Chatbot for Expecting Women and their Families Using Machine Learning and Natural Language Processing

Ch. Rama Satya[1], G. Rishika[2], J. Akshaya[3], G. Tarun Kumar[4], D. Shashi Kanth[5], M. Nikhil[6*]

[1]Assistant Professor, Department of Computer Science and Engineering, VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad, India
[2,3,4,5,6]Department of Computer Science and Engineering, VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad, India

Abstract: Deep learning and Natural Language Processing is widely used in research fields like health-care and medicine. In an era of smartphones, almost every task is done on the finger tips. The objective of this project is to provide customized information to pregnant women and their families. Though there is a vast amount of information available on pregnancy and childcare on internet and other sources, surfing the internet to find the right and most suitable answer to our query every time is a tiresome task. Through this project we aim to provide customized answers to user queries. We designed a Q&A chatbot which provides information on prenatal and postnatal conditions. This chatbot is the major part in the website developed for pregnant women. The main idea of website, is to provide a chatbot which delivers support to pregnant women, mothers, and their families by helping them in relevant situations. It also provides water and medicine reminders. It is a user-friendly website which can be easily accessed by anyone. The chatbot is developed using Machine Learning, NLTK and Natural Language Processing technologies. A machine learning algorithm known as Long Short-Term Memory is used in building the chatbot.

Keywords: Pregnant women, prenatal and postnatal, chatbot, machine learning, NLP, NLTK, long short-term memory.

1. Introduction

Pregnancy is the most special phase in every woman's life. The whole experience and journey of the pregnancy varies from one woman to another. This is because many factors like health, habits, genes etc. play judging factors for the pregnancy journey. This journey can be worrying and overwhelming for women who experience it for the first time. Through this project, all the basic queries related to pregnancy and the baby are clarified. It also assists pregnant women in their pregnancy journey by providing useful information, resolving queries, and also has features like water reminders and medicine reminders.

A chatbot also called chatterbot is a software which is used to generate online chat or conversations through texts and also text-to-speech (updated version). Using this provides a live contact to the agents of respective organizations. Chatbots were introduced in 1994, but were later on improvised and used for many purposes like customer service, company internal platform, messaging apps, healthcare and so many.
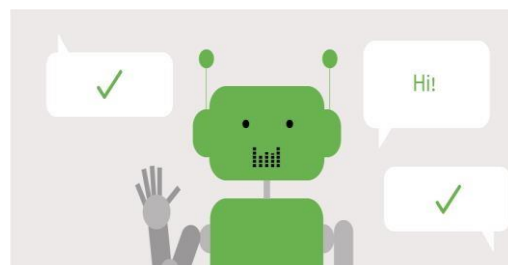

Fig. 1. A chatbot - An artificial human

This is basically a machine learning and natural language processing based chatbot, which is present in a website, that is designed for pregnant women and their families. In this a machine learning algorithm called LSTM is used, which is abbreviated as Long Short-Term Memory. LSTM is an artificial recurrent neural network architecture used for deep learning. It has four major components i.e., cell, input, output, forget. The cell has arbitrary time interval values, while the other components are responsible for flow of information through the cell. LSTM's main advantage is that it deals with the time series data in classifying, processing and predicting the lags of random durations of the time series. As it deals with vanishing gradient and exploding gradient most of the chatbots are developed using LSTM algorithm. This model is trained with all possible questions and answers, so when a question is asked it predicts the answer and displays it to the users.

Fig. 2. Technology for pregnant woman

2. Related Work

K.W.M.C. Maduwantha et al. [1] They have developed a very interesting artificial intelligence assistant using NLP. They

have also included various features in their application but they haven't yet been implemented. Their application had a user authentication system for which they used Firebase SDK. They also had a feature of reminder and some mind relaxing activities which can be used to relieve the stress of a pregnant women. There is a Dialog flow which is used to match the intent of the user when user inputs a query and a webhook request is sent to webhook service. This service message is reverted back to the Dialog flow which will again send the response to the end-user. To build the application they have used React Native.

Ruyi wang et al. [2] They have developed a chatbot for providing mental healthcare assistance which will help in dealing with perinatal mental health problems. They are mood disorders which may arise during pregnancy or after pregnancy too. This will help pregnant women's families and their relationships. They extracted the main features that will affect the anxiety and depression level of a pregnant women. Then they trained the model to test the pregnant women's mental health. Then it will try to calculate whether pregnant women are suffering from mood disorders or not by performing various tests on the user. Based on the calculation of anxiety and depression levels the chatbot will provide pregnant women with tips and some advices or prescriptions. There were many features in the dataset to calculate the anxiety level like angry (times per day), physical discomfort (times per day), panic (times per day), irregular wakeup(yes/no), mood swings (times per day) and etc. Using the above features chatbot will calculate the mental health level and recommend the tips to the user.

Vaishnavi gupta et al. [3] They built a chatbot to know the behavior of first-time mothers who are breastfeeding and to know what issues they face while breastfeeding and also to take feedback on whether women would like to use chatbot for breastfeeding consultation or not. They have collected this data by calling women and asking them questions and recording the responses. Their analysis gave the insights that majority of the women have shown a positive behavior regarding the adoption of chatbots.

Rashmi Dharwadkar et al. [4] They built a medical chatbot for having a conversation with a patient so that the user may not always have to go to hospital for any small query. The chatbot was built using SVM classifier to distinguish two classes and NLP to understand the human language and transform it into a query which has to be understandable by chatbot. To extract important words and remove some suffixes and consider only proper English words they used Porter Stemming Algorithm and they also used word order similarity checking to check difference between two sentences. Because order of the words can completely change the meaning of the sentences.

Kevin Mugoye et al. [5] An experimental process was used to create the bot. In the dialogue manager, we used MAS (multi agent systems) supporting toolkits to accomplish predicted behaviour and Reinforcement learning to aid learning. The main concept is to capture the most relevant parts of a real-world situation and use reinforcement learning to train the model. The Multi Agent System is unpredictable, difficult to comprehend, and regulate, and it may not be trustworthy.

Jitendra et al. [6] They have researched on various papers and from that one of the systems was designed using google API, SVM (for predicting disease based on the symptoms) and NLP for having conversation with the user about any issues. The other system was the chatbot which was designed to help pregnant women using various Microsoft Bot framework and LUIS (Language understanding Intelligent service). One more system was chatbot built using AIML (Artificial Intelligence Modelling Language). They used Lemmatization for extracting important keywords from user input to match them with their predefined set of questions and answer them accordingly. One of the systems was self-diagnosis chatbot which is very helpful for some users who are not able to reach to the doctors. At that time, they can use this chatbot for self-diagnosing. The only thing they need to do is give the input to the chatbot which should include their symptoms. Their system has three components which includes user validation, extraction of symptoms and then map those symptoms with the predefined symptoms dataset and based on the severity of the disease the chatbot gives the suggestion or advises to go to doctor for a checkup.

Iuliana Marin et al. [7] They have built a chatbot the for women who are suffering from preeclampsia. It is a type of disorder which can be caused by hypertension, as well as can damage some of the internal organs like kidneys and liver. They have considered many factors which can cause the preeclampsia. The chatbot contains information about preeclampsia and also information on other symptoms and complications pregnant women come across. This information is stored as RDF triples. These triples contain the information which is confirmed and verified by the medical staff or experts in order to find out whether system has understood those and remembered or not. They used SPARQL and some predefined rules using which the chatbot will respond to what user has asked. Based on the initial questions, chatbot creates a flow in which it may ask several questions and for each question chatbot may have different answers stored in their knowledge base. Basically, this chatbot serves as a counsellor for a pregnant woman. They have used machine learning to predict the type of disease and give prescriptions based on the disease and guide them to provide the right information.

Kyungmi Chung et al. [8] They built a chatbot using kakao's chatbot builder which is a tool for building chatbots. All they did was to put their questions and answers in the question-and-answer knowledge base database and mapping it with the answers. The chatbot was built in such a way that either it gives answer to the perfectly matched question or it will give the answers to the 3 most closely questions and answers. One of the other main features of this chatbot was most frequently asked questions were displayed on the top of the display or UI. Their main focus was only on women's mental and physical health during perinatal period. They have collected nearly 3000 questions which were very well refined with almost 6 contents covered. This chatbot also handled many exceptions like if there are any unexpected responses or if the user exits from the flow suddenly due to any error. These are very well handled with dialog buttons which will allow them to continue their previous conversation or else start the new one.

Addi Ait-mlouk et al. [9] They built the complex chatbot which was based on the natural language understanding over linked data. The chatbot was built in such a way that it not only gives responses which are predefined but also it takes the query from the user's input and analyses it and then extracts the required information and it presents the user the required response. They have used multiple techniques in this like SPARQL for generating queries from the user queries using NLU (Natural Language Understanding). They have used flask framework to build the UI for their chatbot. Whatever user asks the chatbot tries to save the data in its knowledge base to further improve and learn from it. They have NLU model to process the user query in the form of text/speech. Then it classifies the intent of the query using SVM. From this classification it decides whether to generate a SPARQL query or not. There are various sub modules which will try to convert this query and using that query it will retrieve the response and another sub module will select the most relevant answer and display it to the user.

3. Existing System

As this is a sensitive topic, there are very less resources for pregnant women to look into. Even in the existing systems they only focused on prenatal conditions, but not on post-natal care. In assisting pregnant women with pre-natal care too, they didn't address many of the basic issues like exercises, food diet, psychiatric counselling etc. that are very much needed during pregnancy. There aren't many existing systems which include all the content and features.

4. Proposed System

This proposed system not only focuses on pregnancy period but also focuses on post pregnancy period and baby care. We are building a website using Flask, in which we will be having features like a chatbot and also includes features like pregnancy cycle tracker, water reminders and medicine reminders, basic exercises and diet etc.

Our proposed solution is built on a modular strategy that incorporates semantic web approaches, knowledge graphs, and machine learning. Users can communicate with the system using a chit-chat mechanism to improve usability. The suggested chatbot is built with the Flask framework and can run in a standalone or distributed manner to optimize information retrieval response times. The inquiries and user input are anonymized and saved in a database for future learning and improvement. A text user question initiates the interaction. After that, a model developed with LSTM analyses the user query. Long Short-Term Memories are a type of recurrent neural network that improves its memory by doing a sequence of arithmetic operations rather than just transferring its output to the next part of the network. The LSTM has four "gates": forget, recall, learn, and utilise(the output). The three types of inputs are long-term memory, short-term memory, and E (E signifies a new data set or a training example)

Step 1: The three inputs enter the LSTM and are routed to forget or learn gates.

Long term data is sent to the forget gate, where, surprise, some of it gets lost (the irrelevant parts).

The learn gate receives the short-term information and "E." This gate determines what information will be gathered.

Step 2: Information will be transferred to the remember gate (as it develops a new long-term memory) and the use gate (it updates short-term memory and also is the network's outcome) after passing through the forget gate (information is not forgotten but stays at the gate) and the learn gate (which is learnt).
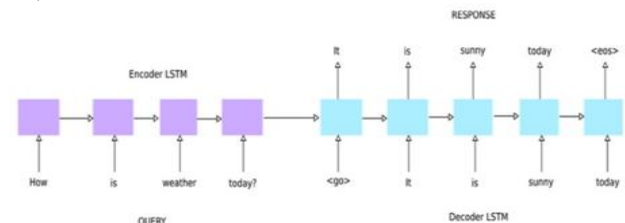

Fig. 3. LSTM model

5. Implementation

Pregabot offers some multiple features to make it a interesting web application.

The features which are included in this pregabot are:
- Chatbot
- Water Reminder
- Medicine Reminder
- Trimester Chart

User Authentication: To utilise this pregabot app, the user must first create an account. If the user does not have an account, they must register on the page, and we utilise the Firebase SDK to store the user's information. It is one of the most effective methods for identifying users. It has a number of features, including email and password resetting.

The user needs to enter email address and password to login into the application. The details are sent to the firebase and it authenticates the user with the provided details. There is also reset password option which is being made easy with the help of firebase.

Chatbot: This is the most important element of the app we created. The goal of this chatbot is to give the best possible replies to the user's questions. Using deep learning techniques, we created a chatbot. The information, which includes categories (intents), trends, and responses, will be used to train the chatbot. We use a recurrent network called as LSTM to classify the user's message in which category their message belongs to and after classifying, we the model then chooses a suitable response and responds to the user.

To be able to provide the perfect response we need to process the text in our dataset. For that we have used NLTK. We'll change the full text to either upper case or lower-case strings, so that, algorithm doesn't confuse similar terms in various contexts.

Tokenization: Tokenization is a term that describes the conversion process of ordinary text into a list of words that are important. To get a list of sentences and words in tokens, use the sentence tokenizer and the word tokenizer, accordingly. A

previously trained tokenizer named Punkt tokenizer which is for English language is included in the NLTK data package. Getting rid of any noise or characters that aren't numbers or letters.

Stop words Removal: Few surpassingly regular words that found are less valued in assisting the selection of publications that meet the user's needs are sometimes completely removed from the lexicon. These are known as stop words.

Stemming: The process of reducing skewed (or sometimes procured) words to their stem, base, or root form, usually a written word form, is known as stemming. If we stemmed the words "Stems," "Stemming," "Stemmed," and "and Stemtization," the result would be the single word "stem."

Lemmatization is slightly distinct from stemming. The fundamental difference is that the stemming frequently results in non-existent words, where lemmas are real words. You can search up a lemma even if you can't look up the root stem. For example, "run" is base form for similar words like "running" or "ran," although "better" and "good" are in the same lemma and are thus regarded correspondents.
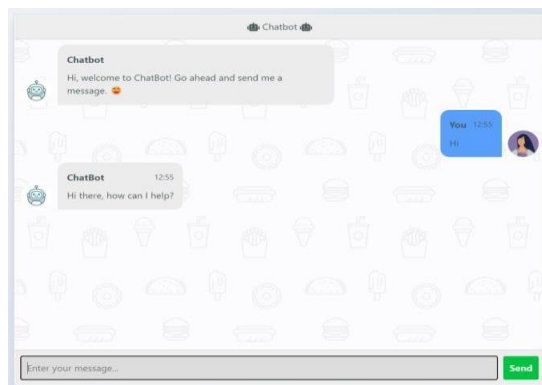

Fig. 4.

Water Reminder: This feature is used to remind user about drinking water at frequent intervals. We send a notification to the user for every one hour or two hours to drink water. We have built this feature using javascript. There is a set value associated with every user. This set value is stored in the firebase database. Initially when a new user is created the set value is declared 0. When the user clicks on the remind button the set value is changed to 1 and the remainder is ON. The user receives the notification till the user turns their reminder OFF.
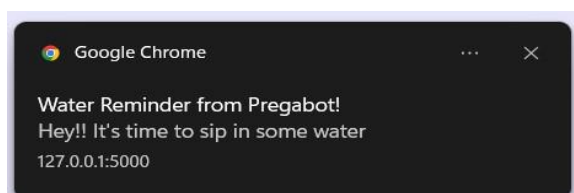

Fig. 5. Water reminder

Medicine Reminder: This feature is somewhat similar to Water reminder. Every user has different medicine requirements. So, we are giving the user to fill a form of the medicines he needs to reminded of. The form consists the medicine name and at what time the medicine needs to be taken.

We are storing the details of this medicine and it's time in the cloud fire store for every user. Then we will retrieve the medicine name at every moment and check whether the time of the medicine is matching or not. If the time of the medicine matches then we will send the notification to the user reminding them about the medicine.
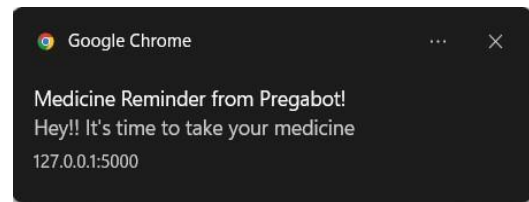

Fig. 6. Medicine reminder

6. Future Scope

The expectations from any application are never ending, hence there is always scope for future. We can improve the accuracy of responses for chatbot, include more diverse questions etc. As most of the pregnancy care applications did not have a chatbot feature we focused on it only.

Additionally, we can include features like music - provides soothing music for baby, exercises - this feature can help pregnant women by suggesting appropriate physical exercises and yoga and other breathing exercises. If we want to go more advanced, we can include features like stories - which is reading stories to baby.

7. Conclusion

We have studied various existing applications for pregnant women and observed that many of them didn't have an Artificial Intelligence based chatbot feature. And the features they provided were not sufficient. So, we have come up with an idea to create an application with chatbot feature with which pregnant women can get their queries resolved and also included other features like medicine and water reminders to help them. We have tested our application by trying various kinds of profiles. The results were satisfactory.

References

[1] K.W.M.C. Maduwantha, V.N. Vithana "MumCare": An Artificial Intelligence Based Assistant"
[2] Ruyi wang, Jiankun wang, Yuan liao, Jinyu wang "Supervised Machine Learning Chatbots for Perinatal Mental Healthcare."
[3] Vaishnavi Gupta, Nikita Arora, Yash Jain, Sushil Mokashi, Chiranjibi Panda "Assessment on Adoption Behaviour of First-time Mothers on the Usage of Chatbots for Breastfeeding Consultation."
[4] Rashmi Dharwadkar, Neeta A. Deshpande "A Medical Chatbot."
[5] Kevin Mugoye, Henry Okoyo, Sylvester Mcoyowo, "Smart-bot Technology: Conversational Agents Role in Maternal Healthcare Support."
[6] Jitendra Chaudhary, Vaibhav Joshi, Atharv Khare, Rahul Gawali, Asmita Manna, "A Comparative Study of Medical Chatbots."
[7] Iuliana Marin, Nicolae Goga, "Preeclampsia Counseling Via Chatbot for Pregnant Women."
[8] Kyungmi Chung, Hee Young Cho, Jin Young Park, "A Chatbot for Perinatal Women's and Partners' Obstetric and Mental Health Care: Development and Usability Evaluation Study."
[9] Addi Ait-Mlouk, Lili Jiang, "KBot: A Knowledge Graph Based Chatbot for Natural Language Understanding Over Linked Data."