Handwritten Answer Script Evaluator

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Abstract – **Exams is a universal tool for evaluating student performance in the field of education. The written exam provides a mechanism by which instructors and organizations ensure the consistency of the assessment process. But human effort required for the assessment is very high and it depends on several factors such as knowledge of the evaluator, criteria of the marking and time allotted for evaluation. Furthermore, traditional evaluation processes consume very costly efforts and take huge time for the completion of evaluation. This paper proposes a approach of automating the evaluation of the answer scripts using machine learning. The modules implemented here are image to text conversion using pytesseract OCR ,The second module is the similarity identifying module where the model find the similarity between the written answer from the answer script and the answer key uploaded by the teachers using cosine function similarity. Then produces the similarity percentage. This similarity percentage is fed to the third module where it gets converted to the respective marks and is stored in the excel sheet.**

I. INTRODUCTION

Being in the time where technology is at the peak of advancement writing a exam might seem a bit old tradition but it remains the only way to evaluate a student without being biased. Since the evaluation of students is totally based on the exams, the process of correcting the answer scripts is a tedious and time consuming process. Although a lot new methods have been introduction in the modern world, the traditional way of evaluation of answer scripts remains unchanged for ages. Since the evaluation of answer scripts requires a lot of time and concentration from the teachers side, the automation of evaluation of the answer scripts has a crucial effect of reducing the energy and time of the teachers who evaluate the answer scripts manually. In the times of corona break out, many educational institutions desired the tradition way of examination but due to social distancing and the possibility of answer sheets getting misplaced or damaged during transport stood as a hindrance in conducting the traditional examination. Though educational institutes technically shifted to a new way of examination that is the online mode. The conduction of MCQ's weren't as simplified and fair as the traditional way of handwritten examination. So in order to address the problems faced we have come up with an idea to automate the evaluation of the answer scripts. This automation of answer scripts will prove to be efficient in the near future which reduces the time of teachers evaluating the answers scripts and focusing more on the welfare of the students in academics. Since the answer script evaluation requires scanning of images to extract the text of answers written we use Optical character recognition(OCR) which is imported in python using tesseract .Tesseract is the most open-source software available for OCR. It was initially developed by HP as a tool in C++. Since 2006 it is developed by Google. The original software is available as a command-line tool for windows.

So , our project will evaluate answer scripts based on some keywords and similarity of answer key and the written answer from the answer script using sentence transformer which is also available on python. Sentence transformers supports a variety of pretrained models fine-tuned for different tasks out of the box. The sentence transformer finds similarity on the following bases ,the approach is to use the model to encode the two sentences, and then calculating the cosine similarity of the resulting two embeddings. The final result will be the semantic similarity score

This project has various implementation in the university and schools to make the work of teachers at easier. It also help the students to have a accurate and fair correction result without the interference of human errors while correcting the answer scripts

II. Objective

The objective of this project is to create a answer script evaluating system which lets the teachers to upload the image of the answer script of the students.

1) The uploaded answer script must be fed as a input to the tesseract OCR which produces a result as a text file containing the answer of the student

2) The output of the OCR must be fed as a input to the sentence transformer which produces the similarity using cosine function.
3) The last part where the keyword matching takes place and the output score or mark is generated
4) Record the generated marks

The output of the last phase will give an evaluated mark for the answer written in the answer script compared to the answer key given by the teachers.

III. LITERATURE SURVEY

[1] A Study of Automated Evaluation of Students Examination Paper using Machine Learning Techniques. – [Sanuvala et.al ,2021]
This research introduces the design and implementation of Handwritten Answer Evaluation (HAES) system for student exam papers. In this study, Optical Character Recognition (OCR) tool is used to extract the text from human written scanned answer script and machine learning and natural language processing (NLP) techniques are used for grading the answer sheets. The scores are based on cosine set similarity measures, where each sentence in the evaluated answer paper carries their corresponding mark.

[2] Subjective Answers Evaluation Using Machine Learning and Natural Language Processing – [Bashir et.al, 2021]
This paper proposes a novel approach that utilizes various machine learning, natural language processing techniques, and tools such as Wordnet, Word2vec, word mover's distance (WMD), cosine similarity, multinomial naive bayes (MNB), and term frequency-inverse document frequency (TF-IDF) to evaluate descriptive answers automatically. Solution statements and keywords are used to evaluate answers, and a machine learning model is trained to predict the grades of answers.

[3] Machine Learning Tensor Flow Based Platform for Recognition of Hand Written Text – [Nitin et.al,2021]
The proposed work implemented the handwritten text recognition system which is based on artificial neural networks. Feature of input images are improved by pre-processing method. After that for classifier, problem is simplified. Then Probability distribution of the character on every position of image are contained by matrix of the recurrent neural network outputs. The function of connectionist temporal classification is decoded the matrix into the final text. In the decoded text, post processing is done like correcting spelling errors which increases the accuracy of the system.

[4] Handwritten Documents Text Recognition with Novel Pre-processing and Deep Learning– [Nidhi et.al, 2021]

The proposed work presents an end to end solution wherein a text image is uploaded, and handwritten text from the entire image is extracted as-is. The three main contributions of the thesis are 1. Improved text localizer trained on the various handwritten and printed dataset, 2. Novel classification model to segregate printed and handwritten words, 3. Effective image preprocessing techniques applied to handwritten word crops to make them eligible to be fed to the deep learning model for improved overall accuracy.

[5] Cursive Text Recognition in Natural Scene Images Using Deep Convolutional Recurrent Neural Network – [CHANDIO et.al, 2022]
The proposed model gets a whole word image as an input without pre-segmenting into individual characters, and then transforms into the sequence of the relevant features. The model is based on three components: a deep convolutional neural network (CNN) with shortcut connections to extract and encode the features, a recurrent neural network (RNN) to decode the convolutional features, and a connectionist temporal classification (CTC) to map the predicted sequences into the target labels. To increase the text recognition accuracy further, we explore deeper CNN architectures like VGG-16, VGG19, ResNet-18 and ResNet-34 to extract more text.

[6] Towards Automated Evaluation of Handwritten Assessments - [Rowtula et.al , 2019]
The proposed work describes about various abstractive summarization techniques like EncoderDecoder model, Pointer generator and UniLM using NLP. They calculated ROGUE-1, ROGUE-2 and ROGUE-L scores in different methods and found out UniLM method to be the most effective one as it has higher ROGUE scores.

[7] Handwritten Text Recognition and Conversion Using Convolutional Neural Network (CNN) Based Deep Learning Model. - [Jebbadurai et.al, 2021]
The proposed model takes a picture of a handwritten text as input and converts it into digital text. The Convolutional Neural Network (CNN) is used to study the features of similar objects from multiple image samples and to classify them. Since the text is sequential data, Long Short Term Memory (LSTM), an extension of Recurrent Neural Networks (RNN) with a longer memory is used. To deal with different placements of the text in the image, Connectionist Temporal Classification (CTC) loss is employed. The IAM Handwriting Database containing handwriting samples from over 600 writers and images of over 100,000 words is used for training.

[8] Using Machine Learning and Image Processing to Effectively Analyze Scanned Answer Scripts after an Examination - [Sadana et.al,2019]
The proposed work uses machine learning and image processing for digital transformation of answer scripts after an examination. A program was developed to work on the scanned copies of answer scripts for generating an excel file consisting of the analyzed data.

[9] Two-Step CNN Framework for Text Line Recognition in Camera-Captured Images – [Cheryshova et.al – 2020]
In this paper, "on the device'' text line recognition framework has been introduced which is designed for mobile or embedded systems. The proposed solution is based on two separate artificial neural networks (ANN) and dynamic programming instead of employing image processing methods for the segmentation step or end-to-end ANN.

[10] Deep Sparse Auto-Encoder Features Learning for Arabic Text Recognition – [Rahal et.al,2020]
The authors have proposed a deep learning based system that recognizes Arabic text contained in images. They have also proposed a novel hybrid network, combining a Bag-of-Feature (BoF) framework for feature extraction based on a deep Sparse Auto-Encoder (SAE), and Hidden Markov Models (HMMs), for sequence recognition. The proposed system, termed BoF-deep SAE-HMM, is tested on four datasets, namely the printed Arabic line images Printed KHATT (P-KHATT), the benchmark printed word images Arabic Printed Text Image (APTI), the benchmark hand written Arabic word images IFN/ENIT, and the benchmark handwritten digits images Modified National Institute of Standards and Technology (MNIST).

IV PROPOSED WORK

The proposed work can be basically divided into three modules :
(i) Handwritten Text Recoginition module.
(ii) Answer Evaluation module.
(iii) Score Recorder module.

(I)HANDWRITTEN TEXT RECOGINITION MODULE.

In this module text is recognized and extracted from the answer script image, this is done by first pre processing the image such as removing noise and unwanted details using gaussian filter and then transforming gray scale image to black and white image using binarization technique, after this skew detection is done in our proposed system which aims to align an image before processing because text segmentation and recognition requires properly aligned next lines. After this image preprocessing process it is passed on to segment each line and then identify each character in each word. These characters are recognized using classification algorithms which are then put together to form an entire word.
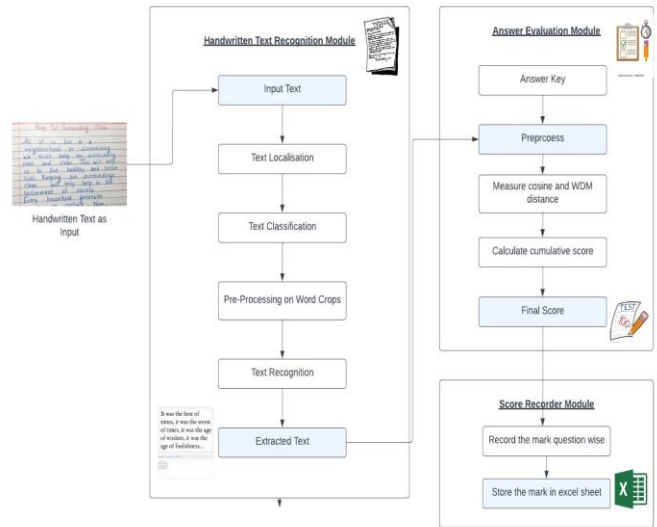

Fig 1 ARCHITECTURE DIAGRAM

(II) ANSWER EVALUATION MODULE.

In this module we evaluate answer scripts based on keywords and similarity of answer key and the written answer from the answer script using sentence transformer. The sentence transformer finds similarity on the following bases ,the approach is to use the model to encode the two sentences, and then calculating the cosine similarity of the resulting two embeddings. The final result will be the semantic similarity score.

(III) SCORE RECORDER MODULE

In this module the output of answer evaluation module is fed as input and the percentage of similarity between the written answer and the answer key is taken and is multiplied with the respective mark of the given question which gives the respective mark of the student for that question. Now the mark is recorded in a separate excel sheet for later use.

V. IMPLEMENTATION

The proposed work has been implemented using python. We have considered three handwritten sample questions and have evaluated the scores and stored it in the excel sheet question wise. The sample hand written texts are the following :

Answer1 : Written by student

Answer 2 : Written by student

Answer 3: Written by student

The handwritten answer script have been successfully converted to text and have been written into a file and is stored. Similarly the answer key has been given as input by the teachers. Now the similarity score is measured using sentence transformers.

Predicted scores for the handwritten answers

Predicted scores written into excel file

VI. CONCLUSION AND RESULTS

In the time driven world, time has the important feature of waiting for none. The energy spent and the time spent cannot be retrieved as it was before so in order not to make the mistake of wasting the precious time of teachers when we can actually make the time spent on evaluating answers automated. We have came up with the project of evaluating the written answers automated using machine learning.

The proposed work successfully predicts score for the handwritten answer and stores it in an excel file. The proposed work can be extended further for multiple languages and developing an interface will make it easier for the teachers to use. Hence the work can be further developed in future for more feasible solution.

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