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Subjective Answer Script Evaluation using Natural Language Processing

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Abstract: The study projects a model developed to evaluate subjective answer scripts using NLP and Machine Learning. The motivation comes from the challenges encountered during the recent COVID-19 pandemic. This work presents the evaluation of subjective answers and automatically awards score based on the similarity feature and the answer keywords from the reference solution. The model is developed using Natural Language Processing model that takes advantage of key attributes from the descriptive answers in namely keywords, QST, and grammar. A Machine learning approach then is used to train this model using Gaussian naive Bayes approach yielding an accuracy of around 80%.

Index Terms **– NLP Natural Language Processing, QST-Quantum Serge Therapy, ML-Machine Learning.**

I. INTRODUCTION

This paper presents research carried out to provide solution for the subjective answer script evaluation encountered mainly during the COVID-19 pandemic and lockdown, A model that aids in automated evaluation, reward of marks for a descriptive answer is developed using natural language processing and machine learning.

Though there have been several research work and models developed to suggest the solution to the subjective answer script evaluation challenge, the highlighting feature of this is automated score allocation based on three different entities namely keywords, quantum serge therapy and grammar being incorporated in a single model.

An automated assessment system developed having verified accuracy and trainability pf the model. With an additional incorporation of artificial intelligence such a system can help in reducing burden on the education system and delays in publication of results. It can facilitate entire teaching community to enhance their productivity, contribute more efficiently towards active teaching-learning. A block schematic shows how the is being processed within the system using NLP (Figure-1)

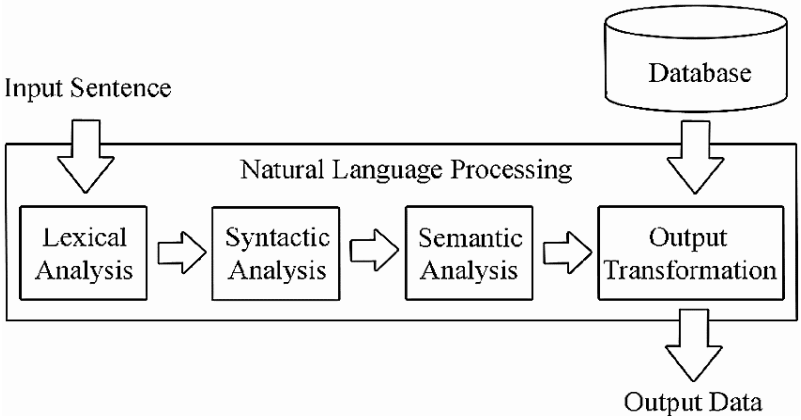

Figure-1 System -Data Flow Diagram

II. EXISTING SYSTEMS: A REVIEW

The research work that addresses uses the method of text extraction from the answer sheet , estimating different similarities between summarized extracted text and stored correct answers, and then assign a weight value to each calculated parameters to score the answer script[1]. An image processing technique is used for text extraction as a preprocessing part. The image processing has been a text extraction in an another research that aims to automate OMR sheet[2]. This projected research utilizes the artificial neural network to attain better accuracy for optically recognize the character. The proposed approach is tested and implemented on character database consisting of English characters, digits and special characters.[3] The paper also discusses other methods used for evaluation of OMR answer sheets quickly and efficiently by other researchers [3]. Focusing on the new branch ,a Computer assisted Assessment (CAA) a method to study how computers can be utilized to evaluate the learning progress of students is projected in a research [4]. There are other research papers presenting machine learning techniques for yielding better results of the implemented model[4]–[8] The techniques to mention include modified BLEU (M-BLEU) algorithm presented to perform an assessment, using established repository of reference answers written by course instructors or related experts, application of the m- BLEU algorithm to find

similarity and producing subsequent outcome based on the comparison.[4].Machine learning using application of probabilistic sematic/ text matching techniques [8],and using ontology [9].

A machine learning approach based on categorization of the question and student answers using Naive Bayes classification is also presented [6] in which the classifier adopts a supervised learning with direct probability to choose the best likelihood of answers. Use of image processing tools for identification of signs and use of natural language processing for handwritten text recognition [10], [11]for subjective answer sheet evaluation is also presented in the existing research papers projected for development of automated systems. [12], [13].

The elaborate study of automated answer sheet evaluation has been projected for embedding it into a learning management system using natural language processing tools such as Wordnet, Word2vec, word mover's distance (WMD), cosine similarity, multinomial naive bayes (MNB), and term frequency-inverse document frequency (TF-IDF) have been used to evaluate descriptive answers automatically[7], [8].

III. Model Design and Implementation

Studying the existing available research works, a solution for evaluating subjective answer script proposed through this paper using natural language processing and machine learning approach. The proposed model is implemented using Python entirely which is open source and very rich in terms of its libraries having precision image processing functions. [14], [15]The model is trained to yield better results using machine learning.[10], [11], [16], [17]

The proposed system consists of data collection and annotation, pre-processing module, similarity measurement module, model training module, results predicting module, machine learning model module, and final result predicting module.

First, the inputs are taken from the user, which consists of keywords, solutions, and answers. Use of cosine similarity is preferred as it captures the orientation (the angle) of the text features in the documents when plotted on a multi-dimensional space, where each dimension corresponds to a word in the document.[12], [13], [15], [18], [19] It also calculates the Euclidean distance instead if you want the magnitude. The metric of cosine similarity is used to determine how similar subjective answer is with the reference or standard expected answer regardless of the size of the text matter.

For training the model a dataset of reference answer or model answer is added in the repository and different answer sheets having multiple answers to the same question have been evaluated. dataset manually with the use of TexteGear API and some online student and model answers. Essentially, looking for the likelihood of event A if event B is true. Evidence is also referred to as Event B, Bayes Theorem is used to calculate the chance of an event occurring given the probability of a previous event having formula as [3], [11], [16], [20], [21]

$$P(A/B) = \frac{P(B|A)P(A)}{P(B)} \quad \text{----------(1)}$$

P(B) = 0, where A and B are events . The priori of A is P(A) (the prior probability, i.e. Probability of event before evidence is seen). The proof is a value assigned to an unknown instance's attribute (here, it is event B). P(A|B) is the a posteriori probability of B, or the probability of an occurrence after seeing evidence. [16], [20]–[22]With this Bayes' theorem can be applied to the dataset under study as:

$$P(y|X) = \frac{P(X|y)P(y)}{P(X)} \quad \text{----------(2)}$$

Using text processing libraries from python such as NumPy, Pandas, Fuzzy Wuzzy, requests, regular expressions the Pre-processing of the text data under study has been accurately done,[23][14], [15]

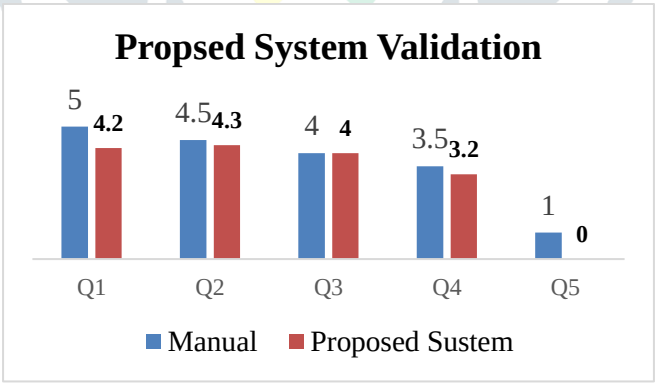

Figure-2 : Comparison of the proposed system manually.

To test the model a local dataset has been used and validation is done for the data. The five questions evaluated manually and using the system when compared the plot obtained is indicated in the figure 2.

IV. Conclusion:

The answer script evaluation system works very significantly comparing the model answers provided. The system is capable of generating a text file that specify the awarded score for the answers. The similarity cosine values are the key features explored for the successful implementation of the system.

The model has been implemented and tested successfully re-arranging the dataset through multiple iterations .Though initially ,the accuracy rate was (60-65) %, upon enhancing the dataset and with some minor fine tuning to the model the model yielded accuracy of almost 80%. The tool will give an added advantage to the educators that can aid in answer script evaluation flowless , economic and time saving.

The model may be embedded into any Learning Management Systems, Document verification/Authentication systems, and further can be enhanced through incorporating mathematical tools for evaluating specific mathematical, chemical equations with precision.

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