Chatbots For Customer Support

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Abstract: Customer service is probably one of the most critical elements of the user experience. With the advancement of natural language processing techniques, the industry is looking into automated chatbot technologies to deliver high-quality service to an ever-growing user base. This paper provides a case study of such chatbot strategies. The implementation of chatbots and virtual assistants is discussed in this article. An introduction to the area of chatbots is given, as well as a quick overview of previous and existing methods used to create chatbots. The theory underlying the methods used is then presented. Deep learning methods, such as gated recurrent unit neural networks, are primarily covered. Following that, a checklist of issues resolved, basic characteristics, method of communication, services provided, accuracy, technology providers of virtual assistants is also written down.

IndexTerms **- Machine learning, Keras, Chatbot, GUI, Natural Language Processing, Virtual Assistant, Chatbot Knowledge, Chatbot Domain.**

I. INTRODUCTION

Chatbots are reshaping the consumer engagement space like never seen before. Yes, patience is a virtue, but not everyone is endowed with it. Consider having to wait many hours in a potentially never-ending line before connecting with a customer service representative. Human behavioral patterns have been assessed, and inferences show that technical developments are to blame. Businesses are looking for fast ways to speed up operations while our tolerance wears thin, and they have the right to. Many consumers, for example, expect their questions will be answered within a moment. Presuming that the company receives tons of such queries every minute, it is utterly impossible to respond to everyone promptly, unless, of course, there was a medium that could provide immediate satisfaction, such as chatbots.

And from the customer's perspective, chatbot solutions have a one-of-a-kind experience of being able to get advice and assistance for a product at any time of day. This contributes to a better overall consumer experience. In reality, it has been found that customers favor chatbot systems to human contact, and in the future would prefer these systems than to physically entering shops. [2]

Due to their vast applications, chatbot systems have grown in popularity in recent years. Apart from their wide variety of uses, chatbot systems are common because they are approachable, improve user service, can handle a huge number of users, and are very cost-effective. It has been discovered that chatbot solutions help to reduce average running cost. Chatbot solutions are projected to minimize workload at upper levels of management by up to 70% soon. [3] [4] [5]

The following are the reasons why chatbots are necessary:

1. **Quick response:** Chatbots have predefined knowledge to answer certain questions which are frequently asked by people thus, the solutions are provided quickly. They are available 24/7 to provide answers.
2. **Better support:** The chatbots are made to give comprehensible answers such that the person can solve the issue on his own without calling for support. They are created to provide quick answers and fast response time. Also, the answers are consistent. [6]
3. **Reduce time:** The chatbot not only saves time for customers with fast responses but also the company by using their workforce in addressing different jobs and reduce time in customer support. Also, in certain call centres due to low employees, many customers are unsatisfied if they do not respond to, thus a chatbot can solve certain queries while customer support can address difficult ones. In certain areas, the chatbot can directly take the customer to an expert in solving that problem.
4. **Increase in sales:** The chatbots are very helpful in quick marketing on social media sites. The people can have a quick conversation with the chatbot to understand the company or product more. For example, a reservation company can advertise on various social media sites where people can directly converse with the chatbots to make a reservation for a hotel or a cab while scrolling through the media. The chatbots can also ask some questions to give a personalised experience. Figure 1 shows a snap of a chatbot in social media.
5. **Does repetitive work:** The chatbot can ask the same questions and can give the same answers tirelessly. Human is more prone to mistakes while doing the same tasks but the chatbots aren't.
6. **Saves money:** It does the work of several employees and can handle multiple people at once. It cuts down the cost of hiring new people. IBM's study shows that in the upcoming year the customer interaction with the chatbots will be >80% so implementing it will minimize the expenses while also giving customer satisfaction. [7]

Figure 1 Chatbots In Social Media [1]

7. **Multiple languages:** The chatbots can be programmed to be able to work with people with different languages and overcome the language barrier. This might help to grab the attention of a potential customer overseas and can help to spread the brand name across the world.
8. **Self-learning:** With the implementation of an AI or machine learning, the chatbots can learn new things which are not stored in their database on their own with the knowledge they receive from customers and interact better next time they'll be interacting with similar customers. Also, they can deduce the answers for which they are not trained for.
9. **Provide insights:** The customer can keep track of the customer demands and send the acquired data to concerned authorities for feedback or to learn about the new trend. This can also help to come up with new ideas to make changes with the interface or any products by directly asking for the customer's experience. [8]
10. **Wide applications:** Chatbots can be made for any industry to interact with various kinds of people. It can be also used by the employees in the company itself. It can be used as a certain communicating way in the company to learn about the employees and track their needs. The chatbots can be used in schools or universities for students and teachers. The chatbots can be used in the HR department to interact with applicants while also answering the queries asked by them. Thus, chatbots can be used in any industries as they are easy to implement and need a smaller number of executives to work upon.

II. LITERATURE SURVEY

Michael Mauldin coined the term "chatterbot" in 1994 when Julia was being developed to compete for the Loebner Prize. Following that Sylvie was developed which was a virtual human interface having real-time animation, speech and natural language processing. After it well receiving a final 3rd version was released in the year 2000 called the Verbally Enhanced Software Robot or Verbot. [9]

Deshpande, et. al. presents a detailed survey of chatbots including chatbots that came in early 1964 such as ELIZA and chatbots like ALEXA and SIRI of the present.[10]

Bala, et. al. proposes a system that can take complaints from a user and identify the level of negation of the complaint by using sentiment analysis. Once the complaint is prioritized based on the negation an appropriate response is given from the database if available otherwise the admin needs to provide a reply to the user. [11]

Lalwani, et. al. presents a chatbot that uses AIML and NLP for giving the user responses based on the data available in its database. If the bot finds no answer to the question it tries to search for keywords and then look for a solution. Still, if nothing is found as a solution it is logged for the admin to improve the system later and no answers found message is displayed to the user. [12]

Ranoliya, et. al. presents a way to reply to the user even if the Artificial Intelligence Markup Language (AIML) method of responding to the user fails. So Latent Semantic Analysis (LSA) is used to fill the gap of unanswered queries. [13]

AIML (Artificial Intelligence Markup Language) is used to build the FAQbot, a chatbot that serves as an undergraduate advisor at the student information desk. This study differs from ours in that it employs an information base that already includes the topics of all available questions. The method is also directly based on the chatbot architecture that was used to create the ALICE (Artificial Linguistic Internet Computer Entity) chatbot. A significant finding of this study is that domain-specific information combined with conversational knowledge generated the best results, with an accuracy of 21.1 per cent. [14] [15]

As seen till now that a chatbot needs a database from which it can gather answers for the user's question but in this paper Kader, et. al. proposes a method wherein the chatbot goes on to the world wide web to look for answers to the questions that the users have asked. [16]

Authors Su et. al. has a particular focus group for whom the chatbot was developed and they were the elderly. Since the elderly do not have company most of the time this chatbot was proposed which will have a database containing two thousand messages and its response pairs for making small talk with them. [17]

Baby, et. al. proposes a way in which chatbots can be implemented in home automation with the help of the Internet of Things (IoT). In this, the chatbot will recognize keywords entered by the user and then hand it over to the microcontrollers which can then control the equipment connected to the IoT network. [18]

Madhu, et. al. proposes a chatbot for the diagnoses of diseases as well as prescribe medicine along with dosage when the user provides the chatbot with the symptoms. Though the need for a chatbot in the medical field is very useful, this paper had drawbacks such as for the disease prediction the paper provides a pseudo-code which reveals that each disease and its symptoms have been mentioned and that the system has been coded explicitly which turns out to be a very difficult task making the system non-scalable. [19]

TABLE 1 CHATBOT SYSTEMS ANALYSIS

Paper Title	**Automatic Question Generation from Children's Stories for Companion Chatbot [20]**	**Question Answer System for Online Feedable New Born Chatbot [21]**	**Automatic Dialogue Template Synthesis for Chatbot by Story Information Extraction [22]**	**A Chatbot Using LSTM-based Multi Layer Embedding for Elderly Care [23]**	**Content-Oriented User Modelling for Personalized Response Ranking in Chatbots [24]**	**Chatbot for College Website [25]**	**BANK CHATBOT – An Intelligent Assistant System Using NLP and Machine Learning [26]**
Language Processing Technique Used	Stanford tool	NLTK framework	CKIP toolkit and AIML	Not mentioned	Not mentioned	Facebook Messenger Application Programming Interface	NLTK framework
Chatbot Domain Of Interest	Children	Open-ended	General	Elders	General	University / College / Education	Banking / Finance
Machine Learning Algorithm Used	Logistic Regression	Nil	Nil	LSTM	Deep Neural Network	Not mentioned	Random forest and SVM

III. EXISTING TECHNOLOGY

Chatbots are applications that interact with people using natural language. In certain business fields, chatbots could be used to substitute individuals. That being said, e-commerce is the most common method of using chatbots to simplify customer care. Chatbots help to strengthen customer relations while also significantly reducing human effort. Here are some examples of current systems:

1. **ELIZA** is the first chatbot developed by joseph Weinbaum which uses a keyword matching technique. The idea was to convince the client, of information and search for specific keywords; if a catch was found, the right answer was retrieved. If there is no catch, ELIZA will continue to gather more information from the client by the guidelines outlined above to keep the conversation going.[27]
2. **IBM Watson** is a query answering (QA) computing framework that is built to apply advanced natural language processing, information extraction, data visualization, automatic reasoning, and machine learning technology to the field of open domain question answering. [28]
3. **The Artificial Linguistic Internet Computer Entity** (A.L.I.C.E.), created by Richard Wallace in 1995, is one of the most popular chatbots that work on Pattern Matching Strategy. The formally formalised paraphrase uses the teamwork design and store information in the vocabulary file of AI. An AIML record is like an XML file and it is used to save chatbots design records. [29]
4. **AMY** is a personal assistant chat-bot created by the company x.ai. It is still in Beta mode and currently only serves a small number of users. The email must be sent as a carbon copy to AMY (amy@x.ai). Amy then speaks with the other group, arranges a convenient meeting time, and sends acknowledgement emails to both parties. [30]
5. **Jabberwocky** was one of the first attempts to create an AI through human contact. It was meant mainly as an entertainment medium. It planned to switch from a text system to a fully functioning speech system. [31]
6. **Google Assistant** is the virtual assistant developed by Google and you can find google assistant on most android powered devices. It uses natural language processing algorithms to receive, identify and react to voices [31]. Figure 2 shows the interface of Google assistant when prompted with the keyword 'Ok Google'.
7. Cortana is developed by Microsoft and it uses a Bing search engine to perform tasks demanded by the user [31]. Figure 3 shows the interface of Cortana.
8. Siri is developed by Apple and Siri can take inputs through voice and gesture controls. [31]
9. Alexa is the Amazon Echo device's voice support. For voice contact, Alexa employs natural language processing algorithms. These algorithms are used by Alexa to receive, identify, and react to voice commands [31]. Figure 4 shows an Amazon Echo device featuring Alexa.

Figure 2 Google Assistant [32]

Figure 3 Cortana [33]

Figure 4 Alexa [34]

TABLE 2 CHATBOTS

Name of Chatbot	Year of Release
Eliza [26]	1964
A.L.I.C.E [28]	1995
Jabberwocky [30]	1997
IBM Watson [27]	2010
Siri [30]	2011
Cortana [30]	2014
Alexa [30]	2014
Amy [29]	2015
Google Assistant [30]	2016

IV. TYPES OF CHATBOTS AND VIRTUAL ASSISTANTS

There are various chatbots categories like:

1. **Retrieval Based Chatbots,** which has a heuristic approach for getting a final response based on predefined responses, performs a task called "customer request analysis" where the input given to the bot is recognized and the output would be a predefined response, these are the most common chatbots used now.
2. **Generative Based Chatbots,** which use the deep neural network, where a huge amount of data is used to train models to achieve the easy translation of user input to output. In the case of generative based chatbots, the response given by the chatbot would not be pre-defined, the bot learns by retrieving its past or previous conversations the more conversations it has done in past, the bot becomes more accurate in giving the right responses, these bots are commonly used by food delivery customer services and complaints and grievances. [35]

These two are the main categories from which chatbots can be further classified into:

1. **NLP Chatbots,** here NLP stands for natural language process and is used to recognize what the user will ask, and an appropriate predefined response is generated. This enables a Chatbot to be as responsive as a real human with capabilities of having conversations like a normal human, NLP falls under Artificial intelligence rather than machine learning. [36]
2. **Scripted/Quick Reply**, where the question is obvious questions are guessed and then stored in the database to give quick responses.

3. **Action/Service Chatbots** are those who complete the task by asking for relevant information, these are common in the service sector, these are done by retrieving information from a database saved with the questions and answers or simply interactions with people. These bots will be programmed with information on several shops, cinema halls, restaurants and to give direction to the user who is too busy to search for it.
4. **Social Messaging Chatbots** are those which are integrated with social media websites, these are the bots that help the user to give aid and to give information regarding the apps.
5. **Context Enabled Chatbots** to use AI and machine learning to learn from previous interactions with the users. Thus, they get better with time these can be regarded as the smartest among chatbots where they can give a response based on context and can predict the response. [37]
6. **Voice-Enabled Chatbots** receive input via voice and give possible responses from personalized experience the input would be converted to text and then stored in the database which can give a personalized response. These types of bots are a booming market as personalized voice-controlled devices control the everyday life of people and give them efficient and personalized content. As the data would be different for each user this would need a single bot for a single user.
7. **Multimodal Chatbots,** multi-modal chatbots can be used on multiple channels and interfaces and are mostly made as an app for easy use. These are Level 4 fluid chatbots and are called the most innovative and complex bots out there. This is kind of a future of AI where flawless integration with apps. [38]

Open Domain vs. Closed Domain

The customer can control the discussion wherever in an open domain environment. No well-defined reason or purpose still exists. Discussions on social platforms, like Twitter and Google, are usually open for interpretation. It is difficult to have infinite amounts of topics and a certain level of knowledge of the environment to generate sensible responses.

Since the device is attempting to accomplish a very specific objective, the space of potential inputs and outputs is somewhat restricted in a closed domain environment. Closed domain issues include technical customer service and shopping helpers. This structure need not be able to address politics, they need only carry out their mission as efficiently as possible. Users can still talk whenever they choose to, but the frameworks are not necessary and users don't have to handle all these scenarios.

The simplest plan is to build a retrieval-based virtual assistant in a closed domain. Chatbots that use retrieval on pre-defined answers and can use specific languages. Figure 5 shows different kinds of chatbot models.

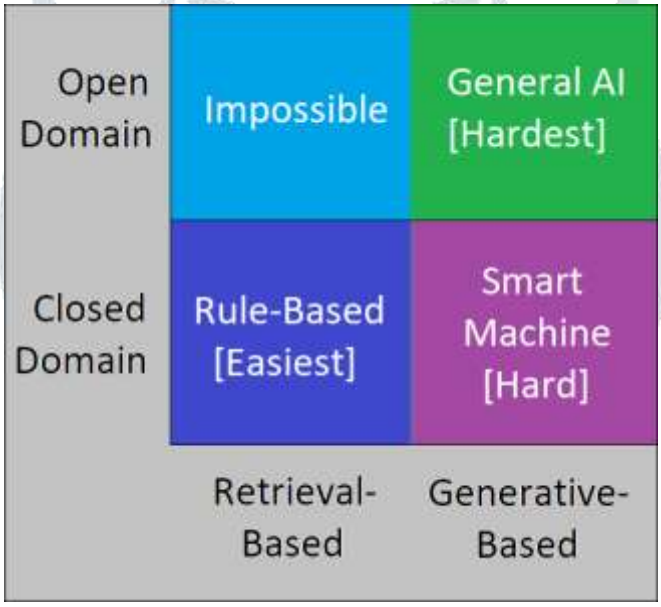

Figure 5 Chatbot Models [39]

V. CONVERSATIONAL CHATBOT ARCHITECTURE

The heart of chatbot creation is its architecture. The architecture involved in creating a chatbot varies significantly depending on its usability and the background of business operations. So, depending on the client's needs, various elements need modifications; however, the basic communication flow remains the same regardless of the form of a chatbot. [40]

The correct architecture is critical, and it is determined by the type of domain the virtual assistant would have. For instance, you could ask a chatbot a question, and the chatbot would respond. Perhaps you leave a discussion in the middle of it, only to resume it later. The chatbot can or may not save the conversation history depending on the type of chatbot you create. A pattern mapping architecture would be suitable for narrow domains. Even, a broader domain is preferred for chatbots dealing with many domains and resources. In these cases, you would have a better choice of cutting-edge neural network frames like LSTM (Long Short-Term Memory) and improved learning algorithms. The evolving character of the chat usage helps the architecture to be modified according to the unique specifications of the chatbot.

The core components of a conversational chatbot architecture are as follows:

I. NLP Engine
II. Question and Answer System
III. Plugins/Components
IV. Front-end Systems

NLP Engine: The NLP (Natural Language Processing) Engine is the core component that defines what people say at any time and makes it a structured input, which the computer can further process. Since the virtual assistant is domain-specific, it must accommodate a wide range of features. The NLP engine provides sophisticated learning algorithms to classify the user's purpose and correlates them with the bot-aided list of possible attempts. This engine performs several text processing methods like removing contractions, tokenization, removing stop words and special characters, replacing all integers with their textual representation, lemmatization, vocabulary building, data vectorization. These methods prepare the data for further processing. Some of them are explained below:

a. **Lowercasing:** Although it is often ignored, lowercasing all of your textual information is one of the easiest and most powerful forms of text pre-processing. It is applied to the majority of text mining and NLP issues and can be useful when your dataset is not very large. It also greatly improves the accuracy of expected results.
b. **Stemming:** The method of reducing inflexion in words (for example, runs, ran) to the root form is known as stemming (e.g. run). In this scenario, the "root" may not have been a true root word, but rather a canonical version of the original word.
c. **Stopword Removal:** Stop words are a category of words that are widely used in a language. Stop words in English include "a," "the," "is," "are," and so on. The idea of using stop words is that eliminating low-information terms from the script, which helps to concentrate on the relevant words.
d. **Normalization:** Text normalization is an often-skipped pre-processing phase. The method of converting a text into a standard form is known as text normalization. For example, the words "2morrow" and "2moro" can be translated to their canonical format, "tomorrow." An instance is the reduction of close proximity words like "stop - word," "Stopword," and "stop words" to only "Stopwords."
e. **Noise Removal:** Noise reduction is the method of eliminating letters, numbers, and text fragments that can interact with text processing. One of the most critical text pre-processing steps is noise reduction. It is also extremely domain-specific.
f. There are several such methods of natural language processing that can help the model process the data more easily and have fewer errors in the final output.

Question and Answer System: This is a key element in reacting to often posed customer questions in the backend. The question-and-answer approach interprets the inquiry and presents relevant answers from the body of information. This framework is usually comprised of a machine learning algorithm capable of classifying the user's intents. The intent classifier takes the user's input, describes its meaning, and associates it with one of the chatbot's intents. This role can be performed by a variety of machine learning models. Following purpose classification, a response is either extracted from a given list of responses or created based on the type of model used, which is either generative or selective.

a. **Generative Models** are typically implemented using a sequence-to-sequence (seq2seq) method developed in the field of machine translation and successfully applied to dialogue problems. The framework is made up of two RNNs (Recurrent Neural Network) with separate parameter sets. The first is an encoder, and the second is a decoder.
The encoder RNN generates a list of background tokens one at a time and changes its secret state as it goes. After going through the whole context series, it generates a final hidden state that integrates the meaning of purpose, i.e. motive, and is used to generate the response. The decoder then uses the encoder's context representation to produce a response. In the decoder RNN, a SoftMax layer over terminology is retained for this reason. This layer takes the decoder's hidden state and outputs a probability overall terms in its dictionary at each time level. Figure 6 shows a block diagram for a generative chatbot model.

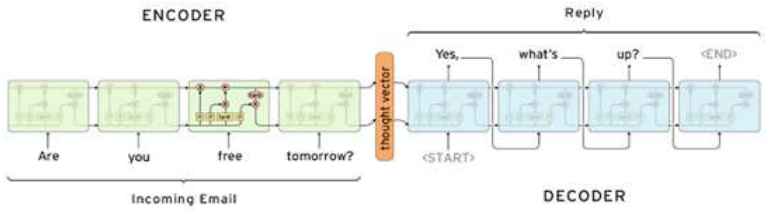

Figure 6 Generative Chatbot Model [41]

However, there are some flaws in this model. For a wide variety of contexts, generative systems trained using maximum likelihood aim to predict the high likelihood for general responses such as "Okay", "No", "Yes", and "I don't know". The second big issue with seq2seq models is that they might provide contradictory responses in transcribed contexts with the same sense as shown in figure 7.

Question: What is your age?
Response: I am 20 years old
Question: What is your age?
Response: I am 40 years old

Figure 7 Generative Chatbot Reference

b. **Retrieval-Based models** first predict the intents then selects a random response from a pool of answers for that intent. Usually, dnns (deep neural networks) are used to achieve this where the model gives the probability of the input for different intents and chooses the one with the highest probability. It also has certain limitations for example it is limited to a certain pool of answers but this can be more grammatically correct and accurate compared to generative models. So, people usually go for this model. This type of model is also known as a selective model.

Plugins/Components: Plugins provide chatbot solution APIs (application programming interface) and other intelligent technology elements for internal company chatbots such as HR (human resources) planning and site chatbots. This can include features like voice inputs, face recognition, document scanning, etc. Such components improve the user experience.

Front-End Systems: Front-end systems can be any platform that interacts with clients. They may be the actual chatbot interfaces found on different platforms. It can be a mobile or a desktop app or a physical robot with which a user can interact. Figure 8 shows the architecture of a chatbot system.

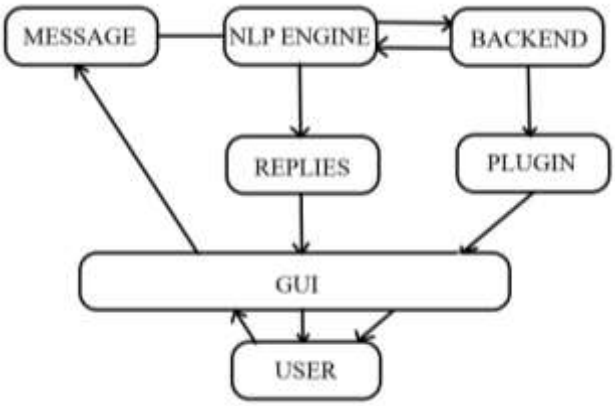

Figure 8 Chatbot Architecture

VI. RESULT AND DISCUSSION

According to the study, even though many scientific studies have been published and chatbot systems have been developed for a variety of categories, the majority of the papers neglect to note the language processing methodology used, the type of information used, whether machine learning algorithms were used or not, and whether dataset was processed or not. The bulk of articles appear to concentrate on the development and adaptation of the chatbot rather than any research in the area of natural language processing.

From the literature survey, it can be concluded that closed domain retrieval-based chatbots are the most reliable and accurate chatbot, also it is relatively easier to train and are less computationally intensive. The problem with generative chatbots is that it does not have consistency and has low accuracy. With the current technology, it is nearly impossible to implement an open domain chatbot capable of answering any query.

VII. CONCLUSION

Companies are actively investing in new technologies around the world to stay ahead of the market and stay ahead of the competition. However, there is still a long way to go in terms of the adoption of emerging technologies such as AI-powered chatbots/virtual assistants. Service robots/ chatbots can and will take over at least parts of the tasks in the customer service sector. Thus, providing better service to the customer while reducing cost and time. All the data on one screen is also impossible to make without having to work through different styles and windows. This issue is addressed by chatbots by offering a common and user-friendly interface for answering questions from college students, faculty, and parents.

Chatbots were given a lot of weight because they were labelled as "The New Apps." There was a major trend with chatbots in 2016, a trend that has diminished for the time being but is still lingering in the background. However, chatbots have a long way to get there before they can be used entirely in an unsupervised manner. Nonetheless, as previously illustrated, the basic domain of customer service is very susceptible to chatbot usage and is already very systematic. Many various machine learning or deep learning approaches may be investigated to improve the accuracy of the chatbot systems. The future might hold promising results, especially in the field of natural language processing: new strategies can be adopted daily, and old techniques are becoming even better.

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