Chapter-1 Introduction

Correlation of human factors to the computer has become a very interesting topic after the invention of the digital computers. Many algorithms have been evolved to recognize the characters to the machines.OCR is the system that takes the character file from the image that is a scanned copy of the handwritten document, text document. It converts text message to the text that is editable.

OCR technologies increases the efficiency of the office work as it involves the recognition of characters from the image which is as easy from re-typing the text.OCR technology is widely used in many fields.OCR technology is classified into two types On-line recognition and off-line recognition. In online method, real time devices like digitizer tablets are used to collect the data while in offline method static devices like scanner and cameras are used to collect the data. Writing of information is allowed in online recognition for real time because of concurrent data collection. In offline recognition the image of recognition is prepared by few technologies and the noise and errors of the image are removed that are caused during the collection process.

A number of commercial system can be seen in the market that are being used for machine characters and clear hand written characters but no system has been developed for hand writing so the difference between the upper case character and the lower case character is not able to recognize by the system.

In this Thesis we are focusing on using number recognition on a new platform known as IntelliJ and to find the solution for number matching. IntelliJ provides an agent based environment. Working is through controlling the agent and calculation of both numbers is done by following the attributes of the agents.

IntelliJ is an agent based approach and it works by controlling the agent and the process of recognition is observed.

1.1 Machine Learning;

Machine learning is an artificial intelligent branch and it is concerned for the development of computer algorithm. [1]Machine performed a wide range of task. From these two last decades of the most important techniques is machine learning, and used in different types, such as robotics, computer vision, computer science theory, identification and optimization science. Learning tasks and learning style are two factors of machine learning tasks, and its performance depends on the supervision and unsupervised learning is two areas of study types. Trying to supervised learning, in order to enable the computer to learn classification technology, which is pre-defined, such as handwriting recognition. Handwriting recognition performance by one of the correct classification of words and their rate measurement. But in unsupervised learning is not set such classification. But its main function is to develop classification matched internal data, such as clustering algorithms and data mining.

1.2 Optical Character Recognition:

When the character is read typewritten achieve accuracy. However, OCR systems may still be inaccurate handwritten characters. Thus, the character recognition is still a part of the challenging area of research. On the basis of data collected and the OCR text type classification.

1.2.1 System according to text type:

There are two types of text in OCR system:

1. Handwritten character.
2. Typewritten characters.

The most advantage of typewritten characters is the limitation of text styles and thus reduce the rate of accuracy and therefore the time processing rate is reduced.

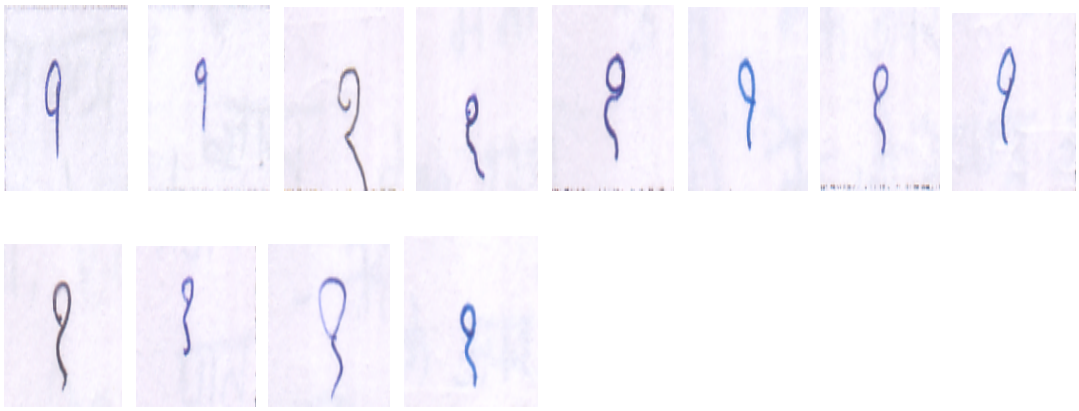


Figure 1.2 Samples of Handwritten One by Different people.

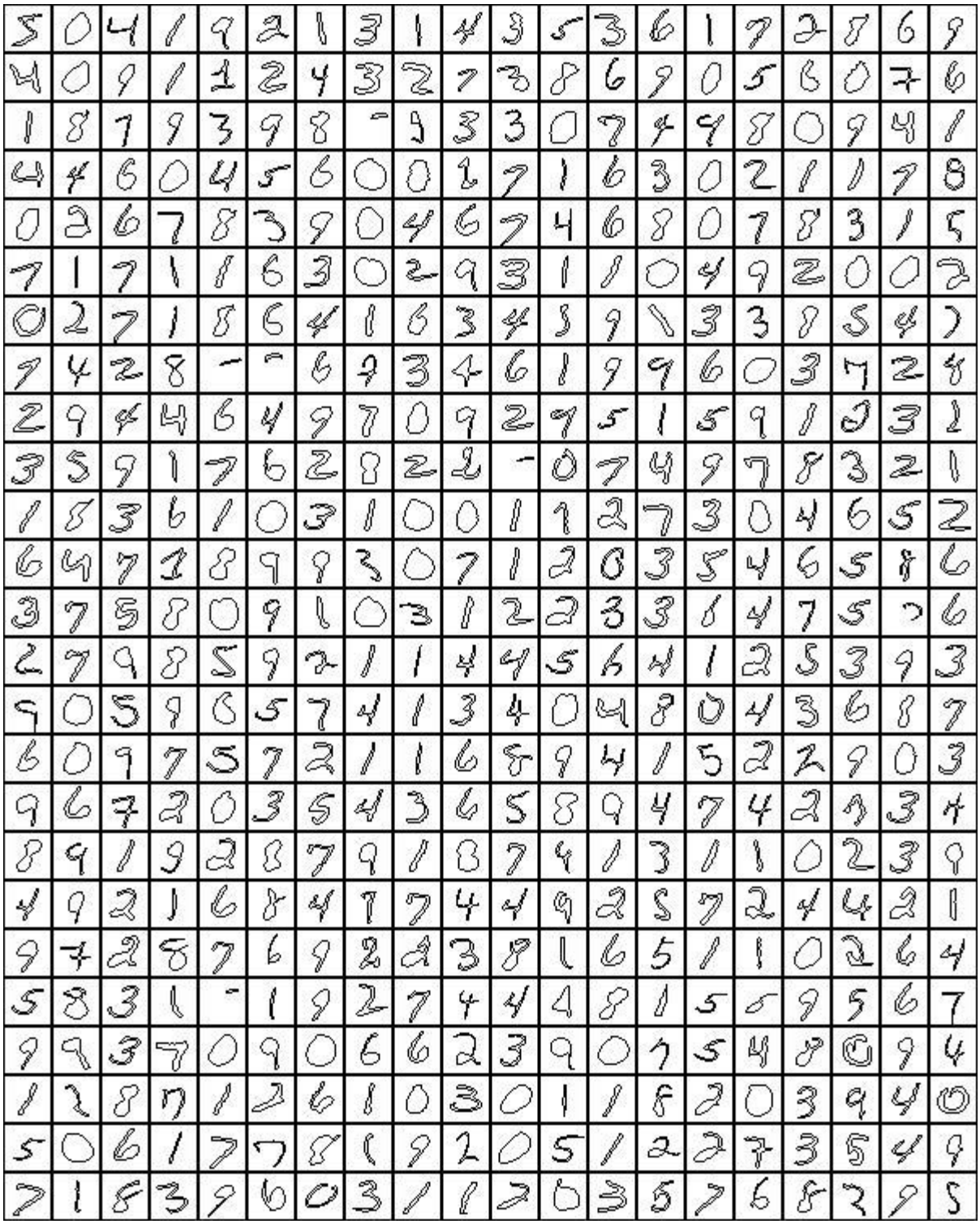


Figure 1.3 Samples of different handwritten numbers by people

1.3 Methodologies of OCR

The OCR process is divided into the following steps

1. Preprocessing process
2. Segmentation process
3. Feature extraction process
4. Classification and Recognition process

1.3.1 **Preprocessing**

Texting role in this process retain useful features, important information is discarded in this image. Images having this purpose by means of a pre-processing operation. And are selected according to the image structure of these operations. Some activities may be removed , or may be applied in a different order.

The important method in this phase is as follows

1. Gray scale and Thresh holding method.
2. Color Image Processing method.
3. Morphological operations method.

1.3.1.1 Gray Scale and Thresh holding:

Here is converted into another form , is a gray-scale format , so as to extract the background and foreground of the gray scale pixel intensity will be executed only by each pixel .

Threshing holder is the gray i image is converted into a binary image processing. The main method of threshing two such adaptive worlds. In threshing remains constant global threshold method is used, each pixel intensity threshold comparison. Otsu threshing business method is used in diverse applications finds a lower threshold.

Picture showing different value of threshold required for specific image area; adaptive threshing business is very suitable for that image. Ni between blocks method to produce the different method to keep very suitable value of Thresh holding.

1.3.1.2 **Color Image Processing**

This method is mainly based on the filtering of the image. The process of filtering, the method in which the pixels are changed from a picture for various types of effects . Each pixel area makes use of filtering techniques of the image and the convolution filters of an image. Any neighborhood of pixels is composed of a large number of pixels is connected in series with a given pixel.

The process of convolution operation, wherein the selected pixel color values to be multiplied and as its neighbor with the aid of convolution filters. The convolution filter other name filter kernels and which matrices of n * m, where n is the width of the filter n and m are the length of the filter.

a)Noise Removal

Because data transmission in the electronic images noise performance. So this noise with non - linear filters removed and linear filters soften gray level occurs.

Import value and its weighted average is calculated in the linear filtering to the image smooth. Linear filters that are common: Gaussian filters and Mean (average). The smoothing is carried out by the particular color pixel value is replaced by its neighbors average value. One of the simplest methods of smoothing average filter as is apparent from the diagram. But can reduce the sharpness by blurring the edges.

Compared to linear filtering, non-linear filtering is very effective because the storage, for example, all the details of the image that is useful Median Filter . Median Filter use is the same as the average filter, but it is calculated in the mean average filter, while is calculated in the Median filter median.

b) Deblurring

While taking an image or picture of an object , there may be some movement in the object and therefore fading occur. The hazy than is done by passing by the Wiener filter is a stastical method. The use of the Wiener filter is the picture which is removed when the additive noise is blurred put.

c) Edge Detection

In an image, the edges of the borders between the two regions. Determination of the edge is carried out with the discontinuities and color changes. In gradient points generally changes the color intensity. The image gradient is calculated using the formula.

1.3.1.3 **Morphological Image Processing**

Morphological technology operations are a useful component of the extracted image-based, such as convex hull or skeleton. Presented a set of robust shape, it will be different problems of image processing. Among the various methods, a method Minkowski method.Minkowski method, the use of morphological operations in which the logical operation is replaced by the convolution process. Is completed, the image processing objects using their element structures. Sign pattern having the results of this pattern is how to filter or absent interaction of structural elements in the image field of the image. To reduce noise, smooth area boundaries and artifacts they use.

Some of the major process of Morphological operations is:

1. Erosion process
2. Dilation process
3. Skeletonisation process image

1.Erosion process

As its name suggests its function is etched foreground pixel boundaries. Thus, reduced in size as a result of the foreground pixel, if the presence of holes is extended in this region.

This method is applied to different algorithms elilation. Those pixels selected as the original when it turned to the left, a structural element matching background pixels values of the pixels is set to give background values.

2.Dialation process

In the pixel boundary dilation foreground region for enhancing the operation of the binary image. Operating dilation A binary image for which the B.

When AB is at the origin, and the A, B of translation, and its main purpose is to reduce the gap as shown by FIG. Structural elements as compared to the origin, each pixel in the image. If you select the structural elements of a project prospect of pixels, the input pixels (the selected neighbor pixels) than selected, foregrppund value of the pixel at the bottom. However, if the point corresponding to the element of the background pixel, then the pixel value is set as the background.

4. Skeletonisation and Thinning:

Here the area decreases in width is one pixel. A structuring element such as erosion and dilation operators is used in the method of skeletonisation. Here extraction of certain regions critical .for example, intersection or terminal portion is provided by the operator. Two major subdivision of the activities of skeletonisation are parallel and the operations sequential..Both use connectivity as well as attributes of the neighborhood pixels. The first definition of Blum was given in 1967 to the skeleton Medical Axis wash function (MAF). A special group in which the boundaries of several regions neighboring the MAF.MAF and thinning algorithm is used to define the image skeleton. Dilution of great importance skeletonisation method of [52] .and that user of straight lines and curved region. The following are some popular algorithm thinner, Zhang-Suen and SUSAN Algorithm Zhang -suen used structuring element of 3 * 3 and has two sub iteration. In structuring element pixels there are 9 in number and that clock is summed up with it as shown in FIG.

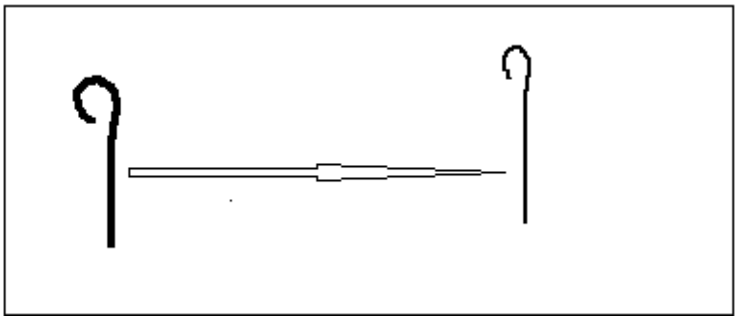


Figure 1.4: Skeletonization and Thinning of Hindi number one.

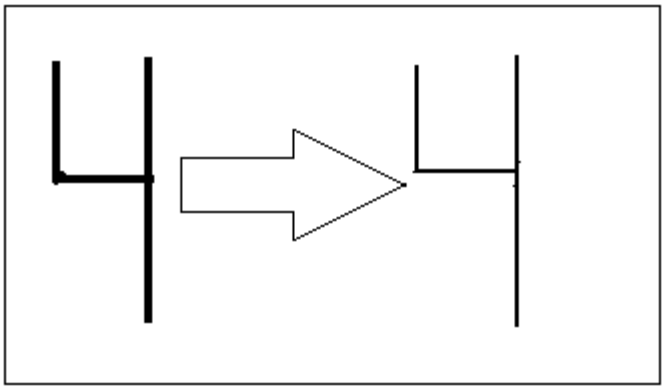


Figure 1.5 : Skeletonization and thinning of number four

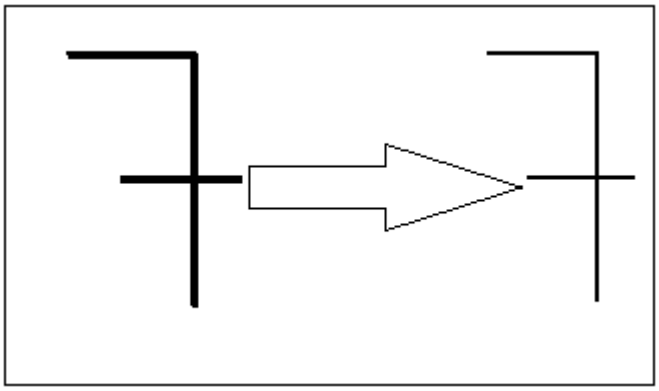


Figure 1.6 : Skeletonization and thinning of number seven

Zhang-Suen algorithm both sub iteration has four entries. And the rule is applied if the central structuring element attached foreground pixel. One can see that if all conditions are perfect compliance (structuring element central pixel) is marked as deleted. The process of iteration is repeated until all of the pixel is not removed. The rules of the first iteration, there are as such:

• Central pixel compound number one.

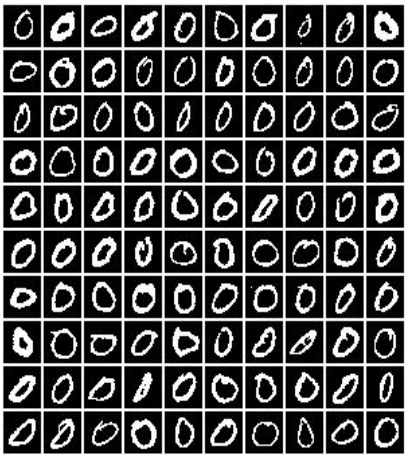
• At least 2 neighbors of foreground and no more than six foreground neighbors in the central pixel.

• and of p2, p4 p6 or at least one must background pixels.

• And of P4, P6 and P8 at least one has been background pixel.

At each iteration, the end marked pixels is removed. The second iteration is only applied when the first iteration is completed. Adjust the second iteration applied is the same as the first except only line 3 is introduced p6 and p8 in place of line 4 rather than p4, is placed p2. All pixels of contour except that belong to skeleton removed with the help of following algorithm.

ORIGINAL IMAGE



CONTOUR IMAGE

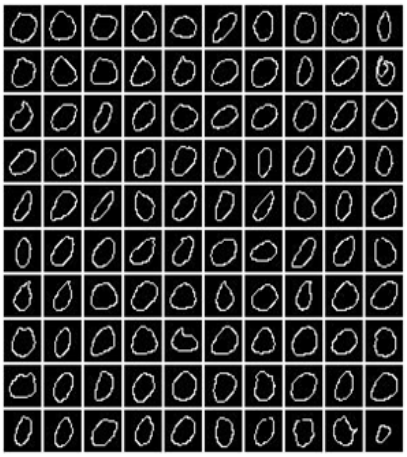


Figure 1.7: Diagram representing the contour formation

1.3.2 **Segmentation:-**

Character line image is converted into characters according to the following method of words and sentences, which also aims same segment [3] .The step is very important at this stage because the character extraction directly affects the accuracy of the identification process. The two main types of segmentation process are: -

a) Explicit.

b) Implicit.

In a word it determines clearly in it at some point to help the division point pass. Such as intersections or intervals [3] in the explicit method k institutions.

Page layout analysis in two steps to its logical part by the explicit method. In the first step of dividing lines of text completion, paragraphs and words, but the point docation based functional components have been extracted document in a second step. However, the implicit segmentation and character recognition are sequentially managed. [4] search image components give it matches the letters in the class, so all decisions are deferred until recognition of split phase [5]. However, some problems exist in the process, as an example of the character portion, can be divided into sections of any other characters. In [6], identifying some performance loss was observed which is causing division concurrent recognition.

1.3.3 **Feature Extraction**

Most present during the identification of the original data before performing the following phase is extracted representative information. There are various techniques to extract them mainly divided into three categories [7] [8]

1. Geometric features.
2. Statistical features.
3. Global Transformation

1) Geometric features:

These features include in its histogram , direction and time attributes .

1) Moments: - It is the character of global properties such as the shape of a region or center mass.
2) Histogram: - it is the image of gray scale, it represent the pixels distribution.
3) Direction attributes: - strokes to exist in helping with curves, lines, or poly lines attached to each other under the character. In order to communicate about the hundred directions between the pixel numbers of strokes occurring character symbol information is a very important factor.

The local direction of character can be determined by various method such as

- Gradient direction.
- Stroke Segment.
- Skeleton structure.

2) Statistical features:

These are determined by points of statistical distribution. Some of them are as follows

A) Zoning: The framework includes a character. The framework is divided into zones based on the dot density. Therefore, the calculation of the density of each region and therefore determine the function.

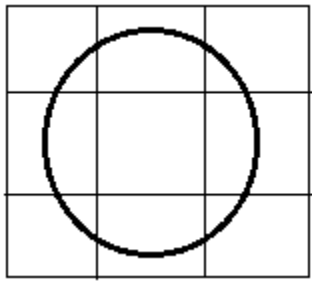


Figure : zoning of the zero number

b) Crossing and Distances: Crossing technology transitions from the foreground pixel count is done by background pixels vertical and horizontal feature lines. However, if the distance from the pixel count first boundary technique to partition frame boundaries.

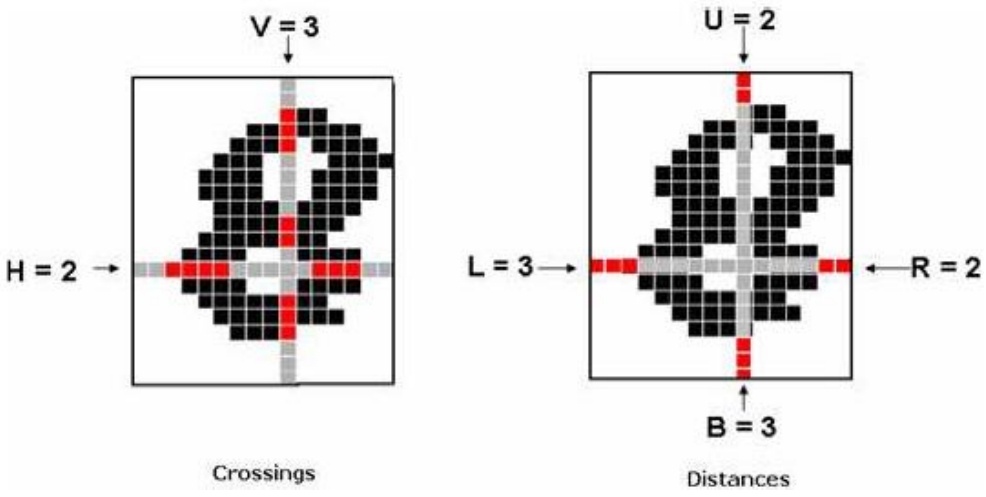


Figure 1.8: The crossing and distances method of English numeral 8.

3) **Global Transformation:** Dimensionality reduction of feature vectors in this method. They use part of the character that is a word cursive together better. Therefore, for this reason it is very sensitive gap. Some popular methods transformation is Pourer, Hal and Hove.[9]

1.3.4 **Classification and Recognition:**

In number recognition last step, according to the specialization of numbers they are recognized and classified.

The important categories are as follows:-

1) Template matching.

2) Statistical Technique.

3) Structural Technique.

1) **Template matching:**

Character Recognition is a simple template matching method in which the characters are identified by matching a predefined character prototype and to be recognized characters. [10] Character similarity is determined as its template so the classification is done here.

2) Stastical Techniques:

This technique depends on optimality criteria in a group and uses those functions that are statically decision based.

3)Structural Techniques:

In structural technique the syntactic patterns are created to measure the similarities between the structural components. The character structure is described by each class and using its own rule.

1.4 OCR MODEL:

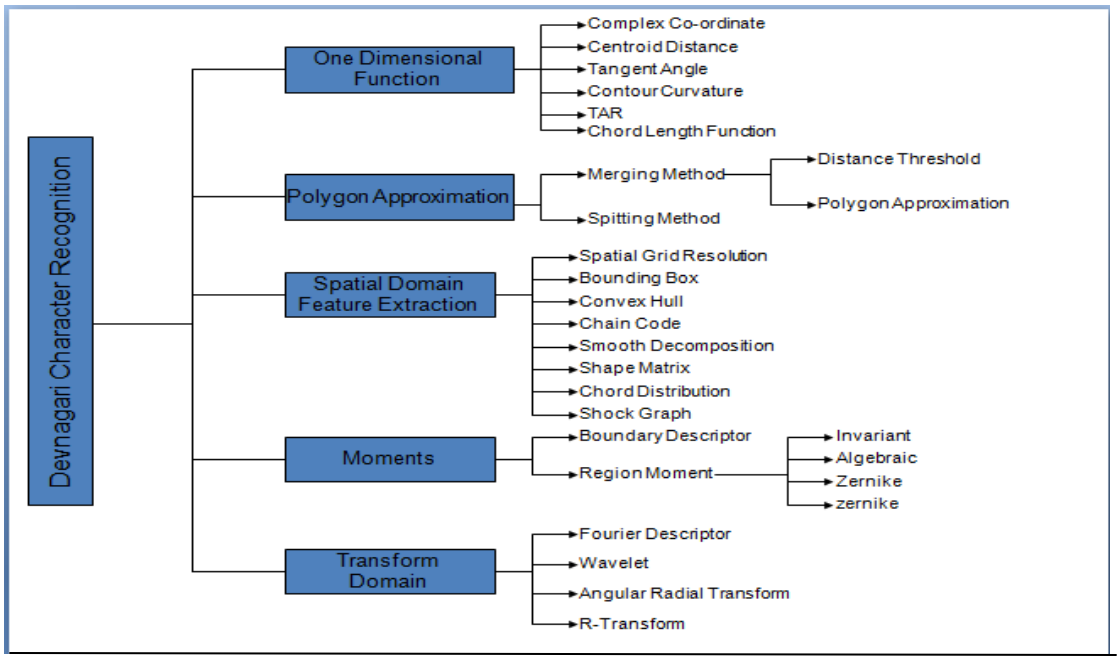


Figure 1.9 Diagram representing the OCR Model

Above diagram is representing different methods that are used for character recognition of Devanagri Script. The main five methods are as follows:

1. One dimensional function
2. Polygon approximation.
3. Spatial Domain Feature Extraction.
4. Moments.
5. Transform Domain.

1.5 Use of OCR:

- Banking, this is the first field that makes use of this technology. Until today OCR technology for banks is important technology. This technology helps in reading digital and handwritten characters on the check which helps in the transfer of money without any control of mankind.
- Therefore, the importance and the accuracy of OCR have been highlighted because it saves time banks and customers.
- Application by OCR, the document should be working applied. Industrial companies and hospitals in places where such applications are found. The company documents including employee and customer information , billing and other products using OCR saves time and also reduces syntax errors , it may be possible to manually type instead of text manually recorded .
- The same OCR system is another application for a patient in the hospital or other document format.
- For extraction of scanned images of text. Researchers and students can use OCR systems. Here only the book, those portions of the image are interested in and then use their machine code format and in all types of files.
- Text -to-speech technology and a combination of OCR systems and then used in an application in which blind people can read the file.
- In the field of robotics in the OCR system is very useful. The robot's eyes are able to use OCR software applications and embedded camera records a history file and script is one of the very exciting uses OCR.

Chapter 2 Literature Survey

In the field of number recognition the first study was completed in 1970 and a retinal scanner of the present invention. The inventors of this technology are CR Carey in Boston Massachusetts. This technology is used an image transmission system through the use of photovoltaic cells mosaics.

In 1890 Paul invented the scanner in continuous development of machine-readable result. Optical image scanning method was used by this author. This optical image scanning method is applicable to its image into a point, line inlay technique [11]
Digital computer in 1940, after the invention and development of new OCR mode begins. However, the present invention is limited only to a few characters and their specially designed for use in commercial restrictions. Little data is processed by using this method.

Use of electronic data processing methods are becoming popular in 1950, the researchers are taking interest in this topic. Development of a device based on OCR in 1954.The typewritten character is recognized by the machine and ready to use in the market. However, due to the high cost of the hardware for the OCR device is not used in the market.

In the year 1960, below the curve methods have been developed, making the design of characters to be flexible. Cathode ray tube and a photomultiplier tube, for use in the process. I got the idea here is to manipulate the data, and then identify the handwriting. [12]

In 1970, the idea came to recognize handwritten numbers exist. The character set is limited, but progress is continuing the development of OCR technology few brands such as IBM, Hitachi and Toshiba, trying to increase the number of characters and reduce costs.

A system in which the invention was developed at the beginning of 1970 and the commercial use of the system's OCR technology to read credit card. Various techniques for 10 years of the present invention such as in the food packaging process, passport start. With the invention of new technology daily popularization of this technology is increasing.
In 1994, the author proposes Hindi handwritten character comparison between two networks were identified. Comparison of the two networks is a radial basis function and multi Preceptor (MCP).

The algorithm MCP network is trained back propagation algorithm. This article has been submitted to the system automatically Hindi Character Recognition (HCR), which uses MLP and RBF network. Experiment two hundred five authors of 45 samples Multilayer tutor (MLP) as the recognition accuracy than work better memory usage. But the disadvantage of this system is that it relatively affected because RBF neural network training for a long time.

Neural networks are used in a plurality of pattern recognition process. Character recognition is a pattern recognition part; it is researchers of an interesting topic. A lot of work has been done some, like English, Arabic, Chinese, Persian language text recognition. However, the Hindi language discussed herein handwritten character recognition. Automatic character recognition is in the author's mind development, because the language is widely used in most Indian office. [13].

Related derived from this is the basic function of the fuzzy box method using normalized distance assessment method on ; basic amendments proposed in 2008 author index membership function on handwritten character recognition Hindi characters. In 2007 collection. Index membership function takes two parameters in a modified way, their structures were evaluated.

Structural parameters by optimizing an objective function evaluation; objective function used is entropy and error functions. Improve the use of reinforcement learning from past policy has been to reuse policy. The convergence rate of the learning process is the use of recycling policies improved; compared to no learning and reuse policy also incorporates reinforcement learning

purposes. Training is increased by 25 times. The experiment was performed with a 4750 sample on the database. Whole recognition rate of 90.65%. [14]

In 2008, the proposed research should be done free style line handwritten documents segmentation. Algorithms have been developed for gravure printing documents and hand problems facing the curve in terms of lines of text and a small gap between the adjacent texts. Research on which this article will be completed technology is the most advanced in the art of image segmentation, density, estimation and level set method.

According to the probability of the input image file Fig estimated. There are some elements in the probability map. Probability of pixels located below the text line is represented by each element and is found that by using the level set method text next boundary.

This is the proposed algorithm that does not use this specific script any knowledge. Algorithm used herein is varied steady rotation, noise and size. The main parts of a document image analysis are the text line segmentation. Character recognition, segmentation and screws corrected data and information was given by the dividing line. Problems faced in this article have a free - style handwriting is taken into account. This problem is generated because of the following reasons.

a) The handwritten text lines are curvy in nature.

b) The text of handwritten which is there in neighboring may be variant to each other or may be very close to each other. [15]

In 2010, the authors believe that there is such a handwritten script devanagri implementation met online on my phone. Devanagri script is one of India's script; the script used in many different Indian languages such as Sanskrit, Marathi, Hindi and Nepal. Write devanagri compared to English cursive script is more complicated because there are variations in the direction of the subsequent stroke, the sequence number and shape. Devanagri script contains 13 consonants and 36 vowels.

After studying the various figures of 42 pens form. This is a design stroke recognition method and recruit people recognized and hidden Markov model (HMM) based. For each level HMM help build an itinerary. For classification purposes is a step for Identification using a lookup table of the results of character stroke classification.

In this paper it has pointed that the phone is a touch -enabled smart phones. The program has completed my phone, which supports more than 20 kinds of international languages. However, my phone does not support script devanagri, so online identification referred to herein isolated devanagri script. [16]

In the 2011 proposal article by its composition of Marathi and Hindi (Devanagri script). One technique of 26720 handwritten words you can identify the handwriting India bank checks data sets. Many words are in the lexicon of similar size and shape; there are some words have prefixes and suffixes. The method is used to identify that it uses two techniques. One technique using binary vectors match (BVM) technology structures and cavities (GSC) is provided.

The other technique is based on the Dynamic time wrapping (DTTW) and vertical project profile (VPP).The knowledge which has relation with the language was also used in achieving the reliability. The devanagri script can be written in only one style and cannot be written in cursive. [17]

In 2011, the authors point out, there are some gifts appraiser parameters; but they say that this is more than a handwritten document. A lot of work has been acknowledged Roman script for these parameters is very important but very little work has been recognized by the Roman script completed but very little work has been done in India admit script.

One of India's most popular Hindi language; it is devanagri coding and writing scripts for it. The method is called the partition, use, wherein the n * n grid superimposed on the character image.

In some partitioning methods were compared in this paper. Discover and analyze the performance of flexible boundaries and fixed boundaries. This is used in this paper is characterized by an average angle of the image pattern and the average distance of the skeleton of black pixels. In order to identify the digital classification based on the MLP and SVM are used. [18]

Chapter 3 Problem Statement

3.1 Structure of the System

The main platform for the development of OCR systems in the project; these platforms is Java programming language and network identification the result will be stored in .dat file.. Requirements of these platforms allow agents based methods are met. Agent -based approach an important part, is to take the image and character of its implementation identified in the network to identify any image. But the other two platforms, making network identity are supported.

Few steps that are used in optical number recognition are as follows:

1. The text document image is loaded to the system by the user with the help of java interface. The original image of text document is also loaded by the user to the system for finding the result.

2. User will select the few image processing algorithms from a number of options and works on the image processing that are supported by java.

3. When the image processing in java is done then the pixel information is written by java (location and color) of the image that is processed to the "common.dat" document and then Net logo is run by java.

4. The approach of agent-based is applied to the image with the use of Net logo after it reads the complete image information from the "common.txt" document. Each number is detected by the Net logo based on the results from the MYSQL database of the agent based approach.

5. All the recognized text is written to the file name "Result.txt" by the Net logo when the recognition process gets complete.

6. The recognized text is read by the java from the "Result.txt".The rate of accuracy is determined by making the comparisons between the original text and the recognized text

which was loaded by the user. The rate of accuracy is determined by applying some posts processing algorithm.

Few result given the number information; only when the agent moves completed in a character. This is our role from a sports match all of the character, the results obtained to figure out which character belongs, which is why a list of all numbers having required characteristics (e.g.: people -edge count); and for matching network the results of the identification of the motion. The next platform will help store a list of numbers.

For storing a list of other platforms can be removed because the net logo can stored in the form of the list of programs. The list has 74 characters, each character having an edge many functions like counting, start or end point. When this list net flag implementation; the increased complexity of network identification code. Complexity, including a lot of time to look for a character, and then update the list.

Some features of IntelliJ are given below:

IntelliJ program is named the model; the interface of these models is interactive. However, if the net mark -interface components is limited. Some of the required image processing method in an OCR system; the implementation of these models are difficult to identify in the network.

• Since the second programming language, network identification is required limit. The user can choose a second language should have components from different interfaces. It should have a vast library to OCR algorithm easy to implement.

• The language should be able to control the IntelliJ.

• Another program can run which also runs on the net mark Java virtual machine.

Java is chosen as the programming language because of some of the following important reason:-

1. The IntelliJ is invoked by the Java.

2. The program interface is created and maintained by the help of components that are functional.

3. The IntelliJ command is controlled by java.

4. Both IntelliJ and java can write and read text so both can share information by communicating with each other.

3.2 The number recognition process is classified into three parts by the system and they are as follows:

.

1. Image Processing.

2. Recognition.

3. Evaluation.

1.Image Processing:

Java handles the first step. The image processing is done by java, and after the processing of image it gets ready for recognition.

2.Recognition:

The second step is dealt by the Net logo; the number is removed from the image in this phase. The Net logo actively participates by the support of MYSQL server.

3.Evaluation:

The last phase is again dealt by java. The result of the proposed OCR is analyzed in the final step. The numbers that are recognized in that improvement is made with the help of post processing algorithm and in last the recognized number accuracy is calculated.

3.3 IntelliJ for OCR:

- IntelliJ contributes to the environment which consists of both world and turtles.
- World is defined as a two dimensional ground.
- The ground in the world is having equally-sized, small squares known as patches.
- Each path has its particular co-ordinates and color.
- Turtles are defined as the agent in the world that makes movement on the patches.
- The properties of IntelliJ are used in implementing the optical character recognition.
- The image is related to the world of the IntelliJ.
- The extraction and recognition process in optical character recognition involves the walking of a turtle over the patches. That's why both the feature extraction and recognition process simultaneously.

3.4 The Advantage of IntelliJ:

1) Reduces Complexity

All three properties identified in a network environment, extraction, classification, and identification is fully applied to the image in a single step. Reduce the complexity of such a system and save time.

• In a network environment identification mark is what the system can be observed step by step. Therefore, if the program fails, it can be easily observed and recognized the new algorithm can be framed.

2) Reduces Time

Multi- Agent network modeling run and supports logo environments. Multi-agent modeling feature is that it can run multiple turtles once. Thus, each turtle is given the task of reading the text line. And a lot of time can be saved as a text file, which is a large size.

If we only want to see results and do not want to display interface; therefore identifies network can run in the background; and this pattern is called headless mode. The time is saved in this mode and main java programming interfaces are not affected.

3) Functionality

In a network environment marked by a number of command and control of turtles. This command is used to control the turtle through the use of spot and coordinates.

• The IntelliJ is a network of agent-based language. So the patch information is easier and faster to achieve.

• Proxy walking in the image provides some result; count by the patch, the direction of movement or start point. These results are especially for each word, which is why they mistakenly identify different characters and reduce network ID.

Chapter 4 Implementation

4.1 Image Processing

Image processing work is to prepare environmental network identification image recognition and processing them in the IntelliJ environment. This step is taken as they are having a noisy, fuzzy, damage, handwriting documents. However, this is not correct typewritten documents because if the quality of the paper is very high then the steps of the algorithm are skipped when typing. This is why some preprocessing algorithm keeps optional. In this case, the user decides which use image processing according to the quality of the paper. There are several ways it is used in the image processing they are thinning algorithm, Thresh retention algorithms and convolution filter. But few convolution filters is optional this plan work for programs.

On the other hand the refinement and threshold algorithm used for image always. In the image network identification image should always be black and white. Black and white images are provided by the threshold algorithm. In each line of characters in the image should be one pixel wide, when these images are processed in the network identity. And in the character of a pixel width line by thinning algorithm.

Image text document is loaded by the user into the system by using the “Load Images" button. The loaded image is displayed on the left on the button. This is the original text of the document is to be called button to load the “Load Text" button by using. When the user clicks on the image processing button, the image processing options are displayed. Convolution filters this image processing options such as edge detection and noise removal filter threshold and thinning algorithm method.

The methods which the system implements are as follows:

- Thresh holding: - The local methods and Ostu methods are used in the first method.
- Edge detection: - Sobel filter, Robert filters, Prewitt filters, and Laplacian filters are used in the second method.
- Noise Removal:-Gaussian filters, Mean filters and Median filters are used in the third case.
- Thinning method:-Hilditch algorithm and Zhang-Suen algorithm is used in the last case.

The user is allowed to use any of the method stated above. Therefore, when it is applied by a method selected by the user on the image and in the final resolution of the net identified model the user clicks the button displayed on the java interface. However, if no image button is chose by user then thinning algorithm invented a new project and OSTU threshing maintains the selected "image processing "button is applied to the image.

4.1.1 **Edge Detection filter**

Edge detection filter is the optional point in the program. The edge detection filters detects edges of the image pixels, but remove all other pixels from the image and serve as important information needed cleaning pixel thinning algorithm. Example of this problem is in bold letters. In the case of edge detection algorithm bold letters considered as due to the two lines of characters a line width. The thinning algorithm to detect each edge as two different candidate characters. Four types of edge detection filters that are used in the program are as follows:

- Sobel filters
- Prewitt filters
- Laplacian filters
- Robert filters

4.1.2 **Noise Removing:**

This is not the important part of preprocessing step. To remove the noise from the image the image first gets blurred by the filter. If there is a very small quantity of noise is present in the image then the filtering process goes to the blurring of the image and as a result lot of important information is lost in the noise removing process. The amount of blurring of the image depends on both the size and type of the kernel. If the size of the kernel is big than the blur on the image will be large but if the size of the kernel is less than the blur will be small. We can use three noise removal filters in the program. The three filters are: mode filters, mean filters and Gaussian smoothing filters.

4.1.3 **Thinning Algorithm:**

There is some refinement algorithm which are very famous they are: Hilditch Zhang, Sun, these are used in the program. The algorithm is iterative, parallel thinning algorithms, rules and

structure of the two algorithms are the same. They work effectively large bold characters. However, in this case, between the entire portion of the character or character component connection has been cleared at the time of writing in small-sized files and the connection may be between parts of character.

But all parts of this program are connected to run this program valid characters are connected. This is done because of the nature of the confirmation information based transitional portion of those characters between the characters on. If any gaps exist between two parts of a character, the program considered complete until the character is a gap, it is considered that the gap after another character. Thinning algorithm to clean both unnecessary parts, but sometimes they also need to clean parts. As mentioned algorithm does not fulfill the requirements of the program of work, to make a new refinement algorithm development. This is a newly developed algorithm refinement, connectivity in the protected characters. But extra parts are present. The algorithm can work effectively in small-sized characters. But it is not so effective in bold.

4.2 Agent based OCR in IntelliJ:

The IntelliJ model is developed for number recognition in the given project. The processed image is transferred to the IntelliJ environment from java in this project. The next section comprises of the approach which is agent based and used for the OCR is explained. The structure of the IntelliJ world is also given.

Its design has been completed, including the mentally pap ret. The IntelliJ programming language grammar development network identification is very simple this is it and forms a system that is well thought out to create a complex world model. A world is composed of four types of agents and those agents are turtles, links, patches and observer. World are considered turtles, links and patches. The world can be 2D or 3D environment.

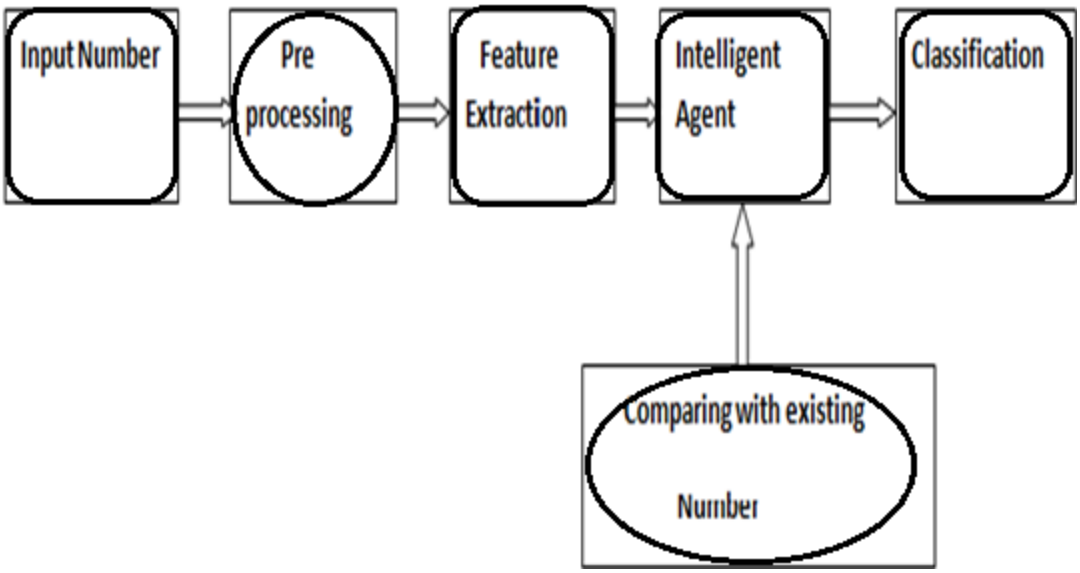


Figure: diagram representing the method for tracing the handwritten numbers using the intelligent agent.

4.2.1 Displaying the processed image in the IntelliJ World.

2D integer array is being used to transfer the image to the Net logo. This 2D integer array consists of the color of each and every pixel, 1 for black and 0 for white. The final array is written to the "common.dat" line by line after the thinning process gets complete by the java. The image dimensions (width and height) is written to the" dimension text" by the java, and after that the Net logo model is run. A two-dimensional array of integers for image transfer to the network identification, the two-dimensional array of integers containing per pixel, one is black, 0 representing white color. After thinning process consists of an array antenna which it is done by a final written line "common.dat" line in java. After the image size (width and height) is written, "marked the words" by the java, and run the network identity model. The working of IntelliJ is as follows:

- In the very first phase the IntelliJ reads the file naming "dimension.txt" and after reading the file a world is created which consist of patch agents in Net logo in accordance to the dimensions.
- After the first step gets complete the model read the file "common.dat" line by line.

- Each row of the world is determined by each line of the documents and each patch of the row is represented by line each item.
- The patch color is finalized by the value of the item; if the item value is 1 then the patch related to it in the world is colored black, on the other hand if the item value is 0 then the related patch is colored white.

Therefore, when the basis for all lines of the document is read by the model and patch line formed on; the whole text is displayed in the world's net flag. Image conversion is possible to identify the worlds only patches exist on the network structure, as possible. It does not limit the size of the network identity of the world. It can be amplified in accordance with the purpose. Scalable network identity global network identification world. The memory size limit can be extended up to 2000 * 2000 in this project.

4.2.2 Methodology of the agent based approach for OCR

The OCR technology new approach is processed by the given three steps:

1. Line determination methods.
2. Number recognition methods.
3. Method in which the character is matched from the database.

The right bottom of the turtle world consists of IntelliJ; the turtle is being used to move the number. IntelliJ reads all the text lines. And a turtle also makes the sport from all over the world from the bottom to the top. When the turtle placed on any line and then move it from right to left; and the character is read by the turtle and also extracted. Character Extracted from the database matches the character and then display it in the world network identity.

4.2.2.1 **The Determination of the Line:**

Line is determined by the turtle. The full text of turtles moves one each by one line moves from the right from the left margin. Determine whether any of the text line is carried out by thresholding; and decided to do this before the turtle begins to move. Threshold Algorithm threshold values used; this value can vary depending on its use by a user; threshold slider

through the current network ID on the interface. Value 4 behavior acts more effectively in the program.

Thresh holding Algorithm undergoes with the following steps:

- In the very first phase the value of the thresh holding is set and named as T. Threshold slider helps in setting this value.
- The present row coordinates are recorded.
- All the present row blank patches are counted by the user and these are known as n.
- The upper row co-ordinates is recorded and then situated on the present row.
- Then again the present row the black patches is counted and termed m.
- Now the text line is determined with the use of formula if (m/n)>T; then present row will be considered as text line.
- Now lastly the present row should be at top of the world and if it is not then make the present row on the top of world and follow the same process from the step 2 onwards.
- The accuracy of the algorithm is very high so the whole task is performed by the algorithm in a very small amount of time. The value of the threshold determines the accuracy of the checked lines in the text. When the text value is greater than the deserve value; then some of the lines are missed in the determination of the text line.

4.2.2.2**Number Recognition:**

The number is recognized by the following steps:

1 First of all the turtle is located below the bottom base line of the world to the right side.
2 Then the user moves on the left side of the line; one step till it finds the black patch.
3 The black patch is considered to be the starting point of any character; and the turtle is placed on the starting point.
4 The black neighbor of the detected path is found and the color of the neighbor is changed from black to red. The heading is set in the direction of the neighboring patch.
5 The heading is recorded and the visited patch is increased in count by 1.
6 The process from the step 4 is repeated till a single black neighbor is not left of the located patch.

7 The located patch is stated as the finish point of the character.

8 When the finish point is not present at the end of the line; then the process is repeated from step 2.

9 At last the user moves on the next upper line and repeats all the process from step2.

4.2.2.3 **Methods used by the number recognition Algorithm:**

1.) Start point: - Every number is denoted by a start point; the turtle heads over the row selected by the user; and the row first black patch is admitted as the starting node. The Color of the starting point is switched from black to blue.

2) Finish point: The finish point too determined by the turtle; it is the point when the turtle movement gets completed. As long as the finishing point is achieved by the turtle; the finishing point is dislocated and then the turtle starts finding the new starting point.

3)Edge: An edge is formed of black patches which are connected and these black patches should lie on X co-ordinate or Y co-ordinate.as for e.g.: one edge is present in character I because the connected patches are present on the same X co-ordinate. For character w there are three edges. For number 1 the patches are present on the same X co-ordinate. And for number 2 the patches are on the same Y co-ordinate.

4) Corner: The turtle moves in four directions that is top, bottom, left and right. The turtles heading of top are 0 degree, bottom is 180 degree, left is 270 degree, and right is 90 degree. Until corner is achieved by the turtle, its movement lies in a particular direction. When the corner is achieved by the turtle then the direction changes accordingly to the corners position.

There are three edges that are considered by a corner and need to fullfilled any one of the condition mentioned below.

1st condition:

When any of the two out of the three patches are located on the same X-coordinate and any two out of the three patches are located on the Y co-ordinate.

In the above figure patches 1 and 2 are present on the same X co-ordinate and the patches 2 and 3 are present on the same Y co-ordinate. When the turtle makes the movement from bottom to top; it finds there is a corner when it comes till patch 3;and its direction is changed from bottom to right.

5)**Branch:**

Branch is defined as the character patches; that provide more than the one option for the next step of the turtle. The branch patches consist of black color when any of the two conditions is matched, then to a patch can be considered as a branch point.

1st condition:

The turtle present direction is considered as top. But if in the next step of the turtle a black patch is available with the same direction of the turtle, which is on the top and minimum one corner is present, the present patch where the turtle heads to next point is considered a branch point.

2nd condition:

When no blank patch is present in the turtle direction, but if there are minimum two corners are present, the present patch from where the turtle moves to the next is considered as a branch point.

4.3 Methods of the new algorithm used in this project

The new algorithm has used the 2D integer agent, and thresh holding algorithm has created this 2D integer agent. Each item of the array corresponds to the pixel of the image. The row and column information of an item that is the part of an array is significant to the co-ordinates of the pixel in the image. The item consist of two value 1 or 0; 1 correspond to black pixel and 0 correspond for white pixel.

If the algorithm makes the decision to delete any pixel, then array item is swapped from 1 to 0 by the algorithm. When the thinning process is completed, then for the phase of recognition the 2D

array of integer is used by IntelliJ. All the black pixels provided neighbors from p1 to p8 is listed by the new algorithm; and the black neighbor's count of the pixel is chosen. This is the first black neighbor and is considered to be the basis of an ordered sequence of pixels on the Start pixels. This is the beginning of pixel connectivity for a search between the neighbors.

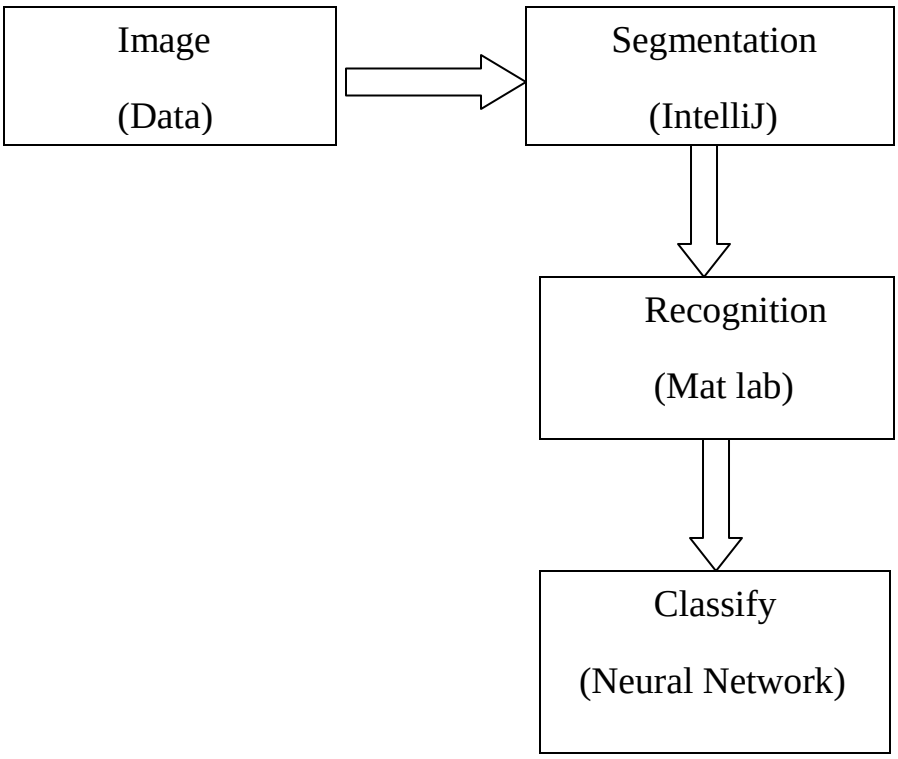


Figure 4.1 Representing the Processing of Image (Data) Through the Three Platforms.

The statements for the new thinning algorithm are as follows:-

1. Scan the number images.
2. Read the number images by the system.
3. Remove the noise from the number image using the thinning algorithm.
4. Segment all images and convert all images into 48*48 pixels.
5. Use the Java Api IntelliJ to find the features of image and slant correction.
6. To convert all images feature in binarisation.
7. Use the Java api IntelliJ to find the formation of number.
8. To form the number those have lines.

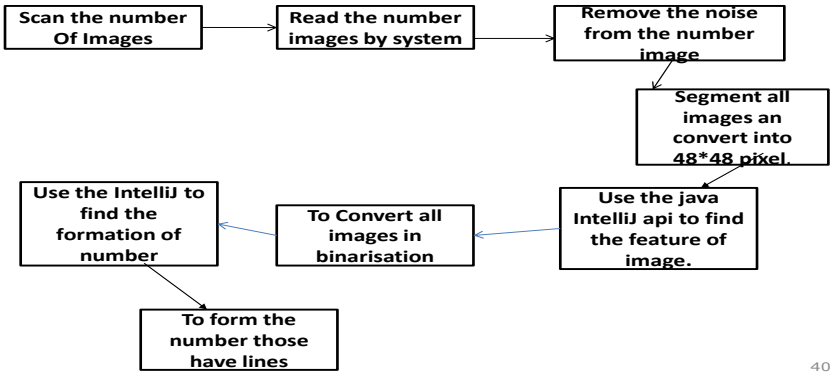


Figure 4.2 Representing the Logic Diagram

Some snapshots of the IntelliJ are described below.

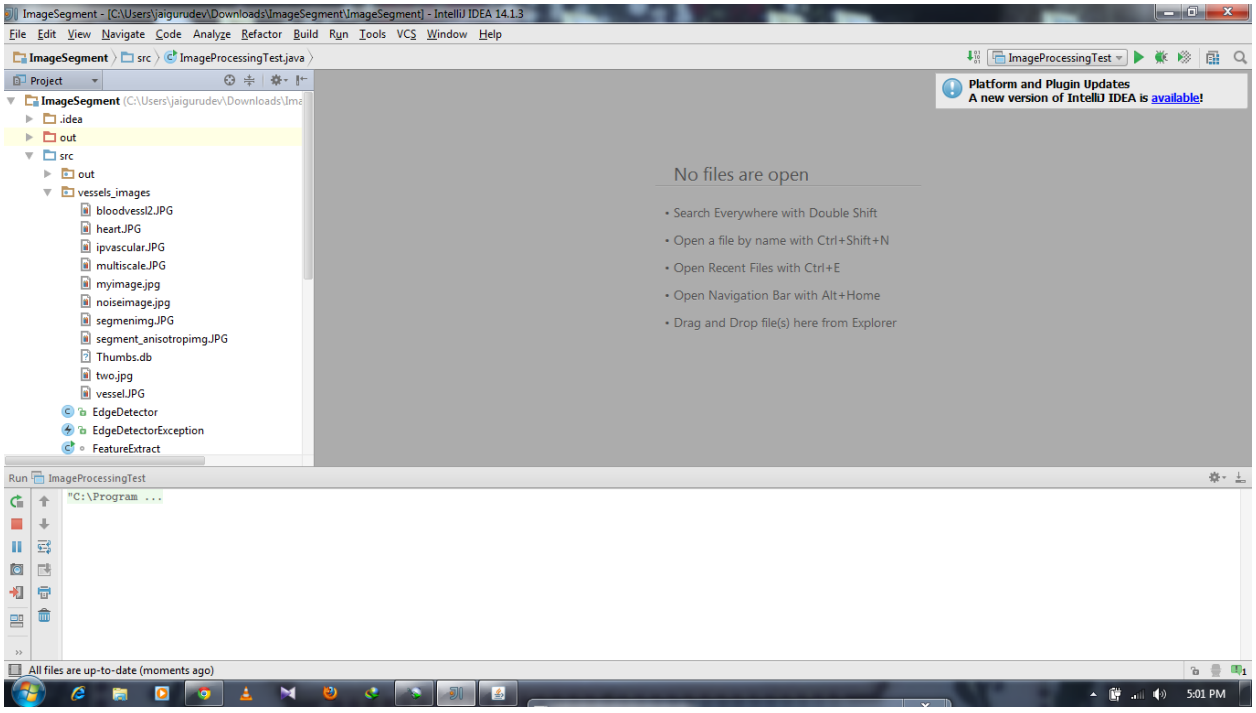


Figure 4.3

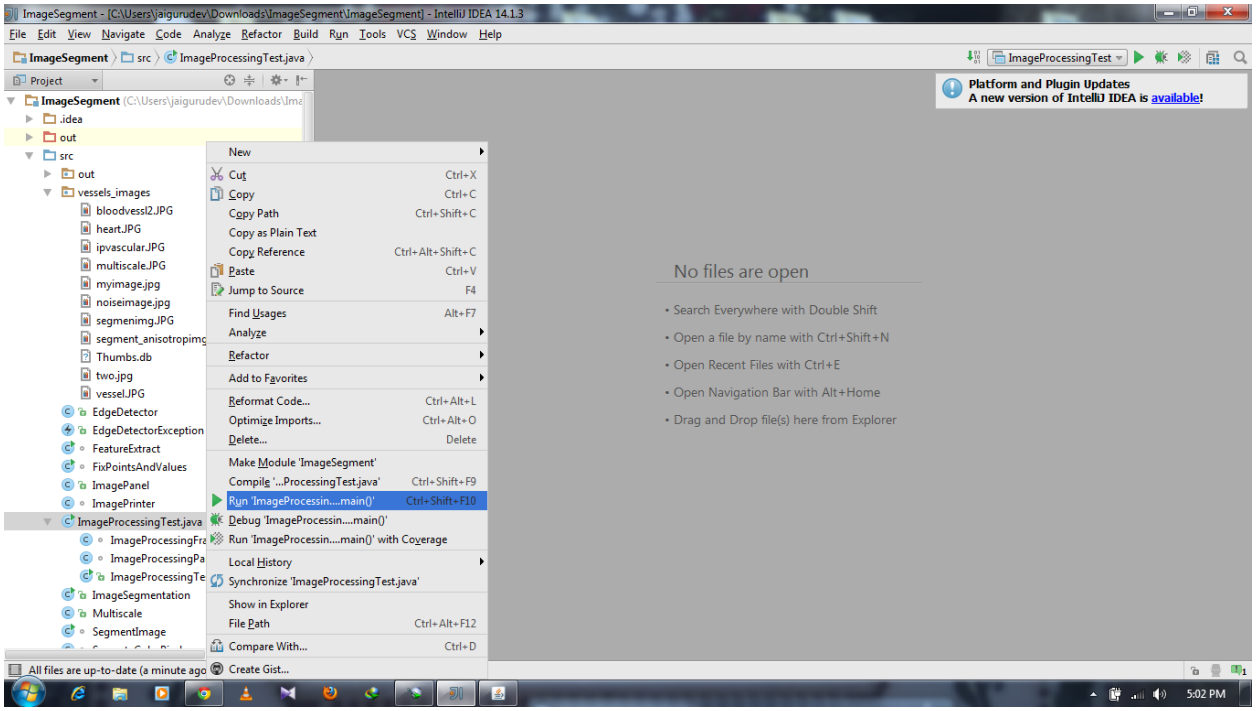


Figure 4.4

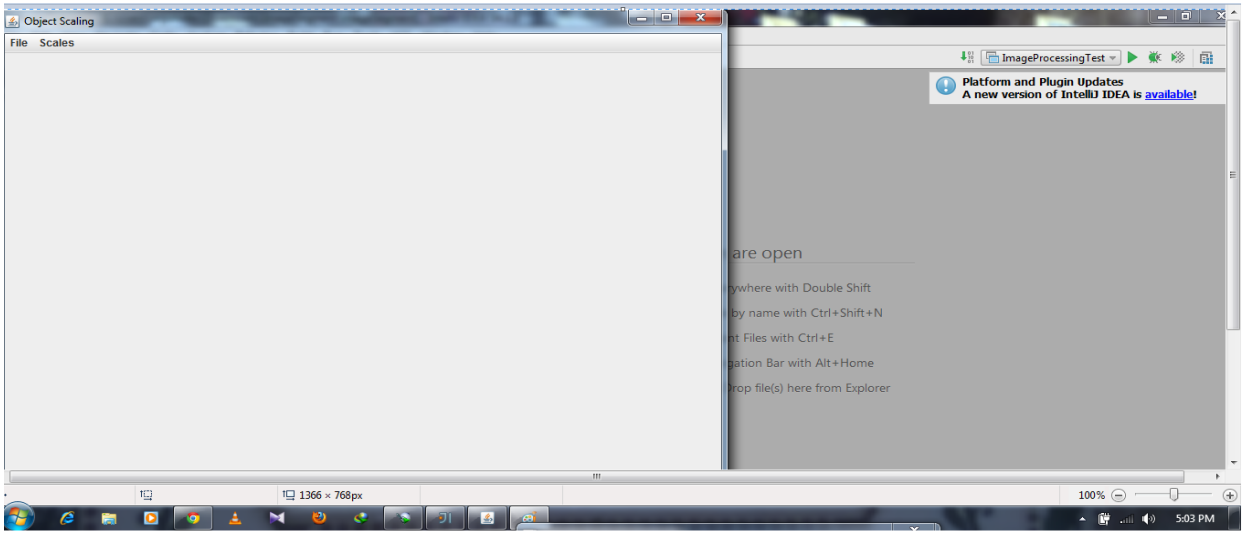


Figure 4.5

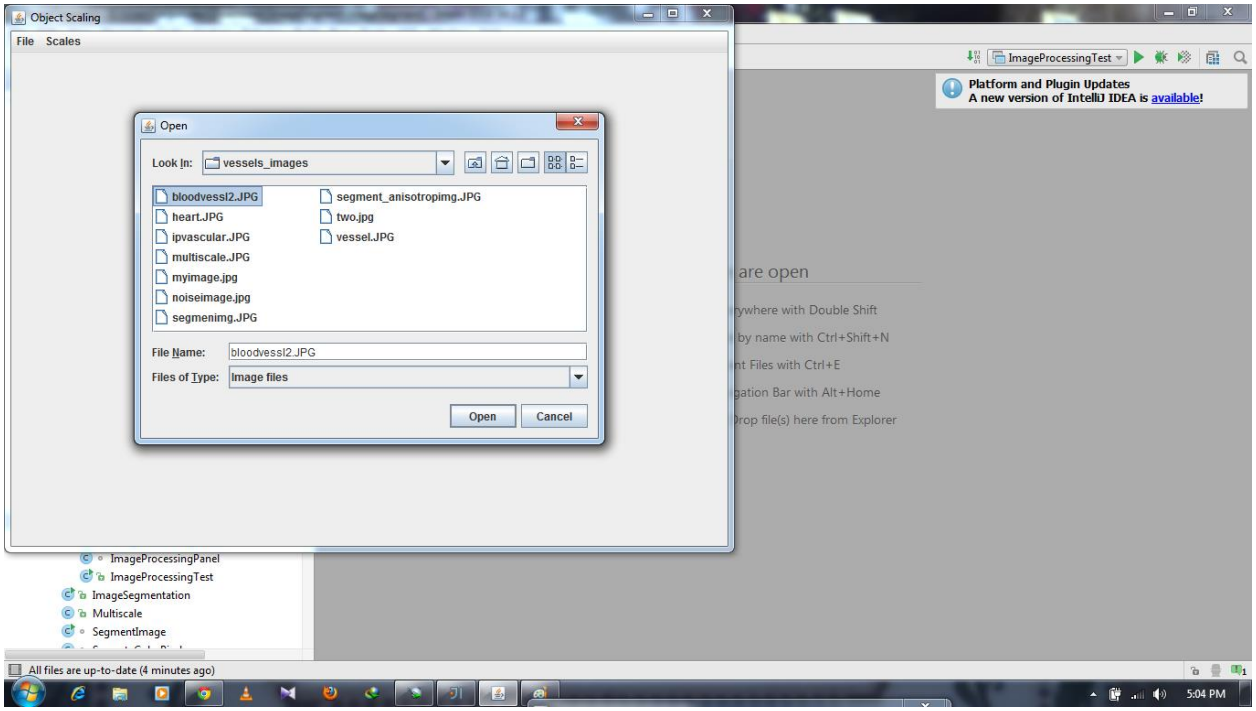


Figure 4.6

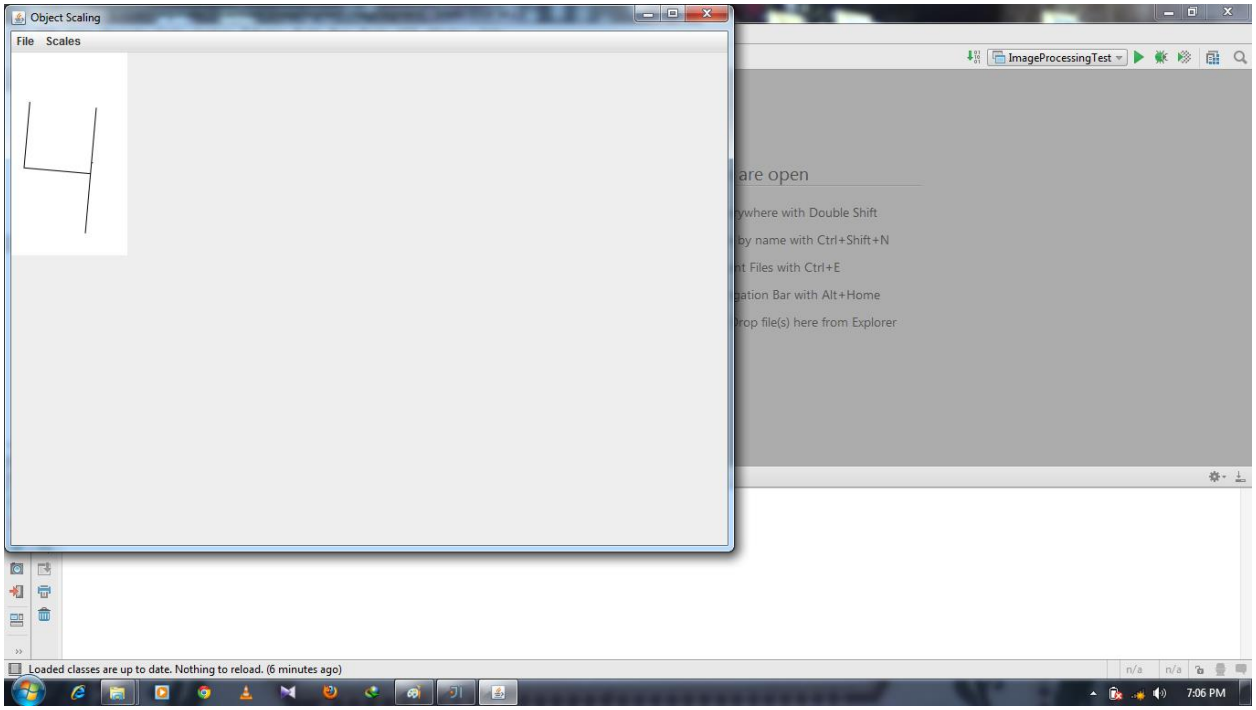


Figure 4.7

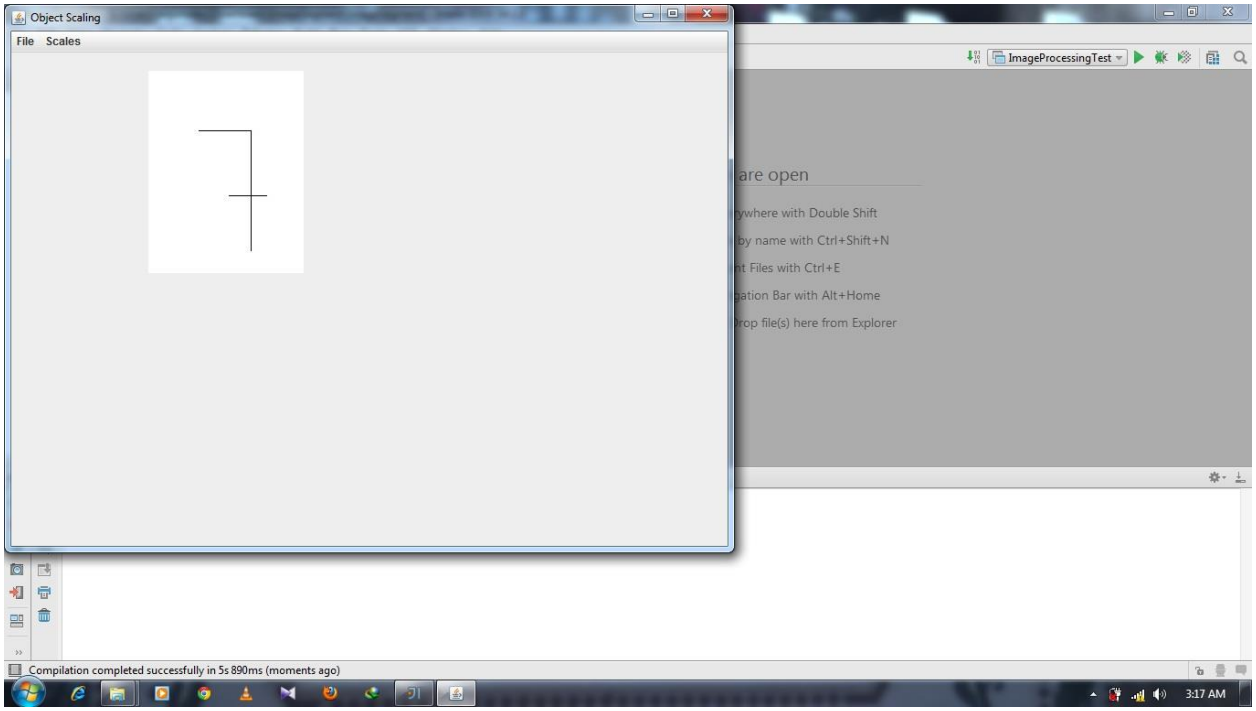


Figure 4.8

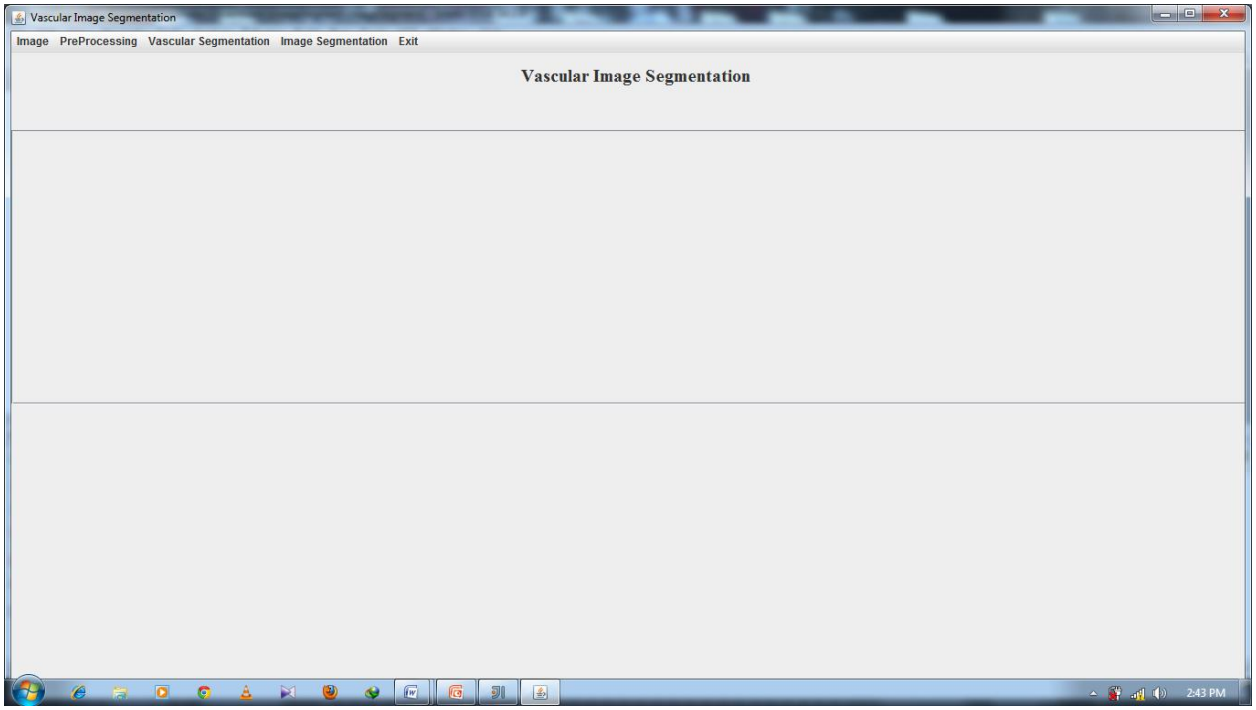


Figure 4.9

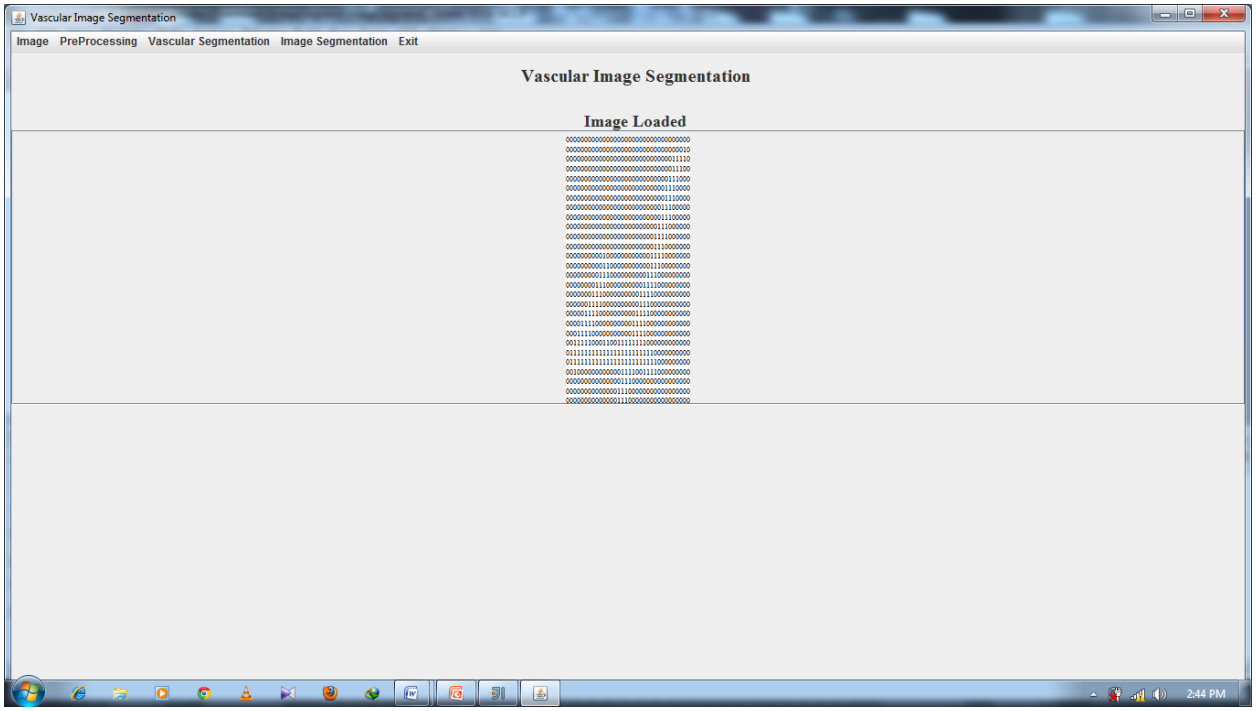


Figure 4.10

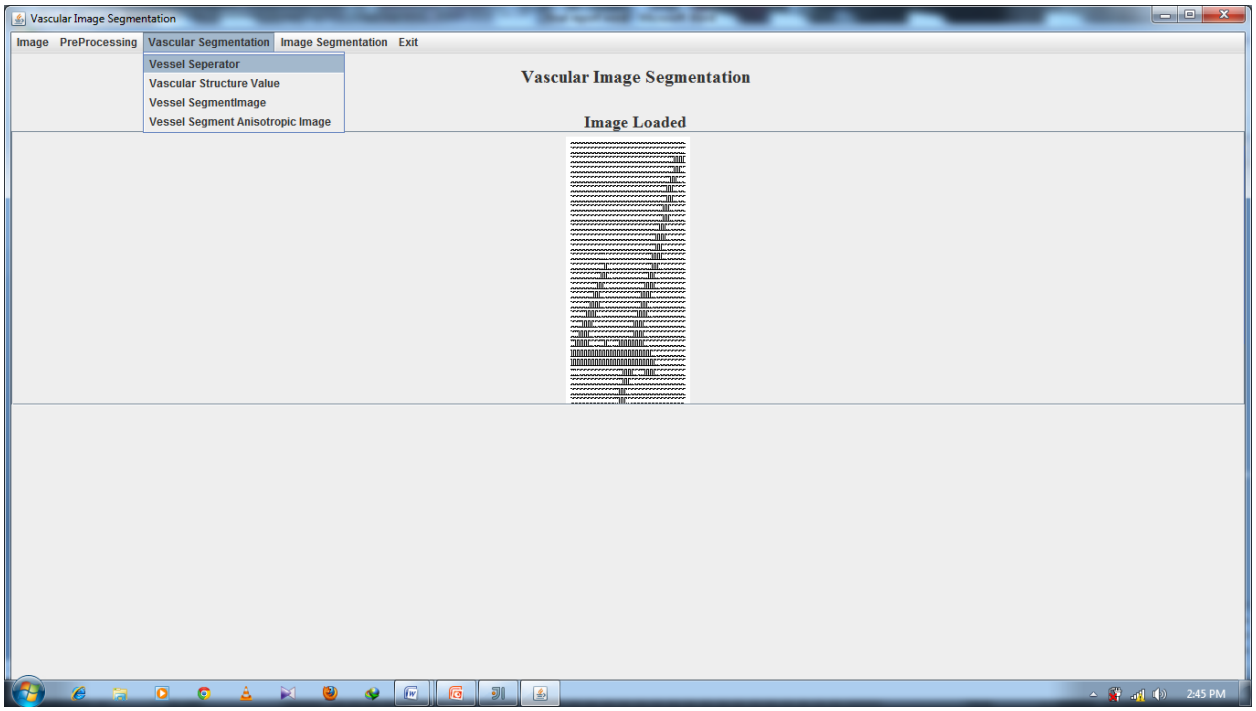


Figure 4.11

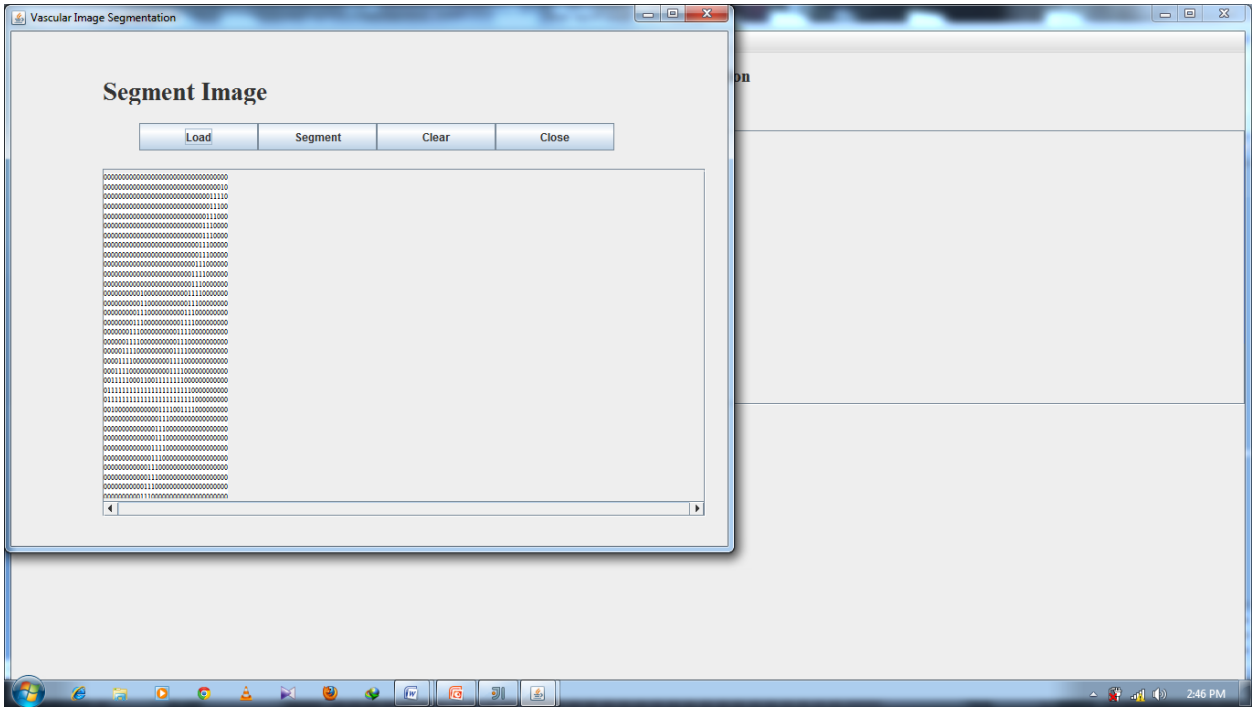


Figure 4.12

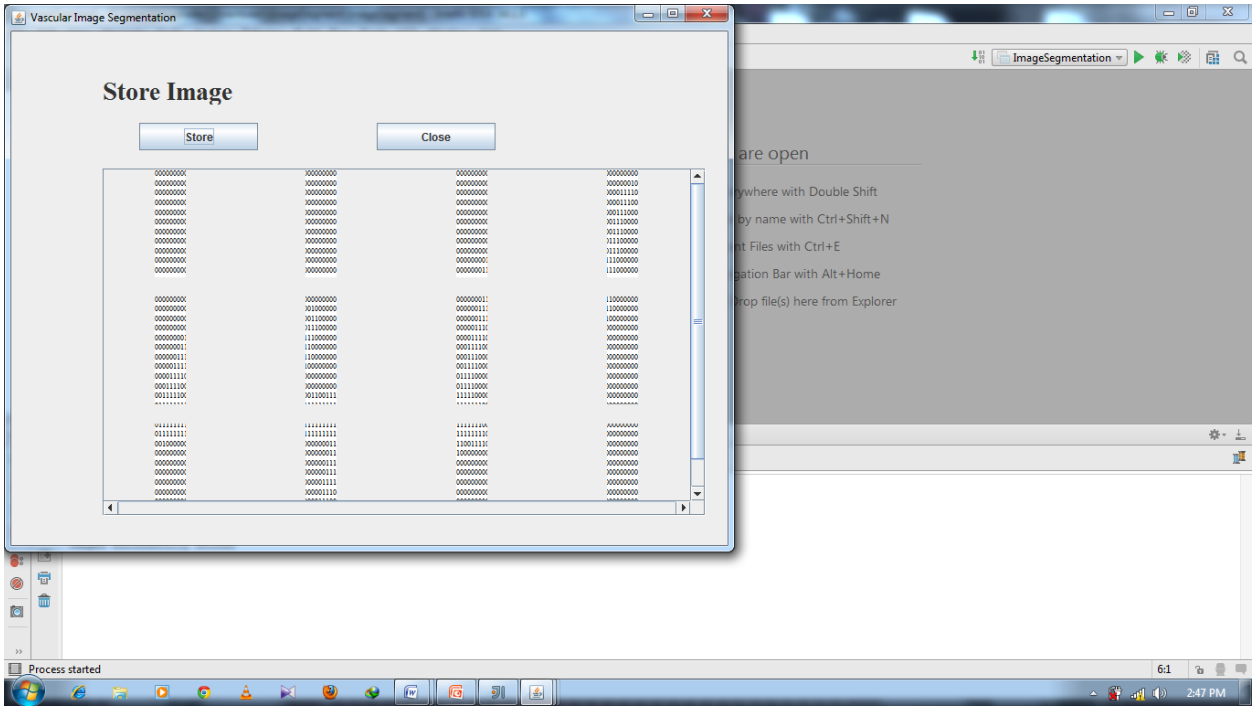


Figure 4.13

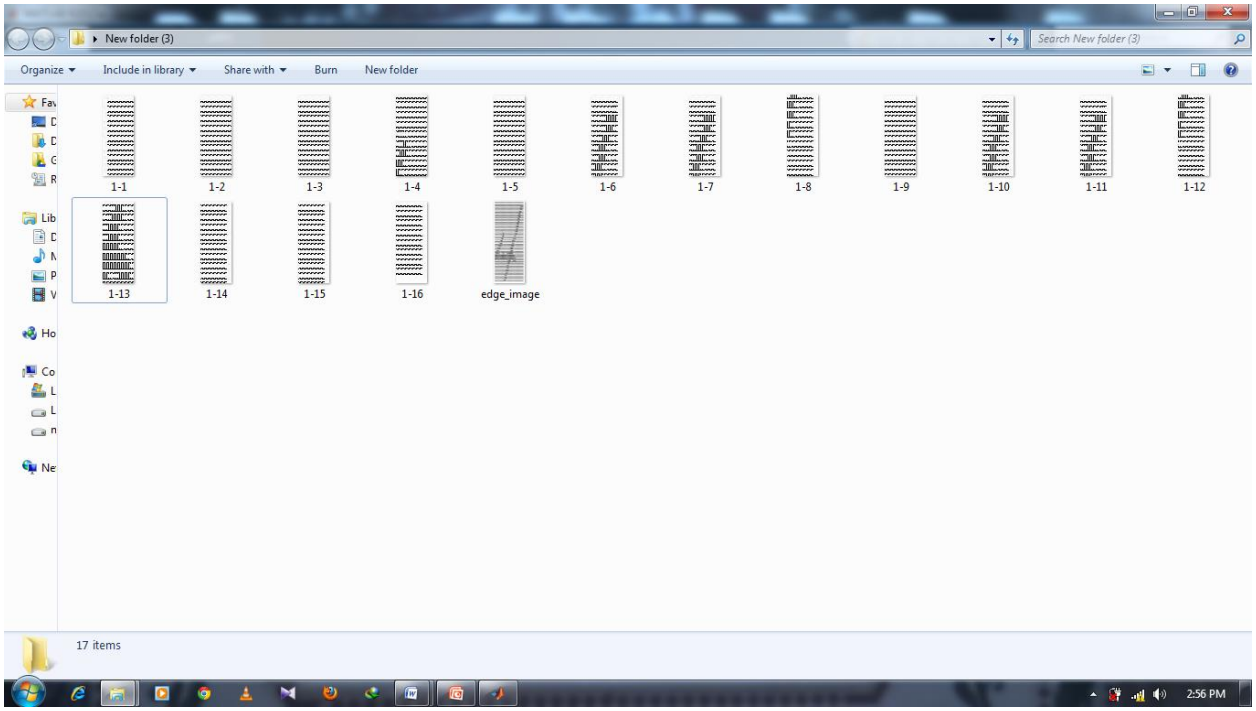


Figure 4.14

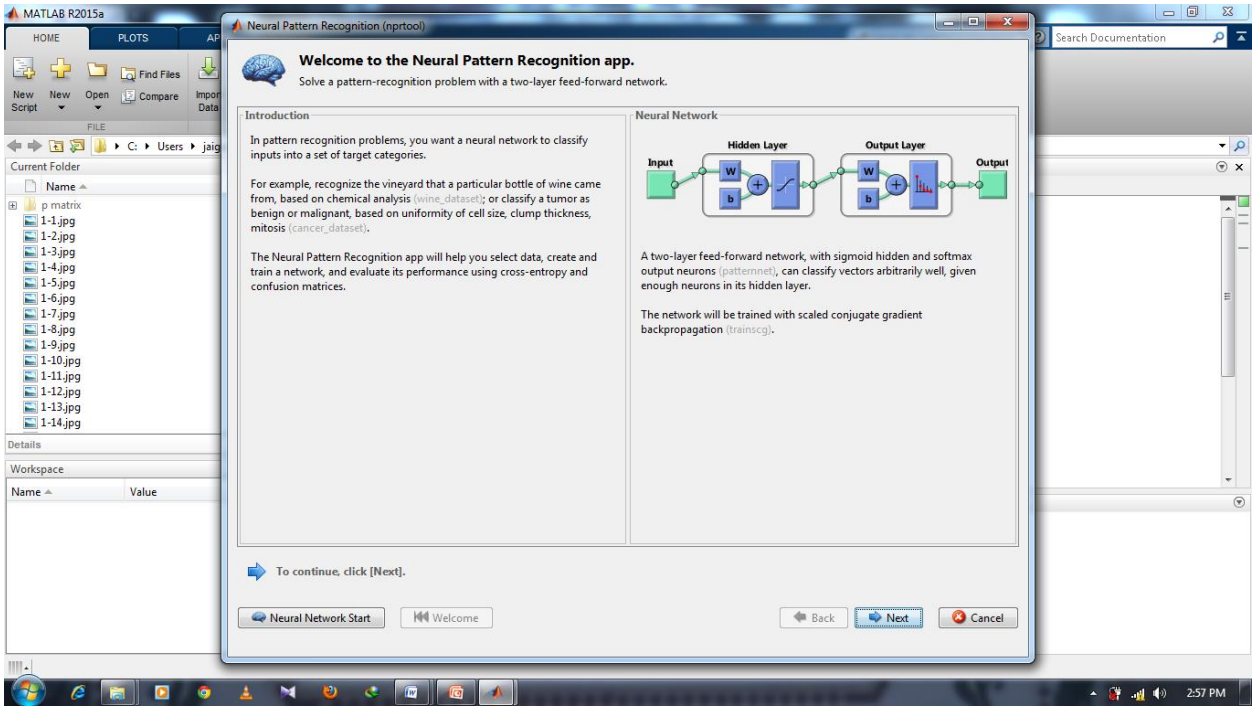


Figure 4.15

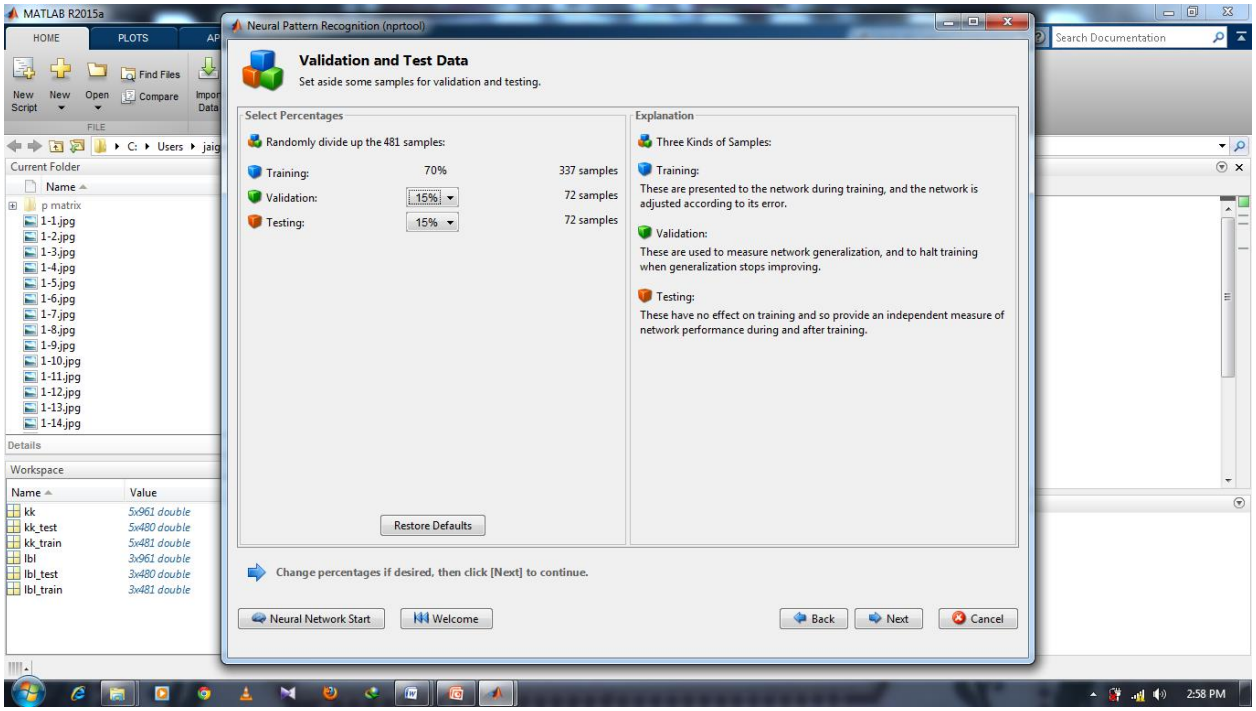

MATLAB R2015a
Neural Pattern Recognition (nprtool)
Validation and Test Data
Set aside some samples for validation and testing.
Select Percentages
Randomly divide up the 481 samples:
Training: 70% 337 samples
Validation: 15% 72 samples
Testing: 15% 72 samples
Restore Defaults
Explanation
Three Kinds of Samples:
Training:
These are presented to the network during training, and the network is adjusted according to its error.
Validation:
These are used to measure network generalization, and to halt training when generalization stops improving.
Testing:
These have no effect on training and so provide an independent measure of network performance during and after training.
Change percentages if desired, then click [Next] to continue.
Neural Network Start
Welcome
Back
Next
Cancel

Figure 4.16

Chapter 5 Result

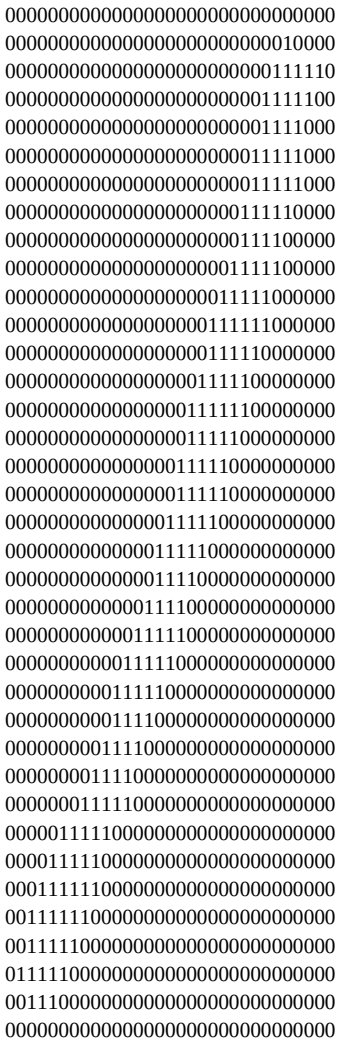


Figure 5.1 showing the formation of one by the turtle movement, on number written by different people.

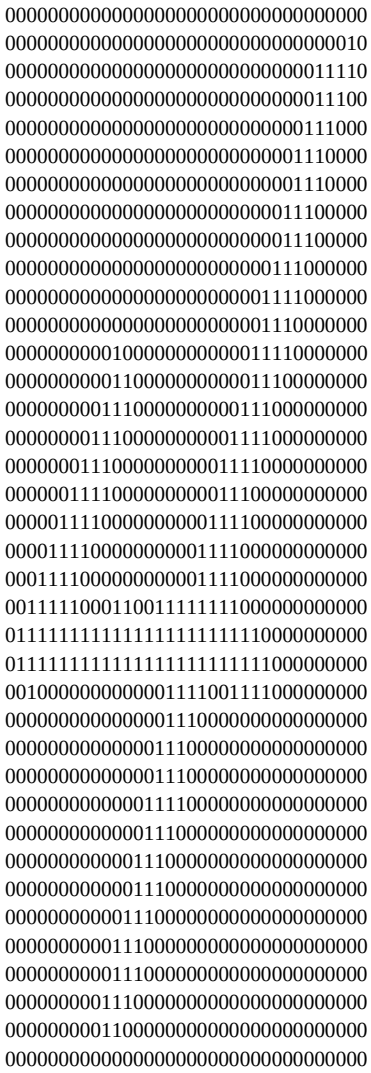
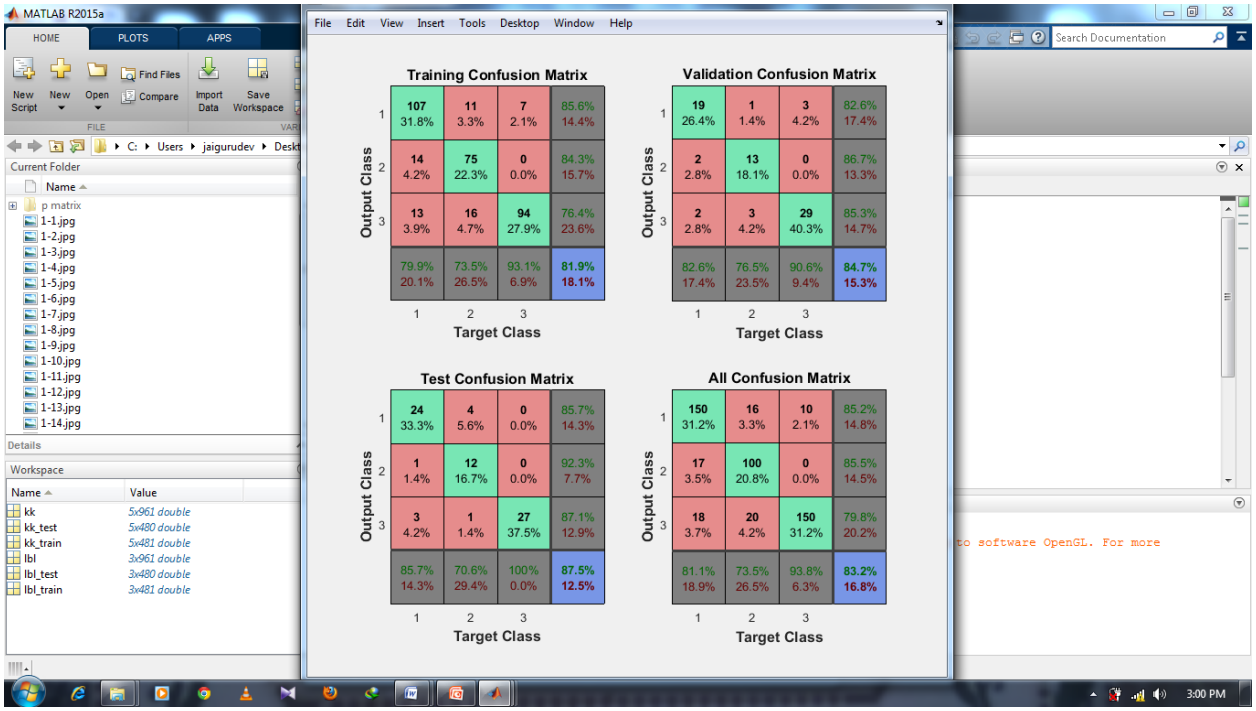


Figure 5.2 showing the formation of four by the turtle movement on number written by different people.

00000000000000000000000000000
00000000000000000000111111000
00000000000011111111111111100
00000000011111111111111111110
00000001111111111111111111110
00000111111111111111111111110
00011111111111110000001111100
00111111111000000000011111100
01111111110000000000011111100
00111111100000000000111111000
00111110000000000001111110000
00011100000000000001111110000
00000000000000000011111100000
00000000000000000011111100000
00000000000000000111111000000
00000000000000001111111000000
00000000000000011111110000000
00000000000000111111100000000
00000000000001111111000000000
00000000000011111110000000000
00000000001111111000000000000
00000000011111100000000000000
00000000111111000000000000000
00000001111110000000000000000
00000011111100000000000000000
00000111111000000000000000000
00001111110000000000000000000
00011111000000000000000000000
00111110000000000000000000000
00111110000000000000000000000
00111110000000000000000000000
00111100000000000000000000000
00001000000000000000000000000
00000000000000000000000000000

Figure 5.3 showing the formation of seven by the turtle movement on number written by different people.



. Figure 5.4 Neural Network Confusion Matrixes

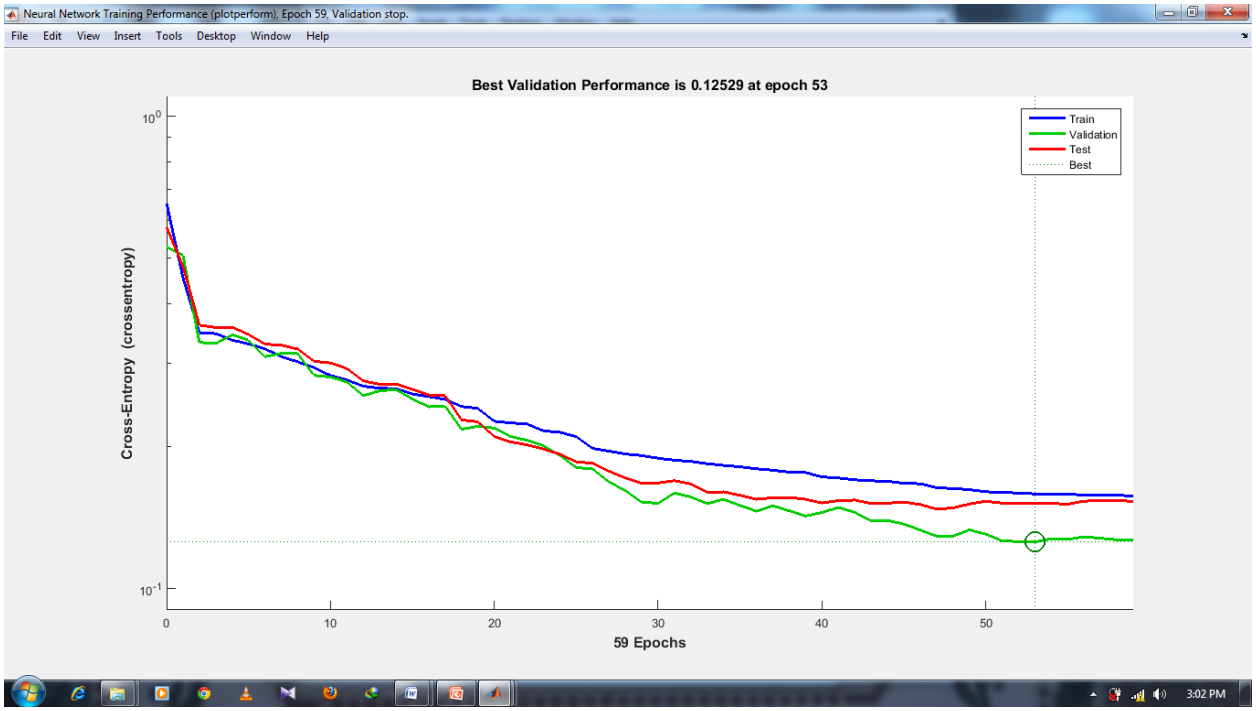


Figure 5.5 Neural Network Training Performances.

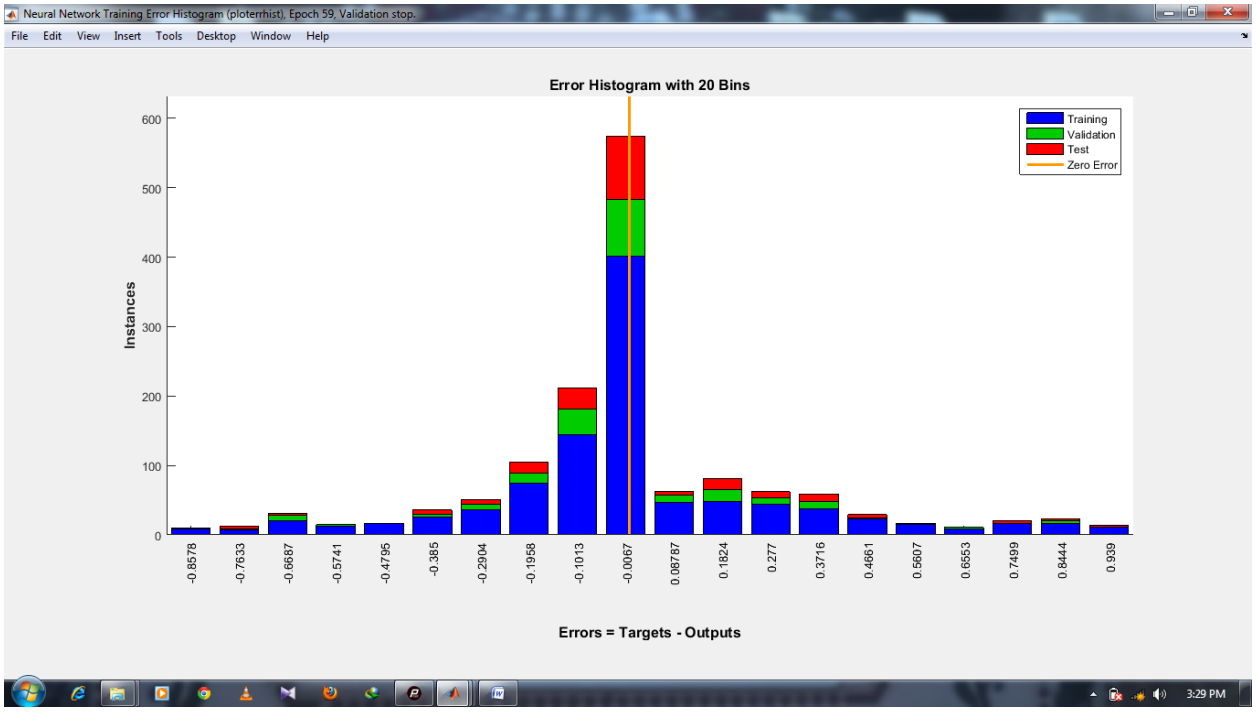


Figure 5.6 Neural Network Training Error Histogram.

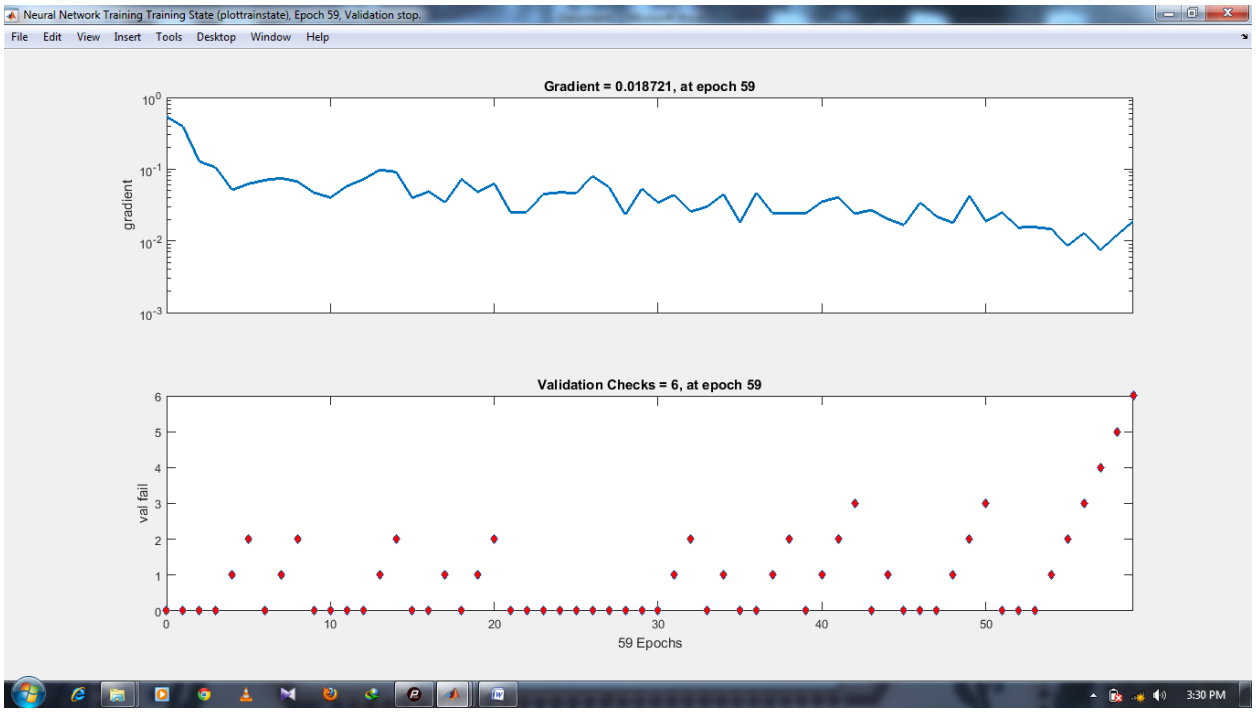


Figure 5.7 Neural Network Training State.

5.1 Movement of turtle is shown in the below steps:

Sample: 4

Step 1: In the very first step, the pixel will move down once.

Initial Move is SOUTH to NORTH

To Start Tracing : *First Move 1 Row down from the Starting point.*

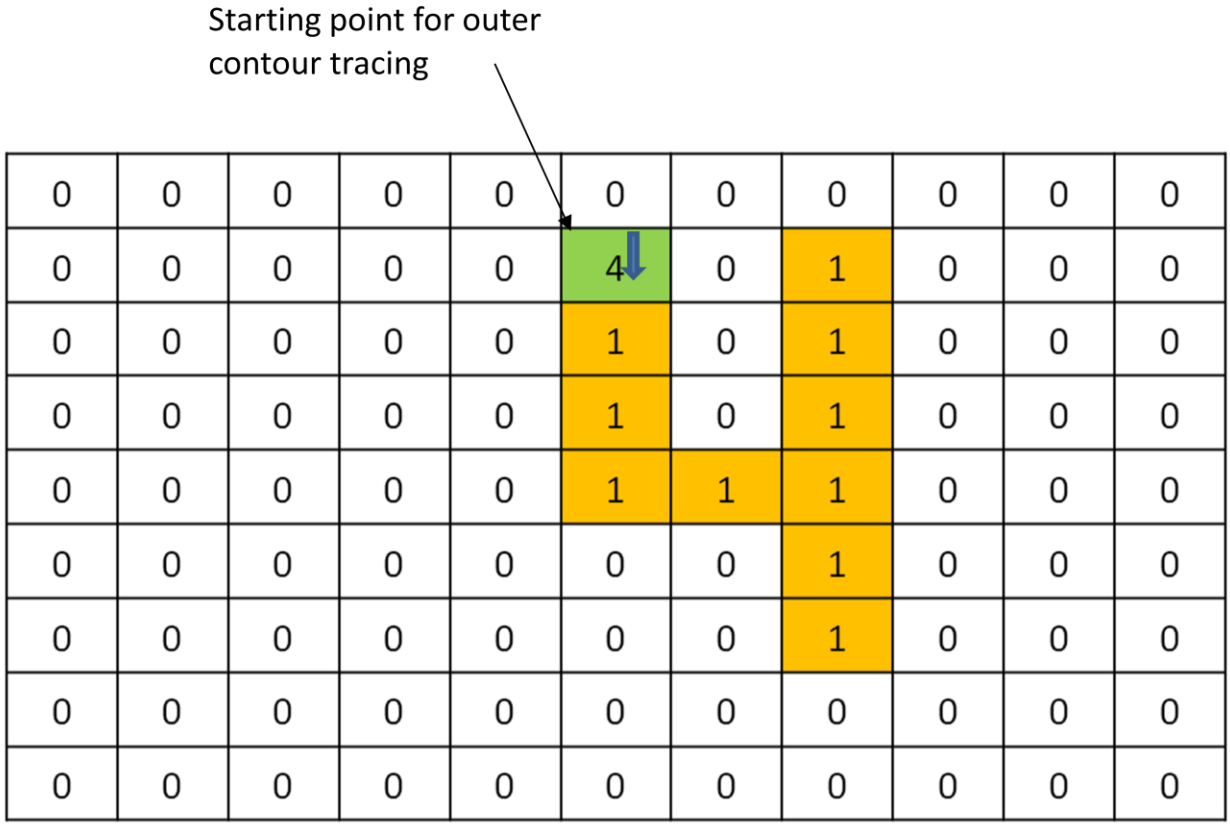


Figure 5.8 showing the step 1 of turtle movement in Intellij.

Step 2: Since Current Val is 0 : turn down and move 1 step.

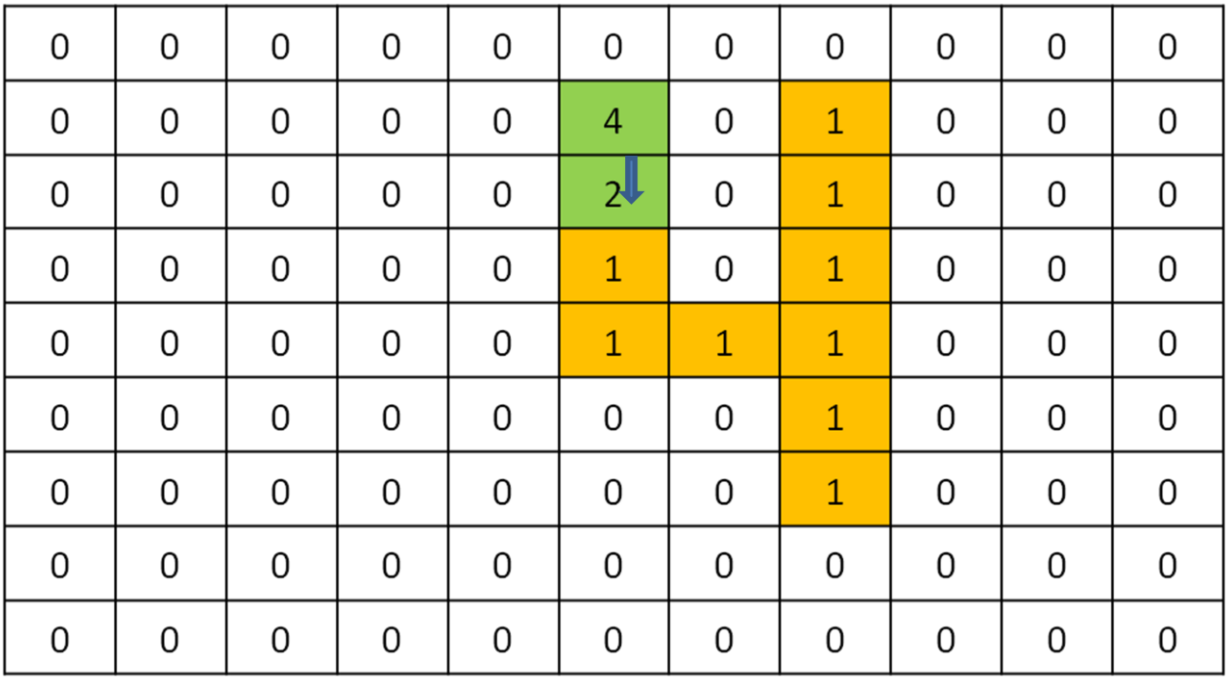


Figure 5.9 step 2 of turtle movement in Intellij.

Step 3: Again turn down and move 1 step.

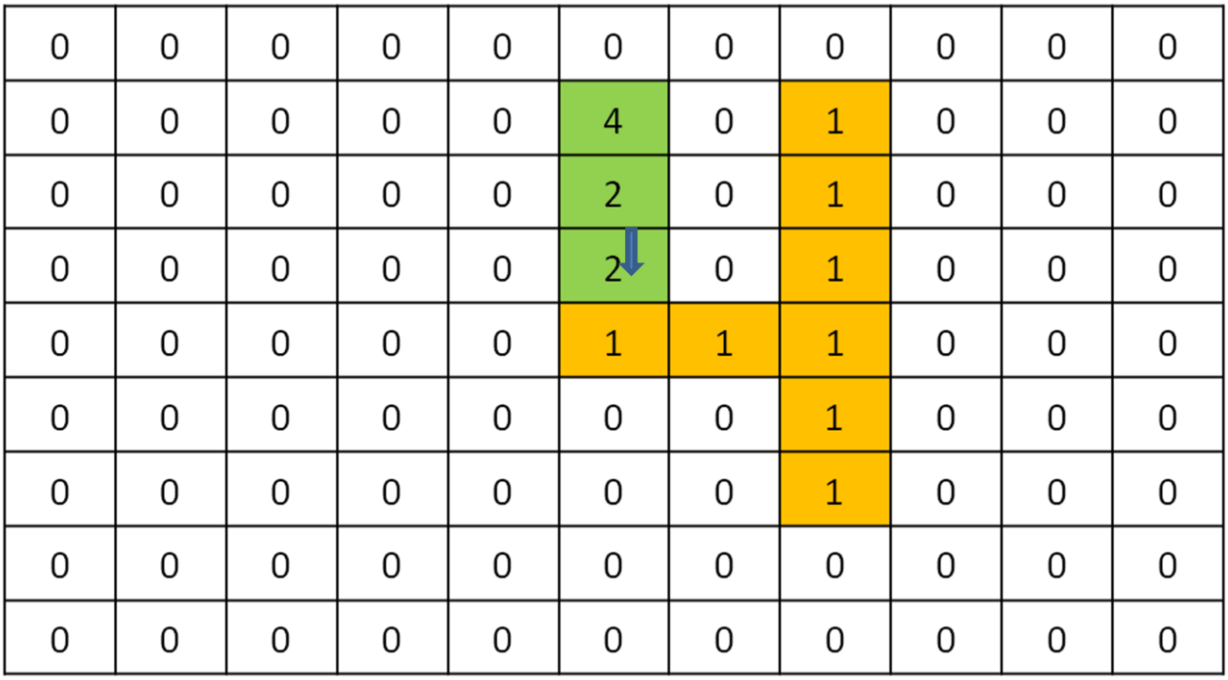


Figure 5.10: step 3 of turtle movement.

Step 4: Turn down and Move 1 Pixel.

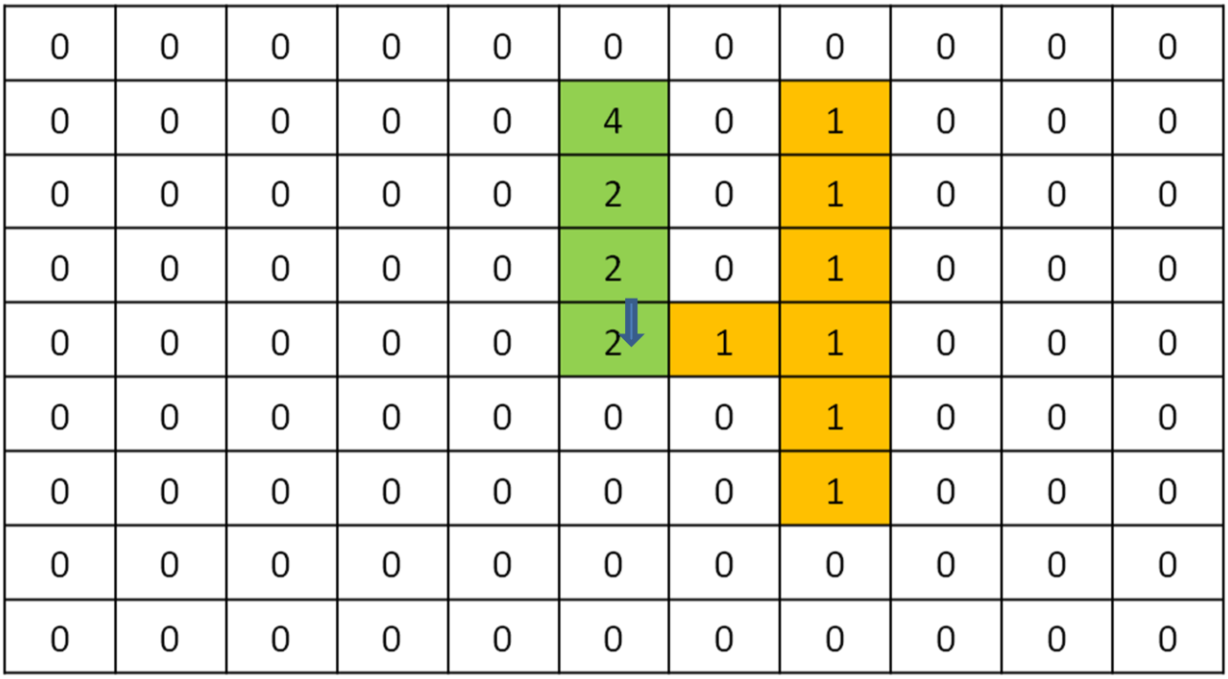


Figure 5.11: Step 4 of turtle movement.

Step 5: Turn RIGHT and Move 1 Pixel

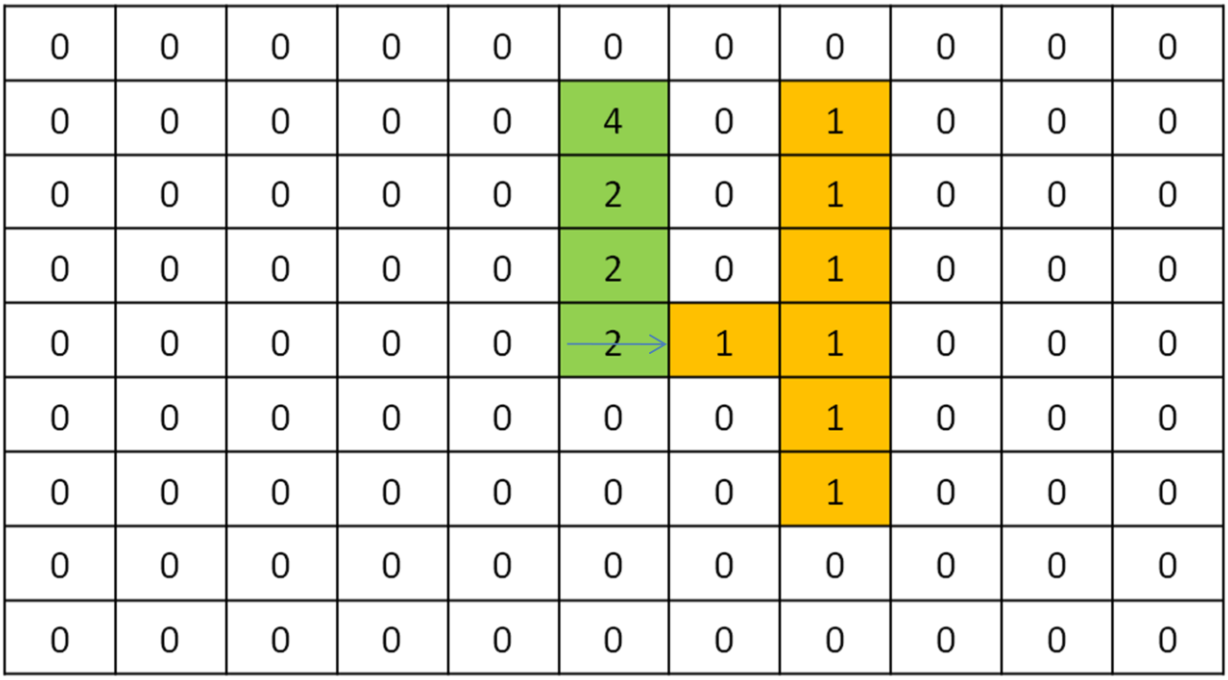


Figure 5.12: Step 5 of turtle movement.

Step 6:

0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	1	0	0	0
0	0	0	0	0	2	0	1	0	0	0
0	0	0	0	0	2	0	1	0	0	0
0	0	0	0	0	2	2	1	0	0	0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

Figure 5.13: Step 6 of turtle movement.

Step 7: Turn down and move one pixel.

0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	1	0	0	0
0	0	0	0	0	2	0	1	0	0	0
0	0	0	0	0	2	0	1	0	0	0
0	0	0	0	0	2	2	2	0	0	0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

Figure 5.14: Step 7 of turtle movement.

Step 8:

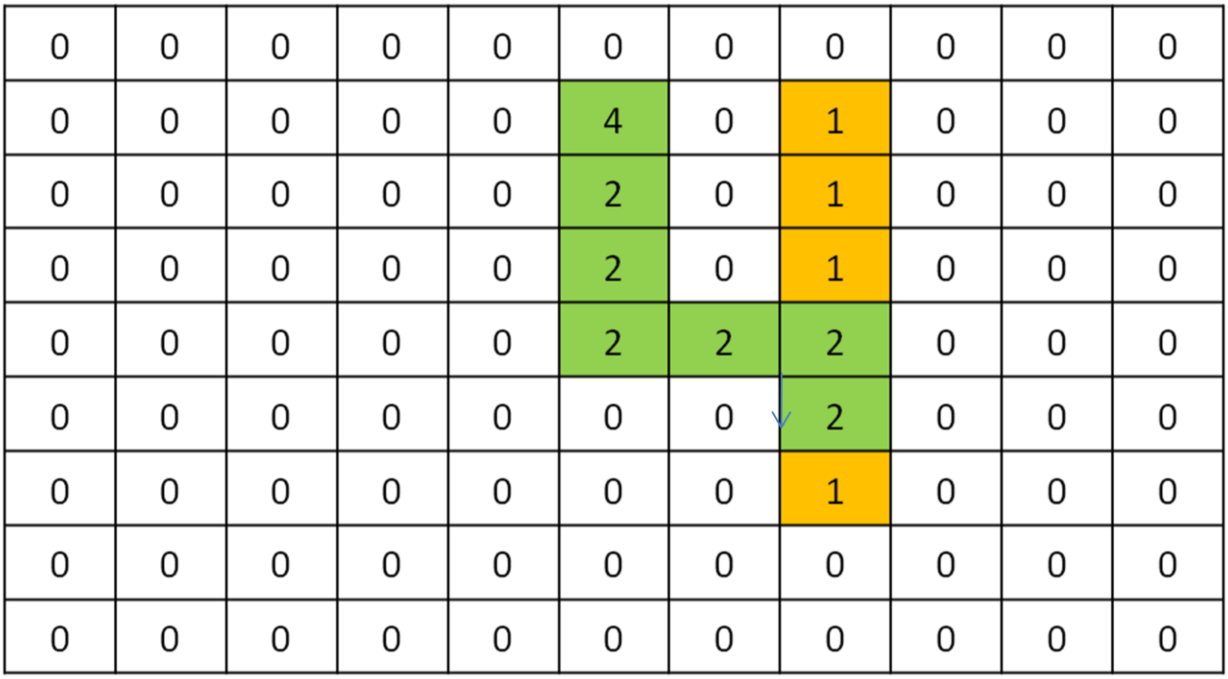


Figure 5.15: Step 8 of turtle movement.

Step 9: Turn up and move one pixel.

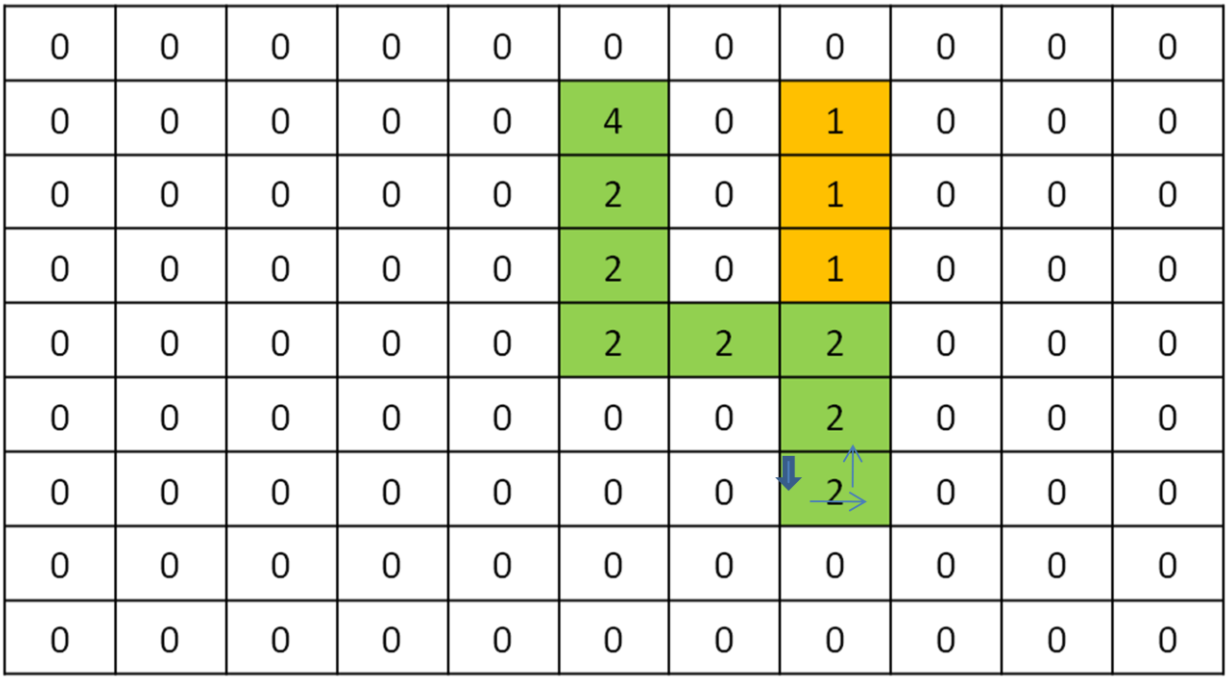


Figure 5.16: Step 9 of turtle movement.

Step 10:

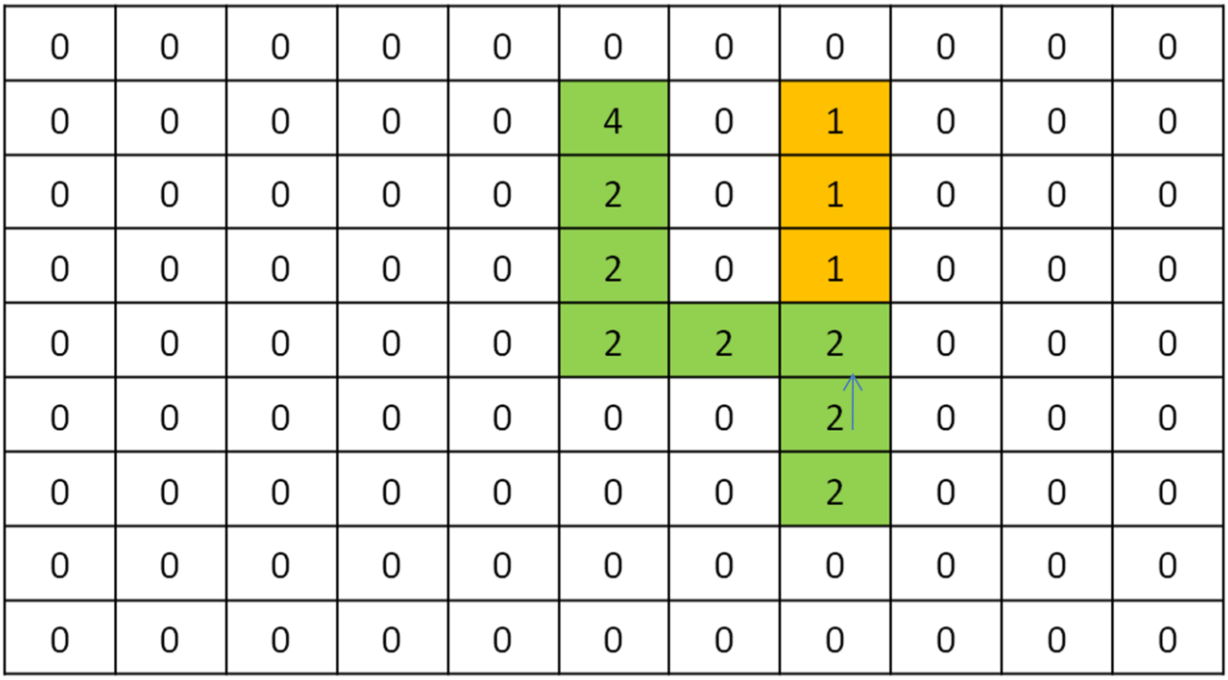
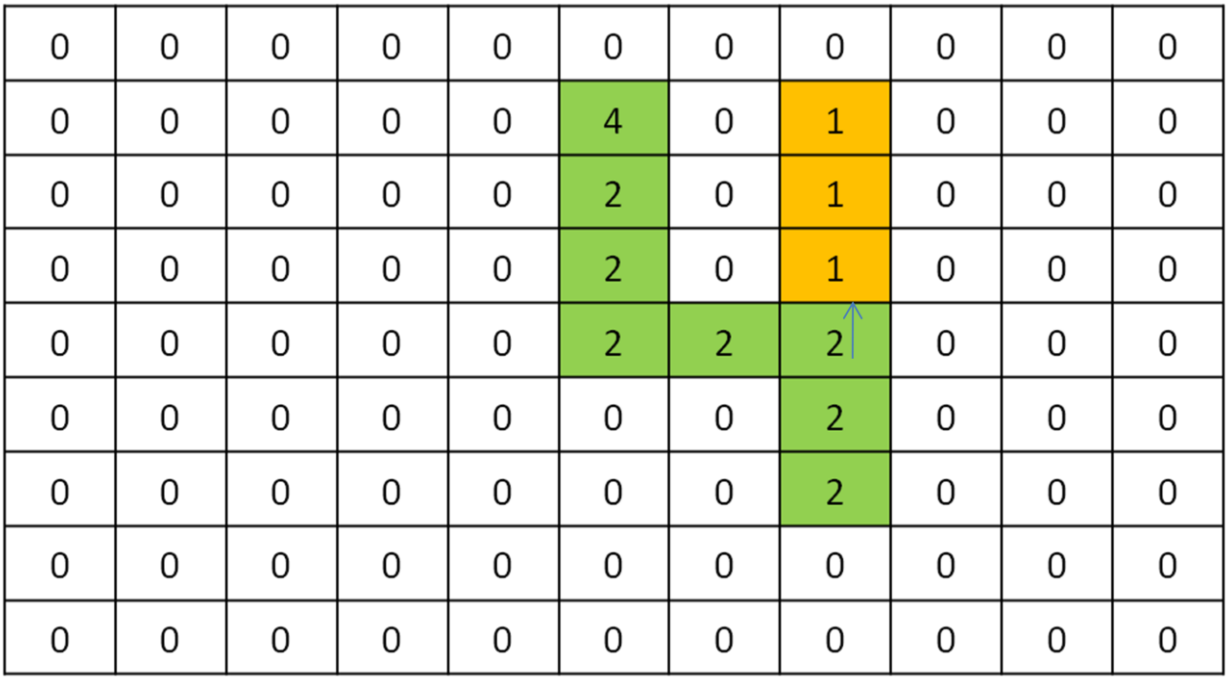


Figure 5.17: Step 10 of turtle movement.

Step 11: The Pixel has already been visited before But, since up turn is assigned to every pixel .Hence, Move UP.



Step 12:

0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	1	0	0	0
0	0	0	0	0	2	0	1	0	0	0
0	0	0	0	0	2	0	2	0	0	0
0	0	0	0	0	2	2	2	0	0	0
0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

Figure 5.18: Step 12 of turtle movement.

Step 13:

0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	1	0	0	0
0	0	0	0	0	2	0	2	0	0	0
0	0	0	0	0	2	0	2	0	0	0
0	0	0	0	0	2	2	2	0	0	0
0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

Figure 5.19: Step 13 of turtle movement.

Step 14: In the last step the final is formed.

0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	2	0	0	0
0	0	0	0	0	2	0	2	0	0	0
0	0	0	0	0	2	0	2	0	0	0
0	0	0	0	0	2	2	2	0	0	0
0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

Figure 5.20: Step 14 of turtle movement in which final four is formed.

Recognition Results:

Test number	Recognized number	%Accuracy	Non-Accuracy
1	1	88.9	11.1
4	4	90.2	9.8
7	7	86.3	13.7

Table 5.1: showing the recognition result.

The test number and the recognized number are 1, 4 and 7.The accuracy found for the number one is 88.9 while for the number four is 90.2 and for the number seven is 86.3.

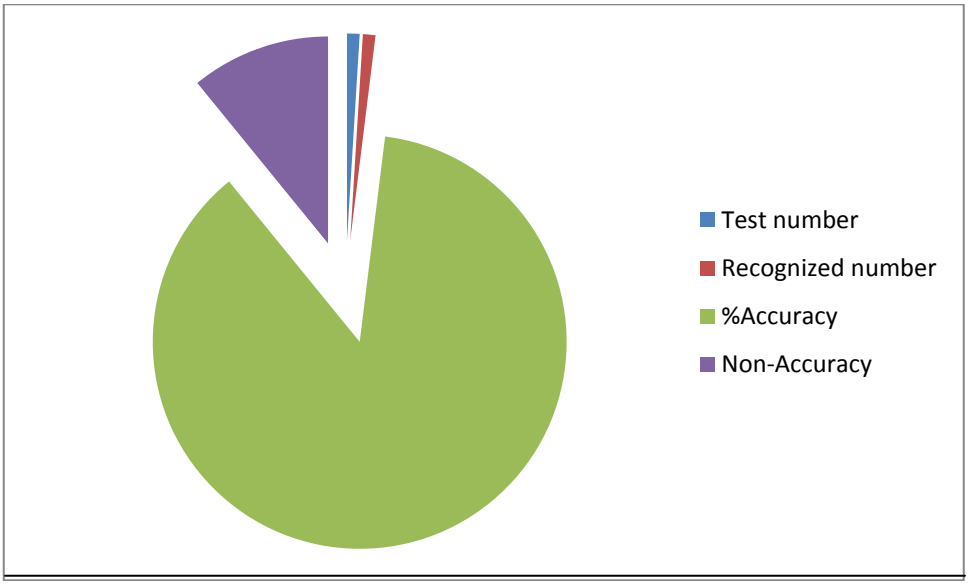


Figure5.21: Pie chart showing the recognition result.

CHAPTER 6 CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

The system is giving the best result for the straight line numbers for example we have one, four and seven. The system developed by using the IntelliJ api of java to recognize the straight line numbers is giving the best output. Numbers can be of different shape and size and is completely depends on the writing style of different users so for recognition of that number is a quite tough task as variation of moment is too a big hurdle in the number recognition. But after adding the dataset we get the much better result to recognize the number.

6.2 Limitations

The system will not work accurately on the curve numbers for example on the number eight, three, and two. However it can work on the recognition of number six as it is having less curve. It will work best on the straight line number like one, four and seven.

6.3 Future Scope

- This proposed system can be implemented and used for the recognition of curve number like on the number two, eight and three.
- This described system can also be used to recognize the number online.
- The implemented system can further be classified into recognition of online numbers in which the user will enter the number through data pin and the entered number will be recognized.

References

1) A.smola and S.V.N Vishwanathan. Introduction to machine learning.Cambridge University, 2008.

2) A.Mellouk and A. chebira. Machine learning. Intech, crotia, 2009.

3) L.C jain and B.lazzerini.knowledge based intelligent techniques in character recognition.CRC press, London, 1999.

4) A.rehman, D.mohamad and G.sulong. Implicit vs. explicit segmentation and recognition. A performance comparison on benchmark database.

5) G.sulong,A.rehman and T.saba. Improved offline connected script recognition based script on hybrid strategy.Enginnering science and technology.

6) A.S Britto,R.sabourin,F. Borotolozzi and C.Y suen. An enhanced HMM topology in an LBA framework for the recognition of handwritten numeral strings. Proceedings of international conference of advances in pattern recognition,pages 105-114,2001.

7) V.J Dongre V.H Mankar. A review of research on devnagari character recognition. International journal of computer Applications.

8) M. cheriet, N.kharma, C. Liu, and C.Y suen. Number Recognition System:A guide for student and practitioner. John Wiley and Sons, Inc..,NJ,2007.

9) A.smola and S.V.N Vishwanathan. Introduction to machine learning.Cambridge University, 2008.

10) A.Mellouk and A. chebira. Machine learning. Intech, crotia, 2009.

11) L.C jain and B.lazzerini.knowledge based intelligent techniques in character recognition.CRC press, London, 1999.

12) A.rehman, D.mohamad and G.sulong. Implicit vs. explicit segmentation and recognition. A performance comparison on benchmark database.

13) G.sulong,A.rehman and T.saba. Improved offline connected script recognition based script on hybrid strategy.Enginnering science and technology.

14) A.S Britto,R.sabourin,F. Borotolozzi and C.Y suen. An enhanced HMM topology in an LBA framework for the recognition of handwritten numeral strings. Proceedings of international conference of advances in pattern recognition,pages 105-114,2001.

15) V.J Dongre V.H Mankar. A review of research on devnagari character recognition. International journal of computer Applications.

16) M. cheriet, N.kharma, C. Liu, and C.Y suen. Number Recognition System:A guide for student and practitioner. John Wiley and Sons, Inc..,NJ,2007.