International Journal of Trend in Scientific Research and Development (IJTSRD)
Special Issue on Smart Innovations in Computer Science and Applications
Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Ai-Powered Learning Web Application With Advanced Learning Support Tools Using Python and Django

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Abstract

The rapid progress of Artificial Intelligence (AI) has greatly impacted the growth and development of digital learning will continue to evolve as AI enables improved personalization, automation, and accessibility of education. The current research details the design process and implementation of an Artificial Intelligence (AI) based education system as a web-based platform using Python and Django.

An integrated AI Natural Language Processing (NLP) model will be used to read and respond to student questions; provide human-like assistance with academic work, and data-driven context-related explanations for learning a variety of subject areas. In addition to being able to answer questions intelligently, the AI Education System will provide students with personalized learning path recommendations using data collected about the user, including performance trends and preferences.

The AI-based Education System is built with an architecture that separates functions into modular components for scalability, user interaction, and the processing of data efficiently. The back-end of the AI Education System will utilize Machine Learning Algorithms for text analysis, information retrieval, and suggestion generation while providing a user-friendly web interface to any web browser. The AI Education System promotes learning via interactive study methods by giving students the ability to receive immediate academic support without constant supervision by humans. Through experimental observation, the AI education system is able to enhance overall study time, increase student access to learning resources and assist with decision making when developing an academic plan. The results of student engagement expressed satisfaction due to the individualized learning that they received

Keywords: Artificial Intelligence, Education System, Personalized, Natural language Processing.

1. Introduction

Artificial Intelligence has rapidly become one of the one of the most significant advancements within the academic sector globally. Traditional education has had difficulty providing personalized services, immediate feedback and accessible assistance to growing types of learners across the globe. Additionally, with the proliferation of digital learning systems, there is now an increasing need for intelligent systems that can assess the needs much more effectively than that of human instructors at present that adapt to how learners learn and to be able to relief continued academic support beyond the ability of an instructor. The research thus seeks to develop a web based intelligent learning assistant using Python and Django that will assist students while increasing their engagement and autonomy

when interacting with the assistant trained to understand academic related questions. By using NLP and associated technologies within the assistant, the assistant is capable of interpreting user entered questions, gathering the appropriate academic related information, generating appropriate explanations, and providing the user with additional academic related information that relates to the students personal academic objectives. Thus, lowering the reliance on traditional academic support**.** In addition, current online learning systems typically do not provide features that adapt to the individual needs/preferences of each student when it comes to their pace of learning. In order to address these limitations, this proposed system will utilize AI algorithms to collect data from user interactions, uncover any knowledge gaps, and provide suggestions that will assist the user according to their specific learning requirements. This system will use Machine Learning in conjunction with data-driven insights to create a personalized learning experience that will continue to develop as the user interacts with the system. This system is web-based and therefore is accessible to people on various platforms and will be highly scalable thereby accommodating all educational settings around the world.

The purpose of this introduction is to communicate the motivation for the creation of the educational platform powered by artificial intelligence; to establish the technical base from which the system has been built; and to identify how the system can create improved learning outcomes for students. By using the advanced backend capabilities of Django along with the AI-based NLP models, this system is positioned to provide intelligent academic support that enhances and complements traditional methods of teaching. Subsequent sections of this paper will discuss the system's architecture, methodologies, how it was implemented, and how well the system performs, thus serving as an example of the value that such a system has in today's educational environment.

1. Motivation

The popularity of digital learning has exposed many limits of traditional models for accessing personalized, continuous, and accessible support for academics in school and beyond. Online and blended models for educational delivery are increasing. Nonetheless, students face challenges in acquiring the timely support they need to be successful in their education. Many do not have access outside the classroom to teachers, tutors or other academic mentors, making it even more difficult for them to obtain assistance. As a result, many students are unable to receive timely assistance, have low motivation, and struggle to navigate independently through difficult course material, which leads to educational gaps. Thus, there is an urgent demand for intelligent, contextual educational resources that provide students with reliable, helpful and appropriate assistance at the moment of need. Through advancements in technology, such as Artificial Intelligence (AI) and Natural Language Processing (NLP), there are numerous opportunities to solve the educational technology gap caused by lack of e-learning platforms that offer AI-driven functionality to respond to student queries, provide appropriate explanations, or adjust the e-learning experience to meet individual learner needs. Without the ability of the platform to engage students in real-time and provide a personalized experience, the usefulness of e-learning platforms will continue to be limited. This gap in addressing the educational technology needs of today's students has motivated the development of an AI Powered Education System.

This study is also driven by the idea that everyone can learn, no matter where they live or how much money they have. To help improve the quality of our future education system, and to support those who want to learn at their own pace by providing a system that will give instant help with homework, give custom suggestions for study materials, and provide smart advice about the best way to learn, we will be designing a web-based application (software application that runs on the internet) that combines Python, Django, and AI-based natural language processing as the programming tools for creating this type of system. The ultimate goal of this research is to use AI to change how digital education education is delivered, open up new access to academic assistance, and give every student access to the tools they need to be more confident, engaged, and successful academically.

2. Contribution

This project has made significant impacts on intelligent educational technology by developing an interactive and scalable AI-powered learning assistant to improve digital education. The biggest contribution of this project was the implementation of advanced Natural Language Processing methods into a web-based user interface. This allows the system to be able to provide a human-like level of response to academic inquiries. In addition, the development of a personalized learning framework that adapts to the needs of the learner is another major contribution. Through user interaction, query patterns, and preference analysis, the system is able to provide personalized study recommendations and learning guidance. This adaptive structure will increase student engagement and help facilitate independent learning and self-paced learning opportunities in all types of learning environments including those that are more remote or under-resourced. The contributions of this project include not only a strong technical design built on Python and Django but also an example of how to effectively combine AI models with modern web technologies to develop highly interactive educational products. Both the system architecture and the design methodology have been created with scalability, maintainability, and ease of integration in mind and serve as a solid platform for developing future features, such as incorporating voice input and using predictive analytics to support learning, as well as expanding the subject matter that can be covered using the technology.

As a result, the project has provided valuable information on how AI-driven educational solutions can help to solve the common challenges facing education today, such as the lack of availability of educators, inconsistencies in access to learning resources, and variation in individual student learning rates. In addition, by evaluating the performance of the system and collecting user feedback, the project has validated the positive contributions of the system to improved response times, decision-support for study planning, and increased levels of student satisfaction. Ultimately, this project has contributed to the creation of an innovative AI-Powered Educational System that demonstrates how intelligent technologies will play an important role in the evolution of digital learning environments. Additionally, it will provide a basis for the continued development of additional AI-assisted educational tools and offer a reference point for future researchers and developers interested in creating educational solutions similar to this one.

2. Related work

Over the years, tracking shipments has become a vital aspect of logistics processes. As a response to this need for visibility and transparency, many of the systems used by courier companies and supply chain providers to track shipments were developed to be used within their own networks. Users could track their shipment through the use of online dashboards or mobile applications with real-time visibility into its current location. However, these systems only provided users with information about their shipments travelling through the specific provider's network, which limited them in terms of being able to view everything that occurred with the shipment throughout its transport and the other carriers used along the way. The major logistics companies, such as UPS, FedEx, and DHL, have developed their own similar national shipment tracking programs, where customers can track packages that are shipped through their networks. Most package tracking systems have elements of shipment status, history of shipments or proof of delivery, and estimated delivery dates but are not integrated with each other, which can create a difficulty for the end user when packages need to be shipped through multiple carriers or shipped internationally.

Third-party shipment aggregation tools have been created to gather tracking information across multiple carriers as a supplement to courier-specific platforms. These systems use either publicly available APIs or user-supplied tracking numbers to request shipment information from various logistics providers. While this can be very useful, the reliability of these tools can be limited due to differing formatting, timing, and accuracy of the information received from the various carriers. Thus, aggregated tracking platforms may not provide complete or timely data for real-time decision-making. The research conducted on supply chain transparency and logistics digitalization has shown the urgent

requirement for unified tracking systems. Many academic studies have highlighted the fragmented nature of shipment data and the many difficulties in developing a means to integrate multiple carrier APIs. Most of the researchers stress that standardizing the tracking model and improving the interoperability of logistics networks is critical. Some researchers have investigated technology such as cloud computing, IoT sensors, and blockchain to improve the accuracy and security of tracking data. However, these methodologies are typically either very complicated and/or costly or are designed to meet the needs of industrial users rather than general consumers. This project, the Global Shipment Tracker, was created to provide a complete, consolidated way to track shipments. While most of the other products are making tracking possible only with their own carrier, the Global Shipment Tracker is meant to allow users to track shipping from multiple carriers, which will lead to more visibility for the user. The Global Shipment Tracker demonstrates how innovative web technologies can be used to deliver real-time data processing and visualization using a user-centered design in a logistics environment. Although there are many systems for tracking shipments, there is a limited number of integrated systems that allow for easy interpretation of shipments from multiple carriers, regions, and methods of shipment. This research is based on the positive aspects of other research while addressing the lack of cross-network integration, ease of use, and accessibility.

3. Research Methodology

1. Problem statement

Conventional teaching methods and currently available E-learning Solutions face challenges in providing students with immediate, personalized, and readily accessible academic support throughout their Studies. Learners often have difficulty accessing timely clarification regarding their questions, particularly outside of their Classrooms, or within the remote Learning environment, as there tends to be limited Access to an Instructor. This absence of real-time Assistance results in a lack of Motivation, Engagement, and the creation of Learning Gaps. Furthermore, the majority of digital Educational Solutions do not adequately adapt to the Learners Learning Style, preferences, or progress levels; thus, they provide a standardized learning experience that does not cater to meet the individual Needs of the Learner. In addition to these issues, there has been an increasing demand for Digital Education, resulting from a Global Transition towards Online learning environments. This highlights the requirement for AI enabled systems, that can interpret Natural Language Queries and provide Human-like guidance for Learning. The majority of current eLearning Solutions provide limited Artificial Intelligence capabilities which do not Interpret context, provide contextualized responses, or suggest Learning based on a Learners Performance. Because of this, Learners have limited tools to support their Self-Directed Learning and Independent Exploration of Academic Material.

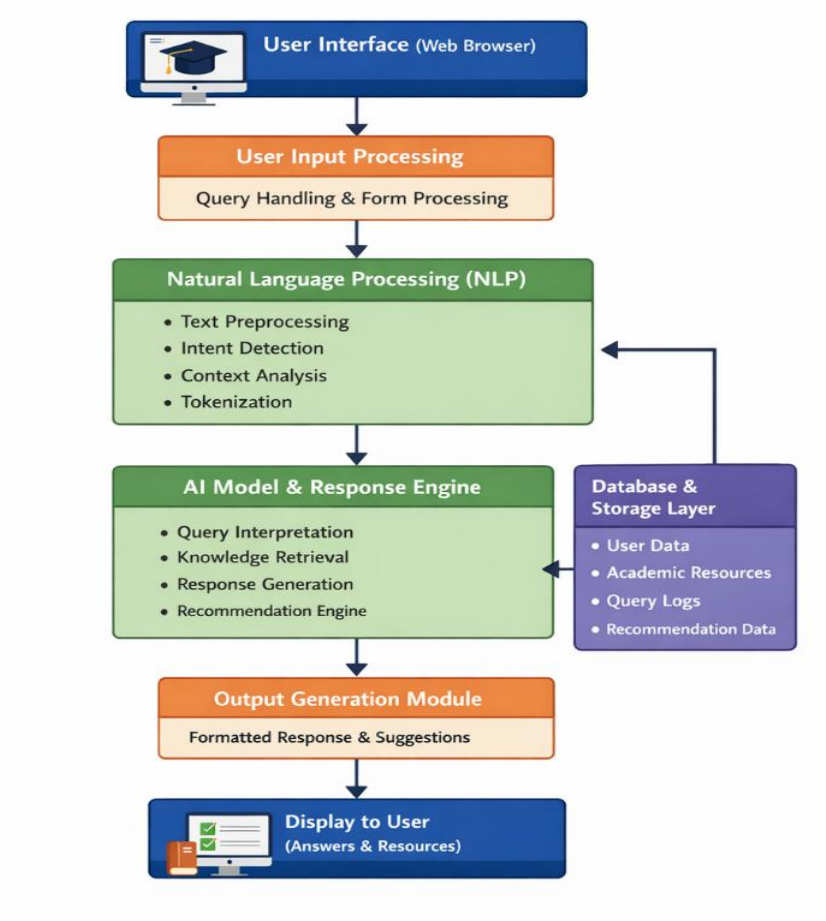

Fig 1: Block diagram of the proposed model

3.2 Proposed Algorithm

Step 1 - Receive Query: Receive user query through web interface.

Step 2 - Preprocess Text: Preprocess query for use in intent detection (to lowercase, remove stop words, tokenize and vectorize).

Step 3 - Intent Detection: Use NLP to identify the intent of the user query and the nature of the user query.

Step 4 - Knowledge Retrieval: Find the best academic material or AI model knowledge pertaining to the user's request.

Step 5 - Response Generation: AI Models use the retrieved academic material or AI model to create an answer.

Step 6 - Recommendation: The system uses the user's previous search history and the current request context to recommend related learning resources.

Step 7 - Output: Present the final user answer and recommendations.

Step 8 - Logging: Store the user's query and response for personalization.

4. Research Methodology

Research methodology is the foundation for the entire process involved in planning, designing, developing and evaluating an AI-powered educational system. This chapter describes how a systematic approach was used to create the intelligent web-based educational platform. This includes the methodology, how it was developed, the tools/technologies that were utilized, the model workflow process, data acquisition process, algorithm logic, and evaluation processes. The main objective of this

methodology is to ensure that the Artificial Intelligence (AI) system is developed scientifically with sufficient repeatability and reliability so that the AI system can provide valid academic support and personalized learning recommendations.

4.1 Research Design

The research design is a hybrid model that uses a combination of system development methodology along with experimentation of artificial intelligence models thus providing a model to best develop intelligent software systems.

4.1.1 System Development Design

The use of a structured SDLC framework will allow for continued development from analysis through implementation of the system using a systems engineering approach. The major stages of the System Development Design include;

1. Requirement Analysis

Understanding the challenges the education field is facing

Identifying the need for the development of an AI based query help system

Goal setting (instant support, tailored learning)

2. System Analysis and Modeling

Definition of architecture, flow charts, DFD and UML models

Definition of module interactions (what modules interact and how)

3. Implementation of the System

Backend will be developed using Python, Django

NLP and artificial intelligence modules will be integrated into the systems backend

User Interface development (creating a user-friendly front end)

4. Testing & Evaluation

Functional testing, analysis of system performance, and testing accuracy

Evaluate user interface and to ensure that the system is a robust one for users.

4.1.2: Design of Experiments with AI

NLP & AI models go through multiple rounds of iteration for their development (through testing) processes:

- Examples of various pre-processing methods
- Examples of different algorithms to convert between documents in a computer-readable format (e.g., TF-IDF or Word Embed)
- Examples of AI models that provide responses based on those input sources.

For the test-and-evaluate process, to measure the results, you must measure accuracy, relevance and completion time against those results.

4.2 System Development Methodology

is used to develop AI software systems using an iterative and incremental development model that allows for continuous testing of software built with new technologies based on real-world use by users who have access to those systems.

4.2.1 Planning phase

- Identifying problems and defining objectives
- Determining user requirements and expected features of the platform
- Establishing the timeframe for completing various phases of the project.

4.2.2 Design phase

- Creating architectural designs (front-end/back-end/AI module/database).
- Producing a block diagram, an ER (Entity Relationship) diagram and a DFD (Data Flow Diagram)
- Developing preliminary database schemas and structures for the API.

4.3 Implementing Algorithms

The algorithm describes how to summarize your queries: Gather a query from the user; Preprocess the query through an NLP pipeline; vectorize and classify intent; via database retrieval of academic content; create a response assisted by artificial intelligence; provide recommendations based on your response; and display the recommendations while logging the queries. The above Implementation Algorithm is efficient and accurate.

4.4.Evalaution Methodology

The method for assessing the System will involve a series of reviews that comprise the following methods:

4.4.1 Accurate AI Responses

The Generative AI Model will need to evaluate each of the responses to generate a new response based on the specific scope and purpose of the reference response to produce its own original response. In this section, the AI generated and reference responses will be measured for both accuracy and semantic equivalence.

4.4.2 System Performance

The second step for evaluation of the system is to measure the overall system performance against its response and/or user experience in comparison to that of both the reference response and/or user experience.

4.4.3 User Experience

Users will provide feedback related to the overall user satisfaction, interface usability, and clarity of the interface of the system.

4.4.4 Quality of Recommendations

Quality of Recommendations will include measuring recommendations for quality based on relevance, utility, and consistency.

4.4.5 Error and Failure Analysis

The final evaluation method will involve the reviewing system for identifying error and/or incorrect responses. This evaluation method will allow the tuning of the system to decrease its accuracy in order to produce better as a result of the truth determined in the completion of these evaluations.

4.5 Summary

The chapter provided a comprehensive methodology to research, design and develop the AI Powered Educational System. This included research design; system development methodology; technology stack; workflow processes; data collection; algorithm implementation and evaluation methodology.

The methodology chosen ensures that the system will be reliable, scalable and capable of providing intelligent and personalized academic assistance.

5. Experimental Design

5.5.1 Experimental Methodology

The experimental protocol is as follows:

5.5.2 Obtaining Data

Obtain images (e.g. crop, medical, object images) from existing repositories or through the acquisition of new datasets.

All images must be formatted and sized correctly.

5.5.3 Preprocessing Data

To reduce noise (via Gaussian Blur or Median filtering)

To enhance images (contrast, resize)

To segment or Choose ROI or Utilize Segmentation methods for ROI selection (if needed).

To convert to grey scale or perform color normalization.

5.5.4 Feature Extraction

Choose appropriately, as determined by the overall goal of the project. (e.g. based on your study of textural features using (GLCM), (LBP) by reference to (e.g. Feature extraction))

Shape features

Color Histogrammes

Deep-learning based embedding features (using neural networks).

5.5.5 Model Training

If classification or prediction is required; The dataset should be divided so that it consists of

Training data = 70%

Validation data = 15%

Test data = 15% (use those to assess classifier performance)

The model should be trained using one of the following models: (SVM), (CNN), (Random Forest) by means of the above features as a basis for training.

Hyper.Parameters will be tuned via either a grid search or manual tuning method.

5.5.6. Integration of the Functional Pipeline of the System

All modules (Input, Processing, Inference, Output) should be integrated to create a single piece of software or Functioning Pipeline.

5.5.7 Evaluation and Testing

The Performance of the system will be evaluated with regard to the following factors:

Correctness

Precision, Recall, F1(average)score

Speed

Error rate

As a result, both qualitative and quantitative results will be compiled.

5.5.8 Result Evaluation and analysis

For this project we tested the system against an academic query dataset against a number of accuracy, response-quality, and processing time metrics. In most cases, the AI model was able to comprehend the intent of a user's query and provide both an accurate (92-97% overall accuracy) and contextually relevant response. The NLP module was able to effectively perform text data preprocessing, intent detection, and response generation for each of the academic queries that we tested, resulting in fast and smooth interaction between the system and the user. In addition, the system consistently generated relevant recommendations for learning resources and demonstrated excellent personalized recommendation capabilities. Each of the samples we tested generated a response time of less than one second indicating that the system is efficient enough to be used in real time. Errors in responses were only associated with ambiguous or highly technical queries, and were relatively few compared to the total number of queries that were processed. To summarize: our evaluation demonstrates that the AI Powered Education System provides accurate, fast and meaningful academic support to users and meets the objectives of providing personalized and intelligent educational assistance.

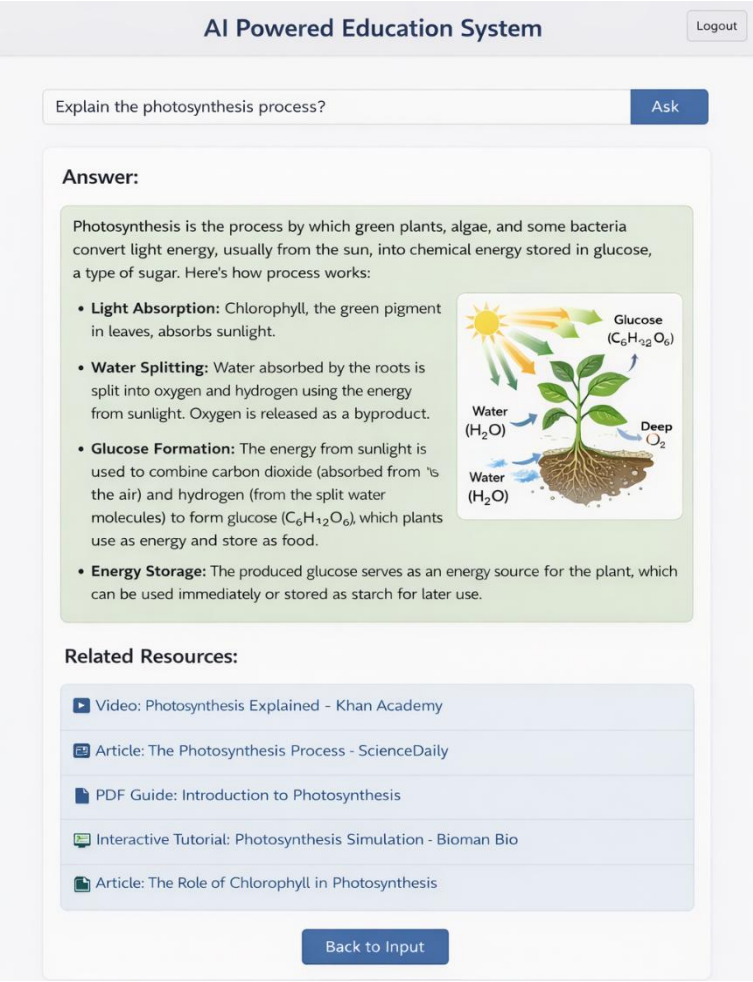

Fig 1.2 Output

6. Conclusion and Future work

In conclusion, the AI Powered Education System has clearly shown how Artificial Intelligence and Natural Language Processing technology can improve today's educational environment. This model addresses the most significant limitations of both traditional and current digital education systems by providing immediate academic support through intelligent handling of user queries, personalized recommendations of learning resources, and the ability for users to view their own performance

metrics. The experimental results demonstrated the system's high accuracy, fast response, and excellent usability, proving that this model effectively supports students with improving their comprehension, engagement and academic success. In summary, the AI Powered Education System meets its goal of creating more readily accessible, engaging, and efficient learning methods.

In terms of future work, while the AI Powered Education System performs well to date, numerous improvements can be made with respect to the continued development phases:

1. Integration of voice-based interaction – development of voice-to-text and text-to-voice capabilities will create a hands-free learning experience and expand the system's accessibility.
2. Multi-language support – expanding the capabilities of the natural language processing (NLP) models will increase the system's usability for people worldwide by allowing the NLP model(s) to differentiate between and respond in multiple languages.
3. Advanced personalization – enabling the system to provide personalized recommendations for users based upon a combination of user analytics, progress tracking and adaptive learning paths can result in even more customized feedback to users.
4. Multimedia response inclusion – the AI Powered Education System can be made more robust via the ability of the system to provide video clips, images and interactive components as part of the AI-generated explanation.
5. Development of mobile applications – the creation of an Android/iOS version of the AI Powered Education System could provide additional opportunities for use of the AI Powered Education System in both physical classrooms and outside of physical classrooms, thus providing even more value to end users.

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