Volume 9, Issue 3, March – 2024 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR640

Using Text Data, Neural Networks are Trained to Develop Emotions that Mimic Human Emotional Understanding

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Abstract:- Recent methods of AI have revolutionized the field of computer science. Different sub-sectors of artificial intelligence (AI), like natural language processing (NLP) models, generative AI, computer vision, autonomous and recommendation systems, cybersecurity, quantum computing, etc., have helped automate human tasks, resulting in a tremendous amount of time and energy being saved. Despite the massive development of AI, all AI models lack one major factor, which is emotion. How can emotion be built into AI in order to for it to develop the emotional intelligence of the human brain to interpret and understand emotions so that it could create more human-friendly interactions? In this paper, we hypothesized developing emotions in neural networks as predictive sentiment analysis models using text data in order to replicate the emotional intelligence of the human brain to benefit human relationships. By using the Anaconda Repository, NVIDIA's CUDA Toolkit, and TensorFlow, we were able to create a sentiment prediction model that achieved an accuracy of 94% and predicted the six basic emotions of joy, sadness, anger, fear, love, and surprise. Concluding this research, we observed that neural networks can develop the habit of recognizing emotions. This can be further fed into complex AI algorithms and systems to fine-tune emotional intelligence, resulting in more natural interactions, benefiting humans in

Keywords:- *Artificial Intelligence, Emotion in AI, Neural Networks, Sentiment Analysis, Emotional Intelligence, Human-friendly Interactions, Natural Language Processing (NLP), Generative AI, Computer Vision, Autonomous Systems, Recommendation Systems, Cybersecurity, Quantum Computing, Anaconda Repository, NVIDIA's CUDA Toolkit.*

I. INTRODUCTION

According to human life, researchers have found evidence of the development of human emotions in our ancestors six million years ago [1]. Despite the tremendous amount of change that has occurred in the human world, emotions are one key factor that remains the same in humans even today. The six basic emotions of human life—joy, sadness, anger, fear, love, and surprise—have been permeating humans forever. With the development of technology and artificial intelligence (AI), the inability to comprehend emotions is one of its biggest drawbacks. Recently, machine learning models have been developed by scientists that could recognize human emotions. This process starts with selecting an emotion model (EM) or creating custom neural networks that are able to contextualize data given by the user in the forms of text, speech, and visuals. The data is further processed through a process called vectorization, where the EM associates different emotions with a range of numerical values. This is further fed into a machine learning algorithm where the model is able to be trained in order to produce a formula to predict new inputs given by the user. The idea behind this whole creation of emotional machine learning models is to produce machines that feel more human-friendly for humans to work with [2, 3]. Thus, we hypothesized developing emotions in neural networks as predictive sentiment analysis models using text data in order to replicate the emotional intelligence of the human brain to benefit human relationships.

II. RESULTS

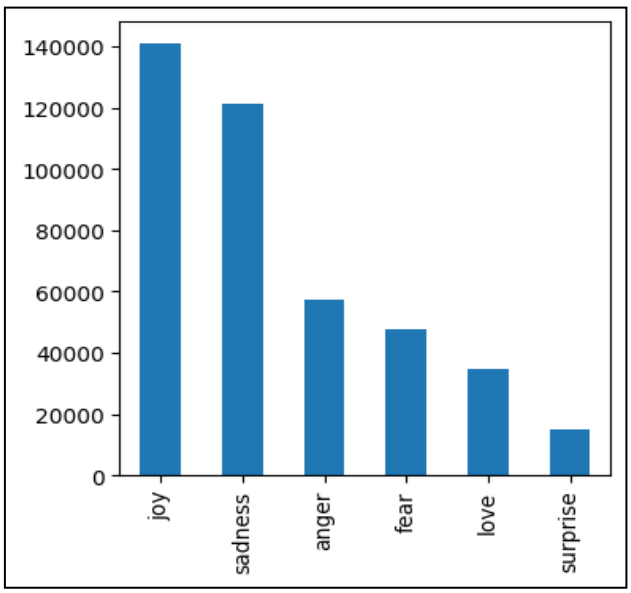

Fig 1: - Represents the Six Basic Types of Emotions: Joy, Sadness, Anger, Fear, Love, and Surprise, and Each of the Respective Numbers of Samples for Each Type of Emotion.

To test our hypothesis, we first searched the internet for emotional datasets that could be used to train machine

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learning models. we came across a GitHub repository, github.com/dair ai/emotion_dataset, which consisted of a file with an associated piece of text (e.g., I feel so enraged but helpless at the same time) and the classified emotion (e.g., anger) labeled next to it. This dataset consisted of the six basic types of emotions: joy, sadness, anger, fear, love, and surprise [4]. This dataset is represented through the graphical form shown below in Figure 1, where you can see how the data is mapped out. Next, we vectorized the emotions category of the dataset so that it could be fed into the custom machine learning neural network that we were going to build. We came up with a custom neural network based on TensorFlow's Keras library. Keras is a high-level application programming interface (API) used to build deep learning neural networks. Keras consists of two main components called layers and models. Layers are a major component of network topology in AI that perform a simple input/output transformation. Models are simply a directed acyclic graph (DAG) consisting of layers [5]. By using a system of models and layers, we built a neural network that trained on the vectorized dataset. The two figures shown below, Figure 3 and Figure 4, show the testing and evaluation results of my model. Through observation, we can see that our model has shown an increase in progress during both the evaluation and training stages of creating the AI model (Table 1 & Table 2). Our model capped out at about 94% accuracy overall. Further attempts and the increased number of epochs trained caused overheating issues in our hardware as well as frequently crashing my system.

Table 1 : - Represents the Evaluation and Training Outcomes for Epochs 3, 5, and 10 along with their Corresponding Accuracy and Loss Metrics.

Training Results	Accuracy	Loss
3 Epochs	0.8873	0.2540
5 Epochs	0.9393	0.0975
10 Epochs	0.9426	0.0879

Table 2: - Represents the Evaluation and Training Outcomes for Epochs 3, 5, and 10 along with their Corresponding Accuracy and Loss Metrics.

Evaluation Results	Accuracy	Loss
3 Epochs	0.9384	0.1005
5 Epochs	0.9361	0.1028
10 Epochs	0.9374	0.1057

III. DISCUSSION

This experiment showed us that neural networks could be created and trained in order to develop emotional interpretations of given prompts; in this demonstration, text prompts specifically. One issue that we found out while testing out this model is that it had a bias in interpreting the emotions joy and sadness compared to the rest. It had a hard time understanding the rest of the emotions. we believe this is due to the increased number of samples of joy and sadness compared to the rest of the emotions in the dataset that we used, as represented in Figure 1. we also believe that a larger dataset and better hardware could have been used to train the model to achieve more accurate results, something that we lacked. By conducting this experiment, we determined that neural networks do have the ability to understand emotions. This could be further improved to make larger models that perform interactions with people as well as integrating these emotion models into multipurpose artificial intelligence systems to make AI more human-friendly while also administering the needs of human beings. A use case would be using emotion AI models in healthcare. An example of this would be used with people who have dementia. People with dementia have a hard time understanding their feelings and communicating them to their caregivers. This puts a tremendous amount of pressure on caregivers to decide what they need and how they're feeling. By using such emotion AI models, these models are able to analyze biometrics or psychometrics like facial expression, speech, or behavior to predict the state of being, further aiding the caregiver in administering the patient more easily. They can also increase compassion toward caregivers as well as their stamina [6]. In essence, this scenario highlights just one of the vast potentials of emotion AI models.

IV. MATERIALS & METHODS

The dataset used in this experiment was collected from the GitHub repository github.com/dair-ai/ emotion_dataset, which consisted of a pickle file. The pickle file was then converted into a CSV file using a custom Python script and the Python library Pandas, which was done in order to be able to clean and preprocess the data. we used the Anaconda software, which is an open-source Python/R data science distribution specifically made for machine learning and data science [7]. By using Anaconda, we were able to create custom environments that could be populated with specific packages associated with our task and be able to maintain and control them. we also used NVIDIA's CUDA toolkit, which allowed me to use my GeForce GTX 1650 GPU on my gaming laptop and TensorFlow together to train the model. The IDE used to write code was Jupyter Notebook. we started off this experiment by taking the cleaned dataset and associating emotions with numerical values. These numerical values were then appended to the dataset and then split into test and training datasets, where they were tokenized and padded to create arrays, which were then fed into the model created using TensorFlow's Keras API. The model was thus trained, evaluated, and finally tested. Weights, layers, and hyper-parameters were adjusted to achieve the model's best performance and intended output during this experiment. The GitHub repo used for this experiment is here: github.com/Aj-Cdr/Development-of-Neural-Networks-as-Predictive-Sentiment-Analysis-Models.

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