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ENHANCING LIBRARY CHATBOT USING MACHINE LEARNING WITH READ ALOUD TECHNOLOGY

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Abstract: Enhancing Library Chatbot Using Machine Learning with Read-Aloud Technology project aims to enhance user experiences and Uses streamline Framework as it's Front end and leveraging conversational AI technology. This Chatbot will serve as a virtual assistant, providing users with quick and convenient access to information about library resources, such as books, opening hours, and events. Additionally, it will assist in answering common library-related questions, guiding users through the library's physical layout, and recommending books based on their preferences. The Chatbot will offer 24/7 support. It will incorporate natural language processing capabilities to understand and respond to user queries effectively and has Read-aloud technology.

Keywords—Library Chatbot, Read aloud Technology, machine learning.

INTRODUCTION`

Enhancing Library Chatbot Using Machine Learning with Read-Aloud Technology project aims to enhance user experiences and uses streamline Framework as it's Front end and leveraging conversational AI technology. This Chatbot will serve as a virtual assistant, providing users with quick and convenient access to information about library resources, such as books, opening hours, and events. Additionally, it will assist in answering common library-related questions, guiding users through the library's physical layout, and recommending books based on their preferences. The Chatbot will offer 24/7 support. This project seeks to improve user engagement, reduce operational workload, and create a more user-friendly library environment, ultimately fostering a culture of lifelong learning and reading. Furthermore, the "Chatbot for Library" project will prioritize user-centric design, ensuring that the Chabot's interface is intuitive and accessible. It will incorporate Natural language processing capabilities to understand-learn and respond to user queries effectively and has a feature of text to speech and vice-versa. The Chatbot will continuously learn from user interactions and adapt to evolving user needs, making it a dynamic and valuable tool for library users.

By promoting digital literacy, providing quick and accurate information, and offering personalized recommendations, this project aims to contribute to the library's mission of facilitating learning and knowledge dissemination in an increasingly digital age. It will be developed with scalability in mind, enabling it to serve as a model for other libraries looking to enhance their services through AI-powered conversational agents. The Problem Statements for this project is, Inappropriate response**,** sometimes database may give the inappropriate information to the user. Crash Down of Chatbot**,** More the data base server is busy or When Many people try to access the Chatbot it has a chance of crashing down.

A Chatbot may crash caused by the technical issues, sometimes the software bugs may lead to crash down, or sometimes there may be an error in the code. Lack of engagement, if a Chatbot fails to engage users effectively, it would not stick to their interest or provide valuable information. This could be due to a lack of conversational flow, insufficient understanding of user queries, or a limited ability to generate relevant and interesting responses. Lack of user experience**,** a rare user can experience errors from various factors, such as a clunky interface, slow response times, or difficulty in navigating the chatbot's functionalities.

Literature Review:

The integration of chatbot technology with read aloud capabilities in libraries presents a promising avenue for enhancing user engagement and accessibility to library resources. Studies such as "Implementation of Chatbot Technology in Libraries" and "Enhancing Library Services through Chatbot Technology" highlight the potential benefits of chatbots in providing instant assistance, personalized recommendations, and improving overall user experience. [9]

This project aims to address the complexity of human emotions in the modern environment, where individuals are exposed to a plethora of information and experiences due to technological advancements and globalization. The project recognizes that user interests across multiple social network platforms are interconnected and non-uniform, posing challenges for traditional approaches. To tackle this, the project proposes a web application integrated with machine learning techniques, such as linear regression, to predict human sentiments. Users are invited to participate in surveys, and their responses are processed to identify relationships between independent variables (such as user activities across social networks) and a dependent variable representing sentiment.[10]

This study explores the implementation of a voice-enabled chatbot for library services, highlighting the benefits of hands-free interaction and personalized assistance. The research emphasizes the importance of user-centered design in optimizing the chatbot experience.[1]

Chen and Li investigate the potential of voice-activated chatbots in academic libraries, focusing on their role in streamlining reference services and supporting information retrieval tasks. 3The study underscores the significance of natural language processing (NLP) algorithms in enhancing chatbot effectiveness.[2]

Davis and Garcia discuss how voice-enabled chatbots can enhance library accessibility, particularly for users with disabilities. Their research highlights the integration of read aloud technology as a means of providing equitable access to library resources.[3]

Kim and Lee examine the user experience implications of voice-activated chatbots in public libraries, emphasizing the role of user interface design in facilitating seamless interactions. Their findings underscore the importance of user feedback in refining chatbot functionality.[4]

Patel and Shah investigate the utilization of read aloud technology in library chatbots specifically for visually impaired users. Their study offers insights into the design considerations and technical challenges associated with accommodating diverse user needs.[5]

Gonzales and Nguyen explore voice-activated chatbots as a novel frontier for library services, highlighting their potential to enhance patron engagement and information access. The research emphasizes the importance of usability testing in optimizing chatbot performance.[6]

Wang and Liu focus on the design principles behind voice-enabled chatbots for library reference services, emphasizing the need for natural language understanding and conversational capabilities. Their study offers practical recommendations for implementing voice-activated features in library settings.[7]

Martinez and Rodriguez present a case study on implementing read aloud technology in library chatbots, detailing the technical implementation process and user feedback. The research highlights the importance of continuous improvement and iteration in chatbot development.[8]

Methodology:

Creating library chatbot along with read aloud feature goes with the following steps:

- Training data preparation

- Pre trained Neural model
- Neural network model development using pytorch
- Creation of GUI and chatbot

First let us go through the system architecture that shows the functioning of chatbot.

3.1 System Architecture

The system architecture gives a high-level overview of the functions and responsibilities of the system. It defines the breakdown of the system into various sub systems and the individual roles played by them. The system architecture of the proposed system is shown.

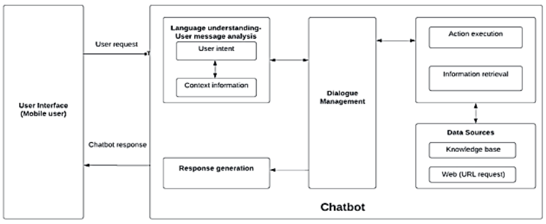
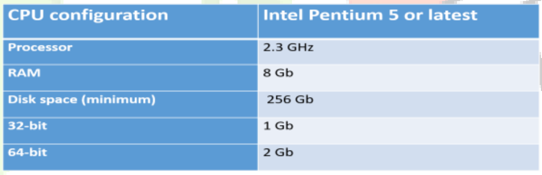


Fig.1: System Architecture

3.2 System Requirements

Hardware Requirements:

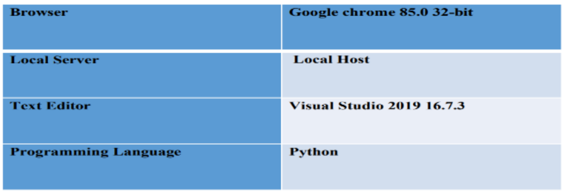


CPU configuration	Intel Pentium 5 or latest
Processor	2.3 GHz
RAM	8 Gb
Disk space (minimum)	256 Gb
32-bit	1 Gb
64-bit	2 Gb

Table.no 1: Hardware Requirements

Hardware Requirements that are required for the project are shown in the above table.no 1.

Software Requirements:



Browser	Google chrome 85.0 32-bit
Local Server	Local Host
Text Editor	Visual Studio 2019 16.7.3
Programming Language	Python

Table.no 2: Software Requirements

Software Requirements that are required for the project are shown in above table.no 2.

3.3 Training data preparation

Tokenization and Bag-of-Words Representation: Tokenization: Involves breaking down of sentence or pattern into individual words or tokens.For e.g.: "How are you?" would be tokenized as: ["How", "are", "you", "?"].

Bag-of-Words Representation: Once tokenized, we create a numerical representation of each pattern using a bag-of-words approach. This representation counts the occurrence of each wordin the pattern and creates a vector where each element corresponds to the count of a particular word in the pattern. For e.g. if we have a vocabulary of ["How", "are", "you", "?", "today"], thebag-of-words represented as "How are you?" might be [1, 1, 1, 0, 0].

3.4 Pre trained neural model.

For each pattern (tokenized and represented as a bag-of-words), we pair it with its corresponding tag. This creates a dataset where each input pattern is associated with a target tag.

For example, if we have the pattern "How are you?" with the tag "greeting", we pair them together as (input pattern, target tag) => (["How", "are", "you", "?"], "greeting").

3.5 Neural network model using pytorch

A simple module in Artificial intelligence that teaches computers to process data in a way the human brain works.

- Model Definition: First, we define the Architecture of this Neural network model using PyTorch.
- Loss Function and Optimizer: We choose a suitable loss function to measure the difference between the predicted outputs of this representative and the actual target labels.
- Training Loop: We iterate over the training dataset for a particular number of epochs (passes through the entire dataset). For each epoch, we divide the dataset into batches andfeed these batches into the neural network model for training.
- Monitoring Training Progress: During training, we monitor the model's performance byperiodically printing the loss value. The loss of value provides perception into how good the model is fitting the training data. A decreasing loss alerts that the model is learning andimproving its predictions.
- Completion: Once the specified number of epochs is completed, the training process ends,and the trained model parameters are saved for future use.

3.6 Modules used to train the data.

- numpy (np): Used for numerical computations, especially array operations.
- Random: Used for fabricating random numbers or shuffling sequences. Part of Python’s standard library.
- Json: Used for reading and writing JSON data. Part of Python's standard library.
- torch: PyTorch is a famous Deep learning framework for developing and training neural networks. Requirement: PyTorch package (torch). Install using pip install torch.
- torch.nn (nn): Contains various neural network layers, loss functions, and utilities.
- torch.utils.data.Dataset: An abstract class representing a dataset in PyTorch. Used forcustom dataset creation. Part of PyTorch.
- torch.utils.data.DataLoader: Wraps a dataset and provides batching, shuffling, andmulti-threading data loading. Part of PyTorch.
- nltk_utils (Custom module): Contains utility purpose for Natural language processing taskslike tokenization and stemming. Needs to be implemented separately. Here it seems tobe provided as a separate file nltk_utils.py.

3.7 Modules used to build chatbot.

- tkinter (tk): Tkinter is Python's standard GUI (Graphical User Interface) package. It provides tools for creating GUI applications. In this code, it's used for creating the chatbot'sgraphical interface. Requirements: Tkinter is part of Python's standard library, so no additional installation is required.
- tkinter.scrolledtext (scrolledtext): A module within Tkinter that provides a widget for displaying and editing text with horizontal and vertical scrollbars. Used here to display thechat history. Part of Tkinter, no separate installation needed.
- random: The random module gives the functions for fabricating random numbers and selecting random elements from sequences (such as lists). It is used frequently when you need to introduce randomness into your code. Requirement in Code: In this code, the random. choice () function is used to randomly select a response from the list of responses for a given intent.
- json: The json module in Python is used for working with JSON (JavaScript Object Notation) data. It provides functions for encoding Python objects into JSON strings and decoding JSON strings into Python objects. Requirement in Code: In this code, the json. load() function helps to load the intents from a JSON file containing responses and tags.
- torch: Torch is a machine learning library in Python primarily used for building and training neural networks. It provides data structures and operations for tensorcomputations, as well as modules for building neural network architectures. Requirement in Code: In this code, the torch module is used for loading a pre-trained neural network model and making predictions with it.
- model: The model module contains the definition of the Neural network model used by thechatbot. It likely includes classes and functions for defining the architecture of the Neural network.

3.8 Modules used for Frontend:

This Project implements a simple chatbot using Streamlit, a library for creating web applications with Python.
Imports:
streamlit: Used for building the web-based user interface.
random: Utilized for generating random responses from the bot.
json: Necessary for loading and saving data in JSON format.
torch: PyTorch library for building and training neural networks.
pyttsx3: A text-to-speech conversion library.
threading: Used for running tasks concurrently.
os: Gives functions to relate with the Operating system.

3.9 Model Loading and Initialization:

The code loads pre-trained intents and a neural network model from files (intents.json, data.pth, model.py, nltk_utils.py).

It sets up the PyTorch model (NeuralNet) for inference and initializes some parameters like input size, hidden size, output size, etc.

It loads the chatbot's name and initializes the text-to-speech engine.

3.10 Functions:

init_engine(): Initializes the text-to-speech engine.
load_chat_history(): Loads chat history from a JSON file.
save_chat_history(): Saves chat history to a JSON file.
send_message(): Handles sending messages to the chatbot and getting responses.
speak_response(): Speaks out the response using the text-to-speech engine.
clear_chat_history(): Clears the chat history and deletes the chat history file.

3.11 Streamlit UI:

Initializes the Streamlit application with the title "Library ChatBot".
Provides a text input field for the user to enter messages.
Provides a button to send messages to the chatbot.
Provides a button to trigger reading aloud the user's message.
Provides a button to clear the chat history.
Displays the chat history in the UI.

IV. JSON Database.

We will use customized JSON files to train our model.

JSON data files contain different Tags such as ‘Greeting, Fees, Name, Books, Canteen etc.

The pre-trained data set consists of 450 tags and 1500 key-value pairs.

Example Data:

```
"tag": "greeting",
      "patterns": [ "Hi", "How are you"]
      "responses": [ "Hello!", "Good to see you again!", "Hi there, how can I help?"]
```

V RESULTS

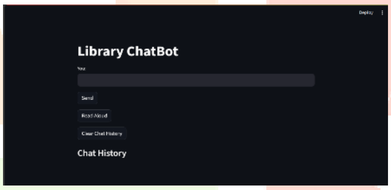
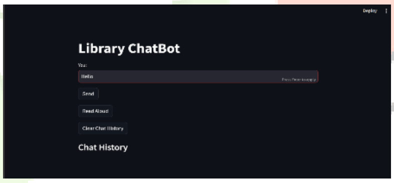
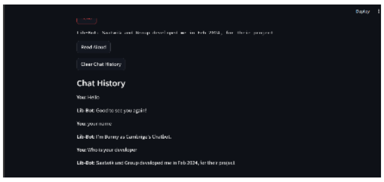


Fig 2: Chatbot interface.



Hello

Fig 3: Chatbot user’s input



Lib-Bot: Saatwik and Group developed me in Feb 2024, for their project

You: Hello

Lib-Bot: Good to see you again!

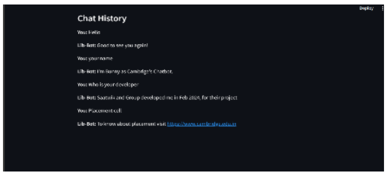
You: your name

Lib-Bot: I'm Bunny as Cambridge's Chatbot.

You: Who is your developer

Lib-Bot: Saatwik and Group developed me in Feb 2024, for their project

Fig 4: Chatbot Response



You: Hello

Lib-Bot: Good to see you again!

You: your name

Lib-Bot: I'm Bunny as Cambridge's Chatbot.

You: Who is your developer

Lib-Bot: Saatwik and Group developed me in Feb 2024, for their project

You: Placement cell

Lib-Bot: To know about placement visit https://www.cambridge.edu.in

Fig 5: Chat history

Fig.2 shows the chatbot interface. In Fig.3 we can see that whenever the user gives an input, it checks for the matching intent and compares the identified intent with the group of intent already existing in the json file. After comparison the matched intents responses will be generated as an output to the users' queries Fig.4. And after result being generated, we can use the option read aloud to hear out the displayed text or response. We can also check previously searched queries that a user had and responses that the chatbot has generated in the chat history, which is shown in Fig.5.

VI. CONCLUSION

In conclusion, our project, titled "Enhancing Library Chatbot using Machine Learning with Read Aloud Technology," has successfully demonstrated the potential for significantly improving library services through the inclusion of advanced Machine Learning Technique and read-aloud technology. Through extensive research and development, we have made many key determinations that not only justify the need for this research but also underscore its significance in enhancing user experiences in libraries. This research has discovered that the incorporation of Machine learning into library chatbots allows for more context aware and user-specific interactions, ultimately leading to a more efficient user experience. Additionally, the integration of read-aloud technology can be a great benefit. Furthermore, the project highlights the importance of ongoing innovation in library services to stay relevant in the digital age. As the digital landscape continues to evolve, libraries must adapt and embrace emerging technologies to meet the changing needs of their users. Our findings serve as a strong justification for the continued development and enactment of Machine learning and read- aloud technology in library chatbots to enhance their functionality, accessibility, and overall user satisfaction. Considering these findings, we propose that libraries and academic institutions invest in the further development and deployment of machine learning-enhanced chatbots with read-aloud capabilities, fostering a more inclusive and user-centric libraryenvironment, thus ensuring that libraries remain vital and responsive institutions in our ever- evolving digital world.

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