



Recognition of Emotional State Based on Handwriting Analysis

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Abstract: Emotions describe the physiological states of an individual and are generated subconsciously. They motivate, organize, and guide perception, thought, and action. Emotions can be positive or negative. Negative emotions manifest in the form of depression, anxiety and stress. It is necessary to identify negative emotions of an individual who might be in the need for counselling or psychological treatment. Body signal analysis, handwriting analysis, and psychological assessment are some mechanisms to measure them. It's a key factor for every individual to keep his mental health well. Among the various reasons for causing illness, some of them can be lot of tension, stress and depression. It is important to know if a person is suffering from depression or stress, which are negative emotions. The positive emotions are joy, happiness, excitement etc. while negative emotions are sadness, anger, disgust, fear, depression, anxiety and stress.

I. INTRODUCTION

Machine learning (ML) is the scientific study of algorithms and statistical models that computer systems use to effectively perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering, and computer vision, where it is infeasible to develop an algorithm of specific instructions for performing the task. Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a field of study within machine learning, and focuses on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics.

Handwriting analysis helps in identifying these emotions through machine learning. Approaches such as random forests, neural networks, Bayesian networks, k-NN and SVM are implemented for recognition of emotional state. Emotions can also be predicted through psychological analysis and graphology. Depression is a feeling of sadness, anger, loss of interest, and feeling low from time to time, which affects day to day activities like behavior, sleep, appetite and social life. CNN is used to extract the features from handwritten text sample. Convolutional Neural Network (CNN) is a popular technique used for image recognition.

II. PROBLEM STATEMENT

Lack of user-friendly methods for psychological analysis and psychiatrists are expensive. Algorithms has been proven less effective in terms of accuracy and precision.

III. OBJECTIVE

Analysis of human psychology and mental health status by analysis of their handwriting through image of the individual handwriting.

IV. EXISTING SYSTEM

The combination of psychological assessment and handwriting analysis is executed. Dataset is created in which handwriting and drawing are related to emotional state. The handwriting and drawing samples are taken from 129 users, who attempted the DASS questionnaire. The emotional states, like anxiety, depression, and stress, are evaluated by the DASS test. Random forest classifier is used for feature extraction. They have used cross-validation experiments to obtain the different evaluation measures including accuracy. Anxiety and Stress are recognized more accurately than depression. It is stated that through handwriting analysis various characteristics in personality can be detected. Controlling the



emotions is one of them. It is helpful for the counsellors to identify the emotions of their counselee. For feature extraction from handwriting, they have used the fuzzy technique. The level of emotion is identified using baseline or slope of the handwriting with the help of Mamdani inference.

Disadvantages

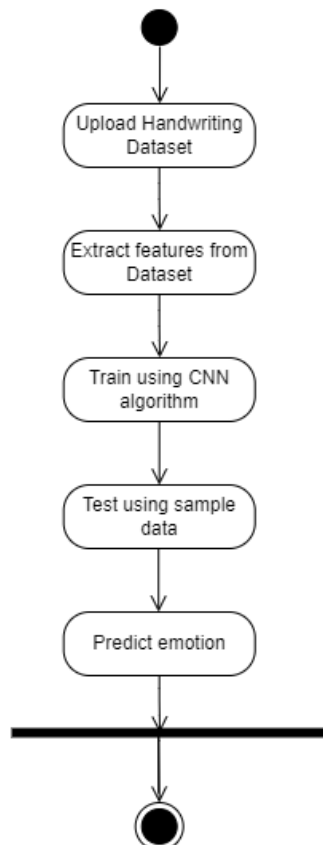
fuzzy logic is based on degrees of truth which can be suitable for engineering for decisions without clear certainties and uncertainties, or with imprecise data such as with natural language processing technologies but handwritten analysis required much more understanding of the hidden layers to give precise and accurate results

V. PROPOSED SYSTEM

Emotion recognition using handwritten text sample. The system is trained from the classified image dataset which are classified from psychological experts. The classified image dataset is used to train the CNN with 14 layers to identify the essential features from the image and recognize the state of a person emotion which eliminates the need for the users to assess the additional questionnaire. The CNN model is then further used to create the model. This model is used for the front end web application used for GUI with the help of flask module.

VI. METHODOLOGY

The CNN algorithm is used to achieve the same and cross validated. The Cross Validation is a technique for evaluating machine learning models by training on subsets of dataset and evaluating on complementary subsets of dataset. In this CNN model, k-fold cross-validation divides the dataset into k parts of equal size, one part is kept for validation and remaining parts are used for training.



CONVOLUTIONAL LAYER

It always comes first. It receives the image (a matrix of pixel values). Assume that the input matrix's reaction starts at the top left of the image. The software then chooses the smaller matrix there, which is referred to as a filter. The filter then generates convolution that moves over the input image. The filter's job is to multiply the original pixel values by its value. All of these multiplications are added together, yielding a single number. The filter moves because it only reads the image in the upper left corner. Additionally, one unit on the right performs a similar operation. A matrix is created after passing



the filter through all points, however it is less than the input matrix. From a human standpoint, this operation is comparable to distinguishing visual boundaries and simple colors. However, in order to recognize the fish, the entire network is required. Several convolution layers will be blended with nonlinear and pooling layers in the network. The first layer to extract features from an input image is convolution. Small squares of input data are used in convolution. It's a mathematical procedure with two inputs: an image matrix and a filter or kernel.

- ✓ Dimension of an image matrix (h x w x d)
- ✓ A filter (fh x fw x d)
- ✓ Outputs a dimension (h-fh+1) x(w-fw+1) x1

Consider a 5 x 5 whose image pixel values are 0, 1 and filter matrix 3 x 3 as shown in below

Convolution with a filter example

Then the convolution of 5 x 5 image matrix multiplies with 3 x 3 filter matrix which is called "Feature Map" as output shown in below

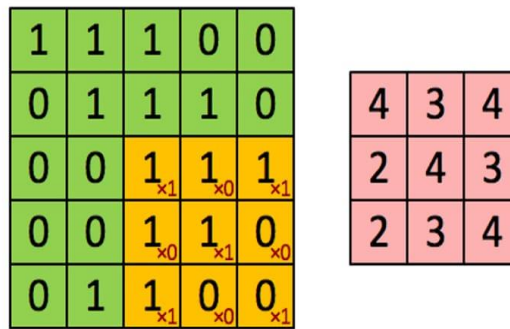


Fig 2:- Output of Convolution Layer

THE NON-LINEAR LAYER:

After each convolution process, it is adder. It features an activation function that provides a nonlinear property; without this trait, a network would be insufficiently intense and unable to simulate the response variable.

THE POOLING LAYER:

It moves in the same direction as the nonlinear layer. It works with the image's width and height, performing a down sampling procedure on them. As a result, the size of the image is lowered. This means that if some features were already recognized during the previous convolution operation, a detailed image is no longer required for further processing and is reduced into smaller images.

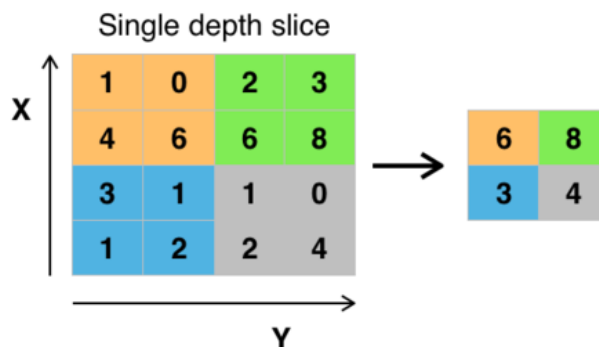


Fig 3:- Max Pooling Layer



FULLY CONNECTED LAYER:

It's primary to link an overall linked layer after completing the succession of convolution, non-linear, and pooling layers. This layer receives the convolution network's output data. When a completely connected, layer is attached to the network's end, it produces an N-dimensional vector, where N_i is the number of classes from which the model chooses the needed class.

CNN MODEL

- The TensorFlow framework and the OpenCV library were used to create this CNN model, which is widely utilized in real-time applications.
- This concept can also be used to create a full-fledged software that scans everyone entering a public meeting.

LAYERS IN CNN MODEL

1. Conv2D Layer
2. MaxPooling2D Layer
3. Flatten () Layer
4. Dropout Layer
5. Dense Layer

1. Convo2D Layer:

It has 100 filters and the activation function used is the 'ReLU'. The ReLu function stands for Rectified Linear Unit which will output the input directly if it is positive, otherwise it will output zero.

2. MaxPooling2D:

It is used with pool size or filter size of 2*2.

3. Flatten () Layer:

It is used to flatten all the layers into a single 1D layer.

4. Dropout Layer:

It is used to prevent the model from overfitting.

5. Dense Layer:

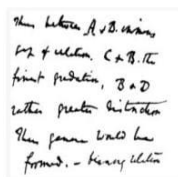
The activation function here is SoftMax which will output a vector with two probability distribution values.

VII.RESULT

We Have Used Classified Image Dataset and applied CNN Algorithm. 80% of the total data was used for training and 20% was used for testing and checking the model performance. The Best Results are displayed.

Upload Handwriting Image (.png,.jpg,.jpeg)

Upload a Valid Handwriting Image



Predicted Status is: Depression



VIII. CONCLUSION

The handwriting of a person can be considered an important factor for the determination of mental wellbeing. Machine learning is used to achieve the same. Convolutional Neural Network algorithm is used for extracting features from the handwriting samples and classification to appropriate class. When cross-validation is used, the number of training samples increases which gives a better accuracy. The best weights of the cross-validation models are saved during training.

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