A Comparative Study of Chatbot Implementation Techniques

Prof .Shailaja Pede [1], Shreya Joshi[2], Aishwarya Bornare[3], Akash Ghadge[4], Dhiraj Bhujade[5]
[1,2,3,4,5](Department of Computer Engineering, PCCOE, SPP University, Pune, India
Email:pede.shailaja@gmail.com,shreyajoshisj@gmail.com,aaishwaryab12@gmail.com,akash.ghadge2897@gmail.com,dhirajbhujade97@gmail.com)

ABSTRACT
Today, Artificial Intelligence is a part of a major chunk of aspects of human life. Computer Science has had a lot of advancements in the past decade, and Artificial Intelligence definitely stands distinguished among them. Chatbots are nothing but computer programs, which are meant to carry out conversations with humans, giving the impression that it's a real person the human is conversing with. In this paper, we present a comparative study, encompassing several techniques that are taken into consideration during a chatbot implementation. Chatbots are preferred to better analyze the user's emotions and words, as they considerably reduce a lot of human efforts, but for the same, it is important for the chatbot to correctly comprehend the user's emotions so that it can generate a response likewise.

Keywords *- Chatbots, AIML, LSA*

I. INTRODUCTION

Not all interfaces or systems are user friendly. Even if they are, there is always something the user might be confused about. Chatbots bridge the gap between the user and the system by carrying out a conversation with the user and answering user queries. Thus, a chatbot's job is to carry out a smooth conversation with the user to provide a better experience to the user. This survey paper does a comparison of the various chatbot implementation techniques, covering a few popular existing techniques. For the same, we have studied as well as done a few implementations to better understand the techniques.

II. HISTORY OF CHATBOTS

Professor Alan Turing marked the beginning of the evolution back in the year 1950 through his paper “Computer Machinery and Intelligence”. He proposed the famous “Turing Test” in this paper, which has been ever since used as a standard for the evaluation of intelligence of a computer system and a criterion for judging whether or not the machine's intelligent behavior is indistinguishable from that of a human [1].

Fast forward to year 1996, Professor Joseph Weizenbaum designed a computer program ELIZA at the MIT AI Laboratory. This computer program aimed to simulate conversation similar to that of a Rogerian Psychotherapist [2]. Weizenbaum intended to reveal the superficiality of a human-computer interaction, but instead, he found a lot of people to attribute human-like feelings in the chatbot. The chatbots designed back then, however, were not intelligent at all, as they were mere programs having predefined set of inputs and the predefined set of outputs to be generated in response to those inputs. All they used were string matching and pattern matching to create an impression of a human to somehow keep the conversation flowing. But in actual, they had no contextual understanding.

III. EXISTING CHATBOTS

ELIZA is the first ever chatbot to have passed the Turing test. Basically, ELIZA had a set of certain keywords. Every time it received input from the user, it looked up the input for those keywords, applied values to them and then converted it into a response [3].

PARRY was a computer program written 6 years later after ELIZA, in 1972 by psychiatrist Kenneth Colby, at Stanford University. It was described as "ELIZA with attitude", as it attempted to simulate a paranoid schizophrenic personality. It was much more advanced in comparison to ELIZA. [4] A number of psychiatrists worked together to analyze a combination of patients and chatbots, and they were only able to correctly identify the chatbots 48% of the time.

Jabberwacky was then created, with the sole intention of entertainment and was the first program to accept voice-inputs instead of text-based ones [5].

ALICE (Artificial Linguistic Internet Computer Entity) was created in 1995 by Richard Wallace, is an open source natural language processing chatbot program. It uses certain user heuristically pattern matching rules to evaluate user response. Its knowledge base is XML. But,

its knowledge base is not that wide and is limited to only a predefined set of responses, which is why it fails to adequately respond to some user queries. However, ALICEBOTs can expand their knowledge base through an XML dialect AIML [6]. This way, ALICEBOTs can be simulated as domain experts.

IBM Watson was built as a question answering (QA) computing system that applied machine learning technologies, information retrieval, advanced natural language processing, knowledge representation and automated reasoning. It runs on the SUSE Linux Enterprise Server 11 operating system and uses Apache Hadoop framework to provide distributed computing.

Siri uses ASR (Automatic Speech Recognition) to directly convert human speech into text, and this also includes conversion of commands and short dictations, such as, “Call the police”, “set an alarm for morning” etc. It then parses the transcribed text using Natural Language Processing (part of speech tagging, noun-phrase chunking, dependency and constituent parsing). If SIRI identifies a speech as a question but fails to answer it, it forwards the same to a more generalized question-answering service, such as the one provided by Wolfram Alpha.

The Amazon Echo device is inhabited by Alexa- a voice service, which makes use of natural language processing algorithms for voice processing and uses the same to receive, recognize and respond to voice commands. Apart from making to-do lists, setting alarms, providing weather report and fetching and reporting other real-time data, it is also capable of controlling several smart devices using itself as an automation hub.

Mitsuku, a two-time Loebner Prize winner in 2013 and 2016 as well as the 2015 runner-up, uses AIML to comprehend and respond to people.

IV. APPROACHES

A very basic and generic approach for designing a chatbot is, accepting the user query, sending it to NLP (Natural Language Processing) Engine. Returning of phrase entities by NLP to find relevant data. Once this data is found, it is returned to the chatbot so that it can be transformed into a response that could be given to the user.

A domain specific chatbot always tends to have an edge over a generic chatbot, because of a defined boundary for the knowledge base. A domain specific chatbot also has a greater efficiency than a generic chatbot. This hypothesis can be proved using the above approach.

Domain specific chatbots can be used on educational websites, e-commerce stores, help desks and even for fetching customer reviews about specific products or services. Once the input is mapped to the semantic elements, conflicts are resolved by conversing with the user furthermore to identify the topic and pass it to the topic navigator. The topic navigator then looks up the information repository for an appropriate answer to the user's query. Once the answer is found, it is fed to the response generator so that it is translated into user understandable natural language before it is sent out to the user as a response.

OCR (Optical Character Recognition) is another approach for implementing a chatbot. Apart from OCR, it also makes use of AIML (Artificial Intelligence Markup Language), over generating transformations and ranking algorithms. OCR converts handwritten text documents or other scanned images into text in digital format, i.e.., machine encoded text. Logically equivalent questions from source sentences are generated by over generating transformations and ranking algorithm. First, text is extracted from various text sources such as PDFs or scanned images. Ranking algorithms and over generating transformations then generate questions from the information contained in the extracted text. So, the three main phases in the proposed system are: Plain text extraction, Question Generation and adding Question and Answers to the knowledge base of the chatbot using AIML. This approach can be used in cases where information to be added to the chatbot's knowledge base is from non-digital sources. FAQs (Frequently Asked Questions) can be easily answered using this approach in call centers and customer care services.

One of the major challenges in the field of e-commerce is the delivery of quality customer service in time as less as possible. Thomas NT proposed a solution for the same by integrating AIML and LSA so that responses could be generated immediately. [7] Whenever a user query is received, it first checks the AIML block to find out if the query matches any of the mentioned templates. For this, it is necessary to find the intersection between the input sentence and the template mentioned in the knowledge base. The intersection can be represented as: S1 ∩ S2 & S2 ∩ S1, where S1 and S2 are sentences.
The formula for calculation of semantic score is given as:

$$\frac{\text{Count}(S_1 \wedge S_2) \cup \text{Count}(S_1 \wedge S_2)}{\text{Count}(S_1) \cup \text{Count}(S_2)}$$

where, S1 and S2 are both sentences [8]. If not, the query is passed to the LSA block the user query is matched to the expected output using trained data. For training the LSA model, any of the FAQs from a similar e-business domain could be used. The FAQ corpus first converts the question into tokens and then, stop words from these tokens are removed. The generation of a word-document matrix takes place, followed by computation of SVD(singular value decomposition). Evaluation of result with minimum distance is done from user query is done using the concept of Cosine Similarity and the same is generated as the response. User queries are stored in AIML and HBase. The model achieved 0.97 precision and LSA based questions gave correct responses [7].

Thus, the traditional or existing chatbots make use of pattern-matching algorithms to search keywords in the user input. Using AIML as a knowledge base, a set of predefined queries and their variants can be built. If we just limit the knowledge base to AIML, the answers will be somehow hardcoded. To avoid this, we can use a combination of AIML and another database. While AIML will continue storing fixed responses, the dynamic or varying responses can be contained in this database and this database can be updated in a timely manner. Besides, users also tend to use a lot of slangs and short forms and even emojis at times. For this, the chatbot can employ various reinforcement and unsupervised learning algorithms to constantly improve its performance and efficiency and better project itself as a human personality.

V. APPLICATIONS

With the progression in the field of Artificial Intelligence and the way it is mushrooming in every field, chatbots can provide a lot of assistance and significantly reduce human effort. Chatbots can be employed on websites, so that the user can inquire about anything related to the website. Adding chatbots to online shopping websites can also be beneficial for the business as they can keep track of the sentiments of the users and how much happy or satisfied the customers are, with their website. Some of the most notable examples include use of chatbots as personalized stylist, book tickets, and even as a credit score coach. [7] Besides, chatbots can also function as personalized assistants.

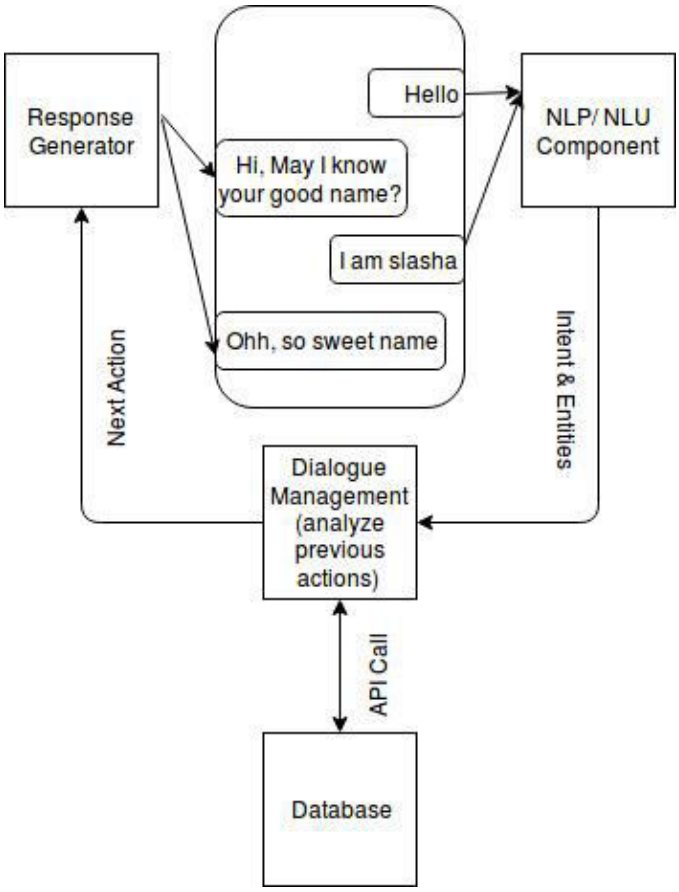

Figure 1 Chatbot Architecture

All in all, chatbots encompass a large number of fields in human life, with the most popular application being their use in the field of e-commerce.

VI. FUTURE SCOPE

Even though chatbots are gaining a lot of popularity in today's world, they still can't compete with humans, or replace human, due to a number of reasons. Since chatbots are nothing but computer programs, they need to be trained to learn slangs and abbreviations, as well as emojis. Currently, chatbots comprehend all the people they converse with to have the same personality, i.e., they may fathom the emotions well, but cannot distinguish between personalities. The knowledge base of a chatbot is also restricted to a certain language, because of which it is not possible for everyone to converse with that chatbot. Thus, there is also a lot of scope for chatbots to improve if the language barrier is eliminated.

VII. CONCLUSION

The study of all the approaches discussed above and our survey leads to the conclusion AIML is most popular and widely used among all the techniques considered, as it covers a wider spectrum of domains than the other approaches.

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