales based on faster R-CNN a different scales face detector (DSFD) based on Faster R-CNN. The new network can improve the precision of face detection while performing as real-time a Faster R-CNN. First, an efficient multitask region proposal network (RPN), combined with boosting face detection, is developed to obtain the human face ROI. Setting the ROI as a constraint, an anchor is in-homogeneously produced on the top feature map by the multitask RPN. A human face proposal is extracted through the anchor combined with facial landmarks. Compared to state-of-the-art face detection methods such as UnitBox, HyperFace, FastCNN, the presented DSFD method achieves promising performance on popular benchmarks.

Nianyin Zeng, Hong Zhang, Baoye Song, Weibo Liu, Yurong Li, Abdullah,M. Dobai e et. al., [7] presents Facial expression recognition via learning deep sparse auto encoders. deep sparse auto encoders (DSAE) are established to recognize the facial expressions with high accuracy by learning robust and discriminative features from the data. The experiment results indicate that the presented framework can achieve a high recognition accuracy of 95.79% on the extended Cohn–Kanade (CK+) database for seven facial expressions, which outperforms the other three state-of-the-art methods by as much as 3.17%, 4.09% and 7.41%, respectively.

Ali Mollahosseini, David Chan, Mohammad H. Mahoor et. al., [9] describes Going deeper in facial expression recognition using deep neural networks. This paper presents a deep neural network architecture to address the FER problem across multiple well-known standard face datasets. Specifically, our network consists of two convolutional layers each followed by max pooling and then four Inception layers. The network is a single component architecture that takes registered facial images as the input and classifies them into either of the six basic or the neutral expressions. The results of presented architecture are comparable to or better than the state-of-the-art methods and better than traditional convolutional neural networks in both accuracy and training time.

Junnan Li, Edmund Y. Lam et. al., [10] presents Facial expression recognition using deep neural networks. They present a technique using deep neural network for human facial expression recognition. Images of human faces are pre-processed with photometric normalization and histogram manipulation to remove illumination variance. Facial features are

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then extracted by convolving each pre-processed image with 40 Gabor filters. Kernel PCA is applied to features before feeding them into the deep neural network that consists of 1 input layer, 2 hidden layers and a softmax classifier. They construct confusion matrix to evaluate the performance of the deep network. It is demonstrated that the network generalizes to new images fairly successfully with an average recognition rate of 96.8% for six emotions and 91.7% for seven emotions.

Yadan Lv, Zhiyong Feng, Chao Xu et. al., [11] presents Facial expression recognition via deep learning. This paper mainly studies facial expression recognition with the components by face parsing (FP). The face parsing detectors are trained via deep belief network and tuned by logistic regression. The detectors first detect face, and then detect nose, eyes and mouth hierarchically. A deep architecture pre-trained with stacked auto-encoder is applied to facial expression recognition with the concentrated features of detected components. The parsing components remove the redundant information in expression recognition, and images don't need to be aligned or any other artificial treatment. Experimental results on the Japanese Female Facial Expression database and extended Cohn-Kanade dataset outperform other methods and show the effectiveness and robustness of this algorithm.

III. A NOVEL FACIAL EXPRESSION RECOGNITION SYSTEM

In this section, a novel facial expression recognition system to rate restaurant facilities through deep learning is presented. The block diagram of presented system is shown in fig. 1. This system is based on facial expression detection using pre-trained convolutional neural network (CNN) models and can be used in unmanned restaurants. It enables the customer to rate the food by taking or capturing a picture of his face that reflects his emotions. There is much less information and no individual experience reports collected when compared to a text-based rating system. However, this simple, quick, and enjoyable rating system should provide a broader range of perspectives on the experiences of the customers with the restaurant concept.

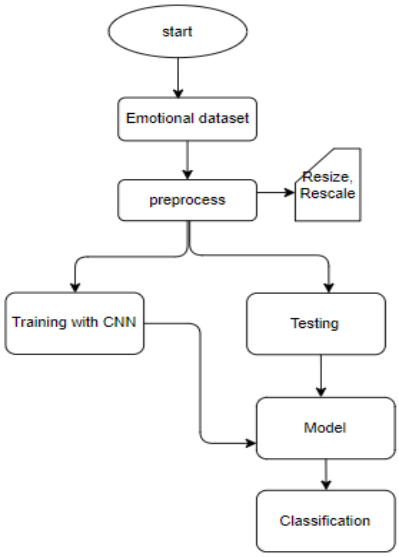

Fig. 1: Block Diagram of Novel Facial Expression Recognition System

Emotion dataset fro kaggle is collected. This dataset is a Collection of documents and its emotions and it helps greatly in NLP Classification tasks. Emotion is a dataset of English Twitter messages with six basic emotions: anger, fear, joy, love, sadness, and surprise. List of documents with emotion flag, Dataset is split into train, test & validation for building the CNN model.

Data preprocessing is a crucial data mining step in machine and deep learning, where meaningful features of the raw data are extracted to be efficiently trained to obtain accurate results. In this step, the raw input image data are transformed into relevant floating-point tensors for feeding into the final classification convolutional neural network model. It is essential to get good

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accuracy. Tensors are considered multidimensional arrays, which are used for data storage. It is challenging to predict the best data preprocessing steps when training a convolutional neural network model. Initially, the raw images are not ready for training, as they are in different shapes, sizes, and angles. The scaling of the pixel values is performed, and augmentation techniques are applied during both the training and evaluation of the model.

Convolutional Neural Network: A convolutional neural network (CNN) is a multi-layered deep artificial neural network that can detect and analyze visual patterns from the input image with minimal preprocessing compared to other image classification algorithms. CNN is a powerful visual image analyzing technique, which consists of hidden convolutional layers and filters. In this work, the CNN technique is used for facial expressions classification.

Convolutional neural networks have several layers: a convolutional layer, a pooling layer, a rectified linear unit layer, a fully connected layer, and a loss layer. The convolutional layer is the core component of the convolutional neural network algorithm. The number of layers in the convolutional layer may be adjusted according to the technique and the real requirements, and each layer can extract features from the input picture using different methods.
Under nonlinear situations, the pooling layer samples the input data.

Max Pooling: Max pooling layer selects the maximum value from the matrix of a specified size. This layer extract features with significant importance or which are highlighted in the image. It also reduces the pixels and the image dimensionality from the preceding convolutional layer. Maximum pooling layer and average pooling layer are the two most popular forms of pooling layers. The maximum pooling layer can be used in the final display of the image.

Rectified Linear Unit: The rectified linear unit (ReLU) is a special type of activation function in a neural network, which introduces non-linearity and overcomes the vanishing gradient effect. The ReLU works like a filter, ignores the negative signals, and passes the positive signals. It introduces fast learning and better performance of the total system. Rectified linear layers are usually applied after each convolutional layer. When dealing with nonlinear features such as hyperbolic tangent and S-shaped functions, rectified linear layers use a variety of basic operations to solve the problem of gradient disappearance and gradient explosion, transforming nonlinear problems into linear ones and improving the accuracy rate. The last part of the convolutional neural network is the fully connected layer, which is responsible for processing the final output of the whole neural network. Finally the CNN model classifies different emotions through customer face expression recognition as happy, satisfied and disappointed.

IV. RESULT ANALYSIS

In this section, a novel facial expression recognition system to rate restaurant facilities through deep learning is implemented. A web page is created and is shown in Fig. 2.

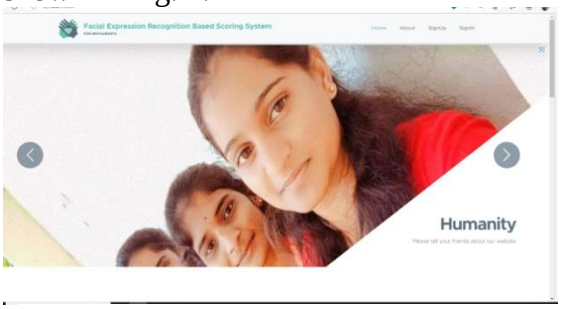

Fig. 2: Home Page

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The Fig. 2 shows the description of page.

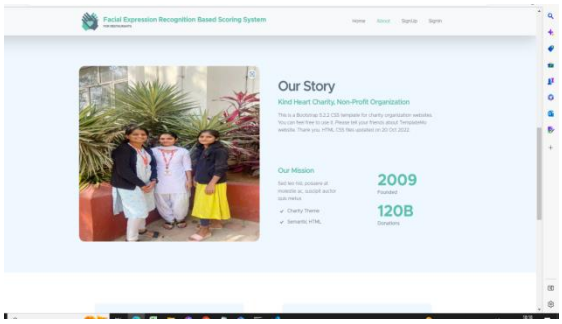

Fig. 3: About Page

The Fig. 4 shows the login and registration phase.

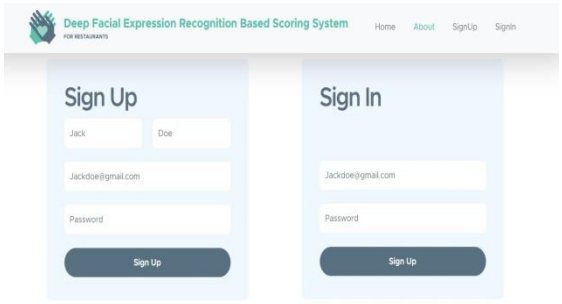

Fig. 4: Log-in and Registration Phase

The Fig. 5 shows the home page of user.

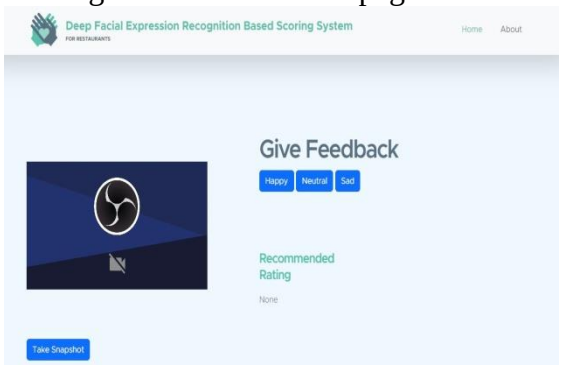

Fig. 5: Home Page of user

This approach classifies the emotions as sad, happy, anger, surprise, etc. The Fig. 5 shows the accuracy comparative graph.

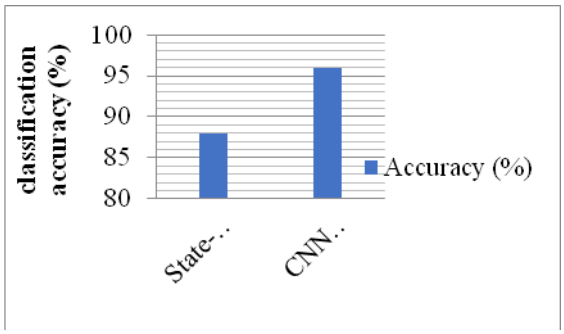

Fig. 6: Accuracy Comparative Graph

Compared to state-of art algorithms, presented CNN algorithm has high facial emotion classification accuracy.

V. CONCLUSION

Facial expression emotion identification is a fascinating area of the study that has been applied in a variety of contexts, including safety, health, and human-machine interfaces. Researchers in this area are working to improve computer predictions by developing ways for interpreting, coding, and extracting facial expressions. Because of deep learning's exceptional success, several sorts of architectures are being used to improve performance. Hence in this work, A novel facial expression recognition system to rate restaurant facilities through deep learning is presented. Emotion dataset from kaggle is used here. The data collected from emotion dataset is preprocessed. The preprocessed data is divided as training and testing data to train and test the CNN model. The CNN algorithm classifies the facial expressions as happy, sad or angry. In addition this approach creates a web page for users to share their experience and feedback. The performance of presented approach is validated in terms of accuracy. Compared to state-of art approaches, presented approach has better accuracy. Facial expressions are classified for restaurant scoring and categories them as happy, satisfied, or disappointed.

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