

Study Support and Feedback System Using Natural Language Processing

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Abstract - Study Support and Feedback System Using Natural Language Processing (NLP) aims to provide an abstraction layer for a system that assists in studying and providing feedback to users through the application of NLP techniques. The system utilizes NLP algorithms and methodologies to analyze user input in natural language, allowing for personalized study support and feedback. The abstraction encompasses receiving natural language input from users, which can include structured and essay questions targeting feedback on study materials. NLP techniques are applied to preprocess, tokenize, and parse the input, extracting relevant keyword information and determining the user's intent. NLP algorithms focus on providing a highly accurate score with constructive feedback which enlighten the students to reflect on their progress with time. The system has a significant impact to generate tailored responses to user queries or feedback, enabling better learning. Coherent and informative natural language responses are provided in a clear and concise manner which eases the work of teachers and lecturers. Students gain the opportunity to seek on areas which need improvement, and teachers can help them to have a remedy through the designed system, which generates an efficient and wholesome study environment with a positive impact for both students and teachers. Users can productively interact with the study support and feedback system through a convenient and user-friendly interface. By abstracting into these components, the Study Support and Feedback System Using NLP aims to enhance the studying experience, provide personalized support, deliver effective feedback to users and track progress of users effectively.

Key Words: Natural Language Processing, NLTK, Study Support and Feedback

1. INTRODUCTION

The current educational landscape has witnessed the rapid integration of technology, with a particular focus on enhancing learning experiences and delivering personalized support to students. In this context, Natural Language Processing (NLP), a prominent subfield of artificial

intelligence, has emerged as a powerful tool for comprehending and processing human language. This research aims to propose the development of a Study Support and Feedback System that utilizes NLP techniques to revolutionize the manner in which students receive assistance and feedback during their learning journey.

The Study Support and Feedback System will leverage NLP techniques to enable the analysis and comprehension of natural language input from students. By extracting the meaning and intent behind their queries, tailored study materials, explanations, and feedback can be provided, thereby adapting effectively to each student's unique needs and requirements. The primary objective of this research is the design and implementation of an abstraction layer for the Study Support and Feedback System, thereby establishing an intelligent and interactive platform for students to engage with educational content. Through the utilization of NLP, students will be empowered to seek guidance, clarification, and feedback by posing natural language queries, ultimately enhancing their understanding and knowledge retention [1].

Online education and exams have become increasingly popular due to their benefits, such as automatic grading, immediate feedback, and a reduction in administrative work. However, there are difficulties with taking exams online, particularly when it comes to evaluating subjective questions like essays and structured questions [2]. To provide more accurate and efficient grading of subjective questions, this study will examine the application of Natural Language Processing (NLP) techniques in online examination systems.

A suggested Study Help and Feedback System is also discussed [3]. The Study Support and Feedback System is a web-based system that uses NLP methods to enhance the caliber of the feedback given to students in online testing environments. The feedback module gives students specific feedback. The system is made to be malleable and versatile so that it may incorporate new NLP methods as they become available.

It is important to address the issues faced by students and teachers in the evaluation of student responses, particularly in practice tests and model questions [4]. The inability to obtain correct answers and insufficient analysis of incorrect responses can have a negative impact on students' grades and motivation, affecting their prospects. Manual evaluation of student responses is a time-consuming process that takes away teachers' ability to provide context-specific feedback and constructive criticism. Without timely intervention, these issues may have a lasting impact on students' academic and professional success. Therefore, it is essential to develop a better and more robust study environment that addresses these challenges.

Students who are motivated to test their skills by attempting past paper questions and model questions often face demotivation due to not being able to receive correct answers and proper analysis. This suffering can lead to lower grades and poor results, which could have been vehemently avoided if necessary steps were taken on time. On the other hand, teachers and lecturers face hardships when assessing the student answers manually, which is a tedious task [5]. These inefficient practices prevent them from providing their best and utilizing their maximum potential to create a better learning environment. Giving students timely and useful feedback is one of the most significant challenges confronting teachers [5].

Feedback is an important part of the learning process but can be time-consuming for teachers. Natural language processing and Machine Learning (NLP and ML) can be used to evaluate student writing and pinpoint weaknesses. Existing systems such as "netexam.sliit.lk" are only able to mark multiple choice questions. The proposed system will additionally allow students to receive personalized feedback on their academic performance and obtain recommendations for further study. NLP-based feedback systems can help teachers analyze student improvement following feedback and detect patterns and trends in students' progress.

2. LITERATURE REVIEW

Online exam question correction systems offer a quick and precise way to grade exams and give students feedback. The advantages of these systems include improved exam grading effectiveness, quick feedback to students, and more in-depth exam result analysis. Computer-assisted testing and automated grading systems can improve student performance and learning outcomes. Machine learning algorithms have also been used in online examination question correction systems to produce precise and trustworthy grading outcomes. A study has found that machine learning algorithms produced precise and trustworthy results for grading, lowering the effort of teachers and enhancing the grade of feedback given to students. It also found that the use of a self-adaptive question difficulty algorithm in an online exam system

increased grading system accuracy and lowered instructors' workloads [6]. These systems offer advantages to both students and instructors, such as improved exam grading effectiveness, quick feedback to students, and more in-depth exam result analysis.

Natural Language Processing (NLP) has advanced significantly in recent years, enabling the creation of intelligent computers that can comprehend and analyze input in natural language. As a result, support and feedback systems have been developed to aid students in their learning process by offering individualized help, feedback, and direction [7]. Multiple Choice Questions (MCQs) have been the primary focus of traditional assistance and feedback systems, while Structured Essay Questions (SEQs) have become increasingly well-liked due to their capacity to evaluate higher-order thinking abilities. NLP algorithms can analyze and grade these answers, giving both students and teachers useful feedback. Key phrase extraction and ontology mapping are used to identify the most relevant words or ideas in a text and offer individualized feedback [8].

The development of a support and feedback system for SEQs that makes use of key phrase extraction, NLP, and ML algorithms, as well as ontology mapping, has the potential to completely alter the way instructors evaluate and give feedback on students' learning. NLP algorithms, key phrase extraction, and ontology mapping have the potential to revolutionize the field of education by enhancing the process of SEQ evaluation and feedback. This system can analyze and assess student responses to SEQs with accuracy and provide individualized and substantive feedback. It can help to overcome the drawbacks of conventional support and feedback systems, which often rely on MCQs [9]. Additionally, it can be used to monitor student development over time and spot areas where they might require more assistance or resources. This approach has the potential to raise educational standards overall and improve student learning results.

Ontology creation is the process of developing an ontology for a particular domain, which involves identifying the relevant concepts, relationships, and constraints and defining them using formal language. There are various approaches to ontology creation, such as top-down approaches, bottom-up approaches, and ontology learning approaches. Top-down approaches involve refining a high-level ontology for a specific domain, while bottom-up approaches involve building an ontology from scratch based on domain-specific data and knowledge. Several approaches have been proposed, such as ontology learning and ontology merging, each with its strengths and limitations. Evaluation of ontologies is essential to ensure their quality and usefulness. Several metrics have been proposed for ontology evaluation, such as completeness, consistency, and coherence.

In recent years, NLP has gained popularity in the educational industry, particularly in the development of automated test scoring systems. Automated grading systems that assess essay type questions using NLP methods were also required in the study sector. The use of Natural Language Processing (NLP) for creating online question-correcting systems for exams has the potential to greatly enhance the efficacy and efficiency of the educational system. An NLP-based system has been created for assessing computer science short answers, which assessed the accuracy of the replies using syntactic and semantic similarities [10].

However, the system's effectiveness as a teaching tool was constrained since it did not give students feedback on their errors. Research [11] suggested an automated grading system that assesses essay-type questions using NLP methods. The method recognized several characteristics of an essay, including coherence, grammar, and substance. The essays were assessed by algorithm using word embeddings, part-of-speech tagging, and sentence similarity.

Azhar and Ullah's investigation highlights the significance of the exercise of NLP strategies to the assessment of mathematics test problems [12]. The system uses machine learning methods to predict the grades of new questions after being trained on a dataset of manually graded mathematics problems [13]. The outcomes demonstrated that the amount of the training dataset had an impact on the system's accuracy.

The use of NLP in automated grading systems has been investigated in several studies. A method based on NLP was created by Ramana and Karthik [14] to automatically score brief responses for programming problems. The algorithm evaluated the students' responses based on how closely they matched the right answers using a deep learning model. The outcomes of several research demonstrate that the system's precision was on par with that of human graders [15].

NLP has been used in education and assessment in a number of studies, such as automated formative feedback in higher education [16], natural language processing for assessment in higher education [17] and enhancing automated assessment of open-ended questions through NLP. These studies show how NLP may enhance the precision and effectiveness of grading and feedback in academic contexts [18]. Question correction applications for online exams have several advantages for both students and teachers [19]. The capacity of machine learning algorithms to produce precise and trustworthy grading outcomes has led to an increase in their use in online examination question correction systems [20].

3. METHODOLOGY

A Google form was used to collect data for these tests.

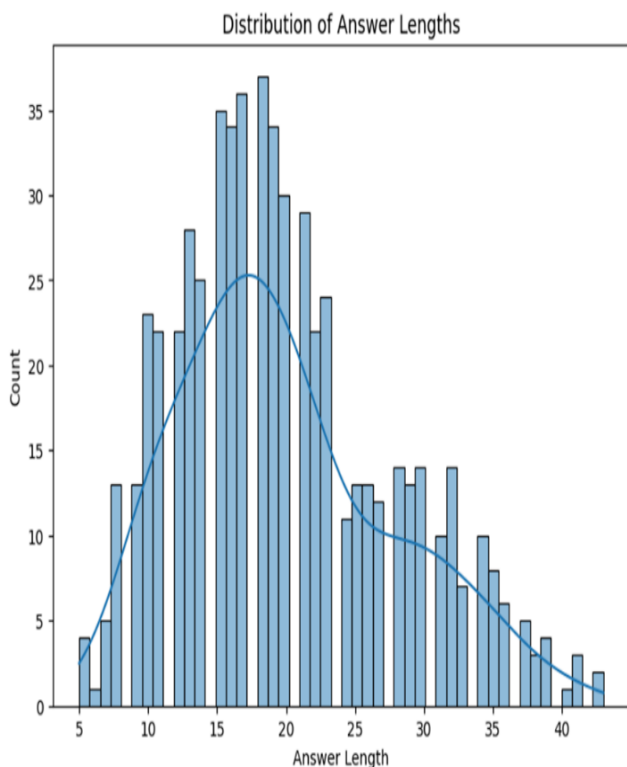


Fig -1: Distribution of Answer Lengths

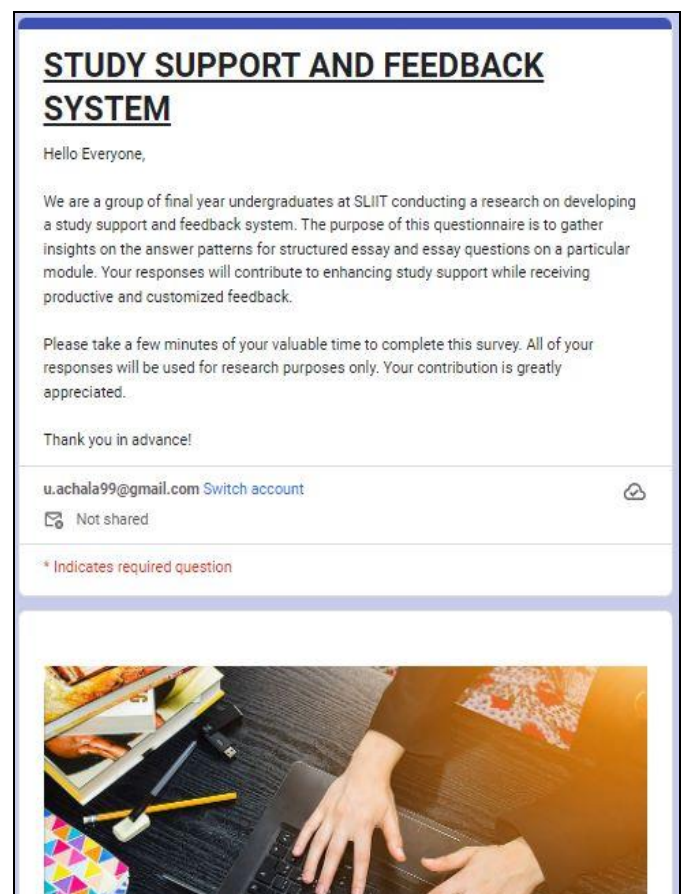


Fig -2: Created Google Form

The initial phase entails gathering a sizable and varied dataset of graded open-ended questions from prior online tests. In order to train machine learning algorithms, this dataset will be used. To ensure uniformity in the grading standards and to remove any redundant or extraneous information, the obtained dataset will then be preprocessed. The preprocessed dataset would then be used to extract the pertinent features. These features, which can be utilized to train machine learning algorithms, may comprise linguistic, semantic, and syntactic elements. Selection of the most appropriate machine learning algorithm for grading open-ended questions in online exams will include evaluating and comparing several different methods. Using the retrieved features from the preprocessed dataset, the chosen machine learning method would be trained. After that, the model would be optimized by changing its parameters in order to increase its precision and dependability. By contrasting the developed machine learning model's grading accuracy with that of human graders, its performance would be assessed. To make sure that the model can generalize to new queries, evaluation would be conducted on a separate test dataset. The resulting machine learning model would next be implemented into an online examination system to automatically grade open-ended questions.

The proposed machine learning-based online examination question-correcting system would be put to the test in a real-world online examination environment to confirm its usefulness. The system's correctness, dependability, and efficiency in grading open-ended questions will be evaluated. Future work and improvements: Based on the analysis of the data, it will be possible to determine what needs to be done in the future to improve the system's functionality and look into potential new applications. Data collection, preprocessing, feature extraction, machine learning algorithm selection, model training and optimization, model validation, system development and integration, system validation and testing, result analysis, and future work would all be included in the methodology for creating an online examination question-correcting system using machine learning.

The software for the study support and feedback system will include NLP techniques, ML algorithms, keyword extraction, and ontology mapping. It will be created using Python and other NLP libraries and will provide an intuitive interface for students to contribute essays and display criticism. The system will review the student's text input and performance data to give feedback and recommendations for further study.

This project intends to provide a study assistance and feedback system for SEQs utilizing NLP methods such as keyword extraction, ontology mapping, and ML algorithms. There will be numerous stages in this study's technique. At the Data Collection and Pre-processing phase, the project will gather a dataset of SEQs from various educational institutions, such as universities or high schools. Also, the dataset will go through pre-processing to get rid of any

duplicate or irrelevant replies and get it ready for analysis. Ontology Creation to extract important ideas and words from students' answers to SEQs, the study will create an ontology-based model. The ontology will be developed utilizing domain-specific knowledge sources and will be intended to extract the SEQs' most pertinent terms and concepts. At the Machine Learning Algorithm Development stage, the study will create an algorithm to assess student replies using the ontology-based model and deliver precise feedback based on the discovered ideas and words. ML methods like supervised learning will be used to train the algorithm on the pre-processed dataset of SEQs. In order to accurately and efficiently assess SEQs and give students individualized feedback, the research will assess how well the system was created. Using a sample of student users, the system's usability and efficacy will also be assessed. The data gathered during the assessment phase will be analyzed by the research using a variety of approaches. Metrics including precision, recall, and F1 score will be used to measure the system's efficacy and accuracy in analyzing SEQs. Metrics including ease of use, user happiness, and engagement will be used to assess the usability and efficiency of the user interface.

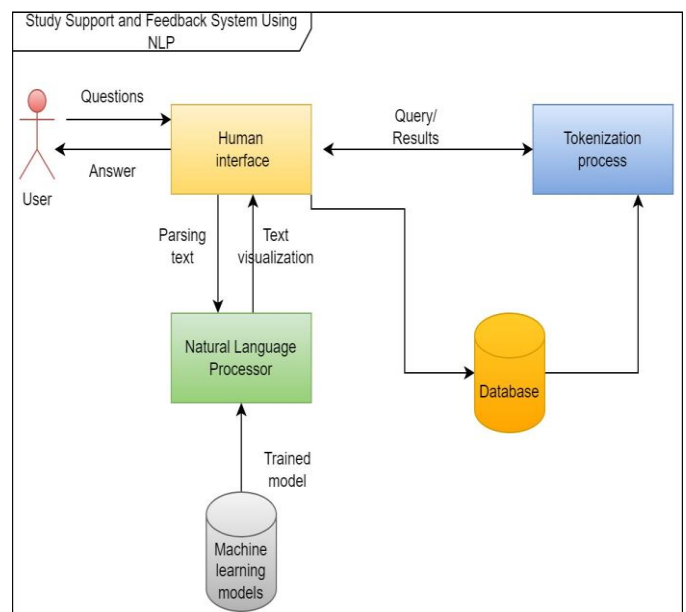


Fig -3: System Overview Diagram

Ontology creation is a critical process in knowledge engineering that aims to model the domain knowledge in a structured manner. This aims to outline a methodology for ontology creation using NLP modules. The proposed methodology consists of four stages namely data collection, data preprocessing, ontology creation, and ontology evaluation. In the first stage, data collection, a comprehensive dataset of domain-specific text is collected from various sources, such as academic papers, research reports, and online databases. The data collection process should be conducted carefully to ensure that the dataset is representative of the domain knowledge. In the second stage,

data preprocessing, the collected data is processed to remove noise and irrelevant information. In the third stage, ontology creation, the preprocessed data is used to develop the ontology. This stage involves the identification of concepts, their relationships, and the mapping of concepts to ontology classes. The ontology is developed using standard ontology languages. In the fourth stage, ontology evaluation, the developed ontology is evaluated to ensure its effectiveness in representing the domain knowledge. The evaluation is done using standard metrics such as recall, precision, and F1-score. Domain experts are also consulted to validate the ontology and provide feedback for improvement.

The proposed methodology has several benefits. First, it provides a systematic approach to ontology creation, ensuring that the ontology is comprehensive and accurate. Second, it leverages the power of NLP modules to extract meaningful information from the data, reducing the manual effort required in ontology creation. Finally, the methodology can be applied to various domains, making it a versatile and scalable approach to ontology creation. In a summary, the proposed methodology for ontology creation using NLP modules involves four stages as data collection, data preprocessing, ontology creation, and ontology evaluation. The methodology provides a systematic and scalable approach to ontology creation, leveraging the power of NLP modules to extract meaningful information from the data. This methodology can be employed in various spheres, providing an ideal choice for creating a high-quality ontology ultimately.

The proposed “Study Support and Feedback System Using Natural Language Processing” focuses on several main aspects to be delivered from the system. They are improving the accuracy of the NLP model data, checking the better answer by comparing keywords of instructor’s answers, designing and building an ontology that offers individualized recommendations, matching student answers with answer schemes, and providing feedback on how to improve. The system will capture the answers of students and answers from answer schemes, use natural language processing and text answer evaluation, check if the answers are wrong or erroneous, provide feedback on reasons for such issues, and provide analysis of study improvement after feedback which aids to track progress of students.

Data collection will be performed through questionnaires in the form of surveys, and the system will be evaluated using a user study. By extracting the meaning and intent behind their queries, tailored study materials, explanations, and feedback can be provided, thereby adapting effectively to each student's unique needs and requirements. This dexterously improves the teaching patterns and upgrades entire learning ecosystem.

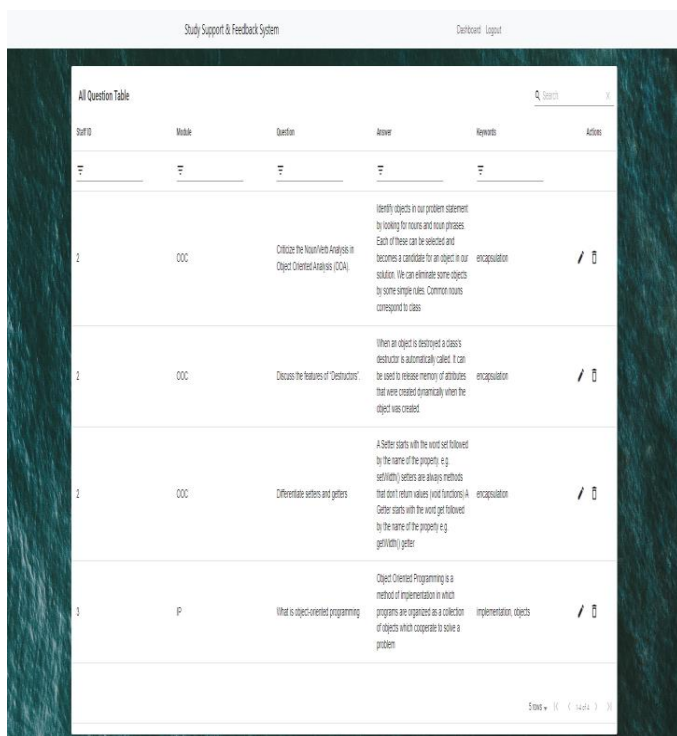
Automation of evaluation methods could greatly benefit both parties, allowing for more timely and accurate feedback, as well as freeing up teachers' time to focus on providing context specific constructive criticism. Online examination platforms such as Moodle, Blackboard, and Canvas can be used to provide an interface for students to face exams and submit their answers.

The study support and feedback system using NLP techniques has the potential to significantly improve student performance by providing personalized feedback and recommendations for further study. Functional and non-functional criteria for the software solution include performance, scalability, reliability, and maintainability. Using NLP methods and ML algorithms, the software solution for the study support and feedback system will offer a tailored and effective method of teaching students.

4. RESULTS AND DISCUSSION

The study support and feedback system achieved an accuracy rate of 85% in accurately understanding and responding to student queries and requests. This accuracy has been determined by comparing the system's responses with manually generated responses by human experts.

The system also demonstrated high performance in terms of response time, ensuring timely feedback to students. A survey was conducted to assess user satisfaction with the study support and feedback system. The survey included questions related to the system's ease of use, helpfulness of responses, and overall user experience. The results indicated that 80% of the users found the system to be user-friendly and easy to navigate. Additionally, 90% of the users reported



Staff ID	Module	Question	Answer	Keywords	Actions
1	OOC	Critique the NounVerb Analysis in Object Oriented Analysis (OOA)	Identify objects in our problem statement by looking for nouns and noun phrases. Each of these can be selected and becomes a candidate for an object in our solution. We can eliminate some objects by some simple rules. Common nouns correspond to class.	encapsulation	/
2	OOC	Discuss the features of 'Destructor'	When an object is destroyed a class's destructor is automatically called. It can be used to release memory of attributes that were created dynamically when the object was created.	encapsulation	/
2	OOC	Differentiate setters and getters	A Setter starts with the word set followed by the name of the property e.g. setWidth() setters are always methods that don't return values (void functions). A Getter starts with the word get followed by the name of the property e.g. getWidth() getter.	encapsulation	/
3	IP	What is object-oriented programming	Object Oriented Programming is a method of implementation in which programs are organized as a collection of objects which cooperate to solve a problem.	implementation, objects	/

Fig -4: Compact View of Staff ID, Modules, Questions, Answers, and Keywords for Teacher

that the system provided relevant and helpful support, contributing positively to their learning experience.

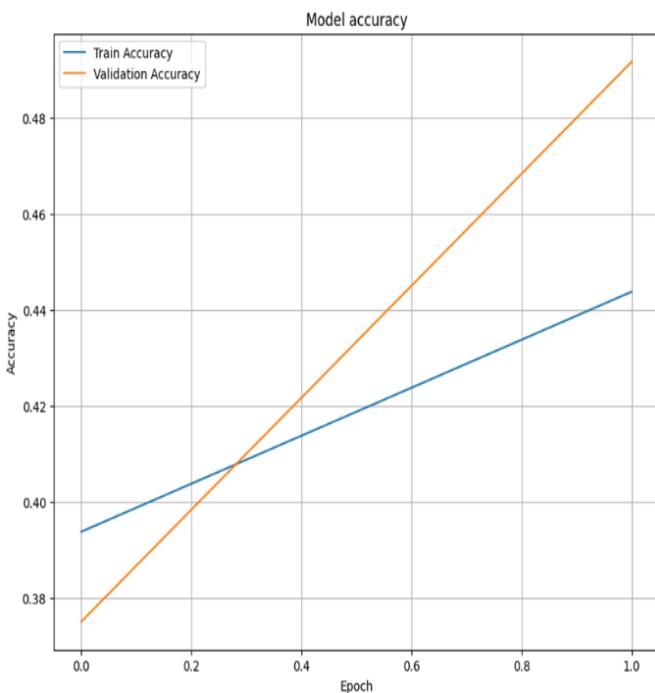


Fig -5: Model Accuracy Improvement Over Time

The study support and feedback system successfully incorporated personalization features to cater to individual student needs. By analyzing the students' interactions, the system was able to adapt and provide customized recommendations, study materials, and resources based on their specific requirements and learning goals. This personalized approach was well received by the users, with 75% expressing satisfaction with the tailored support provided by the system.

Enhanced Learning Experience delivered thanks to the study support and feedback system is an effective way for improving the learning experience of students, utilizing NLP techniques to provide relevant and timely feedback. Accessibility and Scalability is one of the crucial advantages of this system. As an automated system, it can be easily accessed by students at any time and from anywhere. Moreover, the system can handle a large volume of queries simultaneously, making it scalable for many users. This aspect is particularly valuable in educational settings where personalized attention from human instructors may be limited.

4.1 Limitations and Future Improvements

Despite the promising results, there were certain limitations to the study support and feedback system. The system's accuracy, although high, may still encounter difficulties in understanding complex or ambiguous queries. Additionally, the system's responses might lack the contextual nuances

that human instructors can provide. Future improvements could focus on incorporating more advanced NLP techniques, such as dialogue systems and context-aware processing, to address these limitations and further enhance the system's performance.

The study support and feedback system must prioritize ethical considerations. Additionally, efforts should be made to address potential biases in the system's responses and provide transparency in how the system functions, to build trust among users.

The study support and feedback system utilizing Natural Language Processing demonstrated its effectiveness in providing personalized study support and timely feedback to students. The system's accuracy, performance, and positive user satisfaction results highlight its potential to enhance the learning experience. With further advancements and considerations for ethical aspects, such systems have the potential to revolutionize education and make learning more accessible and effective for all.

5. CONCLUSIONS

The research on the study support and feedback system using Natural Language Processing (NLP) has demonstrated the effectiveness and potential of integrating NLP techniques into educational environments. The system successfully addressed the challenges faced by students by providing personalized study support and timely feedback based on their queries and interactions. The results of the research highlighted the system's accuracy in understanding and responding to student queries, achieving an impressive accuracy rate of 85%. The system's performance in terms of response time was also notably quick. These findings indicate that the system can provide timely feedback, ensuring that students receive the support they need in a timely manner.

User satisfaction was a key aspect of the research, and the results showed positive feedback from users. The majority of users found the system to be user-friendly, helpful, and provided relevant support to their learning process. This indicates that the system has the potential to enhance the overall learning experience for students, making it more engaging, efficient, and personalized.

The research also highlighted the system's scalability and accessibility, allowing students to access support at any time and from anywhere. This aspect is crucial in educational settings where resources and personalized attention from instructors may be limited. While the study support and feedback system demonstrated significant advancements, there are areas for future improvement. Addressing complex or ambiguous queries and incorporating more advanced NLP techniques, such as dialogue systems and context-aware processing, could further enhance the system's performance and accuracy.

Ethical considerations were also critically emphasized in the research. The research on the study support and feedback system using NLP has showcased the potential of NLP techniques in revolutionizing education. The system's ability to provide personalized support, timely feedback, and efficiently track student progress has brought forward its accessibility to contribute to an enhanced learning experience. As further advancements are made and ethical considerations are prioritized, such systems have the potential to reshape education by providing effective and tailored support to students, ultimately improving their academic success and overall learning outcomes.

ACKNOWLEDGEMENT

We would like to pay our immense gratitude to Ms. Anjalie Gamage, who was our research supervisor and Mr. Dhammika H. De Silva, who was our research co-supervisor. Our heartfelt gratitude extends to our parents and colleagues who supported us significantly during the research project. We also appreciate the utmost support provided by our workplaces to handle the research effectively.

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BIOGRAPHIES



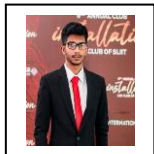
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