International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

Exploring the 10 Key Ai Technologies Used In Educational Chatbots: A Comprehensive Analysis and Practical Insights

S. Kanmani,
Department of Information Technology,Puducherry Technological University, Puducherry, India

Swetha B,
Department of Information Technology,Puducherry Technological University, Puducherry, India

Fayaz Ahamed M,
Department of Information Technology,Puducherry Technological University, Puducherry, India

M Vijayalakshmi,
Department of Information Technology,Puducherry Technological University, Puducherry, India

Date of Submission: 08-04-2024 Date of Acceptance: 20-04-2024

ABSTRACT:
With the invention of chatbots, we have come to a new technological era. This paper investigates ten key Artificial Intelligence (AI) technologies that are revolutionizing the landscape of chatbots: Natural Language Understanding (NLU), Word Embeddings, Recurrent Neural Networks (RNNs), Transformer Models, Sequence-to-Sequence Models (Seq2Seq), Conversational Bot Services, Slot Filling, Intent Recognition, Named Entity Recognition (NER), and Dialog Management Systems (DMS). We analyse their functionalities, advantages, and limitations within the context of classification tasks for chatbots. A comparative table explores the training data, testing parameters, and real-world applications of these technologies, highlighting their strengths and weaknesses for different classification needs. This analysis empowers developers to make informed decisions about integrating these AI technologies into chatbots. Furthermore, we explore real-world examples of chatbots utilizing these technologies specifically within the educational domain, showcasing their versatility across various classification tasks. This research aims to equip developers and stakeholders with the knowledge necessary to create more effective and user-friendly classification systems by identifying the functionalities, datasets used, application types, and overall advantages and limitations of AI-powered chatbots.

KEYWORDS: *Educational Chatbots, AI Technologies, Natural Language Understanding, Recurrent Neural Networks, Personalized Learning, Educational Applications*

I. INTRODUCTION:

The digital landscape is rapidly evolving, with chatbots emerging as powerful tools for communication and interaction. These automated conversational agents are finding applications in various fields, including customer service, marketing, education, and healthcare. However, their effectiveness heavily relies on their ability to accurately categorize user queries and requests. This classification process is crucial for delivering relevant responses and completing tasks efficiently.

A key challenge lies in choosing the most suitable AI technologies to equip chatbots with the necessary classification capabilities. A wide range of AI technologies exist, each offering unique strengths and weaknesses. Understanding these nuances is essential for developers who want to build effective chatbots that excel in specific classification tasks.

This study delves into ten key AI technologies that are shaping the future of chatbots in the area of classification. We analyse these technologies in detail, focusing on their functionalities and how they enable chatbots to effectively categorize user queries and requests. We explore their advantages and highlight the specific classification tasks where each technology is best suited. Additionally, we acknowledge their limitations to help developers make informed decisions about their applicability for specific tasks.

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

To demonstrate the real-world applications of these AI technologies, we'll examine the educational domain. We'll explore how chatbots, powered by these technologies, are being used to enhance the learning experience. By showcasing concrete examples, we'll illustrate the versatility of AI-powered chatbots in various classification tasks within the educational setting.

This research aims to empower developers and stakeholders in the chatbot development field. By providing a comprehensive analysis of ten key AI technologies, their functionalities, advantages, limitations, and real-world applications, we equip developers with the knowledge necessary to build more effective chatbots that excel in classification tasks. This newfound knowledge will enable them to create chatbots that lead to user-friendly and efficient interactions across all domains.

We present our findings in a well-organized format, offering insights into the capabilities, limitations, and potential use cases of each technology within the educational domain. By elucidating the role of these technologies in educational chatbots, we aim to provide educators, researchers, and developers with a comprehensive understanding of the tools at their disposal for enhancing learning outcomes and enriching educational experiences. This exploration underscores the transformative potential of AI and Machine Learning (ML) technologies in revolutionizing education, paving the way for a more inclusive, personalized, and effective learning paradigm.

II. LITERATUE SURVEY:

A literature review, sometimes known as a survey, examines the body of knowledge surrounding a specific subject. It is crucial for providing readers with a thorough understanding of the topic, identifying areas requiring further investigation, and contextualizing recent findings within earlier research. This section offers a summary of the literature on various chatbot classifications and conducts a detailed exploration of chatbots built using the 10 key technologies mentioned.

In paper [1], a detailed multifactorial classification of chatbots is presented to provide a clear understanding of their nature, creation approaches, advantages, and disadvantages. Research and analysis of modern chatbot features led to the categorization of chatbot programs based on seven criteria: purpose, location, interface type, user count, access form, algorithm, and functionality. It is argued that chatbots represent one of the most promising directions for web interaction with users.

Paper [2] provides a detailed analysis of chatbot evolution and the different technologies employed, comparing them to understand techniques, current leading chatbots, and their limitations, aiming to guide improvements in specific areas to make chatbots more human-like.

In the paper [3], the focus is on intelligent chatbot systems utilizing RASA NLU and NN. A chatbot system is built using the RASA NLU method for entity extraction and the Neural Network (NN) method for system implementation, employing the RNN method for stock price, cap, and volume search. It was observed that NLP plays a crucial role in intelligent chatbot systems, with RASA NLU outperforming NN in accuracy for a single experiment. However, NN demonstrates better integrity in classifying entities from segmented words. Limitations include spelling and expression recognition constraints in RASA NLU, as well as missing entities in the process for both RASA NLU and NN.

Paper [4] discusses the development of an Educational chatbot using the RASA framework for rural students, aiming to enhance educational interactivity and motivation through personalized recommendations. Natural Language Understanding and DL are employed for chatbot development, with Automatic Speech Recognition, Dialog Management, NLG, and Speech Synthesis for teaching. The RASA chatbot's accuracy is evaluated based on understanding intents and entities, with test stories created to assess accuracy. Limitations include the need for increased training instances for the RASA NLU component and enhanced chatbot deployment in native languages for rural populations.

In the paper [5], the focus is on LLM chatbots for physical science research, demonstrating combined methods to create domain-specific chatbots for scientists. Image embedding aids in the search and retrieval of scientific publication figures, and the LLM chatbot (Chat-GPT4) is utilized as a digital assistant. LLMs are deemed suitable for physical scientists to accelerate research efforts, with the ability to classify scientific documents and accelerate literature-based discovery. However, limitations include limited knowledge of physical science and deployment challenges for non-experts, requiring simplified fine-tuning methods and efficient strategies for local deployment and utilization by physical scientists.

In paper [6], deep learning for an Assistant

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

Conversational Agent is the focus, utilizing the Tensorflow library for the Neural Machine Translation model and employing Bidirectional RNN with attention layers for conversation appropriateness. Initial perplexity, learning rate, Bleu score, and average time per 1000 steps are evaluated, with the maximum Bleu score reached at a specific step.

Paper [7] introduces the Build-a-Bot tool for AI education with transformer-based chatbots, aiming to teach AI principles through natural language pipeline training. The tool focuses on AI education for students and teachers, facilitating constructivist learning of AI in the classroom and developing problem-solving skills by engaging with complex systems.

In the paper [8], the Seq2Seq model's potential in educational chatbot development is explored, focusing on optimizing the model for natural answer generation. The importance of word embedding over character embedding is demonstrated, with a recurrent Neural Network based Sequence-to-sequence (Seq2Seq) model utilized. Dropout rates impact model performance and variations in questions are handled, generating correct answers. However, limitations include the need to address word embedding limitations and more research on the Seq2Seq model for conclusive findings.

Paper [9] provides insights into Azure chatbots and their potential impact in various fields, highlighting their benefits for businesses and sectors with less-educated users. .NET and Node.js are central to this technology, offering accessibility to a wide range of users and holding promise for future advancements.

Paper [10] scrutinizes intent recognition and slot-filling strategies, offering a meticulous analysis of the literature and suggesting potential avenues for future research. By addressing both progress and open issues in e-commerce chatbot technologies, this work aims to foster further innovation in the field.

Paper [11] describes the development procedure for chatbots in recruiting, focusing on user-centered intent identification and analysis. Approaches for intent consolidation and their impact on intention identification quality are discussed, providing insights for chatbot developers.

In the paper [12], the focus is on Named Entity Recognition (NER) and Intent Classification models integrated into the NLU service of a Chatbot. The proposed architecture employs an artificial neural network for the NER model, trained on manually created entities and evaluated using the CoNLL-2003 dataset.

Paper [13] examines dialogue management from a design perspective, discussing state-of-the-art approaches, recent advances, and challenges. The paper aims to guide researchers and practitioners in selecting appropriate dialogue management approaches aligned with their objectives.

III. 10 KEY AI TECHNOLOGIES USED IN BUILDING CHATBOTS:

In the dynamic world of artificial intelligence (AI) and chatbot development, many important technologies are helping to create intelligent chatbots. These technologies help define the chatbot's functions and features. This article takes an in-depth look at ten key technical concepts used in chatbot development. Through a detailed analysis of each technology, we aim to gain a deeper understanding of their importance, practical use and impact on today's chatbot systems. We begin with an introduction and brief review of these ten technologies.

1. NATURAL LANGUAGE UNDERSTANDING:

Imagine a student interacting with a patient tutor who can decipher not just languages but also the unique way students express themselves while learning. This "tutor" is Natural Language Understanding (NLU), a technology that bridges the gap between a student's questions and the knowledge a chatbot possesses. NLU acts like an interpreter, unraveling the intent behind a student's words and enabling the chatbot to respond in a clear and informative way.

Natural Language Understanding goes beyond simply understanding the dictionary definition of words. It empowers chatbots to grasp the underlying meaning, intention, and context within a student's query. Think of it as giving a machine the ability to understand the "why" behind the "what" – the student's learning goals and thought process when they ask a question.

NLU is the secret weapon that allows chatbots to understand your questions and requests with greater depth. It enables them to move beyond simple keyword matching and respond in a way that's relevant and helpful to your specific needs. This makes chatbots more engaging and effective for educational tasks, as well as various applications like customer service and healthcare.

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

Fig 1. Model Diagram for NLU

2. WORD EMBEDDING

Imagine a student asking a chatbot, "What are the synonyms for 'happy' but not 'glad'?" A traditional chatbot might struggle, relying on exact keyword matches. Here's where **word embeddings** come in – they act like a super-powered thesaurus for chatbots, understanding therelationships between words, not just their literal definitions.

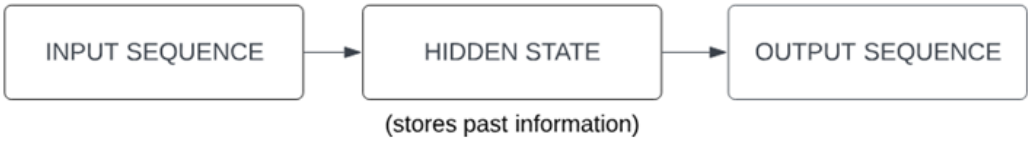

Fig 2. Model Diagram for Word embeddings

Word embeddings are numerical representations of words. Each word is mapped to a vector ina high-dimensional space, where similar words occupy nearby positions. This allows the model to capture semantic relationships between words based on their co-occurrence or context in a large corpus of text.

Word embeddings address a significant challenge faced by traditional chatbot development - data sparsity. Traditional methods often struggle with rare words or unseen phrases that mightnot be present in the training data. However, word embeddings overcome this limitation by representing words based on their relationships to other words. This allows the chatbot to make informed guesses about the meaning of unfamiliar words, reducing the impact of data sparsity and fostering more robust chatbot interactions.

3. RNN

Traditional chatbots often operate in a sentence-by-sentence world, lacking the ability to remember past interactions. This can lead to repetitive or irrelevant responses. Here's where Recurrent Neural Networks (RNNs) come into play. Unlike their forgetful counterparts, RNNspossess a unique "memory" that allows them to analyse the entire conversation history, leading to more contextual and engaging chatbot interactions.

Fig 3. Model Diagram for RNN

RNNs achieve this feat by incorporating a loop within their architecture. Information from the current input and a hidden state containing the "memory" of previous inputs are processed together. This hidden state is then updated and used in conjunction with the next input, allowing the network to learn from the entire conversation sequence.

RNNs pave the way for personalized interactions. By analysing past conversations, they can tailor responses to individual user preferences and conversation history. This fosters a more natural and engaging experience. Imagine a chatbot that remembers your favourite movie genre and recommends similar films based on past discussions. RNNs empower chatbots to learn from past interactions and create a more user-centric conversation experience.

4. TRANSFORMER MODEL

Imagine a student seeking help with a complex math problem. A traditional chatbot might struggle, analysing the equation piece by piece. This

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

can lead to misunderstandings, as the meaning often relies on the relationships between different parts. This is where Transformer models come in – a powerful AI technique that excels at understanding these long-range dependencies in language.

Unlike traditional Recurrent Neural Networks (RNNs) that process information sequentially (word by word), Transformers can analyse the entire problem statement at once. This holistic approach, similar to how humans read and understand, empowers chatbots to tackle complex queries and deliver more accurate results.

The secret to this ability lies in the unique architecture of Transformers. They analyse all parts of a sentence simultaneously, allowing them to identify relationships between words, even if they are far apart in the sequence. In the math problem example, the Transformer can understand the connections between variables and operators, leading to a more accurate interpretation of the problem and potentially a solution.

By leveraging Transformers, chatbots gain the ability to handle complex language tasks with greater ease. This unlocks a new level of understanding and interaction, enabling chatbots to deliver superior user experiences across various domains.

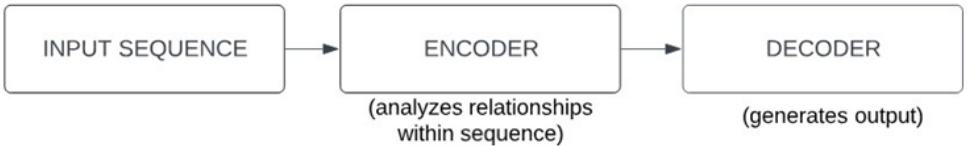

Fig 4. Model Diagram for Transformer

5. SEQUENCE-TO-SEQUENCE MODEL

Imagine a student asking a chatbot to explain a complex scientific concept. A traditional chatbot might struggle, offering fragmented pieces of information. Sequence-to-Sequence (Seq2Seq) models offer a solution. They act like skilled storytellers, analysing an input sequence (the student's question) and generating a corresponding output sequence (a clear and concise explanation). This ability to translate between different information formats makes Seq2Seq models a powerful tool for chatbot development.

Seq2Seq models function by utilizing two key components: an encoder and a decoder. The encoder analyses the input sequence, capturing its essence and meaning. This information is then passed to the decoder, which generates a new sequence based on the encoded information. In our example, the encoder would understand the scientific concept from the student's question, and the decoder would translate that understanding into a clear explanation.

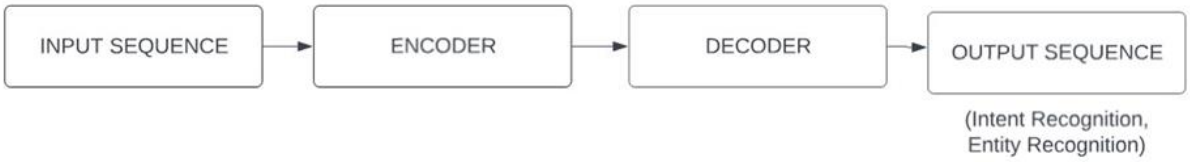

Fig 5. Model Diagram for Seq2Seq

Seq2Seq models bridge the gap between understanding a user's intent and delivering a comprehensive response. Their storytelling abilities make them valuable tools for crafting engaging and informative chatbot interactions.

6. CONVERSATIONAL BOT SERVICES

Imagine you're building a new chatbot for your business, but the world of AI development seems overwhelming. Here's where Conversational Bot Services come in – like pre-built toolkits for chatbots. These services offer a simplified approach, allowing you to develop chatbots without extensive coding knowledge. Think of them as user-friendly platforms with drag-and-drop functionalities and pre-trained models.

Conversational Bot Services streamline the chatbot development process in several ways:

- **Reduced Development Time:** By offering pre-built components and intuitive interfaces, these services significantly reduce the time and effort required to build a chatbot. You can focus on customizing the chatbot's functionalities and

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

training it on your specific data, rather than starting from scratch.

- **Simplified Integration:** Integrating chatbots into your existing website or application can be a technical hurdle. Conversational Bot Services often provide easy-to-use integration tools, allowing you to seamlessly connect your chatbot to your preferred platform.
- **Accessibility for Non-Programmers:** These services democratize chatbot development by making it accessible to a broader audience. Even without extensive coding expertise,you can leverage pre-built functionalities and user-friendly interfaces to create a functional chatbot.

Fig 6. Model Diagram for Conversational Bot Services

However, it's important to consider potential limitations:

- **Customization:** While offering flexibility, Conversational Bot Services might have limitations in terms of deep customization. For highly specialized chatbots with unique functionalities, custom development might be necessary.
- **Vendor Lock-In:** Some services might restrict you to their platform and ecosystem. Thiscould limit your control over the chatbot's data and future development options.

Conversational Bot Services offer a compelling option for businesses looking to build chatbots quickly and efficiently. They are a great starting point, particularly for those without extensive programming resources. However, carefully evaluate your needs for customization and long-term control before making a decision.

7. SLOT FILLING

Imagine a travel chatbot assisting you with booking a vacation. You tell it you'd like to go somewhere "sunny and warm." While this narrows things down, the chatbot needs more specific details to find the perfect getaway. Here's where Slot Filling comes in – it acts like a detective, gathering crucial information from users to complete tasks. In our example, the chatbot would use Slot Filling to identify missing details like your preferred travel dates, destination type (beach, city, etc.), and budget.

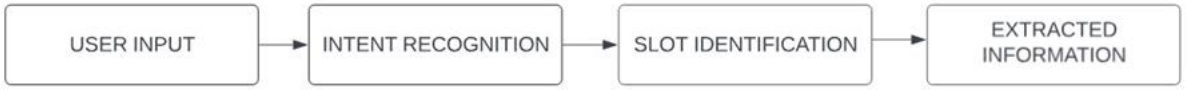

Fig 7. Model Diagram for Slot Filling

Slot Filling works by recognizing pre-defined pieces of information (called slots) within a user's query. These slots could be anything from locations and dates to names and quantities. The chatbot then employs various techniques like pattern matching or machine learning to extract the missing information from the user's conversation.

This targeted information gathering empowers chatbots in several ways:

- **Improved Task Completion:** By filling in the blanks, Slot Filling ensures chatbots gather all the necessary details to complete tasks efficiently. This translates to a smoother user experience, as users don't have to repeat information or answer unnecessary clarifying questions.
- **Enhanced Personalization:** With the missing pieces filled in, chatbots can personalize responses and recommendations. In our travel example, knowing your preferred dates and budget allows the chatbot to suggest specific destinations and deals that align perfectly with your needs.
- **Reduced User Frustration:** Imagine constantly repeating information to a chatbot. Slot Filling eliminates this frustration by proactively prompting users for missing details in a natural way. This keeps the conversation flowing smoothly and ensures theuser gets the desired outcome.

By acting as a detective for missing information, Slot Filling plays a crucial role in creating efficient and user-friendly chatbot experiences. It ensures chatbots gather the necessary details to complete

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

tasks accurately and personalize interactions, ultimately leading to happier users and a more successful chatbot implementation.

8. INTENT RECOGNITION

Imagine you're chatting with a friend online. You might say, "Hey, can you recommend a good movie?" Instantly, your friend understands your intent – you're looking for a movie recommendation. This ability to grasp the underlying goal of a message is crucial for chatbots as well. Intent Recognition acts like a mind reader for chatbots, allowing them to understand the user's true purpose behind their words.

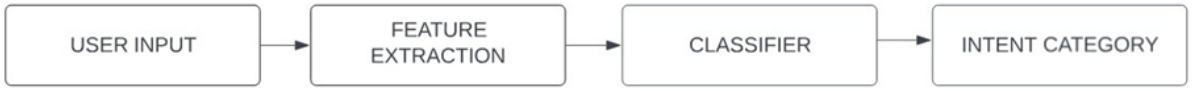

Fig 8. Model Diagram for Intent Recognition

Intent Recognition works by analysing the user's query and classifying it based on pre-defined categories. These categories represent the different actions or tasks a user might want the chatbot to perform. In our example, the chatbot would analyse your message and recognize your intent as "seeking movie recommendation."

This ability to decode user intent unlocks several benefits for chatbots:

- **Efficient Task Routing:** By understanding the user's goal, the chatbot can efficiently route them to the appropriate functionality or response. This ensures a smooth user experience without unnecessary back-and-forth exchanges.
- **Accurate Information Retrieval:** When a user asks a question, their intent determines the kind of information they seek. Intent Recognition allows the chatbot to retrieve the most relevant information based on the user's goal, leading to more preciseand helpful responses.
- **Improved User Satisfaction:** Imagine a chatbot constantly misunderstanding your requests. Frustrating, right? Intent Recognition minimizes such situations by accuratelyinterpreting user intent. This leads to a more satisfying chatbot experience for users.

Think of Intent Recognition as the foundation for meaningful chatbot interactions. By understanding what users truly want, chatbots can deliver relevant information, complete tasks accurately, and ultimately create a positive user experience.

9. NAMED ENTITY RECOGNITION (NER)

Imagine chatting with a virtual travel assistant, crafting your dream vacation. You mention your interest in visiting "the Eiffel Tower." While this conveys a general preference, pinpointing specific entities (places and landmarks) is crucial for creating a perfect itinerary. Here's where Named Entity Recognition (NER) steps in. It acts like a digital mapmaker, identifying the real-world entities users mention in their conversations. In our example, NER would recognize "The Eiffel Tower" as a landmark and "Paris" as a location.

NER analyses text and categorizes specific words or phrases into predefined categories like people, organizations, locations, dates, and more. This allows chatbots to grasp the context of user queries with greater accuracy.

This ability to pinpoint specific entities offers several advantages for chatbots:

- **Accurate Information Retrieval:** By identifying entities users mention, chatbots can retrieve relevant information with pinpoint precision. In our travel example, NER allows the assistant to find information about the Eiffel Tower, like visiting hours or ticket bookings.
- **Enhanced User Experience:** Imagine a chatbot misinterpreting "Paris, Texas" for the city of Paris. NER prevents such errors by accurately identifying specific locations and other entities, leading to a more accurate and frustration-free user experience.
- **Contextual Responses:** With a clear understanding of entities, chatbots can tailor responses to the specific context of the conversation. This allows them to provide more relevant and informative answers to user queries.

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

Fig 9. Model Diagram for NER

10. DIALOG MANAGEMENT SYSTEMS

Imagine you're having a complex conversation with a friend. You don't just throw random sentences back and forth; you build upon each other's ideas, keeping the conversation flowingnaturally. This ability to manage the flow of a dialogue is crucial for chatbots as well. Here's where Dialog Management Systems (DMS) come in – they act like conversation conductors, ensuring a smooth and coherent interaction between the user and the chatbot.

DMS operate behind the scenes, keeping track of the conversation history and context. They analyse the user's current query in relation to what's been discussed before. This allows them to:

• **Maintain Context:** DMS ensure the chatbot remembers past interactions and avoids repetitive introductions or clarifications. Imagine a user asking about different features of a product they previously inquired about. A DMS-powered chatbot wouldn't start from scratch, but would reference the past conversation to provide relevant details aboutthe specific features.

• **Navigate Multi-Step Requests:** Some user requests might involve multiple steps. A DMS allows the chatbot to track the progress of the request and guide the conversation towards its completion. For example, if a user asks for flight recommendations and then mentions a preferred price range, the DMS ensures the chatbot keeps the price range inmind when suggesting flights.

• **Handle Errors and Recover:** Conversations don't always go perfectly. A user might ask an ambiguous question or provide incorrect information. Here, a DMS plays a crucial role in error handling and recovery. It can prompt the user for clarification, rephrase the question, or offer alternative options, keeping the conversation moving forward productively.

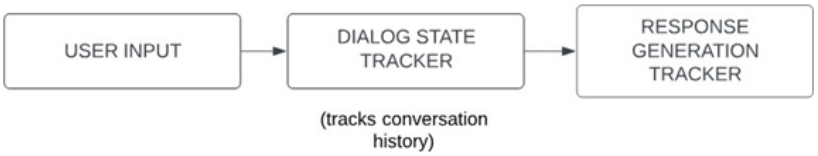

Fig 10. Model Diagram for DMS

By acting as the conductor of the conversation, DMS are essential for creating natural and engaging chatbot interactions. They ensure the conversation flows smoothly, avoids dead ends,and ultimately leads to a more satisfying user experience.

Here we can have a structured comparison of the AI technologies based on their data sources, frameworks/languages used, advantages, disadvantages, and parameters used for testing. Each technology offers unique capabilities and considerations for chatbot development.

AI TECHNOLOGY	DATA SET /DATA SOURCES	FRAMEWORKS /PROGRAMMING LANGUAGES	A ADVANTAGES	D DISADVANTAGES	PARAMETER USED FOR TESTING	MODEL /IMPLEMENTATION
NLU	Educational websites, Textbooks, Educational forums	Python (SpaCy, NLTK)	Accurate interpretation of user queries	Limited understanding of complex nuances	Accuracy,Precision, Recall	Pre -trained language models (e.g.BERT, RoBERTa)
Word Embedding	Large text corpora, Web pages, Wikipedia	Python (Gensim, TensorFlow)	Captures semantic meaning ofwords	Requires extensive preprocessing	Similarity, Contextual Understanding	Word2Vec,Glove

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

RNN	Chat logs, Conversational data	Python (TensorFlow, Keras)	Captures sequential dependencies	Vulnerable to vanishing gradient problem	Loss, Perplexity, ConvergenceRate	Long Short Term Memory(LSTM)
Transformer Model	Large-scale textcorpora, Web pages	Python (Hugging Face Transformers)	Efficient handling oflong-range dependencies	High computational cost during training	Attention Scores, BLEUScore	Encoder- Decoder architecture with attention mechanism
Sequence-to-Sequence Model	Chat logs, Conversation data	Python (TensorFlow, PyTorch)	Suitable for generating responses in dialogue systems	Prone to generating generic responses	BLEU Score, ROUGE Score	Encoder- Decoder architecture
Conversational Bot Services	Pre-built chatbot platforms (Dialogflow, Microsoft Bot Framework)	Dialogflow, Microsoft Bot Framework	Rapid development and deployment	Limited customization and control	Conversational Flow, Error Handling	Pre-buildAPIs or Platforms
Slot Filling	Annotated text data, Domain-specific datasets	Python (Rasa,Snips)	Precise extraction of structured information	Difficulty handling ambiguous queries	Slot Accuracy,F1 Score	Machinelearning classifier
Intent Recognition	Annotated text data, Chat logs	Python (Rasa, Dialogflow)	Accurate classification of user intents	Limited performance withrare intents	Intent Accuracy, ConfusionMatrix	Support Vector Machine(SVM)
Named Entity Recognition (NER)	Annotated text data, Domain-specific datasets	Python (SpaCy, NLTK)	Accurate extraction of named entities	May struggle with out-of-vocabulary entities	Entity-Level Precision, Recall	ConditionalRandom Field(CRF)network
Dialog Management Systems (DMS)	Rule-based systems, decision trees	Python (Rasa, Dialogflow)	Controls conversation flow, maintains context across multiple turns	May struggle with unforeseen user interactions, requires manual rule definition	Average Conversational Length, Number of handoffs to live agents	Rule based system with state tracking

Table 1. Detailed comparison of 10 key AI technologies used in building chatbots

This table highlights the key aspects of each AI technology, aiding you in selecting the most suitable tools for your chatbot development project. Remember, the best approach often involves combining multiple techniques to create a robust and engaging chatbot experience.

IV. REAL WORLD APPLICATIONS ON EDUCATIONAL CHATBOTS:

Over the past decade, AI-based chatbots have revolutionized education by offering personalized learning experiences, accessible 24/7 learning resources, and interactive learning interactions. These chatbots act as virtual assistants, efficiently supporting students with queries and providing guidance through complex concepts. Moreover, they offer scalability and accessibility, accommodating diverse learning needs and preferences. Educators benefit from data-driven insights, enabling them to track student progress and tailor instructional strategies. Continuous improvement and innovation in AI technologies ensure that chatbots evolve to meet the evolving demands of education, promising a future where learning is more accessible, engaging, and effective for all learners.

Let's explore ten real-world applications that demonstrate the utilization of key AI technologies discussed above within educational chatbots. Each application showcases how these technologies are integrated to enhance learning experiences and provide effective support for students and educators alike.

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

AI TECHNOLOGY	CHATBOT EXAMPLE	DATA USED FOR TRAINING	TYPES OF USERS	APPLICATION DESCRIPTION
Natural Language Understanding (NLU)	Duolingo chatbot	Educational websites, Textbooks, Educational forums	Students learning languages	Interprets user queries about grammar, vocabulary, and pronunciation for language learning.
Word Embeddings	Khan Academy chatbot	Wikipedia, Google News, Educational materials	Students of various subjects	Recommends educational content based on semantic relationships between words.
Recurrent Neural Networks (RNNs)	IBM Watson tutor	Educational dialogue datasets, Transcripts of educational videos	Students seeking personalized tutoring	Engages students in dialogue-based learning interactions and provides tailored assistance.
Sequence-to-Sequence Models	Socratic by Google	Translation datasets, Question-answer datasets	Students seeking homework help	Generates step-by-step explanations for homework problems and assists in understanding concepts.
Transformer Models	Brainly chatbot	Pre-trained language model datasets, Educational forums	Students seeking academic help	Provides detailed explanations and answers to academic questions across various subjects.
Dialog Management Systems	Quizlet chatbot	Chatbot interaction logs, Simulated student-tutor dialogues	Students studying with flashcards and quizzes	Guides students through interactive study sessions and adapts the learning sequence based on progress.
Named Entity Recognition (NER)	Chegg chatbot	Labeled educational text data, Educational documents	Students seeking specific information	Identifies and categorizes named entities such as course names and academic terms to provide targeted assistance.
Intent Recognition	Coursera chatbot	Student query logs, Labeled datasets of educational queries	Students interacting with online courses	Classifies user queriesinto categories such ascourse enrollment, assignment submission, or technical support.
Slot Filling	Grammarly chatbot	Annotated student interactions, Task-specific datasets	Students seeking writing assistance	Extracts specific information from student writing samples to provide grammar andstyle suggestions.
Conversational AI Platforms	Blackboard chatbot	Educational chatbot interaction data, Multi-domain dialogue datasets	Students and educators in various educational settings	Offers personalized tutoring, feedback, and support across diverse educational domains and subjects.

Table 2. Comparison of 10 AI technologies with current available chatbots

Overall, understanding different AI technologies, their applications in AI chatbots, and studying successful products in the field equips developers with the knowledge and insights needed to create high-performing, engaging, and successful chatbot solutions.

International Journal of Engineering, Management and Humanities (IJEMH)
Volume 5, Issue 2, Mar.-Apr., 2024 pp: 224-235 ISSN: 2584-2145
www.ijemh.com

V. RESULTS:

Our research has been primarily focused on examining ten key AI technologies tailored for educational chatbots, providing a specialized insight into their advantages and limitations within the educational context. Through meticulous analysis, we aimed to offer valuable insights specifically targeted toward developers and educators.

The comparison table not only shed light on the diverse training data sources, testing parameters, and performance metrics associated with each AI technology but also facilitated a deeper understanding of their specific advantages and disadvantages in educational applications. For instance, while Natural Language Understanding (NLU) showcased proficiency in interpreting user queries related to language learning, it encountered challenges with handling complex linguistic nuances or specialized educational topics.

Furthermore, our exploration of real-world chatbot applications in education underscored the versatility and adaptability of AI technologies in meeting diverse educational needs. For instance, Recurrent Neural Networks (RNNs) demonstrated effective utilization in personalized tutoring scenarios, where they engaged students through dialogue-based learning interactions, providing tailored assistance based on individual learning preferences.

Additionally, we identified significant advantages of AI-powered chatbots in education, including their capacity to offer personalized learning experiences, provide 24/7 access to learning resources, and enhance student engagement through interactive learning interactions. However, we also acknowledged potential limitations, such as the necessity for large and diverse datasets for effective training and the challenges associated with maintaining context and understanding complex user queries.

In summary, our research highlighted the transformative impact of AI-powered chatbots on enriching learning experiences for students within the educational domain. By gaining a deeper understanding of the specific applications, advantages, and limitations of these ten AI technologies, developers and educators can make informed decisions about integrating chatbots into educational settings, ultimately fostering improved learning outcomes and student success.

VI. FUTURE RESEARCH DIRECTIONS:

This study provides a valuable foundation for understanding the role of AI technologies in chatbot classification especially in educational field. However, there's always room for further exploration. Here are some interesting avenues for future research:

- Investigate the ethical considerations surrounding the use of AI in chatbots, particularly regarding data privacy, bias mitigation, and transparency in decision-making processes.
- Explore the potential of emerging AI techniques like explainable AI (XAI) for improving user trust and understanding how chatbots reach their classifications.
- Examine the user experience (UX) implications of different classification strategies. How can chatbots be designed to effectively communicate the reasoning behind their classifications to users?
- Analyse the scalability and integration challenges associated with deploying AI-powered chatbots across diverse applications and domains.

By delving deeper into these areas, researchers can contribute to the development of more robust, ethical, and user-friendly chatbot classification systems, paving the way for a future where chatbots seamlessly integrate into various aspects of our lives.

VII. CONCLUSION:

In the grand tapestry of educational innovation, the threads of AI-powered chatbots weave a narrative of endless possibilities. Our voyage through the realms of AI technologies has unveiled vistas of personalized learning, perpetual access to knowledge, and profound student engagement. Yet, amidst the boundless promise, we encounter the rugged terrain of dataset limitations and the labyrinthine pathways of user interaction complexities.

Our exploration of ten key AI technologies paints a vivid picture of their transformative potential in empowering chatbots for classification tasks. Our journey through the intricate world of AI classification has unveiled a treasure trove of insights. The meticulously crafted comparison table stands as a testament to this, offering a comprehensive roadmap for developers. Each AI technology, from Natural Language Understanding to Named Entity Recognition, brings its own unique strengths to the table. We've witnessed their prowess in educational chatbots,

personalizing learning paths, offering 24/7 access to knowledge, and fostering interactive learning environments. However, the path forward isn't without its challenges. Dataset dependence, the complexities of user queries, and ethical considerations all demand careful attention. Yet, the potential is undeniable. By equipping developers with this newfound knowledge, we empower them to create chatbots that excel in classification tasks, ultimately shaping a future where AI-powered interactions become seamless and transformative across all domains.

As we take the next strides forward, let us embrace the dawn of a new era, where technology becomes the beacon guiding learners toward new horizons. Let us seize the opportunities that beckon, leveraging the power of AI to empower minds, enrich experiences, and sculpt a future where learning transcends barriers and shapes generations to come. Together, let us embark on this journey, where the fusion of technology and education ignites the flames of innovation, illuminating the path toward a brighter tomorrow.

REFERENCES

[1]. O. Trofymenko , Y. Prokop , N. Loginova and A. Zadereyko, "Taxonomy of Chatbots", National University "Odessa Law Academy", Fontanska doroga str., 23, Odesa, 650091, Ukraine State University of Intellectual Technologies and Communications, Kuznechna str., 1 Odesa, 65029, Ukraine

[2]. Dr.M.V.Vijaya Saradhi, G Swajan Reddy, Ch Arun Reddy, Ch Saikumar, Tamarapu Adityan, "Survey on Chatbot Classification and Technologies", International Research Journal of Engineering and Technology (IRJET), Volume: 09 Issue: 11 | Nov 2022

[3]. Anran Jiao Nankai University, Tianjin, 300071, China, "An Intelligent Chatbot System Based on Entity Extraction Using RASA NLU and Neural Network", Journal of Physics, 2020

[4]. Supreetha H V, Sandhya S , "Implementation of an Educational Chatbot using Rasa Framework", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075 (Online), Volume-11 Issue-9, August 2022

[5]. Kevin G. Yager , "Domain-specific ChatBots for Science using Embeddings", Digital Discovery, 2023

[6]. Manyu Dhyani , Rajiv Kumar, "An intelligent Chatbot using deep learning with Bidirectional RNN and attention model", 2214-7853/ 2019 Elsevier

[7]. Kate Pearce, Sharifa Alghowinem, Cynthia Breazeal, "Build-a-Bot: Teaching Conversational AI Using a Transformer-Based Intent Recognition and Question Answering Architecture", arXiv:2212.07542v1 2022

[8]. Kulothunkan Palasundram, Nurfadhlina Mohd Sharef, Nurul Amelina Nasharuddin, Khairul Azhar Kasmiran, Azreen Azmanm "Sequence to Sequence Model Performance for Education Chatbot", International journal of Emerging Technologies in Learning.

[9]. Khushbu Tolani, Anupama Jawale, "Study of Azure chat bots services", International Research Journal of Modernization in Engineering Technology and Science, Volume:03/Issue:06/June-2021

[10]. Avinash Adsare, Ayush Kadam, Nikhil Jadhav, Sandesh Pansare, Professor Sapana Bhirud, "Intent Recognition and Slot Filling for Ecommerce Chatbot: A Review", International Journal of Science, Engineering and Technology, 2024

[11]. Stephan Bohm, Judith Eißer, and Sebastian Meurer, Olena Linnyk, Jens Kohl, Harald Locke, Levitan Novakovskij, and Ingolf Teetz , "Intent Identification and Analysis for User-centered Chatbot Design: A Case Study on the Example of Recruiting Chatbots in Germany", The Thirteenth International Conference on Advances in Human-oriented and Personalized Mechanisms, Technologies, and Services, CENTRIC 2020

[12]. Nazakat Ali , "Chatbot: A Conversational Agent employed with Named Entity Recognition Model using Artificial Neural Network", 2020

[13]. Hayet Brabra, Marcos Baez, Boualem Benatallah, Walid Gaaloul, Sara Bouguelia, Shayan Zamanirad , "Dialogue management in conversational systems: a review of approaches, challenges, and opportunities", IEEE Transactions on Cognitive and Developmental Systems, 2022