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Design of College Chatbot using Amazon Web Services

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***Abstract*- As the mobile and web-based applications have increased rapidly there is a growing need for chatbots. A chatbot helps in easy navigation through a website, simplifies the process of searching information and helps in understanding the needs of the customer. Over the years, the world has seen multiple uses of chatbots implemented in banking and e-commerce platforms. Inspired by these examples, a chatbot for college website can provide various functionalities to the students, lecturers, and visitors. This chatbot can provide information like announcements, quick links to various subjects in the site, account related information for registered users. Students and lecturers can mostly use this to access their college portals to check numerous things like attendance, examination results, assignments deadlines and timetables etc. This deviation from traditional search capabilities through a website can reduce the search time and can make accessing information easier. It also provides an engaging user interaction and imitate real life conversations for the users. Also, such functionalities implemented via cloud are economical and easy to update.**

***Keywords* – Chatbots, Search Time, User Interaction.**

I.INTRODUCTION

Chatbot is an AI Software that can simulate a conversation with a user in natural language through messaging applications, websites, mobile apps, or through the telephone. Chatbots are often described as the most advanced and promising expressions of interaction between humans and machines. In a technical perspective, chatbot represents the evolution of a Question Answering System leveraging Natural Language Processing (NLP). Implementation of this system for a website can increase customer engagement, monitoring data, instant answers and 24/7 customer service [1].

Most websites rely on menu-based navigation and search bars to provide data to the users. However, websites with improper structure or those containing large amount of data presents a challenge for accessing the information by the user. In such scenario, a chatbot makes it easier for the user to navigate through the site for necessary information. The user has an option to chat with the bot (voice or text) to get appropriate responses. The chatbot has pre-programmed responses, but it can work with dynamic information from a user to make a relevant conversation and suggest pertinent information.

[2] Many companies provide proprietary and open source platforms to develop chatbots. Amazon Lex, part of Amazon Web Services, is one such service for building conversational interfaces into any application using voice and text. Amazon Lex is a flexible chatbot framework with Natural Language Understanding and Machine Learning capabilities. With Amazon Lex, one can build everything from simple bots for messaging to complex bots for enterprise environments. It utilizes the same backend technologies and services of Alexa, so it can be used to build a conversational bot that listens to users when spoken to, speaks back to them, and converts their words to text via automatic speech recognition (ASR).

II. RELATED WORK

ELIZA is considered as the first chatbot which works on the pattern matching system. It was developed by Joseph Weizenbaun in 1964. ELIZA's key method of operation include the pattern recognition of cue words or phrases in the input, and the output of corresponding pre-programmed responses that can direct the conversation in a meaningful way [3]. However, the drawback is that its knowledge is limited.

In 1972, PARRY appeared; It acted as a patient with schizophrenia. PARRY is considered more advanced than ELIZA is as it is supposed to have a "personality" and a better controlling structure. In general, PARRY is considered a chatbot with low capabilities concerning language understanding and the ability to express emotions. It also has a low speed of responding and it cannot learn from the conversations. Artificial Intelligence is firstly used in the domain of chatbots with the construction of Jabberwacky in 1988. It used contextual pattern matching to respond based on previous discussions. Still, Jabberwacky cannot reply to high speed

and work with a massive number of users [4]. Another step forward in the history of chatbots was the creation of ALICE (Artificial Linguistic Internet Computer Entity) in 1995. ALICE was based on pattern-matching, without any actual perception of the whole conversation but with a discussion ability on the web that allowed longitude and included any topic [5]. ALICE was developed with a new language created for this purpose, Artificial Intelligence Mark-up Language (AIML). More recent notable programs include A.L.I.C.E, Jabberwacky and D.U.D.E. While ELIZA and PARRY were used exclusively to simulate typed conversation, many chatterbots now include functional features such as games and web search abilities. Most companies like IKEA, SBI, Lloyds Banking Group are using automated online assistants as first point of contact.

III. SYSTEM ARCHITECTURE

The system consists of three components: client, server, and content acquisition. The server is Amazon Lex (provided by AWS) which integrates with Amazon Lambda to easily trigger functions for execution of back-end logic for data retrieval and updates. Once built, the bot can be deployed directly to any client platform viz. website, mobile clients, and IoT Devices. It also provides the track of metrics for the bot [11].

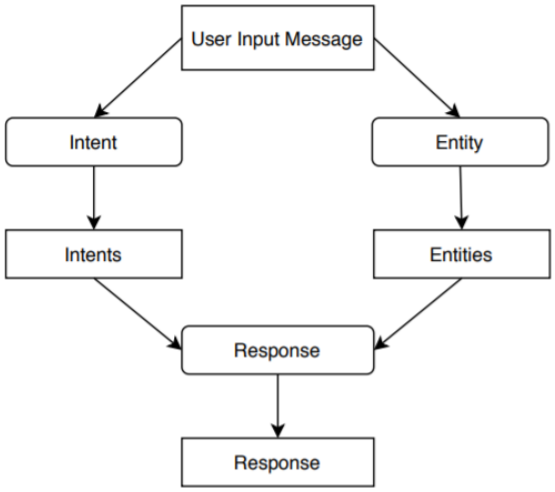

Figure 1: System Architecture of a chatbot.

A shown in figure-1 lex bot directs each of the user's queries to an intent, which parses the question into slots. The Amazon Lex bot then passes the intent and slot data to an AWS Lambda function, which uses the data to construct a SQL Query, and execute it in the Amazon Athena Database. Athena retrieves the query results from a set of CSV files stored in Amazon S3 bucket and returns the result set back to the Lambda function, which converts it into a natural language response. Athena is used for simplicity and convenience, but this architecture will work with an SQL- based database and can be adapted to other types of data sources, such as NoSQL databases. Moreover, Athena is serverless, so there is no infrastructure to set up or manage. Athena scales automatically running queries in parallel- so results are fast, even with large datasets and complex queries.

IV. CONCEPT DESCRIPTION

A website consists wide range of information in various categories which result in a vast and complex database. This information is spreads across various subpages and categorized according to their type. Navigating through these pages for relevant data, according to the user specification is time consuming and an uphill battle. A user visiting a website looks for specific information, or general browsing. The default search tools in the site, match try to match the key words to display results. If the instructions are obscure or ambiguous, the results obtained might be inconclusive or irrelevant. This in turn leads to unpleasant user experience. Moreover, if a user does not have clear knowledge on what he intends to find, the conventional search option cannot help them. A chatbot can address all the above issues by presenting a more intuitive way of interacting with the website. It interacts with the user, find their needs, provides suggestions, and guide the user to access the necessary information.

1. Proposed System

The need for college inquiry system arises due to the various reasons which include slow nature of college websites, difficult for person outside college's domain to extract information. The smart solution for all the drawbacks leads to the need for this proposed system: Chatbot. This project is implemented on a college website which has a database of department data, announcements, login portals etc. The website has a conventional search option along with a chatbot that can be accessed from any page. The user can interact with the bot using Natural Language. The bot can make suggestions, give information relating to domains such as admissions, examination cell, notice board, attendance, placement cell and other miscellaneous domains.

2. Context Identification

Pre-processing is applied to the input text to standardize the input as per the system's requirement. Based on the keywords used in the text, appropriate context is recognized as shown in figure 4.

3. AIML Response System

If the user is trying to make a normal conversation with the bot, the input is mapped to an appropriate pattern in Artificial Intelligence Modeling Language (AIML) files. If the response is available. The workflow of this model is represented in figure 5.

4. Personal Query Response System

Upon receiving the personal query such as Attendance, CGPA, Announcements etc., the authenticity of the user

is verified through user-id and password. If the user is valid, an appropriate response is sent. If the user authenticates successfully, the input text is processed to extract keywords. Based on keywords, information required by the user is understood and the information is provided from the databases as shown in figure 6.

5. Query Analysis and Response System

If the user is trying to make a normal conversation with the bot, the input is mapped to an appropriate pattern given in the intent. If the intent files have no entry like the query pattern, keywords are fetched from the input. An algorithm to check sentence similarity (NLP) is applied to the modified input to check its similarity with the questions of the predefined question-set, whose answers are available. If the sentence is retrieved with confidence>0.5, lex returns the answer to that question as the response. The flow of this model is given in figure 7. If no questions map to the user input, the input is saved in a log file for improvement of the system by the admin. The administrator can incorporate the answer to that query in the knowledge base if it is convenient. Also, a random response is sent to the user suggesting "Answer Not Available".

6. Context Reset

Once the user is satisfied with the response of the bot and does not wish to chat further, they can either logout of the system or simply exit. Once the user exits the system, all input parameters are automatically reset.

V. DESIGN

1.Data Flow Diagram

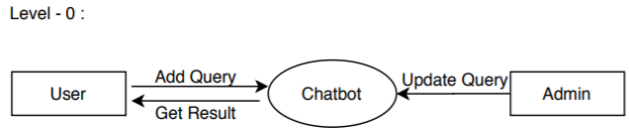

Figure 2: Dataflow Diagram at level-0

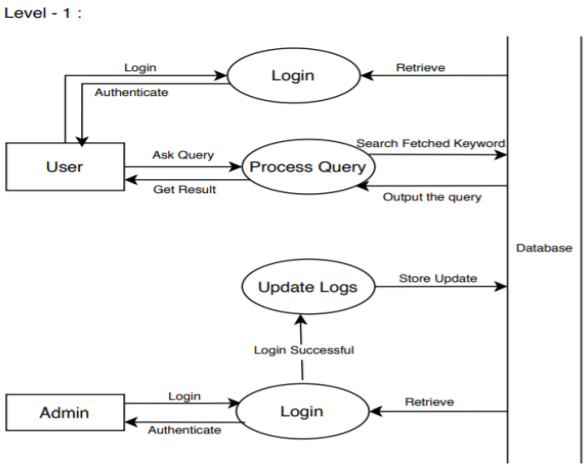

Figure 3: Dataflow diagram at level -1.

VI. IMPLEMENTATION

Amazon lex is a fully managed service, and as such, provides all the necessary features to build, deploy, scale, and monitor the chatbot. A bot consists of several child configuration items, such as intents, utterances, slot types, channels, lambda functions, to name a few.An intent represents some sort of outcome or action that boy may perform. A single bot may be comprised of multiple intents. Utterances are several phrases that user speaks or types to activate the intent. Fulfilment process is a method to complete or fulfil the intent, for example, a configured lambda function implementing the respective business logic. In addition to the custom intents, lex provides several built-in intents than can be leveraged. Each intent may require and must solicit additional attributes, otherwise known as slots, from the user to complete this intended outcome. Slot types provide a typing system for slots. That is, each slot that is defined is used to specify a slot type.

In the proposed system, the intents are specific to the type of query given by the user. Some of the intents include details regarding their academics, announcements, timetables, course details, attendance, academic prompts, and information regarding various clubs of the college. The chatbot gets all this information from the AWS S3(Simple Storage Service), a service that provides object storage through a webservice interface, linked to it. This database consists tables of data retrieved form the website and the details of all the students and faculty of the college. This makes the chatbot a door for all the information on the website.

The queries are executed by another service called Amazon Athena. Athena is an interactive query service that makes it easy to analyse data directly in Amazon S3 using standard SQL. Any requests made by the user are matched to their intents and the slots are used to understand the specific bit of data requested by the user. Now, with a few actions in the AWS management console, Amazon Athena can point to data stored in Amazon S3 and begin using standard SQL to run ad-hoc queries and get results in seconds. Also, as an administrator it is important to monitor and review any missed utterances, as it allows them to update and refine the utterances list within an intent to ensure that it fires under as many commonly used phrases as possible. This chatbot can be integrated to the website using the concept of channels. Developers can build and configure a chatbot application within Amazon Lex, and then deploy it to multiple channels. This allows conversation to take place from within the platform beyond AWS's or developers own application. All network connections established to Amazon Lex are done using HTTPS.

Therefore, all conversation data exchanged with Amazon Lex is encrypted, and can be considered secure. The chat bot created in Lex can also be integrated with other AWS platform services. Like, AWS Lambda to write lambda function to code initializations, validation, or fulfilment requirements. Additionally, it also works with Amazon Cognito for user authentication, and Amazon Polly for text to speech synthesis.

VII. RESULTS AND DISCUSSIONS

Initially, the chatbot successfully provided the right output in about 40% of cases. However, as the training data improved with continuous interaction with the chatbot, this accuracy has improved to 70%. For queries unrelated to the intents described in the chatbot, a generalized response is generated, and such questions were logged to be checked later and included to the datasets. The Amazon S3 connected to the chatbot have successfully monitored the traffic to various sections of the chatbot by capturing the general purpose of the user. This information can further be used to analyse the kind of people visiting the site and their purpose. Hence more emphasis can be put on such For performance testing, we measure two parameters: answer delivery delay and question matching accuracy.

1. Answer Delivery Delay: It is defined as the time taken from the question sent by the user until he/she gets the answer. This latency was constantly under 3 seconds with an average of 1.76 seconds.
2. Matching Accuracy: In this, we check whether the chatbots works even when the sentence is mistyped, and the proposed system has successfully matched the sentences to the predefined utterances in 70% of the cases.

VIII. CONCLUSION

The purpose of a chatbot is to stimulate a human conversation. Its architecture integrates a language model and computational algorithm to emulate information through communication between a human and a computer using natural language. It is impossible to get all the data on a single interface without the complications of going through multiple forms and windows. The college chatbot aims to remove this difficulty by providing a common and user-friendly interface to solve queries of college students and teachers. The college student and employees can freely upload their queries. The chatbot provides fast and efficient search for answers to the queries and gets the relevant links to their question. The database storage includes information about the questions, answers, keywords, and logs. Since the database is independent of stored responses, new information/data under any category can be easily added and removed and require no modification of the stored chatbot responses.

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