

Development of an Alphabetic Character Recognition System Using MATLAB

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Abstract:

When it comes to pattern recognition and image processing, character recognition is an important field. It is used to match symbols to pictures of characters and is a significant area in pattern recognition and image processing. The core topic is introduced in this section. the process of converting uneditable images (such as those scanned from a page or typed) into editable images into a text format that may be edited (html, doc, txt, or any other format you like). formats. There are just a limited number of Bangla characters to choose from. Even if there is a document recognition system in place, it will not be able to recognise the whole document. a collection of letters The following research is driven by this and demonstrates a number of interesting findings. MATLAB is used to develop a system for recognising characters in printed text. Writings in the Bangla language are available. Also possible is a comparison of the characters in a single image with those in another picture. relocating the file to a different place In this particular case, binarization and other processing steps were carried out. Noise reduction and segmentation with varying degrees of complexity, as well as other features, are discussed. The procedures of extraction and identification are both critical in the process' success. These are just a few of the words that appear in this index: OCR, Character Recognition, MATLAB, Cross Correlation, and Image Processing, to name just a few.

Introduction:

Character recognition was first studied in the 1990s as a subject in pattern identification, artificial neural networks, and machine learning, and it has since gained popularity. In terms of hardware and software needs, CR may be divided into two categories: on-line CR and off-line CR, with each category having its own set of requirements. Identification methods are classified as follows: Among the developments in the area of online character recognition is The computer recognises the symbols in the applications precisely as they appear on the screen. drawn. The digitising device is the most often seen piece of data collecting equipment. There are several types of tablets available, including those that are electromagnetic, electrostatic, and pressure sensitive.

A light pen, in addition to sensitive sensors, may be used to detect movement. Taking up the role of the protagonist A image is drawn and the successive placements of the pen are memorised while the picture is being created (the drawing technique). The normal sample frequencies are between 100Hz and 200Hz), and, second, the sampling frequency ranges from 100Hz to 200Hz. It is these phrases that are used by the recognition algorithm. Character who is not online at the time As soon as the inscription or printing has been completed, the procedure of recognition is complete. performed. Examples of this are often distinguished in the following ways: magnetic In addition, OCR (optical character recognition) is employed. In the shape of a magnetic

character, for example Optic character recognition (OCR) is used to read the fonts that are stored on a magnetic disc (OCR). After a magnetic field has been established, they are designed to be adjusted in a certain way. As a result of the acquisition device, MCR is most often seen in the banking business. As a result, applications such as those for reading bank checks are being developed in the future.

The process of overwriting or overprinting these letters has no influence on the content of the document. The accuracy with which the identification is accomplished. When it comes to visual character, the possibilities are endless. The topic of this research is the domain of recognition, which is concerned with the recognition of others. Applied along with the identification of characteristics gathered via visual approaches, Typically, this is performed by the use of a scanner or a digital camera, respectively. It is possible to differentiate between the symbols. between themselves or to structures such as words, paragraphs, or phrases as well as figures, and so on Printed or handwritten, any size, and in any language, they are permitted to be submitted. (2) The shape or orientation of the thing. (3) The size of the object. Bangla is the language spoken by the people of Bangladesh as their first language. It is the official language of Bangladesh, and it is one of the world's most frequently spoken languages. Bangladeshi is also the second most extensively spoken language in the world. Bhangla is the second most frequently spoken language on the Indian subcontinent, behind Hindi (which ranks first). language. Apart from that, there are 200 million people from eastern India and Pakistan Bangladeshi are fluent in this language, which also happens to be the country's official language. [1] inside our own country The Bangla alphabet is thus difficult to comprehend as a consequence of these factors. We are especially interested in this because of the enormous number of government officials that are involved in it Every day, hundreds of sheets of paper are scanned and processed, resulting in significant savings. This piece of art is excellent. The goal of this project is to develop a system that can divide a given input (in Bangla) into different categories. rather than identifying people, characters) are shown as belonging to a certain class. Every input pattern, and thus every one of them, is distinct. It also has the

capability of doing character animation. A character's recognition is performed by turning it into a numerical representation in the computer's computer system. The geometrical characteristics of the character are used in the creation of a vector-based object. image. If this strategy becomes more widely used, it may result in a decrease in the amount of hard effort that is necessary. Every day, government employees are anxious about the future of their positions.

II. BACKGROUND

Bangladeshi characters are composed of 11 vowels, 39 consonants, and ten numbers as part of the basic character set. There are also compound characters, which are made up of a combination of consonant and consonant as well as consonant and consonant. with the vowel sounds [1, 4]. It is necessary to include the whole cast of characters. The suggested recognition system, which is described in detail in the following section: Figure1.

Numerals	୦ ୧ ୨ ୩ ୪ ୫ ୬ ୭ ୮ ୯ ୧୦
Independent Vowels	ଅ ଆ ଇ ଓ ଊ ଋ ଌ ଐ ଔ ଶ୍ଵ
Consonants	କ ଖ ଗ ଘ ଙ ଚ ଛ ଜ ଝ ଞ ଟ ଠ ଡ ଢ ନ ତ ଥ ଦ ଧ ପ ଫ ବ ଭ ସ ଷ ହ ର କ୍ଷ ଣ ଫଳ୍ୟାୟ

Figure1: The whole character set of Bangla Alphabet

A. OVERVIEW OF THE IMAGE TYPES AND PROPERTIES

A similarity exists between the RGB (true-color) photos and the wavelength-sensitive cone in that they are stored as three separate image matrices: one with red (R) in each pixel, a second with green (G), and a third with blue (B). cells in the human retinal pigment epithelium If you're dealing with grayscale or graylevel digital, you should know that When viewing an image, each pixel has a single value, and each pixel has just a single bit of information. It is possible to get information about the intensity. A

grayscale image is not the same thing as a black and white image, for example. A binary image with two different degrees of whiteness. The colour grey is used to depict the grey image in this case. Shades of black and white are employed, as well as a combination of levels. A grayscale image with an 8-bit colour depth.

This display has 288 levels, spanning from black to white, with 0 representing black and 255 representing white in the colour spectrum. Binary images, on the other hand, which have just two potential values for each individual pixel, are formed by thresholding a collection of pixels together. Use a grayscale or colour image to identify one object from another in a photograph to make it easier to read. [5] The historical setting of the work. Furthermore, the word "colour image" is often used to describe colour photographs. The three terms that follow are: Hue, Saturation, and Lightness (in order of importance). The colour is referred to as hue. In the context of light, colour is a word that relates to the wavelength of the light and is determined by it. This display contains 288 levels of brightness ranging from black to white, with 0 being black and 255 representing white in the colour spectrum, and each level represents a different colour. On the other hand, binary pictures are created by combining a number of pixels and thresholding them together, resulting in each individual pixel having just two conceivable values.

To make it simpler to understand a picture, use a grayscale or colour image to distinguish one thing from another in the shot. [5] The historical context in which the poem is placed. Furthermore, the term "colour picture" is often used to refer to colour images in general. These are the three words that will be discussed in this section: Hue, Saturation, and Lightness (in order of importance). The hue of a colour is the name given to it. The term "colour" refers to the wavelength of light and the way it is determined by it in the context of optics.

METHODOLOGY

Created in this part are the components of the proposed Bangla Chracter Recognition system, which are described in detail below:

The printed Bangla script is put into the scanner in step one. Scanned document in its raw form, straight from the scanner

(Step 2). Follow the steps in Step 3 to convert the scanned RGB image to grayscale. image

At the end of Step 3, you will have transformed a grayscale image into a binary image.

Feature Extraction and Segmentation are the last phases in the process of classification.

Step 5: It is important to classify and post-process the information.

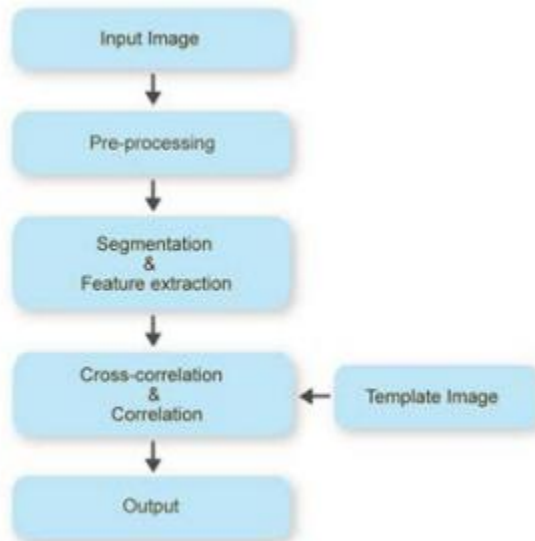
Step 6: Construct a text file that may be changed by the user.

In this particular instance, the system gets as input a scanned RGB colour image. The The approach for text detection, identification, and translation that has been proposed is as follows: According to the technique shown in Figure 2, the following stages must be completed: Binarization, Techniques such as noise reduction, segmentation, feature extraction, and correlation are among those that are used. [1, 7] as well as Cross-Correlation are examples of this. A. Materials Preparation and Preparation of the Materials

Binarization

Binarization is the technique that has been used in this instance to make the grey scale more evident. Noise reduction is made possible by converting pictures to binary images, which are then compressed. removal. The two colours that are most often used in a binary picture are red and blue. The most prevalent colour combinations are black and white, however any two colours may be used. The colour of the sky blue The colour that was used to represent the object in the photograph is referred to as the foreground colour, while the colour that was used to represent the backdrop is referred to as the background colour. The colour of the background is carried through the rest of the photograph. Binarization is the process of dividing anything into

two halves. Background information [1-2] is used to distinguish between the foreground (text) and the background information [1-3].



Noise Reduction is important.

Scanned documents often include noise that is created by the printer or scanner's accessories, print quality, or the age of the scanner, among other things. as well as other materials As a consequence, it is necessary to filter out this background noise prior to using the data. preparing the image for further processing This low-pass filter should make every effort to prevent as much as it can. [1, 8] The goal is to produce the least amount of distortion possible while keeping the whole signal.

B. The classification and categorising of information

Essentially, picture segmentation is the division of a digital image into smaller fragments via the use of software. in order to subdivide into a number of parts (sets of pixels, sometimes known as super segments) pixels). The goal of segmentation is to make things easier to understand and/or distinct from one another. an alteration of a photograph to produce something more significant the message is more meaningful

and less difficult to understand Image segmentation is the process of categorising photographs and splitting them into categories. In order to guarantee that all pixels in an image have the same label, it is necessary to label them all individually. Pixels with the same name have similar features or are of the same origin as pixels with different names. Characteristics such as colour, concentration, and quality are all examples of attributes. This is the final result of the process. Picture segmentation is a collection of pieces that, when combined, comprise the area of interest in a photograph or other visual medium. A picture in its entirety, or a sequence of lines drawn away from the picture (or boundary of the image) detection). The segmentation of a binary image is conducted in a different state from the original state. Line segmentation, word segmentation, and character segmentation are all levels of segmentation. segmentation.

Thresholding is a simple and effective approach that is frequently overlooked. in which this segmentation will be carried out on the client's behalf Color concentrations in the foreground and background are different in each image. Areas in the foreground and background Each and every pixel in the image is processed in a separate operation. This threshold value has a strong relationship with the If the intensity of the pixel is higher, the pixel is more intense. When the value is larger than the threshold, the pixel is set to white in the output; otherwise, it is turned to black. The foreground and backdrop should be complementary to one another. If the value is less than the threshold, the value is set to that amount. from white to black, indicating the existence of a background [1, 2, 8] One of the qualities is the ability to extract information. It is only in this context that a kind of dimensional reduction known as feature taking out is used. that accurately depicts the most exciting aspects of an image as though they were really happening route with a large number of characteristics When the image sizes are huge, this method is suited for the situation. a distinctive and focused characteristic It is vital to make use of pictures in order to communicate effectively. among other things, do image matching and recovery tasks Feature Detection, feature mining, and matching are often used in concert with one another to provide successful results. Identify and resolve common

computer vision problems, such as object identification and tracking. Picture detection and recognition, content-based image retrieval, and image classification and recognition are all examples of image processing techniques.

It is critical to reduce background noise.

For a variety of reasons, noise in scanned documents is common. For example, printer or scanner accessories, print quality, and the age of the scanner are all factors to consider. In addition to other materials. Consequently, prior to utilising the data, it is important to filter away the background noise that has been introduced. processing the picture in preparation for future processing. When it comes to prevention, this low-pass filter should make every attempt to prevent as much as possible. In order to preserve the whole signal intact, it is necessary to create the least amount of distortion feasible [1, 8].

B. Information is classified and categorised according to its kind.

Picture segmentation is, in its most basic definition, the partition of a digital image into smaller parts via the use of software. in order to split anything into a lot of different components (sets of pixels, sometimes known as super segments) pixels). In order to make things more understandable and/or separate from one another, segmentation is used. snapshot that has been altered in order to make something more meaningful. There is more significance in the message, and it is less difficult to comprehend. Image segmentation is the process of categorising photos and dividing them into groups based on their subject matter. It is required to name each and every pixel in an image separately in order to ensure that all pixels in a picture have the same label. Pixels having the same name share characteristics in common with pixels with different names, or they are of the same origin. For example, colour, concentration, and quality are all characteristics that may be described as attributes. This is the end outcome of the whole procedure.

In a photograph or other visual media, picture segmentation is the collection of parts that, when put together, form the area of attention in the image or other visual medium. A complete picture, or a series of lines drawn away from the picture (or boundary of the image) detection). The segmentation of a binary picture is carried out in a state that is distinct from the initial state of the image. Line segmentation, word segmentation, and character segmentation are all examples of levels of segmentation in computer programming. segmentation. Thresholding is a straightforward and effective strategy that is all too often disregarded.

This will be carried out on the client's behalf in terms of segmentation. Each picture has a varied colour concentration in the foreground and background due to the various camera angles. The foreground and backdrop are divided into two halves. Each and every pixel in the picture is subjected to a different set of operations during processing. Because of this close association, the threshold value is used to determine how intense an individual pixel is. If the threshold value is greater, the pixel is more intense. When the value exceeds the threshold, the pixel is changed white in the output; otherwise, it is converted black.

Foreground and background should be complimentary to one another. If the value is less than the threshold, the value is set to the amount that is less than the threshold. When the colour changes from white to black, suggesting the presence of a backdrop [1, 2, 8]. One of the abilities is the capacity to extract information from different sources. When it comes to feature taking away, it is only in this context that a particular kind of dimensional reduction is used. that faithfully shows the most thrilling portions of a picture as though they were really taking place. route with a significant number of distinguishing features. When the picture sizes are really large, this approach is the most appropriate for the scenario. a distinguishing and narrowly concentrated trait. In order to communicate successfully, it is essential to make use of visuals wherever possible.

Perform image matching and recovery jobs, among other things Feature

When it comes to achieving good outcomes, detection, feature mining, and matching are often utilised in conjunction with one another. Computer vision challenges such as object recognition and tracking are identified and resolved in this course. Image processing methods include picture detection and recognition, content-based image retrieval, image classification and recognition, and image classification and recognition, to name a few.

Correlation and cross-correlation are two types of correlation.

A methodology for accurate 2D and 3D image tracking and correlation is an optical technology that works with a tracking and image registration method. the extent to which pictures shift in size Cross-correlation is a kind of correlation. The degree to which two photographs are similar. Each of the photos is a separate file. split into rectangles of equal size Each block in the first picture is a separate image. connected with the block in the second picture that corresponds to Obtain the cross-correlation value as a function of the location of the cursor [10,11].

TECHNIQUE DE IMPLEMENTATION DE MATLAB

In computer science, an implementation is the transformation of a technical specification or approach into a computer programme, software component, or other form of computer code that is usable by other computers. computer system that makes use of computer software and other technologies deployment. The MATLAB programming language is used to create the system that has been proposed. In addition, the precision is verified for accuracy. Using the MATLAB function 'imread' to read a file In order for this operation to be performed, a noisy scanned RGB image is fed into

the input of the device. system (as a colloquial expression) (Figure.3). The conversion from grayscale to colour has been completed by Figure.4 is formed as a consequence of the usage of the 'rgb2gray' command; the command 'rgb2gray' eliminates the use of colour from the image. colour, saturation, and hue information from the RGB image while keeping the original picture the degree to which the light is brilliant After binarization, the final result is shown in Figure 5-6. This black and white image has been converted to black and white using the 'im2bw' command, as well as having noise reduction applied. image. Using the example of Figure 7-8, we can see how character segmentation is done. [12-13].

It is necessary to do a cross-correlation between the input image and the template. It has been determined where the highest point is in the photograph (Figure.9). The highest point is, of course, always the highest point. In cross correlation, this denotes the area where there is the highest level of matching between the two variables. In this way, the appropriate character may be identified and recognised. (Figure.10). In this scenario, the hex value of the Bangla Unicode Characters is used instead of the actual character. a machine-readable representation of the character that has been identified [14] The character is shown in the built-in browser of MATLAB in this instance.

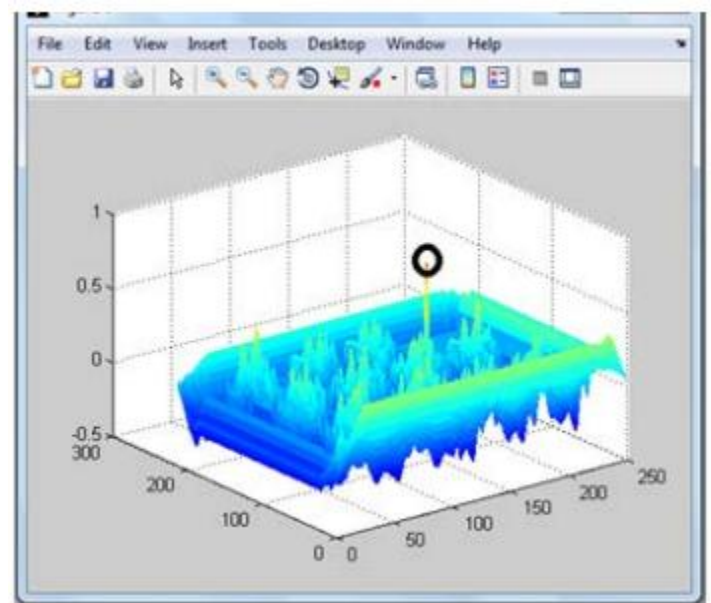


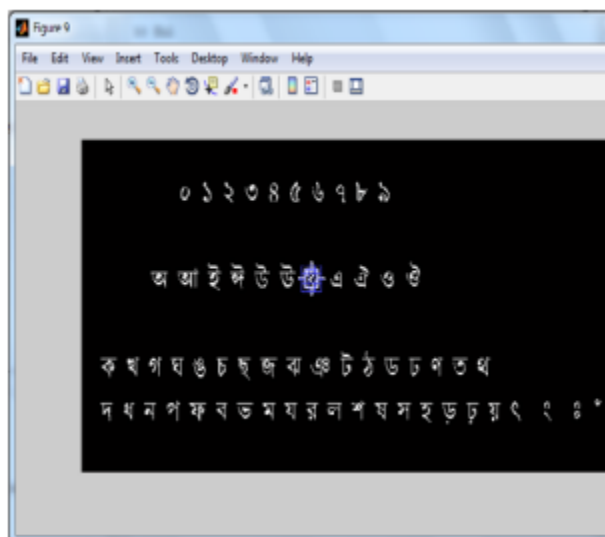
Figure 9: Marked Peak in cross correlation refer
Character Detection

Figure 10: Recognized character from Template.

V. DEVELOPMENT OF THE VISUAL INTERFACE (GRAPHICAL USER INTERFACE)

Additionally, a Graphical User Interface (GUI) that is user-friendly has been developed for this purpose. user-friendly system in which the user may submit a photograph that will be recognised by the system character. The "Load Picture" option enables the user to upload any picture that they like to the server. Following the loading of a photo, the user may choose a character by clicking on him or her with the mouse button Move the mouse over the image, crop it, and then proceed with the "Image" command to complete the processing. "Processing" is an option that is accessible. Following the algorithmic instructions, the system would function properly. to identify the character that was chosen and provide an editable version of that character Identifying the character will be accomplished by selecting the "Recognize Character" command from the drop-down menu.

VI. ANALYSIS (or evaluation) (or evaluation)

The proposed strategy to recognition has a recognition rate of around 80%, according to the data. With an accuracy rate of about 98-100 percent, this is an outstanding accomplishment. Image New versions of the processing toolkit and the built-in MATLAB algorithms have been released. When it comes to identifying a single Bangla character, it is really handy in this situation. It is possible to collect the input images using any optical scanner or camera that is available. camera. The output allows you to save detected characters as html, for example, and then edit them later. For further processing, text files in formats such as txt, doc, and so on are employed. The only constraint is that it must be done in a public place. The fixed font size of the character is represented by the computer system. Further in every manner that is possible, make improvements The font style and size are exclusively intended for this purpose. in the foreseeable distant future Additionally, it is only intended for use with a single Bangla letter. Once in a while, there is a moment of recognition Recognition of a variety of letters, in addition to the alphabet Additionally, the option of other linked letters is left open in the future. Bringing the two together is important. It may also be advantageous to construct an algorithm with the help of a neural network.

Conclusion:

The findings of the successful review and payment will be published by the International Journal of Scientific Research in Physics. your paper for the journal's current issue is being considered The payment information may be found on this page. You may learn more about the charges for online publishing at <http://ijsrp.org/online-publication-charge.html>. Seventh and final point of view Bangla, being a character-based language, needs this in a straightforward manner In order to fulfil its goals, it will need to do considerable study. The characters of Bangla are readily recognised. is still in the very early phases of development at this time. The system that has been proposed is as follows: This website was created by using a template matching method in

order to determine character representation on an individual basis. Despite the fact that the UI is simple and straightforward, this strategy, which offers a number of advantages to individual users, is still in widespread usage. Facing a number of constraints that are both severe and time-consuming. It is necessary to modify the system in order to accept handwritten characters that are all printed. When designing fonts, it is necessary to put in a large amount of effort and maintain extreme perfection. A suggestion for additional research and development.

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