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STRESS RECOGNITION USING EEG SIGNALS USING MACHINE LEARNING

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ABSTRACT:

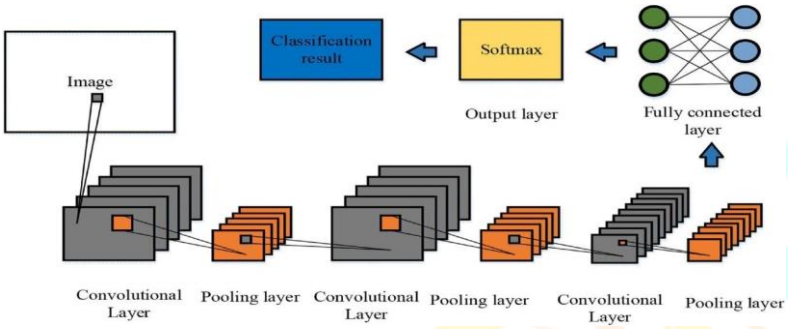
Firstly the stress detection using electroencephalogram(EEG) signals have become ab important area of research in the field of affective computing.EEG signals are non-invasive and can provide valuable information about the emotional and cognitive states of individuals. we adopt the three basic emotions that are: high stress,medium stress and low stress.This experience has allowed us to acquire EEG signals and to create an emotional datasets.For this we have used recored brain waves image and also chosen the CNN techniques to classify the image and to analyze the results.

1. INTRODUCTION:

In our daily activities such as thought function,conversation and decision making ,emotions play a significant part.Its also really important for human machine interaction. Recognition of emotions has gained considerable interest from various study groups, documenting the mental condition of the individual, such as facial gestures, speech and body language, both of which are new forms of identifying human emotions. And using combination of deep learning and machine learning algorithms it is really helpful in identifying human emotions accurately and there are many techniques such as using humans voice based emotion recognition ,facial expression and using new technique called EEG signal. So by this method taking the recored brain waves from humans is the new way of finding emotion classification.Electroencephalograph (EEG), is the brain exploration method that uses electrodes mounted on the scalp for brain electrical activity monitoring,often shown in the form of a line called electroencephalogram.Brain wave signals can be recorded by these electrodes and it can be Delta waves that are between 0.5Hz and 4Hz and they refer to deep sleep,and Theta waves that are between 4Hz and 7Hz and they refer to light deep meditative state and hypnosis,Alpha waves that are between 7Hz and 13Hz and they refer to relaxed alertness and light meditative state, Beta waves that are between 13Hz and 30Hz and they refer to active and vigilant state and finally,Gamma waves that are between 30Hz and 100Hz and they refer to intense neuronal activity and hyper vigilance.In this paper we are presenting how the CNN model has been performed in predicting

emotions especially using electroencephalograph signal brain waves and how much accuracy it has given .And most important thing here is any algorithm or model depends on the dataset and based on the how much dataset we are collecting, it gives better model performance

Figure 1- CNN Architecture



2. PROPOSED SYSTEM:

In this project we are using CNN model for prediction of classification using machine learning we are using EEG emotional images dataset which is collected trained data using CNN model and model is saved.And this project is web application based work using html,css and javascript as a front end languages.For user friendly detection web application flask is designed where user can upload signal image using flask framework check classification type as high stress,medium stress and low stress and it provides preventive measures based on the classification of emotion .

3. WORKING OF ALGORITHM

3.1 Deep Learning (DL)

Deep learning is a subset of machine learning algorithms that uses the CNN extended version of artificial neural network to analyze the data. It has been applied to many areas of research,including the analysis of eeg signals for emotion detection,speech recognition,voice based detection tasks.

In the context of stress detection using eeg signals, deep learning algorithms have been used to automatically learn the useful features from the raw eeg signals data,without the need for human work procedure

3.2 Convolutional Neural Network (CNN)

Convolutional neural network is one of the DL algorithms used for learning feature in stress recognition ,it functions well in recognizing emotion, the CNN model is built , simplified in Keras , and it makes CNN layers available. To train the model many preprocessing techniques are involved such as feature extraction , artifact removal ,normalization and fine tuning .We have taken 15 input datasets to train and test the model and accuracy depends on the how much features of dataset we took .

Now explanation of CNN architecture :-

We are taking input image as the brain waves here.

In the CNN , every image is represented in the form of arrays of pixel values.

There are convolutional layer,pooling layer and fully connected layer as shown in figure 1 .So here these layers are feature extraction methods and last one is output layer i.e fully connected layer.

Convolutional layer is main building block of CNN to extract features from the raw image data and this layer uses a matrix filters , so sliding the filter matrix over the image and computing dot product to detect patterns in the image.

And next is pooling layer , here it's main purpose is reducing the dimensionality of feature maps so the feature maps are type of array of numerical values and these are output from the convolutional layer. By reducing the dimensionality of the feature maps, pooling layer can be used to avoid overfitting in the model.

Repeatedly apply these layers to get accurate features and transmit to final layer of the CNN.

Next is fully connected layers these are used at the end of the CNN and these layers take the output of convolutional and pooling layers and apply a set weights to produce the final output.

Using ReLu like activation function can help improve performance of the model and to learn more complex features from the EEG signals.

Softmax is also a activation function in the output layer and is used for classification in the final output layer.

3.3 ReLu

In stress recognition ,the Rectified Linear Unit (ReLu) layer is a commonly used activation function in deep learning models, including convolutional neural network.The ReLu activation function sets all negative input values to zero and keeps all positive values unchanged.The ReLu layer is typically used after the convolutional layers in a CNN as it helps to introduce non linearity to the feature maps produced by the convolutional layers.

$$f(x) = \max(0,x)$$

and we can use the cross entropy

$$E(X) = -\sum P(X)\log P(X)$$

3.4 Batch Normalization

Batch normalization is a technique used in deep learning models to improve the performance of stability of extended version of artificial neural networks. It is particularly useful in the context of emotion detection using eeg recorded brain wave signals where deep learning models can be more complex and difficult to train the process.

In neural networks,each layer applies a linear transformation to the input data,followed by non linear activation function.However,the distribution of the input image data can change as it passes through the layers,leading to the phenomenon of internal covariant shift.And especially it is for improving the performance of the whole algorithm model and dropout techniques were used in identifying the best image features.

3.5 Implementation steps

1. First,the user uploads an image of their recorded eeg brain waves through the Flask web application.
2. The Flask web application receives the image and sends it to the **'model_predict'** function.
3. The **'model _predict'** function loads a pre-trained CNN model from a file using the **'load_model'** function from Keras.
4. The loaded model takes the input image and processes it through a series of convolution and pooling layers which learn different features from the image.These features can be thought of as patterns in the image that are important for predicting the stress level.
5. The output of the convolutional and pooling layers is then fed into a fully connected neural network,which learns to classify the input image into one of the three stress levels.
6. The **'model_predict'** function then uses the loaded CNN model to predict the stress level of the input image.It returns the predicted

stress level as well as the name of the HTML template file that corresponds to the predicted stress level.

7. Finally, the Flask web application renders the HTML template file and displays the predicted stress level to the user.

CONCLUSION

In this work,we proposed batch normalization ,dropout techniques and 2D-CNN on the basis of CNN model and it is for improving the performance of stress prediction of the human physiological signals of EEG brain waves and we found better accuracy using CNN algorithm and mainly the convolutional,pooling and fully connected layers plays a crucial role in extracting useful features from EEG brain waves input image data and at last for classification of the result we have used softmax activation function in the fully connected output layer and we got to know that CNN algorithm is best suited for classification tasks or problems and the accuracy we got 91% for CNN .In future work ,we can use deeper networks and multiple networks to improve recognition rate.Besides,feature level fusion and feature selection are also effective methods.

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