AI-Based Interactive Agent for Health Care Using NLP and Deep Learning

U. Hemavathi and Ann C. V. Medona

Abstract Artificial intelligence (AI)-based interactive agent plays a vital role in health care. In this paper, we have implemented AI-based Interactive agent using natural language processing (NLP) and deep learning (DL) which deals with resolving simple queries and provide health care services. This work helps to build a system for providing better health care service for user and increase user interaction. This work builds a chatbot using DL and NLP pipeline. We conclude that chatbots build with NLP and neural network are more efficient than human resource and predefined chatbots that are not efficient. It is necessary to discuss potential research directions that can improve capabilities.

Keywords Deep learning · Artificial intelligence · Natural language processing · Health care

1 Introduction

AI chatbot is intelligent software that can provide efficient communication and perform actions similar to human beings [1]. It yields various services such as marketing on social networks and effective customer interaction. In recent periods, chatbots give answers to the client's questionnaires for any particular domain where it is used. It can accept speech and text inputs for its operation. Chatbots are mainly used for information acquisition. These AI embedded agents use natural language processing techniques to answer the user questions. Predefined knowledge base helps develop a response to the query [2, 3]. There is a need for such mechanisms to

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A. Joshi et al. (eds.), *Information and Communication Technology for Competitive Strategies (ICTCS 2021)*, Lecture Notes in Networks and Systems 400,
https://doi.org/10.1007/978-981-19-0095-2_2

determine the response to query from available data. Hence, to solve the problem, feed forward neural network-based mechanism is proposed which can analyze the response and reply the user [4, 5].

1.1 Scope of the Work

AI chatbots are time efficient and cost effective which provides efficient services for 24*7. This work proposes to implement AI-based interactive agent for health care using NLP and deep learning which deal with resolving simple queries and provide health care service. Deep learning techniques use artificial intelligence (AI) that can make the computer to learn from the data instead of being explicitly programmed. Training data are processed, and features are extracted by ML algorithm which is stored in database for further investigation. Preprocessing is done by natural language processing pipeline. Literature survey expresses the use of chatbots in medical field as well as various researchers and their experimental analysis of chatbots for various services.

1.2 Literature Survey

This paper explains the systematic literature survey of medical chatbot applications proposed and used by various successful researchers. Taobias Gente et al. proposed a systematic literature review of Medical Chatbot Research from a behavior change perspective in 2020. This paper reviews the published research results relating to details of designing techniques of chatbot. It explains about the design of conversation systems methodology. Emanuela Haller et al. designed a chatbot that can simulates an historical figure. This paper reviews the published research results related developing of architecture chatbots. It explains about the design and implementation NLP and machine learning.

1.3 Methodology

The proposed work consists of the following modules,

- Prepossessing and feature extraction
- Training phase
- Test phase.

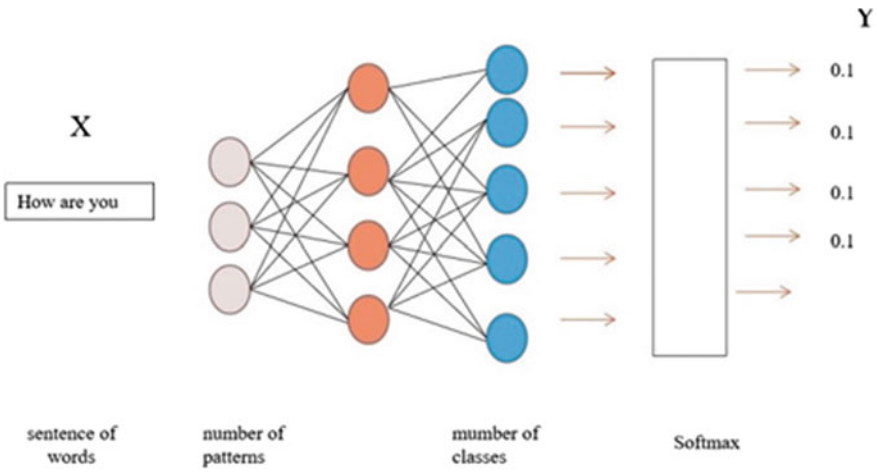


Fig. 1 Feed forward neural network architecture

Prepossessing and feature extraction

It is implemented using the natural language processing pipeline. Tokenization is used for splitting a string into meaningful units, for example, "how are you?" is spitted as ["how," "are," "you," "?"]. Stemming helps to generate the root form of the words. The crude heuristic is used to chops of the ends off words (for example, "organization" is chopped as "organi"). NLP and information retrieval techniques use the concepts of bag of words to convert string to vector. In this model, a text is characterized as the bag of its words by disregarding grammar. This method is commonly used for document classification where the incidence of each word is used as a feature for training a classifier.

Training Model using Deep Learning Algorithms

Figure 1 depicts the feed forward neural network architecture used for training. The step-by-step procedure is given as follows,

- Creation of database which contains information about diseases and its ir symptoms
- User or client sends a message in the form of text or voice.
- NLP uses implicit and explicit expression analysis to identify the similar word patterns in the input data [4]
- NLP converts input to machine understandable format.
- To respond to the user's input, the chatbot creates an answering sentence out of the knowledge stored in the database.

This method does not need manual processing, hence time required for processing the data is very less and provides accurate response [1, 5]. The retrieval-based method

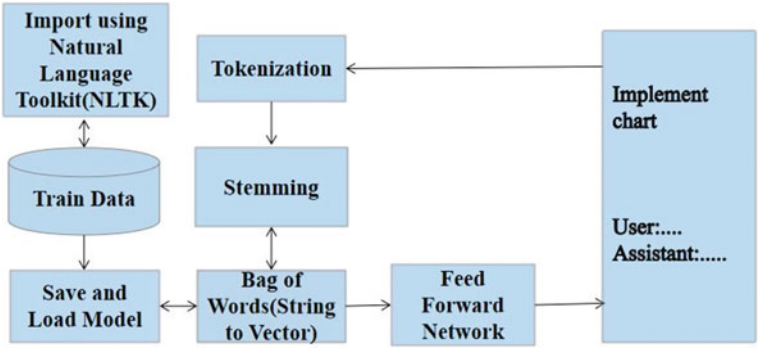


Fig. 2 Proposed architecture diagram

compares queries with message-response pairs and can retrieve sentences with high naturalize and fluency but is usually used in a closed domain.

Test phase

Artificial neural networks (ANNs) and deep learning techniques yield better solutions for many real-world problems such as image recognition, medial data analysis, and speech recognition [6]. NLP plays a vital role in AI field that helps to examine how computer systems can interpret and control [1, 7] text or speech. Most NLP techniques rely on deep learning and machine learning techniques. The proposed system helps to rectify all shortcomings of the existing system and helps users to exploit services maximum and also to provide more advantages than manual methods [8, 9]. In this paper, we propose a general artificial intelligent chatbot agent, and model is built. Deep learning model which analysis the query data from NLP pipeline and provides response to user [10, 11] (Fig. 2).

1.4 Module Description

1.4.1 Preparation of Dataset

Deep learning models are used to train the dataset which is collected from the client. Every new data details collected at the time of application form act as a test dataset.

1.4.2 Preprocess Data

Tokenizing is the first and most basic step in preprocessing. It converts the entire text into small parts like words. Lemmatizing process is applied to convert word into

lemma form. At the end of preprocessing, pickle file is created to store the Python objects.

1.4.3 Creation of Training and Test Data

Training dataset is created from the client input. After preprocessing, it is stored in database for experimental investigation purpose. Output pattern uses bag of words concepts to give response to the client.

1.4.4 Build the Model

- Deep neural network layer which consists of three layers is built using keras sequential API. The model is trained for 200 epochs, and the model is saved as "data.pth"
- Loading the trained model and then use a graphical user interface that will predict the response from the bot.
- The model implements appropriate functions which will identify the class and then retrieve us a random response from the list of responses.

2 Implementation and Testing

2.1 Input and Output

We can test the input by providing details by the user. After that, deep learning model provides the below output Figs. 3, 4, and 5.

2.2 Sample Input and Output

See Fig. 6.

2.3 Advantages of the Chatbot

- Easy to analyze.
- Less time consuming and easy to control.
- External evaluation can be reduced.

Fig. 3 Output image1

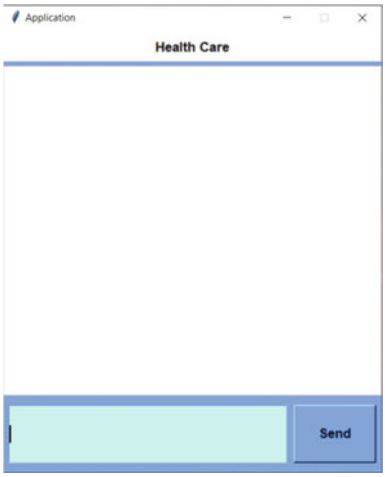
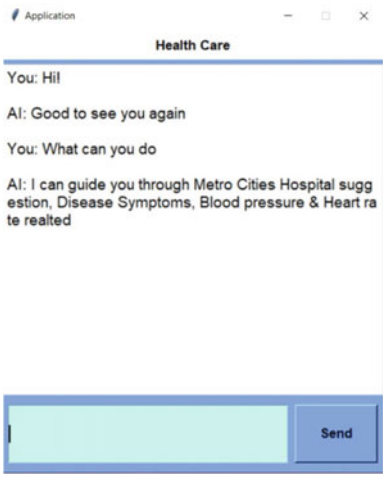


Fig. 4 Output image2



- System can be accessed from anywhere using Internet.
- Fast and more efficient than existing system.

3 Results and Discussion

This work is trained successfully using Python with custom dataset. Data are processed by tokenization, stemming, and bag of words (string to vector) using natural language toolkit (NLTK). Then, training data are created. The PyTorch model and training by feed forward neural network with 3 linear layers and 2 hidden layers

Fig. 5 Output image3

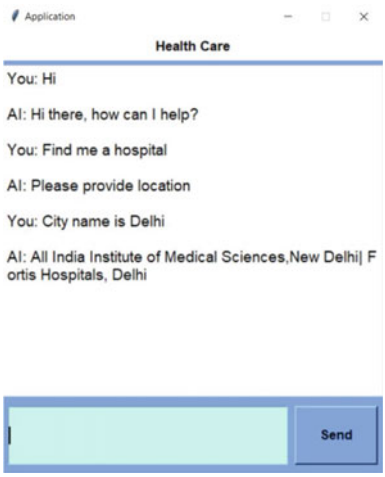


Fig. 6 Test image

```
import random
import json

import torch

from model import NeuralNet
from nltk_utils import bag_of_words, tokenize

device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')

with open('intents.json', 'r') as json_data:
    intents = json.load(json_data)

FILE = "data.pth"
data = torch.load(FILE)

input_size = data["input_size"]
hidden_size = data["hidden_size"]
output_size = data["output_size"]
all_words = data['all_words']
tags = data['tags']
model_state = data["model_state"]

model = NeuralNet(input_size, hidden_size, output_size).to(device)
model.load_state_dict(model_state)
model.eval()

bot_name = "AI"

def get_response(msg):
    sentence = tokenize(msg)
    X = bag_of_words(sentence, all_words)
    X = X.reshape(1, X.shape[0])
    X = torch.from_numpy(X).to(device)

    output = model(X)
    _, predicted = torch.max(output, dim=1)

    tag = tags[predicted.item()]

    probs = torch.softmax(output, dim=1)
    prob = probs[0][predicted.item()]
    if prob.item() > 0.75:
        for intent in intents['intents']:
            if tag == intent["tag"]:
                return random.choice(intent['responses'])

    return "I do not understand..."
```

with Softmax are used for train the data. The system proposed helps to provide health care services for all the people with high efficiency.

4 Conclusion and Future Enhancements

The proposed system helps to provide health care services for all the people with high efficiency. The artificial intelligent agent component of the is receiving increasing attention from researchers. Since these health care services are provide help to user and aid in information. The information provided by chatbot becomes important. This will eradicate the manual method of human interaction to the user in this increasing population which is very tough and hard to provide the service and also the efficiency of services will be very low in manual method. This work is trained successfully using Python with high accuracy. Our work is an initial attempt to develop and provide health care service virtual agent. In future, we can improve it by having dataset and model in the cloud. Hence, the speed of accessing the system could be improved. We use various deep learning models and improve their accuracy and visualize the various parameters that help in improving the accuracy.

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