

Recognition of Broken Text In Images Using Fuzzy Membership Descriptor

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Abstract: Fuzzy logic based image text recognition is very new concept in the field of Digital Image Processing. OCR is the system that works in the domain of Image Processing. OCR is translation of images into machine recognizable editable text. OCR engine takes the image comprise text information and convert it into text format. Much work is done in the field of text recognition by researchers when the image consists of handwritten text, printed letters or Xerox documents. The text recognition was limited to particular area where the images to be recognized have good quality of text. The problem arise when the image consists of text which is broken, segmentation of alphabets and overlapping of text or text lines. In the case of those images OCR is not capable enough to recognize text. OCR faces the challenge of segmentation of text which is overlapped or broken. This paper focalizes on executing an efficient algorithm to detect the broken alphabets in text of grayscale images and to use Fuzzy Logic based techniques for segmentation of overlapping characters.

1. Introduction to Text Recognition in Digital Image Processing

Fuzzy logic based image text recognition is very new concept in the ground of Digital Image Processing. OCR is the system that works in the domain of Image Processing. OCR is translation of images into machine recognizable editable text. OCR engine takes the image consists of text information and convert it into text format. Much work is done in the field of text recognition by researchers when the image consists of handwritten text, printed letters or Xerox documents. The

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Text Recognition in Digital Image Processing is a technique of applying operations on an image to detect and identify the characters or text in image. The raw image consists of irregularities. Thus the technique of processing image enhances quality of image and later used to extract image information or other features associated with image such as text from it. Broader classification of Image processing is analog and digital. In Analog image processing, electrical signals are considered to process image such as sine cos waves. Whereas, Digital Image Processing is done with the use of digital computers. The image is alienated into pixels and RGB values are assigned to each pixel and modifications are made by modifying the RGB values of pixel.

1.2 Text Image Processing Techniques

The processing of grayscale digital image contains text goes through number of techniques [1] and each step has significant importance which is explained further:

1.2.1 Image Acquisition: It is a process of acquiring a digital text image using an image sensor. The image acquired by image sensor has continuous data and we convert it into digital form using image sampling and Quantization. In Sampling, the image is segmented in equal regions and rate of sampling determines resolution of the digitized image. In Quantization, digital value is assigned as magnitude to each sample space. It detects the number of grayscales present in the digitized version of the image on which the text recognition techniques needs to be get applied. .

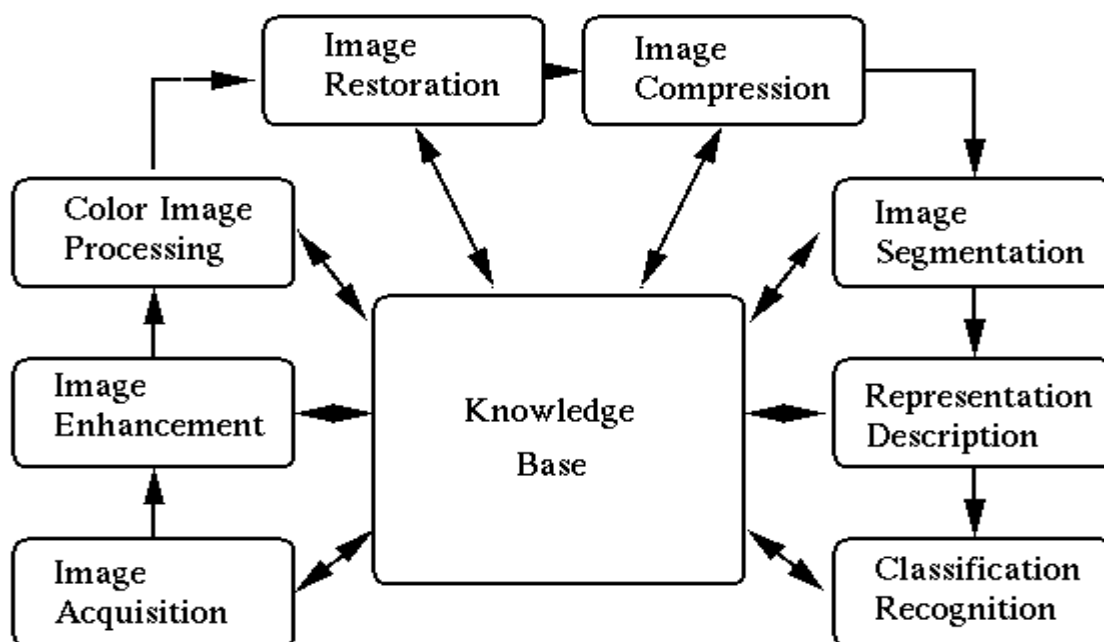


Fig.1: Digital Image Processing And Compression Techniques[2]

1.2.2 Image Enhancement: The key principle of image enhancement is to accentuates or sharpens the picture characteristics includes noise filtering, contrast and edge enhancement sharpening, pseudo-coloring, and magnify images, to make a graphic display more helpful for analysis and feature extraction. Some of the enhancement techniques are:[3]

- a. **Histogram modification:** It represents the virtual frequency of occurrence of the diverse gray levels in the image. It provides a total depiction of the emergence of an image. Images' histogram displays the graphical demonstration of tonal distribution of the image.[3]
- b. **Noise Filtering:** In this technique, an image is taken as an input it is processed to clear the not needed pointless data or noise in the image being processed. Filtering is a closely located operation, where pixel value of resultant image is ascertained by implementing any algorithm over the pixel values in the nearby locations of associated pixel which is to be input.
- c. **Contrast Stretching:** It is intended completely for repeatedly encountering circumstances. Numerous stretching methods are discovered to enhance the slender range to the entire range of the available accessible dynamic range.[3]

1.2.3 Image Restoration: It is implemented to improve the emergence of an image. Image is developed towards perfection using various correction techniques. In order to renovate an image in its original form, there are several correction techniques available i.e. like Linear Filtering, Median filtering, Adaptive Filtering etc. Image Restoration methods are discussed below:

- a. **Median Filtering:** Analysis is performed to find the median of any image pixel then alter it through median of the gray levels in the close locations of the pixel.
- b. **Adaptive Filtering:** In this process the gray space and color space is used for elimination of impulsive noise in the image to be recognized. Under Median Filtering, whole of the execution is dependent on the gray space and it is also dependent on the colored space of the image. It is a technique to provide finest noise suppression outcome and also prevent the thin fine lines, boundaries and image description to reach to the image of good quality.
- c. **Linear Filtering:** It is a process to rectifying or enhancing an image. An image is filtered to highlight its characteristics or to vanish some other characteristics. With the help of filtering, there are certain operations such as smoothening, sharpening, rendering and edge empowerment can be implemented in a better way.
- d. **Weiner Filtering:** It [1] integrates the deprivation function and statistical traits of image noise to restoration process. This filtering technique considers the image as an arbitrary process of two things one is the image itself and other is the noise present in the image. . The main purpose of Weiner Filtering is discovery of an approximate function f^{\wedge} of the original unfiltered image f so to minimize the square of mean fault within the functions f and f^{\wedge} .
- e. **Histogram Equalization:** Through histogram demonstration the image generates contract intensities which is not equally distributed. Due to which, variety of alterations need to be applied on the image so to get the more effective resultant contrast image based on colors. While this technique is in process, the coefficient values of intensity of

the images are dispersed efficiently. It will help to improve the portion of image with minimal contrast to have an enhanced or maximum contrast. Probability is the base of histogram equalization

- f. **CLAHE:** It is an acronym stands for Constructive-Limited Adaptive Histogram Equalization .It is implemented on the small regional parts of an image instead of working on the entire image. The small region over which CLAHE is implemented are called tiles. In this process every contrast combination of tile is improved such that the histogram of the resulting regional area is matching approximately with the histogram specified by distributed overall image regions parameters..

1.2.4 Image Detection & Estimation: In this step, the image attribute values such as pixel code, color code and intensity is detected. Image detection and estimation is considered for calculating first order derivative filters to estimate detection of edge and motion in a image's attributes. It is also used to find the Second or higher order derivative filters which will help in extraction of traits of curvature information. Optimization of Filter Kernel uses this technique [7] and it works towards the optimization query generation by compliant the associated filter kernels.

1.2.5 Image Reconstruction & Projection: It is a special class to provide the solution for the problems related to restoration of images. In this technique, using numerous one-dimensional projections we can construct two or n-dimensional object. Each projection is achieved by introducing the image to X-rays .It projects numerous number of parallised X-ray beams through the object image to generate various 1-dimensional projections.

1.2.6 Image Data Compression: Data compression is a process of encoding data in such a manner that the resultant representation of data has reduced overall size than the actual data size. This reduction is achievable only when the actual dataset consist some type of redundant information, which can be removed while compressing the data. Compression is an extremely vital technique for image data archives and also for data transfer over the network in the form of images. To have lousy and lossless compression there are various ways available. One of most famous compression method which is general in based ion Discrete Cosine Transformation (DCT) based is, JPEG (Joint Photographic Experts Group) image type.

1.2.7 Classification: Classification [10], Based on the grey value of group of pixels or monapixel, labels are assigned to them. It is used for feature information extraction. Almost every feature extraction methods based on examination of the spectral reflectance behaviour of image and extraordinary algorithms are planned to perform numerous types of 'spectral analysis'. Spectral Analysis achieved in two ways:

Supervised classification spectral analysis technique, the characteristics and location of maximum of the land cover in images which is known already through an amalgamation of field works and top sheets. The spectral analyst is the person to handle spectral analysis and tries to locate definite regions in the data through remote sensing.

In Unsupervised classification, the machinery is used to perform the analysis, computer is a necessity which will help in grouping of pixel data into various spectral classes as defined by the statistically resolute criteria.

1.2.8 Image segmentation: This is the procedure of subdividing an image to its basic components. The constraints which helped to do the subdivision are concededly depends on the area of problem being occurred.

1.2.9 Image Analysis: In this apprehensive technique, we make the quantitative measurement based on the dimensions of given image to construct a depiction of it.

1.2.10 Image Preprocessing: It is a semi final step to make an enhancement of image data that suppresses unnecessary distortions and enhances features which will be actually needed or used for further processing. It improves brightness of grey scale transformation of an image.

1.3 Text Recognition in Images

As the technology nurtures, ease in life is exceedingly demanded. Because of omnipresence of cameras in this era, we are concentrating on doing much more than clicking and viewing the images. Now a day, if the image has important data we want our computers to recognize it and save it as a documented file. Recognition and detection of text or typescript in images is a very demanding task. Images of scanned documents restrain similar quality fonts and equally

distributed background of all scanned document images. Therefore, images captured with trendy cameras and hand held devices also possess an alarming challenge for text character recognition. There are various sources of deviation when extracting text from an image having low-contrast of colors or complex image, from shaded or textured background, or from images with different font size, alignments, color and orientations.[13] Although images captured by scanning main cover of books, CD covers, or other documents have multi-color text or other similar characters as the document images. Researchers classified scene text as ‘Graphic Text’ and the other one is caption text as ‘Superimposed’ also known as ‘artificial text’ .A very less work has been done in the field of Scene Text as it is more difficult to extract the attributes of scene text images because scene text images qualities are highly affected by variations in the conditions of environment and camera features such as motion, intensity, illumination and focus. The images classifications is done as gray scale or color on the basis of color code, compressed or un-compressed on the basis of size, motion or motionless text in the image i.e. the text present in scene text images is able to move or not . It causes defects in the sequential execution method for text mining from image. The sequential execution method consist of five sequential steps i.e.: (i) detection, (ii) localization, (iii) tracking, (iv) extraction and enhancement, and (v) recognition (OCR) [14]. Detection of words in text images leads to a high extent of surety of the occurrence of text in captured image. Localization of English word image text is a method of finding the approximate appropriate position of English word image text in the captured image and it also creates the rectangular boxes around the text in the image act as boundaries. Tracking in text images is implemented on captured image to reduce the time taken to process the image. For localization of text as well as to preserve the authenticity of arrangement in all the adjacent frames, even though the exact text location in captured image can be pointed within the bounding boxes but still segmentation of image text is necessary as it will help the base background of image to assist recognition of text. Thus, the text image extracted from the step three is to be now transformed in digital binary image and improved before giving it as an input to the OCR engine. Next step is Text extraction at which the components of text from the image are segmented based on the background of input image. Using fourth step enhancing the components of text extracted from the input image is necessary step, as the image area consist of text generally has reduced the pixel resolution and is more subjective to noise quality of image. After this is done the

extracted text binary image is given as an input to OCR and OCR runs a designed sequential process on the input image and transform it into plain text as the output.

1.4 Optical character recognition (OCR)

OCR [15, 16] is the first method to recognize text characters in an image. OCR is electronic or machinelike method which converts image, contains text, into machine-encoded characters. The text can be Printed, Typed or handwritten from a scene photo, scanned document or photo of a document. OCR is a system of generation of printed characters digitally so that it further can be electronically explored and become useful in processes of machine. It is an ordinary method of converting printed texts into digital form, so that amendments can be done electronically. Which is very helpful to edit, search, store data more compactly, displayed data on-line. OCR maintains a dedicated database in the back end to store images in binary form, later used for recognition. To scan an image consists of document or text, a dedicated scanner machine is needed to scan the printed image text or even the handwritten text in the images. The quality of output of scanned image is dependent on the type of scanner being used. The scanner with high speed and good color intensity is desired for good results. Optical Character Recognition is further divided two modes on the basis of type of process .

Offline OCR , the source from which the image is taken can be any type of available images or it can also be a scanned document.

Online OCR, the succeeding points in the images are characterized based on the time function and it also uses the order of strokes available in the image.

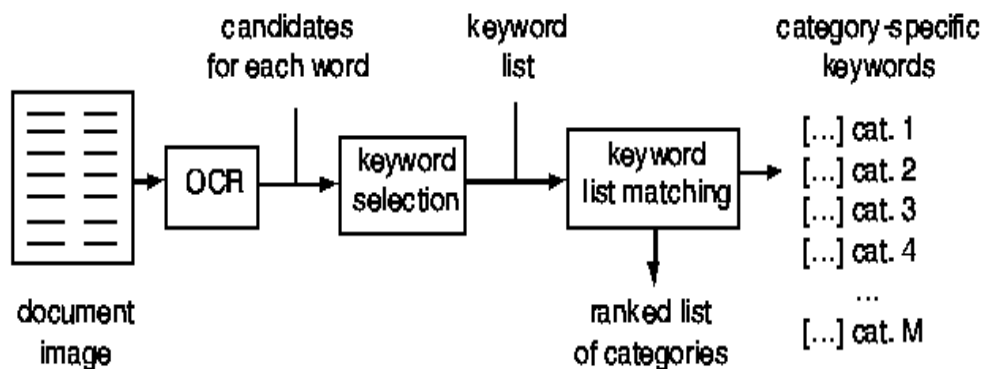


Fig.2: Block diagram of an OCR [18]

1.5 Fuzzy System:

Traditional computation and set theory was all about true or false, zero or one, in or out and black or white. On the other hand, Fuzzy computation is a control based mathematical system that examines analog input values in expressions of logical variables that receive on continuous values between 0 and 1. The theory of fuzzy system calculates the near approximations and effective means to describe the distinctiveness in a system even when that system is too intricate to confess crisp mathematical analysis. It replicates the human approach of thinking. Fuzzy system represents the set of object where the conversion from membership to non membership changes steadily rather than abruptly. Fuzzy logic uses reasoning systems in which the ideas of truth and falsehood are measured in a graded manner, in contrast with traditional mathematics where only absolutely true statements are taken into consideration.

Fuzzy logic in wider sense serves primarily as an system software to provide fuzzy control, It is used in analysis of elusiveness in natural language (NLP) and various other domains. Fuzzy system is a technique of soft-computing. It means it is used for computational techniques which are charitable to non optimality and giving quick, effortless and sufficiently good answers.

Fuzzy logic in the narrower sense is symbolic logic with a relative notion of truth industrialized fully in the spirit of traditional logic.

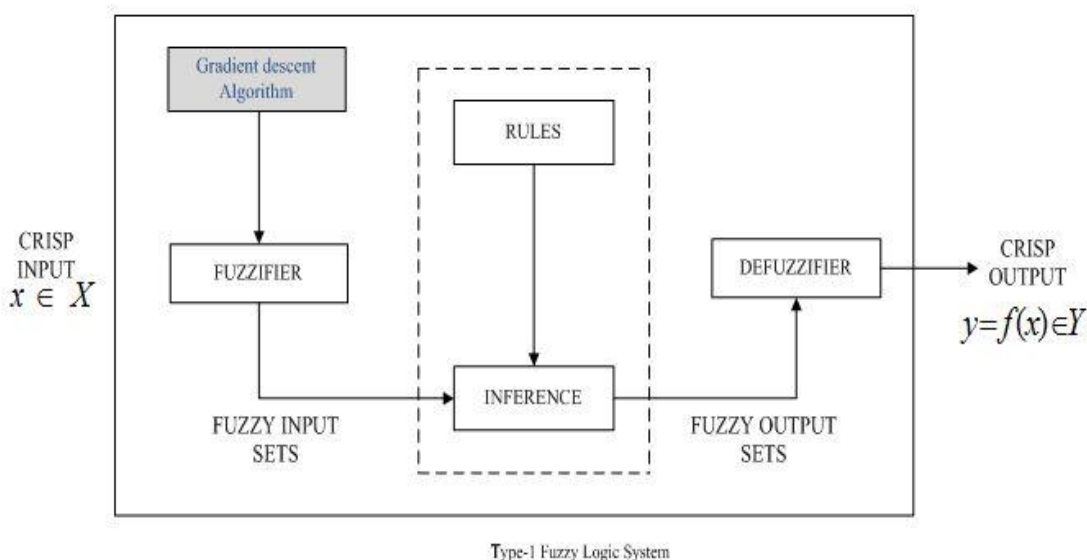


Fig.4: Fuzzy System and its Elements[20]

1.5.1 Fuzzy System elements

Fuzzy system consists of five basic elements[21]

- a. **Input Vector:** The set $X = [x_1, x_2, \dots, x_n]$ denotes crisp input values, which are altered into fuzzy input sets in the fuzzification obstruct in the above diagram.
- b. **Output Vector:** The set $Y = [y_1, y_2, \dots, y_m]$ denotes crisp output values appears from the defuzzification area, which converts an output fuzzy set again to a crisp value set.
- c. **Fuzzification:** It is a method of transforming exact values obtained at the time of fuzzification, into graded levels of membership for the situational linguistic of the created and associated fuzzy sets. The input data exact crisp values are fuzzified by passing the input data to membership functions which is also predefined by the programmer, which can have different shapes. The fuzzification value zero leads to the conclusion that the provided input value does not act as a component of predefined fuzzy set which is predefined by the programmer, Till the fuzzification value leads to the conclusion that input value is completely a component of predefined fuzzy set that means, exact match is found in the fuzzy set.
- d. **Membership function:** It has a function which calculates a measure of the degree of likeness of elements in the universe of discourse U to fuzzy set available.
- e. **Fuzzy Inference system:** This provides a method of mapping the given input to an expected approximate output in the fuzzy membership set using fuzzy logic. This method includes collaborative theory of information that we discussed about in the preceding sections such as fuzzy logic operators, membership functions and if-then rules.
- f. **Defuzzification:** It is used to translate final output result of fuzzification back to the actual world values. Defuzzification[23] sum up the fuzzy set by finding distinct crisp value. Numerous mathematical methods available such as mean defuzzification, centroid works on central regions, maximum defuzzification, maximum, bisector and weighted average defuzzification[24]

2. Literature Survey

In recent years, frivolous development is being done in the ground of Image Processing and recognition of text in images. Extraction of features from a text image is the problem of interest and standard approach is bottom-up view i.e. first classify local original image areas into candidate characters. One it is done, then the candidate characters will be combined with top level word representation which comprises Conditional Random Field (CRF)[25]

Jose A. Rodriguez-Serrano, Albert Gordo and Florent Perronnin, [26] discovered a new paradigm, which was very different from typical bottom-up view. It is feasible to execute text recognition in the image without even explicitly identifying or categorizing characters, with astonishingly perfect accuracy, by means of a “frugal” technical approach. This paper intended to utilize a universal Euclidean space and entrench labels of words and images of words into that universal Euclidean space. For the given image which contains text and for the extraction of text being recognized from the image, first discover the nearly coordinated word label-word image pair in Euclidean space and situate it nearer as compared to the position of all the non coordinating word label-word image pair. Recognition progresses by discovering the nearest label provided in an image. The bottleneck of this method using the lexicon is as the system is unable to recognize characters of words out of the lexicon. This technique used linear relationship function which is not able to confine complexity of the query of mapping or overlapping text images to words of label .

Shimpy Goyal[27] Human Handwriting acknowledgment is the capability of a computer to grasp the handwritten word from an image as an input. Image of the handwritten written text, which is to be processed, may be scanned "off line" from a part of paper by giving it as an input OCR system. In early times this system's performance was very poor, due to which less exploration on handwriting character recognition in images took place. To provide a solution to this problem, a solution is provided by constructing OCR system that stores abstracted characters to database mechanically after taking into consideration only correspondent and required

characters from a huge quantity of document by implementing Kohonen's algorithm . This algorithm is one of the Artificial neural network.

Kai Wang and Serge Belongie [28] represents method which spots words in original images captured in fully natural non corrupted surrounding. Text originate in the wild images has an astonishing range of complexity to recognize. In starting, Optical Character Recognition is implemented to images consist of text, which has plain arranged words. OCR works fine with visual CAPTCHAs where text is plainly emerges to fool computer visualization algorithms. But again it is extremely challenging task. In this work, look of words in wild has a range of complexity so to overcome this, we proposed a fresh text recognition method based on state-of-the-art methods from generic object recognition. In Generic Object Recognition object categorized as words itselfes.

Mohit Kumar, Norbert Stoll, Kerstin Thurow, and Regina Stoll [29] Local image descriptors based on Fuzzy membership function was introduced as an alternative which can compete effectively to the other most widely used descriptor named Histogram Based Image descriptors. This technique of fuzzification of image using fuzzy membership descriptor is highly distinctive and it leads to facilitate with output of image matching which is more accurate . It conveniently uses fuzzy membership descriptors. Based on that, a technique is designed which is used to perform the image matching operations .It helps to find the degree of correspondence within the set of images to be matched. This study also invents fuzzy model based on gamma mixture which will help to detect the degree of correspondence within the set of images to be matched based on the geometrically consistency.

3.1 Existing System

Previous work in area of Text recognition in digital image processing explored a paradigm that is different from standard bottom-up view[26]. Frugal approach is one of the way with which makes the text recognition possible without outsided detection or classification of image characters, that too with a conveniently high accuracy of the resultant . If we take a deep glance at the architecture of existing system which deals with text recognition in images, we see, it used a common Euclidean space and embedded labels of words and images of words into that common Euclidean space. Each vector feature of image was then placed in this space and then projections are applied. Given an image which consists of text and for the retrieval of text

recognition, first it checks the closely matched word label-word image pair in Euclidean space and placed it closer than the non matching word label-word image.

The diagram below shows the working of existing system. Optical Character Recognition Engine is used to recognize text from grayscale images and convert it into machine encoded language. At the very first stage, A sentence image is taken. OCR Engine process a loop over sentence image which break down sentence image into word image. Then each word image is divided into alphabets image. Once the alphabet images are driven, the OCR run a loop to match the input alphabet images with the buffered Literal images. If the exact match occurs between input alphabet-literal images, then that literal is stored in memory and so on. All the matched literals concatenated to form a string of literals which are then taken and again concatenated as words. The words formulate sentences .These sentences are dumped from memory to notepad file and displayed on screen. But if the input character image matches partially with the buffered literals. The result would be No character matched .

3.1.1 Architecture of Existing System

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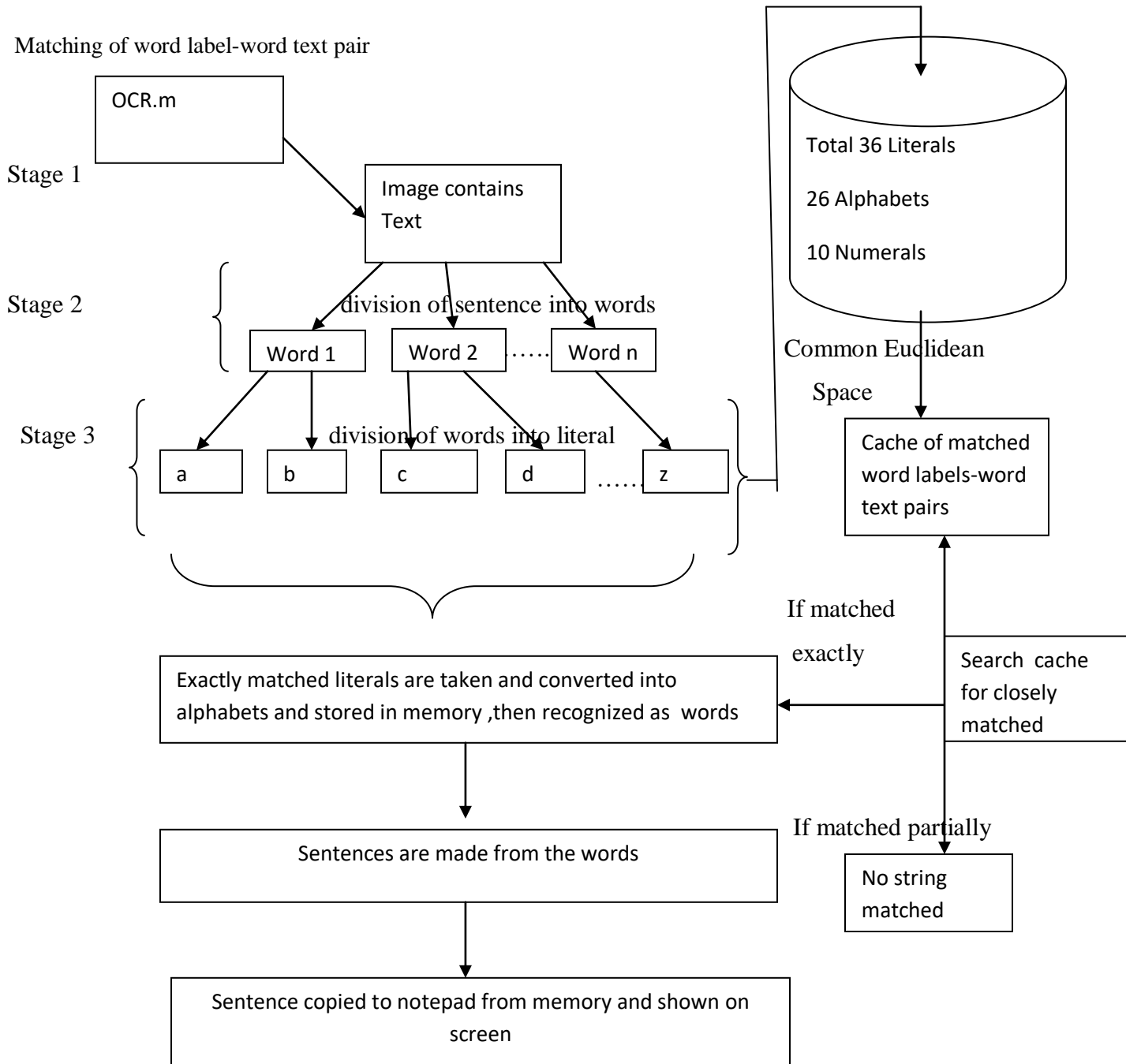


Fig. 6: Architecture Model of Existing System of Text Recognition

3.1.2 Problem Definition

Existing model of approach has certain drawbacks which degrade its performance. The problem arises when image consist of natural background or scattered font style text. Optical Character Recognition Engine is efficient to only recognize text image which has constant background and a well formatted text font. But area of problem is that it is not capable of recognizing Text which is segmented, overlapped or broken. If the text image has broken alphabets OCR does not identify it and gives the result as string not matched.

3.2 Proposed System

To eliminate the problem area of existing system, it proposes an Architectural system modification on existing system where we use a common lexicon space and embed text based english word labels and English word images over that Euclidean space which is common to all the data set available. Consider an image consist of text and using Optical Character Recognition which divide the sentences into words and further into characters. A matching is performed over word text-word label pair. Now, find the closely matched word label-word text pair in Euclidean space and place it in separate memory than the non matching word label-word image. Then after this separation, recognition of text in the word text images is processed by further finding the nearest label present already in Euclidean space. Information present in the image is then matched by using fuzzy membership descriptor [29]. This descriptors is distinct in nature and comes with a more accurate image matching. It also helps to detect the degree of correspondence between the two grayscale images given as input. It also performs matching of labels and images by dot product of their representation and with the use of fuzzy membership operator. We are using grayscale images for text recognition and text extraction using membership descriptors instead of working with colored images because grayscale images helpt to reach to the destined result as our purpose is to detect the text from the image and it is not based on colored or black and white image . but if we consider the colored images we have to apply an algorithm to convert it into grayscale image to simplify our destined algorithm and to reduce computational requirements.

3.2.1 Architecture of Proposed System

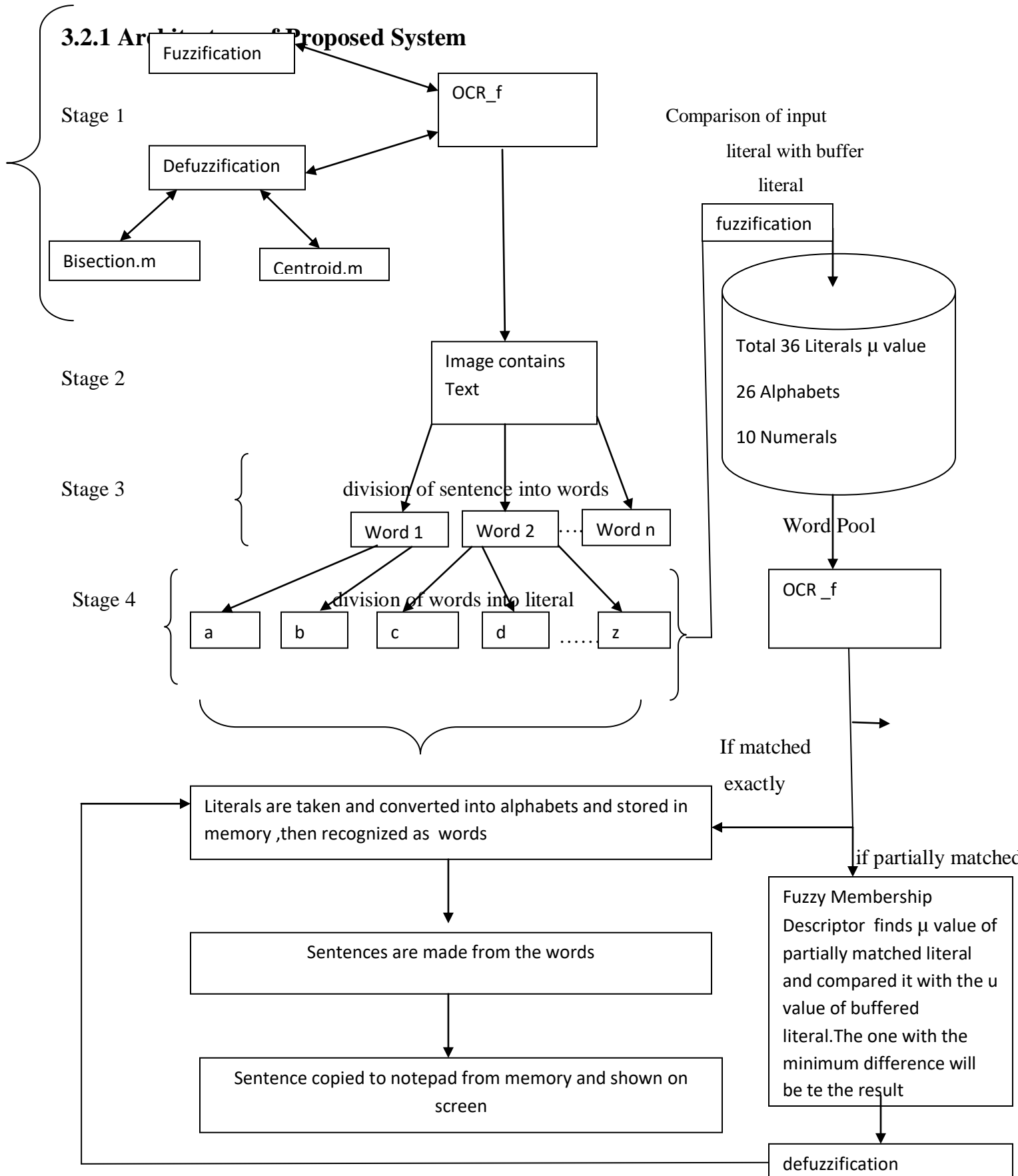


Fig. 8: Architecture Model of Proposed System of Text Recognition

Diagram above shows the working of Proposed system. Optical Character Recognition Engine is used to recognize text from grayscale images and convert it into machine encoded language. At the very first stage, a sentence image is taken. OCR Engine process a loop over sentence image which break down sentence image into word image. Then each word image is divided into alphabets image. At this point, we applied Fuzzy System, first stage i.e.fuzzification which transforms crisp values into gradual grades of descriptor for fuzzy sets. Then using pre-defined input membership functions the input values are fuzzified to detect degree of matched skills of the text in the image. Fuzzy membership descriptor function is used to find the U value of alphabet image Once the alphabet images u value is driven, the OCR matches the U value of input alphabet with the with the value of buffered Literal images over a loop. If the exact match occurs between input alphabet-literal images U value, then that literal is stored in memory and so on. But if the input character image consists of segmented, overlapped or broken character. Then the U value of the character is matched over a loop with all buffered literals and the one with minimum difference would be given as result where defuzzification is done i.e. translate result back to the real world value. Now these matched literals concatenated to form a string of literals which are then taken and again concatenated as words. The words formulate sentences .These sentences are dumped from memory to notepad file and displayed on screen.

4. Results

This thesis concentrates on the architecture of label embedding along with fuzzy system. A Process is designed to show working of this model. The final result after computations of that process are shown in te form of tables and graphs.

4.1 Fuzzy Membership Descriptor (μ)

Any character image has crisp value i.e. 0 or 1. That character image is taken as input by Fuzzy System for fuzzification. Fuzzification is done using a member function called Fuzzy Membersip Descriptor also called (μ). After fuzzification μ value of character image is

computed as shown in table 4.1. The character image is now sent to FIS as input. FIS takes this fuzzified input and process it to provide a measure of the degree of similarity of elements in the fuzzy set character image to input character image. The process of mapping the input taken to the expected output using fuzzy logic is known as Fuzzy inference .

4.2 Observations

Certain things are observed while executing the process of architectural model. Observations are made to show a comparison between existing and proposed system. It is shown through graphs that how much time was taken to execute data in existing system and in proposed system. Ten a comparison is made between them.

- a. Graph shown in Figure 4.3 depicts the comparison between Mu factor of existing and proposed system and observed that value of Mu factor in proposed system is less than that of existing system. Which decreases its time complexity. Thus the performance of proposed system is better than that of existing system in terms of time taken to execute the literal values.

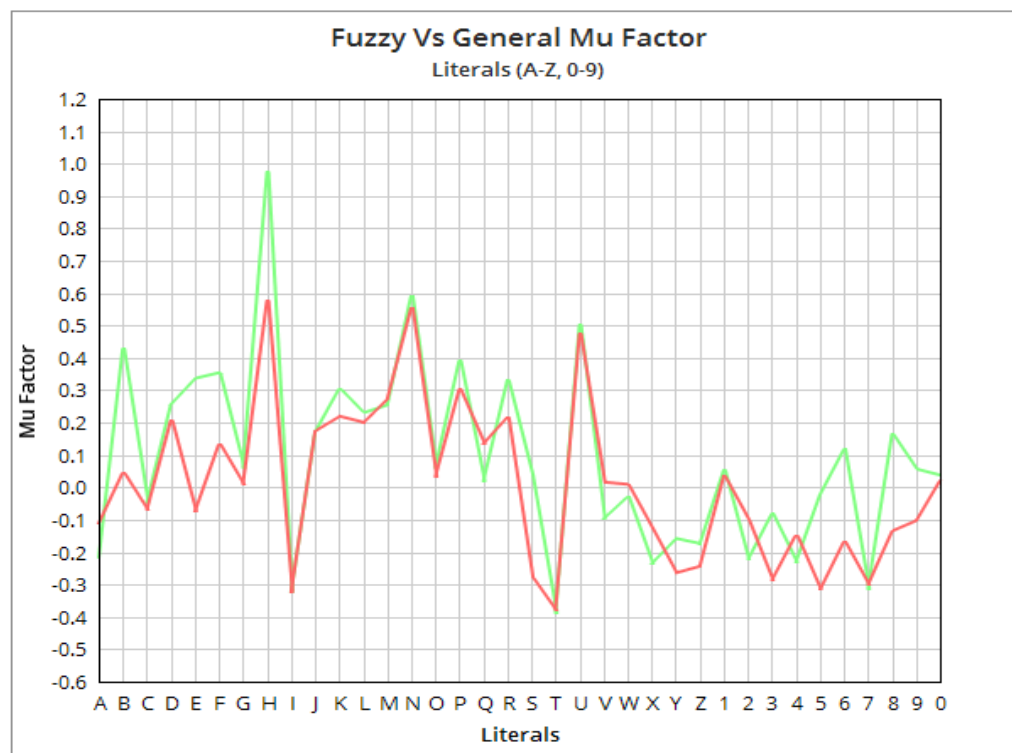


Fig. 12: Fuzzy Vs General Mu Factor

5. Conclusion

Text Recognition is currently acting as an area of interest and become a challenging issue now days as use of digital data on computers is increasing at a very high rate. With the emergence of text recognition in digital image processing number of applications have started to store their data in digital form. According to a research done by IBM [29], 2.5 quintillion bytes of digitized data is developed each and every day, It is to an extent such that 90% of the digital data in the overall world by today is developed with in the duration of passed years. Although OCR technology accurately recognize, such big data challenges, digital data in images but still the task of Broken, segmented text in digital images remains unresolved. Architecture of Label Embedding along with Fuzzy Membership Descriptor is the best choice among text recognition approaches in digital images. Comparison of this technique with other text recognition in images technique reveals that it provides high level of exactness in the final output result.

Thus we have proposed an architecture based on label embedding for text recognition in grayscale images along with fuzzy membership descriptor that resolves the weaknesses of the previous schemes. A process is designed to show the working environmental characteristics of proposed architecture model. This system does not require any post-processing or pre-processing which makes it cost efficient. We have used grayscale images for text recognition in this approach as it helps to simplify the algorithm and to reduce computational requirements. Whereas in color images special fxn is needed to manage RGB values of each pixel in color image.

5.2 Future Scope of Work

Further research can be carried out in the following areas:

- i. As the digital world expands, Mostly the images are clicked colored. Colored images have RGB value concerned with each pixel of image. Further research can be done in the field of text recognition in colored images as new technique is needed for recording and modification of RGB value of each pixel.
- ii. The proposed Text Recognition model can be extended by taking different types of font text and natural background. Text Recognition in Natural scenes using fuzzy logic can be used as new area of research.

References & bibliography

- [1] Gonzalez, Rafael C , Richard E.Woods “Digital Image Processing” / © 2002 by Prentice-Hall, Inc.Upper Saddle River, New Jersey 07458
- [2] Ms. Pradnya M. Kulkarni, Mrs. Archana.N.Naik, Ms. Arati P. Bhadvankar ,Department of Electronics & Telecommunication Engineering SIT, Polytechnic, Yadrav “Review Paper on Image Processing Techniques”, IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 10, 2015 | ISSN (online): 2321-0613 , All rights reserved by www.ijssrd.com
- [3] Jai Prakash1,AkankshaGohil, Geetanjali Institute of Technical Studies,Udaipur, Rajasthan, INDIA , “Image Processing: A Review” 33International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459,ISO 9001:2008Certified Journal,Volume 4, Issue 6, June 2014)
- [4] 1Er. Jyoti Rani, Assistant Professor, Dept. Of CSE, GZS PTU Campus, Bathinda, Punjab, India ,2Er. Sarabjeet Kaur, Student of M.Tech, Dept. Of CSE, GZS PTU Campus, Bathinda, Punjab, India,“Image Restoration Using Various Methods and Performance Using Various Parameters ”, Volume 4, Issue 1, January 2014 ISSN: 2277 128X Research Paper Available online at: www.ijarcsse.com
- [5] Poobal Sumathi,Ravindrang G,” the performance of fractal Image compression on Different imaging modalitiesUsing objective quality”Jan 2011.
- [6] YAN-xin SHI, CHENG Yong-mei1” Adaptive Filter for Color Impulsive Removal Based on the HSI Color Space”2011.
- [7] “Parameter Estimation in Image Processing and Computer Vision” Christoph S. Garbe and Björn Ommer
- [8] KMM Rao, Medical Image Processing, Proc. of workshop on Medical Image Processing and Applications, 8th October 1995 @ NRSA, Hyderabad-37.
- [9] A. Roman-Gonzalez, K. Asalde-Alvarez, “Image Processing by Compression: An Overview”, Proceedings of The World Congress on Engineering and Computer Science 2012 Vol I WCECS 2012,October 24-26, 2012, San Francisco, USA
- [10] International Journal of Remote SensingVol. 28, No. 5, 10 March 2007, 823–870 , “A survey of image classification methods and techniques for improving classification performance”, D. LU*{and Q. WENG{{Center for the Study of Institutions, Population, and Environmental Change, IndianaUniversity, Bloomington, IN 47408, USA{Department of Geography, Geology, and Anthropology, Indiana State University, Terre Haute, IN 47809, USA(Received 23 November 2005; in final form 31 March 2006)
- [11] “Remote Sensing Digital Analysis” - John A. Richards and Xiuping Jia, enlarged edition, Springer-Verlag, 1999. Image segmentation

[12] PurnaVithlani Department of Computer Science Saurashtra University, Rajkot, Gujarat,India“Pre-processing Techniques in Character Recognition”, Volume 4, Issue 11,November 2014ISSN: 2277 128X International Journal of Advanced Research in Computer Science and Software Engineering Research Paper Available online at: www.ijarcsse.com

[13] Text Information Extraction in Images and Video: A Survey Keechul Jung, Kwang In Kim, Anil K. Jain

[14] S. Antani, U. Gargi, D. Crandall, T. Gandhi, and R. Kasturi, Extraction of Text in Video, Technical Report of Department of Computer Science and Engineering, Penn. State University, CSE-99-016, August 30, 1999.

[15] http://en.wikipedia.org/wiki/Optical_character_recognition.

[16]“A Review on the Various Techniques used for Optical Character Recognition”, Pranob K Charles, V.Harish, M.Swathi, CH. Deepthi/ International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol. 2, Issue 1,Jan-Feb 2012

[17] Shalin A. Chopra 1, Amit A. Ghadge2, Onkar A. Padwal3, Karan S. Punjabi4 Prof. Gandhali S. Gurjar5, “Optical Character Recognition”, International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 1, January2014Copyright to IJARCCCE www.ijarccce.com 4956

[18]https://www.google.co.in/search?q=OCR+Block+diagram&client=firefox-b-ab&tbm=isch&imgil=KYfcb4kYNMNJMM%253A%253BCChPAPsFQTL8HM%253Bhttp%25253A%25252F%25252Fjdesbonnet.blogspot.com%25252F2010_09_01_archive.html&source=iu&pf=m&fir=KYfcb4kYNMNJMM%253A%252CCChPAPsFQTL8HM%252C_&usg=__J7_TgMSyJkBdGXZ8EVLrCIDnlaw%3D&biw=1366&bih=656&ved=0ahUKEwjezKXskcjNAhUGwI8KHTszAaQQyjcINg&ei=0xJxV56XNYaAvwS75oSgCg#imgrc=FMLaxJGYcV0vwM%3A

[19] Sushmita Mitra*, Sankar K. Pal ,“Fuzzy sets in pattern recognition and machine intelligence” Machine intelligence Unit, Indian Statistical Institute, Kolkata 700108, India Available online 20 June 2005

[20]https://www.google.co.in/search?q=Fuzzy+Logic+for+image+processing&client=firefox-b-ab&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjamY_go8XNAhUIN48KHcKMCRAQ_AUICSgC&biw=1366&bih=656#imgrc=2xDxyW1TEEVWzM%3A

[21] <http://access.feld.cvut.cz/view.php?cisloclanku=2012080002>

[22] Ross T.J., HASSANEIN H., ALI A.N.,: Fuzzy logic with engineering applications: design and stability analysis. 3rd ed. Chichester (Royaume Uni): Wiley, 2010, xxvii, 275 p. ISBN 978-047-0748-510.

[23] Kaehler S.D.,: Fuzzy Logic Tutorial. Seattle Robotics Society [online]. 1998. ed. [cit. 2012-08-22]. Available at: <http://www.seattlerobotics.org/encoder/mar98/fuz/flindex.html>

- [24] Applications of Fuzzy Set Theory and Fuzzy Logic in Image Processing, Jamileh Yousefi CIS 6320, W11
- [25] Fuchun Peng a,*, Andrew McCallum ba BBN Technologies, 50 Moulton Street, Cambridge, MA 02138, United States b Department of Computer Science, University of Massachusetts Amherst, 140 Governors Drive, Amherst, MA 01003, United States “Information extraction from research papers using conditional random fields” Information Processing and Management 42 (2006) 963–979 www.elsevier.com/locate/infoproman Received 31 March 2005 Available online 6 December 2005
- [26] Jose A. Rodriguez-Serrano · Albert Gordo · Florent Perronnin ,”Label Embedding: A Frugal Baseline for Text Recognition”, Int J Comput Vis DOI 10.1007/s11263-014-0793-6, Received: 17 May 2014 / Accepted: 3 December 2014, © Springer Science+Business Media New York 2014
- [27] Shimpy Goyal Department of Computer Science and Applications, M.D. University, Rohtak, Haryana, India, “Optical Character Recognition ” Volume 3, Issue 11, November 2013 ISSN: 2277 128X International Journal of Advanced Research in Computer Science and Software Engineering Research Paper Available online at: www.ijarcsse.com
- [28] Kai Wang, Boris Babenko and Serge Belongie Department of Computer Science and Engineering University of California, San Diego “End-to-End Scene Text Recognition” fkaw006, bbabenko, sjpg@cs.ucsd.edu
- [29] Mohit Kumar, Norbert Stoll, Kerstin Thurow, and Regina Stoll [29], “Fuzzy Membership Descriptors for Images”, Conference: IEEE TRANSACTIONS ON FUZZY SYSTEMS, VOL. 24, NO. 1, FEBRUARY 2016