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Subjective Answer Marking Using Keyword Extraction

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Abstract

The Covid-19 pandemic gave a significant impact on educational institutions throughout Malaysia and had caused these institutions to diverse their teaching and learning method from face to face to online learning to ensure continuous learning can be implemented optimally. This situation also forced all assessments (final exams, quizzes, tests, etc.) to be done online. These assessments are marked manually either the lecturer or teacher downloads the students' answers and prints them or marks the answers digitally using any available apps. This affects the lecturers or teachers in many aspects, especially computer related health problems due to long use of digital devices and looking at the monitor screen. Therefore, this study aims to develop a web-based system that can assists marking process especially for subjective answers using keyword extraction approach. The system is developed and utilized python and flask micro web framework.The keywords similarity being tested to compare the student's answer to an answer scheme. The marks from the automated evaluation and manual evaluation by the lecturer were compared and the differences were calculated. The results of the automated marks are approximately as the same as manual marking with a little difference value.

Keywords: Subjective Answer, Word Similarity, Keyword Extraction, Assessments, Web-Based System.

Introduction

In 2019, the world was shocked by the arrival of Corona Virus or better known as Covid-19. The virus has become more serious when it was declared as a global pandemic on 11 March 2020. Malaysia also has been impacted with the pandemic and because of that, the government has implemented a Movement Control Order (MCO) throughout the country to curb the spread of the virus. The MCO was not only impacted the industry but also the education sector. Face to face meetings between lecturers and students were forced to be implemented online through video conferencing applications such as Google Meet, MS Team, WhatsApp, Telegram, Webex, and other apps that can fit the teaching and learning process. Schools and higher institutions have made a full use of the technology to not only in

conducting learning activities but also in conducting student assessments. Assessing students is a very important process to ensure that they can be evaluated fairly and effectively based on their performance throughout the learning process, and as a requirement to produce grades. Assessment is a medium to measure the effectiveness of educators teaching and students mastering the subject learned (Veloo, 2011).

In teaching and learning process in higher institutions, the evaluation of students is done based on formative and summative assessment. In formative assessment, lecturers often use some methods or tests to measure students' ability in mastering the course (Thorndike, 2001). Formative assessment is an informal assessment done continuously or periodically by the instructors to monitor students' progress on the subject taught such as quizzes, tests, presentations, and others. While the summative assessment only involves the final examination of the course (Veloo, 2011). Online assessments such as tests or final assessments, mostly consist of objective (multiple choice question) and subjective answers, usually prepared by the course's lecturers. According to Dhokrat et al (2012), subjective assessments mean assessing answers which have descriptive, define, or explain types of question. The subjective answer usually requires the students to explain clearly and briefly based on the requirements of the question. There are several benefits of online assessments such as it is quicker to mark and produce the results, paperless, flexibility to take assessments anywhere, security control over the question paper and many more. Even though online assessments have eased the lecturer's task, the problem arises mostly from the long-answer type question. Manually marking this type of questions is quite challenging to the lecturers because it is time-consuming where the answer is somewhat longer than objective answers. It might also contribute to the health issues such as fatigue, hand numbness, inconsistent marking style because different students had different answers, sore eyes and many more.

Based on these issues, this study aims to develop a web-based marking system for subjective questions to assists lecturers or teachers in marking long answer questions and to reduce the number of papers need to be printed (Barker et al., 2008). The system able to compare student's answer with the answer scheme provided using keyword extraction approach. Keyword extraction is a form of text analysis that automatically extracts from a text the most relevant terms and expressions used. It helps on text summarization and identify the key topics discussed which can lead to evaluate the result (Siddiqi & Sharan, 2015). This automated marking system can give the shortest completion time in the marking process, which then will provide the result. Natural Language Processing (NLP) algorithm and Artificial Neural Networksare used to evaluate the student's answers. The system can provide the identification of some keyword in the answer script to improve the best solution of marking style with the answer scheme provided. It will not be influenced by the emotion or judgement when it will be done by the system. Thus, it will reduce errors in marking and increase consistency.

System Development

The web-based subjective answer marking system follows the Web Development Life Cycle (WDLC) and the development's steps shows in Figure 1.

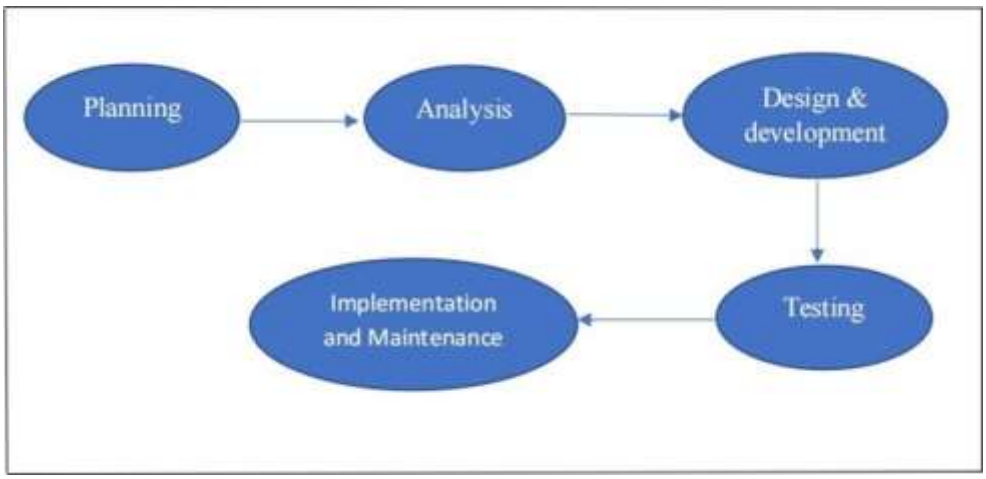

Figure 1. Web Development Life Cycle

Making good decisions about the functionality of website and the page design begins with creating a plan. Thus, planning is the first phase of WDLC that is important for building block of entire web site. It is significant to identify the web site's goals or objectives to fulfill the user request and understand who will use the web site for them to identify any technological constraints they might experience when viewing the site.

Analysis phase is where it is a set of activity in which all the information requirements of the system are gather by reviewing related research paper and observing the frequently keyword phrase that will be used for marking answers from answer scheme. This phase also used to identify the tasks users need to complete and present in consideration of all the processes required to support web site features.

The design and development phase is a process of designing user interface and develop the whole program to the user. The design is implemented using java environment. Meanwhile, the development of the algorithm that is used to find the keyword suitable the answer implies Rapid Automatic Keyword Extraction (RAKE) and TF- IDF technique. These two techniques will help to trace the keyword phrase so that it will evaluate the student result.

Testing phase is where the whole system will be tested to make sure that this system will run smoothly without any error and achieve the project's objectives. During this phase, several answers containing keyword phrase were being tested into the application and the result of the system were recorded. This part would do the implementation and the maintenance part when there is need improvement to the system and the user. This is the stage where the web site, and the users get a chance to work on it for the first time (Kamatchi et al., 2013). Moreover, it involves the most important step of user acceptance testing, which marks the technical and commercial milestone of the WDLC.

System Architecture

System architecture is a diagram that shows an overview of the components that are involved in the project development. These components have their own purpose. Figure 2 portrays the architecture of the proposal system, which is a system for subjective answer marking. First, the candidates' answer would be submitted and being process to the data post processing.

Then, in the segmentation process it will find the stop word and trace all the important data to be transfer to post processing such as function word removal then the document is tokenized (Kian & Zahedi, 2011).

Second, the word extraction process is where the keyword extraction finds the suitable method to use in finding the keyword point and store it in the keyword domain database. The third process is scoring. This process will identify which keyword from the candidates' answer that can be evaluated for their score based on the keyword weight adjustment that is significant with the answer scheme. The noun phrases are scored and clustered and afterwards the clusters are scored. The shortest noun phrase from the highest scoring clusters is then used as the keywords (Kaur & Gupta, 2010). From the scoring process, the final candidate outcome will be shown in the result phase which the end output to the system.

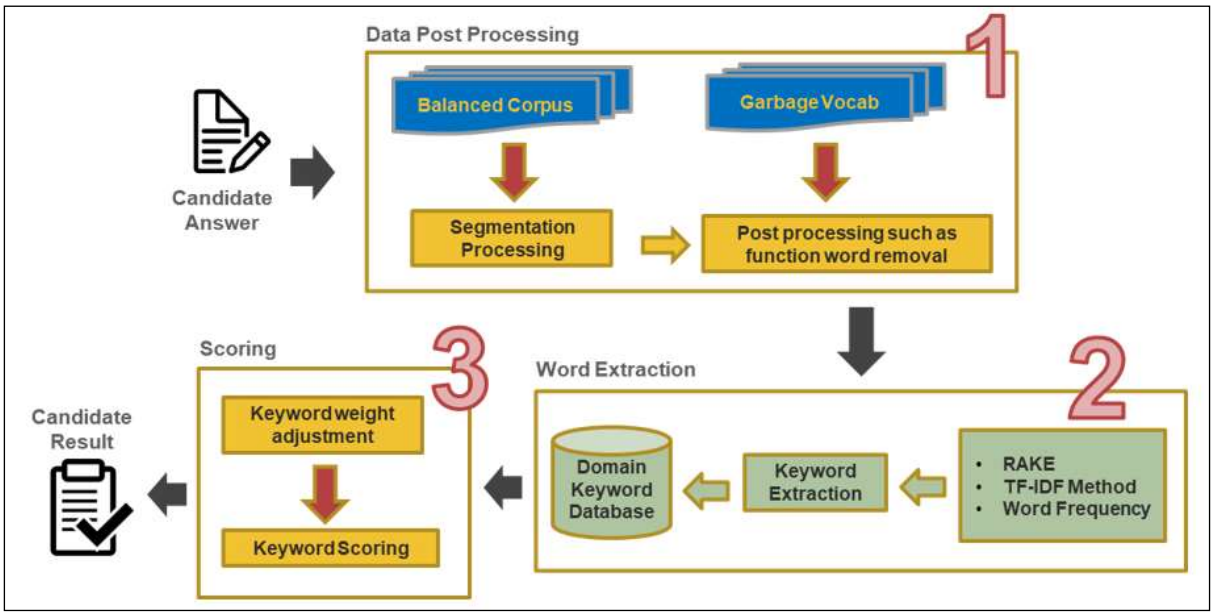

Figure 2. System Architecture

Design and Implementation

The main feature of the system is to evaluate the student's answer by marking based on the answer scheme provided. The user will enter the student answers, the system will evaluate the answer and show the suggested evaluated mark. Figure 3 shows the flow of the web-based system.

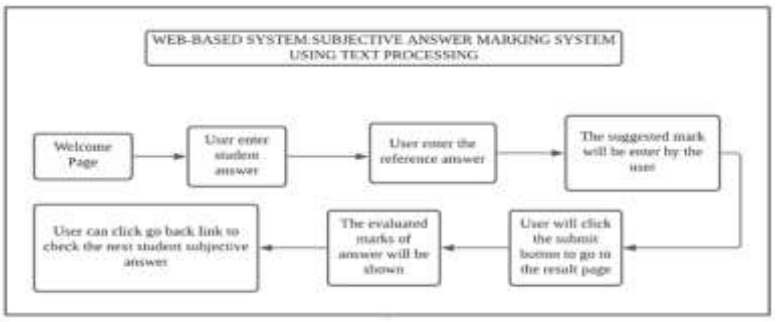

Figure 3. Web-based system flowchart

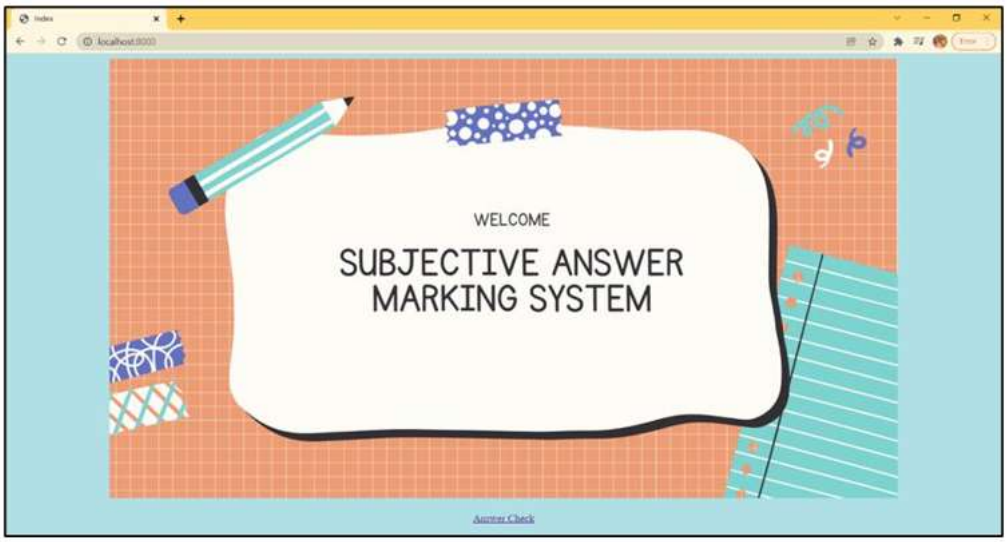

Figure 4. Welcome page

The design of this website was constructed in HTML through Visual Studio Code. It contains pages such as the Welcome Page, Main Page and Result Page. Figure 4 shows the welcome page of the subjective marking system. Figure 5 shows the page where the student's answer is entered. It consists of two forms, student's answer form and reference or answer scheme form. Here, the user needs to enter the suggested marks and submit for evaluation.

Figure 5. Main page

Result page of the system shows in the Figure 6 which includes the evaluated and actual marks of the questions. The results produced by comparing the word similarity with word tokenization.

Figure 6. Result page

Results and Discussion

This project was tested using the students answer and answer scheme from previous exam to observe on how the system works. The testing result shows that the marks given from the system are closed to the marks given manually. Table 1 shows the results between the system and manually marking including their difference values. The highest difference is 0.5 and lowest difference is 0.04. From 15 sample of students' answers, 26% were given marks below than manual marking with difference less than 0.5. Based on the results, it can be concluded that this system can improve marking process by taking into account some improvements.

Table 1
Difference between manual and automated marks

Student	Evaluated marks	Marking system marks 100/100 = 6m (Evaluated marks * 6)	Manual marks = 6m	Difference between manual & automated marks
Student 1	65/100	3.9	4	0.1
Student 2	70/100	4.2	4	-0.2
Student 3	57/100	3.42	3.5	0.08
Student 4	41/100	2.46	2.5	0.04
Student 5	64/100	3.82	4	0.18
Student 6	49/100	2.94	3	0.06
Student 7	60/100	3.6	3.5	-0.1
Student 8	75/100	4.5	5	0.5
Student 9	80/100	4.8	5	0.2
Student 10	94/100	5.64	5.5	-0.14
Student 11	56/100	3.36	3.5	0.14

Student 12	55/100	3.3	3.5	0.2
Student 13	73/100	4.38	4.5	0.12
Student 14	65/100	3.9	4	0.1
Student 15	44/100	2.64	2.5	-0.14

Conclusion

The marking system is a machine learning project that apply the Natural language processing using cosine similarity technique. The specific methodology for this project is Web Development Life Cycle (WDLC) since this project is a web-based system. In the testing phase, this system has achieved a great level of exactness showing that this system is exceedingly accurate and ready to be used by the end user. This system is believed to help in reducing lecturer's time to complete their marking tasks. It also can reduce errors or mistakes and reduce inconsistency marking and emotionally judgments. There are some limitations that can be improved such as the user needs to manually enter the students' answer to the text form (if the answer in the form of handwriting). There is a need to expand the answering type form and improve the adaptive processing technique for each type of answer. There are a few suggestions for improvement such as to extract words from the student's handwriting so that it can be copied easily, compiled all the subjective answers so that it can be marked in one time to reduce marking time, categorized the answer: short or descriptive answer and implement the program into existing web quiz/test platforms to produce automated marks on students' subjective answers.

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