

OPTICAL CHARACTER RECOGNITION

*Project report submitted in fulfillment for the requirement of the
degree of*

BACHELOR OF TECHNOLOGY IN ELECTRONICS AND COMMUNICATION ENGINEERING

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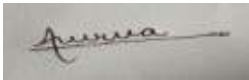
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DECLARATION

We hereby declare that the work reported in the B.Tech Project Report entitled **“Optical Character Recognition”** submitted at **Jaypee University of Information Technology, Wanknaghat, India** is an authentic record of our work carried out under the supervision of **Dr. Vikas Baghel**. We have not submitted this work elsewhere for any other degree or diploma.



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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.



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Project Guide

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ABSTRACT

Optical character recognition (OCR) based recognizing system changes the scanned input data into the text form which is editable for the user. This report tries to focus on the description to recognize the English language's hand written letters. For example, how to distinguish between English-language letters and other Latin-language letters. And what are the difficulties have been faced while trying to recognize the English words as compare to other languages. The various different stages from which the input goes through while the whole process are: transfer a picture from the computer or laptop, the method called segmentation method within which we have a can have tendency to do the extraction of the details of the image recognizable, recognition of the text and also the latter step that is the last process or final method within which the output which we get through the initial stages go through the checking of the error and correcting that errors in the final stage. This project report is the regarding front end supplied with the recognition with the help of that a user will miserably simply add or enhances the segmentation done by the entire system for the input. In this report we have concluded two methods of machine learning. First one used is template matching technique and other one using the neural network techniques for optical character recognition, work has been done proposing the best technique used for the optical character recognition based upon the accuracy and efficiency between both the techniques while performing character recognition on the English script's hand written letter and on alpha numeric numbers.

CHAPTER 1

INTRODUCTION

The Report of this project is about recognizing the characters from the picture given as input to the system and recognizing editable text from them. It is a process of classifying the text from the images to the other editable text. This whole system include few steps through which the image goes to the final stage which are segmenting the image into few segments, extracting the features of the image, and classifying them after at the end.

Content catches changes over Analog content based assets to advanced content assets. And afterward these changed over assets can be utilized in a few different ways like accessible content in lists in order to distinguish reports or pictures.

As the principal phase of content catch a filtered picture of a page is taken. Also, this checked duplicate will frame reason for every single other stage. The following stage includes usage of innovation Optical Character Recognition for changing over content substance into machine reasonable or lucid arrangement.

The system gets the picture which is a picture of the text or a text which is written on the paper and that text Is converted into the machine readable text. Then Optical character recognition system process the picture analyzed into the small components for observing the words and letters. And again those analyzed character components further divided into components to compare with the dictionary letters.

Matlab is a tool used in computer where the question or problem and answer to those problems can be meant in scientific comments. To usage of Matlab induces the use of algorithms, graphs, expressions to get the solution of the problem. It provides us the platform which can solve the problem in no time and very easy to use for the problems to use mathematically.

The Optical character recognized document's text is written in word file which is again put into the research software. That content is utilized with respect to scanning or getting that data for search further. For measuring the accuracy there are different ways which have impact on the efficiency or accuracy rates.

There are a lot of uses of an optical character recognition system it not have limits till just recognizing the image into the text form. Because this system can, in various ways, provides the character recognition's efficiency or accuracy that is less than what a typist or copy writer can achieve this is often presumed that it has a small validation for the documents related to historical events. For an instance if the information requirement for the purpose is provided by the OCR system there can be compromises on the accuracy of the engine. Today's engines work upon the new technologies like artificial neural network technology to analyze the documents and to analyze the difficult hand written documents easily. It works for the irregularities of ink, handwriting, or the strokes of the words written. The OCR engine combines the data for the different algorithms to give a combined result for the better accuracy than other methods.

Artificial Neural Network (ANN) is a system which functions like the human brain. In a way which neurons get trained by time by our activities similarly the engine is trained like human brain then we take work from it. This is method is very efficient so that's why it is now used broadly in various fields such as recognizing patterns, optimization, market analysis, artificial intelligence. ANN would be very useful for the computing processors for various tasks like compressing the data, diversification, computational problem solving, character recognition etc. Artificial neural network has lot of positives over the other traditional methods. ANN gives numerous preferences in character acknowledgment adjusting a setting of the human insight yet in next to no way. In the disconnected character acknowledgment framework, the counterfeit neural system has approached as the precise and quick devices for a stage accomplishing the higher effectiveness of exactness. Arrangement techniques have been suggested to manually written character acknowledgment since the mid 90s. These techniques incorporate strategies

dependent on Artificial Neural Networks, Kernel Methodologies including Support Vector Machines and different classifier blend are utilized.

We have taken the fundamental thought of this task from different research articles referenced in the reference area. We have decided to utilize the picture preparing Toolbox of MATLAB programming to explain the picture's pre-handling phase of the manually written character acknowledgment as writers in different research did. In a back propagation Artificial Neural network method is utilized for performing ordering and acknowledgment assignments. Notwithstanding, I have additionally checked the exhibition of different techniques like Lamstar neural system and Support Vector Machine classifier for this issue yet in the report we have just thought about the ANN. Additionally, we have determined the normal execution in the 10 by 10 sub-grids of their unique network saw from the picture of every individual character, yet in this work we have edited the character pictures into two distinct sizes of 50 by 70 pixels and 90 by 120 pixels at first and got the all-out normal incentive into the 10 by 10 sub-frameworks for the underlying and in the 15 by 15 lattices for the last part.

This report is categorized as mentioned here. We have taken the template matching method into the consideration for the first half of the project and work upon the artificial neural network in latter stage of the project. Results of both the methods have put in the report and comparison between both the methods have also mentioned.

Potentially can be used for:

Indexing – this implies the Optically Recognized content is the yield into an unadulterated word content record that is being contribution to the searcher. That content is then utilized for the content looking of the source. In any case, the client would not have the option to see the perceived content they are conveyed the examined picture of the checked record. This prompts the feeble exactness of the OCR while it despite everything conveys the archives to the requesting body and gives looking through capacities. In any case, along these lines of looking through just discovers the information not doubtlessly the

letters and sentences on those are visible in variant terms or we can say it just shows the document in a different perspective.

Full text retrieval – in this type the Optically Recognized document or text is created as above but the most of the work is finished in the down stage end stage to agree for complete words. The exploration ends are appeared with its featuring other than the page picture showed. This is a significant expansion to the ordering step from the side of the client. A case of this is the Forced Migration of the online advanced library.

Full text portrayal – in this the optically perceived content is noticeable to the back end client as a portrayal of the report initially given. In this the OCR must be proficient or the client would not be certain about the data asset. All sort of designing issues in the conditions of the perceivability of the genuine is taken in this choice and this is incidentally utilized with characteristic or something to that affect. The significant factor is the exactness or proficiency and this heads to the majority of the undertakings need to check and right perceived content to guarantee the precision or effectiveness is appropriate for distribution with time and worth ramifications.

Full text portrayal with xml mark-up – in this sort the perceived yield is introduced to the back end client with design of the yield, structure or information included by means of the XML increase. In the vast majority of situations where perceived content is to be given there would be a base measure of xml work never really structure or external layer. This procedure typically requires the greatest measure of human obstruction from the entirety of the alternatives accessible here as framework rectification is in all probability with included xml increase of the information in a few or other manner. There are numerous instances of advanced content assets with XML increase that are found through the Text Encoding Initiative taken here. The ventures referenced there additionally tell about the assortment in phases of xml increase which is conceivable making it conceivable to fluctuate movement to coordinate the tasks scholarly prerequisites.

1.1 Literature review

The United States postal stamp organization is using Optical character recognizing machinery to figure out the mails from early 60's based upon technological devices mainly by the prolific inventor Jacob Rainbow. In 1965 they started planning to make a complete banker organization of US taking this technology, a step that in future revolutionized the bill payment systems in the United Kingdom. Then in 70's India steps were taken toward this technology by Dr. Singha at Indian Institute of Technology, Kharagpur. A systematic alignment analysis system for recognition of Hindi language is presented in Singha's Ph.D. report. Another this type of system's development was initiated by Palit and Chaudhuri or we know them as Palit and Chaudhri. A team consisting of Prof. B. B. Chaudhari, U. Palit, M. Mitre, and U. Garaian of Indian Institute of Technology, Delhi, invented the one of its kind market level resource or product for printed Hindi Recognizing system in India. The similar type of instrument has been given to Center for Developments for the Advanced Computation (CDAC) in 2000 for commercial sales of the product and it was marketed as "Chitrakan". A methodology is based on the correction of Shirorehkha is given by Chaudhari and Paul with the exception that the angle of these kind of headlines tells about the angle of the full document. Firstly the interconnected components in the document are done with the job. The requirement of slant point is taken by adding of the considerable number of edges between the level and the lines joining the principal pixels of the left line fragment and the last pixels of the correct lines sections of every one of the line. There are not many archives known as multi slant records in which the given content lines are not resemble to one another. This methodology is an expansion of the given for slant estimation in multi slant reports. Dias and Chandra additionally gave a fats and content autonomous slant estimation procedure which was more reliable based upon the mathematical morphology. Das and Chaudhari proposed another technical term for identification and segmentation of the hindi character which were printed by a machine. Das and Chaudhari proposed another technique for segmentation of identification and machinery-print Hindi characters.

In the research papers we have read about the hybrid feature based on zone extraction scheme towards the recognizing of various other scripts which included English and other handwritten south scripts. The character's center is calculated and the numbered photo or character photo is then segmented in to quarter equal zones. An arranged at the midpoint from the character's inside to the pixels present in the segment of the zone is introduced. These steps are in order or in the line was repetition for all the boxes present for the zonal box of (10 highlights). There would be barely any networks vertical box having free fore end pixels. Consequently highlight estimation of these lattices or zone section in the highlights vectors is zero. This technique is bit by bit rehashed for the total zone present in the numeral or character picture. For getting the prospects, the zone-based or matrix based half and half methodology is conceivable for what's to come. in different printed styles. Acknowledgment of transcribed content is secluded type of the Arabic language characters is accomplished completely in both hypothetically and essentially tests works with certain acknowledgment rate was there obviously. The exploration report gives acknowledgment results including counterfeit neural system's presentation, preparing and testing acknowledgment precision and effectiveness rate that is set apart by the disarray frameworks, ANN preparing time and number of ages for different instances of online element extraction and disconnected component extraction and making a likeness examination between the entirety of the cases contemplated. The fundamental goal of this paper is to consider, examine, and build up another online English Handwritten Character Recognition framework. Pre-handling steps that plans on the web and disconnected information to be a contribution to on the web and disconnected character perceiving procedure and it additionally improves the online and disconnected element extraction it is on the grounds that it upgrades the quality and highlights of the image – if there should be an occurrence of disconnected preprocessing and post preparing and the online course of events in the event of internet preprocessing. In this task pre-preparing incorporates two stages or two sorts which are known as internet preprocessing and disconnected preprocessing. This work leads to the character recognition for other languages further and research is somewhat

similar of all other languages too. This can be used to convert the news articles, fax mails into the text format. In order to analyze words, characters, sentences or phrases we can use multiple ANN for diversification. It can be used in post offices for reading postal address and in libraries.

Before this framework can be utilized, the asset materials must be filtered utilizing an optical picture scanner (and at times a specific circuit for this reason load up utilized in the PC). To peruse in the page as a bitmap picture (an example of spots). Programming which can perceive the checked picture is additionally required.

The OCR machine then tries to scans these to sub divide between the scanned photos and the typed data determines what words or numbers have given in those dark and bright areas of the picture. In starting time of the recognition systems system compare these pictures against stored bitmaps of the specific fonts for example Times new roman etc. The try or trial results of those kind of character recognition or pattern recognition systems worked in establishing system's reputation for inaccuracy and inefficiency.

New generation OCR engines take multiple algorithms of neural network's technologies into consideration to determine or observe the skew edge, the line of continuity and dis-continuity beyond the written characters, and the back of the text. Taking into the consideration of the irregularities of pen and paper, ink and then the recognition system make a guess about the character. The OCR system averages all the values from different machine codes to give a one reading solution.

OCR system can understand a large number of fonts of different languages, however recognizing a handwritten text of different shape and size is still an issue for the system, therefore added need of artificial network neural power is needed. Engineers are thinking of variant ways to improve language and hand written recognition. As discussed above, we can use neural network to remove this limitations.

Neural systems are useful, on the off chance that we have an enormous dataset for preparing and learning reasons for the neural system. Datasets are one of

the most significant things when making another neural system. Without legitimate dataset, preparing the neural system is futile. There is likewise an adage about preparing of fake neural system: "Waste in, refuse out". Which implies the sort of information we will provide for the dataset to prepare the yield will be that way. Things being what they are, how would we get the outcome? After the image is filtered, we characterize handling calculation, which will remove significant characteristics from the image and guide them into a dataset or better to state database. Imported qualities will have numerical qualities and will be normally put away in clusters. With these qualities, neural system can be prepared and we can get a decent final product. The issue of all around characterized datasets lies additionally in deliberately picked calculation characteristics. Subtleties are significant and can huge effect the outcomes and ends. The most significant of penmanship for neural system methodologies are:

- I. Negative picture of the image given, wherever the in-put is zero for black, and one is for white, values between these 2 values tells the relevancy of the pixels.
- II. The X coordinate position, counts the pix by the left aspect of the picture, and of the middle from the littlest rectangle grid that might is well made with all "1" pix within the grid recognized.
- III. The Y coordinate position, counts pix from all-time low of the pic, of the grid
- IV. Dimension between the pix of the grid.
- V. Peak between the pix of the Grid.
- VI. Full area of "1" pix within the recognized picture.
- VII. The taken together X coordinate position of "1" pix related with the middle of the grid. This point can have a -ve price if that picture is left-heavy as it might within the case for the letter of English L.
- VIII. Mean of the Y Coordinate of whole "1" pixels related with center of mass of the grid and sub-divided by the peak of the grid.
- IX. RMS value of the X coordinate pix length is measured in half-dozen purpose. This information can have a high price for photos whose

pixels square measure wide separated within the y coordinate as it will happen for W and M.

- X. RMS of the Y coordinate pix values is calculated in seven purpose is calculated.
- XI. Mean result of the even and vertical separations for each "1" pixel as estimated in upper advances. This incorporates a good price for corner to corner lines that moves from left to high right and - ve cost for slanting lines from high one side to another.
- XII. Mean For the square X coordinate distance tunes the Y coordinate difference of each "1" pix. These gave the co-relation of the Y coordinate variance with the X coordinate.
- XIII. Mean square Y coordinate's distance the X coordinate distance for each "1" pix.
- XIV. Sum of these Y Coordinate points of corners encounters as calculated in on top of. This kind of feature can provides a high price if there are additional corners at the highest of the grid, as within the "Y".

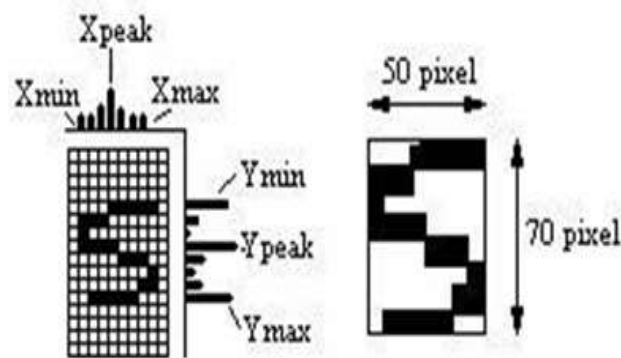


Fig 1.1 Example of image defined attributes

1.2 Scope of the Project

On-line software for written words recognizing has become a commercial product for the market which is used in various fields. Among these products there are the input devices like digital assistants for any person such as running Palm OS, and Google's Google lens. The Apple Newton patented this product. The algorithms made for this product are such that the power, speed, and side of each line segment the given value is known to the useable data. Also, the users have the flexibility to choose between the fonts and the type of letters they wanted to use. These methods cannot be used in paper recognition system that is one of the limitation of the method used for this product. Accuracy rates upto 90% can be achieved for clean hand writing and 80% for slightly disordered text but that small in accuracy leads to large number of errors combined together which limits the application of this technology.

We can develop OCR further for helping the visually impaired people and the main aim of this research is to find the hand-written words with the use of neural networks. We should try to train an artificial neural network with a large data set which can be used to solve the problem of the visually impaired persons. This neural network can solve the issue which will recognize the text by itself and then can spell it loud for the persons who can't see the words. These codes could be written in Matlab and with use of GUI we can develop useable software.

1.3 Benefits and Applications

BENEFITS

First benefit of these engines is that they have low cost entry barrier for getting information from these they are very cost efficient and anyone can use them.

Expense of licensing is low – The license pricing for the engines like OCR and OMR are very low. Which is very good for its growth? For example, if we are using 10 workstations for the OCR and OMR purposes we would need only one license for all of them combined.

Its shares the recognized file in the word font or we can say the xml format which we can use with any other application easily.

APPLICATIONS

There are few industries in our market in which the paper work is the most essential part of their work.

- Banking sector , credit card companies, history archives library etc
- For preserving and conserving the old history documents or banking documents for example which could highly vulnerable

OCR is used at lot of places where a lot of classical barcoding checking is has to be done but it should be done more efficiently than other classical methods. There are place where it used very frequently like Bank checkpoint, license checking and many other places like these too.

Optical character recognition can be useful at places for health care where lot of work has to be kept in the paper form which can save a lot of time of the nurses and doctors. Form the processing techniques used in optical character recognition we can get the processed data and we can store the data at the storage area for the usage, so that information related to every patient coming to the hospital is recorded and its safe with the institute. So as a result the staff of the health care institute can focus on their work to treat parents.

Optical character recognizing softwares are widely used in various fields like educational institutes, finance related institutes. OCR has helped in creating a lot of data put on line from the documentation that were used initially which helped banking sector, finance sector, students and many other fields too. Invoice imaging applications is an application which is used in various fields of the economic sector to keep the track of the future economic activities to stack up the track of the data useful for the predictions. For the government institutes and private freelance institutes or organizations, OCR simplifies the way to understand and grab the data among the different technological uses which are still in the development stage, today there a lot of industries and organization which are using the modified versions of the OCR which are

highly efficient, as well as their focusing more on the recognizing of the handwritten documents which could be recognized easily, and other technological inventions which are highly related to the OCR engine is barcode scanning softwares which are efficiently in ware houses and in retail stores. To make these more efficient and highly useable works has to be done on the accuracy of the software.

CHAPTER 2

CHARACTER RECOGNITION SYSTEM

Character Recognition is a pattern disconnected recognition framework that is created to spot either the printed characters or particular sudden spike in demand for composed characters. It is a segment of the example recognition framework that typically manages the conviction to change over composed contents or composed material into computerized type. The primary preferred position of this methodology (putting away these composed writings into computerized type) is that it needs less house for capacity of composed contents and the advanced structure may be kept up for additional references without contacting the specific content over and over. Character recognition has wide applications like in imparting administrations to type the sends as per their goal abuse the addresses that are composed on the envelope, in repairing old original copies, in advanced mark confirmation, and far extra.

2.1 Classification of character recognition system

Character Recognition is defined as the process of recognizing the characters from the image. It basically includes recognizing the letters, symbols and the numbers present in the image. This means that character recognition techniques symbolically identify the personality of the image. Basically, the character recognition techniques include taking the information from the image and implementing them to the recognition system.

Character recognition is very big field which can be classified as told further:

1. On-line character recognition
2. Off-line character recognition

From the data received from the above process the system can be divided into categories as shown

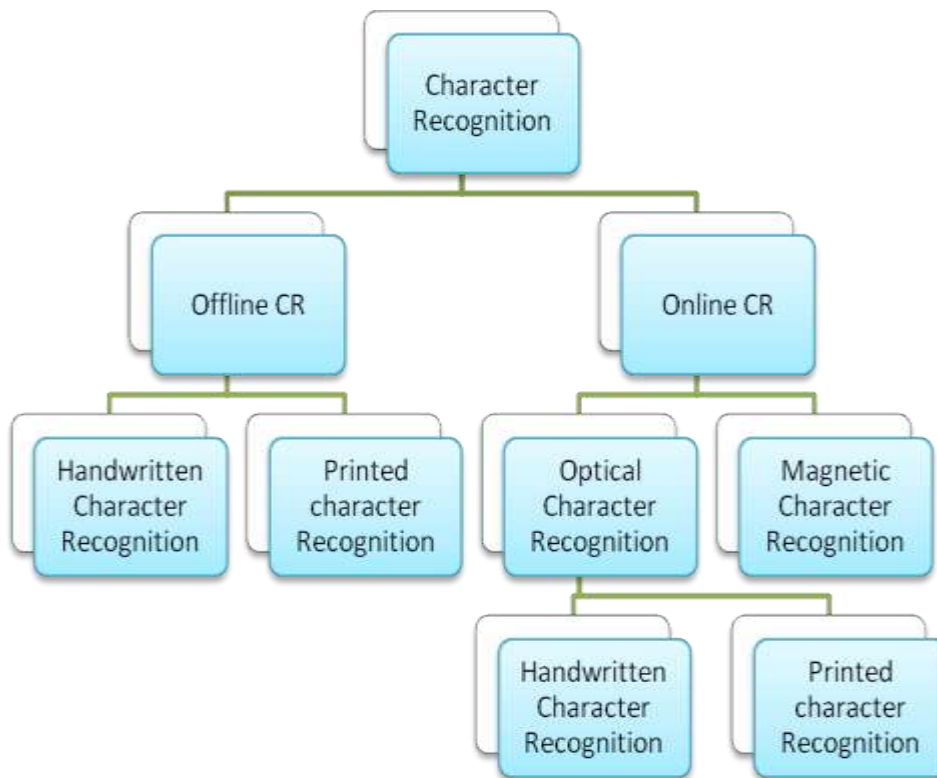


Figure 2.1: Categorization of the character recognition

2.1.1 Character recognition system (ON-LINE)

Online character recognition is procedure of perceiving the characters as that is written in the content. Also, the on-line character recognition framework has the continuous talk information tests of the frameworks that utilization on-line recognition that grasps the Apple Newton, Palm Pilot, bit screen mobiles. If there should arise an occurrence of on-line composed character recognition, the composed information from the picture is perceived and is put away in a carefully structure, further this advanced structure is gone through the character recognition framework with the goal that the information gathered can be perceived. By and large, the imaged is put away in the framework and afterward it is prepared.

2.1.2 Character recognition system (OFF-LINE)

On opposite hand, offline recognition could be a system that acknowledges by capturing a picture of the characters or written text that square measure to be recognized. Off-line recognition systems' potential lies in fields like document process, mail direction, and checks verification. Offline recognition of handwriting means to recognize words that are being examined from a paper sheet and square measure and keep them in form of greyscale. Once this is done it becomes a challenge for other additional process for permitting the advance processes however, offline knowledge doesn't support real-time discourse info. This distinction produces a problem of difference for processes to be performed.

The Character recognition (off-line) can diversify into two additional categories

i. Magnetic Character Recognition (MCR)

ii. Optical Character Recognition (OCR)

i. Magnetic Character Recognition (MCR)

Every character is written with ink; therefore in MCR the device for reading acknowledges every character as a unique character and the force of every character. MCR is usually employed in banks for checking authentication service and additionally for change entries within the group action statements.

ii. Optical Character Recognition (OCR)

Optical Character Recognition is known as the identification of character received by scanning the image or by taking picture. Characters are generally pictures divided into and are handwritten or printed, of different sizes and different shapes. OCR is divided in printed characters and handwritten characters. Recognizing the characters of handwritten pages are harder to do from the printed characters this is due to the different designs in handwriting. For printed characters to be recognized, it is a bit easier as the pictures are in somewhat same format.

2.2 Steps in Character Recognition Process

1. Image acquisition.
2. Pre Processing.
3. Segmentation.
4. Character recognition.
5. Post processing

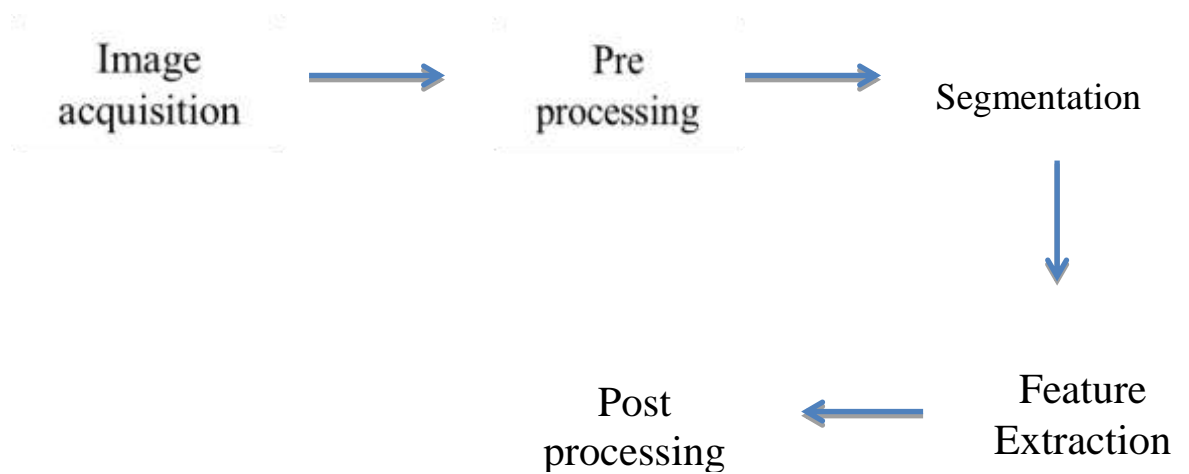


Figure 2.2: Process for recognizing the characters

2.2.1 Image acquisition

Image acquisition is generally the process in which we recover back our picture stored in the sources. Generally, we use some source with some hardware for the image procession. This is called as the first step of image processing as without the image is being processed there are no further steps to be performed.

The input energy that is coming from the scanned image is changed in a signal using voltage signal obtained and the sensor which is which is responsive this type of electrical signal when detected. The waveform is voltage output that is obtained from the output signal and the quantity which is digitally observed from the digital signal and digitizing the output.

There are a few types of sensors that are used in image acquisition.

By using one sensor: Photodiode, known single sensor, is used for obtaining two dimensional image. The motion of the image will be horizontal and vertical direction. One direction motion is given by rotating and the perpendicular direction is given by vertically moving.

By using sensor strips or a line sensor: This strip usually provides the imaging in a single way and the other strip which is providing the image direction of another strip is perpendicular.

By using an array sensor: This is done by arranging the sensors two dimensionally. This is useful as the sensors present respond in such a way by projecting the energy from the light on the sensors.

Output from the sensors get converted and are swept into a form of video signals which is then changed digitally and a digital image.

2.2.2 Pre Processing of Image

It is the common name for operations done with the images at the lowest level of abstraction. Both the input and output of the pre-processing are images with some severity. The image obtained after the process are the same as the old picture from the sensors. The severity of the image is in form of a matrix containing mostly brightness.

Main purpose for pre-processing an image is to improve the properties of the data collected. This process helps in enhancement of some of the attributes of the image that are to be used for other steps.

The geometric transformations of images (rotation, scaling, and translation) are classified among the pre-processing methods here since similar techniques are used.

Adjacent pixels corresponding to one of the objects in real images have essentially to have the same or similar brightness value, so if there is a distorted pixel it can be picked and be changed.

2.2.3 Image Segmentation

Picture division is characterized as the procedure wherein a computerized picture is divided into different sections (sets of pixels, picture objects). The objective of the division is to disentangle the portrayal of the picture into increasingly significant and simpler to break down the structure.

Picture division is fundamentally used to find the articles and limits in pictures. Limits incorporate (lines, bends).

All the more accurately picture division is the procedure wherein we appoint a name to each pixel in a picture with the end goal that pixels having similar names share certain attributes.

Picture division brings about a lot of portions that by and large contain the whole picture. Or on the other hand it is a lot of forms that are separated from the picture.

Every one of the pixels that are available in a specific area are comparable as for a portion of the attributes or figured properties, for example, shading, force, or surface, and so on. Neighboring locales present are fundamentally unique as for the equivalent characteristic(s). At the point when these properties are applied to a pile of pictures (regularly in clinical imaging) the subsequent shapes delivered after the picture division can be utilized to make 3D recreations of the picture.

There are some methods used for segmenting the pictures are discussed below

Thresholding Method: - These techniques are the least complex strategies for a picture to section. In these techniques, the picture pixels are partitioned as for their force level. These strategies are utilized for the pictures having lighter articles than their experience. These techniques can be chosen physically or naturally (can be founded on earlier information or data of picture highlights).

Edge Based Detection Method: - In the edge-based discovery strategy division strategies are essentially founded on the quick change in the power estimation of a picture in light of the fact that the single force esteem doesn't give a bit of good data about the edges. Edge recognition strategies helps in finding the edges where either the principal subordinate of the power has a more prominent incentive than the specific edge or the subsequent subsidiary has zero number of intersections. In this division technique, right off the bat all the edges of the picture are distinguished and afterward they are associated together to shape an article limit to portion the necessary areas.

Bunching Based Detection Method: - - In the grouping based location strategy there are the strategies that section a picture into the bunches which contain pixels with comparable attributes. The strategy that partitions the information components into groups with the goal that the components in a similar bunch are practically like each other is called Data bunching. The grouping is

isolated into two fundamental classifications: Hierarchical technique and Partition based strategy. In various leveled strategies, the idea depends on trees. The foundation of the tree in this strategy speaks to the entire database and the interior hubs of the tree speak to the bunches. Then again, the parcel based strategies use enhancement procedures to limit the target work

2.2.4 Extracting Features

Feature extraction is the way toward decreasing the quantity of assets that are required to portray a huge arrangement of information. At the point when the examination is performed on complex information, one of the serious issues that happen is the stems from the quantity of factors included. To do examination with an enormous number of factors for the most part requires a lot of memory and calculation power. It might likewise cause an issue in the grouping of the calculation, because of which the examples over fit the preparation tests and the new examples sum up ineffectively. In feature extraction, there is a general term for techniques to develop mixes of the factors. To get over these issues yet at the same time portraying the information with greatest precision it is accepted that appropriately improved feature extraction is the way in to the development of a compelling model.

At the point when it is discovered that the information of a calculation is too huge to possibly be prepared and has a similar estimation in the two feet and meters, at that point it very well may be changed into a diminished arrangement of features (feature vector). To decide the subset of the underlying features is called feature choice.

The features chose from feature extraction are relied upon to contain the important data as that of the info information, with the goal that the ideal errand is performed by utilizing this diminished portrayal rather than the total starting information.

A feature, or an attribute, is characterized as the capacity of at least one estimations – indicating some property that can be evaluated (shading, surface,

or shape). This could be of the entire picture or a sub-picture or just of a solitary article.

We primarily center around the improvement of the absolute soonest techniques utilized for dissecting the dark level surface, in view of measurable methodologies. The dim level co-event grid (GLCM), dim level distinction lattice (GLDM), dim level run-length network (GLRLM) are some of them.

Feature extraction of pictures is one of the most dynamic research themes in the field of PC vision. Following the division, feature extraction is thought fundamentally around the estimation of geometric properties which incorporate size and shape and the surface qualities of districts which incorporate shading and surface.

It is essential to know ahead of time what features give the pertinent data to the characterization. To diminish the computational time required in the example acknowledgment process, the vital part is to choose the features that are significant for the arrangement of the picture. Because of this explanation, feature determination must be acted in the preparation period of picture division.

2.2.5 Post Processing

Post processing is the last step of image processing. In this step we find the errors in the image and remove them.

The Error Detection Model: -

In order to evaluate the confidence of the error counts, we analyze the output produced by the recognition system. First of all, we scan the most frequent and the most analyzed relationship between the number of the correct candidates with a certain error count. Using this distribution of the relation, we can come up with a threshold for detecting point when there is an error for the first candidate. In order to further improve the precision of detection, we use a dictionary to reconfirm these detection points

The Error Correction Model: -

Language Model: -

During the first experiment of the correction stage, we used the word segmentation model which locally corrects the detected points. This was a very effective method in correcting errors found in the long words consisting mainly of two or more than two characters. Character bigram model was used for single-character word. From the result of this experiment, two third of the error produced by OCR was eliminated.

Noisy Channel Model: -

The vast majority of the troublesomely in post preparing is found in those situations where the right character is absent from the competitor list. In this way, the uproarious channel model is utilized bring a few characters into the up-and-comer rundown to determine the issue in post preparing.

2.3 Technique used in character recognition

Correlation:

In signal, handling correlation can be characterized as the strategy which gives the connection between any two signals viable.

Types of correlation techniques:-

- Linear correlation
- Circular correlation

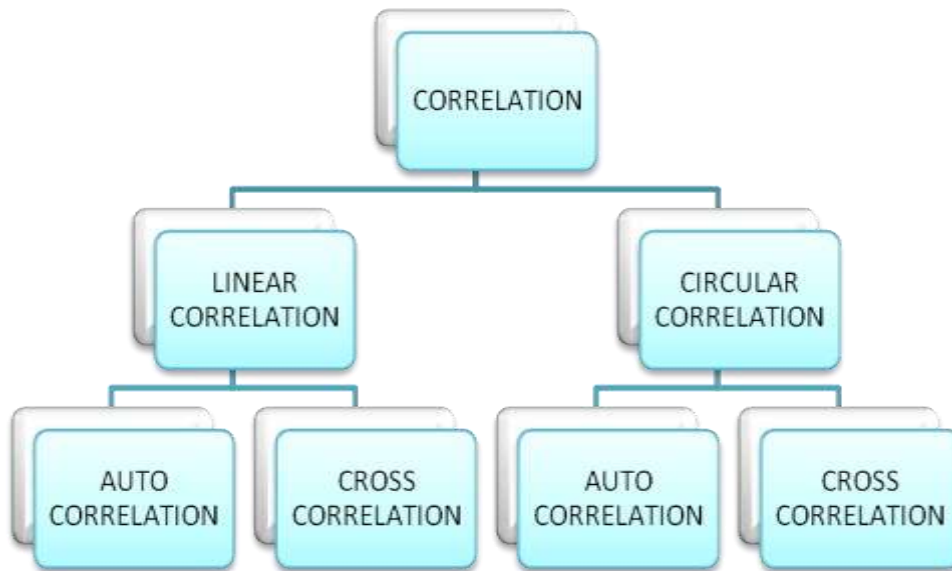


Figure 2.3: Correlation and its types.

2.3.1 Auto Correlation

Autocorrelation is characterized as the cross-connection of a sign with itself. It is characterized as the similitude between the perceptions as an element of the time and the partition between similar signs. Essentially it is a numerical apparatus that finds the examples rehashing itself. The nearness of an intermittent sign which has been covered under commotion, or distinguishing the missing essential recurrence in a sign suggested by its consonant frequencies are a portion of its models. In auto connection, a pinnacle consistently shows up at the slack of zero, until and except if the sign is an insignificant zero sign.

$$f[n] * f[n] = \sum_{m=-\infty}^{\infty} f^c[m]f[n + m]$$

2.3.2 Cross Correlation

Cross-Correlation is characterized as a proportion of likeness of two waveforms as the capacity of time-slack applied to one of them. Sliding spot item or inward item are various names of cross-correlation. To look through a long span signal with a shorter known element we utilize cross-correlation. There are uses of cross-correlation in design acknowledgment moreover.

$$f[n] * g[n] = \sum_{m=-\infty}^{\infty} f^c[m]g[n + m]$$

2.3.3 Implementation of cross correlation for character recognition

Each character in character-recognition can be considered as a picture and in this manner 2D correlation can be executed for character recognition. Before the recognition procedure is begun, the given report needs to experience some starter stages where the picture is really handled with the goal that the characters present in the picture can be perceived.

Figure 2.4 shows a square chart of how the character acknowledgment process is helped out through a few phases.

The steps involved here are,

- 1) Image acquisition
- 2) Pre Processing of the image
- 3) Segmentation
- 4) Character extraction
- 5) Recognition

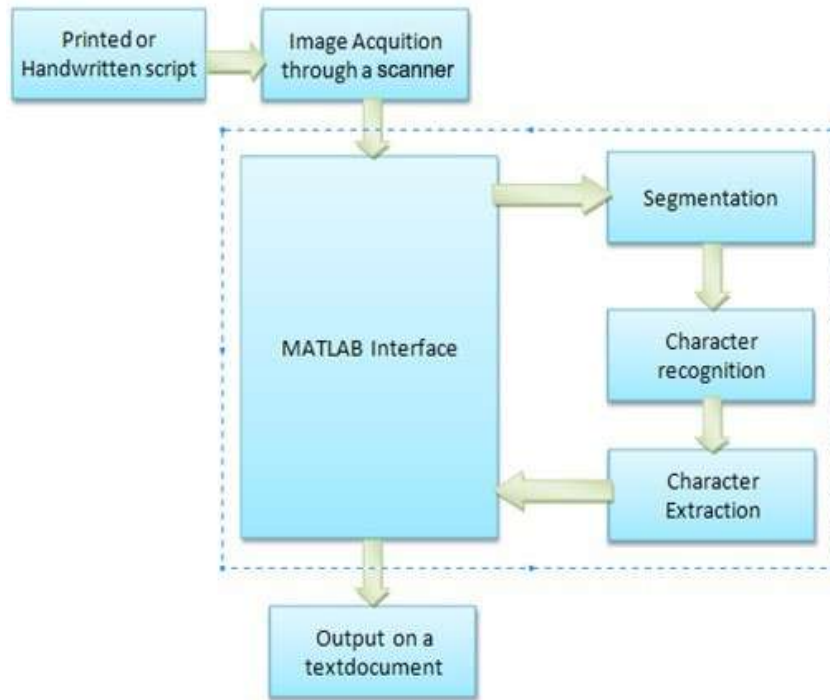


Figure 2.4: Block diagram for implementing recognition process.

Further all these steps are practically proven and discussed in the next chapter results and discussion where all the results are discussed which were practically proved.

2.3.4 Neural Network Method

Artificial Neural Network (ANN), it the brain of computing models and has dispersed preparing components that are adjusted by the connections between the cells called neurons same as found in human brain. Nowadays, it has been broadly used in different areas; for example, in behavior recognition, accord prediction optimization, market investigation, robotic agility etc. simply because of its quality and adaptability. This neural system can be increasingly amazing as computational processors for unmistakable errands, for example, information pressure, order, combinatorial improvement critical thinking, design acknowledgment and so on. This system has numerous influences over

the other old style strategies. As having computational complexities, it offered some help in design acknowledgment consent a piece setting of human insight. As earlier discussed, that there are online as well as offline recognition system, in not internet recognition pattern neural networks are appeared as the quick and stable elements for the characterization and attaining great accuracy in recognition. In 1990's grouping methods have been utilized in written by hand character acknowledgment. These techniques comprise of factual strategies dependent on Bayes choice guideline, Artificial Neural Networks (ANNs), Kernel Methods including Support Vector Machines (SVM) and different classifier mix.

We have taken the fundamental thought of this undertaking from different research articles referenced in the reference segment. We have decided to utilize the picture preparing Toolbox of MATLAB to settle the picture pre-handling phase of the written by hand character acknowledgment issue close by as the writers did. Network is polished for performing grouping and acknowledgment errands. Then again, we have likewise tried the exhibition of the LAMSTAR neural system and bolster vector machine classifier for such issues. In like manner, from the picture of each character we got the greater unique framework yet resized the character pictures into two distinct sizes (50×70 pixels and 90×120 pixels) at first and got the normal incentive in the 10×10 sub-networks for the previous and in the 15×15 sub-grids for the last mentioned.

To fathom the characterized transcribed character acknowledgment issue of grouping we utilized MATLAB calculation programming with Image Processing Toolbox and neural network tool box add-on. The calculation code is partitioned into the following classes and the goal of this venture is to distinguish transcribed characters with the utilization of Back Propagation neural system. . For the Back Propagation an appropriate neural system must be developed and be prepared appropriately.

To discover the arrangement of the characterized transcribed character acknowledgment issue of grouping we worked upon MATLAB calculation programming with Neural Network Toolbox and Image Processing Toolbox

add-on. The reason for this task is to recognize manually written characters with the utilization of Back Propagation neural system so the calculation code is partitioned into the following classes. Thus, for applying Back Propagation an appropriate neural network has to be fabricated and be proficient.

The code used for computational is been sub categorized into few categories:

A) Automated image recognition:

We have very first step that is the image is converted into gray scale image and then threshing technique convert that image into binary form. So as to check for the most extreme associated segment, the parallel picture is experienced the network test, the segments are in the container structure. In the wake of framing the container, the characters are trimmed into various sub pictures as the crude information for the subsequent stage that is highlight extraction schedule.

Because of clamors, which influence the editing forms, the sub pictures are not of fixed sizes they differ starting with one then onto the next. In light of which the contribution of the system doesn't stay standard in this way they deny the information taking care of through the system. Presently this is the difficult which must be unraveled so the arrangement of this issue, the sub pictures are resized to 50 by 70 and afterward find the normal incentive in every 10 by 10 square, the picture can be down to 5 by 7 frameworks, with dubious worth, and become 35 contributions for the system. Presently there is another procedure that must be experienced that is end of the blank areas in the crates and afterward resize the sub pictures.

1) Scan Image

These code written after this are editable in Matalab Toolbox.

```
I = imread('training.bmp');  
    imshow(I)
```

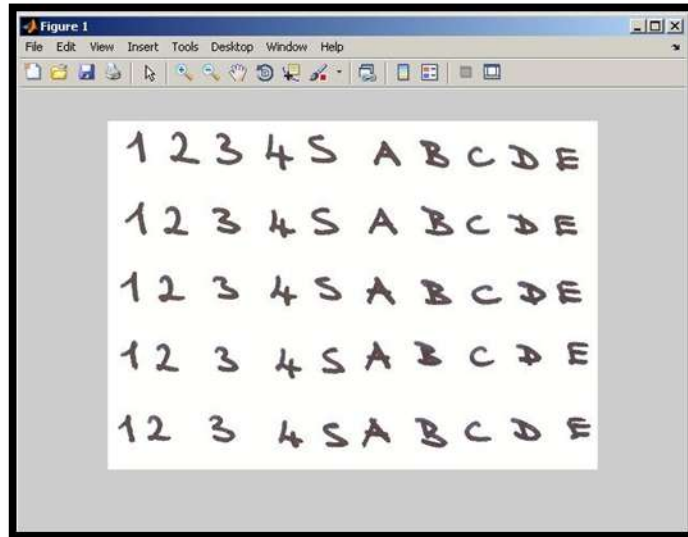


Fig 2.5: Picture of training image

2) Converted to grey-scale picture

The code given is used for converting the regular(RGB) picture into Grey-Scale image.

```
Igray = rgb2gray(I);  
imshow(Igray)
```

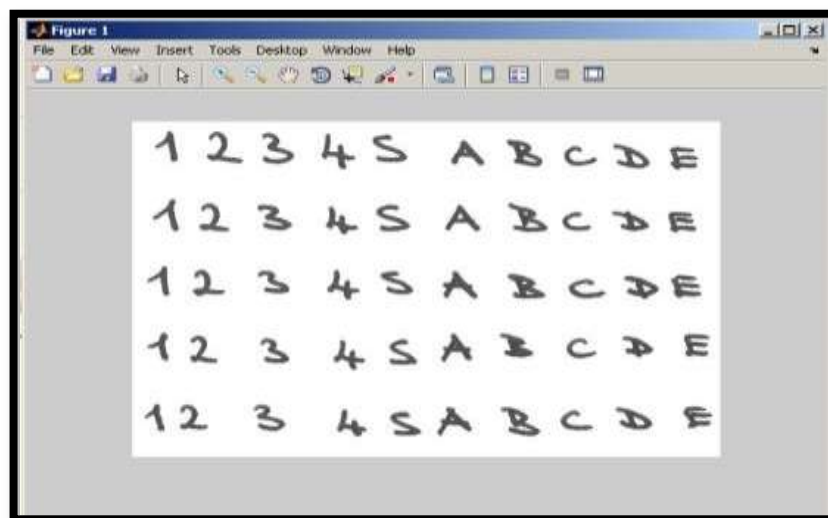


Fig 2.6: Picture changed into Grey-Scale image

3) Changed into Binary type image

The code can be used for converting the grey-scale image into binary type of image.

```
Ibw = im2bw(Igray,graythresh(Igray));  
imshow(Ibw)
```

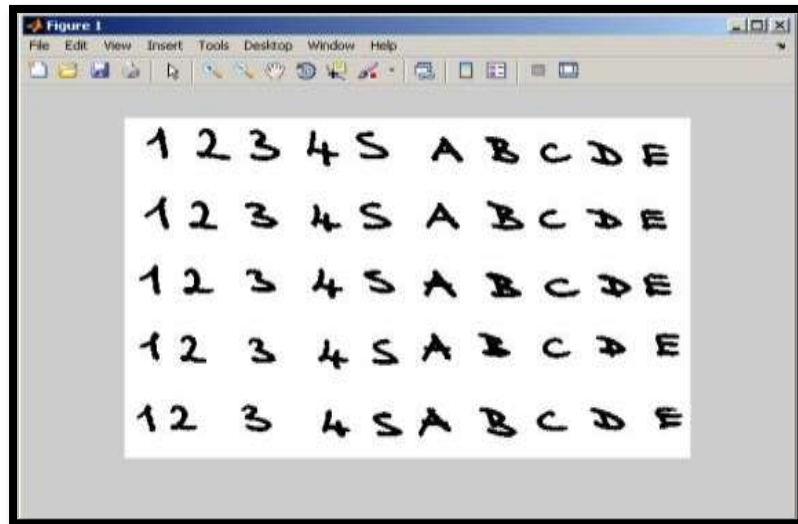


Fig 2.7: Picture of Grey-scale image changed into Binary type image

4) Detection of edges

Code is written to detect the edges of the image.

```
Iedge = edge(uint8(Ibw));  
imshow(Iedge).
```

In edge detection technique the code obtains the edge from the input picture in Matlab with the help of the code given above which further help in dilation and filling of the image.

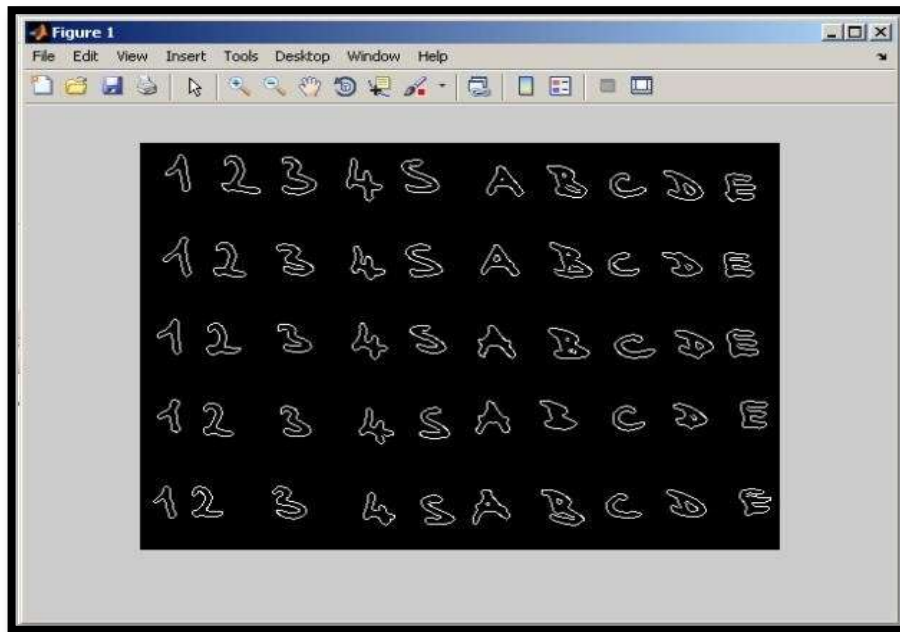


Fig 2.8: Detected edges of the image

5) Architecture

Code is useful for dilating and filling the image.

a) Image Dilation

```
se = strel('square',2);
Iedge2 = imdilate(Iedge, se);
imshow(Iedge2);
```

b) Image Filling

```
IFill= imFill(iedge2, 'holes' )
Im show(ifill)
```

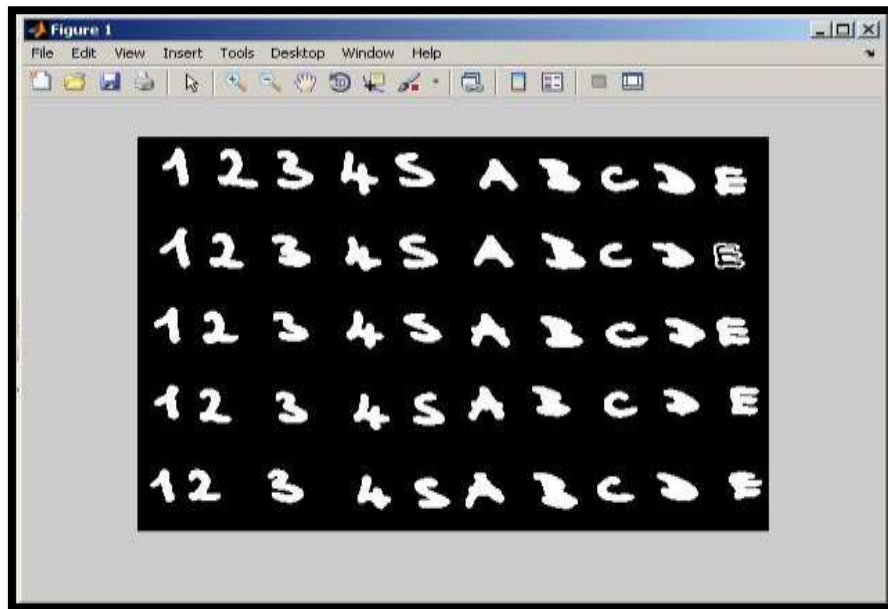


Fig 2.9: Picture after dilation and filling

6) Blobs analysis

Blob analysis contains the code from which it can find the object situated in image and find out the characteristics of the objects.

```

ilabel num = bwLabel(iFill);
disp (num)
iprops = regionprops(ilabel)
ibox = ipropsBounding.Box;
ibox = reshape(Ibox[4 50]) imshow(i)

```

7) To find the Location of the object

Code can find out the locations of object which are situated in image

hold on

```

for Cnt = 1 : 50;
rectangle(position,ibox(cnt),'edge color','r')
end

```

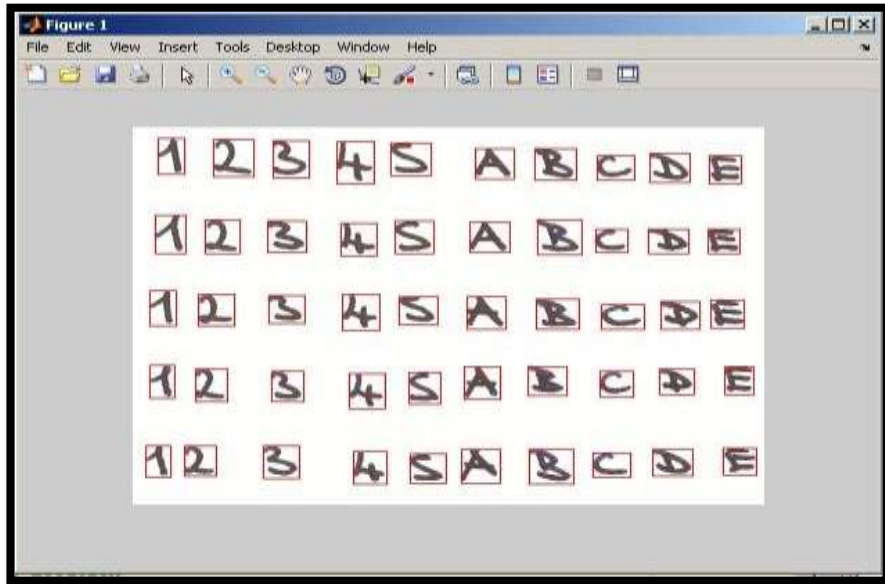


Fig 2.10: Picture showing the locations of objects

Like this, we would be efficient to do the feature extraction from the picture and processing in the further stages

B) Feature Extraction

On the off chance that there is proper dataset for preparing and learning purposes, at that point neural system can be useful. What's more, one of the huge things while building a neural system is dataset without appropriate dataset preparing is of no utilization. There are somethings that must be done so as to get an appropriate dataset-the first is examining of the picture, we need to filter the picture. In the wake of checking the picture, preparing calculation is characterized which removes the indispensable characteristics from the picture and guide them into right dataset.

Extricated properties ought to have numerical qualities and put away in exhibits. At the point when calculation characteristics are picked cautiously the difficult that lies there are well characterizes datasets. The characteristics are critical to such an extent that they can have the urgent effect in ends or

final products. Presently, the means that are required to remove the highlights of each character are portrayed. The sub pictures are trimmed sharp to the edges or the outskirts of the character so as to normalize the sub pictures. The normalization is achieved through the greatest lines and section with the chime point, or increment and reduction the counter until arrives at the blank areas, or, in all likelihood with the lines of all 0's. This method is appeared beneath where a character "S" is being edited and resized.

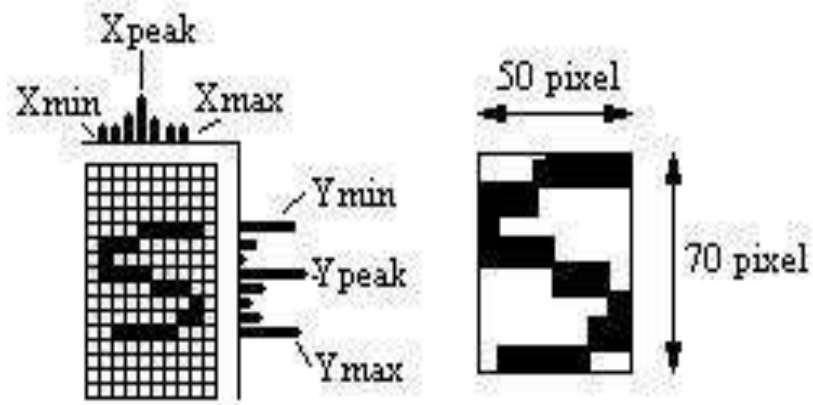


Fig 2.11 Edited and re shaped image

Presently the picture is pre prepared by resizing again to meet the system input necessity, 5 by 7 lattices, where the estimation of 1 would be allotted to all pixel here every one of the 10 by 10 box are loaded up with 1s, as demonstrated after this:

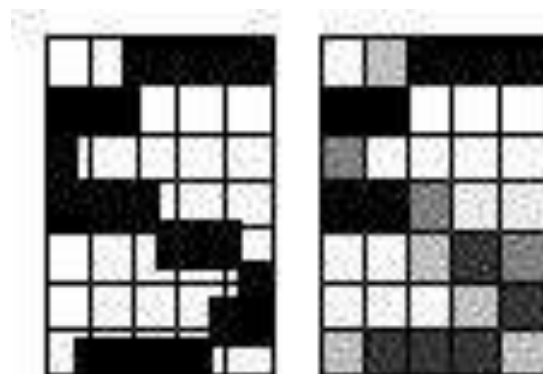


Fig 2.12 Image cropped again to meet the network necessity

So here, the 5 by 7 frameworks is linked into a steam, with the goal that it can

fitted into the system of 35 information neuron network. The input image is the negative image of the figure, of range 0-1, where 0-black and 1-white, and in between values indicate the intensity of the relevant pixel.

2.3.5 Back Propagation Neural Network

The area which we will examine now have, ANN plots the base of an optical character acknowledgment which is prepared utilizing Back Propagation calculation. As clarified before the changed over lattices of English language letters of 5 by 7 or 6 by 8 can be given to the ANN as information. At the point when the Feed Forwarding Algorithm finishes its undertaking of naming the activities of neural systems the Back-Propagation methodology plays out its assignments like Calculating Error, trained and Modified Weights. This calculation begins with the calculation of yield layer since it's the one in particular where wanted yield is accessible. From the yield layer we can compute the blunder rate through the contrast between the ideal yield and the genuine yield. This undertaking gives the subsequent BP ANN network of 1×52. Furthermore, the yield got is utilized to acquire the 52 (26 capitalized and 26 lower case) Alphabets of the English language.

Structure:

The Back Propagation Neural Network impelled with the end goal of this undertaking is sorted out of 3 layers, one is the information, second is the covered up and the other one is output. For the 5×7 (6×8) grids, there are 35(48) neurons in input layer, concealed layer has 100 neurons (controlled by experimentation) and the yield layer has 52 neurons. The yield layer is a serious layer. In this task sigmoid capacity has been utilized as a non-straight actuation work:

$$y = \frac{1}{1 + \exp(-z)}$$

Predisposition terms (=1) with trainable loads were incorporated likewise in the system structure. In the accompanying given figure basic outline of neural system is there:

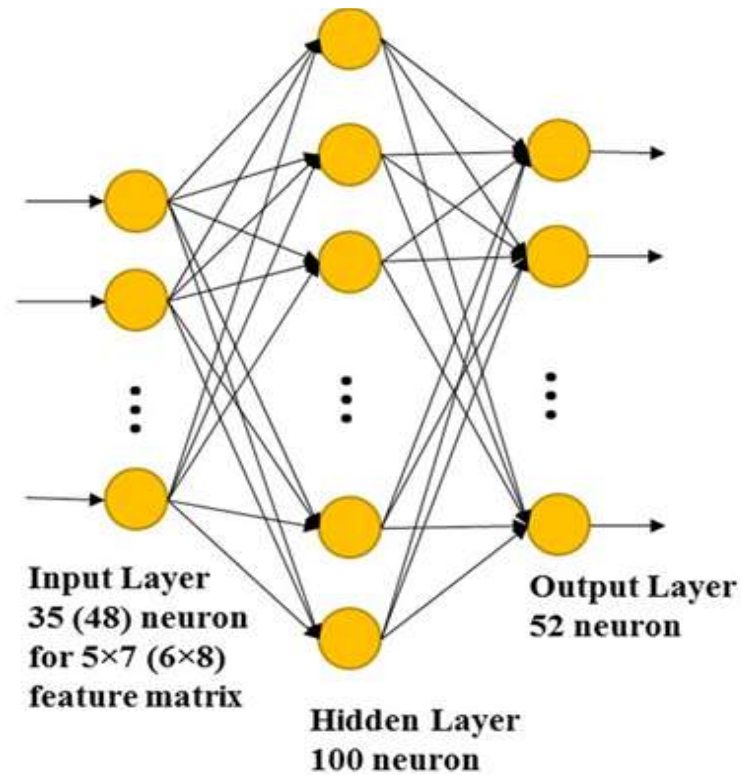


Fig 2.13: Complete structure design for neural network for back propagation.

Connectivity setup:

The objective of the Back-Propagation learning calculation is to limit the vitality of the mistake at the yield layer. In this preparation set of info vectors is utilized vector by vector to the contribution of the system and is sent proliferated to the yield. After that BP calculation balanced the loads. A short time later, every one of these means is rehashed for all preparation sets. The calculation stops consequently when tolerable combination is reached.

Creating Vectors data for the Neural Network (objects):

Making Vectors information for the Neural Network or we can say objects: Here barely any lines of code produce the preparation vector and testing vector

for the neural system. This is simply to coordinate the information acknowledged by the neural system work. The front four lines will be utilized to prepare the system while the last column will be utilized to compute the presentation of the system. `p = out (1:40)`

```
t = eye(10) eye(10) eye(10) eye(10)
```

```
Ptest = out(:,41:50);
```

Training algorithm of the network:

This part makes and prepares the neural system (NN). The `edu_createn` is a capacity record to make and train the system by tolerating the preparation target datasets. In any case, there is some issue identified with the nature, we utilized feed forward back spread neural system for grouping or probably we can say that, we were exploring different avenues regarding multi-layer perceptron (MLP). Following is the image of MLP structure with 2 shrouded

Training the network by using the function data set = `edu_createn (t,p)`

We can also experiment and test the network separately

```
net = newf(t,p,[35], {'logsig'})
```

```
Fnc = 'sse' net.divideindex.trainRatio = 1
```

```
net.divideindex.valRatio = 0;
```

```
net.divideindex.testRatio = 0;
```

```
net.trainindex.goal = 0.001;
```

```
[net,tr,z,u] = train(net,t,p);
```

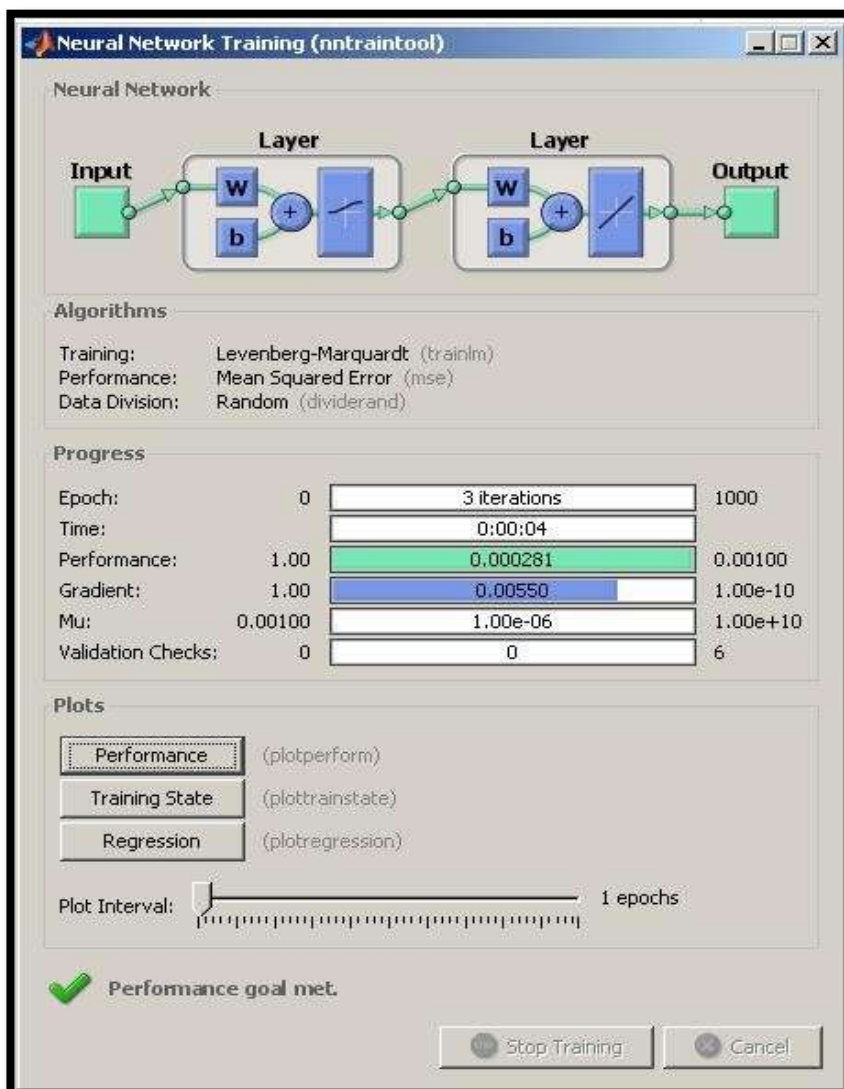


Fig 2.14: Training the Neural Networks

To test the network made:

We have to give a sim command to test and simulate the testing dataset.

Neural network system test

```
[a,b]=max(sim(net,itest)); disp(b);
```

% Result

1 2 3 4 5 6 7 8 9 10.

Encode/Decode

In our acknowledgment framework we can utilize or prepare the system with ten unique signs or characters. Suppose there are five numbers and five characters, so input lattice is a size of one by ten and [1,2,3,4,5,'A','B','C','D','E'] values.

Yet, we cannot characterize arrange focus as a character so we need to utilize numbers. So at the yield of the neural system we get grid with values [1,2,3,4,5,6,7,8,9,0] rather than above given estimations of info framework. This is the motivation behind why we need to encode and translate the yield of our application. The encoding is made with basic code table, in which each record gets another worth. So file 0 gets character E, list 6 gets A, record 3 gets 3, etc. Consummation this with the encoding code underneath.

```
if num<5
num = num 5;
charset = ['A','B','C','D','E'];
else
charset = [1,2,3,4,5]
end
num = charset(1,num)
set(handles.edit.result,'string',num)
```

User face and application purpose:

Characters acknowledgment application can be utilized in couple of unmistakable manners in the principal way you can type each order inside the Matlab comfort and working environment close by and in the other manner you simply use as of now pre-arranged Graphical User Interface. The GUI comprises of two records further so the principal document incorporates all vital programming code, and the other record incorporate obvious interface shapes and structures. The interface works like the work process of acknowledgment process. Right off the bat we transfer the picture, at that point we select the character and after that we click crop, pre-process, and

include extraction lastly it perceived. On each stage, GUI shows us another picture, which is one of a kind in each progression. The pictures can be seen in the principle window, RGB, Binary, Crop to Crop to Edges and Features window.

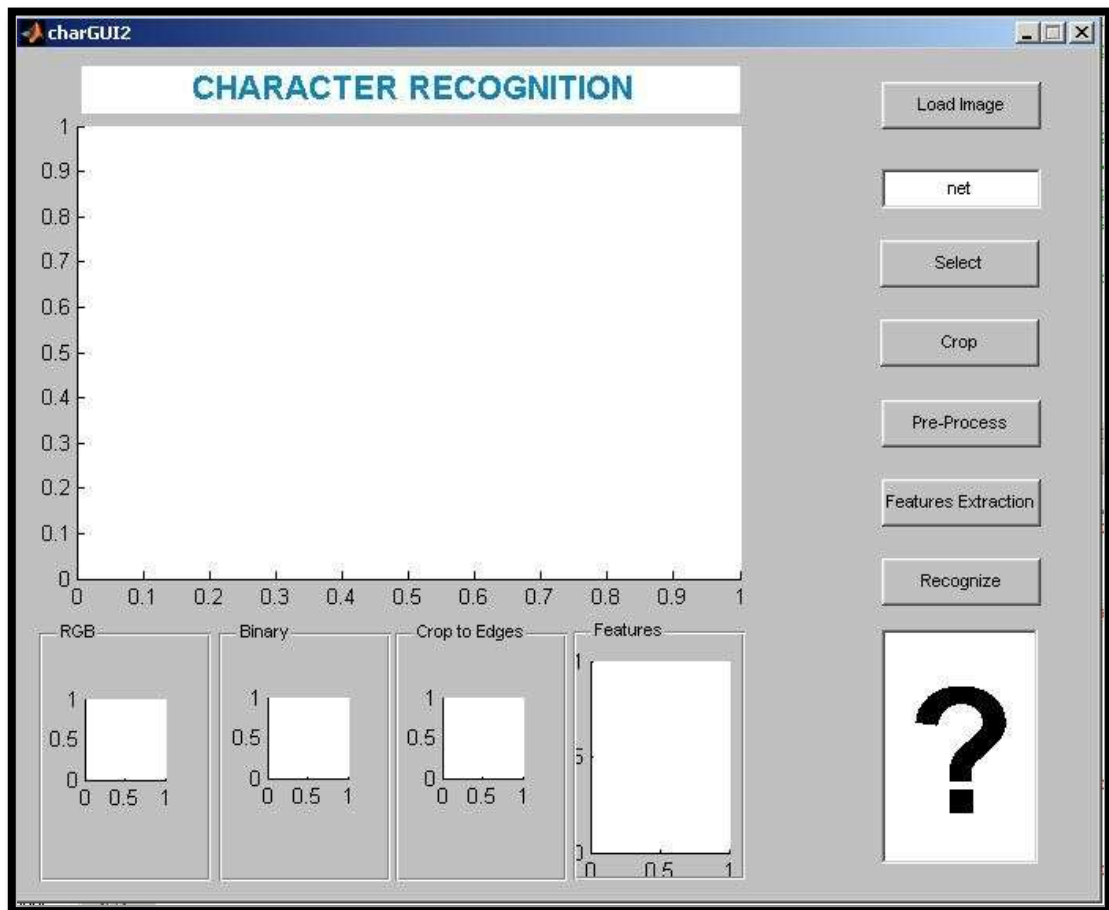


Fig 2.15: GUI and Application of system

CHAPTER 3

RESULTS & DISCUSSION

In this chapter we have discussed the results we have obtained in Matlab. All the pictures we have obtained of the results we have experimentally obtained are given below step by step and also discussed the result about the accuracy of the methodology we are using here for the optical character recognition in Matlab. The accuracy for the different fonts and different handwritten gestures are experimentally shown and we are also discussing the drawbacks of this technique and what we can improve next time.

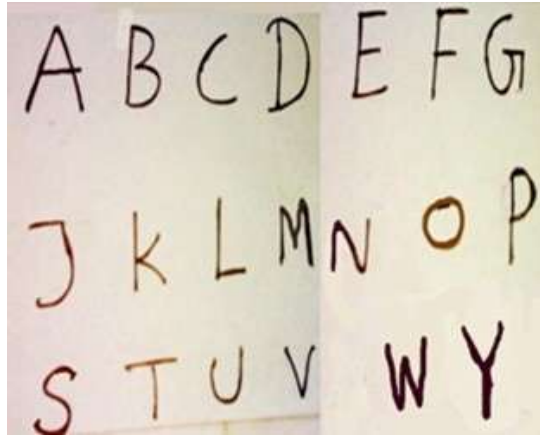
The result further shown is step by step firstly we will acquire the image through a scanner then we will preprocess the image and divided into segments then features are extracted from the segmented image after that we will get the result that is the recognized characters.

3.1 Acquisition of image

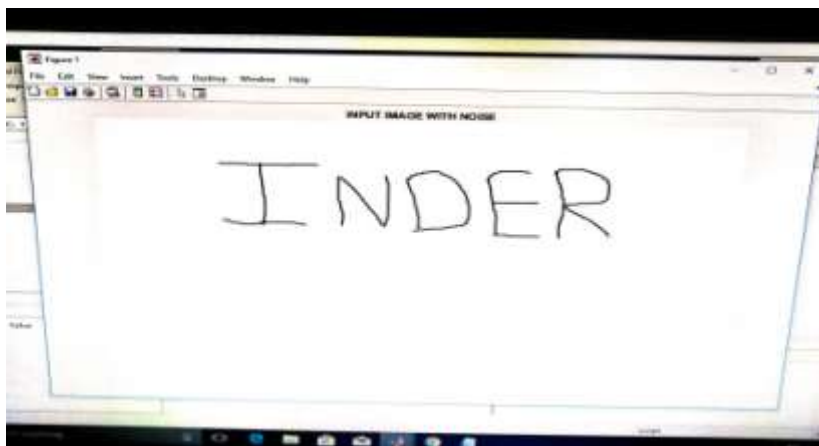
The pictures are obtained through the camera or scanner. Picture colored in nature or we can say RGB pictures. One of perceived pictures is shown in figure 3.1 Figure 3.1(a) is an picture which contains the printed font. Figure 3.1(b), 3.2 both of these pictures show a text written with hand.



(a)



(b)



(c)

Figure 3.1: (a) Picture contains the printed words (b); (c) contains written text with hand

Image (b) was taken by the camera and image (c) was written in the Microsoft paint with the help of paint tools. On the off chance that deliberately watched, one can discover a few varieties in the splendor levels in figure 3.1(a) and some undesirable content imprinted on the rear of the paper if there should be an occurrence of figure 3.1(b). These undesirable components are undesired and in this manner can be considered as clamor. These components can ruin the presentation of the entire framework. In this manner it is required to evacuate these commotions. Henceforth preprocessing is required to be done on the procured picture.

3.2 Pre-processing Stage of image

As the caught picture is shaded in nature, it is required to change over it into a dim picture with power levels differing from zero till 255 (8-piece picture). At this point it is changed over into a double picture with appropriate edge (Black denotes 0 and White denotes 1). The favorable position is that the treatment of the picture for additional handling gets simpler. This twofold picture is then reversed for example dark is made white and white is made dark. Thusly, the division procedure gets simpler, Also some little associated parts present in the picture is additionally evacuated. The preprocessed pictures are

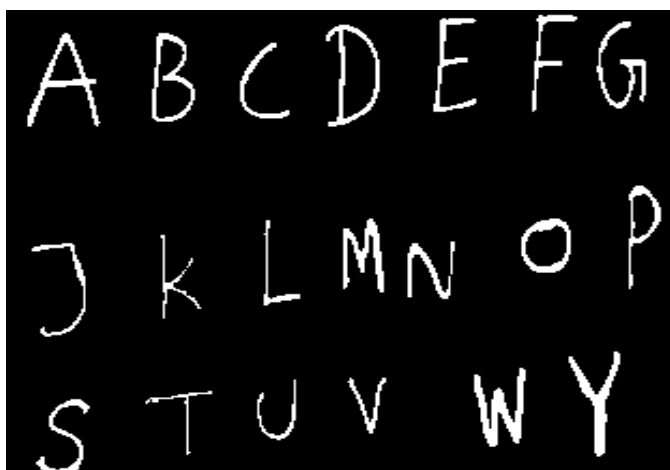


Figure 3.2: Preprocessed handwritten text

3.3 Image segmentation stage

Division is done in two phases in particular (I) Line division and (ii) Word division. The line division is done by filtering the whole line in a steady progression and taking its total. Since dark is spoken to by 0 and white by 1, in the event that there is any character present, at that point the whole would be nonzero. In this manner the line portioning is done. In word division, a similar

rule utilized in line division is utilized. The main contrast here is that the examining procedure is done vertically.

3.4 Extracting the Characters

The characters are separated through a procedure called associated segment investigation. First the picture partitioned into two districts. They are highly contrasting district. Utilizing 8-network (allude supplement), the characters are named. Utilizing these names, the associated parts (characters) are extricated.

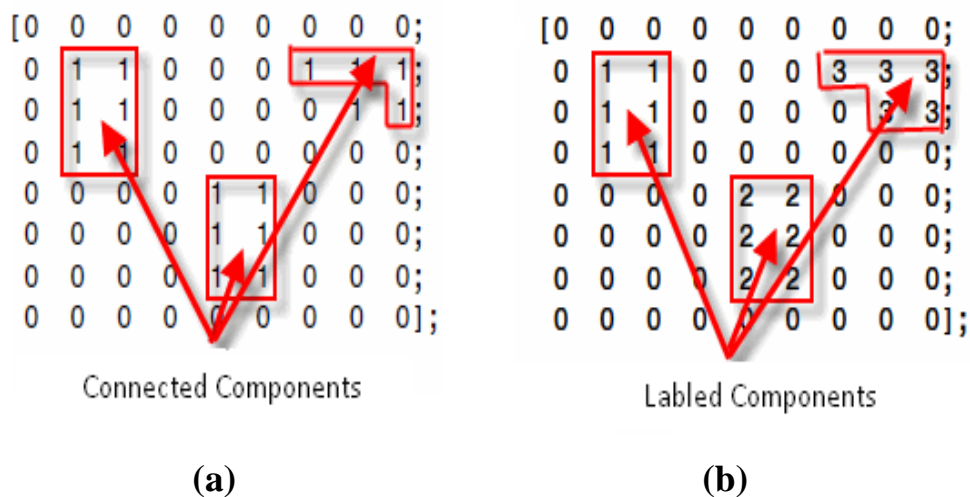


Figure 3.3: (a) component connections from binary picture (b) labeled connected of components of binary image

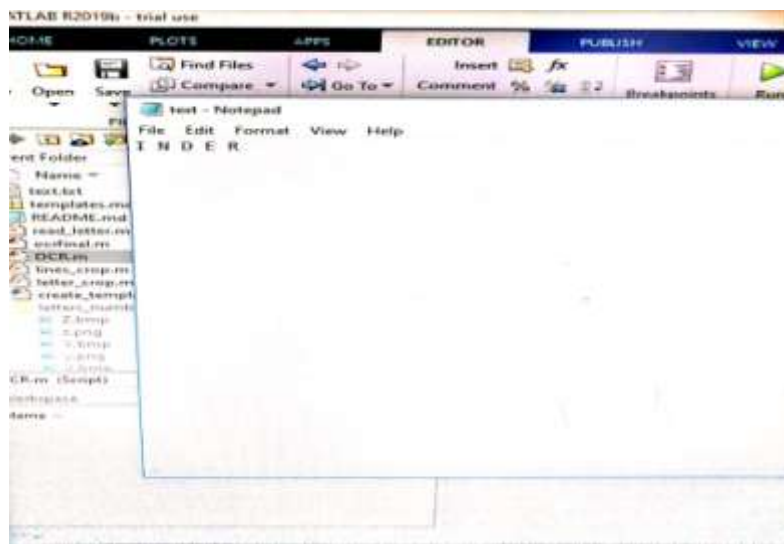
An associated part in a parallel picture is a lot of pixels that structure an associated gathering. For instance, the twofold picture beneath has three associated parts (figure 3.3(a)). Associated segment marking is the way toward recognizing the associated parts in a picture and doling out every one a one of a kind name (figure 3.3(b)). The network (figure 3.3(b)) is known as a name lattice. For imagining associated parts, it is helpful to build a name framework

3.5 Step for recognizing the characters

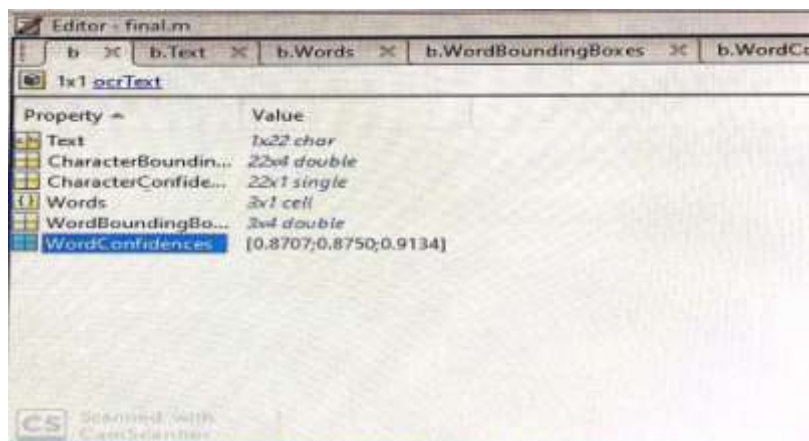
In the acknowledgment procedure, each character removed is corresponded with every single other character present in the database. The database is a

predefined set of characters for the textual styles Times new roman, Tahoma and Verdana. By knowing the most extreme corresponded esteem, from the database, the character is distinguished. At last, the perceived characters are made to show on a scratch pad. Figure 3.11 shows the perceived yields for the sectioned pictures. Acknowledgment for both the organizations have a few mistakes however the blunders in perceiving a printed book are a lot lesser than that the mistakes experienced during the acknowledgment of written by hand wrote characters.

Results obtained for recognizing the characters



(a)



(b)

Figure 3.4: (a) Result of the characters recognized (b) The different factors observed

In both the above figures the final results were obtained in picture figure 3.4(a) the final output of the characters those were recognized is shown there this picture is taken by the camera. And the figure 3.4(b) all the factors which are obtained after recognizing the characters are shown whether it is text or confidences or the accuracy with which they were recognized. In the figure 3.4(c) the character confidences those were obtained is shown for each letter in the input picture.



Figure 3.4: (c) Accuracy for recognizing the characters

These were few of the results which we have obtained while performing the character recognition while performing this we have come through few limitation of the OCR. Which are discussed further and these results which have discussed earlier in the report was for the correlation and template matching in the 8th semester we have done optical character recognition using the neural network and the results for that we are now going to discuss further.

The results here now are obtained by using the back propagation neural network method. We had given some inputs to the model and obtained those results from those pictures. These results were practically taken by the group are obtained on the basis theoretical discussion we have done earlier in this chapter and the introduction part of the project report.

3.6 Results obtained using Neural Network

Now we are going to discuss the results obtained using the back propagation method in the neural network systems. We will show the images of the English and numerical characters stage by stage with the labeled pictures. Now we will move on to the first step of automatic image processing we have discussed previous chapter. Now we will prove it practically with the pictures.

3.6.1 Obtaining the Image

This is the very first step of the image recognition here we obtain the image from the scanner it can be any image. The image could be hand written or can be the printed form text of any font used in word.

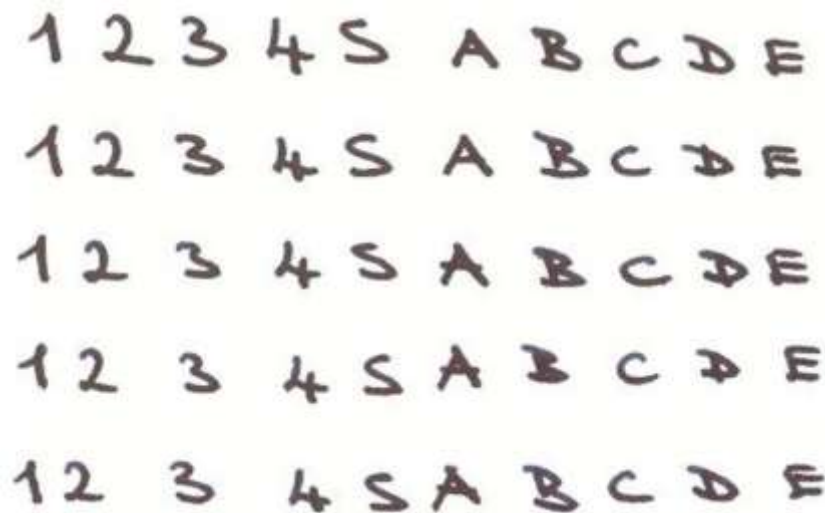


Fig 3.5: Image of hand written characters

3.6.2 Converting image to Grey and Binary

The image we have obtained in the first step is the scanned image. To obtain the characters from this image we have to convert this image first into grey level image and then into the binary level image after that only we would able to do the blob analysis of the image. These both steps are done using Matlab code discussed earlier.

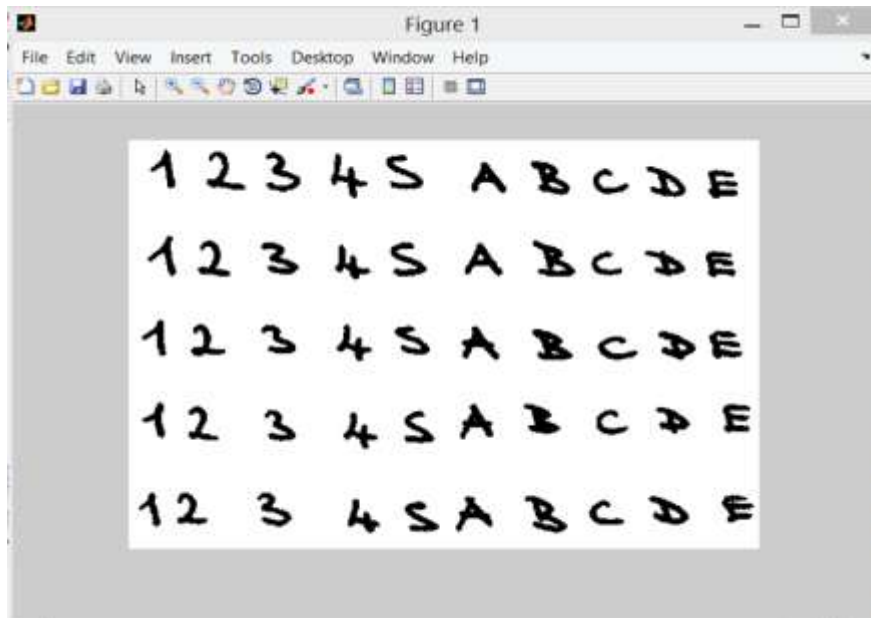


Fig 3.6 Image obtained after grey scaling and Binarization

3.6.3 Performing Dilation and Filling

We will now perform the dilation on the picture and the filling on the image which we have obtained in earlier steps and make that picture ready for the blob analysis. To which we basically say inverting the picture for the blob analysis

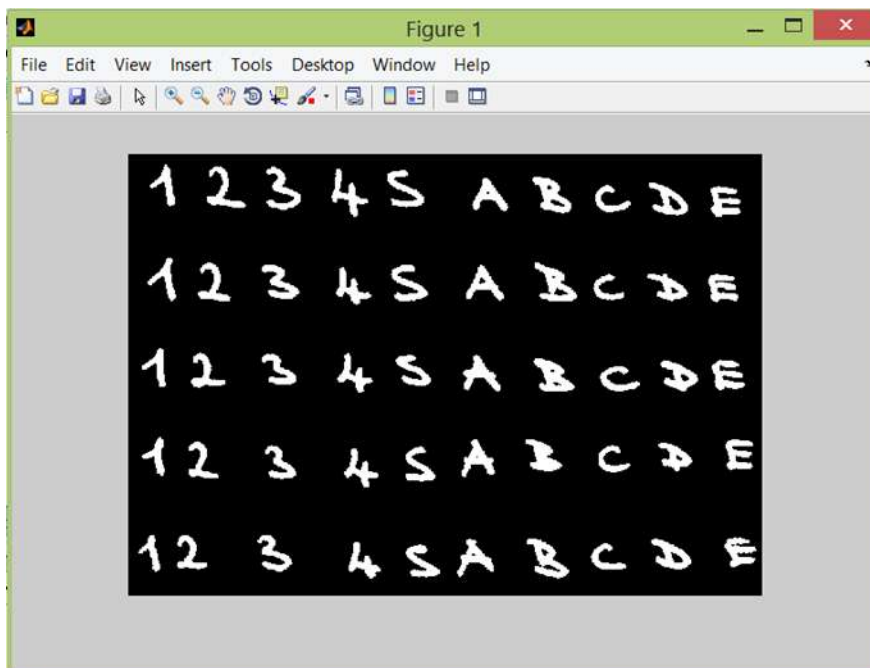


Fig 3.7: Image for the Blob analysis

3.6.4 Extracting the Features from picture

After the blob analysis code, written in the Matlab. We will move towards the feature extractions from the image which is very important step of the recognition. In this step we will mark the location of the objects and mark them in boxes and after that we will resize the picture and crop them for the recognition.

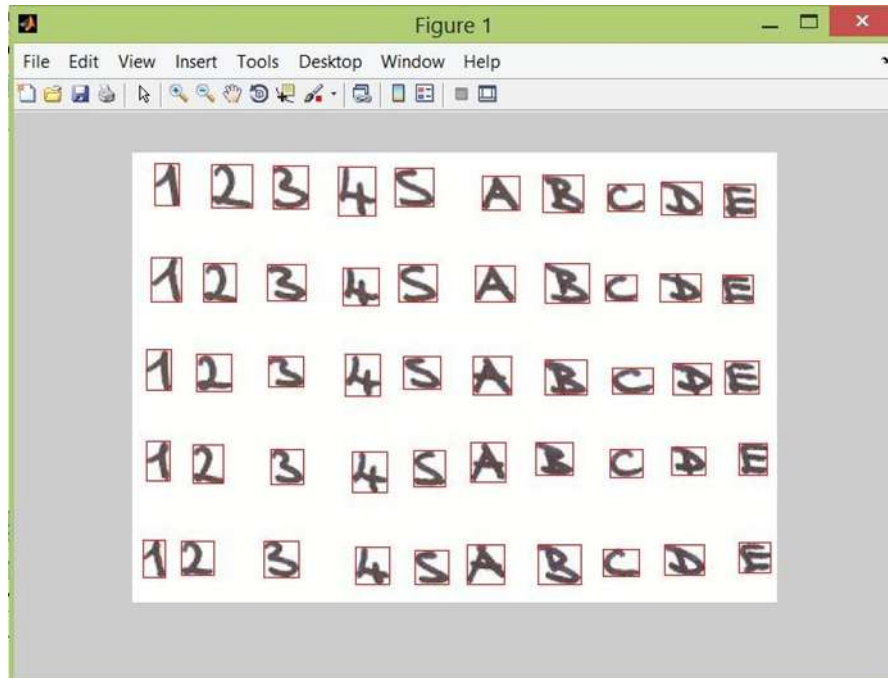


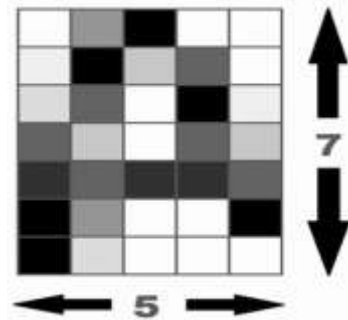
Fig 3.8: Boxed characters and numbers

3.6.5. Resizing and Reshaping the Characters

Here we will show some examples of the characters that are resized into the 7 by 5 matrices because an ideal letter is meant to be of the shape of this box which 7 by 5. We have resized all the letters but in the report showing few of them.



Fig 3.9: (a) Recognized characters



(b) Picture after resizing into matrix of 7 by 5

Other examples of the resized characters are given below with their matrices shown into which they are converted

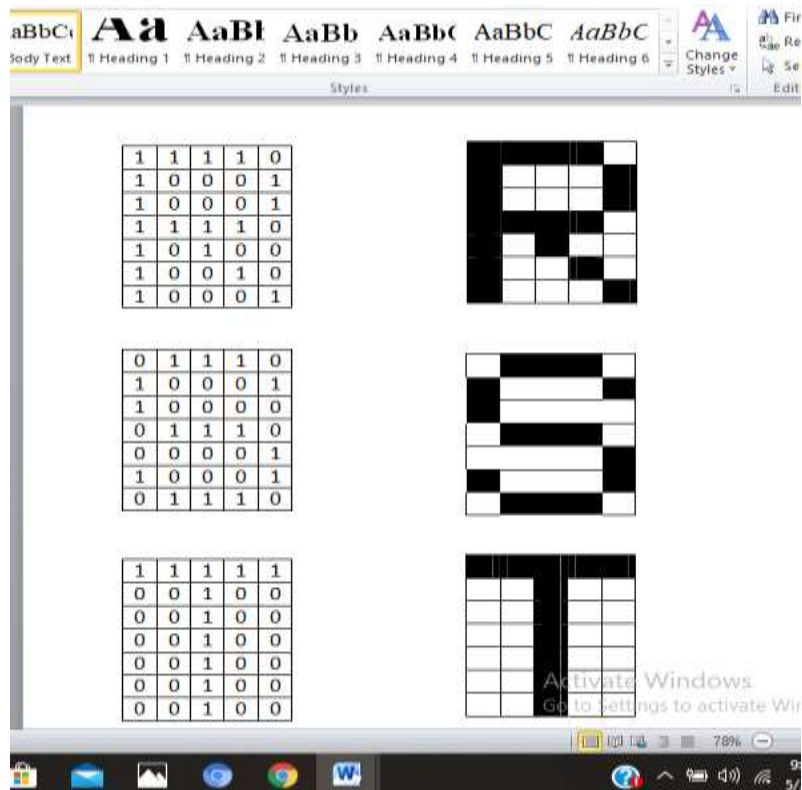


Fig 3.10: Reshaped Characters with their matrices

3.6.6 Example of the recognized Character in GUI

This is one example of the character recognized from the given sample. Similarly, the GUI can show other letters too, but we can't show all the characters here, so we are showing only the output for one character. All other characters have a similar type of output.

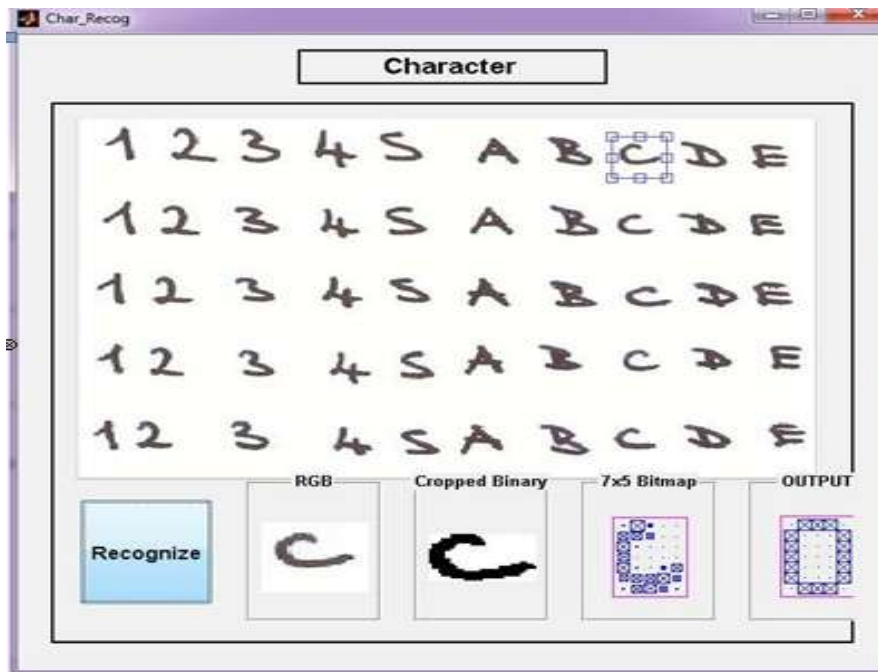


Fig 3.11: Character output example in GUI

3.7 Limitations

1. Black colored text printed on the white sheet is preferred for maximum accuracy.
2. No extra light effects must be present while capturing the image.
3. Font style variation must be avoided throughout the text.
4. It is difficult to differentiate between the characters such as 'l' & 'i'; 's' & '5'; 'z' & 'Z'.
5. Font of text taken as input must match with font of the database images for better accuracy.

These all were the limitations which we observed while performing optical character recognition. We will work on these limitations to remove them and make the OCR more efficient in the future.

CHAPTER 4

CONCLUSION

We have performed the character recognition using mainly the two methods of machine learning. Both the methods are highly efficient for the English language recognition. We have compared the efficiency and accuracy of both the methods, they have slight difference between the accuracy and efficiency. Neural network have edge over the correlation and template matching method.

When we use the template matching for the recognition of the characters it is highly accurate for few of the English language fonts used widely in the world. The method we have used here has various usages across the world it is used in voice convertors, text reading form the number plates etc. are its main uses. It has been also used for the text form which is used in the postal services and sales tax department's, it is highly efficient for that use.

When we do the character recognition in offline mode it takes some as it take times to get complied and it also have some problem in trouble shooting. Which is a huge problem with the off line character recognition. Hence we have done the work on the online character recognition using the neural network system and its algorithm back propagation theorem. Which was highly efficient and accurate than the previous methods, but still it's not 100% accurate for all hand written characters. Which is an issue with this system, it is not completely accurate for all the writing styles in English language. So in future we have to work upon the accuracy of the system and accuracy of the system. And there is need of work that should be done on the regional languages of India. They are still unexplored, for example the languages of upper north for them we can make voice recognizing software and it can convert that language input into the other language like English for an example.

There is lot of work that has been done in the field of optical character recognition but there's a still a lot of room for the future work in this field.

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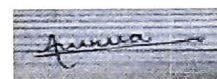
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