



TWITTER TWEETS SUICIDAL IDEATION DETECTION USING DEEP LEARNING

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Abstract: The rise in technological advancements and Social Networking Sites (SNS) made people more engaged in their virtual lives. Research has revealed that people feel more comfortable posting their feelings, including suicidal thoughts, on SNS than discussing them through face-to-face settings due to the social stigma associated with mental health. Many suicidal deaths can be prevented by understanding how people communicate their distress related thoughts. Early understanding of the risk factors and warning signs can decrease the threshold for suicide and help prevent many deaths. This Project aims to develop a system that can detect suicidal ideation on Twitter tweets using DL models. In this project we trained several Deep learning models such as LSTM, GRU, and CNN.

Index Terms - Deep Learning, LSTM (Long Short-Term Memory), CNN (Convolutional Neural Network), GRU (Gated Recurrent Unit).

1. INTRODUCTION

The rise of the social media and the online communities are used to share thoughts about the mental health and express the feelings of suffering, to prevent their suicide it is necessary to detect suicide related post. Twitter is one of the most popular social media sites that help users to share their thoughts and feelings in a real-time. Suicide is one of the significant public health concerns consuming a lot of lives. According to the statistic of the World Health Organization (WHO), around one million people die due to suicide each year, and on average, suicide occurs every 40 seconds. Suicide might be considered as one of the most serious social health problems in the modern society. Many factors can lead to suicide for example personal issues, such as hopelessness, depression, tired, loneliness.

They make statements such as "I want to kill myself", "I hate my life", "I have lived long enough" or "I'm so tired". It is a common saying that suicide is a permanent solution for dealing with temporary problems. Despite the growing numbers of suicidal cases, it can be prevented to some extent by understanding the risk factors related to suicidal behavior in the early stages of the suicidal process. Our work extracts a number of relevant features to differentiate between suicidal and non-suicidal tweets by the help of a novel feature engineering technique. This paper builds a novel dataset by extracting the tweets related to suicide and non-suicide from Twitter. In the digital age, social media platforms have become a significant medium for self-expression, connecting people, and sharing thoughts and emotions.

The process of suicide starts with suicidal thoughts or ideation. Because mental illness may be diagnosed and treated, the early identification of warning signs or risk factors may be the most effective way of preventing suicide. It then matures to suicidal attempt and finally to the completed suicide. Suicide is the second leading cause of death among people aged between 10 and 34 years. Prevention can be done by reducing the risk factors or by reducing the obstacles to mental health resource. The best way to

prevent their suicide is to catch these signals and predict other hidden signals behind their posting content in order to react to them and take appropriate actions.

In order to save the lives of the people, we need to study the behavior and recent communications performed by them. Finally Detecting and addressing suicidal ideation on social media platforms like Twitter is a crucial application of Machine Learning (ML) and Deep Learning (DL) models. Implementation of DL models for suicidal ideation detection could have profound implications for suicide prevention, offering a lifeline to those in crisis and advancing the integration of technology in mental health support.

2. EXISTING SYSTEM

In the Existing system various machine learning algorithms and ensemble approaches like Decision trees, Naive Bayes, Multinomial Naive Bayes, Support vector machine (SMO), Regression, Bagging, Random Forest, AdaBoost, voting and Stacking are implemented for classifying the suicide-related tweets into two groups using the real tweets.

After studying the literature, it was found that dataset used in the research was very low as data is not freely available due to its ethical considerations and the studies which were already done in this area of research have not achieved much accuracy and recall. In this research paper, a classifier is built that automatically distinguishes between suicidal and non-suicidal tweets using the Deep learning model.

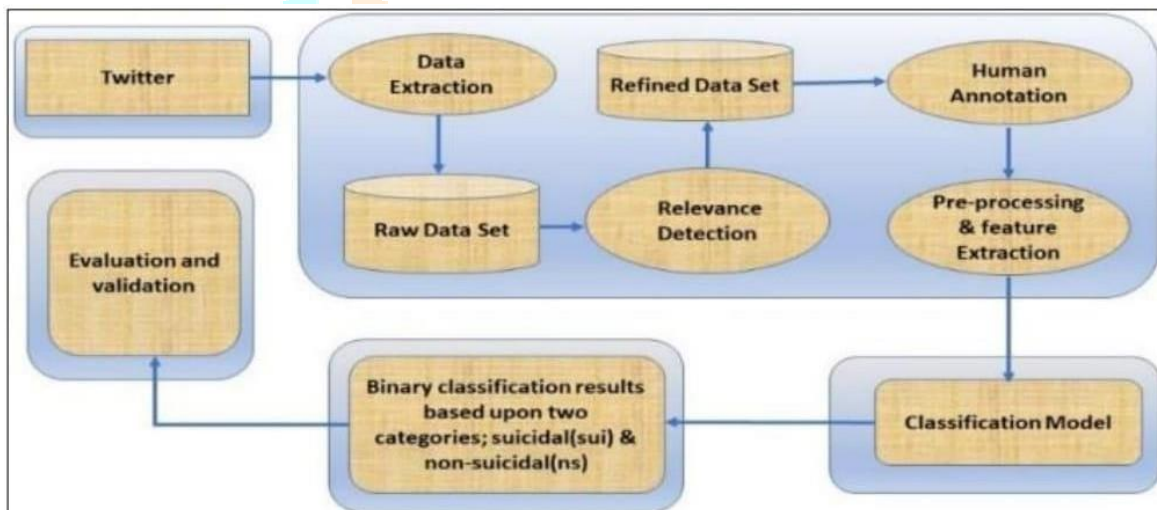


Figure: Existing Methodology to identify the suicidal tweets on Twitter

3. PROPOSED SYSTEM

This project aims to develop a system that can detect suicidal ideation on Twitter using Natural Language Processing (NLP) and Deep learning models include Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Convolutional Neural Networks(CNN). We have used the Twitter Suicide Dataset, which contains Tweets from individuals who have experienced suicidal thoughts and ideations. The dataset includes more than 1787 Tweets and comments, and it has been labeled as either indicating suicidal ideation or not.

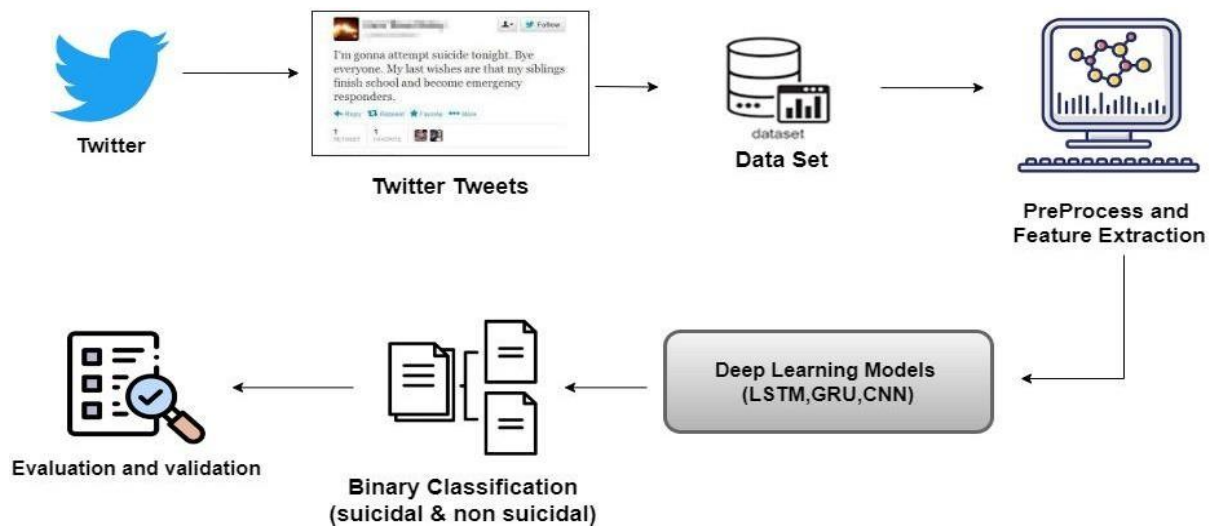


Figure: Proposed Methodology to identify the suicidal tweets on Twitter.

4. RESEARCH METHODOLOGY

4.1 Data Collection

Data collection is the initial step in the analysis process since we need data to train our classifiers. However, the absence of a public dataset is one of the most significant obstacles in the field of suicidal ideation detection. Conventionally, it has been complex extracting data that are related to mental illnesses or suicidal ideation because of social stigma. However, a growing number of people are surfing the Internet to vent their frustration, to seek help, and to discuss mental health issues.

We chose Twitter as our primary source of data since it has been shown to be effective in assessing mental conditions, such as suicidal ideation. Here, the main idea is to collect different types of posts that are connected to suicide other than those that more directly express suicidal ideation. To maintain the privacy of the individuals in the dataset, we do not present direct quotes from any data or any identifying information. And we placed those collected tweets in the dataset.

4.2 Data Preprocessing and Cleaning

In this section, we describe the data preprocessing and cleaning steps undertaken to prepare the dataset for analysis. Ensuring the quality and completeness of the data is critical for the reliability of research findings. One common challenge in working with real-world data is dealing with missing values. Missing values can lead to inaccurate results and hinder data analysis. In our dataset, we encountered missing values in the 'Tweet' column. To address this issue, we used the `fillna` method from the Pandas library.

1. Converting Text to Lowercase

Text data often contains a mixture of uppercase and lowercase characters. To ensure consistency, we converted all text in the 'Tweet' column to lowercase.

2. Tokenization

To analyze the text at the word level, we used a regular expression tokenize to split the text into individual words or tokens.

3. Stop Word Removal

Common English stop words, which often do not carry significant meaning, were removed from the tokenized text.

4. Filtering Based on Word Length

To eliminate very short and potentially less meaningful words, we filtered out words with fewer than three characters and then concatenated the filtered words into a single string.

5. Removing Non-English Words

Words not present in a set of English words obtained from various corpora were removed. The corpus data included words from NLTK's collections, such as the Brown Corpus, Gutenberg Corpus and more.

6. Lemmatization:

The final step involved lemmatizing the text to reduce words to their base or dictionary form, facilitating semantic analysis.

By applying the steps outlined above, we have prepared our dataset for more in-depth exploration and insights. The resulting 'tweet' column contains text that has been converted to lowercase, tokenized, stripped of common stop words, filtered based on word length, cleared of non-English words, and lemmatized. This cleaned and processed data is now poised for meaningful analysis and research in subsequent sections of our study.

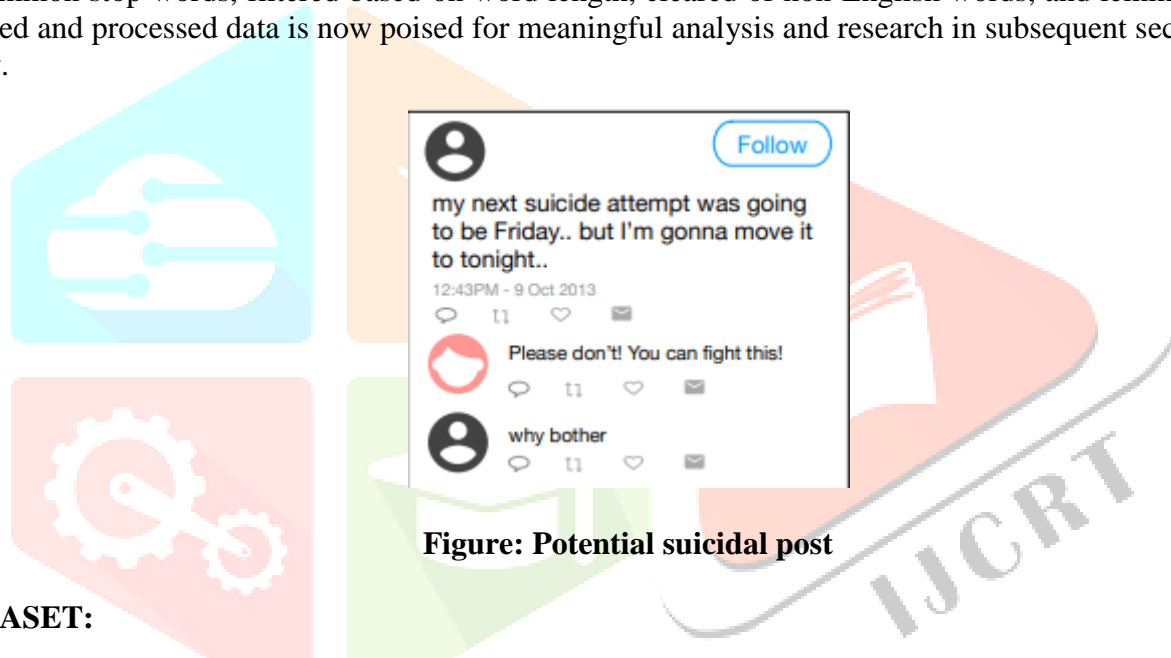


Figure: Potential suicidal post

DATASET:

	A	B
1	Tweet	Suicide
2	making some lunch	Not Suicide post
3	@Alexia You want his money.	Not Suicide post
4	that crap took me forever to put together. Im going to go sleep for DAYS	Potential Suicide post
5	Hey Jer! Since when did you start twittering?	Not Suicide post
6	Trying out "Delicious Library " with mixed results The bar code thought I wanted to add a sport bra instead of a drill Cool app tho!	Not Suicide post
7	Oh, that's good to hear. But is it over already? Or you'll continue it after the Holy week?	Not Suicide post
8	u've got a list for fellow #hotties? You gonna have to share that one Amigo!	Not Suicide post
9	Just because shane made a Series on you Doesnt mean people take you seriously	Potential Suicide post
10	time for some warsaw beer garden chilling	Not Suicide post
11	I hate my life lmao I hope I die soon or sumn I'm too tired of everything	Potential Suicide post
12	Everything your lover does for you is for her survival, everything your mother does for you is for your survival.	Not Suicide post
13	There is a stray cat on campus that looks like Garfield. The students are always feeding him, so he is very fat. Like me.	Not Suicide post
14	is on the go...	Not Suicide post
15	I have an awful habit of avoiding writing papers by watching Instagram live videos of the kids I used to nanny	Potential Suicide post
16	Haha. Well I have more but I don't have to do anything but file the rest away or delete them.	Not Suicide post
17	Gooooooood hwo're you?	Not Suicide post
18	I want to say ill never be active again. Not quite sure, i dont have any reason to be on here anymore anyways bye everyone	Potential Suicide post
19	Focus on opportunities more than you focus on money.	Not Suicide post
20	SOMEBODY PLEASE FUCKING KILL ME IM SO IN LOVE	Potential Suicide post
21	I'm at the point of the semester where im so tired of everything. I just want to roll over and die.	Potential Suicide post
22	I want to die so much, I dont want to be here anymore	Potential Suicide post
23	And I hate the fact if it's true Dojae will do surgery, Dojae has to endure the pain alone	Potential Suicide post
24	When you're tired of living your life, all you can do is close your eyes and go to sleep...	Potential Suicide post
25	i am going to kill myself right now i am sorry you are feeling so desperate	Potential Suicide post

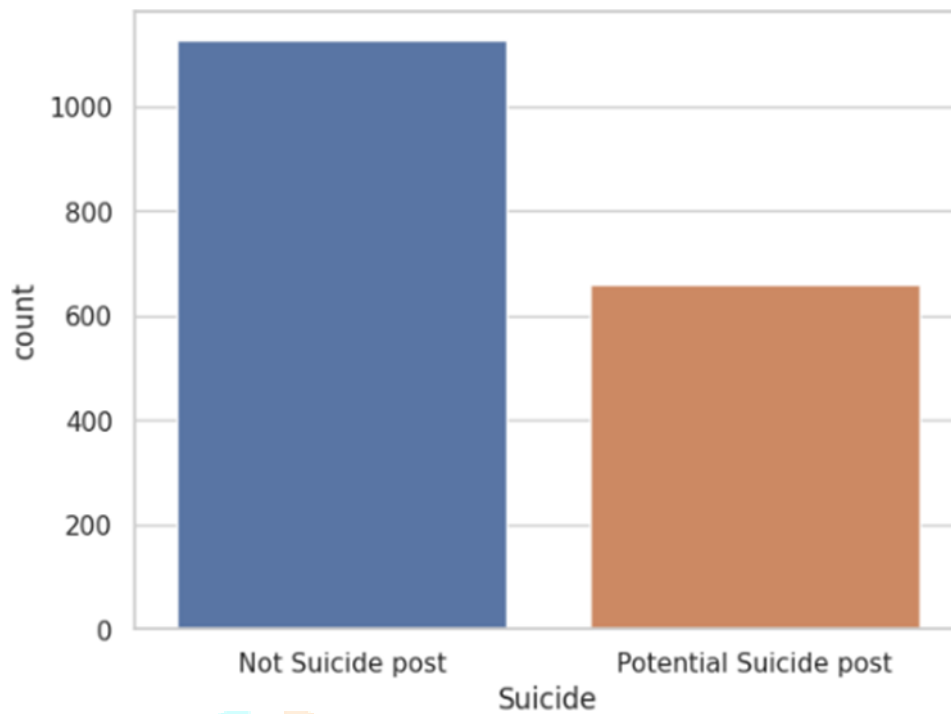


Figure: Class Distribution of Dataset.

4.3 Experimental Results and Analysis:

Word cloud visualization:

Data visualization is a powerful tool in extracting insights from textual data. In this section, we present a word cloud visualization that is integral to our research. The word cloud is designed to reveal the most prominent terms and phrases within our text corpus, enabling us to uncover significant patterns and themes.

Word cloud is the visual representation of the data. It gives a visual understanding of most of the frequent words used in the dataset. As depicted in Fig. 3, the words like “life”, “suicide”, “die”, “kill”, “depression” are used frequently by the posts containing suicidal ideation. The words like “feel”, “want”, “think” also exist in these posts indicating the intension of the suicidal users.

For example: some users having suicidal ideation write like “I want to end my life, I have no one here.”

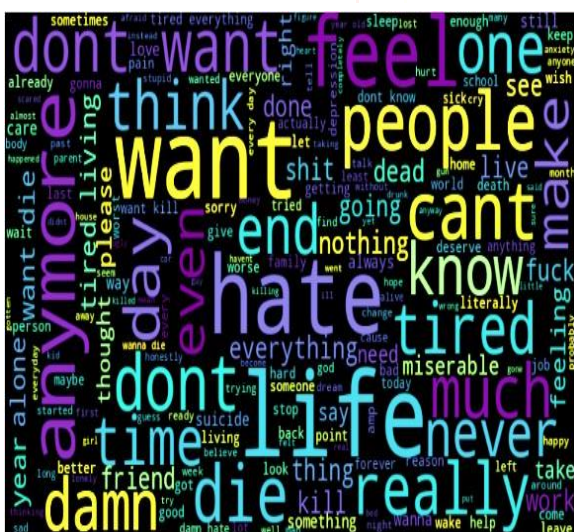


Figure: Word Cloud of suicidal tweets

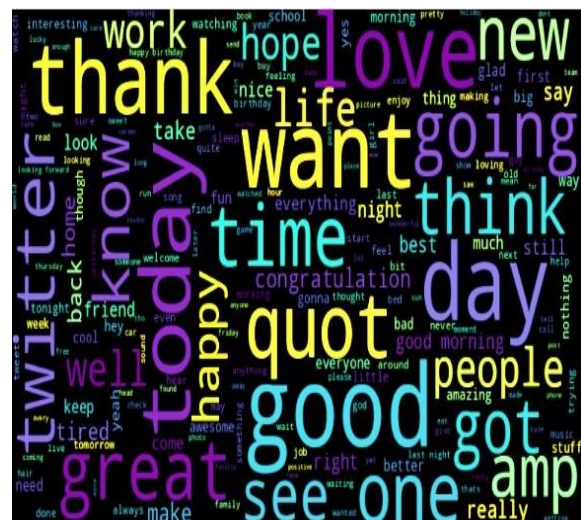


Figure: Word Cloud of non-suicidal tweets

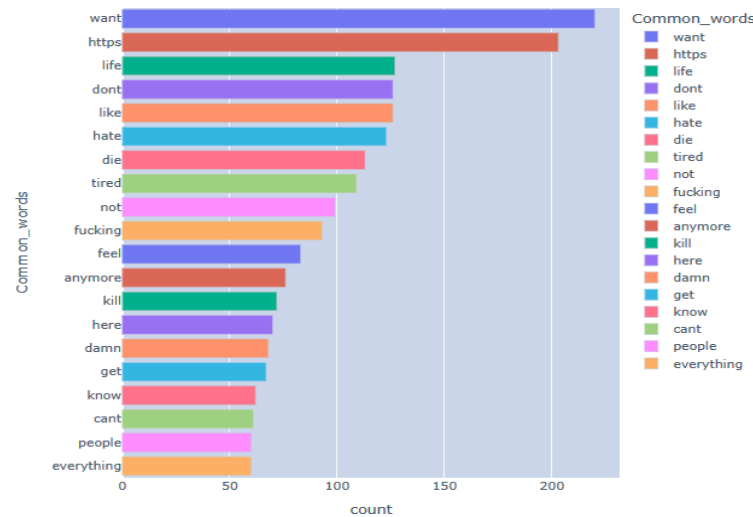


Figure: Most Common Words in potential suicidal post

4.4 Classifiers Performance Analysis:

Model Comparison:

Following the n-grams frequency analysis, we examined the experimental technique for detecting suicide thoughts using DL Models. We used word embedding on DL models such as LSTM, GRU, and CNN. And their corresponding accuracy is calculated.

Model	Accuracy Score
LSTM-2 Layer	93.95%
GRU	93.51%
LSTM-1 Layer	93.28%
CNN+LSTM	91.72%

5. LIBRARIES

5.1 NumPy (Numerical Python)

It was designed to accommodate huge, multi-dimensional arrays and matrices, as well as a set of high-level mathematical functions for operating on these arrays. NumPy is the Python basis for scientific computing and data analysis, allowing for efficient and quick numerical calculations.

5.2 Pandas

It was created to give Python with simple data structures and data analysis capabilities. Pandas have two basic data structures: Data Frames for dealing with structured data and Series for dealing with one-dimensional data, making it a useful library for data manipulation and analysis.

5.3 Matplotlib

It was created in Python to produce static, animated, and interactive visualizations. Matplotlib is a popular and adaptable data visualization library that provides great control over plot components.

5.4 Seaborn

The name Seaborn is not derived from anything specific, but rather symbolizes the company's desire to be visually appealing and focused on statistical data presentation. It is based on Matplotlib and offers a high-level interface for producing useful and appealing statistical visualizations. Seaborn makes it easy to create complicated visualizations and is especially well-suited for working with statistical data and datasets.

5.5 Sklearn

Sklearn, sometimes known as "scikit-learn," is a popular Python machine learning package. It is free and open-source, and it is built on top of well-known libraries like NumPy, SciPy, and Matplotlib.

5.6 Tensor Flow

The Tensor Flow platform helps us to implement best practices for data automation, model tracking, performance monitoring, and model retraining.

5.7 Pickle

Pickle module is a popular format used to serialize and deserialize data types. This format is native to Python, meaning Pickle objects cannot be loaded using any other programming language.

6. RESULT

We created a user-friendly web application using stream lit for users to input text, and it uses deep learning models to assess whether the text contains potential indicators of suicidal thoughts or intentions. It loads several deep learning models from files. These models are used for predicting whether the input text is related to suicide or not. The models include LSTM-based models, a GRU model, and a CNN+LSTM model. The prediction results are visually presented through a pie chart, making it easier for users to interpret the results. The chart shows the percentage of a potential suicide post and the percentage of a non-suicidal post.

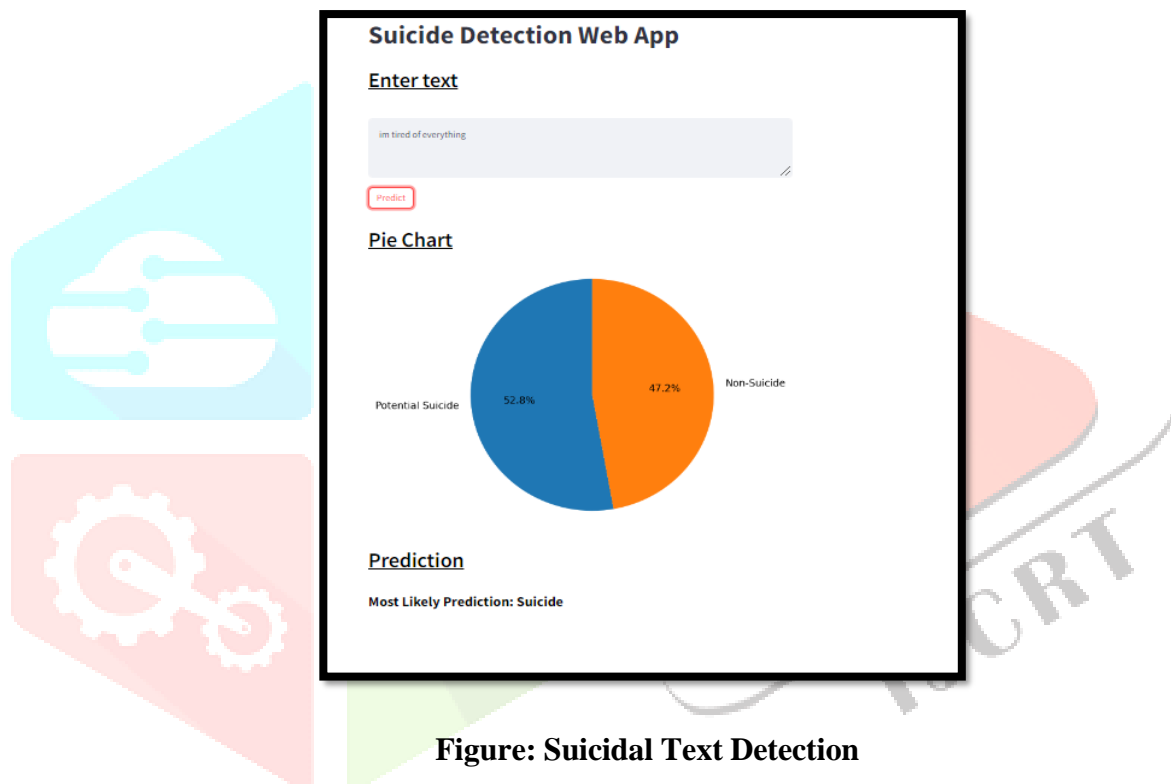


Figure: Suicidal Text Detection

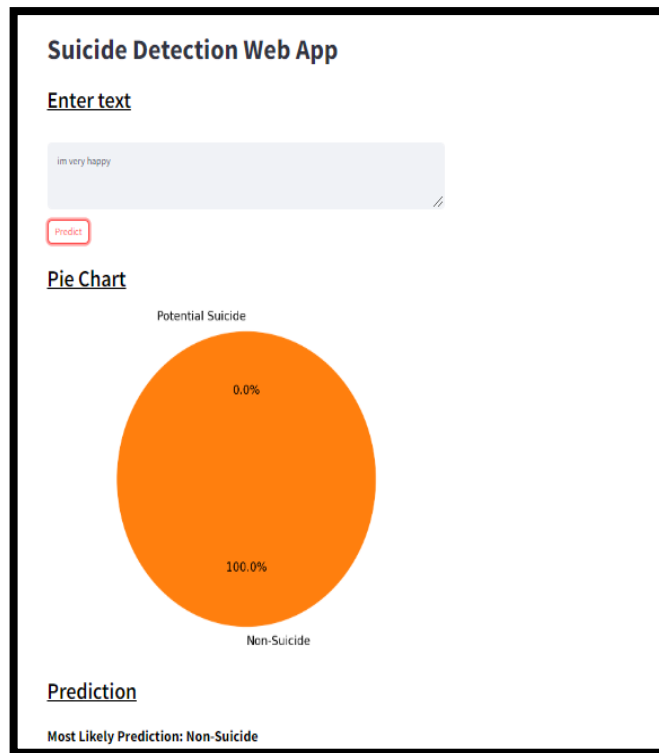


Figure: Non suicidal text detection

7. CONCLUSION

- Our project demonstrates the feasibility of using NLP and DL models to detect suicidal ideation on Twitter Tweets.
- The models we developed achieved high accuracy indicating their potential usefulness in identifying individuals who may be at risk of suicide.
- These findings suggest that NLP and DL models have the potential to contribute to suicide Prevention efforts by identifying individuals who may need help and support.

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