American International University-Bangladesh (AIUB)

Suicidal Tendency Prediction Using Machine Learning

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Abstract

Suicidal propensity prediction using social media data is a novel factor influencing suicidal behavior. suicide is the 11th main reason of death worldwide. [11]. Perceptions of suicide are influenced by social, environmental, and personal factors. Recently, suicide has become a "social" threat. [12]. Twitter is rapidly being explored as a source for displaying and perceiving a person's state of mind. The purpose of this paper is to test whether tweets about suicide can be classified based on their content. This is achieved by iteratively applying machine learning algorithms and engaging programmers. Data from Twitter was analyzed for various suicidal words and comments using public APIs. [13]. Collect suicide-related tweets with suicide-related keywords and save them in a CSV file as a record. A recursive neural network is then used to classify these tweets to determine if they are likely suicides. The proposed model identifies suicidal users so that they can be approached and referred to mental health care. This will benefit them and potentially save lives.

People prefer modern technology and use online social media as a means of communication when they are considering suicide. [14]. The two fundamental risks that lead to successful suicide are suicidal attempts and suicidal thoughts, and primary identification and detection are seen as effective strategies to prevent both. This study illustrates several approaches for understanding suicidal thoughts in online user material, with a focus on Twitter data from the last two years as a form of early detection using sentiment analysis and supervised learning techniques.

Our result got 80% accuracy after implementing a labeling tweeter dataset. The results of this study may aid in the development of machine learning algorithms that may anticipate suicidal ideation and conduct. Eighty percent of suicidal situations were accurately identified by the algorithms. To create a rapid screening tool for use in primary care or community settings, our findings can be applied.

Declaration by author

This thesis is composed of our original work and contains no material previously published or writtenby another person except where due reference has been made in the text. We have clearly stated the contribution of others to our thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, financial and any other original research work used or reported in our thesis. The content of our thesisis the result of work we have carried out since the commencement of the Thesis.

We acknowledge that the copyright of all material contained in my thesis resides with the copyright holder(s) of that material. Where appropriate we have obtained copyright permission from the copyright holder to reproduce material in this thesis and have sought permission from co-authors forany jointly authored works included in the thesis.

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Approval

This thesis titled Suicidal tendency prediction using machine learning has been submitted to the following respected member of the board of examiners of the Faculty of Science and Technology impartial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering on (May 2024) and has been accepted satisfactory.

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Contributions by authors to the thesis

List the significant and substantial inputs made by different authors to this research, work, and writing represented and/or reported in the thesis. These could include significant contributions to the conception and design of the project; non-routine technical work; analysis and interpretation of research data; drafting significant parts of the work or critically revising it so as to contribute to the interpretation.

	MD. RAZIB MOLLAH	EFFAT ARA TANZIN	JAKIR HASAN	MD. IFAZUL ISLAM	Contribution (%)
	20-42153-1	20-42000-1	*18-38795-3*	18-36180-1	
Conceptualization	25%	25%	25%	25%	100%
Data curation	25%	25%	25%	25%	100%
Formal analysis	25%	25%	25%	25%	100%
Investigation	25%	25%	25%	25%	100%
Methodology	25%	25%	25%	25%	100%
Implementation	70%	0%	30%	0%	100%
Validation	25%	25%	25%	25%	100%
Theoretical derivations	25%	25%	25%	25%	100%
Preparation of Figures	25%	25%	25%	25%	100%
Writing – original draft	25%	25%	25%	25%	100%
Writing – review & editing	25%	25%	25%	25%	100%

If your task breakdown requires further clarification, do so here. Do not exceed a single page.

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Keywords

Machine learning, Multinomial Naïve Bayes, Neural Network

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List of Abbreviations and Symbols

API   Application Programming Interface

ML   Machine Learning

MNB   Multinomial Naïve Bayes

Chapter 1

1 Introduction

700,000 individuals commit suicide each year, which is a significant societal issue. People are taking their own lives all across the world, particularly those who are in their 20s and older. [15]. The World Health Organization reports that he made an attempt at suicide in his 30s. Suicide Between the ages of 10 and 34, it is the second largest cause of death. Suicidal ideation, which is what it is often known as, includes the concept of taking one's own life. [16] Suicide may affect people of all ages. Ideas arise from a variety of diverse sources, such as surprise, rage, guilt, melancholy, and worry. Despite inadequate therapy, long-term depression can result in suicide. Most individuals who have suicidal thoughts don't really attempt suicide. Medical experts and medications can be used to treat suicidal thoughts. But the majority of individual's experience suicidal thoughts. Because it is stigmatized, avoid seeking therapy. instead, a lot of people decide to post about their plans to die on social media. [17] As it is mental disease diagnosis and treatment, early warning symptoms, and hazards, the element could be the best strategy for preventing suicide. Social media, which is mostly used by young people, In latest years it has evolved within a powerful aperture into the mental health and comfort of its users. It provides unidentified presence in various online groups and creates a forum for open discussion on socially taboo topics. In general, fifty percent of suicides and over twenty percent of those who attempt suicide write a suicide note. [18] Therefore, any written indication of suicidality is considered to be concerning, and the writer should be questioned about their own thoughts. Social media materials such as blog posts, conference post, tweets and other online notes are often still recorded and strong maintained. The study of social media and associated venues for discussing mental health has grown in the field of computational syntax. It provides a useful analysis environment for generating groundbreaking innovations that could revolutionize suicide risk reduction and suicide detection. [19] It can provide a useful entry point for intervention. investigated the Reddit Suicide Watch users' posting habits when they follow celebrity self-destruction news. He presented a strategy that would effectively stop suicides involving prominent figures We explored Reddit's social media shift from mental health discussion to suicidal ideation. To determine the characteristic signs of this transition, he developed a analytical method based on propensity score identical.

As we all know suicide is the second largest cause issue, [20] and we tried to prevent this occurs by using machine learning. This project can save lives. How? This project will trace people's suicidal thoughts throughout worldwide social media. By that, we can detect that particular person can save lives. If this process continues, we can ensure that this suicide issue will not be the world's 2nd largest cause of death.

We downloaded Tweet dataset records from a GitHub repository. We analyzed data from both routine tweets and messages by persons who had committed suicide. This information was kept in Excel. The label "1" in the dataset denotes suicidal behavior, while the label "0" denotes neutral behavior. There are 9119 samples in total, 4000 for suicidal samples and 5119 for neutral samples,

respectively. We obtain the dataset from Excel, perform any necessary preprocessing, train a **Multinomial naive Bayes classifier**, and then put the model to use via serving.

1.1 General aims

- As far as we know, the social media text data Conduct a comprehensive review of suicide Idea recognition and its methods and applications from a machine learning perspective.

- Present both classic content and discuss them analysis of machine learning and new technologies, Twitter data, Farewell letter and online social content.

- enumerate existing and less explored tasks, Talk about their limits. Combine existing documents and provide perspective for future research The direction of this field.

Our main and primary concern is preventing suicide by predicting suicide posts through social media and also locating papers using tools for prediction and computing PPV estimates for suicidal behavior.

1.2 Research Objectives

- Evaluating optimal suicide rate prediction models across continents.

- Visualize differences in key traits that influence suicide rates.

- Estimating the best suicide rate prediction model

1.3 Overview of forthcoming chapters:

- Chapter 1: contains an introduction to the work. This section defines research goals.

- Chapter 2: Add a literature review, and examples of previous studies relevant to this research.

- Chapter 3: Presents the overall model and proposed architecture.]

- Chapter 4: Describes experiments, results, and research evaluations.

- Chapter 5: Results, future scope, and limitations are described in this section of this chapter.

- Chapter 6: This chapter is conclusion part.

- Chapter 7: This is the last chapter of this project, here we will provide the code.

1. 5 Our Thesis Topic

"Early Suicidal Tendency Predication by Using Machine Learning"

Chapter 2

2 Literature review

It is important to detect suicide tendency precisely, so that to take precautions and create strategies to deal with the situation and minimize the adverse effects. So far, some previous research studies on related fields have already conducted. Social networks have captured attention to the research group, Especially when trying to figure out their format, user wiring and interactions between them. People tend to use Twitter to express their affections and talk around their regular lives. Linguistic Survey and global Count Version 2007 rates specific words and sentiments. Cognitive and basic English language expressed by individuals orally and in writing. Can be recycled to analyze aim in impassioned posts.[1]. They addressed the depression debate by working with language markers and using a bulletin board system to gather information from depressed individuals and pre-existing non-depressive Internet forums. said people with depression were more likely to report medical problems. and who are overseen by regulations that ensure the protection of mortality study participants. General Guidelines Suicide prediction on AI-based social media and medical ethics platforms is mostly outside the healthcare organization. Almost completely separated, the pots always remain independent. Forecast style is considered an exclusive trade secret [2]. A new and different challenge is social networks such as Twitter, A place where users post feedback and conclusion about commodity in actual time. Some early Findings and Recent Analysis of Twitter depressed Data. Mining Opinion has two major research field.[3]. Both document-level and document-level Methods of Classification Sentences are commonly placed on definitive remark of opinion. D.Hotman found that there is room for significant improvement in Suicide forecast and determent entire a combination of novel analytic approach and accessory, such as the use of machine learning algorithms and data science They found that the majority (83%) of those who died by suicide contacted health services in the year prior to death, and 45% contacted those services in the month prior to death. and emphasized the need for better validation and follow-up [4]. Suicide is world`s maximum critical problems.. year by year total More and more people are committing suicide. expect that to happen. about it, 800 people died from various causes. Thousands of people die each year an inference model was created using suicide attempt data. By providing nine properties, researchers were able to predict linear relationships. 99% estimated accuracy. Podlogar et al (2018).[5]. In this task, we compute the affinity between the tweet dataset and the training data. Create a job using the Machine A learning algorithm. In this background, target on pessimistic, awful thoughts and facts, and consider suicide. Evaluate the entire system and present Twitter results with predictive data

Chapter 3

3 Methodology

3.1   Introduction

After determination of doing analysis on Suicidal Tendency Prediction we planned to collect data from twitter posts. But instead of that we found a previous dataset from a Git Repository which was pre-processed with 9224 rows and 2 columns.

So, any pre-processing procedures was not necessary for this dataset. We started by checking the dataset either balanced or imbalanced and as a result we found that our dataset was imbalanced.

Suicidal vs Neutral

■ Suicidal   ■ Neutral
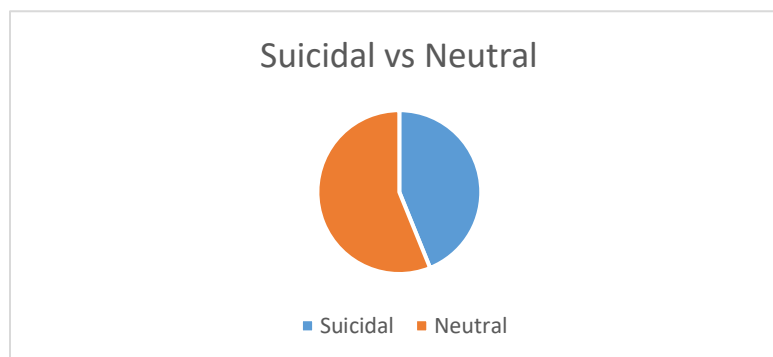
3.2   Procedures

3.2.1   Value Counts

In the beginning we started with value counts, as a result we get the data length: 8800

3.2.2   Missing Value Check

After getting the value counts result, we proceed to check missing values and there was no missing values.

```
In [51]: df.isnull().sum()

Out[51]: label    0
         data     0
         dtype: int64
```

3.2.3   Duplicate Value Check and Drop

We tried to find out the duplicate values & We dropped all the duplicate values from the dataset to make the result more accurate.

3.2.4   Compare Value

In this step we again count the dataset value after checking the missing values and duplicate values and compare with the previous value we got in the beginning.

So,

the previous value = 8800

the current value = 8800

Difference = 8800-8800 = 0

3.2.5   Splitting Data

We separated the label and data into x & y arrays to split our data into train and test sets.

3.2.6   Data preprocessing

We converted the test sets in numerical data to use on the training data so that we can scale the

training data and also learn the scaling parameters of that data and store the data in a multi-dimensional array.

3.2.7   Using Algorithm & Methods

We use Multinomial NB algorithm to analyzing text input and solving problems with numerous classes and supervised learning applications model to get statistics calculated across all of the models. And we used a python score method to measuring the accuracy of the model against the training data.

Finally, we forecast a certain future output based on trends found through historical data using the model prediction method.

Chapter 4

4 Results or findings

We fetched Tweet records published on a GitHub repository. We used data from posts by people who posted suicide and regular tweets. This data was stored in Excel. The label '1' in the dataset represents suicidal and the label '0' represents neutral. The total number of samples is 9119, distributed as 4000 and 5119 for suicidal and neutral samples respectively.

respectively. We fetch the dataset from excel, preprocess it, and We trained our model **multinomial navies bays classifier**, finally the model is used for serving.

The final accuracy of the model is 0.80 and the loss is 0.20.

	Precision	Recall	F1-Score
0	0.95	0.66	0.78
1	0.72	0.96	0.82
Accuracy		0.80	
Macro avg.	0.83	0.81	0.80
Weighted avg.	0.84	0.80	0.80

Fig: Accuracy Level

Chapter 5

Discussion

Our experiment has limitations due to incomplete data and biased annotations. One of the most important problems in today's research, which mostly uses supervised learning approaches, is the lack of data. Normally, they need to be manually annotated. To facilitate more study, there aren't enough labeled data, though. A further problem is a bias in annotation brought about by hand labeling using pre-established annotation criteria. In other instances, the annotation may cause labels to be biased, producing false evidence that supports the authors' decision to commit suicide. Identifying suicidal ideation in its early stages is an important and productive approach to early suicide. The majority of research on this subject has been conducted by a psychologist using analysis of the data. nonetheless, the bulk of computer scientists' research is done through feature engineering-based machine learning representation learning. Machine learning techniques have the potential to do this. Early detection of suicidal ideation and later early suicide prevention. In this study, we sought to test and rate various ML models to detect whether a user's tweets contained signs that would indicate suicide intent. Determine which model performs best. The major goal of the study is to identify the most reliable model for identifying suicidal thoughts on Twitter so that we can do so with a user with a high level of accuracy.

Suicidal inclinations are more effectively-recognized when regular linguistic patterns in social media material are identified. Using different techniques for various NLP methods frequently supports it. Desmet et al. [6] To identify suicidal thoughts, developed a suicide note analysis approach employing binary (SVM) classifiers. Huang et al. [21]. A psychological vocabulary based on a Chinese feeling dictionary was produced. He used the SVM technique to determine a classification for a system that would be used to detect suicidal thoughts in real time on Chinese Weibo. Braithwaite et al [7]. ML technique is effective in distinguishing between those at risk of suicide and those who are not. Sueki et al. [8] said that linguistic framing is crucial for spotting suicide signs in text after studying the suicidal intent of young Japanese Twitter users. For instance, the statement "want to suicide" is more usually associated with a lifelong desire to commit suicide than the phrase "want to die "demonstrates that automatic ML classifiers on TF-IDF characteristics may be used to automatically discriminate between different levels of worry among postings connected to suicide. Wood et al. [9] A total of 125 Twitter users were discovered by Wood et al., and their tweets previous to the data accessible before their suicide attempt were followed. Okhapkina et al. [10], But We download the dataset from Excel, perform preliminary processing on it, train a multinomial Naive Bayes classifier, and then use the model to serve. And it shows a promising result which is 80% accuracy.

Chapter 6

Conclusion

This research goes beyond predicting suicide posts, in this new age social media world, text data is generated every second. This data can be used in many ways. Through deep sentiment analysis, you can solve health-related problems or detect hate and post-toxicity to stop bullying.

In this research, we created and assessed a suicidal tendency prediction ML-based system. Our experimental Findings indicated that the Multinomial NB achieving model performed better with 80% accuracy in employing textual cues, as opposed to the latter's 91.5% accuracy, in diagnosing suicidal ideation. According to our analysis, suicidal postings score worse on attention, mind-thinking, perception, sociality, and cognitive processes than non-suicidal posts, scoring higher on authenticity, anxiety, mentality, depression, negativity, and sentimental melancholy. People today are more sensitive than ever before, which has a significant negative impact on their families, friends, and those around them. The suggested technique may assist in identifying people who need medical care and lowering suicide rates by recognizing suicidal intent in user posts.

Although the results of our research indicate that applied classification algorithms work quite well, the metrics' absolute value suggests that this is a difficult problem that merits additional investigation. We may attempt to obtain a bigger dataset with content connected to suicidal ideation as well as a brand-new dataset with comparable themes in our future study. We might look at the relationship between suicidal thoughts and factors like the family environment, the weather, etc. To better illustrate and evaluate our suggested hybrid approach, both sets of data will be acquired from various social media platforms. The dataset's efficacy will also be utilized to explore deeper learning classifiers in the future, including C-LSTM, RNN, and their combination models, as well as to evaluate parameter optimization.

We believe that our study will contribute to the development of a very successful suicide detection and reporting system that can be used in social media networks as a useful intervention tool between at-risk individuals and mental health providers.

Chapter 7

Code

```python
# import
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
```

```python
# import dataset
df = pd.read_csv('suicidal_data.csv')
```

```python
df
```

	label	data
0	1	my life is meaningless i just want to end my l...
1	1	muttering i wanna die to myself daily for a fe...
2	1	work slave i really feel like my only purpose ...
3	1	i did something on the 2 of october i overdose...
4	1	i feel like no one cares i just want to die ma...
...	...	...
9219	0	supernewj morning bah car won t start waiting ...
9220	0	i m off too bed i gotta wake up hella early to...
9221	0	just picked up some oats from the market to ea...
9222	0	i wish we would get it the same time at the r...
9223	0	need to sleep but cant

9224 rows × 2 columns

```python
df['data'].value_counts()
```

```python
df.drop_duplicates(inplace = True)
```

```python
df['data'].value_counts()
```

posite way when will i stop feeling jealous of tragic characters like gomer pile for the swift end they were able to bring to t
heir lives
1
my twitter always lagsss damn
1
 once tried the freezer method but didn t work for me since then i have a backup hd stored outside my home good luck anyway
1
why am i working today tuesdays are my days off
1

i will end it on my 16 birthday i dont have any motivation to livei amself confident i have lots of friendsi amintelligent and
i am not ugly but i cant do this anymore our lifes have no goal and we are so tiny compared to the whole galaxy life is too bor
ing without weed or alcohol i will kill myself because i have absolutely no patience and motivation to do this for still around
70 years and whats the difference to the world when i kill myself i can do it so quick and afterwards i cant even care about th
e other people that are still in this world alsoi amjust really curious about what happens after our lifes if we become just no
thing its okay because i wont even realize it and if theres some kind of afterlife it wont be as bad as this boring world i gue
ssi amjust an egoistic arrogant lazy and depressed asshole that is really curious   1
what is the easiest way to kill yourself what is the easiest way for a 15 yo to kill himself without much pain
1
injection i attempted suicide a while back and made a cocktail of medicine and injected it in my arm it didn t work i got bette
r temporarily now i need to go is there a way i can make it work this time
1
what is the fucking point what is the fucking pointto be happy how why it doesnt last pain is the default and it always comes b
ackive tried years ive tried pushed from one pill to the next so i can be numb enough to enjoy the rat racegutted myself in fro
nt of every therapist until they feign empathy before taking my crumpled bills since they never accept my insurancemy clothes a
re made in sweatshops my food was tortured horrifically lawmakers are corrupt soldiers work for profit love is an i willusion m
oney is fake everything is a scam everyone lies everyone steals everyone hurts no one is innocent and it just keeps going and g
oing and goingwere all just dumb pack animals who cling to routine and jump from one cycle to the next to keep ourselves busy a
nd blindso why continue whats the point because it gets better why would anyone want to get better in such a crooked world   1
kutnerrrr why why and to think that 13 is still on the show ugh kutnerkal penn you ve been the bright star in ho
1
Name: data, Length: 8800, dtype: int64

In [51]: df.isnull().sum()

Out[51]: label   0
         data   0
         dtype: int64

Seperating the x and y from dataset

In [52]: x = df.data.values
         y = df.label.values

In [53]: x

Out[53]: array(['my life is meaningless i just want to end my life so badly my life is completely empty and i dont want to have to creat
         e meaning in it creating meaning is pain how long will i hold back the urge to run my car head first into the next person comin
         g the opposite way when will i stop feeling jealous of tragic characters like gomer pile for the swift end they were able to br
         ing to their lives',
         'muttering i wanna die to myself daily for a few months now i feel worthless shes my soulmate i cant live in this horrib
         le world without her i am so lonely i wish i could just turn off the part of my brain that feels ',
         'work slave i really feel like my only purpose in life is to make a higher man money parents forcing me through college
         and i have too much on my plate i owe a lot of money i know this is the easy way out but i am really tired all of these issues
         are on top of dealing with tensions in america as well i want to rest',
         ..., 'still 3 more days until my internet gets uncapped',
         'my throat is still really sore i was meant to be going on a 5 day camp from friday but not so sure now',
         'kutnerrrr why why and to think that 13 is still on the show ugh kutnerkal penn you ve been the bright star in ho'],
         dtype=object)

In [54]: y

Out[54]: array([1, 1, 1, ..., 0, 0, 0], dtype=int64)

In [55]: xtrain,xtest,ytrain,ytest = train_test_split(x,y,test_size = 0.2)

Data preprocessing

In [56]: cv = CountVectorizer()
         x_train = cv.fit_transform(xtrain)

In [57]: x_train.toarray()

Out[57]: array([[0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                ...,
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0]], dtype=int64)

In [58]: from sklearn.naive_bayes import MultinomialNB

In [59]: model = MultinomialNB()
         model.fit(x_train,ytrain)

Out[59]: MultinomialNB()

In [60]: x_test = cv.transform(xtest)

In [61]: x_test.toarray()

Out[61]: array([[0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                ...,
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0]], dtype=int64)

In [62]: model.score(x_test,ytest)

Out[62]: 0.7864849517319704

Matix

In [63]: from sklearn.metrics import confusion_matrix
         from sklearn.metrics import classification_report

In [64]: pred = model.predict(x_test)

In [68]: print(classification_report(ytest,pred))

                       precision   recall f1-score   support

                    0   0.95   0.65   0.77   970
                    1   0.69   0.96   0.80   791

             accuracy   0.79   1761
            macro avg   0.82   0.80   0.79   1761
         weighted avg   0.83   0.79   0.78   1761

In [ ]:

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