



## Human Behaviour Modelling & Analysis Using Artificial Neural Network

**Sadhana**Student, Haryana Engineering College  
Haryana, India**Er. Ankita Sharma**Assit. Lecturer, Haryana Engineering College  
Haryana, India

---

**Abstract**— This is a survey based on behavioural biometrics in Artificial Neural Network which is based on skills of Signature used by people while accomplishing their handwriting analysis using a computer. The research in the field is examined and the types of features used to describe different types of behaviour by using signature in this paper are: orientation, letter spacing, thickness, streaks. In this research, using BPN i.e Back Propagation Network Learning algorithm we train our neural network which gives the MSE value(Mean Square Error). By analysing the value of error generated and comparing the target output and predicted output we can concluded the behaviour.

**Keywords**— Artificial Neural Networks , Back Propagation Network(BPN) , Mean Square Error(MSE) , Behavioural Biometrics

---

### I. INTRODUCTION

The most secure and convenient authentication tool is **Biometrics**. To measure individual's physical or behavioral characteristics to recognize their identification for authentication this technology is mainly used. The majority of research is aimed at studying well-established physical biometrics such as fingerprint or iris scans . Behavioural biometrics systems are usually established but less, and only those which are in large part based on muscle control such as keystrokes, gait or signature are examples which are well analysed . Signature-based user verification is a particular type of general handwriting-based biometric authentication. Biometrics is a novel field of research as automatic means of human recognition [3]. Recent standardization efforts have established that biometric sample quality can be considered from three different points of view, namely: *i) character*, *ii) fidelity*, and *iii) utility*. This last characteristic refers to the impact of the individual biometric sample on the overall performance of a biometric system and it is generally accepted that it constitutes the most important aspect to be taken into account by a quality metric (i.e., samples assigned to a higher quality should lead to a more accurate identification of individuals). These standardization efforts have led to the proposal of specific quality measures for certain traits such as the fingerprint (where quality may be computed in terms of the ridge strength, continuity, clarity, uniformity or integrity) or the iris (where quality is measured in terms of the occlusion, the focus, the blurring or the angular deformation). In behavioral biometric traits such as the signature , the proposal of objective and practical metrics for quality estimation is not an easy task. Although some work has been carried out to try to propose indicators of the quality of both on-line and off-line signature[3].

The two verification methods are:

➤ **ONLINE SIGNATURE VERIFICATION:**

- It deal with dynamic feature like speed, pen pressure, direction, stroke length and when the pen is lifted from the paper.

➤ **OFFLINE SIGNATURE VERIFICATION:**

- Uses static information(features) from the image.
- Deals with shape only.
- It is largely used for bank cheques to verify them.

#### 1.1 HANDWRITING ANALYSIS

Recognition of Human personality is becoming more and more important in the world. One of the first accepted civilian and forensic biometric identification technique in our society is Handwritten signature. Beside that there have been some disputes about authorship of handwritten signatures, but in identifying genuine signatures human verification is normally very accurate. The biometric field of computer verification of handwritten signatures introduced the signature dynamics information to further reduce the possibility of fraud[6].

An approach to modeling human behavior is to consider the human as a device with a large number of internal mental states. On the observation the research builds that although human behaviors for example speech, handwriting, hand gestures and face expression, motion or even a American sign language.

By using Biometrics personal identification or identity authentication applies pattern recognition techniques to measure physiological or behavioral characteristics.

Biometric systems that help to understand the link between a person and his/her identity are of two types are.

- First type is Identity verification (or authentication) occurs when a user claims who he is and the system accepts (or declines) his claim.
- Identity identification (sometimes called search) occurs when the system establishes a subject identity (or fails to do it) without any prior claim.

Human personality recognition is becoming more and more important in the modern world. Identifying, evaluating and understanding personality is done by a scientific method known as Handwriting analysis or Graphology, through the strokes and patterns revealed by handwriting. An author can be describe by the type of writing in the form of signatures and letters stroked . The use of signatures is usually used to identify certain personality as with appearance of dots, streaks, shapes or shell, and bottom line[1]. How skilled the analyst is shows the accuracy of handwriting analysis . Human intervention in handwriting analysis although has been effective, but it is costly and prone to stressful. Development in image processing and pattern recognition lead to analyzing of handwriting based on graphology can be done automatically. In the image handwriting is included, so that recognition can be performed through the stages of conversion of images into numerical vector, image processing for quality improvement, followed by pattern recognition and feature extraction.

Several research of handwriting analysis automatically with the aid of a computer without the human intervention to predict personality traits have been conducted. Among all some of them, using baseline, the pen pressure i.e the thickness and the height of the T-bar on the stem of the letter 't' are considered for predicting the personality of the writer. recognition [1], most efforts undertaken by the different parties involved in the development of this technology (industry, researchers, evaluators, etc.) have been mainly (but not exclusively) directed to the improvement of its performance (i.e. finding ways to obtain lower error rates). By various studies it have been proved that a biometric system performance is highly affected by input signals, and even if the systems is best in worldwide it also has to struggle in the presence of noisy samples. The term quality is considered from the *utility* point of view in order to investigate the cause that makes some signatures more suitable for automatic recognition than others[1].

This research is a continuation of previous research that only using handwriting based on four features. From signature pattern, five features identified by ANN and four features which uses multistructure algorithm. Each space had reprocessing performed to improve the recognition accuracy. The combination of letter recognition and signature is intended to provide a more complete overview the personality. Each features recognized side by side that indicates the distinct personality. The success of the system is determined recognition accuracy against graphology test that is done manually.

Handwriting is unique to each one individual, regardless of the word formation of an individual's handwriting; the shape of the character will reside the same. This is applicable to all languages. Fraud of another person's handwriting can easily be identified by proper forensic examining characteristics like pen pressure and oscillation. Theoretically, it is difficult to determine personality especially when it is related to forensics. However there have been many instances in handwriting analysis where a forensic handwriting expert will compare handwriting on the basis of clear sets of characteristics and cannot make any relation between the handwriting characteristics and the personality traits because accuracy is the major issue in such forensic examining. The main focus of this study is to examine known technology that can identify or predict personality traits, as well as those technologies that identify and authenticate handedness, and gender using handwriting samples.

Theoretically, it is difficult to determine personality especially when it is related to forensics. This is because current automated systems are preprogrammed by humans. Another reason why it may be difficult to accurately examine handwriting samples is the fact that there is no threshold or scale available which can accurately provide the results of the analysis. The automated pattern recognition system also may need training on few samples so that they can get the scale and do the analysis for the next available scanned samples.

## **II. RELATED WORK**

The various approaches used for human behaviour modelling and analysis described below:

### **A. Personality recognition based on digit of handwriting and signature analysis**

Author Esmeralda C. Djamal proposed Autography that the written element of each individual's periodicity and design. By studying all elements of handwriting and understanding these elements ,by using the standards of graphology author can initiate a chart of character attribute, behavior, emotions of writer . In this, author use graphical accession based on signature and digit of character of utilization scheme using many-frame algorithms and artificial neural networks (ANN). The image divided into two space: the signature occupied on nine appearance and utilization scheme of digit space of letter. Each space of the letter had performed preprocessing to improve the recognition accuracy. ANN based classifiers apply on five features of impression which has accuracy of 56-78%. While four feature of the signature that detection using multi structure algorithm result 86-100% accuracy [1] .

### **B. Dynamic Markov models to recognize human behaviours**

The author Alex Pentland discussed Many human behaviors can be accurately described as a set of dynamic models like Kalman .lters which are sequenced together by a Markov chain. In order To recognize human behaviors from sensory data and to predict human behaviors over a few seconds time, the author can use these dynamic Markov models. For

testing of the power of this model approach, the author report an experiment in which he were able to achieve 95% accuracy at predicting automobile drivers' actions from their initial preparatory movements[2].

**C. Analysis of the quality of on-line handwritten signatures**

Author Javier Galbally 2011, Based on the Sigma-Lognormal model, the analysis of quality of online handwritten signatures is done. In the study of kinematic perspective of humanly-produced movements two main issues are addressed. On the one hand, what makes some signatures perform better than others in automatic signature verification systems, and on the other side if that information may be used as a quality measure in order to predict the expected performance of a given sample. On MCYT database experiments were done and show the high potential of certain kinematic features for signature quality assessment[3].

**D. Prediction of personality using different handwriting pattern**

Author Ms. Vaishnavi Nair , Ms. Shweta Kulkarni January 2015, explained that we predict human personality by using different type of features such as baseline ,size, slant, margins, speed, zone. Different type of people use different type of writing like print writing or cursive writing. These Features of signature can be match to the rest of signature to map the community[8] .

**E. Analyzing of handwriting by using online tools: NEUROSCRIPT, WANDA, CEDAR FOX, and Gaussian Mixture Model.**

Janet Fisher, Anish Maredia, Nerissa Williams, Anita Nixon and Jonathan Leet,” Identifying Personality Traits, and Especially Traits Resulting in Violent Behavior through Automatic Handwriting Analysis” describe Handwriting analysis is a process that has been carried out for many centuries. Two ways of handwriting analysis are there: Graphology is psychological analysis method, while the forensic document examination or handwriting identification which is the examination of documents and writing samples by a known source or person. In this paper, we carried out research of the various state of the art technologies available in analyzing an individual’s behavior based on their handwriting and the effectiveness of predicting the character and personality of that individual[9]

**III. PROPOSED WORK**

Prediction of human behavior using Artificial Neural network. Prediction is a process of conceiving something as it might happen in future based on knowledge gathered from past experiences and from present scenario.

**Objectives**

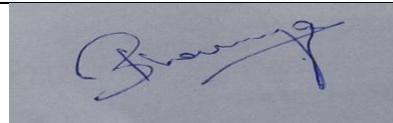
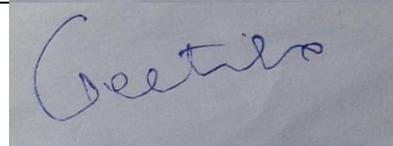
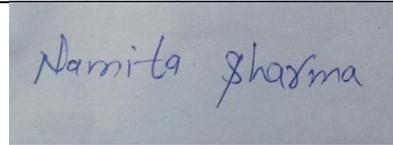
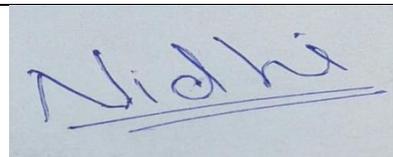
1. Signature analysis to identify the signatures and extract the features from signature.
2. After extracting the features of signature normalize the values.
3. Human behavior prediction using Artificial Neural networks

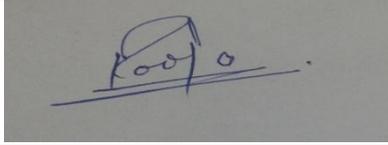
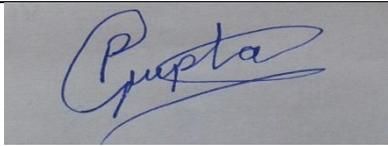
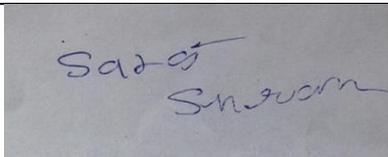
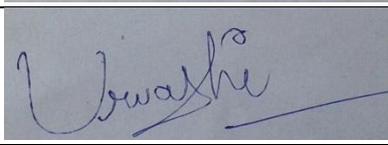
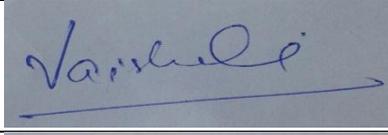
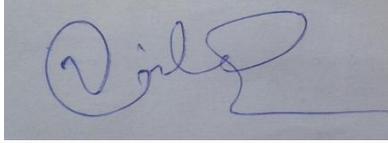
**Table Data Set of Signatures**

**EXTRACTION OF FEATURES**

After scanning the signature by computer then, we have to evaluate the feature of in signature. We have taken the four features which are: Streaks, orientation, thickness, letter spacing. We have taken 10 people signature and extracted features are taken out, calculated in table below :

Table1.1 Extracted Features

Sno.	Names	Signature	Streaks	Orientation	Thickness	Letter Spacing
1	Bhavya		358.8763	-200.4340	65.2239	810.7081
2	Geetika		440.2194	-242.3294	53.8072	806.1978
3	Namita Sharma		118.6859	121.6705	71.1563	983.3250
4	Nidhi		317.1587	-185.4470	60.6047	850.4650

5	Pooja		384.3074	-50.1367	55.4634	262.5680
6	Priyanshu		590.6854	-148.6478	56.0048	546.3344
7	Saroj Sharma		264.1503	223.7208	66.8636	846.2716
8	Urvashi		582.4293	-77.3755	55.4366	745.0734
9	Vaishali		508.9178	-45.7005	53.9864	993.6944
10	Vishal		777.9665	54.8690	58.8903	919.1251

In this research, we will use different samples of handwritten signatures. To check the accuracy of algorithm we will use different scanned images of signatures and will apply ANN for training. Find the MSE value for training and testing of samples. From sample data, results which come satisfying the MSE value behavior through signatures can be predicted.

#### NORMALIZATION OF FEATURES VALUES

As our neural network uses only values between 0 to 1, so we have to normalize the above features values for ease of network and resulted values are in table below:

Table 1.2 Normalized Feature Values

Sno.	Names	Streaks	Orientation	Thickness	Letter Spacing	Target output
1	Bhavya	0.4	-0.7	0.8	0.7	0.9
2	Geetika	0.5	-0.9	0.6	0.7	0.8
3	Namita Sharma	0.1	0.4	0.9	0.8	0.85
4	Nidhi	0.3	-0.6	0.7	0.7	0.95
5	Pooja	0.4	0.1	0.7	0.2	0.45
6	Priyanshu	0.6	-0.5	0.7	0.4	0.75
7	Saroj Sharma	0.3	0.8	0.8	0.7	0.7
8	Urvashi	0.6	-0.2	0.7	0.6	0.6
9	Vaishali	0.5	-0.1	0.6	0.9	0.65
10	Vishal	0.9	0.2	0.7	0.8	0.44

### TRAINING OF NETWORK

The algorithm which is used to train the neural network is Back Propagation Network(BPN). It is the Multilayer network which contains three layers input , intermediate hidden, target output layer. In this units are in feed forward fashion where units are fully connected to each other i.e input to hidden and hidden to output layer. When learning is done during training phase following general step is done:

1. Each input pattern is applied to input set and then propagated forward.
2. The pattern of activation at the output layer is compared with the correct output pattern to calculate an error signal also known as Mean Square Error.
3. The error signal for each such output pattern is then back propagated from the output to the input in order to appropriately adjust the weight in each layer of the network.

By using BPN (Back Propagation Network ) Training we calculated the following results:

1. No. iteration taken to train the network: 25
2. Mean Square Error(MSE) : 0.25
3. Total time taken in seconds: 0.093

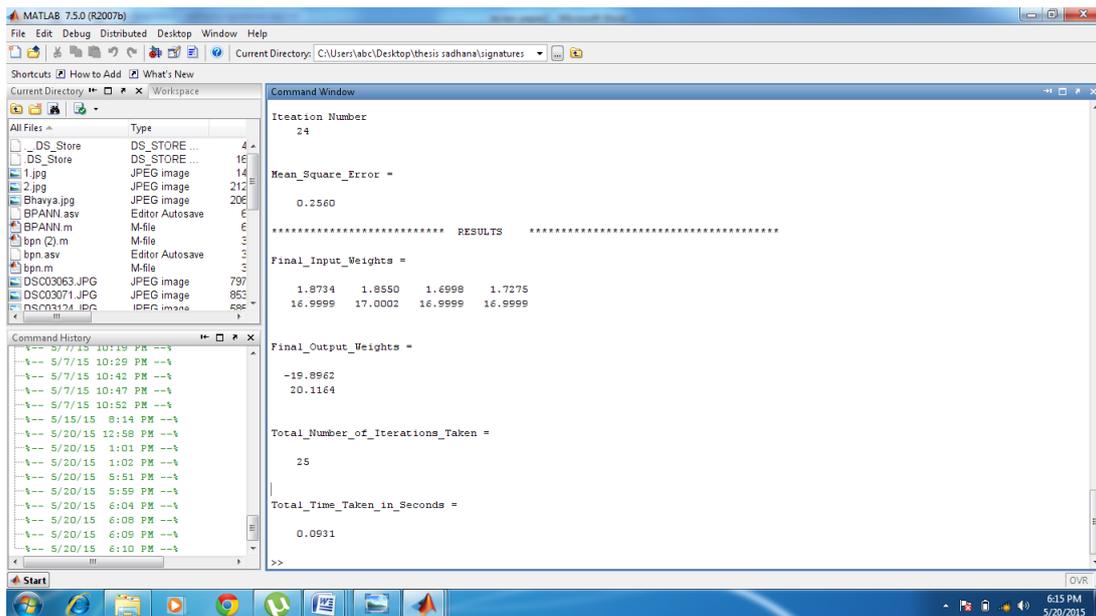


Figure 1

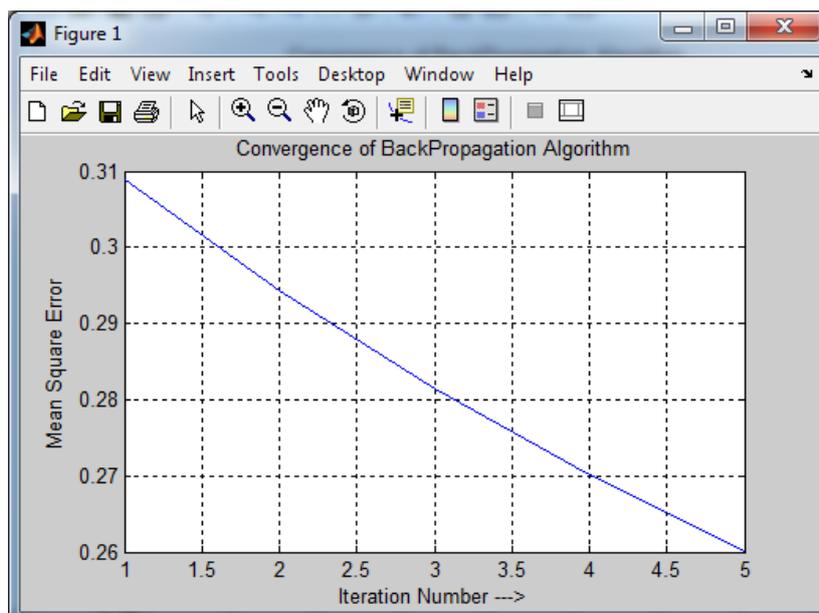


Figure 2 : Mean Square error vs. Iteration Number

Mean Square Error(MSE) is the error value which is generated during training phase. This error is the difference between target output value and actual output. MSE value is set by the user. The iteration is continue until and unless the value of error reaches to its tolerance value or MSE value.

#### IV. RESULTS

For Training:

We uses these five values for training with two features streaks and orientation shows in table below. Table shows the two training input, target output, after training result is given as predicted output, and error value.

Table 1.3

S.no.	Name	Streaks (X1)	Orientation (X2)	Target Output	Behavior
1.	Bhavya	0.4	-0.7	0.9	Polite, Sincere
2.	Geetika	0.5	-0.9	0.8	Kind, Introvert
3.	Namita Sharma	0.1	0.4	0.85	Hardworking, Sincere
4.	Nidhi	0.3	-0.6	0.95	Excitable, Fun loving
5.	Pooja	0.4	0.1	0.45	Charming, Funloving

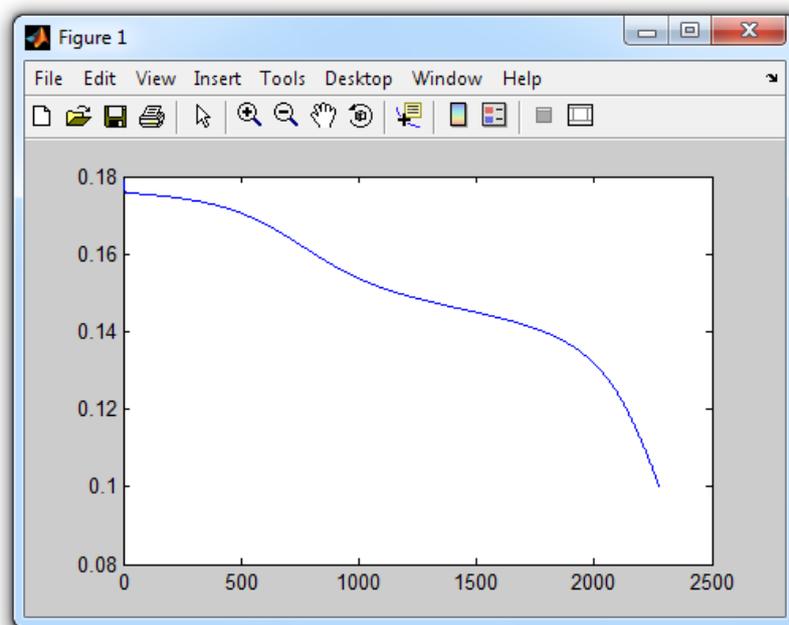


Figure 3:

```

Command Window
Warning: Could not find an exact (case-sensitive) match for 'Sigmoid'.
C:\Users\abc\Desktop\thesis sadhana\signatures\sigmoid.m is a case-insensitive match and will be used instead.
You can improve the performance of your code by using exact
name matches and we therefore recommend that you update your
usage accordingly. Alternatively, you can disable this warning using
warning('off','MATLAB:dispatcher:InexactMatch').
> In BPANN>ForwardNetwork at 144
   In BPANN at 53
Ended with 2277 iterations.

x1_x2_act_pred_err =

    0.6000    -0.5000    0.9000    0.6500   -0.2500|
    0.3000    0.8000    0.8000    0.5220   -0.2780
    0.6000   -0.2000    0.8500    0.5524   -0.2976
    0.5000   -0.1000    0.9500    0.5862   -0.3638
    0.9000    0.2000    0.4500    0.4091   -0.0409

>>
    
```

Figure 4: shows predicted output , MSE

The above figure concluded the predicted output and the error value .

**TESTING**

The table shown below shows the predicted output and error value. So from this table we can conclude that error value which is less than the range set by user of MSE value during training phase. So Target output value of above Table 1.3 is near about the predicted output of Table 1.4. From here it shows behavior of Vishal Verma is same as of Pooja.

Table 1.4

Sno.	Name	Streaks	Orientation	Predicted Output	MSE	Behavior
1.	Priyanshu	0.6	-0.5	0.65	-0.25	Polite, Caring
2.	Saroj Sharma	0.3	0.8	0.52	-0.27	
3.	Urvashi	0.6	-0.2	0.52	-0.29	
4.	Vaishali	0.5	-0.1	0.58	-0.36	
5.	Vishal Verma	0.9	0.2	0.40	-0.04	Fun loving, Loyal

**V. CONCLUSION**

Graphology is an emerging field for personality recognition. Identification of personality automatically through signature will prove it to be a helpful and good system for persons behavior identification.

From the research, it was concluded that with the help of ten samples of signature, we predict the behavior of persons whose signature are taken. From the signature, four features are extracted Streaks, Orientation, Thickness, Letter Spacing. With the help of BPN we train the network from which we got the iteration number and MSE values. Then we uses five set of signature for training and remaining five is used for testing the behavior. By calculated the minimum MSE value, we assign its behavior correspond to the above training sample.

From the study it is concluded that number of features, learning rate, training algorithm affects the accuracy of techniques

**REFERENCES**

- [1] Esmeralda C Djamel, SheldyNurRamdlan, Jeri Saputra, "Recognition of Handwriting Based on Signature and Digit of Character Using Multiple of Artificial Neural Networks in Personality Identification", Information Systems International Conference (ISICO), 2 – 4 December 2013.
- [2] Alex Pentland, Andrew Liu, "Modeling and Prediction of Human Behavior", June 24, 1998.
- [3] Javier Galbally, Julian Fierrez, Marcos Martinez-Diaz, "Quality Analysis of Dynamic Signature Based on the Sigma-Lognormal Model"
- [4] Swarna Bajaj, SumeetKaur, " Typing Speed Analysis of Human for Password Protection (Based On Keystrokes Dynamics)", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-3, Issue-2, July 2013.
- [5] S. M. E. Hossain and G. Chetty, "Human Identity Verification by Using Physiological and Behavioural Biometric Traits", International Journal of Bioscience, Biochemistry and Bioinformatics, Vol. 1, No. 3, September 2011.
- [6] Hugo Gamboaa and Ana Fredb, "A Behavioural Biometric System Based on Human Computer Interaction".
- [7] Albert Ali Salah1, Theo Gevers1, Nicu Sebe2, and Alessandro Vinciarelli3, "Challenges of Human Behavior Understanding".
- [8] Prof. Seema Kedar, Ms. Vaishnavi Nair, Ms. Shweta Kulkarni, Dept. of Information Technology,JSPM's RSCOE, " Personality Identification through Handwriting Analysis", Volume 5, Issue 1, January 2015 ISSN: 2277 128X International Journal of Advanced Research in Computer Science and Software Engineering,
- [9] Janet Fisher, Anish Maredia, Anita Nixon, Nerissa Williams, and Jonathan Leet," Identifying Personality Traits, and Especially Traits Resulting in Violent Behavior through Automatic Handwriting Analysis", May 4th, 2012
- [10] S. Madhvanath, and V. Govindaraju, "The Role of Holistic Paradigms in Handwritten Word Recognition", IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 23, NO. 2, FEBRUARY 2001.
- [11] Z. MohdZam, "Handwriting Analysis for Employee Selection Using Neural Network", Thesis of Intelligent System Faculty of information Technology and Quantitative Science of University Technology MARA, 2006.
- [12] EC. Djamel and R. Darmawati, "Recognition of Human Personality Based on Handwriting Using Multi Structures Algorithm and Artificial Neural Networks", 2nd IEEE Conference on Control, Systems & Industrial Informatics Bandung, Indonesia June 23-26, 2013.
- [13] F. Perronnin, J. C. Junqua, J. L. Dugelay,Biometrics Person Authentication: From Theory to Practice
- [14] A. McNichol, "Handwriting Analysis Putting It to Work for You", Contemporary Books, 1994.
- [15] G. Hargreaves and P. Wilson, "How to Read Handwriting The A-Z of your Personality, Singapore, 1953.
- [16] P.D. Sunar, "Read the full review Graphology Personality Through Writing His handwriting", Yogyakarta: Diva Press, 2010.
- [17] Taufik, M., Rosette, "Step By Step to analyzed personality trait through handwriting", Jakarta, 2010.