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## **Study on handwriting features of ambidextrous persons by using image processing**

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**Abstract---** Handwriting Features of Ambidextrous Persons have been classified as a multi-class classification issue in the deep learning framework, where image recognition task is effectively to test a classifier who can efficiently discriminate each line of paragraph of handwriting. This is very common for a single classifier to be performed on different data sets with a standard deep learning algorithm. It may also be that the same classifying system performs differently with highly differing image instances due to the various manuscript styles of various people on the same numbers. In order to address this problem, it was crucial to develop ensemble learning approaches to enhance overall effectiveness and make the performance highly stable in various data sets. In this text, we are proposing a system involving the CNN-based removal of the data set from an image and algebraic fusion of various words in images to classifies for trained in different sets of edges, which are prepared by means of feature selection applied to the original CNN feature set. Experimental results show that a fusion of classification images can achieve a descriptive word.

**Keywords---** handwriting features, ambidextrous persons, deep learning, convolution neural network, image processing.

## Introduction

Ambidexterity is defined as the ability to use both hands equally skilled. It can also mean the ability to simultaneously use both hands. Just 1% of the term population is ambidextrous according to study. So, it's a very unusual talent to possess. But it is surprising that few prominent actors and historical figures were still ambidextrous. India's first President, Dr. Rajendra Prasad, Albert Einstein, LeBron James, Benjamin Franklin, Leonardo Da Vinci, and Nikola Tesla are the most well-recognized individuals with the same ability. The inventor of AC current, Nikola Tesla, and the man who made the world such powerful and effective electric motors that Tesla's designs are still used today. Nikola Tesla wrote in his autobiography about being ambidextrous. He said, "I'm ambidextrous now, but I was then left and my right arm had relatively little strength" [1]. Ambidextrous Leonardo Da Vinci was one of the many talents Florentine artists possessed. He used both his hands to make paintings because he hurt his dominant right hand in childhood. On 4 Aug 1473, when the artists were only 21 years old, the Opificio delle Pietre Dure (OPD) art conservation and research institution in Florence, Italy, carried out diagnostic examinations of a painting made by da Vinci [2].

One inscription the date written in the top left-hand corner on the front of the drawing is a reverse inscription written by a reflection in a mirror, the Uffizi said. Da Vinci used this so-called mirror writing several times, even though it's vague. The other note was usually drawn from left to right on the back of the page. Frosinini and her colleagues studied in high resolution images and infrared illumination the inscription and painting under a microscope. They often use a fluorescent X-ray device and a handheld computer for organic matter identification. They determined that the inscriptions were written by da Vinci, that the writing was done in the drawing with the same hue, and that da Vinci samples were written according to the sentence. But the contrast between the two inscriptions suggests that da Vinci had composed them with opposite hands. Since examining da Vinci's traditional penmanship in a variety of texts, the conservators concluded that his left hand had to compose the text inverted to the fore of the drawing, while his non-dominant right hand wrote the back of the text [3].

The distinctive handwriting of each individual has been intuitively observed for a long time. Methods have been developed for several decades for human handwriting knowledge. However, studies of the quantitative evaluation of the discriminatory authority of handwriting are important, especially in view of the acceptance of proof by courts presented by challenged examiners (QDE) [4]. The handwriting segregation of a diverse group from around the United States has been confirmed. Students of Veena Vadini have this ambidextrous capacity to write in their school notebook with equal strength to both hands. The singularity of the Veena Vadini School children is not only written with both hands. Yes, besides that there are many other wonders for children in this school that are very simple. Simultaneously, children who write with both hands simultaneously can write in six different languages, including Hindi, English, Urdu, Sanskrit, Arabic and Roman [5].

## Literature Review

(Rahman et al., 2020) identified the author's use of disguise features, which are slant shift, printing process, use other hands to copy handwriting, artificial hesitations, pen-lifts, alterations in letter formation, lengths and height, etc. Nevertheless, inconsistency is the key attribute that suggests camouflage. To determine the most popular disguise techniques, 100 authors were picked and told to copy a text using some disguise. The majority of authors have been noted to alter the tendency to write, use grotesque letter types, alter the image presentation and the writing skills, and use pen-letters as an effective disguise [6]. (Firdaus et al., 2020) analyse to classify different attributes of left handedness and identified those features in a motion in writing that were found essentially opposite to those found in right-hand writers' writing. Based on these attributes, whether a person is left or right may be determined. This study concluded that writing with opposite hand demonstrates typically a lower degree of writing abilities due to unregulated retaining of writing instruments as well as sudden lateral strokes, uncertain stroke motions, the absence of smooth writing and the uncustomary style of letters etc [7].

(Jemimah et al., 2019) analyse the request for writings from 135 individuals to ascertain the most common camouflage strategies used by authors to change their prose, such as pitching, uncomfortable hand, hand printing, scale, layout, angularity, spacing, approach and terminal lines, upper and lower extension, capital and lower case songs, etc. In case of odd camouflage, only 8 people out of 135 used clumsy hands to mask their face. Unusual handwriting did not resemble standard writing similarly. It seems like many authors would follow this form, but few used it awkwardly because they struggled to deliver unaccustomed hand writing. The frequency of shift occurrence was calculated in each feature. The findings have shown that disguise is not reliable or effective. Elements such as alteration or replacement were found to be primarily used to modify and dramatically influence the imagery of the text [8]. (Kalita et al., 2019) analyse that representing 4000 specimens written with the right and left hand. Everything topics completed the penalty for forgery. It has been found that 9 per cent of the left-hand writing and the other hand-writing is characterized by usual hand-writing, as flat r, d, l and other looped letters, vertical slant, fines or odd shaking, open T and d base, t-bar crossing, sudden direction changes, very little executions ability. It was pointed out that if major variations are carefully measured, uncomfortable writing can be found at the roots [9].

(Cilia et al., 2019) analyse that the pen movements of particularly left-handed writers who keep left-handed images of up-side-down strokes and explains some features such as I colon and other punching points, which render forms like bowls or sloping vertically while writers compose rapidly. T-bar indicates that the left-hand writer alone used the hand base for a finger movement that was immovable. Is the right-hander found? The hand is free to step ahead while the t is crossing from left to right while the left hand is crossing? S side, when passing over previously written lines while writing, smudge patterns may occur. Impressions of tin from the hand base are moved to the paper while the hand moves down to the next line of writing [10].

## Problem Statements

The main problems are to classify each word of handwriting feature. Overfit data works not well. During the testing and training process, it doesn't predict results. Handwriting paragraph feature data is not easy to predict and implement the results. Data for this modelling issue consists of structured data from multiple sources so pre-processing of data. The main problems are to implement and find each line with boundary rectangle with the main important feature of the datasets as it is difficult to analyse.

## Objectives

- Classify and implement the handwriting features of ambidextrous persons and non-ambidextrous.
- Predicting the images of handwriting features of ambidextrous persons and non-ambidextrous.
- Analyze the images data of handwriting features of ambidextrous persons and non-ambidextrous with each line of paragraph.

## Methodology

We have used python and deep learning programming language for implementation. We have used Anaconda software. Python is an effective programming language for the creation of a deep recurrent model of neural network. It supports in addition, a version of Python 3.7.1 used for this study is used. In the code creation process, Anaconda jupyter notebook python IDE is used; it is intended for operations in data analysis. A variety of science libraries, including Pandas, Numpy, Scipy, Matplotlib, sklearn and more, are available at Jupyter Notebook. It also provides advanced analysis, debugging, and editing capabilities in many apps, ("Jupyter Notebook: Anaconda Cloud"). The following libraries have been used such as numpy, pandas, matplotlib, scipy, seaborn and tensorflow etc.

## Convolution Neural Network

Deep learning is a machine learning tool that provides multiple linear and non-linear processing devices with a high level of abstraction in a deep architecture. A variety of applications currently use numerous deep learning techniques. It included auto coders, stacked automobile encoders, Boltzmann restricted machines and deep faith networks. In recent years, both vision systems and medical image analysis have gained in popularisation in the CNN-based methods [11]. CNN are micro perceptron evolutionarily inspired variants. In raw image pixels, visual patterns are also immediately identified. The pre- processing of CNN images is limited in many cases. These deep networks are explored by means of multiple layer neurons by small patches of the input image called receptive fields [12]. In order to ensure some variance for dimension, shifted and distortion, CNN combines three architectural ideas. It presents the first CNN model to recognise manually developed characters [13]. The local associations of patterns among CNN neurons in adjacent layers are taken as subsets in layer m1, units that have spatially adjacent convolution layers to exploit the local spatial correlation, for

input from hidden units of layer [14]. Each CNN filter is further replicated across the entire field of vision. These filters share a characteristic map weight and bias vectors. The common weight gradient is the sum of the common parameter frames. A function model is obtained in sub-regions of the entire image, when the convolutions are rendered [15]. This process includes converting the image or function map of the input with a linear filter and adding a bias followed by a non-linear filter application [16]. A bias data is assigned to be irrespective of the classification layer output. The bias values enable us to move either the node's activation function left or right [17]. The weights, for example for a sigmoid function, regulate the steepness of the output, while the distortion is used to offset the curve and allow the model to suit better. The bias values are formed from the testing set and can be controlled by a variable [18]. The  $k$ th filters are indicated as  $h_k$  in a given layer and their filters are determined by the weights  $W_k$  and bias  $b_k$ . Where  $\tanh$  is the hyperbolic function of the  $\tan$  and is used for convolution. There are two secret CNN layers where  $m_1$  and  $m_2$  both contain 4 and 2 maps, i.e.  $h$  and  $h_1$  referred to as  $w_1$  and  $W_2$ . Figure. The calculated using a  $2 \times 2$  window in the following layer as shown in Figure.3 on coloured squares from the pixels of the  $m_1$ -level [19]. The weights of these filter maps are 3D tensors, where there are indices for input characteristics, while pixel co-ordinates are given by the other two dimensions. In combination,  $W_{k1}$  represents the sum associated with each pixel in a hidden layer  $m$  with the hidden layer  $m_1$  map and with  $i-j$ ,  $j$ , and  $j$  coordination [20].

## Results and Discussion

In this evaluation, we divide the entire feature set of three dataset into different categories. It is intended to assess the number of variables who apply for testing and testing process. Every experiment was performed on the same computer with 1.6 GHz processor and 8 G memory configurations. Evaluation was performed for all study classifiers and four algorithms were implemented for training and testing or model assessment.

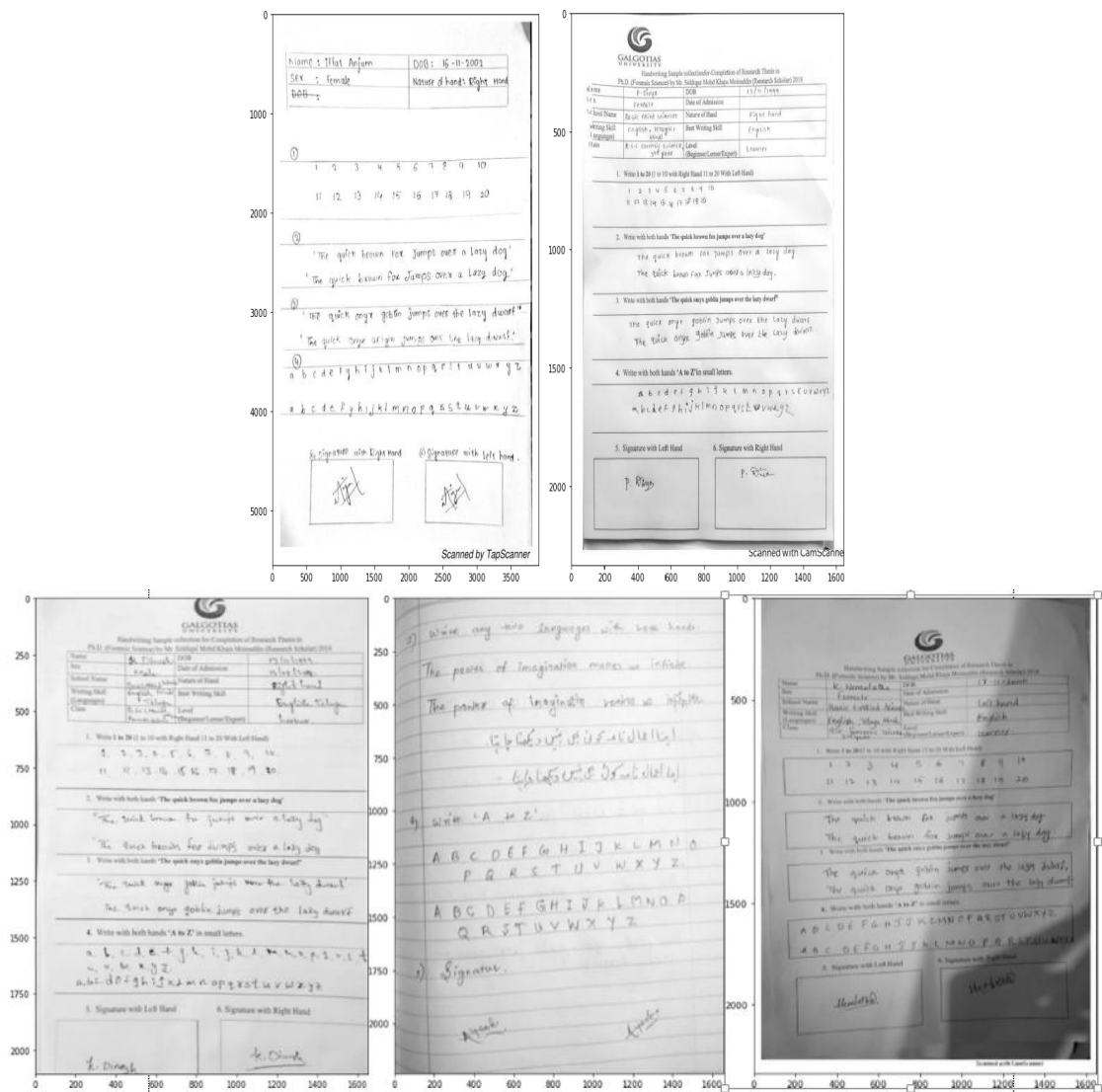


Figure 1. handwriting paragraph with edges of images

Fig.1 analyse the handwriting paragraph with the edges of images. Total number of images in dataset is 108. There are five outputs from images dataset. These images are the handwritten notes. These handwritten notes written from left hand side. The aim of this study is to analyse that left-hand side can right proper word in comparison of right-hand side. The dataset is divided into two sets: the exercise set (70%) and the validation set (30%). Firstly, we have import original images. Fig.1 analyse the images result with edges. We have pre-processed the images with edges. For classify images data, there are aims to implement handwriting paragraph. Images Data used for Predictive handwriting paragraph in structured or unstructured form. Structured data is usually pre-process during testing and training steps.

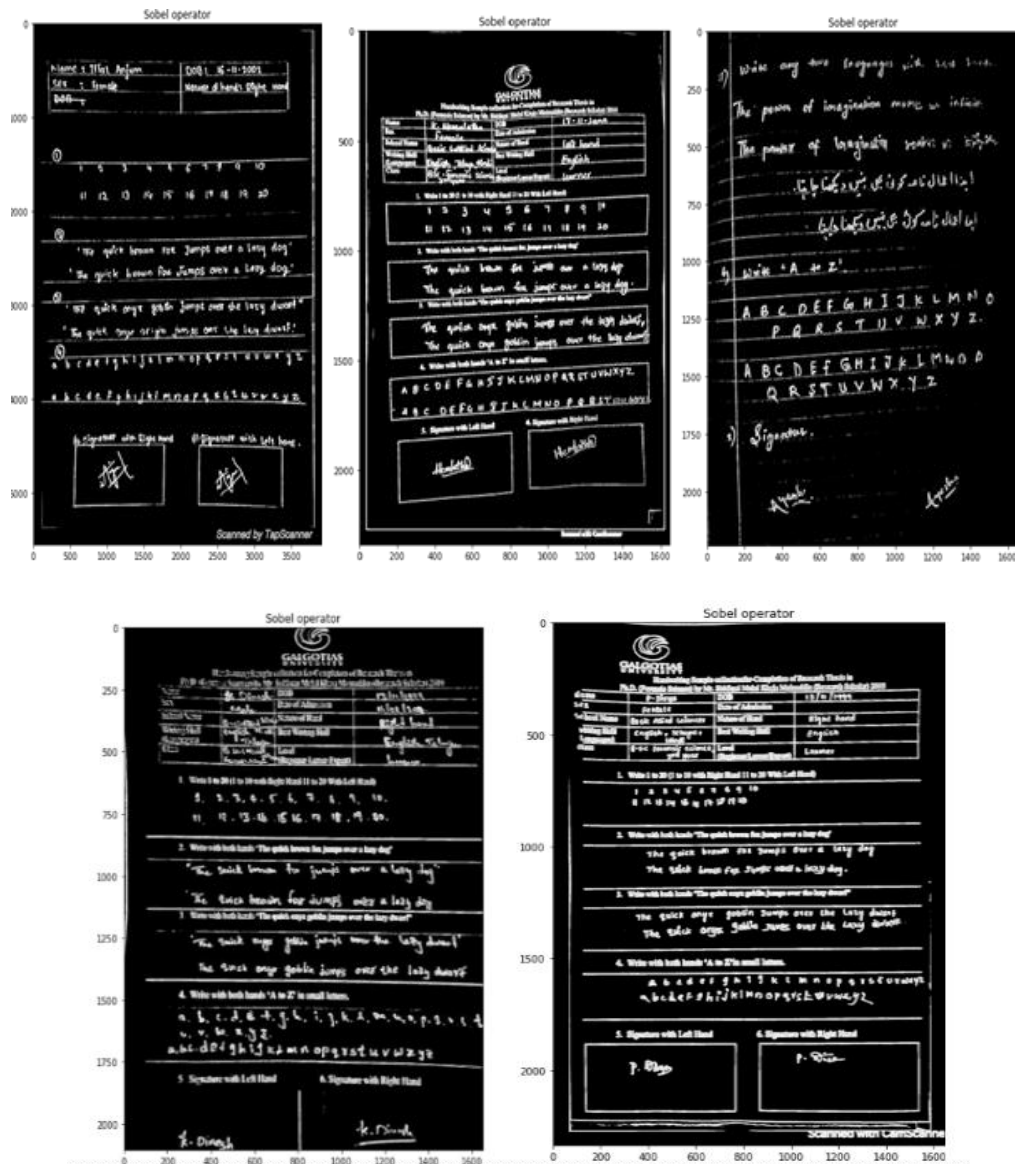


Figure 2. Sobel Operators Outputs with Dark Background

Fig.2. analyse the handwriting paragraph images with dark images. After pre-process the images. We have converted the images into dark images. Here from this result, the words of paragraph are clear. Here we have converted background into dark. Unstructured data is a critical issue for image classification, unshaped and dispersed. Unstructured data is hard to categorize and to choose relevant attributes from it. We have resolve unstructured data.

Bounding rectangles

|                   |                            |
|-------------------|----------------------------|
| Name: Iliya Anjam | DOB: 16-11-2003            |
| SEX: female       | Nature of Hand: Right hand |
| DOB: 16-11-2003   |                            |

1. Write from 1 to 10 with Right Hand 1 to 10 with Left Hand

2. Write with both hands "The quick brown fox jumps over a lazy dog"

3. Write with both hands "The quick orange gobble jumps over the lazy dwarf"

4. Write with both hands "A to Z" in small letters

5. Signature with Left Hand

6. Signature with Right Hand

Scanned by // apScanner

Bounding rectangles

|                 |                            |
|-----------------|----------------------------|
| Name: P. Dheya  | DOB: 13/11/1999            |
| SEX: female     | Nature of Hand: Right hand |
| DOB: 13/11/1999 |                            |

1. Write from 1 to 10 with Right Hand 1 to 10 with Left Hand

2. Write with both hands "The quick brown fox jumps over a lazy dog"

3. Write with both hands "The quick orange gobble jumps over the lazy dwarf"

4. Write with both hands "A to Z" in small letters

5. Signature with Left Hand

6. Signature with Right Hand

Scanned with CamScanner

Bounding rectangles

|                 |                            |
|-----------------|----------------------------|
| Name: P. Dheya  | DOB: 13/11/1999            |
| SEX: female     | Nature of Hand: Right hand |
| DOB: 13/11/1999 |                            |

1. Write from 1 to 10 with Right Hand 1 to 10 with Left Hand

2. Write with both hands "The quick brown fox jumps over a lazy dog"

3. Write with both hands "The quick orange gobble jumps over the lazy dwarf"

4. Write with both hands "A to Z" in small letters

5. Signature with Left Hand

6. Signature with Right Hand

Bounding rectangles

|                    |                           |
|--------------------|---------------------------|
| Name: K. Hemalatha | DOB: 17/11/1999           |
| SEX: female        | Nature of Hand: Left hand |
| DOB: 17/11/1999    |                           |

1. Write from 1 to 10 with Right Hand 1 to 10 with Left Hand

2. Write with both hands "The quick brown fox jumps over a lazy dog"

3. Write with both hands "The quick orange gobble jumps over the lazy dwarf"

4. Write with both hands "A to Z" in small letters

5. Signature with Left Hand

6. Signature with Right Hand

Scanned with CamScanner



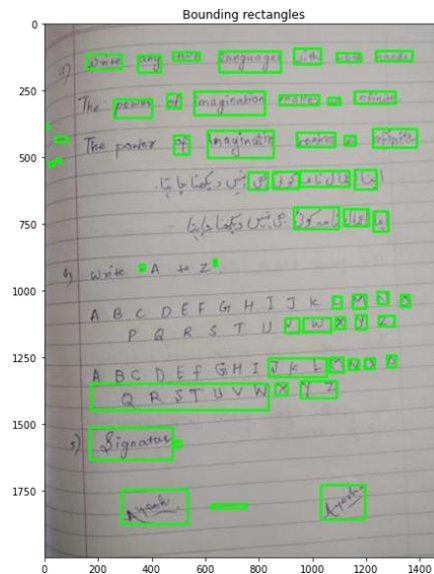


Figure 3. Bounding Rectangles Outputs with Dark Background

Fig.3 analyse the handwriting paragraph with boundary rectangles. Total number of images in dataset are 108. Here we are showing five results of the images. These results showing that the word with bounding rectangle is giving clear identification of words. But words without bounding rectangle is not clearly understandable words. The text inside the bounding showing accustomed and the text outside the bounding analysing unaccustomed. Here we have pre-processed the words of the images. Dataset images size is high-cardinality field for data identification. In redundant data, other highly correlated variables that carry the same information should be removed. If one predictor variable can be linearly predicted by other with a substantial to highly correlated. Collinearity can cause some regression coefficients to have wrong edges.





## References

1. Durina, M.E., 2020. examination and Comparison of Handwriting by Forensic Document examiners Compared to Laypersons. *Forensic Document Examination in the 21st Century*, p.137.
2. Zhao, H.H. and Liu, H., 2020. Multiple classifiers fusion and CNN feature extraction for handwritten digits recognition. *Granular Computing*, 5(3), pp.411-418.
3. Foss, N.J. and Kierkegaard, M.F., 2020. BLENDED AMBIDEXTERITY: THE COPRESENCE OF MODES OF AMBIDEXTERITY IN WILLIAM DEMANT HOLDING. *Long Range Planning*, p.102049.
4. Lien, M., 2020. Ambidextrous leadership in context.
5. Heras, H.A., Estensoro, M. and Larrea, M., 2020. Organizational ambidexterity in policy networks. *Competitiveness Review: An International Business Journal*.
6. Assi, K., Rahman, S.M., Mansoor, U. and Ratrou, N., 2020. Predicting crash injury severity with machine learning algorithm synergized with clustering technique: A promising protocol. *International journal of environmental research and public health*, 17(15), p.5497.
7. Firdaus, S.A. and Vaidehi, K., 2020. Handwritten Mathematical Symbol Recognition Using Machine Learning Techniques. In *Advances in Decision Sciences, Image Processing, Security and Computer Vision* (pp. 658-671). Springer, Cham.
8. Jemimah, K., 2019. Recognition of Handwritten Characters based on Deep Learning with Tensorflow. *Research Scholar, School of Computer Science and Engineering, Bharathidasan University, Trichy, India*, *International Research Journal of Engineering and Technology (IRJET)*, pp.1164-1165.
9. Kalita, S., Gautam, D., Kumar Sahoo, A. and Kumar, R., 2019. A Combined Approach of Feature Selection and Machine Learning Technique for Handwritten Character Recognition. *International Journal of Advanced Studies of Scientific Research*, 4(4).
10. Cilia, N.D., De Stefano, C., Fontanella, F., Molinara, M. and Di Freca, A.S., 2019, September. Using handwriting features to characterize cognitive impairment. In *International Conference on Image Analysis and Processing* (pp. 683-693). Springer, Cham.
11. Singh, A. and Bist, A.S., 2019. A wide scale survey on handwritten character recognition using machine learning. *Int J Comput Sci Eng*, 7(6), pp.124-134.
12. Jha, V. and Parvathi, K., 2019. Braille Transliteration of hindi handwritten texts using machinelearning for character recognition. *Int J Sci Technol Res*, 8(10), pp.1188-1193.
13. Ali, I., Ali, I., Subhash, A.K., Raza, S.A., Hassan, B. and Bhatti, P., 2019. Sindhi Handwritten-Digits Recognition Using Machine Learning Techniques. *IJCSNS*, 19(5), p.195.
14. Assegie, T.A. and Nair, P.S., 2019. Handwritten digits recognition with decision tree classification: a machine learning approach. *International Journal of Electrical and Computer Engineering*, 9(5), p.4446.
15. Challa, A., 2019. Automatic Handwritten Digit Recognition On Document Images Using Machine Learning Methods.
16. Ahmed, R., Dashtipour, K., Gogate, M., Raza, A., Zhang, R., Huang, K., Hawalah, A., Adeel, A. and Hussain, A., 2019, July. Offline Arabic

- Handwriting Recognition Using Deep Machine Learning: A Review of Recent Advances. In International Conference on Brain Inspired Cognitive Systems (pp. 457-468). Springer, Cham.
17. Rehman, A., Naz, S. and Razzak, M.I., 2019. Writer identification using machine learning approaches: a comprehensive review. *Multimedia Tools and Applications*, 78(8), pp.10889-10931.
  18. Jagtap, A.B., Hegadi, R.S. and Santosh, K.C., 2019. Feature learning for offline handwritten signature verification using convolutional neural network. *International Journal of Technology and Human Interaction (IJTHI)*, 15(4), pp.54-62.
  19. Garg, V., 2019. Handwritten Digit Classification using Machine Learning Models.
  20. HAMIDA, S., CHERRADI, B., RAIHANI, A. and OUAJJI, H., 2019, October. Performance Evaluation of Machine Learning Algorithms in Handwritten Digits Recognition. In 2019 1st International Conference on Smart Systems and Data Science (ICSSD) (pp. 1-6). IEEE.
  21. Declaration of Interest Statement

### **Declaration of interests**

- ☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
- ☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

**Siddiqui Mohammed Khaja Moinuddin, Dr. Suneet Kumar, Dr. Sayeed Ahmed, Dr. (Prof) Arvind Kumar Jain**

Figure

**GANGOTRI**  
Handwriting Sample Collection for Completion of Research Thesis in  
Ph.D. (Hons.) Science by Mr. Subhas Mohan Chandra Mandal (Research Scholar) 2018

|                          |                     |                    |            |
|--------------------------|---------------------|--------------------|------------|
| Name                     | Dr. Dinaksh         | Date               | 15/11/2018 |
| Sex                      | Male                | Date of Admission  | 15/11/2018 |
| School Name              | Dr. Dinaksh         | Signature of Hand  | Right Hand |
| Writing Skill (Language) | English             | Best Writing Skill | English    |
| Class                    | B.Sc. (Hons.) Level | English            | English    |

1. Write 1 to 20 (1 to 10 with Right Hand (1) to 20 with Left Hand)

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.  
11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

2. Write with both hands 'The quick brown fox jumps over a lazy dog'

The quick brown fox jumps over a lazy dog  
The quick brown fox jumps over a lazy dog

3. Write with both hands 'The quick very glibly jumps over the lazy dog'

The quick very glibly jumps over the lazy dog  
The quick very glibly jumps over the lazy dog

4. Write with both hands 'A to Z' in small letters.

a. b. c. d. e. f. g. h. i. j. k. l. m. n. o. p. q. r. s. t. u. v. w. x. y. z.  
a. b. c. d. e. f. g. h. i. j. k. l. m. n. o. p. q. r. s. t. u. v. w. x. y. z.

5. Signature with Left Hand

6. Signature with Right Hand

Dr. Dinaksh

Dr. Dinaksh

continued by copy-paste

2. Write any two languages with both hands.

The power of imagination makes us infinite.  
The power of imagination makes us infinite.

3. Write 'A to Z'.

A B C D E F G H I J K L M N O  
P Q R S T U V W X Y Z.  
A B C D E F G H I J K L M N O  
P Q R S T U V W X Y Z.

4. Signature.

Dr. Dinaksh

Dr. Dinaksh

**GANGOTRI**  
Handwriting Sample Collection for Completion of Research Thesis in  
Ph.D. (Hons.) Science by Mr. Subhas Mohan Chandra Mandal (Research Scholar) 2018

|                          |                     |                    |            |
|--------------------------|---------------------|--------------------|------------|
| Name                     | Dr. Dinaksh         | Date               | 15/11/2018 |
| Sex                      | Male                | Date of Admission  | 15/11/2018 |
| School Name              | Dr. Dinaksh         | Signature of Hand  | Right Hand |
| Writing Skill (Language) | English             | Best Writing Skill | English    |
| Class                    | B.Sc. (Hons.) Level | English            | English    |

1. Write 1 to 20 (1 to 10 with Right Hand (1) to 20 with Left Hand)

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.  
11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

2. Write with both hands 'The quick brown fox jumps over a lazy dog'

The quick brown fox jumps over a lazy dog  
The quick brown fox jumps over a lazy dog

3. Write with both hands 'The quick very glibly jumps over the lazy dog'

The quick very glibly jumps over the lazy dog  
The quick very glibly jumps over the lazy dog

4. Write with both hands 'A to Z' in small letters.

a. b. c. d. e. f. g. h. i. j. k. l. m. n. o. p. q. r. s. t. u. v. w. x. y. z.  
a. b. c. d. e. f. g. h. i. j. k. l. m. n. o. p. q. r. s. t. u. v. w. x. y. z.

5. Signature with Left Hand

6. Signature with Right Hand

Dr. Dinaksh

Dr. Dinaksh

continued by copy-paste

2. Write any two languages with both hands.

The power of imagination makes us infinite.  
The power of imagination makes us infinite.

3. Write 'A to Z'.

A B C D E F G H I J K L M N O  
P Q R S T U V W X Y Z.  
A B C D E F G H I J K L M N O  
P Q R S T U V W X Y Z.

4. Signature.

Dr. Dinaksh

Dr. Dinaksh

**GALCOTIAS**  
Handwriting Sample collection for Completion of Research Thesis in  
Ph.D. (Forensic Sciences) by Mr. Nishant Mohd Khaja Muzammil (Research Scholar) 2018

|                           |                                                |                    |            |
|---------------------------|------------------------------------------------|--------------------|------------|
| Name                      | K. Hemalatha                                   | DOB                | 17-11-2000 |
| Sex                       | Female                                         | Date of Admission  |            |
| School Name               | Basic School Akkad                             | Hand of Hand       | left hand  |
| Writing Skill (Languages) | English, Malayalam                             | Best Writing Skill | English    |
| Class                     | BSc. Forensic Science (Regular/Lateral/Expert) | Level              | learner    |

- Write 1 to 20 (1 to 10 with Right Hand 11 to 20 with Left Hand)

1 2 3 4 5 6 7 8 9 10  
11 12 13 14 15 16 17 18 19 20

- Write with both hands 'The quick brown fox jumps over a lazy dog.'

The quick brown fox jumps over a lazy dog.  
The quick brown fox jumps over a lazy dog.

- Write with both hands 'The quick orange goblin jumps over the lazy dwarf.'

The quick orange goblin jumps over the lazy dwarf.  
The quick orange goblin jumps over the lazy dwarf.

- Write with both hands 'A to Z' in small letters.

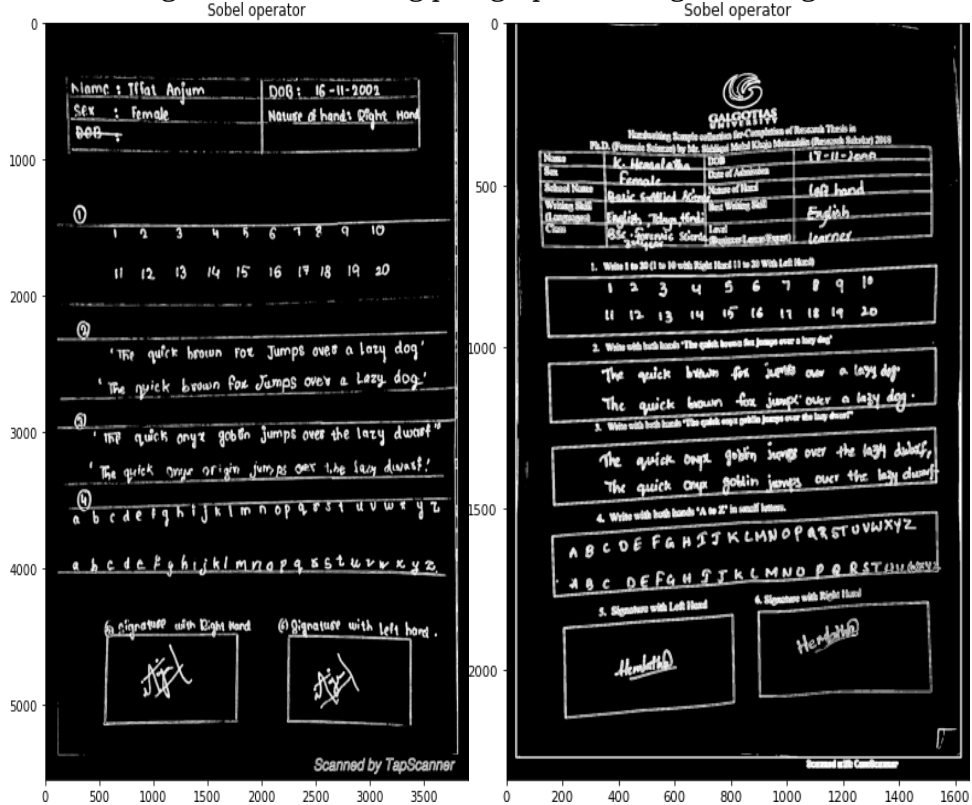
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z  
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

- Signature with Left Hand
- Signature with Right Hand

Hemalatha Hemalatha

Scanned with CamScanner

Figure 1. Handwriting paragraph with edges of images



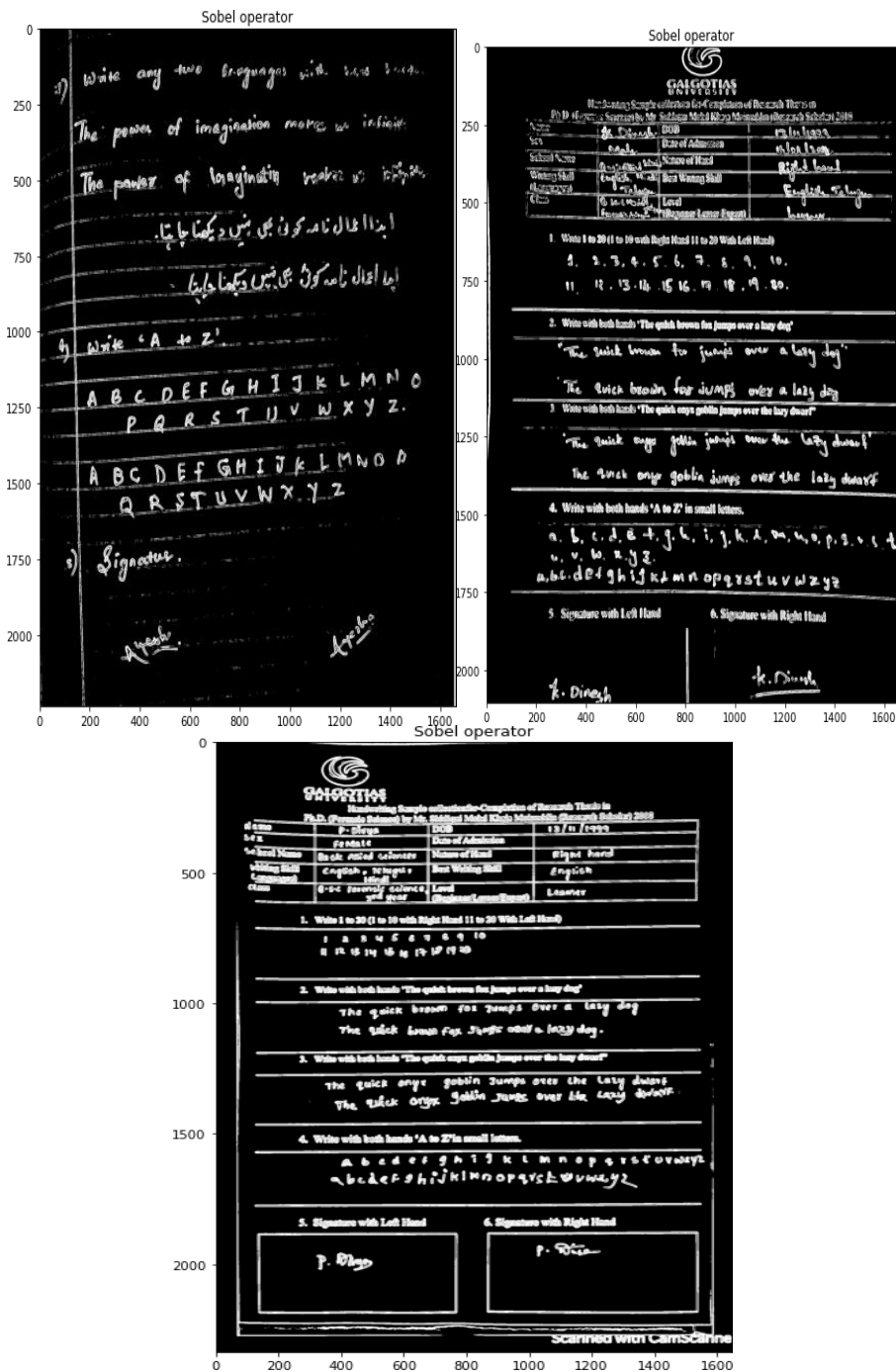


Figure 2. Sobel Operators Outputs with Dark Background



Bounding rectangles

|                   |                            |
|-------------------|----------------------------|
| Name: Illat Anjum | DOB: 16-11-2003            |
| SEX: female       | Nature of hand: Right Hand |

1. Write 1 to 20 (1 to 10 with Right Hand 11 to 20 With Left Hand)

2. Write with both hands "The quick brown fox jumps over a lazy dog"

3. Write with both hands "The quick orange goblin jumps over the lazy dwarf"

4. Write with both hands "A to Z" in small letters.

5. Signature with Left Hand

6. Signature with Right Hand

Scanned by /apScanner

Bounding rectangles

|                                            |                              |
|--------------------------------------------|------------------------------|
| Name: P. Dinep                             | DOB: 13/11/1999              |
| Sex: female                                | Nature of Hand: Right hand   |
| School Name: Basic School                  | Best Writing Skill: English  |
| Writing Skill (Language): English, Bengali | Level: Beginner/Lower/Expert |

1. Write 1 to 20 (1 to 10 with Right Hand 11 to 20 With Left Hand)

2. Write with both hands "The quick brown fox jumps over a lazy dog"

3. Write with both hands "The quick orange goblin jumps over the lazy dwarf"

4. Write with both hands "A to Z" in small letters.

5. Signature with Left Hand

6. Signature with Right Hand

Scanned with CamScanner

Bounding rectangles

|                                            |                              |
|--------------------------------------------|------------------------------|
| Name: K. Dinep                             | DOB: 13/11/1999              |
| Sex: female                                | Nature of Hand: Right hand   |
| School Name: Basic School                  | Best Writing Skill: English  |
| Writing Skill (Language): English, Bengali | Level: Beginner/Lower/Expert |

1. Write 1 to 20 (1 to 10 with Right Hand 11 to 20 With Left Hand)

2. Write with both hands "The quick brown fox jumps over a lazy dog"

3. Write with both hands "The quick orange goblin jumps over the lazy dwarf"

4. Write with both hands "A to Z" in small letters.

5. Signature with Left Hand

6. Signature with Right Hand

Scanned with CamScanner

Bounding rectangles

|                                            |                              |
|--------------------------------------------|------------------------------|
| Name: K. Dinep                             | DOB: 13/11/1999              |
| Sex: female                                | Nature of Hand: Right hand   |
| School Name: Basic School                  | Best Writing Skill: English  |
| Writing Skill (Language): English, Bengali | Level: Beginner/Lower/Expert |

1. Write 1 to 20 (1 to 10 with Right Hand 11 to 20 With Left Hand)

2. Write with both hands "The quick brown fox jumps over a lazy dog"

3. Write with both hands "The quick orange goblin jumps over the lazy dwarf"

4. Write with both hands "A to Z" in small letters.

5. Signature with Left Hand

6. Signature with Right Hand

Scanned with CamScanner

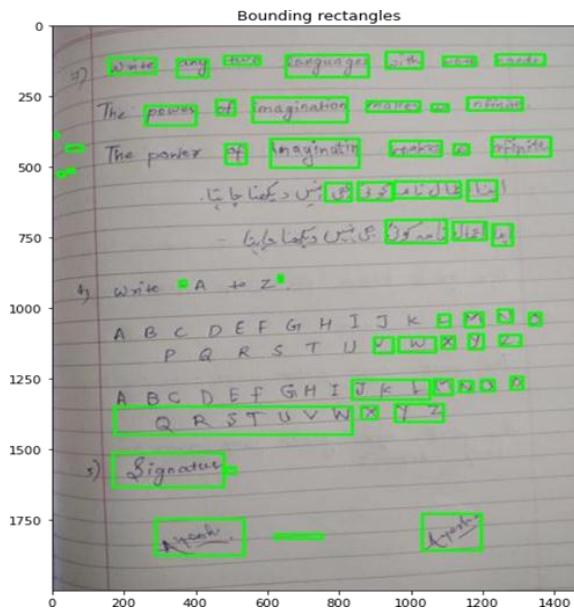
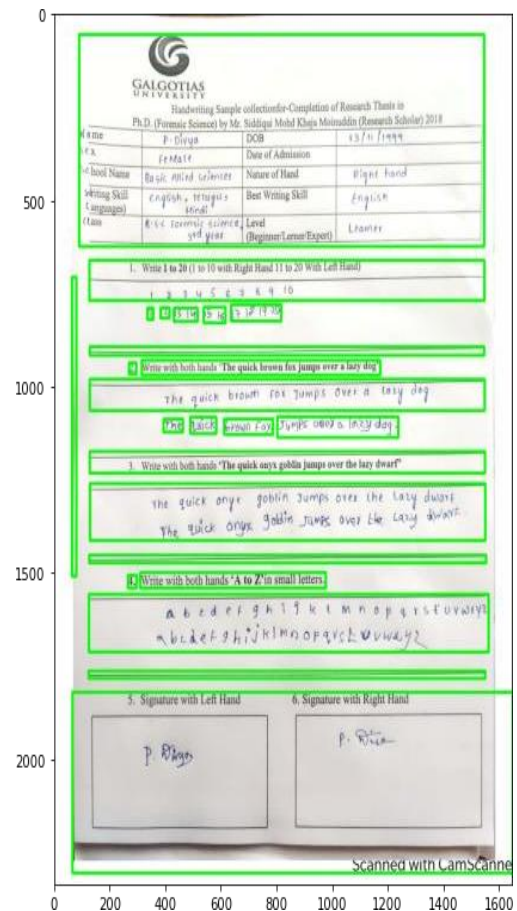
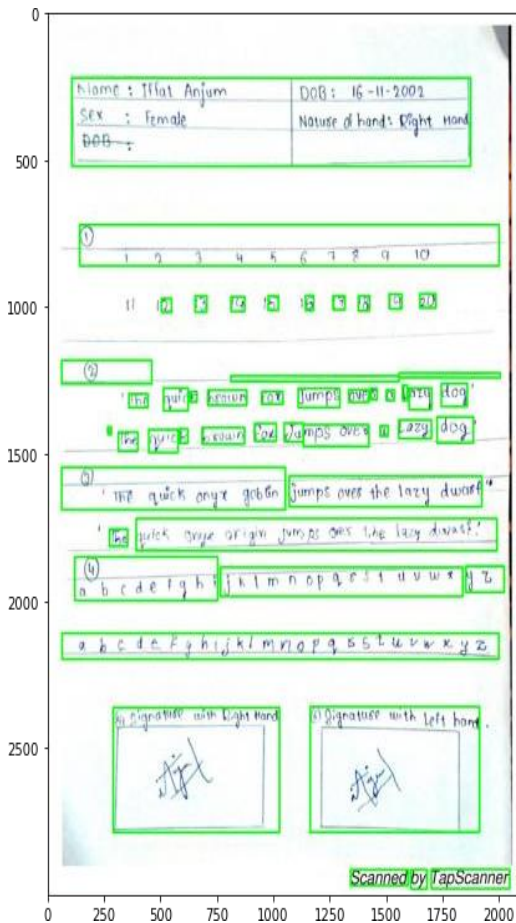


Figure 3. Bounding Rectangles Outputs with Dark Background



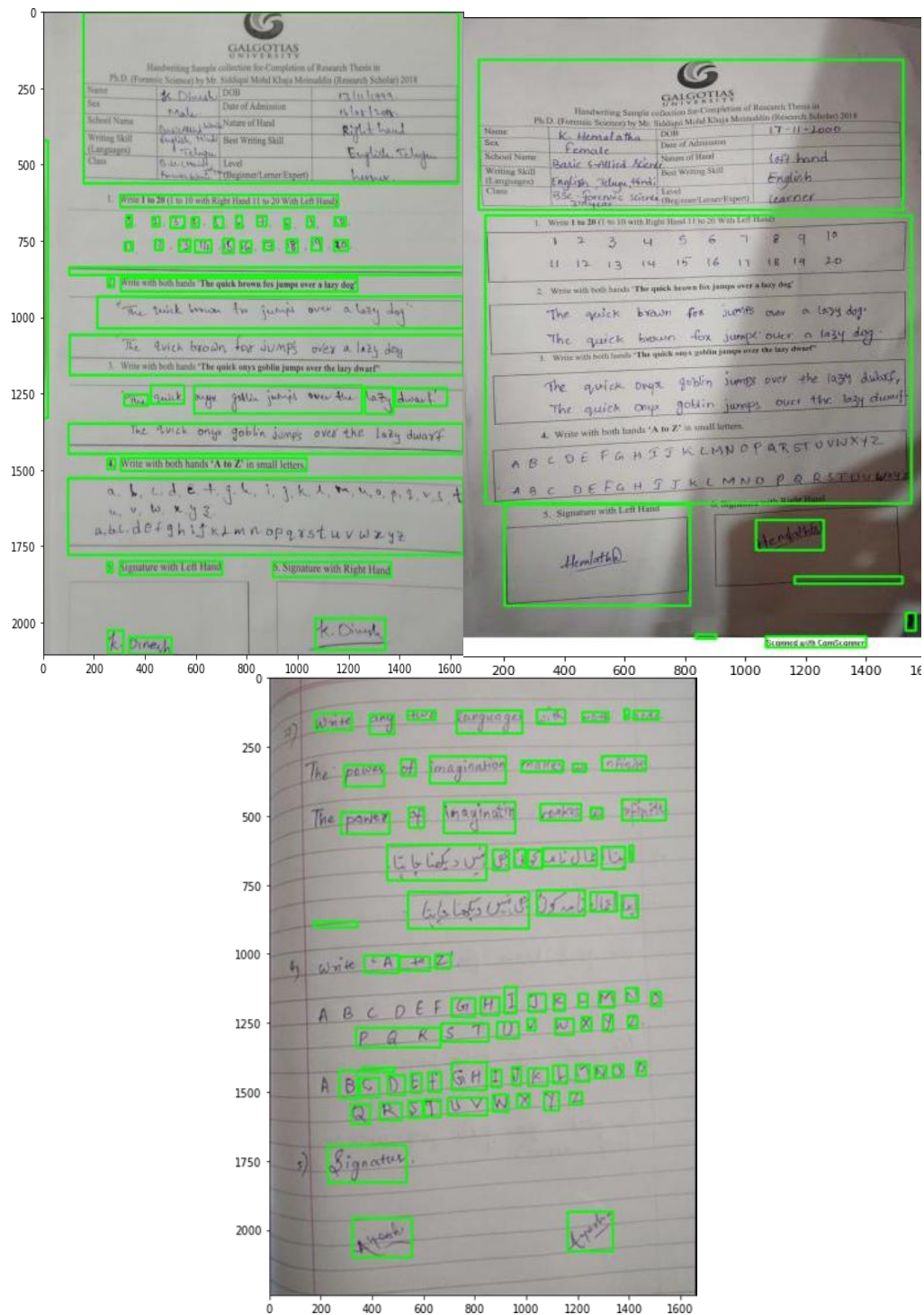


Figure 4. Analyse the handwriting features of ambidextrous persons