

Deep Convolutional Neural Network Methodology to Identify the Character of a Person

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Abstract

Personality is a trait human possess to make himself identify to the community which describes the abilities of how he/she is reacting or behaving with the people around them. There are so many techniques to identify personality. One of them is Handwriting. Handwriting speaks about an individual. It is one of the unique characteristics to represent what is going in our minds, how to communicate with others? and so on. The way our words are organized on a page reflects both the state of our hearts and minds. For instance, sloppy handwriting and a variety of mistakes indicate confusion, whereas neat handwriting demonstrates excellent mental and motor coordination. Handwriting analysis is a successful and trustworthy indicator of personality and behavior. The analysis of handwriting is done by the method called as Graphology. In order to implement the automated handwriting analysis tool, a novel approach of machine learning technique is discussed i.e., Graphology, which is a study of identifying the patterns involved in handwriting sample through various characteristic's involved such as line spacing, word spacing, slant etc. In order to complete the project and to automate or reduce the work load on Graphologist, we have used Deep Learning Technique to identify the personality of a person. Deep learning is like a child node of much bigger field i.e., Artificial Intelligence which helps us to make ideas into reality. These Deep learning filed has got the name has neural network is as they help us achieve human possible things by mimicking the way the human brain works, as in the form of how neurons interact with each other in the brain, similarly the neural network transmits information from one neuron to other neurons in the network. Deep Convolutional Neural Networks had been incorporated which performs very well in classifying images or detecting objects in the frame. The dataset consists of two classes and around 50 images in each class, these images have been loaded and trained on CNN to classify what personality a person is using his/her handwriting sample given as an input.

Keywords: Personality, Handwriting, Graphologist, Deep Learning, Convolutional Neural Networks, Classification.

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I. INTRODUCTION

Handwriting detection has been around in this world from ages and it has evolved a lot of as the technology progressed time to time. To build a model which helps us to identify what type of personality the person is inculcated inside him with the help of his/her handwriting. As we are trying to solve the problem of identifying type of personality using his or her handwriting, so we have to used artificial intelligence to help solve this particular problem, as we all are aware of the fact that how artificial intelligence has been evolved through the decades and helping large number of businesses across the world to achieve what they have dreamt of and increase their Business in terms of revenue and reputation.

In this paper, we have incorporated deep neural networks to ease the work of a graphologist to some extent compared to how the graphologist identifies the character by thoroughly examining the written text by the person on a piece of paper which is very time consuming hectic. In [4] There are different ways of identifying the personality trait of a person such as Baseline, Slant of the sentences, spacing in-between the words, Pattern matching of specific letters and you name a few. However, This paper specifically paper focusses on 2 such methods such as Slant of the text and Letter T.

The rest of the paper is organized in the following pattern. Section II: Related Work, Section III: Proposed Work and Methodology, Section IV: Dataset Description, Section V: Future Enhancement, Section VI: Conclusion, Section VII, Acknowledgment.

II. RELATED WORK

Some of the papers referred to understand the concepts involved with the personality trait and deep convolutional neural networks are listed below.

[1]. (Achinthu Haridas, 2021) Reviews about the author focused on analyzing various style of handwriting like ascending, descending and straight inclination of the baseline of a sentence, space between words, the right, left, irregular slants which will be used in identifying a set of traits associated with the individual, if it is present. CNN (Convolutional Neural Network) is an important set of techniques used for learning neural networks. MLP (Multilevel Perceptron) is a class of feed forward artificial neural network. Convolution is a mathematical operation that merges the two sets of information. In the case of CNN, convolution is applied to the input data for filtering the information and producing a feature map. On analyzing Dataset-1, it is found that slight variation in features were observed that may affect accuracy, so, a new dataset 'Dataset-2' is formed. Primary personalities are predicted using combined CNN and MLP models. Primary personalities are predicted based on combined CNN and MLP model whereas secondary personalities are predicted based on the seven extracted features. For comparing personality of each individual is matched with its corresponding handwriting feature. For better accurate result the author passed the images along with the extracted features to a combined model consisting of CNN and MLP. By observing probabilities of different output labels, he predicted the most dominant class to which the test handwriting sample belongs or the personality traits that person has. The system compared the input image and features with the combined model. The key feature of this project was to extract all the possible traits using combined model (CNN and MLP)

[2]. (Behnam Fallah) In this paper the authors have focused on using multiple layers such as convolutional layer which is a combination of two or more computations and activation function along with pooling layer which will give us a feature vector, this feature vector will be in the form of matrix. The combination of hidden Markov and MLP which was specifically dedicated to classify and identify the properties of the handwriting image, which Intern gives us the reasons of classifying which personality the person was as this involved in using two different models and the results were quite promising. Hidden Markov model is basically a statistic model which helps us to model times series, weather and speech recognition models and helps us to predict the states alrighty then using sequential data which were mentioned above, not only the application of hidden Markov model are limited to these but they also work very well with the image classification as the main aim of Markov model is to identify the rapidly changing states where there is a very good property of Markov model that is the future state which we are trying to predict totally depends upon the previous state/ event but not the older states. The authors have finally concluded that the method they have used has given a superior finality over the others which involved in creating feature vectors music HLSC independent features such as line spacing provide spacing slant of the letters and other characteristic and then multilayer perceptron has been applied such that output will be the personality trait of a person. The main terms involved in hidden Markov model R transition probabilities; these transition probabilities are then converted into matrix.

[3]. (Prachi Joshi, 2015) The authors in this paper have briefly discussed and concluded that Handwriting analysis is a scientific tool for recognizing, assessing and to understand writer's personality with the help of shapes and word patterns present in the handwriting. Graphology is the science that identifies the strokes in handwriting and describes the corresponding personality trait. Handwriting Analysis System includes steps such as Pre-processing, segmentation, feature extraction, classification. They have also mentioned some of the important handwriting features and personalities. Some image pre-processing techniques applied are noise removal, binarization, and normalization. Noise removal techniques were applied to remove the unwanted data and to improve quality of images. Thereafter, feature extraction was applied which reduced the dimension or important data from a high dimensional input data were extracted. The output data was used for analyzing the personality of the person. The author used classification method to recognize the personality traits of the writers. For getting more accurate results, more features can be added to HAS (Hand writing Analysis System).

[4]. (Hemlata, 2018) This paper mainly investigates the personality traits that can be inferred from a person's handwriting, specifically the baseline, margin, word slant, and T-bar height. The handwriting samples' features are turned into feature vectors, which are then compared to a trained data set and mapped to the class corresponding to each personality trait. The polygonization method was used to evaluate the baseline, and vertical scanning is used to determine the margin. To increase the effectiveness of the tool, machine learning techniques like KNN with incremental learning is used. The handwritten samples consist of various parameters, including Margin, Baseline, T-bar, and Slant, which are taken into account to identify corresponding traits due to which graphologists will be able to analyze data more quickly and effectively with the help of the suggested tool.

[5]. (Namatēvs, 2017) Deep convolutional neural networks (CNNs) are designed to process data with a known analysis situs resembling a network. In terms of convolution operation, typical layers, and fundamental training and learning techniques, the paper's goal is to present theoretical and practical aspects of deep convolutional neural networks. Signal and image classification also has some real-world applications. In comparison to conventional fully-connected neural networks, CNNs have fewer parameters that need to be learned, according to research on the theoretical underpinnings of CNNs and some practical applications. Less noise during training results from a reduction in the number of parameters. The number of parameters is dependent on kernel width for this reason. The number of parameters in the model increases with kernel width. CNN, on the other hand, typically requires thousands or even millions of data points that have been labeled. If the weight decay parameters are reduced, the model parameters increase. The dropout rate should be reduced to prevent the rise in the number of convergent iterations.

III. PROPOSED WORK AND METHODOLOGY

So, in order to solve this particular problem of increased workload type and effort of graphologist we have proposed an efficient or rather a better approach, which helps us to identify the personality of a person using handwriting just by passing an input image of the individual cropped to a specific size and just wait for like a minute to get the personality of that person. As this particular model has been trained on very limited amount of data as there were data related issues which involved in restricted access to individual's handwriting, so we have created our own handwriting sample data set by motivating the volunteers to participate. Using which we have trained our model, since this is just in the development process as the days progress, we can increase the data set and train the model furthermore to get approximate predictions when an input is passed of any kind. As we know artificial intelligence has been drastically increasing from the past decade and helping a lot of businesses out there in the world in generating revenue and reputation, so as a matter of fact we have chosen artificial intelligence and incorporated deep learning to solve this problem using convolutional neural networks. The reason we have chosen convolutional neural network is as we are dealing with imagery data set there is no such algorithm which can perform better than convolutional neural network [5] which has a special behavior of identify the patterns involved in the image and even going through minute details which can ultimately yield into learning more accurately and providing us better results unlike artificial neural networks which can also be inculcated but cannot yield better results when compared to convolutional neural networks. But, In the future perspective we are even enthusiastic to use transfer learning to get even better accuracy than the existing one. But as of now we have used convolutional neural networks to achieve the problem we have discussed in the starting.

Methodology

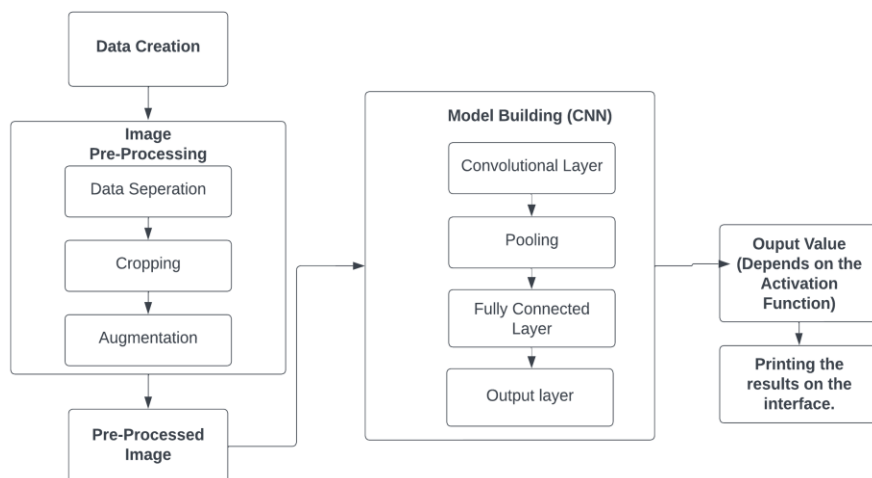


Fig 1: Process flow involved in identifying the personality of a person based on his/her handwriting.

Performance Metric Among Different Algorithms

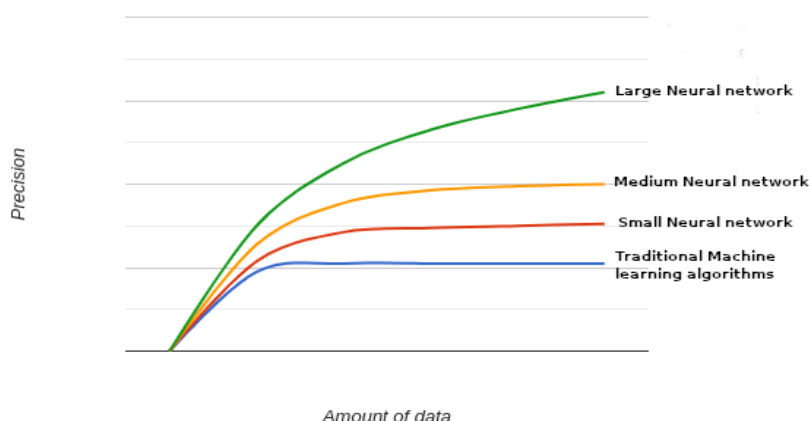


Fig 2: Comparison results of Deep Neural Networks (Large Neural Networks), Artificial Neural Networks (Medium and Small Neural Networks) and Traditional Machine Learning Algorithms when trained on Imagery dataset.

CONVOLUTIONAL NEURAL NETWORKS

Convolutional Neural Networks [5] have been developed as an advancement of Artificial Neural Networks which will try to capture almost everything and anything from the data given. Since the main root cause about this algorithm is with Images, we know that artificial neural networks work very well with tabular data and also with the images but given the fact that computations can soar up high when we are dealing with images, the results might also not be promising. Convolutional Neural networks are built by different layers such as Convolutional Layer, Pooling layer and Fully Connected Layer.

Convolutional Layer: Convolutional layer is core building block in any CNN architecture. It is responsible in identifying features in the image and passing it to further layers. This convolutional layer produces a feature map, which will be in the form of a matrix of numbers. Feature map is then passed onto the fully connected Artificial neural network which are connected with these layers. The flow goes on and using appropriate activation function and dense layers the information is passed to the output layer.

Pooling Layer: Pooling layer is basically used to reduce the feature map size. The filter does a dot product by taking in the input image vector and the filter size and then saving that value in a feature map. This pooling size is applied on top of the area of our feature map and crawls all the way until it goes through all the vector of the feature Map of the size specified. we can increase the size to 3x3 or 4x4, if we want to decrease the dimensions even further. Max pooling layer is often used when compared to the average pooling.

Fully Connected Layer: The Fully connected layer is nothing but the artificial neural networks which takes the input from the flatten layer. Matrix multiplication is one of the central computations in deep learning SMID operation in the CPU. Fully connected layers can have as many dense layers as possible and again it totally depends on time and how big the feature map is. But as a proven fact, the number of neurons after the base dense layer should be to the power of 2 and as the model approaches to the output layer, the neurons in the dense layers decrease to give appropriate prediction value.

Architecture of Convolutional Neural Network

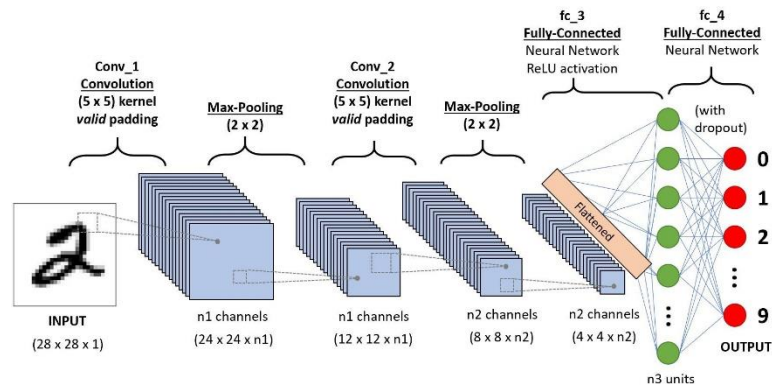


Fig 3: CNN Architecture explaining the process flow using a handwritten digit as an example.

IV. DATASET DESCRIPTION

The dataset was created completely from scratch from data collection to data pre-processing no external data repositories have been referred or used. The data was collected from multiple individuals in our office space with each individual writing their own thoughts into an A4 size sheet paper. The written paper then was clicked through a High-Definition mobile camera using photography stand to keep the mobile still while clicking the images. The images are then loaded onto an image cropping website to crop individual sentences written by the participants. To maintain the scalability of the dimensions when cropped without any external software the dimensions would mismatch and it would allow us to then manually identify the images of different dimensions and change it accordingly, so in order to avoid this a specific dimension size of the image has been recorded and those dimensions have been used for the entire dataset. While collecting or creating the dataset, a Pilot pen has been used and given to every individual who had participated in this data creation, so as to maintain the uniformity across all the individuals. Each image in this dataset is of Dimension 859 x 149 pixels with RGB Format. Since we had limited number of participants for this dataset i.e., only 10, we have thought of augmented it and increasing the dataset, there are also other augmentation techniques available but as of now, image data generator is the best suited for our case. Sample images are shown below.

i. Baseline

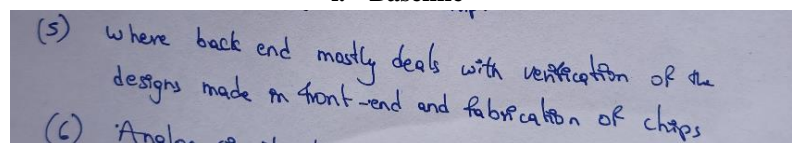
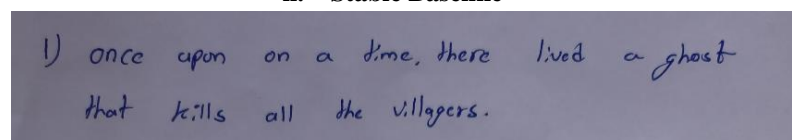


Fig 4: Ascending Baseline illustrating individual has optimistic personality (The person is Optimistic, cheerfulness, Hopefulness, stay busy and active, excitability, choleric behavior.)

ii. Stable Baseline



- **Fig 5:** Stable baseline illustrating individual has Stable personality (The person has stable outward behavior, realism, straightness and disciplined.)

V. FUTURE ENHANCEMENT

As the project is still in the research phase, it can be improved by increasing the dataset and using transfer learning classification algorithms such as VGG16, RESNET etc. to increase the accuracy and reliability. Nevertheless, since we are dealing with sensitive information regarding humans and their behaviors, it is notable

that we have to use this system has a complementary tool and cannot entirely trust until valid scientific result is achieved.

VI. CONCLUSION

The main goal of this particular project was to reduce the workload of graphologists [3], save time and efficiency, and increase the accuracy of identifying people's personality traits using handwriting samples using technology. This project proposed an efficient method to identify or infer a person's personality from handwriting using deep learning techniques including convolutional neural networks. The project mainly consists of her two classes, each representing a specific personality of an individual. Personalities were selected based on handwriting style. The labels Optimistic and Stable have been carefully selected and labeled by thorough review and inspection of handwritten samples provided by volunteers. This project specifically examines specific features among the various available features such as word baselines, margins, and tilts that exist in graphology to identify or characterize a person from handwriting samples that are collected, labelled and trained using a deep learning model to identify a person's personality when presented with a photo. This has led to generate a new way to build a system that helps identify the character of a person.

VII. ACKNOWLEDGEMENT

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