Survey of Chatbot Applications

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Abstract

Chatbot a computer application designed to imitate conversation with human users, especially over the internet. Chatbots, or conversational interfaces as they are also known, present a new way for individuals to interact with computer systems. Traditionally, to get a question answered by a software program involved using a search engine, or filling out a form. A chatbot allows a user to simply ask questions in the same manner that they would address a human. Example, resolving customer queries: Answering questions is helpful but a chatbot is not that useful if it cannot complete transactions. For example, if customers frequently call to check the delivery time of their package, it makes sense to let the chatbot handle those questions, answering frequently asked questions, and recommending new offers: Recommending the right products to the customer based on her verbal feedback. The most well known chatbots currently are voice chatbots: Alexa and Siri. However, chatbots are currently being adopted at a high rate on computer chat platforms.

I. Introduction

With the growth in Internet world, it becomes difficult for any user to access the required information quickly and in a simple way. In order to increase and improve the ease of user interaction with any system, human and artifact collaboration is necessary. A chatbot can be considered as a question-answer system where experts provide knowledge for solicitation of user. A chatbot is software designed to simulate an intelligent conversation with a human partner. This survey paper aims to present an overview of the existing approaches of implementing a chatbot system. We have studied the design and implementation of several chatbots and developed a detailed survey of those systems.

II. History of Chatbots

The history of chatbots can be traced way back to 1950, when Alan Turing published his paper "Computing Machinery and Intelligence". This paper is widely regarded as one of the basic foundations of Artificial Intelligence and the Turing Test he proposed in this paper can be considered as a benchmark for evaluating the intelligence of a computer system [8]. The fame of his proposed test drew a lot of attention to Joseph Weizenbaum's program ELIZA developed in 1966 at the MIT AI Laboratory. ELIZA simulated a simple, text-based conversation between a human user and the computer posing as a Rogerian Psychotherapist. Weizenbaum's main intention in creating ELIZA was to exhibit the superficiality of human-computer interaction.

However, he did not anticipate how a lot of people easily attributed human-like feelings to the program. However, the first chatbots were not actually intelligent, but were programs that had a collection of predefined set responses corresponding to specific inputs. They were rudimentary and used pattern matching and string processing to keep conversation moving between the computer and human. They merely created an illusion of intelligence of the computer, but the reality was that the programs had minimal to none contextual understanding.
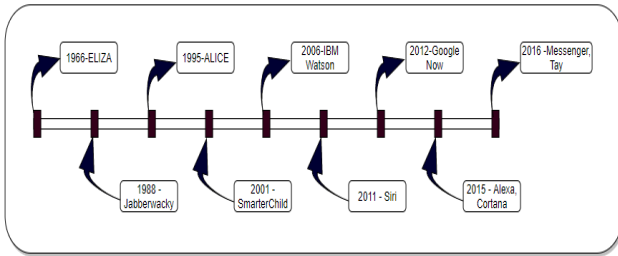
Figure 1. History of Chabot

III. Chatbot user's statistics

According to Comm100 [22], more companies are taking bots from concept to reality, according to data. Efficiency and productivity increased while delivering better customer experiences.

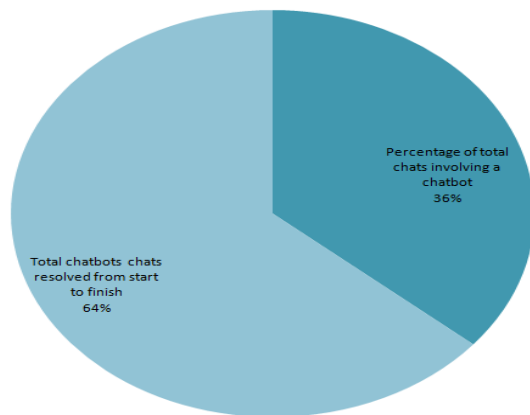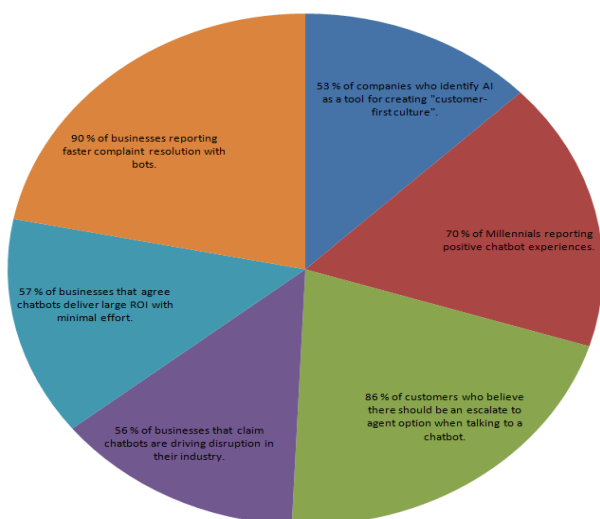Figure 2. Average chatbot usage statistics

Figure 3. Chatbot industry statistics

IV. Type of chatbots

IV.1. Simple chatbots

Work based on pre-written keywords that they understand. Each of the commands must be written by the developer separately using regular expressions or other forms of string analysis. If the user has asked a question without using single keywords, the Chatbot cannot understand it and, as a rule, responds with messages like "Sorry, I did not understand".
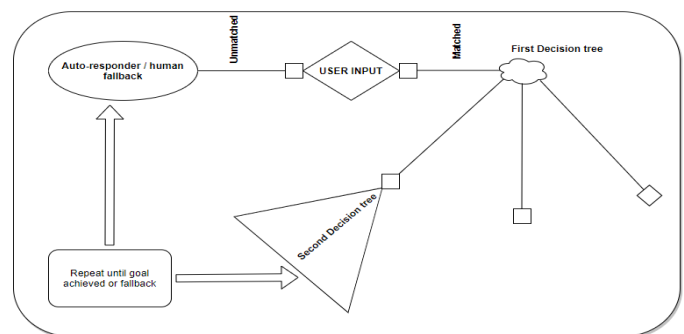

Figure 4. Simple chatbot flowchart

IV.2. Smart chatbots

Rely on the artificial intelligence with they communicate with users. Instead of pre-prepared answers, the Chatbot responds with adequate suggestions on the topic.
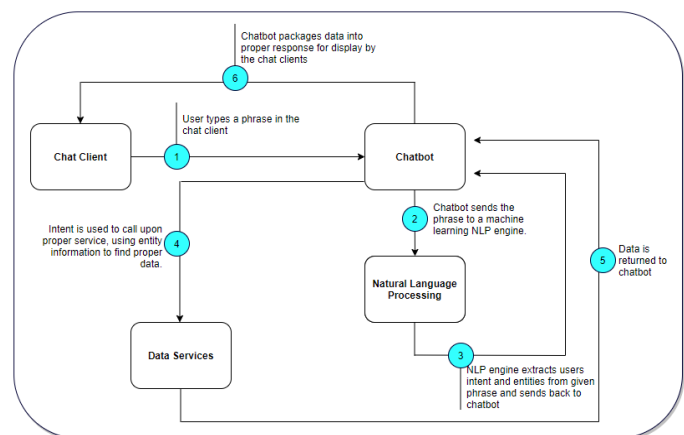

Figure 5. Smart Chabot flow

V. Survey of chatbots
5.1. ELIZA

ELIZA is also considered to be one of the first programs capable of passing the Turing test [1]. At first ELIZA examined the text inputted by the user

and checked for certain keywords. Then it applied values to them, and transformed the input into a response. The script that ELIZA ran determined the keywords, set the values of keywords, and set the rules of transformation for the output [14].

5.2. PARRY

PARRY was written in 1972 by psychiatrist Kenneth Colby, at Stanford University. PARRY attempted to simulate a person with paranoid schizophrenia. It embodied a conversational strategy, and as such was a much more serious and advanced program than ELIZA. It was described as "ELIZA with attitude". A group of experienced psychiatrists analyzed a combination of real patients and computers running PARRY through teleprinters. The psychiatrists were able to make the correct identification only 48 percent of the time [14].

5.3. Jabberwacky

Jabberwacky is one of the earliest attempts at designing an AI through human interaction [2]. It was mainly a form of entertainment. It aimed to move from a text based system to wholly voice operated system [14].

5.4. ALICE

ALICE (Artificial Linguistic Internet Computer Entity) created by Richard Wallace in 1995, is an open source natural language processing chatbot program that converses with a human by evaluating user input using certain heuristically pattern matching rules. ALICE is based in XML knowledge bases. It is possible for ALICE bots to expand their knowledge bases through an XML dialect AIML [13]. Using this, An ALICE bot can be designed to be an expert in any domain specific information [14].

5.5. Watson

Built by IBM is a question answering (QA) computing system designed to apply advanced natural language processing, information retrieval, knowledge representation, automated reasoning, and machine learning technologies to the field of open domain question answering. Watson uses IBM's DeepQA software and the Apache UIMA (Unstructured Information Management Architecture) framework. It runs on the SUSE Linux Enterprise Server 11 operating system using Apache Hadoop framework to provide distributed computing [3] [4]. It participated in the Jeopardy! Competition and won in 2011 [5] [14].

5.6. Siri

Siri uses ASR (Automatic Speech Recognition) to translate human speech (which includes short utterances of commands, dictations or questions) into text. Using natural language processing (part of speech tagging, noun-phrase chunking, dependency and constituent parsing) it translates transcribed text into "parsed text". Using question & intent analysis it analyzes parsed text, and detects user commands and actions. ("Schedule a meeting", "Set my alarm"). Third party web services like OpenTable, WolframAlpha are interfaced using data mashup technologies. They perform actions like search operations, and question answering. Speech that SIRI has identified as a question, but it cannot directly answer, is forwarded to more general question-answering services such as Wolfram Alpha [14].

5.7. Alexa

Alexa is a voice service inhabiting the Amazon Echo Device. Alexa uses natural language processing algorithms for voice interaction. She uses these algorithms to receive, recognize and respond to voice commands. She is capable of music playback, making to-do lists, setting alarms, streaming podcasts, playing audio books, and providing weather, traffic, and other real time information. Alexa can also control several smart devices using itself as a home automation hub [14].

5.8. Mitsuku

Mitsuku uses a programming language called AIML to understand and respond to people. Her intelligence includes the ability to reason with specific objects. She is a two-time Loebner Prize winner in 2013 and 2016 as well as the 2015 runner-up [14].

6.   Approaches

The following figure shows a generic flow of working of a chatbot. Once the user has entered the query, the chatbot sends it to the machine learning NLP (Natural Language Processing) Engine. The NLP returns the entities in the phrase which are then used to find the relevant data. This data is given back to the chatbot and it is converted to an appropriate response to be given to the user.
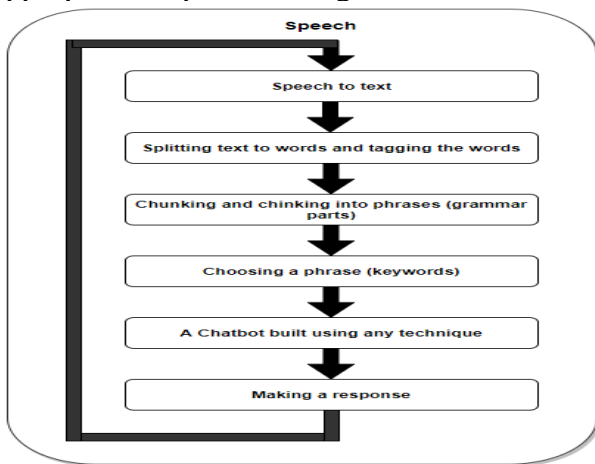

Figure 6. Generic chatbot workflow

One of the approaches of implementing a chatbot is a domain specific chatbot. The hypothesis that a domain specific chatbot yields better efficiency than a generic chatbot can be proved using this approach. Such a chatbot can be used in a variety of domains which include education, Help desks, e-commerce and so on. In the proposed system the user input is given to the semantic mapper, which maps the input to semantic elements. These elements are given to conflict mediator in order to resolve conflicts by having further conversation with user, and are passed to the topic navigator. If there are no conflicts then the elements are directly given to topic navigator which finds the appropriate answer in the information repository [9].
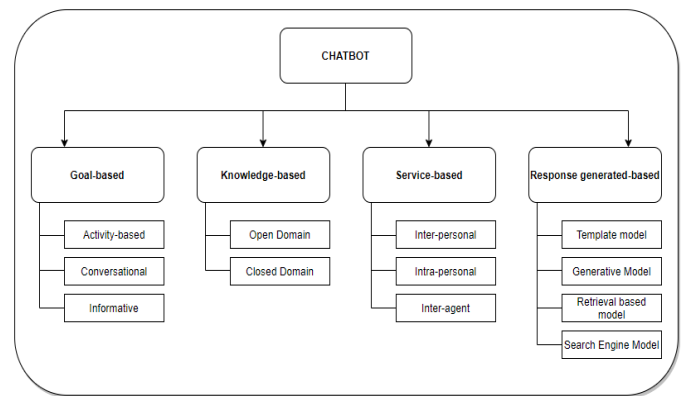

Figure 7.Toxonomy of chatbot application

Another approach of implementing a chatbot is the smart answering OCR based chatbot. This approach uses the Optical Character Recognition technology (OCR), over generating transformations and ranking algorithm and Artificial Intelligence Markup Language (AIML). OCR technology is a mechanism of converting a scanned document, images of hand written text into machine encoded text. The proposed system has three phases Plain text extraction, Question Generation and Question and Answers. Plain text is extracted from pdf documents or images using OCR technology. The corresponding responses are given to the user. This approach provides an efficient way of converting documents into the chatbot knowledge. This system can be used in call center services and educational field for answering frequently asked questions [10].
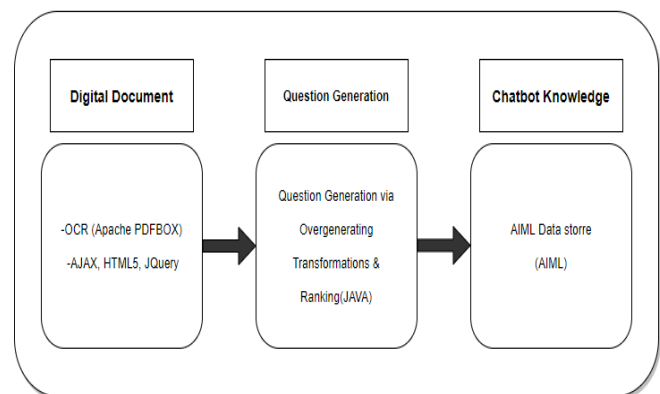

Figure 8. Example of OCR based workflow

An application of chatbots lies in the field of E-business and e-commerce. The main problem that almost every e-business model currently faces

is that of quality customer service in the least amount of time. As a solution to this problem, a solution is proposed by Thomas N T that consists of a chatbot system to generate immediate responses, which is a combination of AIML and LSA [1]. The FAQs in any particular e-business domain is used for training the model. Cosine similarity is used to evaluate result with minimum distance from user query and this result is generated as the response. User queries are stored in HBase and AIML database is updated to improve answers to template based questions. The model achieved 0.97 precision and LSA based questions gave correct responses [11].
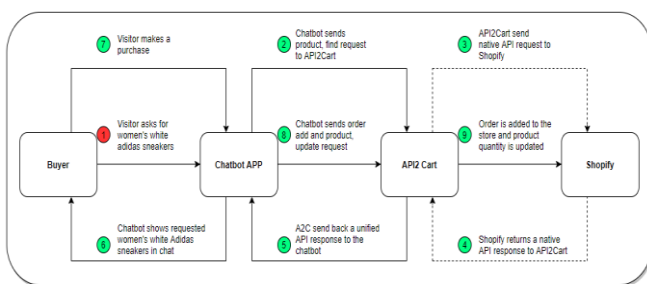

Figure 9. E-Business chatbot workflow

When the user provides insufficient information to answer his query successfully, the chatbot needs to be inquisitive, that is it must proactively ask the user questions in order to mimic a more natural human interaction. This approach details the implementation of such an inquisitive chatbot which recognizes missing data from a query and probes the user to obtain the same in order to answer his query. In this model, more permanent answers are stored in the AIML, while the frequently changing answers are stored in the database. In order to achieve such a proposed system, an additional knowledge base engine (KB engine) is implemented in the current system. This KB engine interfaces with a database for fetching factual data for responding to certain queries. The Knowledge Base Engine is designed to integrate the database functionality with the AIML and to analyze missing information from a query at the primary level in order to evaluate the query and come up with a response. The KB engine works with a two phase evaluation methodology which constitutes identifying the missed data field,

obtaining the data from the user, and processing the retrieved answer for the formation of right answers expected by the user [12].

7. Applications

With the rapid advancement of technology, chatbots have become increasingly important in various domains such as scientific, educational, commercial and educational. Chatbots can be implemented as intelligent personal assistants (also called virtual assistants) on mobile devices, as artificial tutors in the educational field as they can provide instant and personalized feedback to learners, and also in social networking domain for providing personalized marketing to customers.

Chatbots are a big step forward in enhancing human computer interactions. Some of the most notable applications of chatbots are as financial advisors [Credit Score Coach], providing free legal aid [DoNotPay], personalized stylist, and providing personal concierge services, offering preliminary medical advice, and many more [7]. However the widest application of chatbots is in the field of e-commerce for automating customer service. Chatbots help to improve customer relations as well as drastically reduce human efforts.

8. Conclusion

Currently chatbots have limited language support. They do not support multiple languages, dialects and do not understand colloquial usage. Hence there is a great scope for removing such language barriers in future chatbots. Also, AIML templates could be improved to include more variations for the same input. Intelligent personal assistants integrate various chatbot services into one single platform and pave the way for a truly intelligent self-learning artificial entity.

8.2. Future scope

• Next generation chatbots will become increasingly utilitarian.
• Chatbot will become more specialized.
• As bots become more specialized and popular, they will proliferate; managing them could become as overwhelming as managing apps is today [15]

9. Acknowledgements

10. References

10.1. Weizenbaum, Joseph (1976)
[1] "ELIZA", Computer Power and Human Reason: From Judgment to Calculation. New York: W.H. Freeman and Company. pp. 2,3,6,182,189. ISBN 0-7167-0464-1.
10.2. Jabber function
[2] "Jabberwacky" IEEE 802.3 12.4.3.2.3 Jabber function.
10.3. Jackson, Joab (February 17, 2011)
[3] "IBM Watson Vanquishes Human Jeopardy Foes". PC World. IDG News. Retrieved February 17, 2011.
10.4. Takahashi, Dean (February 17, 2011)
[4] "IBM researcher explains what Watson gets right and wrong". VentureBeat. Retrieved February 18, 2011.
10.5. Novell (February 2, 2011)
[5]. "Watson Supercomputer to Compete on 'Jeopardy!' - Powered by SUSE Linux Enterprise Server on IBM POWER7". The Wall Street Journal. Archived from the original on April 21, 2011. Retrieved February 21, 2011.
10.6. Amazon Echo
[6] "Amazon Echo". toptechgadgets. Top Tech Gadgets
10.7. Applications of chatbots
[7] "Applications of chatbots" http://www.techworld.com/picture-gallery/personal-tech/9-best-usesof-chatbots-in-business-in-uk-3641500/s
10.8. "Turing Test" Turing, Alan (1950)
[8] "Computing Machinery and Intelligence", Mind, 59: 433– 60, doi:10.1093/mind/lix.236.433
10.9. S. Ghose and J. J. Barua
[9] "Toward the implementation of a topic specific dialogue based natural language chatbot as an undergraduate advisor," 2013 International Conference on Informatics, Electronics and Vision (ICIEV), Dhaka, 2013, pp. 1-5. Doi: 10.1109/ICIEV.2013.6572650
10.10. Ly Pichponreay, Jin-Hyuk Kim, Chi-Hwan Choi, Kyung-Hee Lee and Wan-Sup Cho
[10] "Smart answering Chatbot based on OCR and Over generating Transformations and Ranking," 2016 Eighth International Conference on Ubiquitous and Future Networks (ICUFN), Vienna, 2016, pp. 1002-1005. doi: 10.1109/ICUFN.2016.7536948
10.11. N. T. Thomas
[11] "An e-business chatbot using AIML and LSA," 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Jaipur, 2016, pp. 27402742. doi: 10.1109/ICACCI.2016.7732476
10.12. Reshmi, S. & Balakrishnan, K. Sādhanā (2016)
[12] "Implementation of an inquisitive chatbot for database supported knowledge bases", 41: 1173. doi:10.1007/s12046-016-0544-1
10.13. AIML
[13] "AIML 2.0 draft specification released". alicebot.org. 2013-01-16
10.14. Aditya Deshpande1, Alisha Shahane 2, Darshana Gadre3, Mrunmayi Deshpande4, Prof. Dr. Prachi M. Joshi
[14] A SURVEY OF VARIOUS CHATBOT IMPLEMENTATION TECHNIQUES, International Journal of Computer Engineering and Applications
10.15. www.slideshare.net
[15] https://www.slideshare.net/AntaraBhattacharya12/chatbot-abstract
10.16. https://chatbotslife.com
[16] Ken Tucker - https://chatbotslife.com/a-chatbot-abstract-1cd002e7a480

10.17. https://blog.ubisend.com
[17] https://blog.ubisend.com/optimise-chatbots/simple-chatbot-flowchart
10.18. https://www.livechatinc.com
[18] https://www.livechatinc.com/help/six-simple-chatbot-ideas/
10.19. https://blog.mlveda.com
[19] https://blog.mlveda.com/a-brief-chat-about-chatbots/
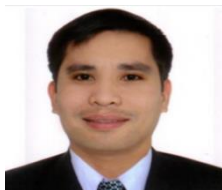**10.20. https://www.altexsoft.com**
[20] https://www.altexsoft.com/blog/business/a-comprehensive-guide-to-chatbots-best-practices-for-building-conversational-interfaces/
10.21. https://api2cart.com
[21] https://api2cart.com/use-cases/chatbots-api-integration/
10.22. Comm100
[22] https://www.comm100.com/resources/report/chatbot-statistics/

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