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Sentiment Analysis-EmotionRecognition

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Abstract: One of the key elements of emotional computing in human-computer interaction is voice communication. The aim of this research is to build and create a speech-based emotion reaction (SER) prediction system in which various emotions are identified using CNN classifiers. Mel-frequency cepstral (MFCC) is an extracted spectral characteristic. The suggested method is developed using the Librosa module in Python, and its effectiveness is evaluated using samples from the Database of Emotional Speech and Song (RAVDESS), which allows users to distinguish between emotions including happiness, surprise, anger, neutrality, sadness, fear, etc. To find the most important feature subset, feature selection (FS) was used. Results indicate that utilizing CNN gives good performance

Keywords*: *Machine Learning, Speech Recognition, CNN, Deep Learning, Feature extraction, MLP

1. INTRODUCTION

The structure anatomy of the human brain has served as a constant source of inspiration for artificial intelligence research. Understanding a language, processing spoken words, and recognizing faces are just a few examples of how the human brain is remarkably capable of picking up complex concepts. The primary goal of AI is to create machines with intelligence that can think clearly and act in ways that are comparable to human ability and reasoning. In daily events, emotions are a major component. The systems must be capable to figure out the emotions expressed in speech in order to communicate with people effectively. Different means of showing human emotions are there but Speaking is a very important tool for conveying emotions, along with body language, voice, and facial expressions. The Maximum Likelihood Principle (MLP), Support Vector Machine (SVM), and Convolution Neural Network (CNN) are three of the most often used linear classifiers for recognizing emotions. The Maximum Likelihood Principle (MLP), Support Vector Machine (SVM), and Convolution Neural Network (CNN) are three of the most often used linear classifiers for recognizing emotions

2. Literature review:

2.1 From a research paper Speech to Text Conversion and Sentimental Analysis on Speaker Specific Data [1]:

The research presented in this work presents a general system that analyzes the message of user-provided audio by automatically converting the voice into text. The text also has a focus for a sentiment analysis model, where the words are coded and it show the opposites and nature of speech in coordination. The model executes speech recognition well with live generated audio inputs, but researchers are trying to collect artificial datasets that are larger in size to increase the efficiency. The system they develop has certain disadvantages, like that it can only handle one audio input at once and is unable to process speech from two or more speakers simultaneously, as well as if the voice is indistinct. However, their model does a good job of accurately translating user-inputted speech into text.

2.2 From the research paper Speech Emotion Recognition Methods [2]:

In the present research paper, various speeches-based emotional recognition systems-based ways are presented and discussed. Similarly, the outcome had been compared in terms of classifier, features, recognition rate, and datasets. Good accuracy in classification between various kinds of emotions had been achieved by efficient classifiers. In this research, it was discovered that HMM, when used with short-term LFPC as a feature, showed good accuracy on the various levels in the graph. In order to achieve the efficiency in identification rate, this researcher designed their own feature similar to MLS. Most of the available datasets cannot be used to evaluate speech emotion recognition. Many of the time, it is difficult for human beings to differentiate between various feelings in specific collected spoken words. In my conclusion, few studies have looked into using several classifiers to recognize speech emotions. Multiple classifier methods (MCM) need to be explored as a possible future research direction.

2.3 From research paper Sentiment Analysis on Speaker Specific Speech Data [3]:

This paper provides an expanded version that uses an audio file containing spoken words among two people as input and examines the content and identity of the speakers by automatically translating the audio to text and performing speaker recognition. In this study, they presented a simple system to perform the previous task. The approach works well with the artificially generated dataset; we are currently working on gathering a larger dataset and boosting the system's scalability. The system has some limitations. At the moment, it can only handle conversations between two speakers, and only one speaker should speak at a time. It is unable to comprehend conversations in which two people are speaking at once.

2.4 From research paper Speech Recognition using Deep Learning Techniques [4]:

This research paper offered an in-depth analysis of methods for deep learning for SER (Speech Emotion Recognition). Deep learning methods such as DBM (Deep Boltzmann Machine), RNN (Recurrent Neural Network), DBN (Deep Belief Network), CNN (Convolution Neural Network), and AE (Auto Encoders) have received a lot of interest in recent times. The classification of multiple natural emotions such as joy, satisfaction, sadness, shock, dullness, hatred, fear, and anger is used to briefly explain these deep learning approaches and their layer-wise patterns. These techniques provide simple model training along with accuracy. Deep learning approaches include limitations such as their huge layer-wise internal layout, lower efficiency for temporally variable input data, and over-learning

during layer-wise information storage. This research study provides the basis for analyzing the performance and limitations of existing deep learning methods.

2.5 From research paper Sentiment Analysis and Emotion Recognition from Speech using Universal Speech Recognition [5]:

Understanding emotion and speech can be difficult task in human language. In this research paper, they have accessed sentiment analysis and emotion recognition from speech using self-supervised learning models. They use universal speech representation with speaker aware pre-trained model. Three different models were used for training 3 sentiment tasks. According to their re-evaluation they got best results with 2 classes, based on both weighted and unweighted accuracy.

3. System's architecture/design

System design in order to reduce noise and improve the precision of learned models, we first give an input wav file, after which we execute feature extraction.

By eliminating redundant data, this step in the general framework decreases the size of the data. enhances training and inference speed naturally. By combining existing features with new ones, it also helps to reduce the number of features in a dataset. After that, we train the model with the Convolution Neural Network Algorithm using a variety of emotions, such as happiness, sadness, anger, disgust, neutrality, fear, and surprise. This input then helps predict emotions

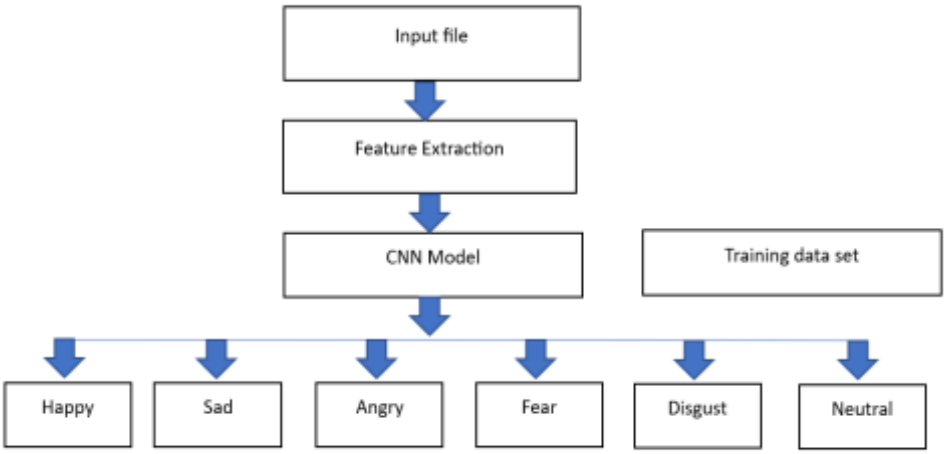

Figure-1- Data Flow Diagram

4. Methodology

A. Dataset: From kaggle.

B. Training and testing model

The system receives training data that includes the expression label, and weight training is also provided for that network of neurons. An audio file is used as an input. Following that, the audio is subjected to intensity normalisation. To train the Convolutional Network, normalised audio is used. This ensures that the impact of the presentation sequence of the examples has no effect on training performance. As a result of this training process, weight

collections emerge, and it achieves the best results with this learning data.

During testing, the dataset provides the system with pitch and energy, and the identified emotion is determined based on the final network weights trained. The result is expressed numerically along with the type of emotion.

Feature extraction is a dimensionality reduction procedure that reduces an initial collection of raw data into more feasible categories for processing. The enormous number of variables in these large data sets requires a large number of computational resources to process.
The Mel scale (MFCC) is a scale that compares the assumed frequency of a tone to the measured frequency. It scales the frequency to fit what the human ear can hear more closely (humans are better at noticing minor changes in speech at lower frequencies). The perceived gap between these two noises may appear to be bigger than the prior two, despite the fact that the actual variation is the same.

C. Training model for accuracy calculation

In this module, we train the model to estimate accuracy. Import the relevant modules first, followed by the dataset. Using the librosa packages and the mfcc function, we will obtain the sampling rate value. This value then holds other variables. Now that audio files and mfcc values have a variable, it will add a list. Then zip the list while holding two variables, x and y. Then we used the numpy package to express (x,y shape value). CNN – Implementation Speech is represented as a picture with three layers. Consider the first and second derivatives of the speech image with time and frequency while using CNN. CNN can forecast, analyze speech data, learn from talks, and recognize words or utterances.

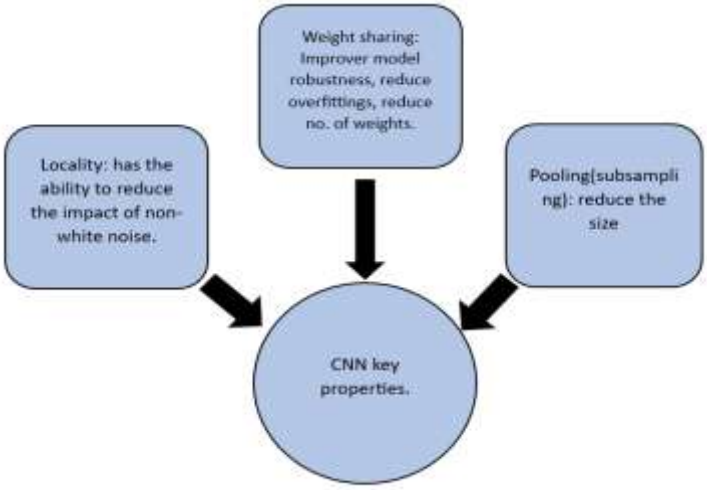

Figure-2- Key Properties of Convolutional Neural Network.

TABLE-1 Features of Convolutional Network Layers

Convolution Layer	**Pooling Layer**	**Full connected Layers**
Filters are included to find feature of an image.	Reduce dimensionality	Aggregate information from final feature.

The filters consist of small kernels (number of kernels)	Maximum or average area is extracted	General final classification
One BIAS per filters		
For every value feature map must apply activation function	Sliding window approach	Parameters full connected (number of nodes, activation function; usually changes depending on role of layers. RELU used for aggregating information, and SOFTMAX for producing final multi-classification)
Parameters of CONV layers (size of kernels, activation function, stride, padding and regularization type and value)	Parameters of pooling (stride and size of window).	

5. Conclusion

This research paper has presented a deep learning-based approach for speech-based emotion detection, the proposed system uses a combination of feature extraction techniques and deep neural networks, which enables it to learn discriminative features from speech signals and model the complex relationships between input features and emotions. This research paper includes the analysis and study of development of a deep learning-based architecture for speech-based emotion detection, the use of a large and diverse dataset for training and testing, and the exploration of different features and techniques The proposed system has potential applications in various fields such as healthcare, education, entertainment, and customer service.

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