

AI based intelligent travel chatbot for content oriented user queries

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ABSTRACT

Automation is the way through which the machine can interact with data as well as a user for proper work or communication. A chatbot is a system which accepts user inputs as queries and respond with suggestions based on the previous inputs and trained models. In this paper, a travel chatbot is being modelled using Deep Neural Network (DNN) where it improves the human and machine interaction seamlessly as the user of the bot does not aware whether he/she is interacting with a machine or a human being. This chatbot suggest safest possible routes, secure and cheaper stay, best places for shopping, etc. to the users. This chatbot respond in a minimal time compared to other systems of similar nature. It also uses Long Short Term Memory (LSTM) to understand the sentence and form the sentence according to the previous reply. It also integrates various open APIs to get the recommended ratings from the internet. As per our analytical results, our chatbot outperforms by at least 20% in handling the user queries and suggest possible recommendations to the end users.

Keywords: Long short term memory, Natural language processing, Artificial intelligence, Deep neural network, Deep NLP.

OPEN ACCESS

Received: December 16, 2020

Accepted: January 6, 2021

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Publisher:

[Chaoyang University of Technology](https://www.vit.ac.in/)

ISSN: 1727-2394 (Print)

ISSN: 1727-7841 (Online)

1. INTRODUCTION

A chatbot is a computer program that is capable of conduct conversation, to do this artificial intelligence program is written. Chatbots are typically used in dialog systems (question understanding and capable of answering that question) for various practical purposes including customer service or information acquisition. Some chatbots use sophisticated natural language processing systems, but many are search important keywords within the input, then choose the best reply with the most matching keywords, or the most similar wording pattern, from a database.

Nowadays, chatbots and virtual assistants such as Google Assistant and Amazon Alexa are becoming famous. Chatbots can be classified into usage categories such as conversational commerce (e-commerce via chat), analytics, communication, customer support, design, developer tools, education, entertainment, finance, food, games, health, HR, marketing, news, personal, productivity, shopping, social, sports, travel, and utilities.

Human-Computer interaction is one of the popular domain in today's research domain. To implement the natural and powerful interaction between human and computer is the primary objective for any chatbots. Systems that can interact with the user in their natural language are a major challenge at present. (According to Ponteves et al., 2018) Chatbots are becoming more and more popular like Google Home, Amazon Echo, etc, this all is the best example of NLP, ML, AI. This chatbot is capable of providing voice interaction with the user.

1.1 Background

Today, the traditional human travel agents developed many issues, that can be conquered by the Intelligent one. The traditional ones are subject to their availability, the Intelligent Agent (Chen et al., 2015) is always available. The information present with the travel agent can be limited or outdated, this makes it not so efficient. In addition to that, when a customer enquires to travel agents about any place, most of them do not remember the history and the interests of the caller.

To predict user intention and update the database, a learning-based system is used. The learning-based usually learns from many hand-labelled data points. This is a major barrier when launching a dialogue system to a new domain/system. Dialogue system will take so much effort to collect thousands of hand-labelled training data to train the machine learning algorithms to learn or the second option is to write many rules which will take too much time. The system should be able to adapt to a new domain or business with good performance.

1.2 Statement

One person is needed in the travel domain to answer the query of another person. What if that question is answered by the machine itself. Travel domain is a very vast area to coverup because every place have their one specialty and some place is famous for some season. So to get all the details about all those places is difficult. The other difficult portion is that to understand and pre-process the human interacted language by the machine is another challenge. If any person is searching for specific information like: hotels in Tambaram Chennai, famous place in Chennai, then the output must be the same as what the person required.

According to SuperDataScience Team (Hadelin, 2018), if any organization used chatbot in its website and application so, it will increase the traffic of that by approximately 36%. This can also be done in many ways, Live chat, Rule-based, or AI conversational. All have their pros and cons like the problem of the live chat requires a minimum one person to answer the query and there may be a chance to get a late response because of the availability of that person. This problem can be solved by the conversational chatbot, which has the capability of doing reply to multiple people at the same time.

1.3 Motivation

There are so many people who travel every day. Some are traveling for their work whereas some are traveling for visiting places for their holidays or vacation. They have multiple doubt like, where they have to stay? where they can get good food? what is famous in that place? and many more. So, what if this all information is available on your fingertips, just by asking this all questions you can get your answer on your screen itself, don't need to ask anybody, and don't need to search this in multiple websites.

1.4 Challenges

The AI-based conversational chatbot is capable of reply to any question asked by a user of the chatbot. To solve this challenge sequence to sequence model is used with the Long Short Term Memory (LSTM). Below are the points which are the main challenges to create this chatbot are:

- Human interaction language has to convert into machine understanding format.
- Creating and maintaining the index for assigning to words.
- Encoding and decoding the whole sentence.
- Deal with a vector for machine understanding.
- To understand the vectorization and answer accordingly in vector form.
- Decode the output vector again.

1.5 Essence of Approach

To implement this work, the sequence to sequence model is trained by the normal chat text file. The sequence to sequence model implemented with LSTM technique to understand the word pairing and sentence framing. LSTM is one of powerful RNN technique which is capable of that decision by their own because in LSTM every data will pass from LSTM memory cell. LSTM memory cell has 3 gates through which each word check and perfect word pairing was formed. That is why this is implemented with seq2seq (sequence to sequence) model. Seq2seq model is a kind of model that use encoder and a decoder on top of the model. The encoder will assign some index to each word of every sentence, and the decoder will decode the output but according to the last input until the vocabulary size and this process is done in sequence so the user will get the required output. For denoting the end of any sentence a token is assigned to the end of the sequence. At the end of the prediction, there will also be a token to mark the end of the output. So, from the encoder, it will pass a state to the decoder to predict the output.

The rest of the paper contains the section as follows. Section 2, literature survey of existing work, section 3, chatbot architecture, section 4, the method used and explanation LSTM, section 5, algorithm for chatbot, section 6, result and discussion, section 7, conclusion for this article.

2. LITERATURE SURVEY

This is showing how they worked in their respective work. But, some are doing their work in the rule-based method whereas some are replacing the rule-based method by the intelligent-based method (Liu et al., 2017). The work focused by Aditya et al. (2018) on producing a valuable solution to real estate, considering the artificial neural network (ANN) algorithm to utilize more applicable and broad measure of information for building an informative real estate system. Performance of ANN shows better than the other algorithms used by the authors.

The rule-based method has a set of multiple questions and answers. If the same question asked then only it can reply that, with the same answer as defined. Whereas intelligent-based (Wang et al., 2018; Argal et al. 2018) method can reply after training from the previous chat conversation. They can capable of extracting some patterns and make a reply on their own. The intelligent system can reply to any type of question but what if that answer is not appropriate. This type of problem can happen because of two reasons, first is that question itself is inappropriate and the other is dialogue management (Kucherbaev et al., 2018) of that chatbot is inappropriate. To overcome this type of problem it needs to first complete the question by asking the same information which is required to answer any question (Michaud, 2018). Dialogue management needs proper training to the system for creating a more powerful system. They all are doing their work in some specific domain but not about any specific place information in detail, which are doing by this chatbot, like are doing their work related to the travel domain but their work is specifically related to hotel booking only. Reinforcement learning based travel bots are so powerful in predicting the routes in GPS systems or even in the internet of things where the sensors are deployed in the terrain to get the routes. As per these authors (Kumar and Krishna, 2018), the reinforcement learning is used to

predict the performance of IoT system where minimal energy routes are considered. Security of the application is an another concern, it need to adopt security standards to prohibit the attacks and vulnerabilities (Pandu et al., 2019).

3. TRAVEL CHATBOT DESIGN

Fig. 1 shows the architecture of the travel chatbot that is designed using LSTM and deep neural networks. It consists of various modules that are necessary for the training of data sets and checks the information with the internet through the open APIs. The following are the key components of this chatbot.

3.1 Architecture

3.1.1 Chat

Chat is User Interface (UI) where the user interacts with the chatbot. This is the place where the user can write their question/query which they want from a chatbot. The chatbot is responsible for the answer the query in a human-readable format in this same UI.

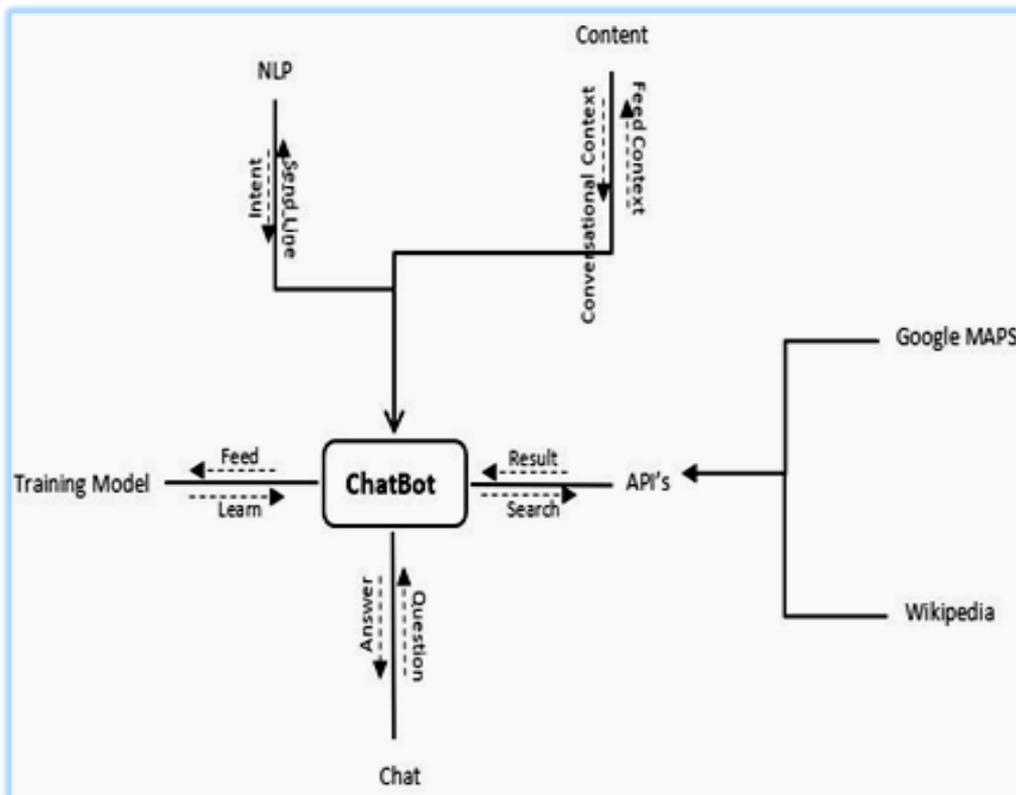


Fig. 1. Travel chatbot architecture

3.1.2 Model

Model is trained by the experience as well as the past trained session. The model which is used in work is seq2seq model implemented with LSTM. LSTM is one of the famous RNN Network. As per its name define it is good at remembering the previous output for a long time. LSTM is a powerful technique because it has 3 gates in its memory cell. They are capable of making a decision (Pérez-Soler et al., 2018), which word is suitable for which place, for example, if the output is like “you are fine” of the question “how are you?”. When the LSTM model is used, so it will check the possibility of the right word in each iteration. It will check each word possibility with the output from the previous cell and if that particular word is not suitable with it, then it will leave that word with the help of the forget gate. So, it will solve the above problem. And the other problem let suppose anybody wants to write “your” instead of “you” then another gate of this memory cell (i.e. input gate) this will resolve. Basically, this cell will search for the proper word for each sentence and if some stemmed word is required (like you and your, proper and properly, etc), then it will do this same for solving this type of problem.

The last gate i.e. output gate, which is checking the whole previous word and change minor grammatical mistakes if it is present there, for example, singular or plural. So, by this process, the model can capable of understanding the query asked by the user, and by understanding it. It will reply to that query accurately with highly match perfect words.

3.1.3 Natural Language Processing

In this work, natural language processing (NLP) used to assign an index to each word, to help the trained model from vectorization. Vectorization is nothing but assigning some value to characters. This is done because model work on the equation and all equations are working on numeric therefore it is difficult to train the model by categorical data.

3.1.4 Content

Content is the collection of all the information through which the model is going to refer and provide the answer of the query after understanding that, and the query is also encoded and decoded with the help of this content. Content is the collection of following terms:

3.1.4.1 Index2word File

In this file, each word has some index number which is unique from another word. This file is used for decoding purposes. Therefore at the training time, this file is created with the group of answer sentences (The answer sentence is referring from the normal existing chat through which model will train).

3.1.4.2 Word2index File

This file is vice versa of index2word file because in this each word have their respective index and this all index is also different from each other. This file is used for the

encoding purpose and this file is created with the group of existing question sentences (The question sentence is referring from the normal existing chat through which model will train).

3.1.4.3 Metadata File

Question-related words are stored in one file and Answer related words are stored in another file so to link up between that metadata file created. The metadata file has prepared all possible links between these files.

3.1.4.4 Checkpoint File

It is very important to file because this file is only responsible for understanding the query encoded the file and prepare an answer and send for further process. This file is nothing but the trained model file which is responsible for predicting the answer. The checkpoint file is created after running the seq2seq model. So, this will train itself by studying the available chats. It will extract all patterns to understand queries as well as to answer any question.

3.1.4.5 Database

This file contains all famous places, hotel, restaurant city wise. This file will automatically be modified if the new search was found and the internet was connected. This file is responsible to show all search items about any city if the system was not connected with the internet.

3.1.5 Application Program Interface

The software that wants to access the features and capabilities of the application program interface (API) is said to call it, and the software that creates the API is said to publish it.

In this work, 2 API's are used, that follows:

3.1.5.1 Google MAPS API

Users can get the information that they plan a trip to a new city or choose some restaurant in their neighborhood. With places, users can get data related location names, addresses, ratings, reviews, contact information, and atmosphere. Local guides (Google Maps Platform, 2018) and users submit tens of millions of updates every day.

3.1.5.2 Wikipedia API

Wikipedia (Wikipedia documentation, 2018) website has multiple articles about many things which are the point of attraction for most of the people. Every place, city, and so many things are available in this, from history to present detail about each thing are available.

3.2 Long Short Term Memory (LSTM)

To answer any query of the customer by the travel agent and the online website is not that accurate. At the same time to answer the query in round the year (24/7) is not possible. In such a situation, intelligent travel chatbot is a key. The intelligent travel chatbot is taking all the queries as input

and through dialogue system or knowledge-based system, it will complete the query for a better understanding of the requirement and then predict the relevant and accurate answer to the query of the user.

The system first identifies the original query and if that query which needs to be answered is incomplete then, first it will get the required detail to answer that query. The query is answered according to user preferences. The user query is the key importance to any chatbot because the chatbot is replying to the answer of the user query only. So, first of all, the model understands the user query itself then process for further steps. To do this, LSTM technique is used, below is the description of LSTM. LSTM (long short-term memory), this technique is one of the most popular RNN architectures because of its memory cell capability (Olah, 2015). LSTM replace the hidden layer of artificial neurons network with the memory cells neurons network, which is capable of doing some operation in between memory cell layers like input, forget and the output gate.

In the Fig. 2, the sigmoid symbol is denoting the neural network layer and the circle is denoting some operation with the layers.

Each cell in LSTM can perform a task and decide whether they have to pass the same input value or have to do some change and then pass it, or not pass that value for further process.

If let suppose the data is irrelevant and may have a possibility to change the meaning of the final outcome or it will decrease the accuracy so for that cases forget gate layer is used in LSTM, which will bypass that value.

$$f_t = \sigma(W_f \cdot [h_{t-1}, x_t] + b_f) \tag{1}$$

Here, Equation (1) is for forget gate layer.

Likewise, if the data is partially relevant and have to change something into it to extract more information from

them. This is also possible with LSTM cell gate that is input gate layer.

$$i_t = \sigma(W_i \cdot [h_{t-1}, x_t] + b_i) \tag{2}$$

$$C_t = \tanh(W_c \cdot [h_{t-1}, x_t] + b_c) \tag{3}$$

Here, Equation (2) is for the input gate layer, Equation (3) is for new cell after getting the required changes.

After the above step, the response from both the gate layer will start preparing the final outcome from those with some operation.

$$c_t = f_t * c_{t-1} + i_t * C_t \tag{4}$$

Here, Equation (4) is for the new cell which is calculated according to forget gate and input gate layers.

And the last step to make the final decision depends on the input data and the requirement of that data. This process is done by the output gate layer. This is layer also capable to add something according to the requirement.

$$o_t = \sigma(W_o \cdot [h_{t-1}, x_t] + b_o) \tag{5}$$

$$h_t = o_t * \tanh(c_t) \tag{6}$$

Here, Equation (5) is for output gate layer, Equation (6) is for the addition of new thing according to the requirement.

3.2.1 Algorithm for Training the Model

Input: data set (di), sample user query (Uiq), answer (Uia)
NLP engine (Ne)

Output: trained data set (D)

Ui < - Ne

Split Ne to Uiq and Uia

Q <= Uiq [] and A <= Uia [] (Q and A are indexed)

File1 <= Q

File2 <= A

Save Q and A in to metadata

Create LSTM (RNN) data

Obtain trained data set

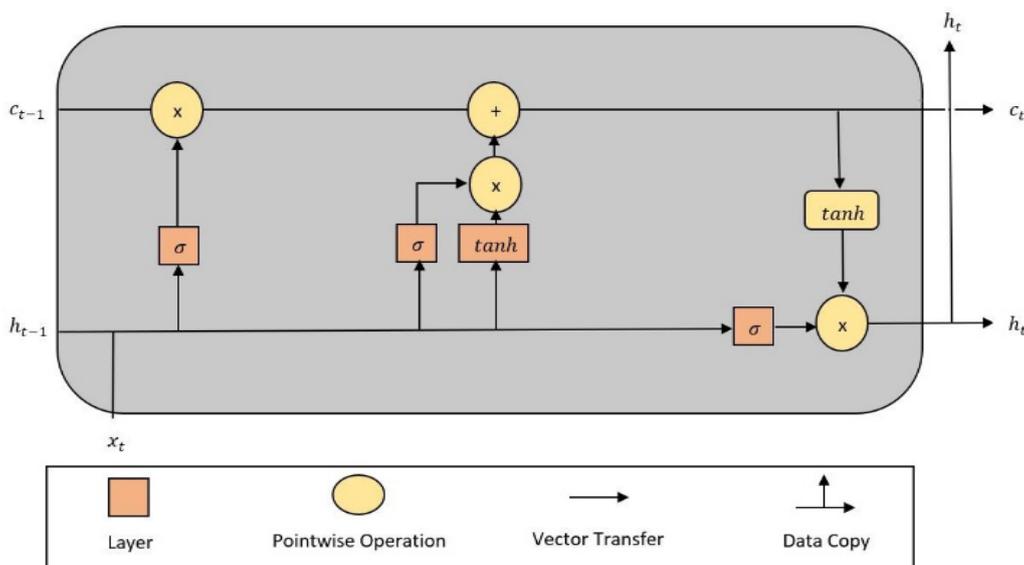


Fig. 2. LSTM memory cell

3.2.2 Algorithm for Training Model for Answering the Query

```

Input: user input (Ui), trained data det (Di), Vocabulary (V)
Output: Recommendation based on the trained dataset. (Rd)
If (Ui is a string)
    Refer Di
Else if (Ui is a Number)
    Loop V
If Ui ∈ Di
    Apply RNN
    Show (Rd)
Else
    Check number of words
    Refer V
    Apply RNN
    Di <= Di + Ui (Update dataset)
Show (Rd)
    
```

4. RESULTS AND DISCUSSION

The seq2seq model is trained with approx. 130422 pairs of questions and answers. From those after pre-processing 8002 words has assigned with the unique index number. In this work, the chatbot is created for the travel domain. Table 1 and the Fig. 3 describes the dataset that is taken for this chatbot. The chat conversation is small, but the question/answer index is considerably higher compared to other datasets.

Table 1. Dataset description

Filename	Count
Chat conversation (CC)	2389
Word to Index file (WI)	8002
Index to word file (IW)	8002
Pair Index of the question and answer words (PI)	130422

Dataset Description

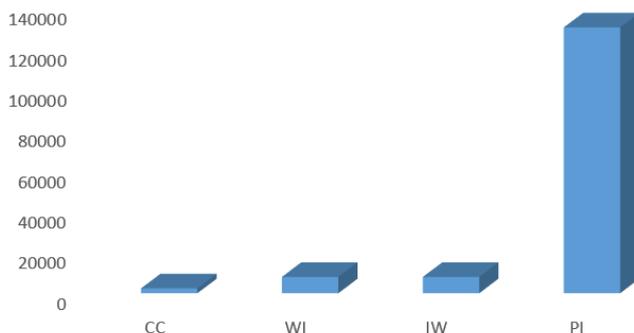


Fig. 3. Dataset description

This chatbot is implemented in deep learning techniques. As it is implemented in deep learning techniques this

chatbot will train automatically from the provided dataset and after training, it will act like the same according to fed data. It will also capable of providing a result of many places with detail.

Table 2. Execution time

Filename	Execution time (seconds)
Loading Model (LM)	15 - 20
Conversational Chat (CC)	0.30- 0.55
Search with Internet (SWI)	1 - 2
More details with Internet (MDI)	0.55 - 1.5
Search without Internet (SWO)	0.35 - 0.55

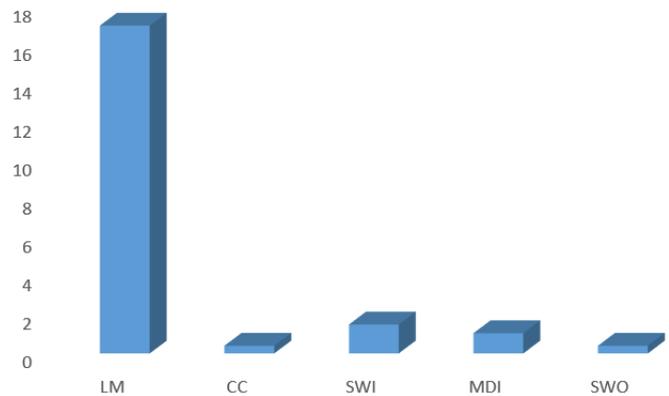


Fig. 4. Execution time of characteristics

Table 2 and Fig. 4 shows the parameter which is chosen to check the execution performance of the chatbot. In which, below are the reasons to choose the above parameter.

- The loading model is the parameter to check that how much time is taken by the chatbot to load all the files and show the final user interface to interact with the user.
- Conversational chat is the normal chat response execution time that shows how much this chatbot requires to answer any person.
- Hotels, Restaurant, Famous place. This parameter is to check how much model time it will take to show this mention detail to the user if the user searched for it. This search can be possible in 2 ways:
 - With Internet:* This shows if the user's searched information is not their content and at the same time the internet is also connected then it shows the required information after fetching with the internet.
 - Without Internet:* It will search only the content if the user's searched information will found then only it will show otherwise it will request you to connect the internet.
- More detail about places. If the user wants to know more detail about some specific place or information so, this feature is used and to show the performance of this as well, therefore this parameter is used.

Table 3. Proportion of answers expected

Travellers	Google	Our chatbot
Family or group travellers	43	72
Solo travellers	49	71
Back packers (Low Cost Travellers)	46	65

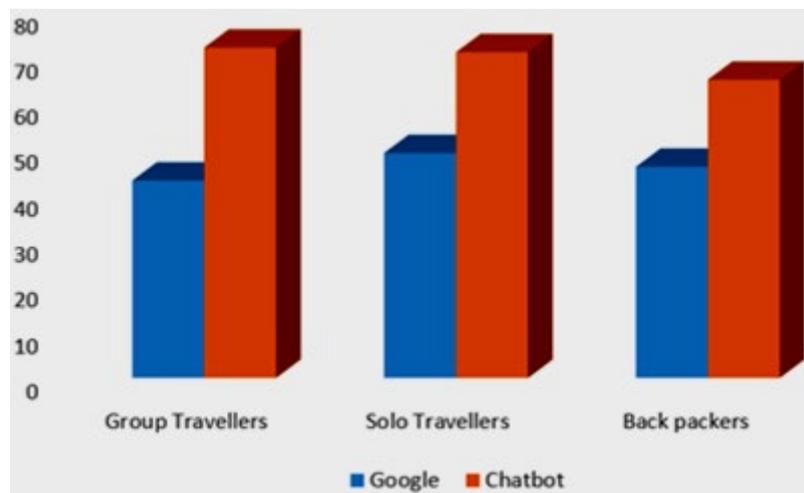


Fig. 5. Proportion of correct answers

This application collected data from group or family travellers, solo travellers and back packers (low cost travellers). The users of this application also used Google as a search engine to find their queries answered. The results compared against theirs as well. Fig. 5 and Table 3 depicts the proportion of correct or expected answers against this chatbot vs Google. Our results outperform that of Google search for travel related queries

5. CONCLUSION

In this work, the AI-Based conversational chatbot for the travel domain is created. To create this, LSTM model is used which is good at data understanding, data forming and predicting the information because of its powerful memory cell. The memory cell is capable of predicting the new word for sentence forming and dropping the current or old word if that word is not appropriate for that sentence. Therefore, this model can understand each query asked by the user and reply that query. In this chatbot, the query is answered within 0.35 to 0.55 seconds but at the time of conversation chat, it is somehow weaker in understanding and sentence framing because of the less conversation chat history which is used to train the model. The performance of chatbot will increase if the chat history was more as well as system configuration is also more. For the other parameter, it is working well, it will show approximately everything about any place and it is automatically learning by the internet if the internet is connected. It will show the current rating of that places which is searched by the user and it will save into the database because if the user is offline and want to retrieve the same information then also it will retrieve that

particular information. But for now, it will be looking only into the travel related question and saving that into the dataset.

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