

Handwritten Devnagri Numeral Recognition using Chain Code Technique

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II. Methodology

In this research work we have used three different methods in our algorithms for identifying the object viz. Chain coding, Fuzzy c means distance technique and Majority voting System.

a. Chain Coding Technique: ¹ [HYPERLINK \l "Fai182" \l](#) ² Feature extraction plays a vital role for any Image processing application. Most common properties of any image are shape, texture and color. All these properties are very important for image identification and classification. Shape description plays imperative role in image classification. Most commonly there are two methods for shape description namely contour base and region based. Contour shape techniques only exploit shape boundary information. In region based techniques, all the pixels within a shape region are taken into account to obtain the shape representation, rather than only use boundary information as in contour base methods.

In this paper, contour based, the chain code description method was experimented for different hand written character recognition. Chain code means consecutive or successive two object points that may be in four directions as shown in figure I. In this way we get 4 features of a numeral and each numeral divided into four quadrants for its spatial relationship. Hence $4(\text{chain code}) \times 4(\text{quadrants}) = 16$ chain code features we used for this experiment.

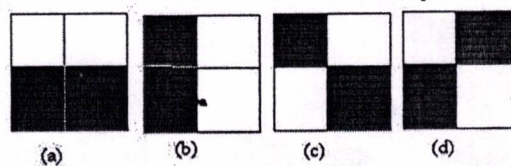


Figure I: Images of four chain code

b. Fuzzy c means distance technique:

¹ [HYPERLINK \l "Jyo19" \l](#) ³ ⁴ This algorithm works by assigning membership value between 0 to 1 to each data point corresponding to each cluster center. It is based on the distance between the cluster center and the data point. If the membership value is more, it means that the item is nearer to the cluster.

c. Majority voting System: ¹ [HYPERLINK \l "AFR02" \l](#) ⁵ Majority voting systems for decision combination, choices between selecting either the "consensus decision" or the "decision delivered by the most competent expert" strategy. We have used Max Voting.

Max Voting: If there are n independent experts having the same probability of being correct and each of these experts produce a unique decision regarding the identity of the unknown sample, then the sample is assigned to the class for which all n experts agrees. Assuming that each expert makes

Abstract: Identifying an object by using its shape is a simple task for human beings. But it is very difficult to implement such capability within a machine. Researchers tried to recognize the different shapes and object by designing different techniques and algorithms. Deep learning and neural network based algorithms were mostly focused by the researchers. In this research paper we have developed a system for handwritten devnagri numerals recognition using chain code technique. We have collected samples of handwritten numerals from different peoples from different regions and age groups. A proposed algorithm successfully identifies a numeral from these samples.

Keywords : deep learning, neural network, chain code.

I. INTRODUCTION

Human beings are born intelligent. They can identify an object very easily by past experience. For examples we can easily identify a mango from a group of different fruits. Generally we identify the object with its shape, color and other features. To develop this potential within a machine is a very challenging task. Researchers tried to impart this ability within a machine by developing different machine learning algorithms. Character recognition is another important challenge to the researchers. Human beings have different style, shape and curvature while writing the devnagri characters. The handwriting changes as the person grows. Therefore the characters written by four years kid will be differs from same that is written by 30 years matured person. Hence this is challenging task to machine to recognize these characters.

In this paper we have proposed an algorithm to recognize the hand written characters in devnagri. We have applied chain code technique to identify the hand written character.

We have also used fuzzy c means distance technique for compute the distance between query image and database images. We have used Majority Voting System for decision combinations.

a decision on an individual basis, without being influenced by any other expert in the decision making process.

III. Experiment

Data Collection: We have formed a local data used in which total 250 numerals exists. In our process of collection of data samples, we have randomly chosen five persons of different age group. We have asked him to draw each numeral five times. In this way from each person we have collected $10 \times 5 = 50$ samples. Thus there are 25 samples for each numeral in this experiment.

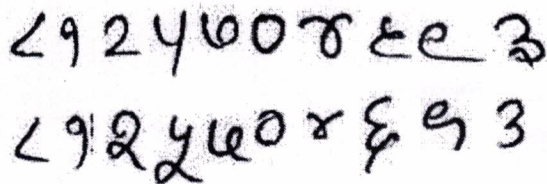


Fig. II. Sample of dataset

The Table below shows the filenames and numerals stored in it.

Table: .jpg filenames and Numerals

File Name (.jpg)	Numerals Stored
1-25	8
26-50	1
51-75	2
76-100	5
101-125	7
126-150	0
151-175	4
176-200	6
201-225	9
226-250	3

Algorithm:

Input: - Input handwritten Devnagari numeral in jpg format for recognition.

Output: - recognize inputted numeral.

- Step 1. Read numeral as an object in jpg image to be test.
- Step 2. To obtain shape of object use 'canny' function and obtain bounding box.
- Step 3. Divide shape of object (i.e. bounding box image) into four quadrants (segment).
- Step 4. Compute histogram by counting chain codes for each quadrant (segment).
- Step 5. Repeat following steps while not end of images from database

- i) Read first image of numeral from database.
- ii) Obtain histogram for this numeral image by repeating steps 2,3,4.
- iii) Compute fuzzy c means distance for test numeral image histogram of four quadrants and database image histogram of four quadrants respectively and store that into array.

Step 6. Display images of numerals which have minimum fuzzy c means distance.

Description of Algorithm

In first step we read handwritten Devnagari numeral in.jpg image format, it may be from 0 to 9. In second step we have used 'canny' function to obtain sharp shape or boundaries of that numeral and remove extra unnecessary space of image from four sides. It is a perfect bounding box as shown in fig III.

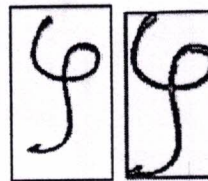


Fig. III Perfect bounding box of image

Step three divide these bounding box into four quadrants for spatial relationship, to recognize upper right side (first quadrant) of bounding box in the same way to recognize upper left side (i.e. second quadrant), lower left side means 3rd quadrant and 4th quadrant means lower right side. These quadrants are for recognition of direction of numeral that is which side has turning part of numeral or which side has an angle part of numeral. In fourth step we count the four types of chain codes for each quadrant of a numeral. One to four steps are for inputted numeral object image and Fifth step is looping step. This step consists of three sub steps. First and second sub steps are same as 2,3,4 for database numerals object image and third sub step computes fuzzy C means distance which is a minimum distance for inputted numeral image of four quadrant and database numeral images of four quadrants respectively and store that into array. In last step sixth, we display numerals which has minimum distance and result as shown in table below.

The Table contents the rows in ascending order of the distance from the query image to the image retrieved from the database of 250 image files. If the image name is between 1 to 25, we get correct result as our query image is for the numeral 8 in devnagri.

In this table we have compared 10 different image files with 25 samples of the numeral 8. For instance in first column 2.jpg is compared with our 25 samples. The column shows mostly matched files numbers (with minimum distance from query image) in ascending order.

Table: Filenames with nearest distance to query image

Image Name Result must be Between(1 to 25)									
Query Image for Character 8									
2.jpg	8.jpg	13.jpg	18.jpg	22.jpg	1.jpg	25.jpg	6.jpg	14.jpg	23.jpg
2	8	13	18	22	1	25	6	14	23
3	16	3*	11	1	21	10	10	19	158
13	7	2	24	21	22	6	25	12	5
15	17	15	133	15	2	179	179	4	167
21	13	21	14	13	13	131	131	72	230
1	3	16	179	3	3	178	24	1	67
16	2	1	19	2	15	24	11	21	75
8	15	8	12	8	16	11	133	22	29
22	1	22	4	16	8	133	178	15	31

7	21	17	72	17	7	18	18	2	155
17	22	7	1	7	17	224	224	13	135
70	70	70	21	70	70	33	33	3	51
4	4	4	6	14	14	122	22	16	36
14	14	14	22	19	19	9	1	8	169
19	19	19	13	12	12	1	21	182	241
12	12	12	3	4	4	22	122	7	199
72	72	72	131	72	72	21	15	17	20
182	182	182	15	182	182	15	13	70	143
94	94	94	2	94	94	2	9	94	237
133	133	133	10	24	11	13	3	18	229
11	11	11	8	11	24	3	2	24	81
24	24	24	16	133	133	16	8	11	190
18	18	18	182	18	18	8	16	133	130
6	6	6	25	6	6	17	17	179	137
10	10	10	17	10	10	7	7	6	177
20	20	20	20	20	20	18	18	19	3
5	5	5	5	5	5	7	7	6	22

Last two rows in the table show success rate and failure rate respectively.

IV Result and discussion:

We have tested 10 images of same numeral 8 and build a table showing the nearest images to the query image. As per the majority voting we get 90% result for the proposed algorithm. We cannot obtain result for test numeral image 23.jpg which shows in below fig IV (a). This image represent 'Eight' in devnagari like this '<' and fig. IV(b) also shows same numeral but we have obtained the result for this image. This is because 23.jpg image has more noise as compared to 25.jpg image. These two numerals are of the same individual.

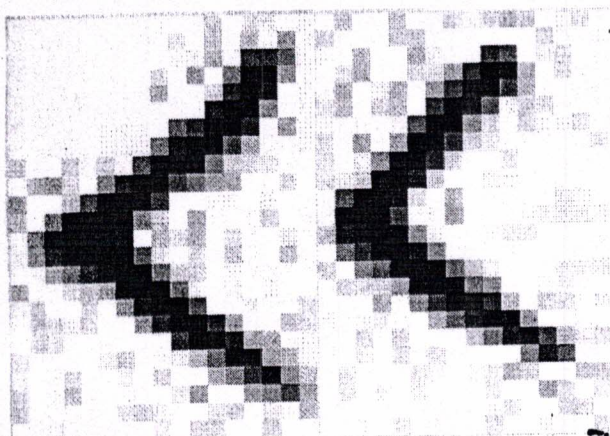


Fig IV (a)

Fig IV (b)

V. Conclusion

After testing the algorithm for presented experimental research, we conclude first that the system can be empower successfully to recognize the handwritten devnagri numeral with the help of chain code. We also conclude that the similar research method can be further extended to recognize any

character such as devnagri letters stored in image format. The proposed system has achieved the highest accuracy of 90% to recognize the numeral as we have collected data samples from different persons of different age groups.

REFERENCES:

- [1] Mihai Mocanu Faiq Baji, "Chain Code Approach for Shape based Image," *Indian Journal of Science and Technology*, vol. 11, no. 3, pp. 1-17, January 2018.
- [2] Sriraman Kothuri, Srikanth Lukka Pulipati Annapurna, "Digit Recognition Using Freeman Chain Code," *International Journal of Application or Innovation in Engineering & Management*, vol. 2, no. 8, pp. 362-365, August 2013.
- [3] Kiran Khatter, Meena Tushir Jyoti Arora, "Fuzzy c-Means Clustering Strategies:A Review of Distance Measures," *Springer Nature Singapore Pte Ltd.* , pp. 153-162, 2019.
- [4] Suhas S. Satonkar, Prakash B. Khanale Ajay B. Kurhe, "Shape based image retrieval through fuzzy c means classifier," *SRTMU's Research Journal of Science*, vol. 2, no. 1, pp. 1 - 12, 2013.
- [5] H. Alam, M.C. Fairhurst A.F.R. Rahman, "Multiple Classifier Combination for Character Recognition: Revisiting the Majority Voting System and Its Variations," *Springer-Verlag Berlin Heidelberg* , pp. 167-178, 2002.
- [6] E.Srinivasan, S.Himavathi J.Pradeep, "Neural Network based Handwritten Character Recognition system without feature extraction," in *ICCCET*, 18th & 19th March, 2011, pp. 40-44.
- [7] Darshan Trivedi , Sagar Satra Rohan Vaidya, "Handwritten Character Recognition Using Deep-Learning," in *IEEE*, 2018, pp. 772-775.
- [8] Shalika, Vinam Tomar, Priyanka Gupta Megha Agarwal, "Handwritten Character Recognition using Neural Network and Tensor Flow," *International Journal of Innovative Technology and Exploring Engineering*, vol. 8, no. 6S4, pp. 1445-1448, April 2019.

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