

Emotion-Aware Chatbot

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Github: <https://github.com/SabaJazi/EA-Chatbot>

Abstract:

The Emotion-Aware chatbot project objective is to design a human-like interactive system using a chatbot that can talk and react to users' written queries with appropriate texts.

We are planning to use python for our backend and Frontend. We aim to demonstrate the NLP and Machine Learning techniques while designing the chatbot for general daily conversations which can act as a companion or friend for the user. Our model will help users to express their feelings and receive appropriate feedback regarding their input.

Background:

Detecting emotions of users through data is not a new subject, but still challenging for many. There have been many efforts to detect them via different sensor data. For example, Asma Ghandeharioun et.al. designed An Emotion-Aware Wellbeing Chatbot(EMMA) which predicts the emotion of a user from mobile phone sensor data, like geological data, distance from work and home, time of data, by a combination of Classification Models, Regression Models, and Personalized Regression Models[1].

The explosion of social media and especially twitter to express feelings has resulted in a publicly available dataset for nlp purposes. Specifically, there have been many efforts to detect different emotions from text during recent years. Srinivas B et.al have designed a neural network to detect emotion from twitter texts[2]. They used holoentropy features based on weighted probability to predict the sentiment on the same dataset that we chose. In some cases, it seems that detecting negative emotions is easier. There were efforts related to specific emotions such as aggression which was done by SaimaSadiq et.al using a multilayer perceptron model[3]. Models like that perform very well in detecting negative tweets.

Data:

In this project, we use the tweeter emotion detection dataset from kaggle[4], which is publicly available. The dataset for emotion detection has been finalized with all team members agreement. We will use and divide this dataset for different steps of our project, including training, tuning, and testing using the standard practices suggested for a good machine learning

approach. We may use a dataset for fine tuning the GPT2 model if we find good sources for that and have enough time. If not, we will just use keywords to fine tune it.

Goals and Objectives

1. Motivation:

Although NLP and machine learning have made significant progress toward tackling different challenges during the last decade, recognizing emotions has remained one of the challenges that are not fully addressed. Detecting emotions can help the communications between machines and humans to sound more human and trustworthy. It also helps to increase the confidence of users in machines' ability to conduct a meaningful discussion. There are many chatbots available developed using different tools. However, they are in many cases good at answering questions, but they are generally not able to detect emotions and react in a manner that shows their emotional intelligence. In this project, we will try to develop a chatbot that will recognize the emotion of users based on their input(text) or will show their emotional intelligence based on the received input.

2. Significance

Humans have emotions, but machines do not. Humans need emotion and awareness to feel and react to what is happening inside and outside the body and mind. If our project will be successful, then the chatbot will realize it's users' emotion although the system does not have a feeling. Thus, users will feel more comfortable and interested to communicate with this emotional aware chat bot. The users will feel like conversing with a real person. This chatbot may not be a therapist or a friend, but can play the role of a companion that can demonstrate the trust and empathy that human beings look for.

If the system is successful in showing the users its knowledge of current emotion, then the user will be more willing to continue conversation and finally, improve their mood.

These specific users can get many benefits from the emotion aware chat bot:

- A lonely person needs to talk with someone but nobody is available. According to [5] approximately 24% of elderly Americans (who are 65 and older) do not have social communication. 35% of Americans who are 45 and older feel lonely. These people may benefit from the emotional awareness chat bot.
- An elder person in a nursing home or who is just lying in the bed (cannot walk around) can talk with the emotion aware chatbot any time to realize their emotion and be aware if they need clinical help.
- People will be recognised by the emotion aware chatbot when they have negative emotions such as anger. In such situations, if they are aware that they are experiencing such emotions for a short time and they could be heard and understood, they could feel much better and be prevented from moving toward high risk activities. Even if It does not work as an anger management tool, it could be very helpful for those who have heart

disease. Research shows that a person gets higher risks of having chest pain, a heart attack, and a stroke while being angry[6].

3. Objectives

In this project, we focus on applying the NLP techniques which have been learned in this course due to our limited time and experience. The Python language and NLP libraries appropriate to our goals will be used to build our system.

First, we will collect our dataset and do the EDA(exploratory Data Analysis) to have a better idea about what we are doing and the efforts needed to do before model building, such as cleaning and other preprocessing steps.

After cleaning the dataset and preprocessing, we will start to build models to achieve the best results in each type of model. We aim to create at least 2 models so we can compare the results and choose the best. After choosing the best model we will try to maximize the performance of the model using usual NLP and machine learning methods. After reaching the highest performance we will use that to classify input data. The label output of input will be used to generate the answer text with help of GPT2 pretrained model. We will get help from this tutorial.[7] We will use this pretrained model and fine tune it with our keywords or maybe a dataset for each emotion and generate our conditional text for the answer.

Work Plan:

Sprints	Description	Deadline
Sprint0:	The proposal, Work plan	09/20
Sprint1:	Data analysis, preprocessing	10/7
Sprint2:	Basic features, build algorithm, training, tuning	10/21
Sprint3:	Testing models performance, Recognizing user's emotion, start working on GPT2	11/7
Sprint4:	Fine tuning GPT2, system testing	11/21
Sprint5:	Final Delivery	12/2

Conclusion:

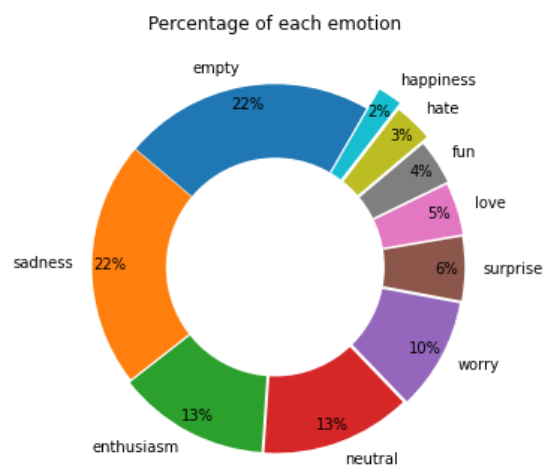
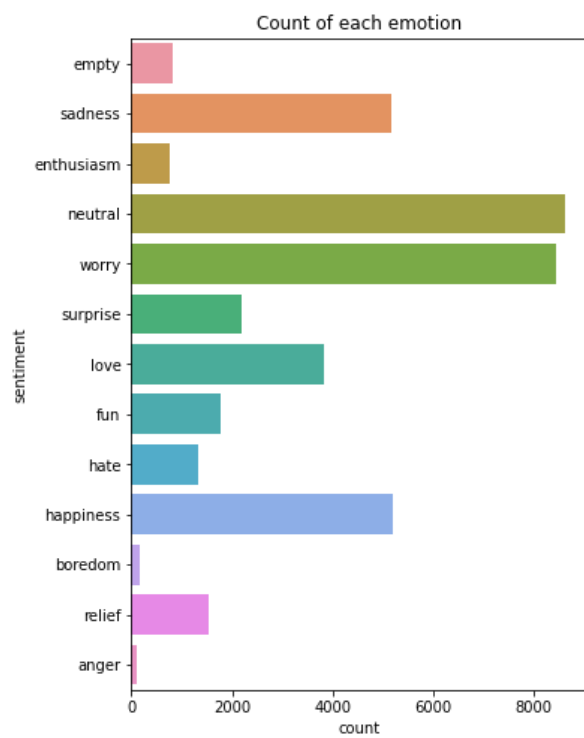
The emotion-aware chatbot will pose as a companion that many need in their daily life. This chatbot will process the input text from the user and try to identify the emotion after reading the text and will give a response to the user depending on their mood. Using the libraries, packages and online resources available, we will try to demonstrate the best knowledge of Natural Language Processing and machine learning we have to achieve the best results for our project.

Increment 1

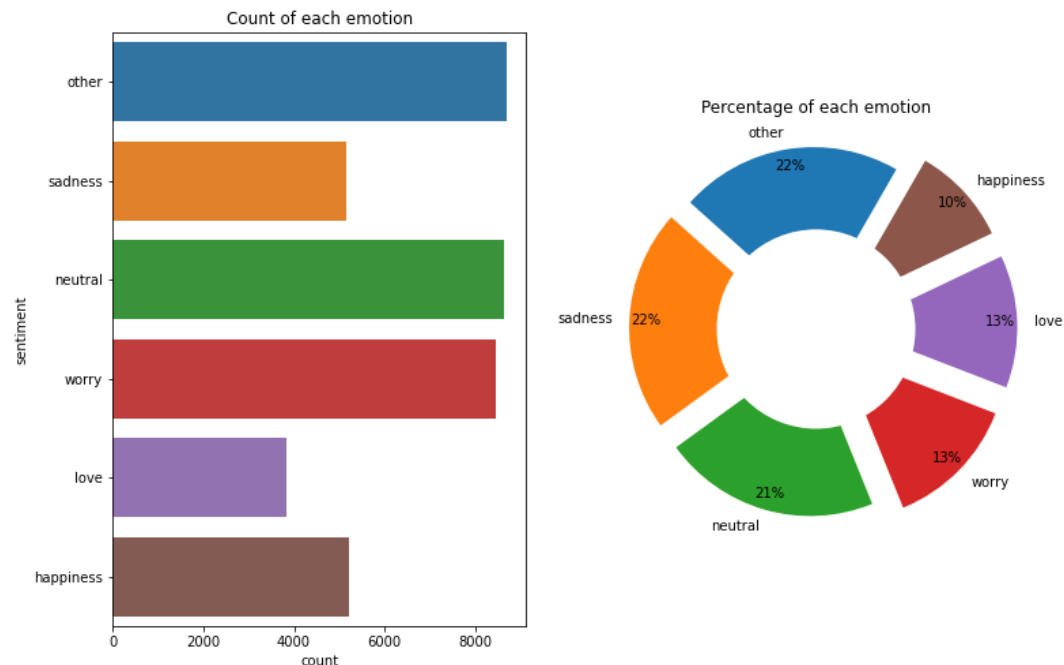
For all the features developed for this increment, write a documentation describing the design, implementation, testing, and deployment (including descriptions and screenshots).

- Detail design of Features

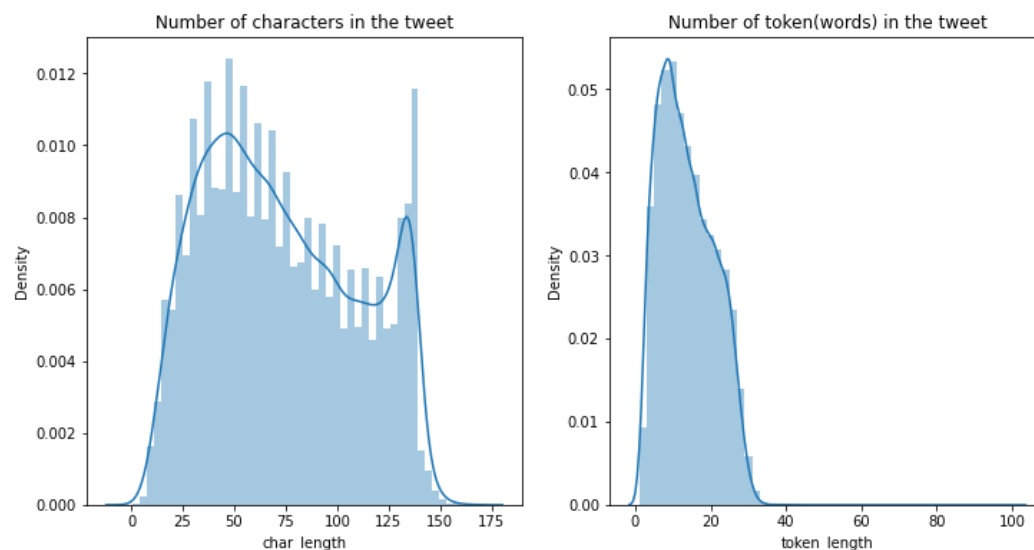
- **Analysis** : From the EDA that we have shown in code, we can see that the dataset is messy and unbalanced. There are 13 classes of emotions in the dataset and the distribution of classes are very different:



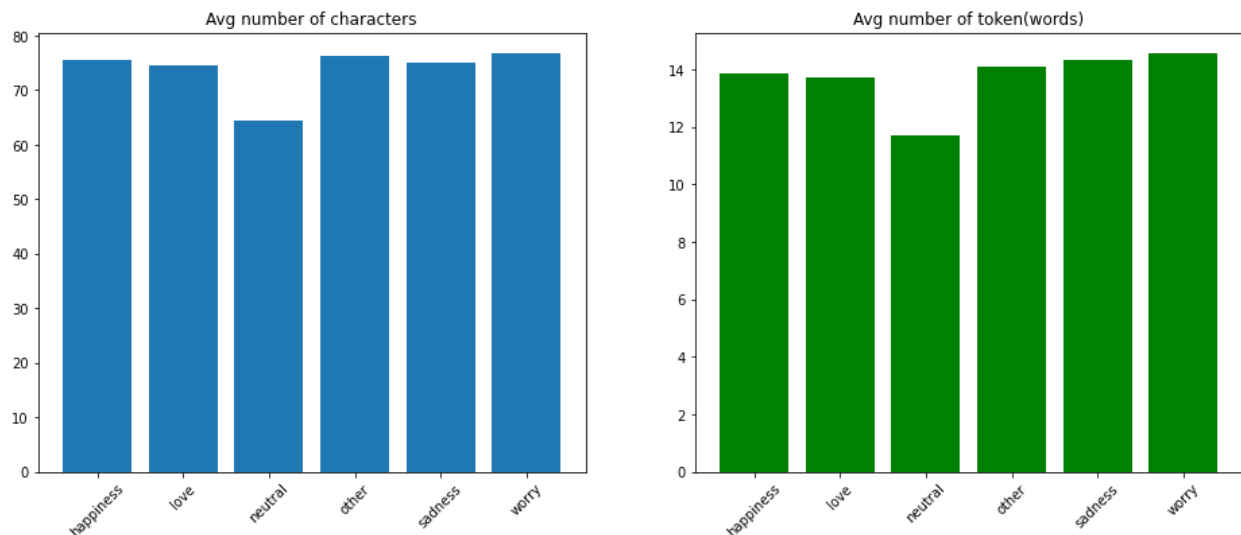
Because of this imbalance issue, we decided to reduce the number of classes to 5 to prevent causing issues for our model to converge. We reduced the number of classes to 5 classes of emotions: love, happiness, worry, sadness, neutral and other that contains all other emotions not in those 5 classes:



We also looked into the length(number of characters) and number of tokens in each tweet. Obviously all tweets are smaller than 40 words because of twitter limitation but also the highest frequency is 15 words for each tweet:



We also looked into the average number of characters and tokens in each of our classes. Except class neutral, other classes seem to have similar number:



• Implementation

- Preliminary Results :at this moment the multinomial naive bayes model that we have developed has an accuracy rate of 22% which is very low and we will use it as the base model for comparison later.

• Project Management

o Implementation status report

▪ Work completed:

- **Description** :The steps indicated in the table that are colored green have been completed. The yellow task is because of our recent update that pushed us back and delayed since we felt that we needed to change our dataset and objectives. We have finalized the dataset for detection, done the EDA, and done preprocessing of the dataset.Also built a simple naive bayes model as baseline.

• Responsibility (Task, Person)

Background and references: Saba

EDA: Saba

Preprocessing: Tam

Model building: Tam

Writing and editing: Mahima, Saba

Video: Mahima

• **Contributions** (members/percentage) :

Tam: 30%

Mahima: 20%

Saba: 50%

• **Work to be completed**

• **Description** : Building Neural network model for predicting emotion and fine tuning the GPT2 model will be our next steps. After that we will see if we can train models on new datasets for each emotion in GPT2 and will compare results.

• **Responsibility** (Task, Person)

Building and improving second model: Tam

GPT2 model configuration and fine tuning: Saba, Mahima, Tam

GUI: Saba, Mahima

• **Issues/Concerns**

We are not fully familiar with GPT2 yet and how to personalize it but will try to use some online resources to help us in that section, especially for fine tuning with new datasets.

References:

[1] A. Ghandeharioun, D. McDuff, M. Czerwinski and K. Rowan, "EMMA: An Emotion-Aware Wellbeing Chatbot," *2019 8th International Conference on Affective Computing and Intelligent Interaction (ACII)*, 2019, pp. 1-7, doi: 10.1109/ACII.2019.8925455.

[2] Kumar, S. S. (2021). Neural Network based Emotion Recognition Model in Twitter Text Data.

[3] Sadiq, S., Mehmood, A., Ullah, S., Ahmad, M., Choi, G. S., & On, B. W. (2021). Aggression detection through deep neural model on twitter. *Future Generation Computer Systems*, 114, 120-129.

[4]: <https://www.kaggle.com/pashupatigupta/emotion-detection-from-text>

[5]:

<https://www.health.harvard.edu/heart-health/from-irritated-to-enraged-angers-toxic-effect-on-the-heart>

[6]: Simard, Joyce, and Ladislav Volicer. "Loneliness and Isolation in Long-term Care and the COVID-19 Pandemic." *Journal of the American Medical Directors Association* vol. 21,7 (2020): 966-967.
doi:10.1016/j.jamda.2020.05.006

[7] <https://towardsdatascience.com/conditional-text-generation-by-fine-tuning-gpt-2-11c1a9fc639d>

[8]: [\[1106.3077\] Chameleons in imagined conversations: A new approach to understanding coordination of linguistic style in dialogs \(arxiv.org\)](#)

Code helps:

ICE 1, 2, 4 notebooks

[9] <https://www.kaggle.com/pashupatigupta/starter-notebook-a-to-z-emotion-detection/notebook>

[10] <https://www.kaggle.com/ikrizanic/twitter-sentiment-and-emotions-analysis>

[11] <https://github.com/shubhamjai9/Emotion-Based-Counsellor-Bot>