

# Implementation of Service Based Chatbot Using Deep Learning

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## Abstract

A conversational agent (chatbot) is a software application which provides communication environment for conversation between machine and humans using natural language. The conversation is to be modeled to make it understandable to the machine and also it is an important task in (AI). In the modern digital era the dependency on computer is increasing day by day. One of the challenging tasks that everybody is looking is how to make a machine conversational with the user. Artificial Intelligence helping the developers to make a digital machine more intelligent and it should behave like a human being in understating the user queries and responding to the queries. The chatbot plays the crucial role in conversion with the user. Chatbot is a piece of software which will run on a computer. Normally chatbots are used for understanding the senetences given by the user and provide responses that are relevant to the user sentence that are already defined. In the past, constructing chatbot architectures have relied on rules specified by hand written and predefined templates or simple statistical approaches. With the rise of machine learning, deep learning and neural networks these models were quickly replaced by end-to-end trainable neural networks. Siri by Apple, Cortana by Microsoft, Google Assistant, and Alexa by Amazon are some of the most popular conversational agents today. They can assist user to get directions, check the scores of sports games and pick the phone number in your address book and call the people. But these chatbots give responses to the user from all the fields included when the people are searching for a particular field. So we are going to develop a chatbot for a service based so that it can give accurate results that the user wants and avoid confusion for the user.

## Article History

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## 1. Introduction

A chatbot (also known as a chatterbox, talkbot, bot, artificial conversational entity) is a computer program which provides the human computer interaction in between digital device and human being. The conversation will be happening either in auditory or textual messages. These chatbots will provide the digital assistance to the user. So chatbots have to behave like a human being in understanding the queries or reading the textual messages. The Chatbot have embedded

knowledge to identify the queries given by user and also give a response to it. Chatbot is integrated into the dialogue system and it act as the conversational agents. Chatbots are becoming ubiquitous in modern digital era. Some of these examples are personal assistance on mobile devices, advising the user to select the suitable product among the many different available products (bank products, life insurance schemes, shares etc.) However building an intelligent conversational agent remains a major unsolved

problem due to the large volume of data it has to process and ambiguous queries.

Our main motivation for developing a service based chatbot is to use advanced artificial intelligence. Our service based chatbot leveraging deep learning. We propose to develop a new set of models using deep learning sequence to sequence model [14] for retrieval and generation of natural language.

A chatbot can be developed using different ways and the bot developed using Deep Learning requires Neural Networks in order to learn the input sequence. Some bots like ELIZA [1], ALICE [2] take only text as input whereas bots like Siri, Google Assistant, Amazon's Alexa accept voice also as input.

**A. Natural Language Processing (NLP):** It is a branch of Artificial Intelligence (AI) which allows interaction between computer and human languages [3]. NLP is required for translation of text and for recognizing speech. Different pattern matching techniques are used to identify the correct matching word.

The successful NLP systems that were developed in early 1960's are SHRDLU which works based on restricted vocabularies and ELIZA which simulates conversation through pattern matching and works based on substitution methodology also falls under this category.

In 1980's most of the NLP's were designed based on some set of hand-written rules. Later they were augmented with Machine Learning (ML) algorithms for language processing.

**B. Recurrent Neural Network (RNN):** It is an extension of general feed forward network [4] in which the network not only considers the current input, but also takes the previous output to generate a response.

Moreover RNN's have memory which can be used to remember the input sequence. Like every other neural network it has an input layer, output layer and some hidden layers [5].

**C. Long Short-Term Memory (LSTM):** The main drawback with RNN [7] is they cannot remember

the input for a long sequence. This problem can be solved by LSTM's [6] which is an extension of RNN and can remember long sequences of data.

But, there is no chatbot for making online movie conversations. Thus, we are designing a chatbot which will help users to do necessary enquiries about the movies.

## 2. Related Work

Artificial Linguistic Internet Computer Entity (A.L.I.C.E) is an open source natural language which acts as a chat robot using artificial intelligence. ALICE utilizes Artificial Intelligence Markup Language (A.I.M.L) to form responses to the queries given by the user. Alicebot engine and A.I.M.L [10] are open source software available freely under the terms of the **GNU General Public License** (used by GNU/Linux and thousands of other software projects). Hundreds of people around the world have contributed in developing the A.L.I.C.E. project. This chatbot provides the various tasks so it can be used for general purpose in any of the industry. So far several chatbots were developed for the purpose of entertainment and to complete a goal. The following are some of the well known chatbots which are developed for different applications.

**A. ELIZA:** Eliza is the pioneering chatbot built in 1966 at MIT. The model uses the famous Eliza system, designed to mimic a Rogerian psychotherapist. (Weizenbaum 1966) [9]. It works through pattern matching. It takes user's input and searches for a relevant answer in a script by using pattern matching.

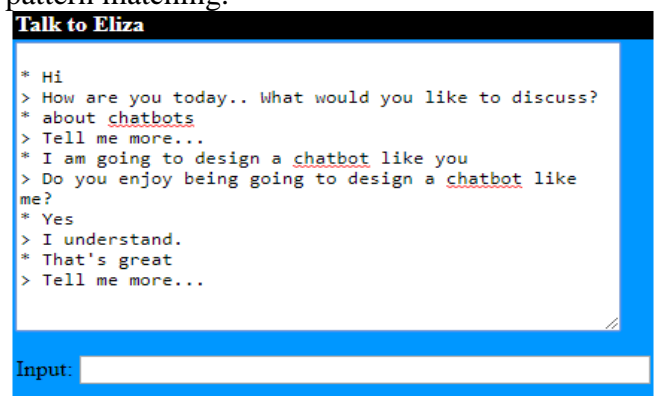


Fig.1: Eliza chatbot.

**B. ALICE:** It was developed in 2009. It allows the users to build a customized chatbots. It uses an Artificial Intelligence Markup Language (A.I.M.L) [10] which was developed based on extensive markup language (XML) to provide interoperability.

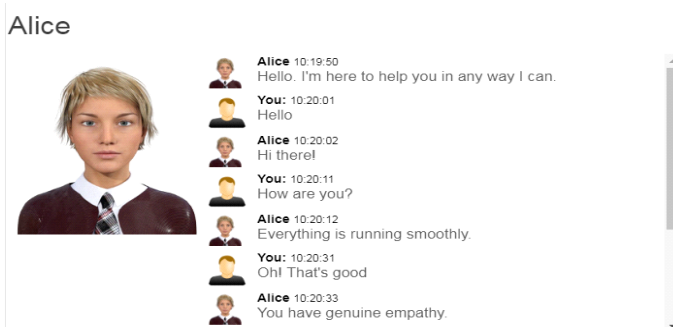


Fig.2: Alice chatbot.

**C. Jabberwacky:** It is an entertainment chat bot. [11]. It mimics human conversation and does nothing else.

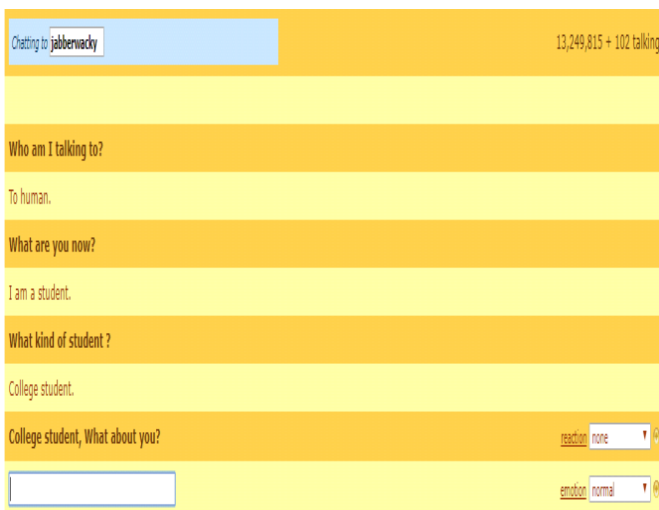


Fig.3: Jabberwacky chatbot

### D. OTHER POPULAR CHATBOTS

The above chat bots are popularly known and in addition to them there are several chatbots that were developed and some of them were stated below.

Colby developed Parry in 1975. It is the first bot that passed Turing test. It is a rule-based bot.

Microsoft's Tay which was launched in 2016 tried to learn about the nuances of human conversation by interacting and monitoring with real people online. Neuralconvo [12], a modern chatbot developed by Julien Chaumond and Clement Delangue which was trained using deep learning in 2016.

In addition to these there are several goal oriented chat bots like MedWhat [12] which makes medical diagnoses faster, easier and more transparent for both patients and physicians.

## 3. Proposed Method

A chatbot is a digital technology that provides conversation environment for having natural conversations that can access any content and also provide some services. Chatbots typically works on client server architecture and it takes the form of a chat client, consisting natural language processing to perform conversation with the user. Chatbots controls the user's conversation flow based on the user's requests context and prepare the response and provide direct answers containing natural language phrases. If the request has ambiguity then it request additional information or recommend actions that can be taken.

A chatbot can be designed in two ways: Response to a user can either be generated from using machine learning models from scratch or create the repository of predefined responses and choose a relevant response from it [8]. The predefined response method is useful for fixed applications. To develop the more generalized chatbot which can be applied on any dataset we designed the chatbot using deep learning. We propose a novel deep learning mechanism sequence to sequence model [14] for natural language retrieval and generation. The proposed method involves three

components Data Preprocessing, Model and View.

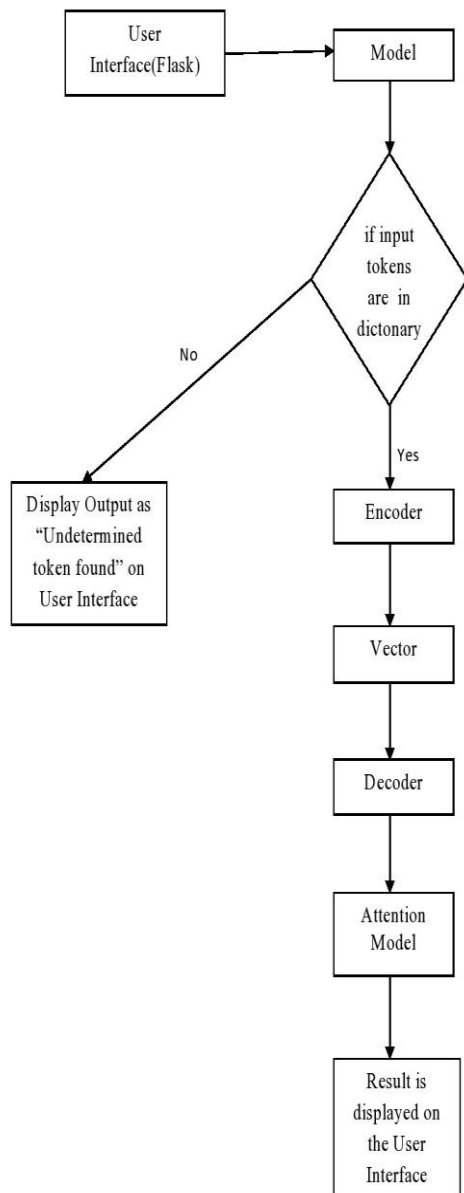


Fig.4: System Architecture

Data plays a crucial role to design any chatbot application. Data sets used to develop the bot application was found at movie dialogue corpus prepared by cornell university and chatterbot-corpus-master [14]. The data set consist of more than eighty three thousand records and the columns are Line Id, Character Id, Movie Id, character name and text of the utterance. The data should be preprocessed in order to obtain a

machine understandable format. Since computers cannot make more sense than humans, we need to provide representations for the words in data which can be done by word embedding [15]. Word embedding is the numerical representation of a text. Since all Machine Learning and Deep Learning algorithms are incapable of reading the plaintext, we require word embedding.

Data normalization is an important step in data preprocessing which do the data cleaning and data tokenizing. Data preprocessing can be done by encoder-decoder mechanism which uses the combination of two separate recurrent neural networks. One Recurrent Neural Network acts as an encoder that performs encoding a given input sequence of variable length to a context vector which is of fixed length. This context vector acts as the final hidden layer of the RNN and consists of meaningful information about the sentence which has been given as input to the bot. The second Recurrent Neural Network acts as a decoder that takes an input word and the context vector which is the output of first RNN, and returns a guess word for the next word in the sequence and also a hidden state to use in the next coming iteration.

This process will be continued to generate a meaningful conversation to the input given by the user. So the encoder RNN performs the iterations by taking the input query(sentence) one token (e.g. word) at a time, process it and then gives an "output" vector and a "hidden state" vector. This hidden state vector is then passed as a input to the next iteration, while the output vector is recorded. At each step the encoder transforms the sentence given by the user at each point in the sequence into a group of points in a high-dimensional space, where the decoder will use this sequence to generate a meaningful output for the given sentence.

We used a multi-layered Gated Recurrent Unit as part of our encoder, which is a bidirectional GRU[16], meaning that it has two independent

RNNs: one will take the given input sequence normally in sequential order, and the other will take the given input sequence in reverse order. At each time the results of each network are combined for every iteration. The usage of bidirectional GRU will give us the advantage of performing the encoding on both past and future context.

### Data preprocessing

1. Creating dictionary and tokens
2. Performing Normalization
3. Setting maximum length of sentence
4. Padding sentences
5. Delete the sentences which are more than the threshold value
6. Delete the sentences which does not match with the words in the dictionary
7. Convert words to index and add padding
8. Converting elements or numbers or arrays into pytorch tensor values

### Model

1. Encoder-convert input sentence into vector
2. Gradient Descent recurrent neural network - calculating loss
3. Attention Model - probability checking

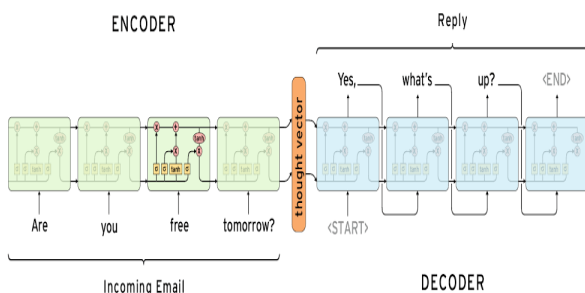


Fig.5: Encoder- Decoder.

### View

1. Through User interface(Flask) we will take input
2. Pass the input to the backend code file named sample.py

3. In the code,the input is passed to the trained model to get the output
4. The obtained output is returned and displayed in the user interface
5. The output is also converted into audio file by using gTTS function and the audio is played while displaying the output on the screen.

### 4. Results

The sample output of the application is shown below. Here the user has enter his query in the given text box and press the enter button so that the application will process the given input and respond accordingly using pattern matching

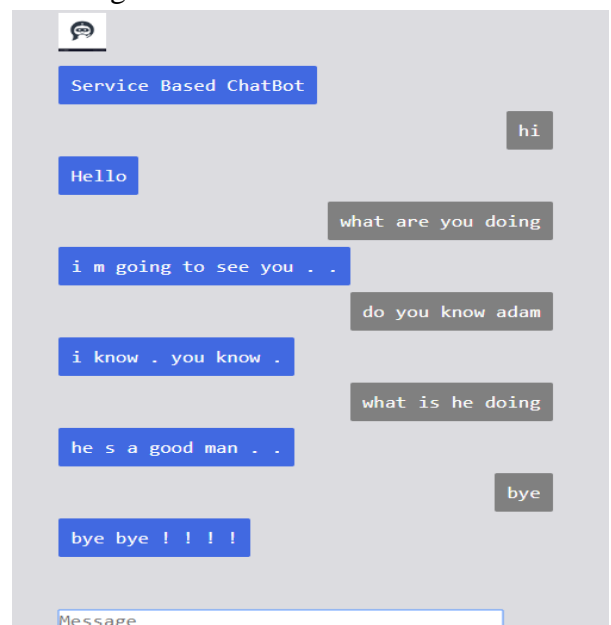


Fig.6: Service based Chat bot window

### 5. Future Scope

In the future, we plan to use reinforcement learning technique and also explore learning by taking user embeddings from previous interactions with the system from each user. The previous projects say that the text alone contains a significant amount of information about the speaker's identity (Serban & Pineau 2015). So by learning and embedding for each user, the system becomes more personalized. This provides our responding models with additional context not

only current dialogue and also beyond the immediate dialogue history.

## 6. Conclusion

Artificial Intelligence is one of the rapidly growing technology which can be used everywhere in the world. With the help of Artificial Intelligence the nature of human being can be simulated to a system. We proposed a system to develop chatbot based on deep learning sequence to sequence methodology to make a conversion between human and machine. This paper has discussed the role of chatbot in modern digital era and also different approaches for designing chatbots with examples. Chatbots are most useful plot-forms and provides customer service solution for companies that are inundated with requests every day. Those which cannot afford to maintain an entire customer service department will use the chatbots. As it requires an initial investment and some resources to get the system installed correctly, implementing chatbots will ultimately cut long term costs, and give customers the 24/7/365 availability and freedom to connect with your company. It also improves the customer experience and increasing satisfaction. Our proposed method will work for develop a chatbot for any application which uses a large data set. We designed the user interface which creates convenient environment to the user to interact with the system either in textual or audio manner. The proposed method can be further extended to use ensemble learning techniques for fast responses.

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