

Optical Character Recognition for Evaluation in E – Learning Platforms

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ABSTRACT– Due to COVID-19, classes are conducted via online mode. In this paper we present a neural network(NN) based optical character recognition (OCR). Our main focus is to design a solution for automatic evaluation of handwritten answer scripts of students both in schools and colleges. Our main aim is to provide an efficient solution that produce accurate results. Students answer scripts are scanned and converted into image. These images are then converted into computerized text format using various methods involved in Optical Character Recognition. Based on the keywords for each question provided from teachers, marks will be allocated for each question. We have proposed a solution with the help of neural network, which is used to learn based on multiple inputs.

Keywords – Neural network, evaluation, Optical character recognition, keywords, computerized text format.

I. INTRODUCTION

Optical Character Recognition is a method of converting the handwritten text into computerized text format by few steps involved in the process. Optical Character Recognition is mainly used in digitizing printed text, so that we can edit and store it digitally. Many old paper records can be converted into digital formats using optical character recognition for easy storage and maintenance. There are many advantages in converting texts stored in paper format to digital formats. Few advantages are data can be easily stored in local machines or in cloud which can be accessed by any one at any time, physical storage of paper are no longer required, searching required data can be made efficient.

During the early stages of optical character recognition, each character has to be trained in order to recognize texts from images. Recent trends on character recognition are done with

greater accuracy. There are many domains to which OCR are applied, they are receipt OCR, invoice OCR, check OCR, legal billing document OCR.

There are different types of OCR used for different purposes. Optical Character Recognition (OCR) which is used for recognizing one character at a time. Optical Word Recognition is used to recognize one word at a time, which is similar to OCR. Intelligent Character Recognition (ICR), is used in recognizing cursive character one at a time. Intelligent Word Recognition which is used for recognizing one word at a time. Based on the requirement, one of the above-mentioned types can be used.

Optical character recognition can be done by following few techniques. These are used to increase accuracy and fetch required output. Initially the process was started by the pre-processing method, which is used to remove unwanted data. By removing we can increase the chances of successful recognition. Few techniques of pre-processing include De-skew, normalize, line and word detection. Text recognition process is carried out after pre-processing of data. There are two types of OCR algorithm, they are Matrix matching, which is also called as pattern matching, compares the character image with the pre-existing stored image in a pixel-by-pixel manner. Second algorithm is Feature extraction, which is used in decomposing the character into lines and loops, which is very useful in recognizing characters in an efficient way.

Post processing is the method that is carried out during the final stage of character recognition. It is used to increase the accuracy in recognizing characters. After recognizing characters, they are converted into ASCII (American Standard code for Information Interchange) code.

II. LITERATURE SURVEY

Venkata Rao, et.al, in the paper “Optical Character Recognition Technique Algorithms”

presented a new neural network (NN) for Optical character recognition (OCR) and handwritten character recognition (HCR). The method has an increased accuracy in both the recognitions. They have compared their solution with the existing advanced solutions which is used to find the accuracy of the proposed solution. Character recognition is used to recognize characters from image. Using character recognition, the interaction between human and machine can be increased and automation can also be done easily. They have discussed about the offline and online character recognition types. Multiple languages can be converted from handwritten to computerized format. They have carried out a literature survey of few journals and the methods used in it for comparing their proposed solution. Various methods are used in optical character recognition, they are Matrix matching, Fuzzy logic, Feature extraction and Neural Network. Artificial Neural Network (ANN), is a powerful technology which is used in dealing with training and test data. Components used in OCR system includes segmentation, pre-processing, feature extraction and post-processing. The proposed system uses training dataset to train itself and provide cent percent accuracy. Systematic representation of the proposed system has also been added for easy understanding. Proposed system is propagated into the network until the desired output is received by using back propagation algorithm. By adjusting the weights, we can get the desired outputs. By using the below mentioned formula the error in the output is reduced by making few changes.

$$Y = f(I) = f\left\{\sum_{i=1}^{\infty} X_i W_i - \phi_k\right\}$$

The proposed solution can be used in various fields such as Invoice imaging, legal industry, banking, healthcare, captcha, automatic number recognition and handwriting recognition. They have also attached the result for the proposed solution.

Honey Mehta et al, in the paper “Optical Character Recognition (OCR) System for English Language using Artificial Neural Network (ANN) Classifier” proposed with the concept of Artificial Neural Network (ANN) for recognizing the characters from scanned image. Non linearity of ANN is very helpful in complex characters in the input image. They have included the major uses of optical character recognition, they are data entry for old books, office papers and old decaying paper materials. A hierarchical diagram representing the types of optical character recognition is presented. Two categories of OCR are offline and online

character recognition. Offline character recognition is further divided into three categories such as, Magnetic Ink Character recognition (MICR), Optical Character Recognition (OCR), Optical Mark Recognition (OMR). The main purpose of using ANN is for its efficiency and it is easy to use.

For ANN the inputs are provided and weights are assigned to each input and outputs are verified whether the desired output is received. Changes are made on the weights of the desired input neurons and the output is verified with the existing outputs. Output is generated with the help of Activation function at the output neuron. One such activation function is bipolar activation function, which produces either 1 or -1 as output. Using Multi-Layered Perceptron (MLP) which consists of three layers, an input layer, a hidden layer and an output layer. They have also done few literature surveys. They have designed the problem definition clearly. The steps involved in the solution are data collection, pre-processing which is used for removing unwanted data from the image, segmentation, feature extraction and text classification. They have also used nearest neighbour approach for clarification purposes. They have also listed the algorithm for clarification of characters in a detailed manner. Outputs are tabulated and shared with slope values. The recognition rate produces a result accuracy of 98.89% and recognition rate proposed about 100%.

B. Vani, et.al, in the paper “High accuracy Optical Character Recognition algorithms using learning array of ANN”, aims in creating and application interface with the help of Artificial Neural network. In the proposed system high accuracy rate is achieved by using neural network. They have tested the proposed system on individual characters of English alphabets. They have discussed various image defects that happens while writing characters. Image digitization which is one of the essential steps. Using image digitization, the image is processes into binaries which will be the input for recognition system. A detailed description of artificial neural network and back propagation neural network is explained with diagrams. Back propagation algorithm is listed step by step clearly with formulas.

The proposed system consists of five different algorithms. They are Adjusting weight matrix, labelling algorithm for images, finding boundary line and generating X, Y coordinates, Matching connected pixels and formation of words. Input is defined as

$$\text{If } I(i, j) = 1 \text{ Then } G(i, j) = 1 \\ \text{Else}$$

$$\text{If } I(i, j) = 0 \text{ Then } G(i, j) = -1$$

A detailed explanation of algorithm is given along with the outputs. After multiple occurrences of trials, words are recognized and formed correctly. Applications of OCR are data entry and text entry, process automation, healthcare, banking, postal tracking and publications. Recognition of each categories are listed with high recognition rates.

Karan Magiya, et.al, in his paper “Multipurpose real time handwriting Recognition” has proposed a system to recognize printed and manual handwriting. In this research he used Neural network which is well suited for training the data. In some cases, the same letter may be written in different ways according to the writer in such there is no well-defined mapping of letters, thus Neural networks provides solution by training the data, which is the main idea of the project. The already existing system that is used in various mobile applications are most probably would recognize characters and alphabets written on the screen. So, the major drawback here is there is no method to recognize only pre-written or present in image texts. To overcome this flaws, various neural network applications are used, they are Image Processing and Feature Extraction.

Image Processing is the technique where image is processed to extract information out of it. Initially the image is converted to workable format either to grayscale or bitwise format. Then the region of recognition is determined by using filter. Each character is then separated and neural network algorithms are exploited in the particular character and the same is carried out through the whole document. The motive of this process is to provide Neural Network algorithm to find the place where the pattern to be recognized lies.

Feature Extraction is the process where we gather various features of the image called feature maps. Through this we can detect edges of the images which contains required text. We can use various axel detecting techniques like: kirsch, sobel, canny, prewitt etc. among this the most accurate in finding the diagonals is kirsch technique. This method uses eight point neighbourhood for each pixel. This is done to ensure that the neural network will learn without large number of samples.

Polaiah Bojja, et.al, in his “Handwritten text recognition using Machine learning techniques in application of NLP” proposed a model for handwritten text recognition and convert them into speech for the application in healthcare, personal care and in some education, platforms using deep learning concept. In this model we used Tensor flow and OpenCV as they contain pre-trained models

that are used directly to obtain accurate results compared to other methods available. The model developed in this project is mainly used to convert handwritten text into different formats especially in text document format. We have mainly used open source models for the development of the project. The architecture of model we have used are based on NLP (Natural Language Processing).

In the development of the project, we have mainly used python version 3 as a language in order to meet the project requirement. Initially we used SPYDER as an IDE. Other than this several libraries including some pre-trained models like pytesseract, OS are used. This model uses Neural network and decision tree to segregate characters and solve the problem.

These decision trees follow the approach of trial-and-error method which solves every possible way and concludes the result. This model is used for the benefit of improving the accuracy of the decision for each and every time it is used to detect output.

$$I_G = \sum_{j=1}^c P_j^2$$

$$I_H = - \sum_{j=1}^c P_j \log_2(P_j)$$

Where P_j is proportional of samples belong to a class for a particular node. Character selection is done based on this.

Prince Sinha, et.al, in his paper “Answer evaluation using Machine learning” proposed a model for answer sheet evaluation and allocating marks accordingly for each candidate. The key idea behind this system is to reduce the man power, it can be achieved by automatic keyword evaluation system. In this system the Keywords required for particular test will be stored manually by the coordinator for the later evaluation process. And those keywords are cross checked with hand written dataset using supervised learning algorithm. Initially the system has to be trained with different datasets that are available in online and algorithm behind this process is neural network with multiple hidden layers. With this backpropagation algorithm is used to calculate errors. The already existing system can only use in multiple choice questions where as our system is about to evaluate marks for the handwritten datasets. To implement this OCR (optical character recognition) is system will split the keywords, based on the keywords available in the answer sheet

and keywords in the dataset, the application will provide marks within the range of 1 to 5. The answer sheet should be in the jpeg format and the supervisor should set the maximum marks and minimum length required for an answer. The number of words in the dataset can be counted and stored in the separate files. Finally, the marks can be evaluated considering how many keywords are matched and percentage of the answer length.

$$\text{maximum marks} \times f(n) \times \frac{[\text{No. of keyword matched}]}{\text{Total keyword}}$$

If the manual of a particular answer sheet takes about 60 seconds, this system will complete the evaluation within 15 seconds thus achieving 300% efficiency over

manual evaluation. And it holds the accuracy of 75–87.5% completely eliminating human effort.

Mean Absolute Error (MAE)

$$\frac{1}{n} \sum_{i=1}^n (Y_i - \hat{Y}_i)$$

Mean Square Error (MSE)

$$\frac{1}{n} \sum_{i=1}^n (Y_i - \hat{Y}_i)^2$$

From MSE the error calculated from a sample dataset is 12.5%, therefore the accuracy rate comes out to be about 87.5% as compared to the manual evaluation.

III. EXISTING SYSTEM

Optical Character Recognition for E-Learning platforms, mainly focuses on the process of converting scanned image into computerized format and evaluating the recognized text with the keywords provided. Based on the matched keyword's marks shall be awarded. In order to convert the scanned image into computerized text format, we need to design an efficient algorithm. For instance, this model can be used to convert scanned image into text format and also evaluates

the recognized text that matches the keyword. But the existing system perform only limited tasks only. Only OCR concepts are used. Many systems use the built in APIs in order to convert scanned image to text format. The main drawback is that manual evaluation of answer script has to be done. To overcome the drawback of the existing system, we have used a method of automatic evaluation.

IV. PROPOSED SYSTEM

This section elaborates the proposed algorithm used in the development of the system.

Module Description

In this stage the system is divided into two stages which is discussed below:

4.1 Optical Character recognition

In this stage, the process of converting the scanned image into text format is done. In order to convert the scanned image into text, we need to collect the image and format the image to the required format. In this we have used IAM handwriting dataset. It consists of different formats of handwritten text. Some of the steps involved in OCR are listed below

4.1.1 Data Pre-processing

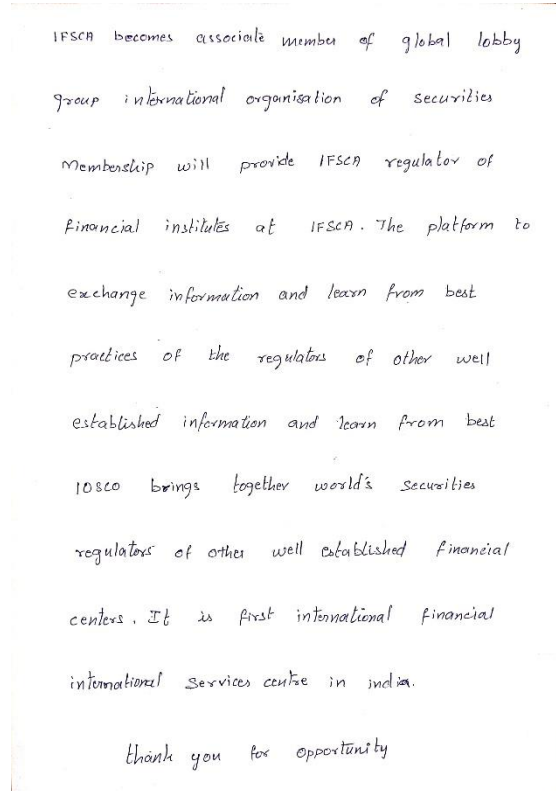
Data pre-processing is the first and foremost step in this process. Data pre-processing is used to convert the image by removing the noisy data. Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN) can be used in this process.

4.1.2 Feature Extraction

Feature Extraction is used in extracting the required processed image. It is very helpful in providing only necessary data from a set of whole data. It is used in deriving combination of the existing text in order to maintain accurate text.

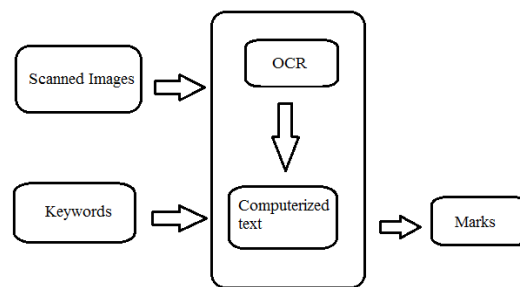
4.1.3 Max pooling

Max pooling is used in gathering the maximum value from each feature that is gathered and segmented from the previous layers. By collecting the maximum value from each feature that is mapped, we can get an overall maximum feature that is mapped from the existing feature values.



Block Diagram

Input Image



The image that is given as an input is a scanned image. Handwritten text papers are scanned and uploaded as input for the system.

After reading the input image, pre-processing process starts and then the image is converted into text format. A sampled of the image is attached.

Scanned input Image

The scanned input images are broken in to features, so that identification of the text can be done in an efficient manner. Breaking down of a large image into much-much smaller image can increase the learning rate and thereby increasing accuracy. After recognizing the text, they are grouped into a word and then to a meaning full sentence. Breaking of sentence is attached below.

Corrected Text:
Iro become asocole membe ot alebal lobby .
Gooup intermalonal organisationof wsecurities
memberehip will prerde , lichregulator of
financialeinstitals afe lescD. the plattor e
exchange information and learnnfrom bests
wpractices of the segiabrs of , other we
established information and leawn from best
aslosco brings ,together worlds , secusitiea
w regulalors , of other well establishedFinoncial
wcenters , It , is Prst intenational financial
entonational services contse in sndang
nnene thank you fosepportanstyena it
64.28571428571429 %

Line 1 IFSCA becomes associate member of global lobby
Line 2 group international organisation of securities
Line 3 Membership will provide IFSCA regulator of
Line 4 financial institutes at IFSCA. The platform to
Line 5 exchange information and learn from best
Line 6 practices of the regulators of other well
Line 7 established information and learn from best
Line 8 Thank you for opportunity
Line 9 IOSCO brings together world's securities
Line 10 regulators of other well established financial
Line 11 centers. It is first international financial
Line 12 international services centre in india.

Recognized text:
IroI become asocole membe ot alebal lobby .
Gooup intermalonal organisationof wsecurities
memberehip will prerde , lichregulator of
financialeinstitals afe lescD. the plattor e
exchange information and learnnfrom bests
wpractices of the segiabrs of , other we
established information and leawn from best
aslosco brings ,together worlds , secusitiea
w regulalors , of other well establishedFinoncial
wcenters , It , is Prst intenational financial
entonational services contse in sndang
nnene thank you fosepportanstyena it

Line 12 Since the whole image is segmented into each time identifying text will be an easy way. Recognized text is attached below.

Using the Autocorrect feature, the recognized text is auto corrected. Any misspelled word will be corrected using the auto correct feature. Auto correct feature is useful for searching the provided keywords for evaluating the answer script.

User is able to see that the marks scored by the student is about 64.25%. Based on the number of keywords matched marks shall be provided for the students. Formula for calculating marks based on the number of keywords is

$$\frac{\text{marks}}{\text{total_marks}} \times 100$$

Here marks represent the number of matched keywords.

V. CONCLUSION

Optical Character Recognition for Evaluation in E-Learning platforms is an essential and a challenging task. In this proposed system, we used IAM handwritten dataset for recognizing text. Based on the type of handwriting, text may vary slightly. Using CNN and RNN, we have recognized the text. Based on the provided keywords, marks are allotted for matched keywords. Since the keywords are not constant users can make alterations based on the required question.

VI. FUTURE WORK

Further works include: We can include a web application where students can upload their answer sheets and get evaluated based on the keywords provided by the concern staff member. Graphical model of the student's marks can be displayed, so that each student can get to know about their growth in each subject. Marks obtained by students can be sent to their parent. These are few future works that are being included in this project.

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