ISSN:2320-0790

An International Journal of Advanced Computer Technology

Handwritten Document Editor: An Approach

Sumit Nalawade[1], Rashmi Welekar[2], Raj Dugar[3]

M.Tech. Student, Department of Computer Science & Engineering, Shri Ramdeobaba College Of Engineering & Management, Nagpur, India [1]

Assistant Professor, Department Of Computer Science & Engineering, Shri Ramdeobaba College Of Engineering & Management, Nagpur, India [2]

Module Lead, Persistent Systems Limited, Nagpur, India [3]

Abstract: With advancement in new technologies many individuals are moving towards personalization of the same. The same idea inspired us to develop a system which can provide a personal touch to all our documents including both electronic and paper media. In this article we are proposing a novel idea for creating an editor system which will take handwritten scanned document as the input, recognizes the characters from the document, then proceed with creating the font of recognized handwriting to allow user to edit the document. We have proposed use of genetic algorithm along with K-NN classifier for fast recognition of handwritten characters and use of marching squares algorithm for tracing contour points of characters to generate a handwritten font.

Keywords: K-NN classifier, Handwriting Recognition, Genetic Algorithm, Contour Tracing, Marching Squares Algorithm, Image Processing.

I. INTRODUCTION

World is inclining towards personalization. Everything from small things like a cell phone cover to big things like a costly car can be customized as per our needs then why should our printed documents look like everybody else's? Out of billion very few people voluntarily read junk mail. In fact, many of such mails never get opened because the printed address on the mail suggests receiver an unwanted advertise. There is a possibility of some personal letter might be considered as junk mails just because they are in printed manner. Many computer emulated handwriting font have come to rescue in such situations, still they fail to provide our document a personal touch and we are now in the era where writing without computer is considered as too old school.

The motivation behind this concept was simple we wanted our documents whether in electronic form or in printed form to look like they are ours.

In this article we are proposing our idea to solve above mentioned problems. We are proposing a system which will not emulate random handwriting font but will use one's handwriting and create its font. Our system will take a scanned sample of user's handwriting as input. It will extract individual characters from the sample and recognize the characters. Further it'll trace the contours of each characters and a font form those contour points will be created. Then this font will be used with an editor to edit existing documents or produce new documents.

We have broadly formulated our concept into a two-step process:

A. Extraction and Recognition of Characters.
B. Contour Tracing and Font Creation.

Before moving to the process specifications we need to take a look at the related work which is going to be very helpful in implementing this concept.

II. RELATED WORK

As the proposed system is two-fold we'll be looking at few character recognition techniques as well as some contour tracing techniques.

A. Character Recognition Techniques

Many authors propose use of Artificial Neural Networks and Support Vector Machines for the character recognition process. Some suggest use of Genetic Algorithm for getting faster and better results. Here we provide a short review of some techniques.

Yonghong Song [1], gives details about multi-language document images where many different types of characters need to be recognised. His document consists different

languages such as Chinese, Japanese, English and also their combination. It uses genetic algorithm for feature fusion and patch type classification. At last uses markov random field model for post processing.

Rahul Kala [2] in his works deals with graph theory and studies various fonts generated by graph. He uses different styles in which characters can be written and uses offline handwritten recognition for identifying characters by converting them into graphs. Finally implemented the genetic algorithm to optimize the results.

S. Impedovo and F. M. Mangini [3] proposed a novel technique for handwritten digit classification which uses binary coded genetic algorithm for optimization and speed up of the K-NN classifier. The main idea behind using genetic algorithm is to reduce number of comparisons by generating best cluster solutions form existing cluster population.

Vijay Patil and Sanjay Shimpi [4] use neural network for character recognition in which they created character matrix and key is suitable network structure. They also use back propagation algorithm to calculate errors and modifying weights.

B. Image Contouring Techniques

Marching Squares Algorithm [5] is one of the popular techniques used for image contour tracing. With the use of a 2x2 grid marching on the edge of the image and pushing each point to list of contour points this algorithm traces the contour of characters.

In another approach A. M. Baumberg & D. C. Hogg present a contour tracking techniques using active shape model. [6] The method demonstrate a combination of shape model or the point distribution model with dynamic filtering to track a non-rigid body in motion.

III. PROPOSED WORK

As mentioned earlier this concept employs a two-fold approach, the detail specification of these steps is provided in this section.

A. Extraction and Recognition of Characters

Extracting individual characters from a handwritten document is a tricky task since it is not the primary objective of our research, for simplification we will be taking a complete character set where in each character is isolated from each other. Fig. 1. shows the sample we'll be considering for our initial procedure.

Fig. 1. Standard character set of English language

This character set contains 26 upper case letters, 26 lower case letters, 10 digits and 32 standard special symbols. For recognition of character we'll be using K-NN classifier [7] together with genetic algorithm.

i) Feature Extraction: Accuracy of any classifier depend on feature extraction mechanism. To capture shape information in detail we'll be applying the character image to different grids. At each point the gradient direction and magnitude is calculated using sobel operator. The directions obtained are resolved into 8-directional chaincodes using parallelogram law for vector decomposition (Fig. 2.).

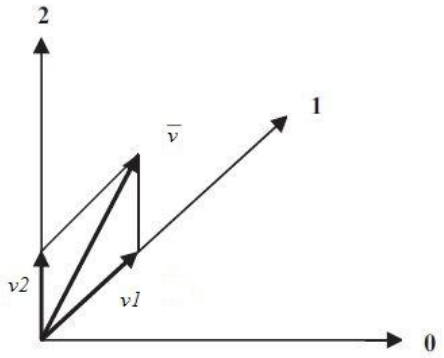

Fig. 2. Vector decomposition of gradient

For each cell in the grid a histogram is built with gradient magnitude contributing to its respective direction. Then a threshold is applied to histogram to get 8-bit binary gradient vector. Every such vector from each level concatenated together to form a feature vector.

For comparison purpose we'll be using Sokal-Michener [8] dissimilarity measure. Further weighting at different levels can be used to improve accuracy.

ii) Cluster Formation: Clustering of training samples will be done with application of 1-NN rule. A predefined threshold is set. For each input pattern if the dissimilarity measure is less than the threshold the pattern is assigned to current cluster and cluster center is recalculated.

If the dissimilarity measure is greater than the threshold new cluster is created with the input pattern as the cluster center. This process is repeated for all the input patterns for training the classifier.

This approach is applied to every characters training set creating clusters for each of them. Note that there can be varying number of cluster will be formed for every character. The nature of this algorithm suggest that this can be applied in parallel to all characters training set.

iii) Genetic Algorithm: A binary coded genetic algorithm [9] is used to design best cluster solutions. The methodology is as follows:

- Choose even number of individuals form the population and select two parents which are best among them.
- Applying crossover to the selected individuals and mutating others, adding them back to previous gives us offspring population.
- Evaluate fitness value to each individual in the offspring population based on the fitness test of the objective function.
- Select predefined number of individuals based on their fitness value and assign them as population for the next iteration.
- Repeat above steps till the stopping criteria is satisfied. When stopped return current population as the best cluster solution.

B. Contour Tracing and Font Creation

We find it convenient to use marching squares algorithm for our system due to its simplicity and fast tracing. The algorithm is simple:

- Find an opaque pixel on the edge of the image as a starting point for the algorithm. Store it as current pixel to be analysed.
- Consider a 2x2 mask which includes the current pixel under consideration usually top left or bottom right pixel.
- When mask is applied we get 16 possible combinations of 2x2 mask because each one of the 4 pixels can be either 0 or 1.
- According to the position of pixels decide the direction to move the current pixel.
- Repeat the steps until we reach the point where we started.

The 2x2 mask used in marching squares is shown in Fig. 3.

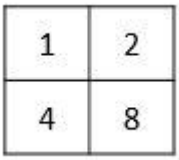

Fig. 3. Mask of marching squares

The conditions for directions are well explained with the help of the figures 4 to 9.

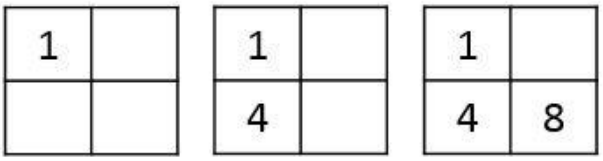

Fig. 4. Direction: UP

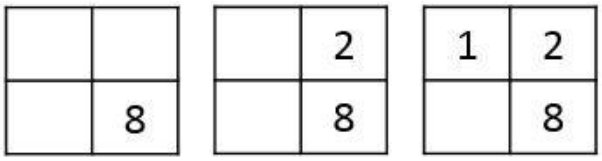

Fig. 5. Direction: DOWN

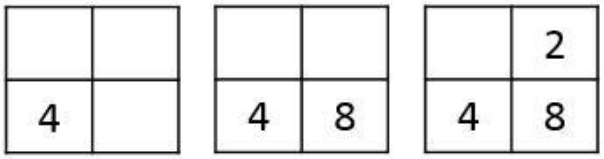

Fig. 6. Direction: LEFT

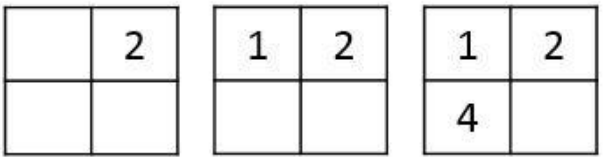

Fig. 7. Direction: RIGHT

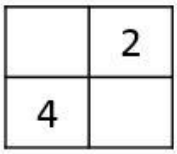

Fig. 8. Direction: LEFT if coming from UP else RIGHT

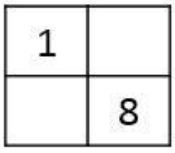

Fig. 9. Direction: UP if coming from RIGHT else DOWN

C. Workflow of the Proposed System

Fig. 10. provides a snapshot how the system will work after implementation.

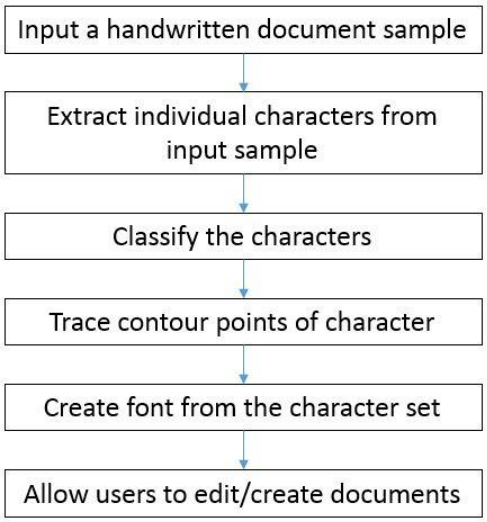

Fig. 10. Flow of the Proposed System

Our Handwritten Document Editor will ask user for the input sample of his handwriting. After accepting the input (Assuming the input does not contain noise) our system will extract individual characters from the sample using connected component labelling. Once the character is extracted it is presented to a trained K-NN classifier for classification alongside the character image will be scaled and presented to marching squares algorithm. The algorithm will return contour points which will be stored with reference to recognised characters. Form the contour points of all characters a true type font will be created using any existing tool. That font will be made available to users for editing existing documents or creating the new ones.

IV. CONCLUSION

As a step forward in the personalization of computer generated documents, in this article we have proposed a system for handwritten document editing. A binary coded genetic algorithm will provide fast recognition desired by the system and simplicity of marching squares algorithm will make it easier to implement the primary version of the system. Further research can be done trying out combination of various techniques for more accuracy and performance. If found a way to provide proper security, handwriting can be a key to future of one's identity on digital as well as printed media.

REFERENCES

[1] Yonghong Song, Guilin Xiao, Yuanlin Zhang, Lei Yang, Liuliu Zhao, "A Handwritten Character Extraction Algorithm for Multi-language Document Image", International Conference on Document Analysis and Recognition 2011.

[2] Rahul Kala, Harsh Vazirani, Anupam Shukla, Ritu Tiwari, "Offline Handwritten Recognition using Genetic Algorithm", IJCSI Vol. 7, Issue. 2, March 2010.

[3] S. Impedovo, F. M. Mangini, "A Novel Technique For Handwritten Digit Classification using Genetic Clustering", International Conference on Frontiers in Handwriting Recognition, 2012.

[4] Vijay Patil, Sanjay Shimpi, "Handwritten English character recognition using neural network", Elixir International Journal, 2011.

[5] Maple, C. "Geometric design and space planning using the marching squares and marching cube algorithms". Proc. 2003 International Conference Geometric Modeling and Graphics: 90–95.

[6] A. M. Baumberg & D. C. Hogg, "An Efficient Method for Contour Tracking using Active Shape Models", University of Leeds, School of Computer Studies Research Report Series, Report 94.11.

[7] H. Zhang, A. Berg, M. Maire, and J. Malik, "SVM-KNN: Discriminative nearest neighbor classification for visual category recognition", in Proc.CVPR, 2006.

[8] R. R. Sokal and C. D. Michener, "A statistical method for evaluating systematic relationships", University of Kansas Scientific Bulletin 38, 1958, pp. 1409-1438.

[9] D. Beasley, D.R. Bull, R.R. Martin, "An Overview of Genetic Algorithms: Part 1, Fundamentals", University Comput. ,Vol 15,n.2, 1993, pp. 58-69.

[10] S. Impedovo, G. Pirlo, R. Modugno, A. Ferrante, "Zoning Methods for Handwritten Character Recognition: An Overview", Proc. 12th ICFHR, Kolkata (India), 16-18 Nov. 2010, pp. 329-334.

[11] N. Otsu. "A Threshold Selection Method from Gray-Level Histograms", IEEE Transactions on Systems, Man, and Cybernetics, 1979, 9(1): 62-66.

[12] Sumedha B. Hallale, Geeta D. Salunke, "Twelve Directional Feature Extraction for Handwritten English Character Recognition", International Journal of Recent Technology and Engineering, Vol 2, Issue 2, May 2013.