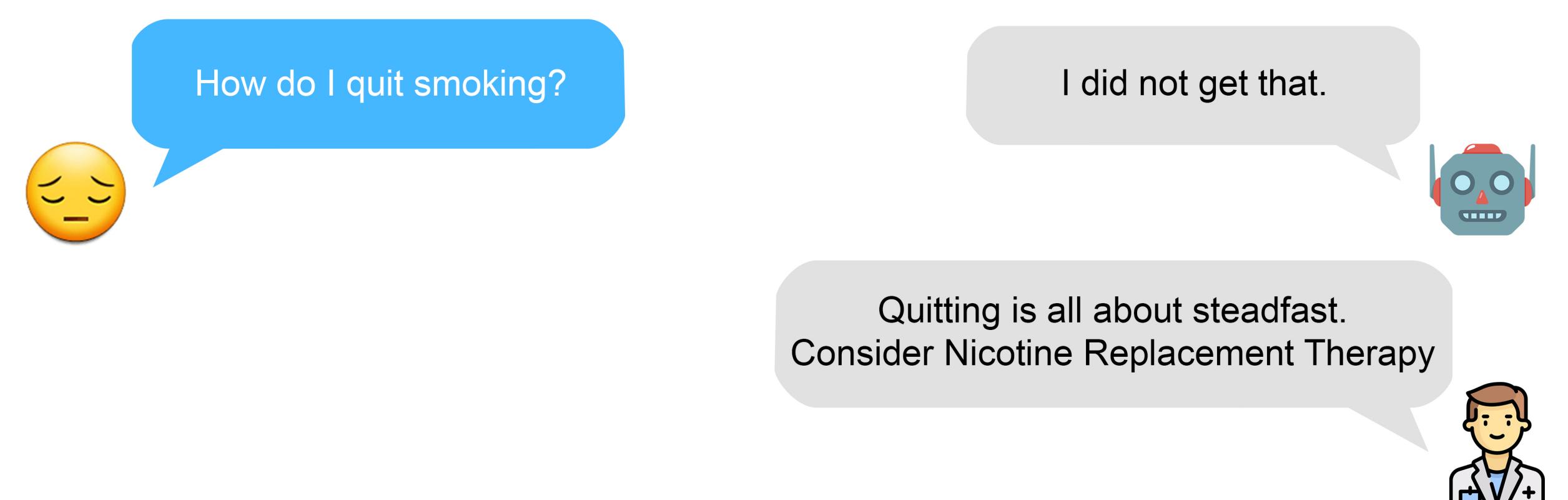




Problem Statement

There has been a rise in the number of patients suffering from major depression over the past decade. Although there are several counseling services available, most of the patients are reluctant and do not open up for it. Conversational applications such as chatbots can be a potential solution to tackle mental health problems while maintaining the anonymity. We are trying to tackle the mentioned problems by proposing a chatbot-based solution.



Motivation

Mental well-being is an essential part of our life. Mental diseases are generally hard to diagnose. Less than 10% of patients have access to formal therapy for their illness [WHO report]. Without proper consult and treatment, a person may fall deep into the depression well. An intelligent chatbot can serve as a customized, round the day mental therapy. Our proposed solution, CARO, may serve as a constant companion for a depressed person by providing an empathetic response or medical advice. Depression is often accompanied by symptoms like fatigue, loss of energy, feelings of worthlessness, impaired concentration, indecisiveness, insomnia. Giving a response which agrees with the user is not always sufficient, as the user's mental condition might not be stable in the first place. We wanted our bot to be able to decide and address the user's query/comment appropriately based on the context. The ability to answer medical queries equip CARO with more futuristic applications. If integrated with the user's medical diagnosis, CARO will be able to understand and monitor the user's health more efficiently.

Methodology

Our chatbot tries to detect whether the person is trying to engage in a general conversation or seeking a medical advice. Based on that, our proposed chatbot(CARO) generates either an **empathetic response(intent = 1)** or a **medical advice(intent = 0)** depending on the context. So, broadly CARO can be segregated into two parts, i.e.:

- If the intent detected is **1 (empathetic response)**, we redirect the model such that it triggers the emotion classifier. The detected emotion along with the user utterance is then fed to the Empathetic Response generator.
- On the other hand, if the intent is **0 (medical advice)**, then we proceed to generate a **medical advice** depending on the context detected from the text provided by the user.

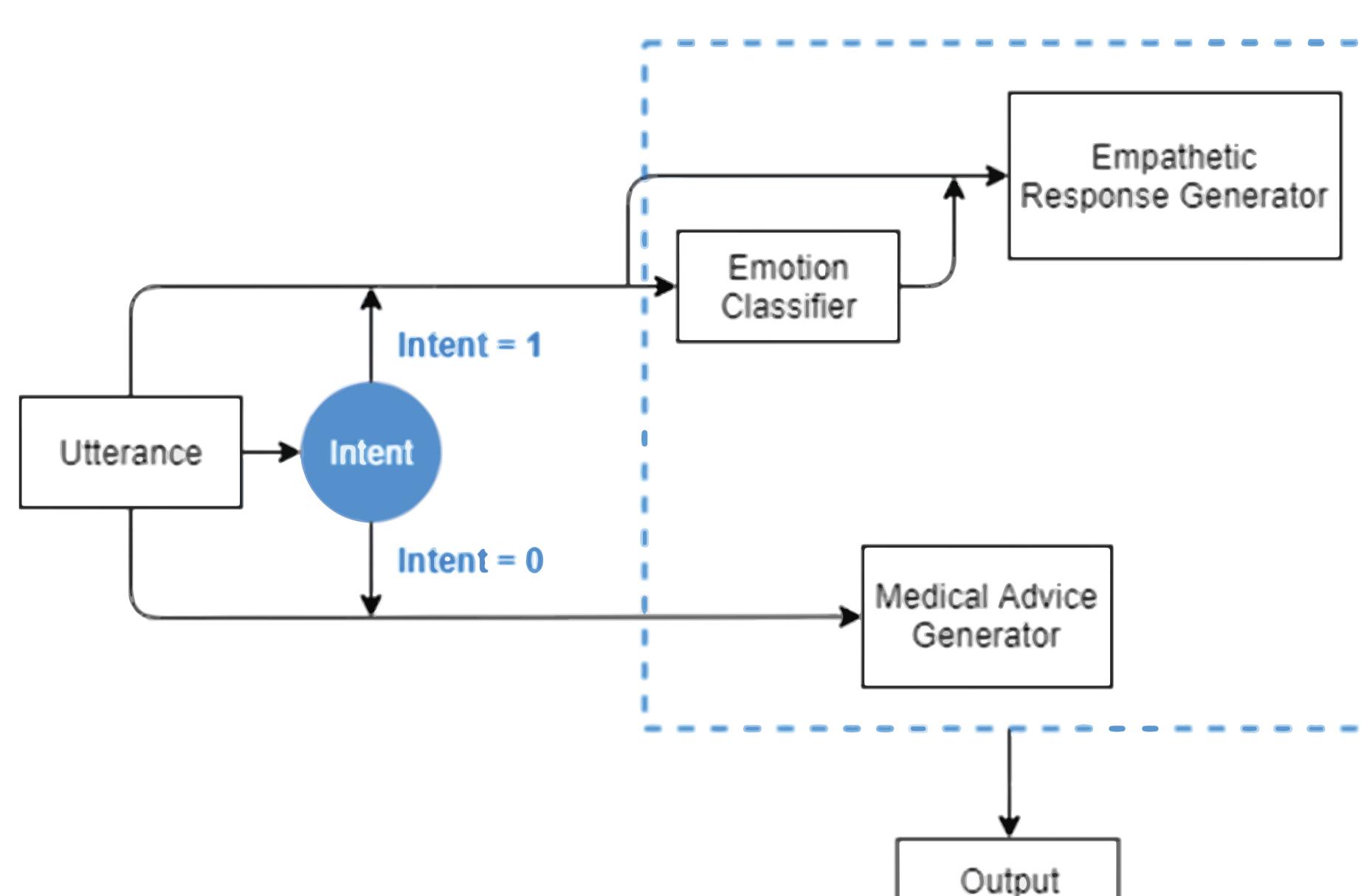


Fig 1: Proposed Pipeline

Architecture

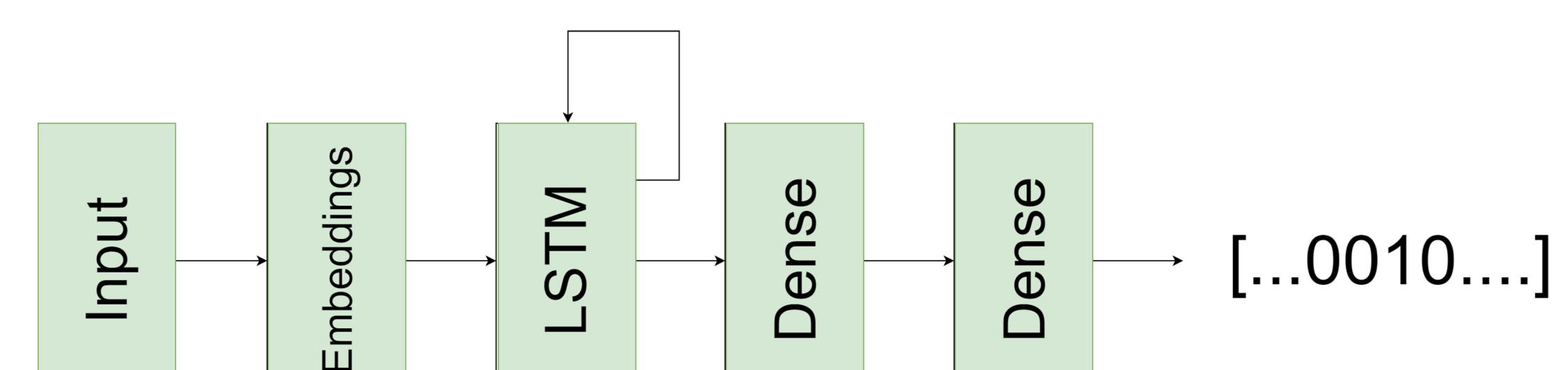


Fig 4: Emotion/Intent Classifier

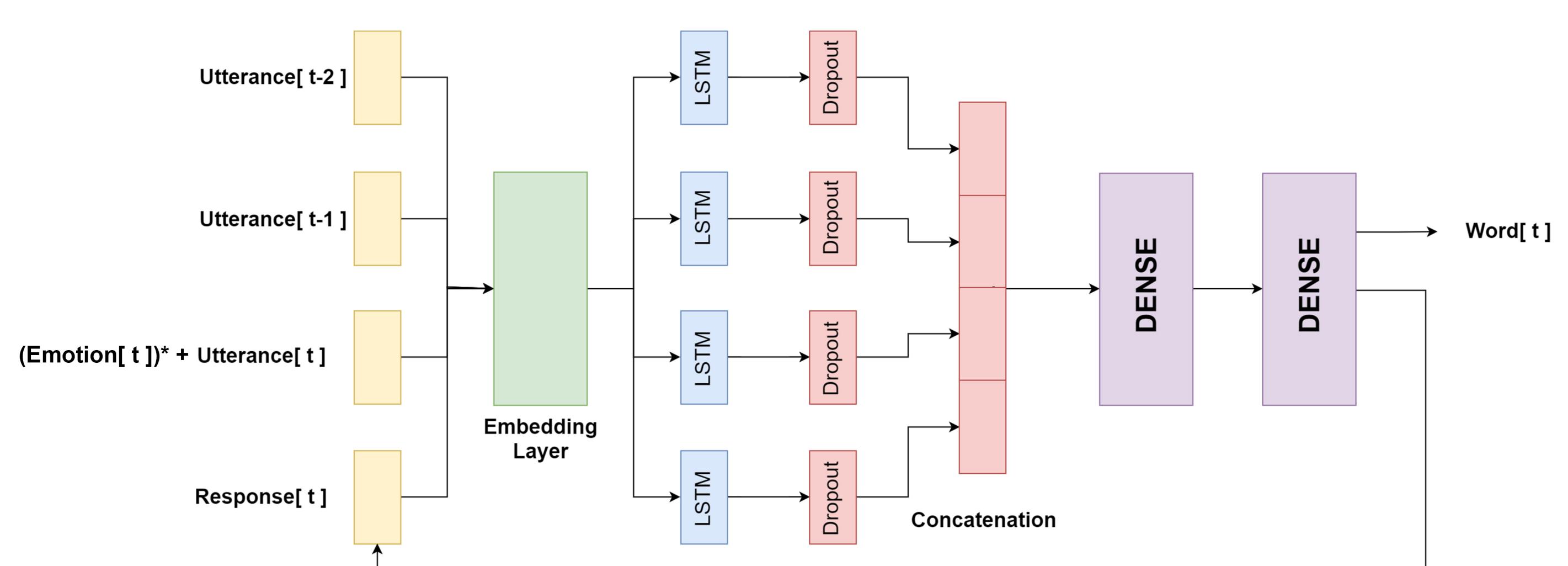


Fig 5: Response Generation Architecture

Classifier : We have two classifiers, i.e., intent(a binary classifier) and emotion classifier, which is a multi-class classifier. Both of them are based on LSTM networks.

Generator : There are two generator based models, i.e., one for generating medical advice and other for empathetic response generation. In the case for empathetic response generator emotion of the current utterance is appended along with the current utterance. As input, the generator is taking into account the previous conversations upto timestep of two while generating the corresponding response. Each of the utterance is passed through a GloVe initialized embedding layer, after which each of the embeddings are passed through stacked LSTMs.

Evaluation

The evaluation metrics for generator that we have used to evaluate are:

- BLEU Score
- BERT Score

Following are the evaluation scores of our model against that of Facebook AI model:

	CARO	Facebook
BLEU Score	0.179	0.08
BERT Score	0.83	--

Fig: Classifier Accuracy

	CARO
Intent	98.7%
Emotion	92.4%

Fig: Classifier Accuracy

Dataset

- Facebook AI Empathetic Dialogue dataset: consists of 25k dialogues.
- Medical Question Answering dataset

In Empathetic Dialogue(ED) Dataset each dialogue is grounded in a specific situation where a speaker was feeling a given emotion, with a listener responding.

Medical Question Answering dataset is web-scraped ensemble of question-answers pairs from various medical counselling forums. Most of the questions in this medical question answering dataset were either too long or are too specific with some irrelevant medical conditions. Questions related to depression related problems were selected based on the topic label of the dataset.

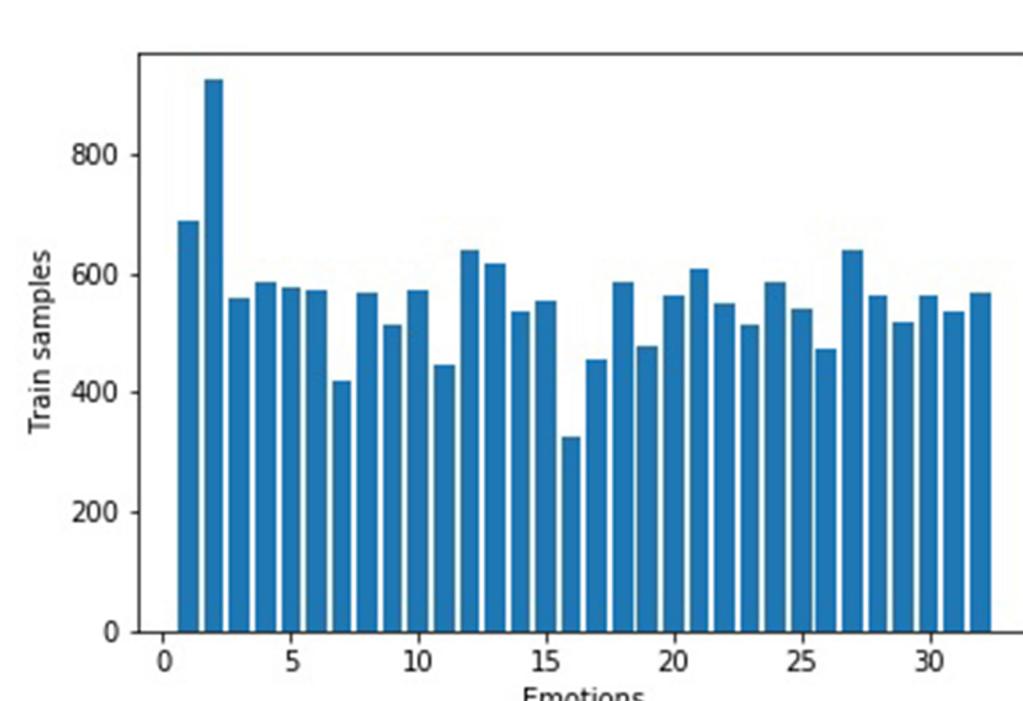


Fig 2: Distribution of Emotions

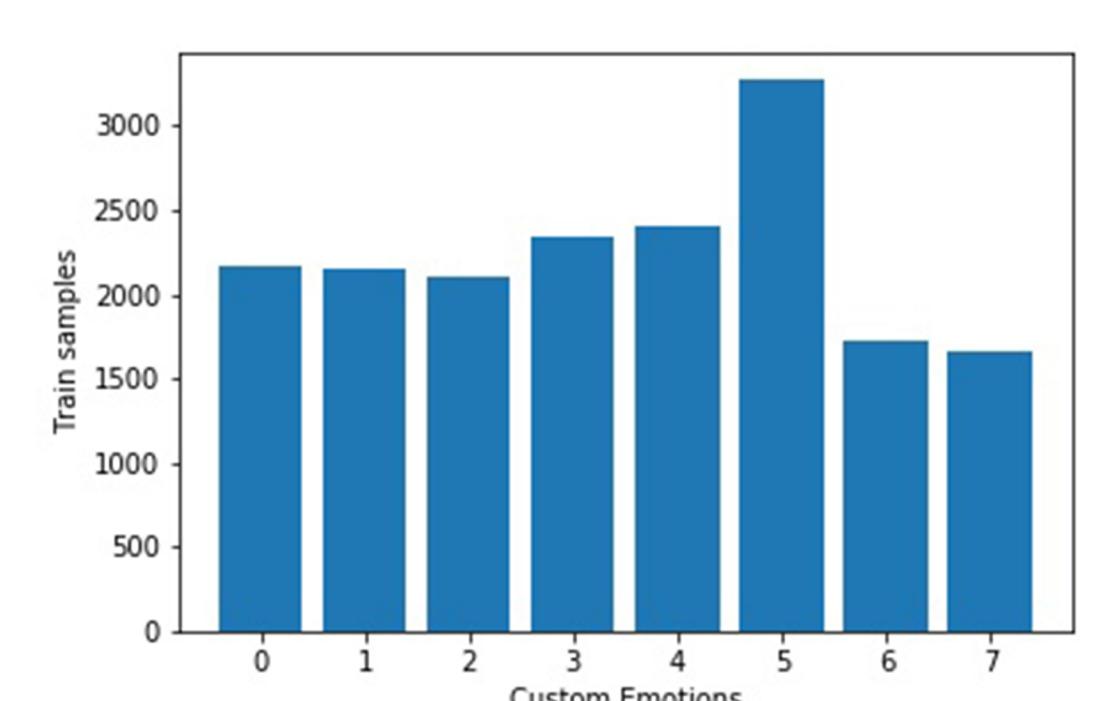


Fig 3: Distribution of Custom Emotions

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