# Chatbots & Its Techniques Using AI: an Review

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# CHATBOTS & ITS TECHNIQUES USING AI : AN REVIEW

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## ABSTRACT

In the modern era of technology, Chatbots is the next massive aspect of the generation of conversational services. A chatbot system is a software program that interacts with users using natural language. Chatbots is a virtual individual who can efficiently discuss to any human being the usage of interactive textual competencies. Recently, the development of them as a medium of conversation between humans and computers has made a great walk. The motive of a machine learning and artificial intelligence chatbot system is to simulate a human conversation; maybe through text or voice. The chatbot program understands one or more human languages by Natural Language Processing. The chatbot structure integrates a language model and computational algorithms to emulate informal chat communication has covered enormous natural language processing techniques. This paper investigates other applications where chatbots could be useful such as a machine conversation system, virtual agent, dialogue system, information retrieval, business, telecommunication, banking, health, customer call centers, and e-commerce. also gives an overview of cloud-based chatbots technologies along with the programming of chatbots and challenges of programming in current and future Era of the chatbot.

***Index Terms***— NLP, NLU, Gated Recurrent Unit,AI, Deep Learning, Machine Intelligence, Pattern Matching, Chatbots, LSTM.

## 1. INTRODUCTION

The Chatbots are computer programs that interact with users using natural languages [1]. Chatbot has been used in various industries to deliver information or perform tasks, such as telling the weather, making flight reservations, answer the educational based queries or purchasing products, also used in call center for reducing the number of customer calls, handling time and cost of customer care also are used by various famous application such as Telegram, Cortana, Slack, WeChat, Facebook Messenger, Google Assistant and Siri, [1]. While the command line was once adequate in the seventies, graphical user interfaces seemed in the eighties, web interfaces in the nineties, and touch display interfaces in the last decade. The subsequent technology of interfaces will handle unrestricted textual content and speech as input. Examples were talking to computer systems is the reality today are navigation devices, Apples Siri, Googles Voice Assistance Search using the voice command line, Amazon's Alexa, and quite a few translation services by created google and other big companies [2]. The first technology was started in the 1960s. The purpose of a chatbot system is to simulate a human conversation; the chatbot architecture integrates a language model and computational algorithms to emulate informal chat communication between a human user and a computer using natural language. Conversational chatbots have been lately relying on applying deep learning strategies on a large text corpus. The most representative chat generation model in this category is seq2seq, which is an aggregate of two LSTM neural networks, the first generates the state of the dialog and second outputs the bots response.[3]. Chatbots have recently come to be popular due to the good-sized use of messaging offerings and the advancement of NLU [4]. The need for conversational agents has intensified with the widespread use of personal machines with the desire to communicate and the desire of their manufacturers to provide natural language interfaces [5].

## 2. LITERATURE REVIEW

Chatbots have presented a new wave of automation via simulating human conversation to its fullest. Today, smart assistants can take care of many guide tasks like managing calendars, making reservations, reserving tickets, placing meal orders, etc. But this is simply the start of the possible of chatbots. With smart residences and voice assistants (like Amazon Alexa and Google Home) making their way into the market, bots will soon be able to operate a lot greater actions. In fact, between 2016 and 2021, the chatbot market is predicted develop at a CAGR (compound annual increase rate) of 35.2% [6]. These platforms are developed by tech giants companies and, somehow, they represent already a standard or at least they are on its way to becoming one:

- Dialogflow (Google, formerly Api.ai)

- Wit.ai (Facebook)

- LUIS (Microsoft)

- Watson (IBM)

- Lex (Amazon)

- ChatScript

- Mitsuku

## 2.1. Elizabot

Elizabot is one of the earliest well-known chatbots in its long history. It used to be developed at MIT Lab in 1966. it is was once the goal to show natural language conversation between humans and machines to provide Rogerian psychotherapy [7]. Rogerian psychotherapy use to encourages the patient to talk to the engaging discussion, Also responses are non-public questions that are meant to interact the patient to proceed with the conversation. It makes use of a rule-based script to respond to patients questions with key-word matching from a set of templates and context identification. The drawback of Elizabot is to preserve a conversation going. Besides, Eliza is incapable of learning new patterns of speech or words, discover context via interplay and logical reasoning abilities [8].

## 2.2. ChatScript

ChatScript is a scripting-based industrial chatbot it uses pattern matching techniques similar to Artificial Intelligence Markup Language(AIML). It's a combination of the NLP engine and the dialogue management system. It enclosed some management scripts. this can be just another normal topic of rules that invokes application programming interface (API) functions of the engine. A rule consists of a type, label, pattern, and output. The engine to mechanically search the subject for relevant rules based on user input. In contrast to AIML, which finds the simplest pattern match for associate degree input, ChatScript initial finds the simplest topic match, then executes a rule contained in this topic.the disadvantage of CharScript is it's tough to find out and there aren't any hosting services. it's additionally tough to introduce during an online page [9].

## 2.3. IBM Watson

International Business Machine (IBM) name as IBM Watson chatbot is a rule-based AI chatbot developed by IBM's DeepQA project. It is designed for information retrieval(IR) and question-answering(Q/A) system that contains natural language processing and machine-learning method. Watson uses IBM's DeepQA software and the Apache UIMA

(Unstructured Information Management Architecture) framework. The IBM Watson Conversation service combines different technologies such as machine learning(ML), natural language processing(NLP), and integrated dialog tools to create conversation flows between applications and users [10]. Watson's mechanisms to identify feature values such as names, dates, geographic locations, etc. The Watson working score level or probability-based score, it ranks all possible answers and selects one as its top answer. Also use in several technologies including Hadoop, Apache Unstructured Information Management Architecture (UIMA) framework to examines the phrase shape and the grammar of the question to higher gauge what's user being asked. Advantages of Watson, it has some primary drawback such as it does not system structure records directly, no relational databases, greater maintenance cost, targeting towards higher organizations and take longer time and effort to teach Watson to use its full potential [11].

## 2.4. Microsoft

Language Understanding Information Service (LUIS) is a machine learning-based service to build natural language into apps, bots, and IoT devices. LUIS is a domain-specific AI engine developed by Microsoft [12]. There is three Microsoft bot which was now day's it uses the first *Informational Bot* can answer questions defined in an information set or FAQ using Cognitive Services QnA Maker and answer more open-ended questions the use of Azure Search. any other chatbot is two Commerce bot Together, Language Understanding and Azure Bot Service allow developers to create conversational interfaces for a variety of scenarios like banking, travel, and entertainment [13]. For example, a hotels concierge can use a bot to beautify traditional email and phone call interactions through validating a customer through Azure Active Directory and using Cognitive Services to higher contextually technique consumer requests using textual content and voice. The Speech recognition service can be added to support voice commands [14].

## 2.5. Google Dialogflow

Dialogflow recognized as Api.ai and it was developed by Google and part of Google Cloud Platform. The app developers provide their users to interact with interfaces via voice and text exchanges powered by machine learning and natural language processing techniques [15]. The focus on other vital parts of app advent alternatively than on delineating in-depth grammar rules. Recently, automatic spell correction is available in Dialogflow API v2 Dialogflow made an important improvement to their service. They provide automatic spelling correction if there are types in the user messages [16]. Dialogflow recognizes the intent and context of what the user says. Then match user input to particular intents and uses entities to extract relevant information from them.

And finally, allow the conversational interface to respond. The drawback of Dialogflow is its use in Limited language support [17].

## 2.6. Amazon Lex

Amazon Lex is an AWS service for building conversational interfaces into applications using voice and text. It was developed by Amazon. It offers deep learning functionality and flexibility of NLU and Automated Speech Recognition (ASR) to build highly engaging user experiences with lifelike, conversational interactions. Amazon Lex integrates with AWS Lambda that user can without difficulty trigger functions for the execution of back-end business logic for data retrieval and updates [18]. The drawback of Amazon Lex is not multilingual, currently, it supports only English. Unlike Watson, Lex has a critical process to follow for web integration. Besides that, the training of the dataset is complicated, the utterances and entities mapping are extremely critical [19].

## 2.7. Mitsuku

The Mitsuku chatbot is a widely used standalone human-like chatbot using AIML. It was designed developed for the general type of conversation and interaction based on rules which are written in AIML and an integrated social platform like twitter, telegram, firebase, Twilio to serve as a personality layer. The Mitsuku bot uses NLP using heuristic patterns and hosted at Pandorabot. Whenever bot fails to find a better match for input, it will automatically redirect to the default fallback category. Mitsuku is the capability to hold a long conversation history, learns from the conversation history, remembers personal information about the user (name, age, location, gender, address, etc). Its feature includes the ability to reason with specific objects. For example, if someone says Can you eat a bike? Mitsuku will look up the properties for bike and find the value of category is set to vehicle and reply No as a bike is not edible. [20]

## 3. NEURAL NETWORK LANGUAGE MODELS

Neural Network Language Models (NNLM) such as Recurrent Neural Network (RNN) and Long Short Term Memory (LSTM) [21]. Deep Learning and Neural networks are achieving importance in the area of NLP with hidden states between the input and output and extensive networking to provide the best results [22].

## 3.1. Recurrent Neural Network

RNN is designed to take sequences of text as inputs or return sequences of textual content as outputs, or both. They are referred to as recurrent because the networks hidden layers have a loop in which the output and cell state from every time step turn out to be inputted at the next time step.
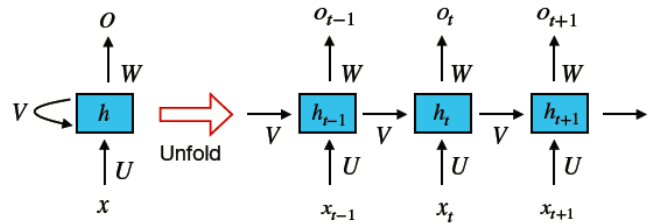


**Fig. 1**. RNN architecture for sequence to sequence

RNN can remember exactly that, because of its inside memory. It produces output, copies that output and loops it returned into the network. The primary strength of an RNN is the ability to memorize the consequences of previous computations and use that records in the current computation. Unlike the traditional translation models, where only a finite window of previous words would be considered for conditioning the language model, RNN is successful in conditioning the model on all preceding words in the corpus. We can reflect on consideration on a sentence as a mini-batch, and a sentence with **k** words would have **k** word vectors to be stored in memory.

## 3.2. Long Short Term Memory(LSTM)

Sequence-to-sequence (SEQ2SEQ) model [23]. There are 2 main tasks in deep learning (DL). The first is to extract that meaning from the input. The second is to generate output from that, either a translation or a response within the case of a chatbot application. The major challenge in developing a decent model is that it creates an adequate sense of context and effectively related inputs to outputs. The sequence-to-sequence (seq2seq) model in deep recurrent neural networks (DRNN) with an attention mechanism [24]. The capability of the deep neural network to have interaction in human spoken language, whereas at an identical time sidestepping a number of the restrictions of applied mathematics models and implementation mechanism. Long Short Term Memory networks generally just called LSTM are a unique type of RNN, capable of learning long-term dependencies. They were introduced by Hochreiter & Schmidhuber (1997) [25]. LSTM cell blocks in place of our standard neural network layers. An LSTM consists of three gates (input, forget, and output gates), and calculate the hidden state through a combination of the three.

In fig.3 showing, the input sequence is *"Are you free tomorrow?"*. So when such an input sequence is passed through the encoder-decoder network consisting of LSTM blocks (a type of RNN architecture), the decoder generates words one by one in each time step of the decoders iteration. After one whole iteration, the output sequence generated is *"Yes what's up?"*. Various LSTM-based models have been

The repeating module in an LSTM contains four interacting layers.

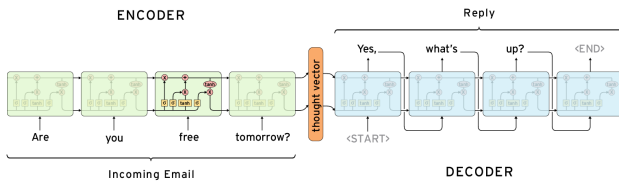**Fig. 2**. LSTM input, forget, and output gates [25].



**Fig. 3**. Encoder Decoder(LSTM) network architecture .

proposed for the sequence to sequence mapping (via encoder-decoder frameworks) that are suitable for machine translation, text summarization, modeling human conversations, question answering, image-based language generation, among other tasks. LSTM networks are an extension for recurrent neural networks, which extend their memory. [26].

### 3.3. Natural Language Processing(NLP)

In the age of information, Natural Language Processing is a part of computer science and Artificial intelligence(AI) which deals with human language [27]. With the rise of voice interfaces and chatbots, NLP is one of the most important technologies of the information age a crucial part of AI. NLP is broadly defined as the automatic manipulation of natural languages, like speech and text. NLP applies computers to understand human language, to the words we use. NLP deals with building process algorithms to mechanically analyze and represent human language. NLP-based structures have enabled an extensive variety of purposes such as Googles effective search engine, and more recently, Amazons voice assistant named Alexa, Microsoft Cortana, etc [28]. NLP is also useful to train machines the capability to function complicated natural language associated tasks such as machine translation and dialogue generation also use in much other application Spell Checking, Keyword Search, Finding Synonyms, Extracting information from websites such as: product price, dates, location, people, or company names, Classifying: reading level of school texts, positive/negative sentiment of longer documents, Machine Translation, field of text classification and categorization, Question Answering,

sentiment analysis, Paraphrase Detection, Language Generation and Multi-document Summarization, Machine Translation, Speech Recognition, Character Recognition, Spell Checking etc,Text Extraction,Entity extraction, Syntactic Analysis, Semantic Analysis, Pragmatic analysis.

### 3.4. Natural language understanding (NLU)

There are two components of NLP (NLP and NLU) Similarly named, the concepts both deal with the relationship between natural language(as humans speak). NLU is a fundamental part of reaching successful NLP in the area of AI. NLP tries to do two things to understand the meaning and generate human language. You might call these the passive and active sides of NLP [29].
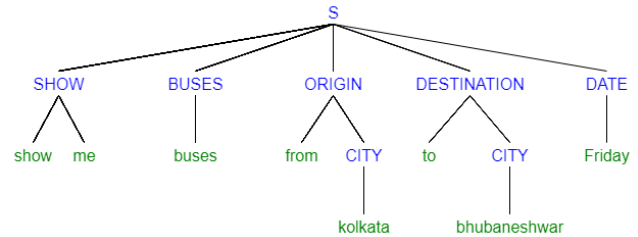


**Fig. 4**. NLU slot filling and intent parsing tree.

NLU can come in many forms. The goal of the NLU component is to extract three things from the users utterance. The first challenge is domain classification based on intent matching the user talking about airlines, Hotel booking, Bus reservation, programming an alarm clock, or dealing with their calendar? The second is user intent determination what familiar challenge or purpose is the user trying to accomplish for example the task may want to be to Find a Movie, or Show a Flight, or Remove a Calendar Appointment, order pizza, etc. Third, is slot filling extract the particular slots and fillers that the user slot filling intends the system to recognize from their utterance concerning their intent [30]. NLU is the understanding of the meaning of what the user or the input is given means. NLU worked on **Intents** and **Entities**: **Intents** are nothing but verbs (activities that the user needs to do). If we want to capture a request, or perform an action, use an intent. **Entities:** Entities are the nouns or the content for the action that needs to be performed. Chatbots are presently the best way we have for software to be native to humans because they provide an experience of talking to every other person. Since chatbots mimic a genuine person, Artificial Intelligence (AI) methods are used to build them. One such method within AI is Deep Learning which mimics the human brain. It finds patterns from the training data and makes use of the same patterns to procedure new data. Deep Learning is promising to solve long-standing AI problems like Computer Vision and Natural Language Processing (NLP). Since the last decade,

deep learning has arisen as a new attractive area of machine studying and ever for the reason that has been examined and utilized in a range of different research topics.

## 3.5. Gated Recurrent Unit

GRU stands for Gated Recurrent Unit's are similar to LSTM. GRU is a variant of LSTM and it is consists of only two gates it combines the forget gate and the input gate to a single update gate and is more efficient because they are less complex. GRU goals to resolve the vanishing gradient problem which comes with a general recurrent neural network also increased the model of standard recurrent neural network [31].

## 4. DESIGN PRINCIPLES

There are three types of chatbot's one is rule-based, retrieval(IR) based and generative based chatbot. In the rule-based chatbot is a predefined set of sentences group in a question-answer system where each question defined as answers in the form pair. Rule-based developing chatbots in XML based language called AIML releases-ed in 2001 [32]. The retrieval(IR) chatbot retrieves the answers/responses from a set of predefined responses and some kind of heuristic to pick an appropriate response based on the input and context. The heuristic could be as simple as a rule-based expression match. A generative model chatbot doesnt use any predefined repository. This type of chatbot is greater advanced, due to the fact it learns from scratch the usage of a process called Deep Learning. Generative models are usually primarily based on Machine Translation techniques, however instead of translating from one language to another like English to Hindi), we translate from an input to output (response) Generative models are the future of chatbots, they make bots smarter.

## 5. CONCLUSION

In this paper, the literature review has covered several selected papers that have focused specifically on Chatbot design techniques in the last decade. We have reviewed Artificial intelligent, deep learning, natural language processing all technologies based chatbot is a rising trend and chatbot increases the effectiveness of human communication with a machine using voice-based, health care, also chatbot use in business by providing a better experience with low cost.

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