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Automatic Answer Evaluation Using Machine Learning

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ABSTRACT
Nowadays, as we are moving towards automation there is a need for an automatic descriptive answer evaluation system. Manual evaluation is a time and energy-consuming task. Presently, we have automated systems for objective type, single sentence answers and descriptive answers with less accuracy level. In this paper, our goal is to develop an automated answer evaluation system using machine learning. The system will evaluate the answer based upon the matched keywords and the minimum length of the answer provided by the moderator. The scanned handwritten answer sheet will be given as input to the proposed system. The system will use an artificial neural network with back-propagation algorithm.
Keywords: - OCR, NLP, ANN, Back-propagation algorithm.

I. INTRODUCTION

Normally educational or non-educational organizations evaluate a student's performance on the basis of examination either in the form of the subjective or objective pattern. Nowadays during this pandemic, everyone is working in a virtual manner. In the present scenario, manual evaluation of subjective answers is a hectic task. Now, we have many systems which can evaluate objective type or MCQ questions. These techniques are evaluated in machines itself after providing a data-set of answers. But it helps only in competitive or objective type exam evaluation. The descriptive examination is the backbone of all the universities. On the basis of the descriptive answer, the moderator will know how much knowledge the student has gained. Manual evaluation of subjective answers is a very tedious, time-consuming task and requires lots of manpower. It also requires a high level of concentration. Answer evaluation varies from person to person according to their way of evaluation and interrelation between student and moderator. This affects the result of the student.

The project aims to automatically evaluate descriptive scanned answer sheet using ML and NLP. The system uses OCR to extract text and cosine similairity to measure the similarity between extracted and provided keywords by the moderator.

After studying research papers[1] we have found that the professors keep some important keywords in mind to evaluate answers. So we have decided to propose a system in which we will evaluate descriptive types of questions. In the proposed system, one has to scan an answer sheet in PDF format. The moderator will provide the scanned answer sheet, keywords for the answer and the minimum length of the answer. Our proposed algorithm will match these provided keywords with keywords extracted from the answer using cosine similarity and it will also consider the length of the answer as a parameter for evaluation of the answer. On the basis of the common keywords, the marks will be calculated. And the results are displayed in the range 1 to 10.

In our proposed system we are going to use ML algorithm with ANN, OCR, back-propagation algorithm and cosine similarity.

The system will convert the handwritten scanned document into machine-readable text using OCR. The handwritten character recognition process has two categories –

A. Online character recognition\newline
B. Offline character recognition

Online character recognition[2][5] uses an optical pen for writing the characters. Then the characters are recognized at that time when we write with the optical pen and displayed on the computer. Offline character recognition[2][5] extracts the text from a scanned handwritten or printed image.

In this system, we will use offline character recognition. We will train the model using the standard MNIST 0-9 dataset by LeCun et al and the Kaggle A-Z dataset by Sachin Patel datasets. The system will convert the handwritten scanned answer sheet into machine-readable text using OCR and then it will extract keywords of answer from the answer sheet. The cosine similarity is used in the system to match these extracted keywords with keywords provided by the moderator. The system will use an artificial neural network and a back-propagation algorithm to calculate the error.

II. LITERATURE REVIEW

Optical Character Recognition Using Artificial Neural Network, Sameeksha Barve[3] says that OCR is a process of converting text obtained in the image which is scanned into the machine- editable format. This paper trains the ANN using a back-propagation algorithm which calculates the error and modifies the weight. It represents each English letter by binary numbers that are used as input to a simple feature extraction system whose output, in addition to the input, is fed to an ANN. Then, the Feed Forward Algorithm gives insight into the inner workings of a neural network.

Evaluation of descriptive answer sheet using artificial intelligence,Sk Asif Akram, Mousumi Saha, Tamasree Biswas[5] proposed a system based on Machine learning and Natural language processing. The proposed system used Stemming algorithm, Stop word removal algorithm, Synonym generator and Gradient descent algorithm.

High accuracy Optical Character Recognition algorithms using learning array of ANN, B.Vani, M. Shyni Beaulah[2] OCR refers to recognition of handwritten text to the machine-readable text which can be used for searching, editing and indexing. This paper is using an artificial neural network with backpropagation algorithm for achieving high accuracy. The proposed system is implemented on a character database consisting of English characters, digits and special characters. The recognition rate is about 99.86.

Evaluating students descriptive answer using natural language processing and artificial neural networks, V. Lakshmi, Dr V. Ramesh[6] proposed a system which can evaluate descriptive answers using ANN and NLP. This system takes the dataset of answer and keywords from the moderators. The answer is first analyzed using NLP and the marks are stored in the database and then the same answer is analyzed using ANN. PoS tagger, WordNet and backpropagation were used. Then they are compared and final marks are provided. The accuracy rate is about 96.75 to 98.7%.

III. METHODOLOGY

The aim of the project is to propose a system which will evaluate student performance on the basis of the descriptive answers. In order to accomplish this, we will take handwritten scanned answer sheet of descriptive answers from students. The scanned answer sheet, keywords, minimum length of the answer will be provided by the moderator as input to the system. Some applications are available for descriptive examination but they are not that accurate and they use different approaches to develop a system.

A. Text Extraction using OCR

OCR, or Optical Character Recognition, is a process of recognizing text inside images and converting it into an electronic form. These images could be of handwritten text, printed text like documents, receipts, name cards, etc., or even a natural scene photograph.

Steps involved for text extraction using OCR:
a. Image Acquisition - In this module, the system will accept the scanned image as an input and image digitization takes place. Initially, some characters are written on a sheet of paper. Now the paper is scanned using a scanner. After the image is scanned, a bitmap image will be obtained. The conversion of the handwritten document into an electronic format is termed Digitization. After digitization, an output image i.e. bitmap image is given to the pre-processing stage as an input.

b. Pre-processing - It is basically the operations that are applied to a digital image. The output of the pre-processing stage will be a normalized bitmap image. Pre-processing involves a number of following steps –
- Binarization - It refers to the conversion of a gray-scale image into a binary image.
- Noise reduction - It improves the quality of the document.
- Skew Correction - These method is used to align the paper document with the coordinate system of the scanner. Main methods for skew detection involve correlation, projection profiles, Hough transform.
- Slant removal - These method is used to normalize all characters to a standard form.

c. Segmentation - The process of dividing pre-processing images into meaningful sub-images, units, such as words, sentences, or topics. The techniques applied for image segmentation is the thresholding method, edge detection-based techniques etc.

d. Feature Extraction - It is the process of extracting the important characteristics of an image. In the feature extraction stage, each character is represented as a feature vector, which becomes its identity.

e. Classification and Recognition Using ANN - A feed-forward back-propagation neural network is used in the process to classify and recognize characters.ANN classification is an example of a supervised learning algorithm.

f. Post-processing - The module will provide the recognized character in a structured text form. It involves data cleaning steps for documents that were digitized. It reduces the number of errors.

B. Back-propagation Algorithm

It is a method of finding the minimum value of the error function using weights. It is called back-propagation because the error at layer n is dependent on the errors at the next n+1 layer from the backward side. Weights of the network are updated with the gradient descent method or partial differentiation of error with respect to weighted input to neurons. The activation function of the algorithm introduces non-linearity into the output of neurons. The activation function used for the model is ReLU.

C. Flowchart of the System

Figure 3.1 shows a flowchart of the Answer Evaluation using Machine learning. The system will accept a Handwritten scanned image of the descriptive answer as an input. OCR will extract text from the scanned answer sheet. The answer sheet goes through image preprocessing, segmentation which will give the bitmap image as output. Then features are extracted from the images and finally ANN classifies and recognizes the characters. We get machine-readable text using OCR. . Then the system will calculate the length of the extracted text from the answer. Using NLP will extract keywords from the answer. After extracting the keywords system will calculate the similarity percentage between provided and extracted keywords. If the length of the answer is greater than or equal to the minimum length provided by the moderator then the system will display marks in the range of 0 to 10. And if the length of

the answer is less than the minimum length provided by the moderator then the system will display marks in the range of 0 to 4.
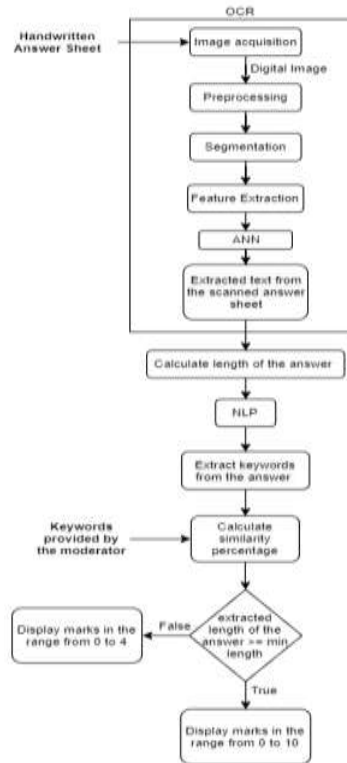

Fig. 3.1 Answer Evaluation System

D. Steps to evaluate the answer

- Provide a handwritten scanned answer sheet as an input to the system.
- Provide keywords and the minimum length of the answer. The system will extract keywords from the given answer. The system will match extracted keywords with the provided keyword data-set.
- The length of the answer will be calculated by counting the words of the answer.
- Display the marks of the answer according to the following criteria.

IV.   RESULTS AND DISCUSSION

Worldwide in any educational system, every student's performance is evaluated by conducting a series of test. After research, we have found that there are many systems available for objective type answer evaluation but only a few are available for descriptive answer evaluation. To evaluate descriptive answer professors keep some important keywords in mind therefore in our system we are providing keywords of the answer to check whether the answer is right. Our system takes an image of the answer sheet and extracts keywords from the answer using OCR and cosine similarity is used to compare extracted and provided keywords from the answer sheet. On the basis of comparison, our system will display the marks of the answer in the range of 1 - 10.

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V.   CONCLUSION

This report gave the detailed information about the project "Answer Evaluation Using Machine Learning". The objective is to propose system which will automatically evaluate the descriptive answer. The proposed system will use OCR having artificial neural network with back-propagation algorithm. The system will evaluate the answer based on the scanned answer sheet, the keywords and length provided by the moderator. The marks are assigned on the basis of:
a. Number of keywords matched
b. The length of the answer.

VI.   FUTURE WORK

In future, this model can be trained for many different languages. We can provide data-sets of different handwritten languages. Therefore, answer can be evaluated for languages other than English. We can also train the system in such a way that it can evaluate mathematical subjects.

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