EduBot: An AI-Driven Educational Platform for Multi-Format Content Processing

Viraj Walavalkar[a], Nishant Desale[b], Yashraj Dhole[c], Janvi Sawalkar[d], Nilesh Sable[e], and Anuradha Yenkikar[f]
Computer Science and Engineering(AI) Vishwakarma Institute of Information Technology, Pune, India

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Abstract: EduBot is an AI-driven learning platform that attempts to revolutionize the whole process of learning with a very efficient input processing system for the formats: Those include, but are not limited to, MP3s, audio files, image files, PDFs, links to YouTube and many others. The above very many content formats are transformed into edifying resources by EduBot augmented with advanced AI models. It supports speech recognition and relies on the LLaMA 3 for various NLP requirements, and employs Retrieval-Augmented Generation (RAG) to generate contextually aware results. EduBot offers small distillations of the content that was previously in more complete forms, consecutive questions and answers, diagrams illustrating relations within concepts, and paths to take while studying material. Its strength is in the Socratic assistant that insists on critical thinking by pointing procedures at solutions for the problems. The interactive aspect guarantees that learners achieve full depth of subjects that they are taught; thus, confidence in relation to competencies to grasp and retain key concepts. EduBot consolidates a teacher's task into one allencompassing interface pack that provides a plethora of learning aids to help the teacher assemble his materials rapidly to enable content creation. Such an approach towards the instructional design process will therefore integrate and clarify the process while at the same time availing an automatic structured learning resource which the students have to develop within their context. In the best of scenarios, EduBot should revolutionalise education regarding access, interest, and efficiency among teachers and students..

1 INTRODUCTION

Fast development in technology threatens no one of the sectors we generally describe as being 'horrifically disrupted'. We truly care it, or at least we tend to, because we are so special or so unique-we really don't care. Ever helpful it makes the old learning styles obsolete these days and even replaced with modern aids which make learning more fascinating and individualistic. That is one of them, the EduBot, nice as it has gone thus far in discussing one of the first steps towards 'smarter' educational outcomes through the intelligent processing of formats such as audio, images, PDFs and You Tube links. That was in that respect in the sense that such information has up to now been more or less easily

Found information and as such, the processing and condensing of educational content became a task for students and teachers. Yet, modern solutions in ed-tech resemble islands of sorts: they are supposed to perform specific activities – summation or generating questions as an outcome but there is no system which comprises all of packages of functionality. It is precisely this gap which EduBot fills introducing into one framework the modules of

[a] https://orcid.org/ 0009-0002-7750-5966
[b] https://orcid.org/ 0009-0007-3892-2579
[c] https://orcid.org/0009-0008-6898-8939
[d] https://orcid.org/0009-0001-1991-8714
[e] https://orcid.org/0000-0002-5855-4087
[f] https://orcid.org/0000-0002-9086-9695

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educational tools, and possibilities of content creation and sharing. This is why it would be of very high value to forge a comprehensive learning milieu so that students may learn with conflict-sensitive interface and diverse learning tools. It was perhaps the most impressive capability of EduBot: This is the opportunity to generate condensed subject overviews, Q&A sets in the context of specific requirements, mind maps that are easy to comprehend and learn structurally by adopting the state of the art NLP trends. For example, if Whisper is available for an automatic speech recognition application and LLaMA 3 for a natural language understanding application, this push gives this added boost to the output of the platform that it knows the context and response needs of an individual learner. The EduBot Socratic assistant inclines towards augmenting the ‘‘thinking’’ in a student—which is how learners are formed, in the process, analytical thinkers while conducting the discussion on their own learning process. Full overview of EduBot has been introduced in this paper; architecture, methodologies and technological integrations used for casting a look at possible implications have been discussed on the background of the impact on the sphere of education. Looking at this aspect as more developed in AI brings the research objectives of the current study to ask in what way such a feature can be used to come up with much more interesting, varied, and unique engagement experiences of students and/or teachers. All aspects of the research paper on EduBot with reference to ways and means in which the applicability of AI will be an obvious proposition if an academic approach is to be considered

2 LITERATURE SURVEY

Hwang and Chen (2019) (Hwang and Chen, 2019) talked about the changes brought in education by use of AI with ITS that could enhance the students' interaction with the content being delivered. In their study they devotes special attention to individual learning environments and learning environment model called learning companion. This fits well with the goal of EduBot to deliver the course that suits the learner's needs as well as having a dynamic approach toward different types of learning.

In the relevant analysis on the use of information technologies in instructional context which was done by Kulik (2003) (Kulik, 2003), it has proved that technological tools improve the effectiveness of tutor and educative processes. Kulik's research evidences for the idea that application of complexed technologies in AI systems used in EduBot can enhance the effectiveness of tutorials and consequentlythe learning outcomes.

Today's advancement in Natural Language Processing (NLP) is key in the features of EduBot's system. Devlin et al. (2018) (Devlin et al., 2018) presented BERT — Bidirectional Encoder Representations from Transformers that significantly changed the approach to text comprehending using deep bidirectional transformers. The model's capability to capture contextual dependencies in text has stimulated improvements on the areas of automated text summarization and question answering—to which EduBot is central.

"Transformer" was developed by Vaswani et al., (2017) (Vaswani et al., 2017) for performing efficient sequence operation through self-attention functional concepts. This model set the backdrop to most of the contemporary NLP solutions that include the functioning of EduBot in providing custom education content based on context. Importantly, since the framework adopted for EduBot is the Transformer architecture, the learning materials produced are structurally and contextually coherent.

In addition, Chen et al. (2020) (Chen et al. 2020) investigated the application of the Retrieval-Augmented Generation (RAG) model, which uses Knowledge Retrieval and the generation task in combination. This integration makes it easy to develop the content to include the information which isalleviated from the other sources to create the output. EduBot harness here this model to avoid drawbacks encountered with pure generative models whereby student may be given wrong or outdated information when posing a question.

RAG models were also explored by Lewis et al. (2020) (Lewis et al. 2020), namelyin terms of benefits of integrating large-scale language models with information retrieval frameworks. This they note shows that their solution enhances the quality of content produced since it combines factual knowledge and generative capacity. This is in line with the objectives of EduBot which endeavours to generate academic content that is informative, useful and current.

In their work, Karsenti et al. (2021) (Karsenti et al. 2021) sought to understand advances in technology towards promoting collaborative learning. Their studies demonstrate the ways in which AI supportscointeractive processes; here primarily, it fosters students' communication and produces immediate feedback. The study supports the use of

Socratic assistants for students such as EduBot to encourage critical use of information dialogically.

Zhang and his coworkers highlighted the role of multimodality and the necessity to work with content of different types: text, audio, and video. According to their research the students are served well when they are able to access and interface with multiple formats into which knowledge delivery is made more flexible and interesting. Regarding the effective processing of different media types like PDF files, YouTube video links, and audio files, EduBot finds its immensity in the modern leaningenvironments.

Other researchers such as Wang, Xin, and Zhang (2022) (Wang, Xin, et al. 2022) were concerned with the use of AI in designing intelligent learning environments. That is why their research focused on adaptive learning environment, which serves students and adapts to their needs. The AI-based individual learning paths developed by EduBot are consistent with their suggestions: a system that responds to a student's learning needs and pace.

Ferguson et al. (2020) (Ferguson et al. 2020) was aimed at discussing the application of AI for formative assessment and providing customized feedback. They also discovered that some of the benefits associated with use ofEducation Information Technologies and AI in particular is that compared to traditional form of learning, the students who learn through the likes EduBot can be provided with quick feedback. It is quite useful especially in environments where the teacher may not be able to hawk over each individual learner.

Graesser and colleagues (2019) (Graesser et al. 2019) explored whether learning companions based on AI technologies can be beneficial to learners. These companions, which operation is similar to the function of EduBot, are informants, they give advice and respond to questions in real time. They found that having learning companions helps to increase the degree of interaction and hence suggests enhances learning.

Another aspect of the use of AI in corporate training environments was also mentioned by Berger et al. (2020) (Berger, et al. 2020). They explained how AI applications could be used to develop learning interfaces that would help the target employee population. Because it is highly flexible, EduBot can be applied not only as an element of formal educational system but also in corporate education, where individualized learning plays a significant role in workforce training.

DeMillo (2021) explained how with the help of AI it is possible to shape the learning environment conducive to the needs of learners with disabilities. Artificial intelligence can easily be configured to fit all learning models to accommodate all the student's needs. Since EduBot adapts to the interface and content presentation, it is a valuable resource for teaching to diversify its audience.

In their study focused on exploring the effects of AI in distanceand online learning, Means et al. (2021) (Means et al. 2021). The authors of their study examined that potential of AI could provide better interactiveand personalized environment for learning in virtual environment. From this research, EduBot which uses AI in online learning affirms this knowledge by availing an environment that lets the learner practice and directly interacts with the tutor same as in face-to-face lessons.

Holmes et al. (2021) (Holmes et al. 2021) explored the role of AI in educations following the current developments and trends, stating that there will be more intense use of AI tools in education contexts applying both near and distant futures. Hence, their research has pointed out that with AVP like EduBot the future of education delivery will hugely rely on Artificial Intelligence tailored learning delivery.

According to Paul and Elder (2020) (Paul and Elder, 2020) understood on how critical thinking skills should be enhanced among the learners.Taking this view, Seemiller asserted that with AI-expression, Socratic techniques could be particular to nurture essential analytical effectiveness in learners. In particular, addressing the findings of this research, EduBot is aimed at the usage of the Socratic questioning approach that promotes critical thinking and meaningful learning.

3 MODEL ARCHITECTURE

3.1 Structure and Working

Being one of the most complex AI-based solutions in the field of education, EduBot is to enhance learning performance due to the multileveled structure. It involves content process, usage interaction and adaptive learning working in combination with the multiprocessor system.

Main Elements and What links or relates Them

Well, this is where UI comes in, UI for short, that is user interface. It is really the end point of user interaction, at least for mostproductive purposes. For as non user input within the system, userscan enter doubts as well as concepts that they want to share and upload materials such as PDFs and YouTube links. In this component, applicative design provides uI

accessibility and thus the users can easily operate within the platform. This component makes it possible to have a smooth experience by constantly inviting the masses to take part in educational material.

User Database and Profile Management: This module willfacilitate the control of user profiles on plethora of data derived from the user history, scores which are potentially given to users on their performance and pathways completed during learning. Securing user information will thus make the system ready torecommend the particular content that one might need in learning during experience and adaptive learning. The user database is very important because it will show trends as to how users have evolved at some point of time and has been personalized based on the user.

API Integrations (Gemini and Groq): For the extended functionalities, EduBot relies on external application programming interfaces. What Gemini API does therefore do is absorb the queries that end users offer, proceed to analyze them and bring back points to relevant education resources. Regarding YouTube links Groq API now handles and users can pull multimedium content. The integrations reveal what material could be processed and used by EduBot, thus diversifying experience with various forms and types of education.

Pdf processing While uploading pdfs this would extract relevant content for analytical purposes and for interaction. the module works by applying complex algorithms to extract textual content from the PDF which was then to be fed to other subsystems of the system. On this level PDF interaction offers affordances by which the extracted content can be further manipulated allowing for further comprehension and engagement with the content of the text.

Module for Handling User Response: This module encompasses and handles inputs which could be in form of questions, feedback on the contents as well as responses to education content. It then elicits an interaction of the users to the educative contents and funnels it back to the User Database for reuse. This way, it develops session continuation – which is a user can revisit or go back his or her previous interactions, because rigidity is kept along her or his learning trail.

Real-time Adaptation Engine: The adaptation engine in EduBot helps keep real time, adapting content as well as the way users interacts with a user based on his or her performance. In its native form it has an ability to generate Socratic questions that put the users to a particular question making them think deeper on what they are learning, with digg. Therefore it presents a challenging exercise for every learner based on the level of proficiency of the software's skill level.

EduBot gives a very much sounder rating system that determines the performance of a user through the kind of interactions and the answers given. It 'S normally seen in the Leaderboard, whichshows the rankings of users according to the scores which they have secured. Such an environment invokes a competitive level that fosters participation with improvement in learning achievements.

Understanding student performance and participation, Progress Analytics and Feedback Mechanism provide the advantage anddisadvantage of the user. Moreover, the Feedback Mechanism also offer users recommendations according to their performance, which could help learners to set objectives and, in fact, monitor progress throughout the years. It's such kind of feedback loop that serves significant in strengthening user motivation as well as guiding him throughout his education.

The Mind Map Generator: EduBot components; It is a tool that is powerful enough in the creation of visual relationships about different concepts in. It brings together ideas in a ways which help in the understanding and memorization of concepts regarding specific issue. The active engagement of the user with them gives the possibility for the content to be explained visually for effective learning.

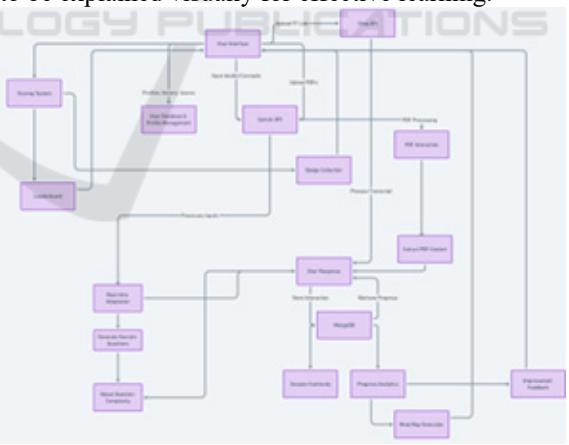

Figure 1: EduBot System Architecture.

4 EXPERIMENTAL SETUP / METHODOLOGY

Establishing EduBot, it was an intentionally designed process of how different advanced AI models, back-end tech, and UI elementswould be incorporated to

create an easy to use educational aid. Methodology section contains information regarding the architecture of the system and discuses technologies used as well as the flow of the process for data handling and the strategies adopted to ensure fulfillment of the functional and non functional requirements.

4.1 System architecture

Designed to address the major input types, which include text, audio, PDFs, images, and links to YouTube, and to deliver all theseas summaries, sets of questions and answers, mind maps, andlearning modules, the architecture consists of the following major elements:

- **Frontend:** The works through which students use toupload their contents and also with which they work on the produced outputs by the educators. The front end has been built with the latest web front end technologies to ensure a good interface on any gadget as it uses HTML, CSS, and JavaScript.
- **Backend:** The Backend can be in Django or Flask as since it takes the request from the user then processes the input and forwards commands to the AI models and receives/stores data in database.
- **AI Integration Layer:** This comprises a number of incorporated AI models that is expected to transform the inputs into an output.
    - **Automatic Speech Recognition (ASR)** - Whisper: Speech recognition which builds the capability to transform audio feed into text.
    - **Llama 3:** Tasks like summarization, generation of questions-answers, and any kind of work which requires passage comprehension, etc., based on the modules learnt by the system.
    - **RAG (Retrieval Augmented Generation):** Ensures that the outcome, information retrieved, answers found or conclusion reached are pertinent to the conversation going on.
    - **Faiss:** It is integrated for quick comparablestudy and classifying instructional information.
- **Database Layer:** MongoDB is used for the variable and horizontally scalable storage of numerical data of users; educational content processed in the learning management system; as well as the content of the interaction history data.

4.2 Intake and Preprocessing Input Data

In the first stage, we received input data and cleaned them in order toanalyse. By so doing, EduBot allows the introduction of any form of educational material in various input formats. All input forms undergo a distinct pipeline:

- **PDFs and Typed Text:** The text inputs can also be decided using a general purpose PDF library to parse or by simple text file processing. The extracted text is then directed further for further processing by the LLaMA 3 model.
- **Audio Data (YouTube Links, Podcasts, Lectures):** Whisper Model is the audio input to text outputprocessor. The obtained text is input to LLaMA 3 to produce summaries, questions and answers, and study material in modules.
- **Image Data:** Optical character recognition techniques are used, while the text is recognized from images. The obtained text is regarded as other text input data, and goes through LLaMA 3.
- **YouTube Links:** For such links, LLaMA 3 handles suchlinks, fetch an audio content through APIs and then transcribes these using Whisper. Only these texts areused to produce the final output.

Once the input data is processed, it stores to a MongoDB and the output can be obtained from the MongoDB for further output.

4.3 Output Generation and Use of AI Models

The output which is generated by the EduBot is of the educational type once the data of the input has been processed. The processesin generating outputs vary depending on each type of output:

- **Summary:** Textual data is then fed to LLaMA 3, and summarized to provide an informative abridged version. The contextual understanding is gained, and the

main features in the incoming text are emphasized so as to ensure that there is always a summary that the users can always refer to when using the paraphrased text.

- **Q&A Generation:** Based on the RAG framework, the input data of EduBot will make up Q&A pairs. It retrieves processed data with RAG to provide answers and questions which are semantically relevant.
- **Mind Map Generation:** The types of the concepts beingclosely associated within the input are defined using a clustering algorithm along with Faiss, so they are illustrated as a mind map to make the visual material easier to comprehend.
- **Module Building:** It is divided by topical modules and LLaMA 3 is organized into a series of lessons complete with Q&A sets with examples to support the implementation of the module being taught.
- **Example Generation:** LLaMA 3 applies its text generating mechanism and comprehension features to formulate examples that refers to a piece of information contained in the data and utilises comprehension strategies to identify the concerns which it then provides examples or actual use of to enhance understanding of.
- **Socratic Questioning:** EduBot does contain a Socratic questioning model that will produce a stream of questions/framing to guide deeply engaging rant and understanding. This ability forces the user to reconsider what they know and how they are arriving at conclusions and indeed makes the user much more involved in the material than the regular learning process, therefore much more interactive and enclosed.

4.4 Database Management and Storage

Mongo DB will be the main storage of EduBot as it containsunstructured data; text audio metadata and logs of interaction. The database holds:

- The following is what all its users upload in their raw format as well as the processed format:
    - Marty somewhere in the processed outputs which include summarized content, question-answer pair, mind maps.
    - The interaction history of the users and activity logs which help the system gradually adjust to the certain demands.
    - MongoDB Document structure helps in accessing the particular data more quickly, it was easily scalable because the part of whole is far easier to build.

5 AI MODEL TRAINING, FINE-TUNING

Based on Whisper and LLaMA 3 high-precision models, EduBot brings additional fine-tuning to be used on educational material only. The following are some of the area that involve fine-tuning:

- **Fine-Tuning Whisper:** Speaker adaptive acoustic training of Whisper so that it can transcribe lectures and podcasts as accurately as informed by words specialized in the domain
- **LLaMA 3 Fine-Tuning:** For this work, the authors used the version of the LLaMA 3 model fine-tuned with a set of educational material, which enabled it to generate high-quality summaries, Q&A sets based on the material, and independent academic modules.

This fine-tuning may well improve the performance of modelsaccording to a given set of educational content whilst promoting quality results.

6 USAGE AND INTERFACE

The frontend of EduBot is very easy to understand and easy to use.Among its main features are :

- **Content Upload Portal:** Allows inputs of various formats such as texts, PDF, audio, as well as links to YouTube. A user will use a graphical user interface, specifically a number of related clickable objects on a screen.
- **Dashboard of Generated Outputs:** The user will be able to see his outputs after the processing has beendone-that is, summaries, Q&A sets, mind maps and modules in a user-friendly dashboard format.

- **Administrator Panel:** Here is the administrators and educators panel for managing the user information, computer performance and users activity.
- **Accessibility Across Devices:** This should be achieved in a way that it is easy to be used by both student and educators with as much as possible of barriers beingremoved.

7 PERFORMANCE AND TESTING

Monitor these performance indicators to assure optimum performance and very good response time.

a. **Latency:** For standard sizes of inputs the system shall becapable of providing output such as summery/Q&A set within five seconds.
b. **Scalability:** EduBot can support many userssimultaneously with high concurrent connectivity and the use of other horizontally scalable methods such as addition of many cloud instances and load splitting to many servers.
c. **Model Evaluation:** Ch., 2017) Educational datasets are used to assess AI model performance and make ongoing

Quantitative assessment of precision, relevance and general quality of output generated by each model.

8 SECURITY AND DATA PRIVACY

Since it handles user data which are personal in nature security and data privacy should be a top priority in its operations.

a. **Data Encryption:** Thus, using the SSL/TLS to ensure secure communication between the user and the system tends to remove hitches concerning the unauthorized access.
b. **Authentication:** The role-based authentication is afeature of EduBot; thus only individuals with the right access privileges can avail some educational and administrative features.
c. **Data Privacy Compliance:** The system can uphold data privacy regulation , for example, protects the general data protection regulation. This ensures any data collected on users is safe and well handled from theclients' perspective.

9 RESULTS

It incorporates diverse elements of artificial intelligence that optimise educational interaction with content as well as its visualisation and feedback. Out of the images provided in thisexperiment, this tool was able to process and apply PDF and YouTube video educational resources and mind map applications for some of the concepts presented in the images.

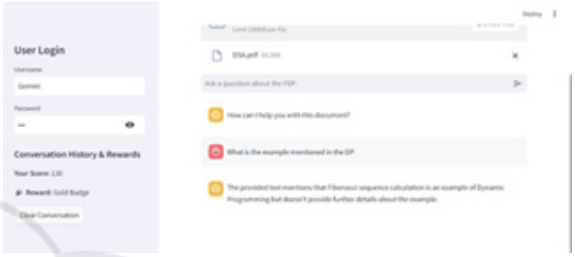

Figure 2: PDF-Mate

For instance in handling a PDF on dynamic search algorithm, the system recognizes the example of the Fibonacci sequence as an example of the dynamic programming approach. Despite pointing out that this example was not explained, it provides evidence of an area which needs extra effort to be spent for content understanding and extraction to be properly accomplished.

Figure 3: MindMap

The most obvious feature may be the concept map which will arrange thoughts in a dynamic nature such as LIFO (Last-In-First-Out) for stacks which general functions include the "push" and "pop" functions. The tool additionally offers the comparison between stacks with other data structures like arrays, links list to enrich the understanding made through breakdowns. Printed and in graphical form, the mind maps cause the variable to be less of an issue for the learners since they are then easily able toget an onset view of principles, operations and usage areas.

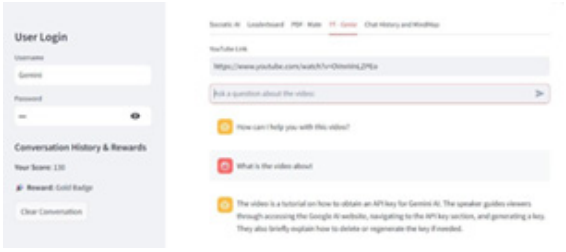

Figure 4: YouTube Genie

The use of the YouTube Genie integration has extended the usefulness of the platform to multimedia content. From the above demonstration, one can realize it gives a video tutorial on how to get an API key for Gemini AI just like how one can move through the google's section of API key and regenerate keys from time to time. It summarises knowledge content from the video resources into written notes for majority of people that catered to their preferred learning style and incorporates multimedia into knowledge acquisition.

Figure 5: Chat History & MindMap

In addition to content processing, the option of visualization and representation, the application provides the system of an interactive engagement based on the history of chats and the mind map. This is more or less like a store, all previous encounters are saved here and the learner can look into his learning process, whatever questions that have been asked earlier can be answered again, and so on I think it will keep the learning process more or less continuous. The mind map that triggers from the chat history assists as a guide of issues discussed during any of the interactions. This capability then turns linear conversations into knowledge maps for users to easily remember and switch between them.

Scoring and rewards mechanism is also included in the interface the keep the audience engaged continuously. The simpler the activity, the more points the users earn, and the more different types of content they come across during their actions-share files, watch educational videos, and ask questions using the Socraticassistant. Such a user as "Gemini" has the score of 130 and the badge "Gold" as seen from the dashboard. Such reward systems create for an extremely social learning environment because the users know they have to come back to the system, time and again. Moreover, the scoring mechanism helps guarantee continued participation in order to maintain the continuing formation of learnings, making the system more suitable for the attainment of enduring learnings in the academic, business, or learning-enabling environments.

10 FUTURE SCOPE

From this perspective, EduBot has a great value for future development, which will bring more positive changes and development to educational technologies. Another area which could be further developed is the multilingual capability: Thus, the suitable extension for the EduBot solution would be the opportunity to translate the material as well as to generate the content in the targeted languages. Sophisticated MT can guarantee concerns of contextuality of language translation. Furthermore, students engagement and individual approach can be developed through the utilization of AI technologies for tracking of the behavior, preferences and performance where the learning path is proposed based on the adaptive learning approach and is tweaked according to the learners' progress. Compatibility with Augmented and Virtual Reality (AR/VR) platforms could lead to creation of virtual environments that could include such use cases as virtual laboratory or complex 3D models of some material. On the other hand, the components of gamification can be branched out to cover such elements of the game as a leaderboard, rewards for achievements, team challenges, etc., to extend the level of engagement and cooperation as well as constructive competition. To increase practical use, it could extend its function to be able to interpret other types of content for example scanned handwritten notes or dynamic media files. It can also integrate with Learning Management Systems (LMS) such as Moodle and Canvas doing so simplifying adoption among educators and organizations improving teaching and learning experiences. In addition, improved Socratic assistant characteristics may give a realistic image of the problem solving and foster critical attitude and directed exploration. New functionalities of data analytics and reporting will allow educators to monitor a student's performance and improve the approach. Furthermore, AI-based support to peer interactions might enhance group

work where students and EduBot work on case-based assignments; EduBot providing guides and feedback.

11 CONCLUSIONS

EduBot is more of a learning helper which learns from data with the assistance of high octane intelligent data processing with large text, audio, PDFs, images and YouTube links, and then it generates summative results in forms of summaries, Q-A pairs, mind maps and learning modules. Overall, it takes little effort to navigate and this tempts the students to operate it physically together with the game aspects which State and purely encourages the users to use the software. In its concerned user representation, it uses EduBot to represent the proper use of the newest Whisper model of automatic speech recognition and LLaMA 3 for natural language processing to answer them with the right contextual content. In view of that, fine-tuning was directed towards optimally addressing quality objectives for issues relating to education content. Data storage was flexible and also scalable using NoSQL MongoDB while user interaction formats and data were also diverse. Here it is possible to distinguish which aspect would be more crucial between the performance metrics and security measures and that is to show reliability and capability to be GDPR compliant. Thus, in general, with reference to connection between content consumption and understanding, EduBot makes consumption more effective and relevant in all the above-mentioned different educational situations and in regard to the improvements that have been going on here.

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