



Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Transformation of handwritten text into a barcode and performing steganography using neural network

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ABSTRACT

The proposed idea is to convert the handwritten text into computerized language of any font. The converted so called text or image transformed to BAR code symbols. Thus the first stage of maintaining secrecy is done and this is encoded with the thermal image that consists of Tri-Color (R,G,B). As the receiver gets a stego image for getting the original text which is converted into barcodes. The barcodes are decoded from the thermal image. Later the barcodes are converted into the desired message or text which transmitter wants to send to the receiver.

INTRODUCTION

The purpose of this project is to convert handwritten text into computerized text or language of any font. The converted text is then transformed into BAR codes. These BAR codes are then encoded into a stego image. A stego image consisting of secret information which is only known to sender and the receiver. The secret information is converted into BAR codes for better security of the information. By using this MATLAB program the background stego image which is used for hiding the secret information is removed and only the secret information is left out with the receiver in the form of BAR codes. The MATLAB program takes handwritten English characters as an input, process the character, train the neural network algorithm[3], to recognize the pattern and modify the character to a computerized version of the input.

This project is aimed at developing software which will be helpful in recognizing characters of English language. The proposed idea is only restricted to English characters and to an image with plain background. It can be further developed to recognize the characters of different languages and to different images. It includes the concept of neural network.

1. System Modeling and Design

A system model represents aspects of a system and its environment. The purpose of designing a document is to examine the reasonable view of architecture, sequence diagram, flow diagram, user interface design of the software for accomplishing the movements such as pre-processing, extracting features and displaying the text present in the images.

1.1 Block Diagram and Algorithm

OCR stands for Optical Character Recognition. OCR technology basically converts scanned images of printed text into machine-encoded text or computerized text that can be easily read by the application user.

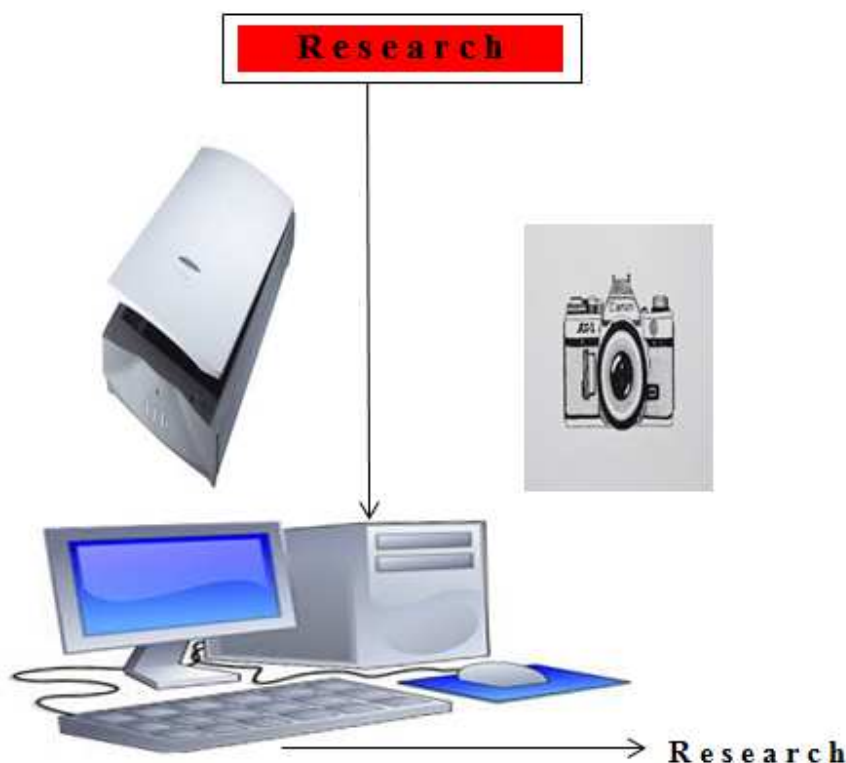


Figure.1 Block Diagram

OCR technology has to go through the following steps:-

1.1.1 Scanning

Scanning involves selection of printed document. The content is fed into the OCR software with the help of a scanned copy of a particular text. The scanned copy of the required text is transformed in an optical image for future processing.

1.1.2 Conversion & Recognition

Conversion involves clearance of background noise that is nothing but the unwanted background of the optical image. The background of the image is removed which can produce noise in future processing of the image. Conversion includes segmentation of the whole image into small bits. These bits collectively frame letters of recognized words which are already present in scanned text.

1.1.2 Printed Output

Printed output is the final stage of the OCR technology. It includes storage of recognized numbers and words into software memory. As a result, the software will produce the stored image along with the scanned image as an output of the OCR technology.

2. Architecture of the System

Architecture of OCR technology includes the following processes:-

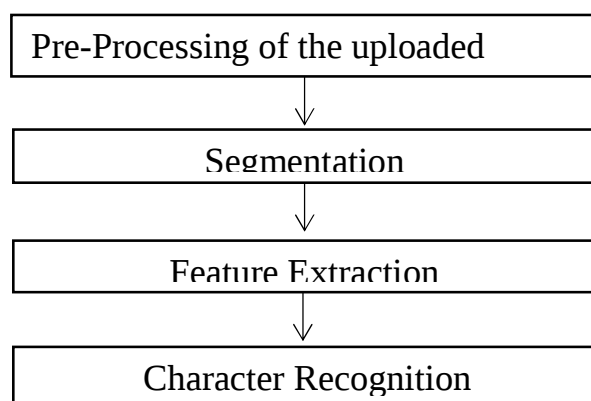


Figure.2 Architecture of the System

3.1 Input Image

Input image can be a hand-written text or printed text form from books, magazines etc. The image can be loaded into the system in two ways:-

- a) By taking photo of the required text from a book, magazine, etc.
- b) By providing a scanned copy of required text to the system.

3.2 Pre-Processing

The pre-processing is a series of operations performed on scanned input image. The role of pre-processing is to segment the interesting pattern from the background. Generally, noise filtering, binarization process, smoothing and normalization should be done in this step.

Pre-Processing includes steps like:-

3.2.1 Image Conversion

Image conversion is a process where the optical image of the required text is transformed into Gray Scale Image. An optical image is converted into Gray Scale image by using thresholding technique. Thresholding technique decides a threshold level depending upon the threshold level of the color in an optical image is converted into black & white color called binary image[1]. If the gray level of the image is greater than threshold image then it is considered as black in color and if the gray level is less than the threshold level then it is considered as white in color. Thresholding technique separates text from background. Thresholding method helps in memory saving.

3.2.2 Noise Removal

Scanning process may include some kind of noise to the digital image which leads into poor recognition of alphabets from original text. Pre-processing takes care of this problem by two methods. Smoothing is the process which includes polishing of the characters present in the digital image by filling and thinning process and also by smoothing the edges of alphabets. Normalization removes graphical feature of the text and bring all the characters of the image into one standard size and provides proper slant with rotation to the alphabets of the image [1].

3.2.3 Segmentation

Segmentation is the process of separating printed text from the unwanted white background. Segmentation of an image includes removal of text which may consists of alphabets, numbers, diagrams and background color in it[1]. Segmentation removes each part of the image and stores it separately in the system memory and later works upon each part to get desired output. It chops the text of the image into small bits of alphabets which in future can be recognized word from the original scanned copy.

3.2.4 Feature Extraction

Feature Extraction is extraction of characteristics of alphabets from the original text. Feature Extraction makes a detailed note of features present in each alphabet. Ex- Intersections, lines, angle of intersection etc.

3.2.5 Recognition

OCR system depends upon Tesseract algorithm for recognition of alphabets present in the image and words can be recognized by the dictionary of Tesseract algorithm. Recognition is done by converting the character bits into a stream of bits for recognition of letters of a particular word. After the recognition of words the entire text is completed the output is generated by displaying only the text part of the original image in the output screen.

4. Features Extraction of Character Recognition

Feature extraction based on character geometry extracts different types of line that collectively form a particular alphabet or a character. It is mainly concentrate upon the geometry of the character that is position of various types of lines intersecting each other in a particular angle. It includes few steps.

4.1 Universe of Discourse

Universe of Discourse is the initiation step of character geometry. It forms a matrix which will be the smallest matrix. It is designed for each character present in the optical image. It includes positions of various line segments of a character so that while recognition these features of an alphabet can be matched with characters present in Tesseract dictionary.

4.2 Zoning

Zoning is done after universe of discourse is formed for each character. It divides the entire image into numerous windows of same size. Then feature extraction is performed on individual windows one by one. The division of image into various number of windows is done to get fine details of character.

4.3 Starters

Zoning divides an image into windows. Each window consists of particular amount of pixels in it. Starters are the pixels which has only one neighbor pixel according to the alphabet. Starters gathers and keeps a record of all the starters present in a character.

4.4 Intersections

Intersections includes a pixel having more than one neighbor. It means crossing of two line segments. Intersection is the important character feature for any alphabet used in the text. It uses two properties:-

a) Direct Pixels

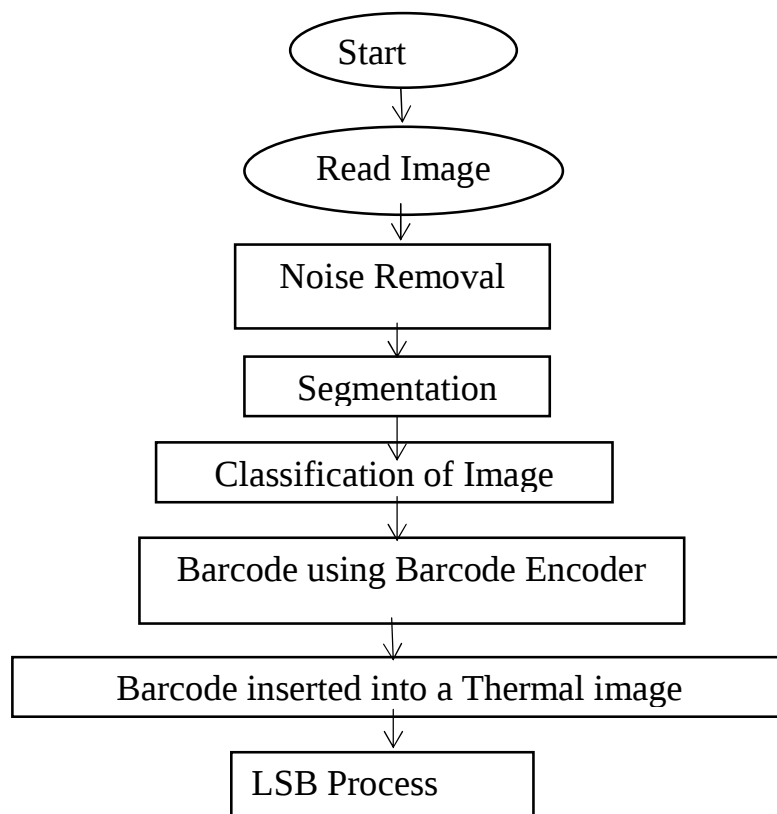
Direct pixels are those pixels who have direct contact with the reference pixel. It must have more than one neighboring pixels with respect to the reference pixel.

b) Diagonal Pixels

Diagonal pixels are those pixels who do not have direct contact with the reference pixel. But they comes under one particular position or neighborhood. These pixels are not connected to each other. Now for finding the number of direct pixels to the reference pixels. Pixels are classified as 3 direct pixels, 4 direct pixels and 5 direct pixels. All the neighboring pixels must be direct contact with the reference pixel. Any one of the pixel is contact with adjacent pixel and also contact with reference pixel, then it is called as an intersection.

4.5 Minor Starters

Minor Starters are formed when a reference pixel has more than two neighbors. Minor Starters are occurred in two ways, if the reference pixel has intersection and if the reference pixel have no intersections. Character geometry includes feature extraction like number of horizontal lines, number of vertical lines and number of left/right diagonal lines with respect to reference pixel. The length of line segments, angle of intersection and total area captured by the character in an image.

5. Flow Chart:

Start: OCR Technology will initiate by choosing text content required by the user to be transformed into OCR machine- Encoded bits.

Read Image: In this step OCR system takes picture of the selected content or it directly undertakes the scanned copy of required text. The required text can be printed form or handwritten text. It converts scanned copy into an optical image.

Noise Removal: Noise removal includes removal of background image. Background image of the image can produce noise and will unnecessarily consume system memory. Therefore unwanted contents from the image is removed.

Segmentation: In the segmentation process the optical image is chopped into small pixels of characters[4]. According to the collection of some bits will produce a word which can be recognized from the original text.

Classification of Image: Classification of Image includes conversion of optical image into (Gray-Scale) image. An optical image can be converted into gray scale image with the help of thresholding technique. Thresholding is a process which transforms an optical image consisting of various colors in it into only two colors that is black and white. Thresholding is done by selecting a threshold value. If the gray level is more than the fixed threshold level the particular portion is converted to black color. If the gray level is less than the threshold level the particular portion is converted into white color. The second stage of classification of image include conversion of gray scale image into binary image. It is done by assigning black portion of the optical image as 1 and white portion of the optical image as 0. The optical image is converted into digital image consisting (0&1) in it.

Adding Stego Image: Later after the image processing, the same will be directed to face the enhancement process. The above said images were converted to BAR code and this barcode is used as the cover image to carry the information signal. The stego image confuse the interpreter and provide security to the data transmitted. And in the receiver, the destination receiver is identified by authenticating the password key provided to open the stego image. Once the stego image is recovered, the first stage of secrecy is maintained and the output, a barcode data will be

appeared, which again provides additional security. After which the feature extraction is done to get back the information signal.

Barcode Encoder Based Cryptography: Barcode and image processing are bringing together to create barcode steganography. The required information to be inserted into a thermal image is converted as barcode using barcode encoder. At the same time decoding process takes place, the data will not misinterpretation and it will simulate the original data. Currently, barcodes are used to secure the information.

The output of the text to barcode conversion process is shown in Table:1

Type of Message	Original Message	Bar-code Output of the Original Message
Alphabets	"Research"	
Numbers	"12345"	
Special Characters	"!@#\$\$%^&"	

LSB Process: LSB Technique inserts information into a thermal image in which pixels are modulated by bits of the secret information. The changes built after cannot be heard by the human being clarity system. Information can be the text, image, numbers, audio or video. LSB can 65,536 bits in a 256x256 pixel by inserting one bit in each pixel.

6. Feature Extraction

Feature Extraction includes extraction of features of symbols from the text. Feature extraction is done by using two methods.

6.1 By using Character Geometry

Character geometry consists of some measurements and dimensions of alphabet present in English characters. According to which it recognizes character from scanned copy and compares dimension of each alphabet with respect to recognized alphabet for the identification of correct alphabet from its dictionary.

6.2 By using Gradient Features

Gradient refers to colors. Gradient features resembles features of color used in the text. Gradient features are taken from gray scale image of the text[2]. It is done because the text present in the original copy may be of any color. For simplification it converts the text to black color and the remaining free space to white color. By default the output of original text will be printed in black. After recognition of alphabets from the software dictionary the required text present in the image is displayed in a text file as an output.

CONCLUSION

The proposed method that uses feature extraction using character geometry and gradient technique for handwritten characters from a scanned image or picture of the required text is presented. This project is restricted to recognize the English characters. Our future work is to recognize the characters of different language. Pre-Processing of image using edge detection, normalization and smoothing are the ideal choice for degraded noisy images. In this project English characters were trained by using neural network algorithm by extracting features from sample images of each characters. The proposed methodology has given good results for both images containing handwritten text written in different styles and scanned image of text, with various background. The system is developed in MATLAB, evaluated set of images containing handwritten text.

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