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An Automated Model for Sentimental Analysis Using Long Short-Term Memory-based Deep Learning Model

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Abstract: A post, review, or news article's emotional tone can be automatically ascertained using sentiment analysis, a natural language processing approach. Sorting the text into positive, negative, or neutral categories is the aim of sentiment analysis. Many methods, including rule-based systems and machine learning algorithms, can be used to analyse sentiment, or deep learning models. These techniques typically involve analyzing various features of the text, such as word choice, sentence structure, and context, to identify the overall sentiment. Here long short-term memory-based deep learning is applied in this research for the model development purpose. Deeply interconnected neural networks are used in this method. Sentiment analysis can be used in many different applications, such as market research, brand reputation management, customer feedback analysis, and social media monitoring. It shows the use of sentiment analysis in a variety of fields and increases the need of technology to perform it on the existing machines.

Index Terms: Tokenizers, LSTM Model, Sentiment, NLP, Machine Learning, Binary Text Classification.

1. Introduction

The reach of the internet to the public is expanding as it gets bigger. Twitter, Facebook, and Tumblr are the most effective social media and microblogging sites for rapidly disseminating trending topics and condensed news across the globe. When lots of people weigh in with their opinions and judgements on a topic or piece of news, it gets popular and becomes an important source of internet perception on that subject. These subjects are meant to raise awareness or to promote political campaigns, well-known individuals running for office, advertisements, leisure such as award shows and movies, and endorsements. Big businesses and organizations use consumer input from these platforms to improve their goods and services, which helps to improve marketing efforts.

One such instance would be the pre-release marketing of the impending iPhone by leaking images of the device to generate excitement. So, there is a big opportunity for business-driven applications to find and analyze intriguing

patterns from endless social media data. Sentiment analysis is the process of identifying emotions in a word, sentence, or corpus of texts. It serves as a tool for analysing the opinions, attitudes, and sentiments expressed in internet mentions [1]. The goal is to be aware of or have access to a summary of general public opinion on a number of issues. It may be used to categories talks as positive, bad, or neutral.

The number of people expressing their views and opinions online is growing along with the rapid advancement of web technologies. Everyone can benefit from this information, including individuals, corporations, and governments. Twitter is evolving into a significant information source with its 500+ million tweets every day. Twitter is a microblogging platform most known for its 140-character messages, or tweets. There is a 140-character restriction. Twitter is a good resource for information because it has 240+ million active users. Users frequently talk about their personal opinions on many topics and current events in tweets. We chose Twitter over other well-known social networking platforms like Facebook, Google+, and Myspace for the following reasons. Sentiment analysis is a developing field of Natural Language Processing, and study in this area ranges from document-level classification to understanding word and phrase polarity. Due to the character limitations for tweets, sentiment classification for Twitter messages is most analogous to sentence-level sentiment analysis [2,3]. Yet, Twitter sentiment analysis is a different issue due to the informal and particular language used in tweets as well as the basic structure of the microblogging domain.

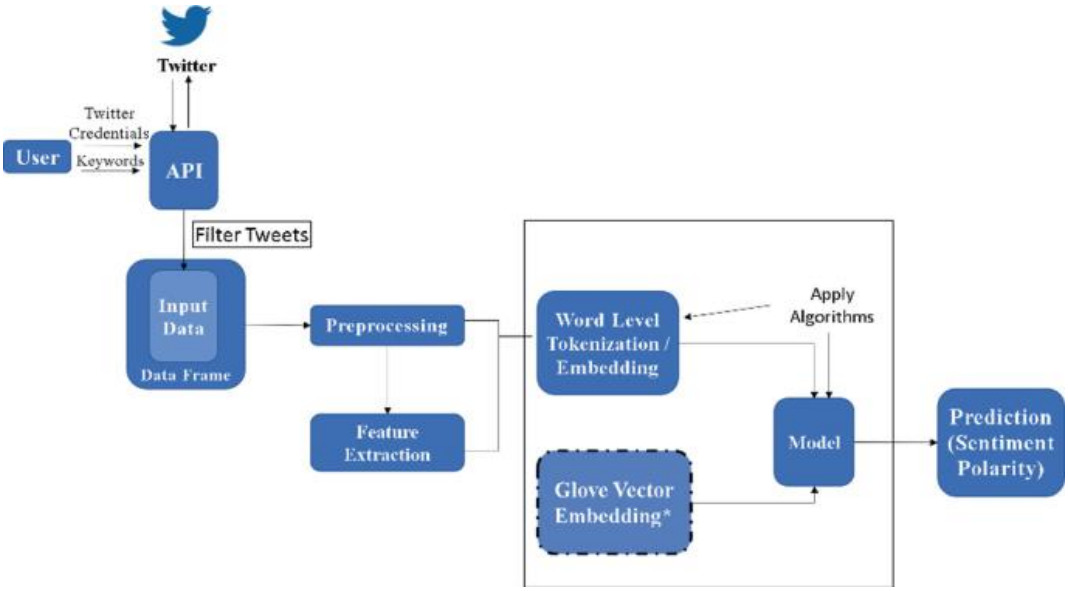

Fig. 1. Process involved in Twitter data sentiment analysis [4]

The method of figuring out the sentiment behind a tweet is called sentiment analysis. This research is mainly focused to develop a model which can identify whether a tweet or other piece of writing is favourable, neutral, or negative. Let's say there is an election in our nation. The government would then begin its campaigning and want to analyze how the public reacted to its advertisements and the tweets of its leaders or party members. To do this, election parties would need to know how the public felt about their actions. To do this, election parties could analyze how the public responded to them on social media platforms and determine whether the public overall approved of them or not. Natural language processing is used in Twitter sentiment analysis to extract, recognize, and characterize the sentiment material.

2. Literature Review

[1] Hate speech identification on Twitter is crucial for applications like contentious event extraction, building AI chatterbots, content recommendation, and sentiment analysis. Online social networks have seen a huge increase in social engagement, but there has also been a rise in nasty acts that make use of this infrastructure. Because the manual method of removing nasty tweets is not scalable, experts are looking for automatic alternatives. This research focuses on the issue of identifying if a tweet is racist, sexist, or neither. Due to the complexity of natural language constructs—different types of targets, different kinds of hatred, and various methods to express the same meaning—the endeavour is exceedingly difficult. In this study, we looked into the use of deep neural network architectures to detect hate speech. We discovered that they perform noticeably better than the current approaches. Gradient-boosted decision trees combined with embeddings discovered from deep neural network models produced the best accuracy results.

[2] Sentiment analysis is a method of superficially analysing the semantics of texts. Its goal is to generate opinions about numerous interesting subjects from the reader. People may be curious about what consumers think about particular products, what voters think about political parties, or what investors think about stocks, for example.

Sentiment analysis received a lot of attention from the early attempts due to the web and social media's rapid expansion in the 2000s. Many techniques for sentiment analysis have been developed as a result of the proliferation of various sorts of textual information (such as news, blogs, reviews, comments on Facebook and Twitter posts, etc.).

To determine the text's sentiment in the first place, the set of words that have been determined to contain sentiment are employed. In the second example, a sentiment classification model is first created using a significant amount of texts that have been sentiment-labeled, and it is then applied to the stream of unlabeled texts. The model is implemented as a function that turns textual properties into sentiment labels (which typically have discrete values: negative, neutral, or positive).

[3] Twitter has developed into a significant social media network and is a topic of great interest for sentiment analysis experts. TSA (Twitter Sentiment Analysis) research is a current area of study in text mining. TSA refers to the employment of computers to process the sentiments and views that are subjective to Twitter data. In this study, a wide range of recently proposed methods and applications are examined along with a complete analysis of the most recent advancements in the field. Social networking services (SNS) have recently exploded in popularity, and as a result, a huge amount of user-generated data, including comments and reviews, is constantly being produced. The information, which is mostly focused on a shared object of interest, expresses people's ideas and sentiments. These data have grown into informational treasure troves, providing several opportunities for evaluating consumer behaviour, which is particularly helpful in predicting product sales, stock market trends, and election results. Sentiment analysis is the focus of the linguistic and natural language processing subfield of opinion mining. It evaluates the degree of polarity of the words and phrases under consideration in order to generate opinions and sentiments from textual data. Given the foregoing, it is evident that the machine-learning-based TSA method is the most often used.

[4] The study of how people connect and communicate on various topics is called social network analysis, and interest in it has lately grown. On social media platforms like Facebook and Twitter, millions of people voice their opinions on a wide range of subjects every day. It has a wide range of applications in many academic disciplines, including business and social science. As there are so many posts on social media every day and it might be challenging to extract people's opinions, opinion and sentiment mining are important research areas. Around 90% of the population has received the data for today.

[5] The following are the contributions made by this work: (1) We give POS-specific prior polarity features. (2) We look into the use of a tree kernel to reduce the need for laborious feature engineering. The tree kernel outperforms the state-of-the-art baseline, performing roughly on par with the additional features (when paired with previously mentioned features). Microblogging websites have evolved into a source of a wide range of information. This is a result of the nature of microblogs, where users post messages in real time about a variety of subjects, current affairs, complaints, and complimentary remarks for things they frequently use.

Manufacturers of these products have started to read these microblogs to determine how customers feel about their products. We use manually annotated Twitter data for our experiments. These tweets have an advantage over past data sets because they were gathered using a streaming method, accurately reflecting genuine tweets in terms of language use and content. Our recent data collection is accessible to other academics. Sentiment analysis has been regarded as a task in natural language processing at various granularities.

[6] Now that it has sophisticated methods for analysing people's opinions, society and organisations might experience a wide range of issues if people are not understood and their perspectives are not taken into consideration. In an era when technology had advanced and communication channels like Twitter, Instagram, and email had experienced substantial changes, we used to convey letters by strolling, which evolved into birds and humans riding horses. Social media sites like Facebook, Instagram, Twitter, and others are used to share knowledge and opinions on various subjects. These websites are producing enormous amounts of data. To analyse this data, a variety of statistical and machine learning technologies are available. Using several methods, we have examined the correctness of the sentiment in this research. The SVM-SGD is the best, according to our research, but after adjusting the grid search and other parameters, the Logistic Regression worked better for us.

[7] Emotion is an evaluation of attitudes towards particular occasions or objects. Sentiment analysis of existing data is the process of gathering opinions. This method can also be used to examine the assessments people make on particular items. The internet is the most reliable resource for sentiment analysis. Many people use social media, particularly Twitter, to voice their opinions on various topics in the Covid-19 epidemic era. Users frequently utilise Twitter as their go-to social media platform for posting their ideas online. Soft computing, particularly fuzzy logic, may be used to create, produce, and build bots that can analyse Twitter user opinions. Almost everywhere in the world has experienced a lifestyle change this year. This is because a new human-attacking virus called Coronavirus Disease 2019 has emerged (Covid-19). The term "coronavirus" refers to a group of viruses from the Ortho Coronavirus subfamily that can infect birds and mammals in addition to humans.

[8] The authors of this study used the publicly available Stanford University Twitter dataset. Many feature extraction approaches were used to evaluate this labelled dataset. We created a system where the preprocessor was used to improve the readability of the raw sentences.

Also, the various machine learning techniques train the dataset with feature vectors, and then the semantic analysis generates a sizable number of synonyms and resemblance metrics that show the polarity of the material. As a result of the internet, people now express their opinions and beliefs in various ways. These days, the main platforms for doing so include blogs, online forums, websites that provide product reviews, social media, etc. These days, millions of people

share their opinions on daily life and express their emotions on social media platforms such as Facebook, Twitter, Google +, and others. We have interactive media available to us thanks to online communities, where members can use forums to educate and persuade others. Many pieces of social media content, including tweets, facebook posts, blog posts, comments, and reviews, generate a wealth of information that is highly sentimental.

[9] To uncover opinions or feelings, Twitter data is examined from a variety of perspectives. For various degrees of sentiment analysis, this document defines the terms "opinion mining" and "sentiment analysis." The methodology and numerous sentiment analysis techniques were covered in this study. Before doing a Twitter emotion study, it is essential to understand Twitter, its architecture, and its significance. This article provides a basic overview of tweets. In this review paper, the crucial data for Twitter sentiment analysis is well covered. To accurately classify tweets into various sentiment groups is the goal of the research on Twitter sentiment. In this field of study, numerous strategies have been created, offering multiple ways to train a model and tests to determine its efficacy. Twitter tweet sentiment analysis is pretty difficult. Opinion mining, often known as sentiment analysis, is a branch of research that analyses text data to interpret how people feel about various topics, events, etc.

[10] Twitter is a well-known real-time microblogging site that enables users to post 140-character tweets or brief pieces of information. People tweet about many subjects related to their daily lives to convey their opinions. Twitter is a great medium for gathering public opinion on particular subjects. . Lexicon-based methods make use of a predetermined list of words, each of which is associated with a particular feeling. Lexicon techniques determine the orientation of a document using the semantic relations of the sentences or phrases in the documents, depending on the context in which they were formed. To connect with it and receive authorization to access data, developers must agree to the terms and conditions of the Twitter development platform. The output of this process will be kept in a JSON file. To investigate how customers view the crucial elements of business performance, Twitter sentiment analysis was developed. The programme will mix machine-based learning techniques with natural language processing techniques to perform sentiment analysis with greater accuracy.

[11] In this study, the author created a model for sentiment analysis that enables real-time processing of Twitter API streaming feeds and categorises their polarity to offer insightful data about the market and consumers. In this study, we present our created sentiment analysis method using Twitter on Twitter data. We provide a comparison of the two most well-known devices, the iPhone and the Samsung, as an illustration. We downloaded 100 tweets from Twitter to an iPhone. Our sentiment analysis of tweets, which was covered in the previous section, has been cleaned up by removing stop words and redundant information using an NLP pipeline. For now, we employed "vectorizer" and "classifier," which are "self" objects made from "tfidfmodel. pickle" and "classifier. pickle," to predict sentiment. In this, the authors suggested a machine learning approach for sentiment analysis using an existing Twitter dataset. a proposed method for sentiment analysis that automatically categorised Tweets as good, negative, or neutral Additionally, they are utilising a tree kernel and Part Of Speech (POS)-Specific polarity characteristics.

[12] The reach of the internet to the public is expanding as it gets bigger. Twitter, Facebook, and Tumblr are the most effective social media and microblogging sites for rapidly disseminating trending topics and condensed news across the globe. When lots of people weigh in with their opinions and judgements on a topic or piece of news, it gets popular and becomes an important source of internet perception on that subject. These subjects are meant to raise awareness or to promote political campaigns, well-known individuals running for office, commercial endorsements, and entertainment like award shows and movies. Large corporations and organisations use consumer feedback from these platforms to enhance their products and services, which enhances marketing initiatives. Sentiment analysis is a developing area of NLP, with studies spanning from document-level classification to comprehending the polarity of words and sentences. Due to character limitations, sentiment analysis at the phrase level is most equivalent to classifying the sentiment of Twitter messages.

[13] Sentiment analysis is the systematic identification, extraction, assessment, and analysis of mental responses and subjective data utilising natural language processing (NLP), text mining, applied linguistics, and bio measurements. It is also referred to as "opinion mining" or "emotion Artificial Intelligence." Sentiment analysis frequently concentrates on the voice in client materials, including online questionnaires, reviews, and social media platforms. The investigation and theoretical comparison of the most recent approaches to sentiment analysis of Twitter data are the main objectives of this work.

[14] Twitter sentiment analysis in several languages is still widely used in research. Analysis of tweets in multiple languages in this situation is not a straightforward task. The initial stage in this process is translating tweets from languages other than English into English before applying the complementing procedures for sentiment categorization. Data sparsity is characterised by typos, underlined words, and contractions. NLP can be used to lessen data sparsity during pre-processing. This is how multilingual Twitter sentiment analysis may significantly increase the classification's accuracy.

[15] Natural Language Processing is the technique used in Twitter sentiment analysis (NLP). We examine the sentiments hidden in each tweet in this project called Twitter Sentiment Analysis. Good, neutral, and negative sentiments are the three types we recognized. The main issue, in the beginning, was analyzing the emotions underlying each tweet, but now it can be resolved with the aid of machine learning. It is also known as opinion analysis, and it is a type of machine learning assignment where the goal is to ascertain the overall tone of a given document.

[16] The publicly accessible tweets included text, emoticons, URLs, hashtags, user mentions, and symbols. Before training the system, we pre-process the tweets to make them suitable for feeding into models. To categorise the polarity

of the tweet, we used several machines learning methods, including Naive Bayes, Maximum Entropy, Decision Tree, Random Forest, XGBoost, SVM, Multi-Layer Perceptron, Recurrent Neural networks, and Convolutional Neural Networks. Bigrams and unigrams were the two types of features we employed for classification, and we found that adding bigrams to the feature vector increased accuracy. SA is textual contextual mining that extracts subjective information from the source material and recognises it. It also helps businesses understand the social attitude towards their services, brands, or products by monitoring internet chats. SA controls opinions, attitudes, and subjective text.

[17] Using sentiment analysis, these reviews are categorised as either good or negative depending on the opinions expressed in them. The dataset was first preprocessed to turn the unstructured reviews into structured forms. After that, we employed a lexicon-based method to translate the structured evaluation into a numerical score value. We preprocessed the dataset in the lexicon-based technique utilising semantic analysis and feature selection. Preprocessing tasks included stopping word elimination, stemming, and emotion score calculation using the Twitter dataset. Finding user sentiment on a subject or text under study is done through sentiment analysis. It's sometimes referred to as "opinion mining." Therefore it establishes if a piece of writing is constructive, destructive, or neutral.

[18] Due to the enormous volume of opinionated data available on many social networking sites, opinion mining has recently gained attention. Microblogging is a relatively new phenomenon, and Twitter is the most widely used platform for it. One of the largest free, public data sources is this one. Twitter today frequently sees a variety of viewpoints. To better understand the feelings of the general population, academics use sentiment analysis and opinion mining. Twitter is used as a source of opinionated data in this essay.

[19] In this research, the author developed a set of machine learning methods with semantic analysis for categorizing words and product reviews using Twitter data. A pre-labelled Twitter dataset will be used to evaluate a huge number of reviews. Maximum entropy is outperformed by the nave byes method and applying a unigram model to SVM yields results that are superior to using it alone. The accuracy rises to 89.9% from 88.2% when the semantic analysis WordNet is added to the previously mentioned method.

[20] Twitter is a fantastic information source where people from all over the world get together to exchange opinions on various topics. As a result, it offers researchers a wide platform to gather a lot of unreliable information. This rudimentary information processing is used to analyze user opinions. We have examined the many categories of text analysis categorization algorithms based on the results of this survey. The text extraction from the provided data is done using the data mining technique. This information is used to classify the text as good, negative, or neutral. Sentiment analysis is a type of data mining that classifies a piece of content's specific data as positive, negative, or neutral based on its overall tone. Opinion mining, which infers the opinions of people, is another name for sentiment analysis. Sentiment analysis provides us with insight into user opinions of products, events, or movies.

3. Methodology

Sentiment analysis is an important aspect of determining industry quality. Each industry must get feedback from its end consumers to identify potential or present problems.

Python can do sentiment analysis to detect and evaluate the sentiment concealed inside every piece of text. An intelligent system may be created by combining machine learning and artificial intelligence approaches. These algorithms enable us to comprehend the emotions of any text or do any sort of analysis on a big amount of data. Binary text classifiers are used to extract the emotion of any sentence in this case. Several natural language processing (NLP) approaches were employed for data cleaning and filtration, as well as the development of a text classifier using LSTM Layers. These text classifications help to extract the sentiment from test data.

4. Dataset

The dataset was taken from Kaggle named “Twitter US Airline Sentiment”. The dataset comprised about 14000 tweet data samples, which were classified into three categories: Positivity, Negativity, and Neutrality [10]. This dataset is already cleaned, and no null value exists.

As this dataset has a huge number of tuples which can fulfill the need of a large and simple dataset for model developing. It has around 15 attributes and 14k tweets which act as tokens during model training.

The following tools and libraries were used over the data set during the model development:

- Python-
- TensorFlow-
- Pandas-
- Matplotlib-

5. Data Preprocessing

There are more than 14000 tweets included in the data set. The dataset looks like the following:

```
df.columns
```

```
Index(['tweet_id', 'airline_sentiment', 'airline_sentiment_confidence',
       'negativereason', 'negativereason_confidence', 'airline',
       'airline_sentiment_gold', 'name', 'negativereason_gold',
       'retweet_count', 'text', 'tweet_coord', 'tweet_created',
       'tweet_location', 'user_timezone'],
      dtype='object')
```

Fig. 2. Attributes of the dataset

As binary text classification is used here so it does not need the neutral tweets so rows containing the neutral tweets get dropped here.

Categorical classifiers get applied in this model hence machine will understand only the data represented with numerical values so factorized method gets used to change the categorical values with numerical values. Here positive perceptions get represented with a value of 0 and negative perceptions get represented with 1 [11,12]. Further, it needs to convert the form of data in a manner so that the machine can understand it. In essence, we must turn the content into an array of vector embeddings. Word embeddings are a lovely method to depict the connection between a text's words.

To perform it, we first assign a specific number to each of the individual words and then substitute that word with the assigned number. This includes the tokenization process within the model. In the tokenization process, all the words are extracted from the dataset and get tokenized with the help of Tokenizer. Tokenizers break down all the words of text into small parts referred to as tokens. The fit_on_texts() function links the words with the numbers allocated to them. This relationship is saved in the tokenizer.word_index property as a dictionary. Now, using the text_to_sequence() function, replace each word with its corresponding integers. The length of sentences within the dataset is different so the Padding method gets used to equalize the length of sentences [13].

6. Model Building

The LSTM model gets used here for text classification. LSTM layers get used in this artificial intelligence model for natural language processing. The model's architecture is made up of three layers: an embedding layer, an LSTM layer, and a dense layer. The model included the Dropout mechanism inside the LSTM layers to reduce the number of parameters [14]. This Long short-term memory technique is an enhanced version of (RNN).

LSTMs are designed to selectively "remember" or "forget" information over time. They do this by using a set of memory cells that are connected through a series of gates, which regulate the flow of information into and out of the memory cells. The gates consist of sigmoid neural network layers that determine which information to keep or discard.

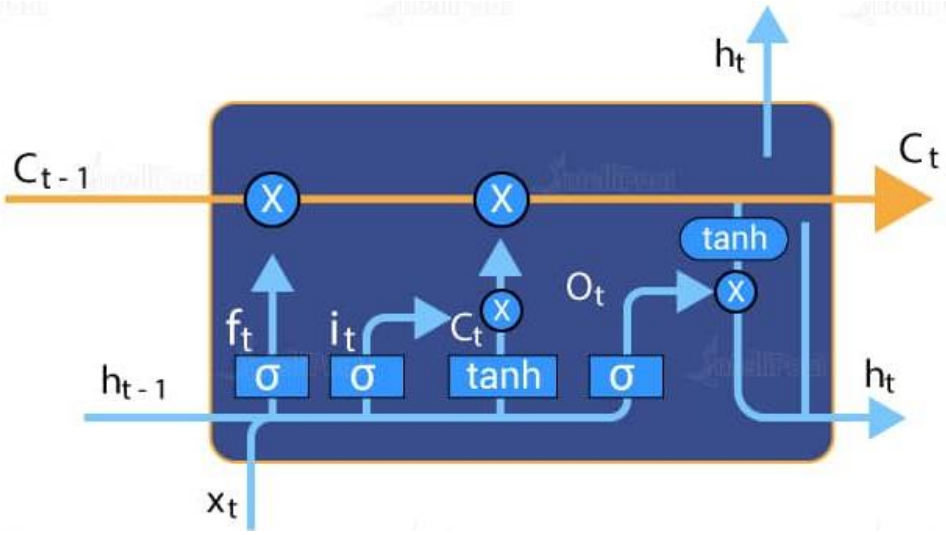

Fig. 3. Working of a deeply connected LSTM network [17].

It works by randomly dropping out (i.e., set to zero) some of the neurons in the neural network during training. During each training iteration, a certain percentage of neurons are randomly selected, and their outputs are set to zero [18,19]. This prevents any individual neuron from being overly dependent on the presence of specific other neurons,

which can help the model generalize better to new, unseen data. The layer accepts as its parameter a value between 0 and 1 that specifies the likelihood that the neurons will be dropped.

```
print(model.summary())
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, 200, 32)           320000

 spatial_dropout1d (SpatialD  (None, 200, 32)          0
 ropout1D)

 lstm (LSTM)                 (None, 50)                16600

 dropout (Dropout)           (None, 50)                0

 dense (Dense)               (None, 1)                 51

=================================================================
Total params: 336,651
Trainable params: 336,651
Non-trainable params: 0
_________________________________________________________________
None
```

Fig. 4. Model structure after the tokenization and padding process.

7. Model Development

Using a batch size of 32 and a testing split of 30%, train the model for sentiment analysis throughout 5 iterations across the entire dataset. During each epoch, the model gets a final accuracy of more than 90% [20,21] which lies between 91 to 95%. It gives a final accuracy of 95% after completing its training. Comparison between accuracy & validation accuracy and loss & validation loss is as follows

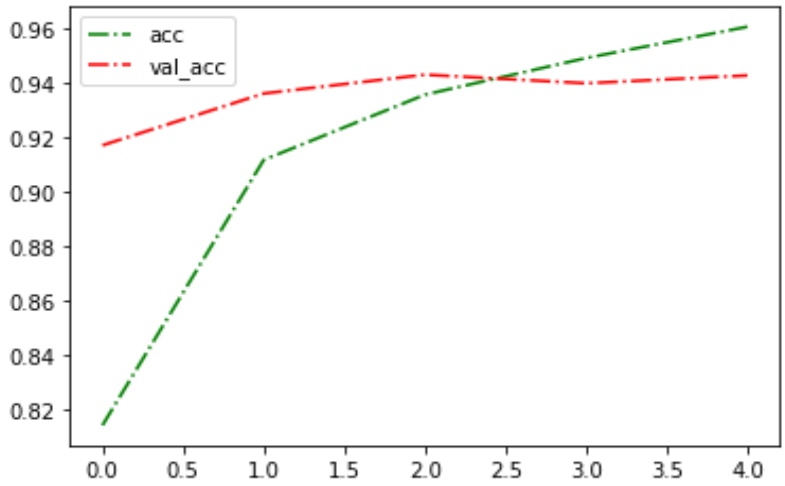

Fig. 5. Comparison graph between accuracy and validation accuracy.

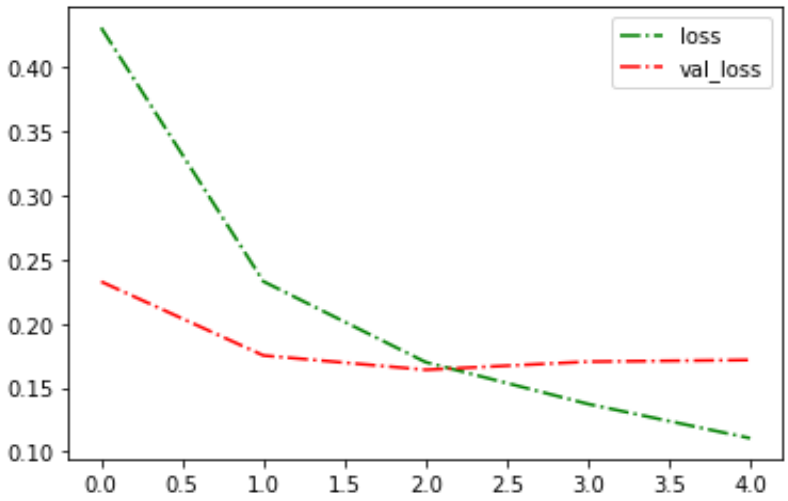

Fig. 6. Comparison graph between loss and validation loss.

8. Result and Discussion

This developed sentimental analysis model is mainly based on the long short-term memory-based neural networks which are focused on binary classification. The model achieved an accuracy of 95% after the completion of all the epochs and their validation [22]. It interprets the sentences or inputs according to their perceptions and gives the output in terms of positive or negative.

```
t_sentence1 = "It is wonderful to fly on this extraordinary journey."
predict_sentiment(t_sentence1)

t_sentence2 = "I despise waiting for the release of the latest installment."
predict_sentiment(t_sentence2)
```

```
1/1 [==============================] - 0s 50ms/step
Predicted label:  positive
1/1 [==============================] - 0s 58ms/step
Predicted label:  negative
```

Fig. 7. Outcome window of the model specifies perception.

9. Conclusion

Sentiment analysis is the practice of examining textual information to identify the writer's attitude or sentiment. Finding the overall attitude of a text, whether it be favorable, negative, or neutral, is the aim of sentiment analysis. In recent times, sentiment analysis has become an important tool for businesses and organizations to gain insights into customer feedback, track brand reputation, and improve their products and services. sentiment analysis is a valuable technique that can provide insights into the emotions and attitudes expressed in large volumes of text data.

Here developed automated sentiment analysis model can extract the perception from the individual input sentence or the collection of huge data. This model is based on the LSTM technique and achieved nearly 95% accuracy which states that the LSTM technique is efficient in the development of these types of NLP-based text classification needs. This model is useful in all types of business domains to take feedback from the end customers and know their perceptions.

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Authors’ Profiles

Shashank Mishra is currently pursuing a Batchelor of Technology from the KIET group of institutions, Murad Nagar, Ghaziabad, Delhi NCR in the Information Technology stream and will be graduating in 2023. He completed his schooling in Varanasi, Uttar Pradesh, India. Mr. Mishra has a keen interest in Artificial intelligence, Machine learning, data analytics and Database management. He has worked to develop automated models with the help of ML and AI some of which are “Fake News Detection” using machine learning, and “Emojify Facial Expression” using Deep Learning And published this research works.

Mukul Aggarwal is an Assistant Professor in the Department of Information Technology at KIET Group of institutions, Delhi-NCR, Ghaziabad. Mr. Aggarwal is an academician, researcher, having 15 years of teaching experience. Mr. Aggarwal has been pro-actively involved with professional associations and associated with various professional bodies: Life Membership of “Computer Society of India” (CSI), Life Membership of “The Indian Science Congress Association” (ISCA), Membership of “The International Association of Engineers” (IAENG), Membership of “International Association of Computer Science and Information Technology” (IACSIT). He has participated as chaired/reviewed in several numbers of Conferences, Workshops and Seminars. His research area includes Information Retrieval, Semantic Web, Artificial Intelligence, and Data Mining. He has attended and coordinated many FDP / seminars/workshops / Conferences.

Shivam Yadav is currently pursuing his B. Tech degree in Information Technology from the KIET group of institutions, Murad Nagar, Ghaziabad, and will be graduating in 2023. He has completed his schooling from KV Uttarlai Barmer with 89.8%. His area of interest is frontend web development, artificial intelligence, machine learning and Deep learning. He has made the project on frontend web development in which Kiet discussion form, and bank management system using technology stack c++, HTML, CSS, react JS and git. His skills are Data structure and algorithms, web development, CPP and Java. He also worked on a research paper COVID disease detection system using prolog system which is published in Joscex.

Yashika Sharma is currently pursuing her B. Tech degree in information technology from the KIET group of institutions, Murad Nagar, Ghaziabad will be graduating in 2023. She has completed her schooling from R L P K D Vidya mandir school with 79.5%. She has done two internships at IBM and Two Waits' Technologies in which she made two projects related to web development and learned skills in HTML, CSS, JS and C++. She achieved global rank 2514 in Google Hash code 2022 and has 3 stars at leetcode and 4 stars at code chef-like coding platform. I participated in KICCS-D-HACK 21.0 and acquired a Rank of 4 in the poetry competition.

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