

# Social Media and Mental Health: An IoT Approach to Identifying Suicide Mentation Using Deep Learning

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## Abstract

Suicidal ideation sufferers post their opinions and ideas on social media frequently. As a result, research from multiple studies has shown that posts on social media can be utilized to spot people who are contemplating suicide. However, it can be challenging to recognize and comprehend patterns of suicidal thought. It is crucial to develop a machine learning system that can immediately spot suicidal ideas or any abrupt changes in a user's behavior by looking at their social media posts. In this article, we suggest a technique for developing a suicidal ideation detection system based on experimental research that makes use of publicly accessible Reddit datasets, word-embedding methods, classification-focused machine learning technology, or deep learning. Through Reddit, the study finds that wise feature selection and combination lead to improved performance.

## 1. Introduction

Suicide is a prominent issue in today's society. According to estimates from the World Health Organization (WHO), 700 million individuals try suicide each year, and many more, especially those who are in their 20s and 30s, committed suicide [1]. The second most common cause of death for people between the ages of 10 and 34 is suicide [2]. Suicidal ideation, also referred to as suicidal thoughts, includes thinking about committing suicide. People of all ages can experience suicidal ideation due to a variety of factors, including shock, rage, guilt, sorrow, and anxiety. Long-term depression can lead to suicide if adequate therapy is not received, even though the majority of people who experience thoughts of suicide do not really attempt to end their lives [3]. With the aid of medical experts and drugs, risk of suicide can be controlled. The stigma attached to medical interventions, however, prevents the majority of those who have suicidal thoughts from seeking help. Instead, a lot of people decide to announce their intention to kill themselves on social media. Early detection of warning signals or risk factors may be the most effective method of avoiding suicide because mental illness can be recognized and treated.

A potent "window" into young people's mental health and overall welfare, social media is widely used by young people nowadays. It enables anonymous involvement in a variety of online groups to establish a platform for candid conversation about taboo themes. Therefore, any written indication of suicidality is considered to be concerning, and the writer should be questioned about their own thoughts. Blog entries, forum messages, tweets, and other online notes are just a few examples of social media content that are frequently documented in the present and well-maintained. [7].

## 2. Related Work

Dholariya, 2017[1] investigates how young people's suicidal thoughts vary by gender. The survey also identifies which gender attempts suicide more frequently. Based on global student data, Pandey et al2019 .'s study identified a number of factors that, depending on the circumstances, are related to students' propensity for suicide[2].

The behavior changes of the users were analyzed by Coppersmith et al. [4] after they noticed a large increase in tweets that showed melancholy in the days leading up to a suicide attempt. In the days and weeks following the attempted suicide, there was a discernible rise in tweets expressing outrage. Numerous research supports the hypothesis that users' social network connections have an effect on their suicidal thoughts. In response to a suicide instance that occurred within the social media group, Hsiung [5] observed the individuals' changing behavior. Jashinsky et al.[6] placed a strong emphasis on the spatial correlation between suicide death rates and the existence of risk indicators in tweets.

Colombo et al. [7] examined tweets indicating suicidal intent based on user behaviour in social network interactions that created strong bonds between users and a high degree of reciprocity. The influence of celebrity suicides on the emergence of suicidal ideation among users of online groups is another intriguing finding. Reddit users' suicidal interests were explored by Kumar et al. [3] in relation to the Werther or copycat effect [8]. His research shows that after news of celebrity suicides, users' posting frequency significantly increased and their linguistic behavior changed. This change was seen as moving in the direction of posts that were more negative, self-centered, and had weaker social integration. A method for anticipating suicidal thoughts was created by Desmet et al. [9]. Their paper describes this strategy. A psychological language built from a Chinese sensory lexicon was created by Huang et al. [10]. (HowNet). The authors developed a real-time method for recognising suicidal thoughts on Chinese Weibo using SVM to create a classification system. Researchers Braithwaite et al. [11] used machine learning techniques to find persons who would harm themselves. Language framing was demonstrated to be a significant element in Sueki et al.[12] study on the suicidal intent of young Japanese Twitter users emphasized the significance of textual suicidal symptom recognition.

When compared to phrase "want to die," the phrase "want to commit suicide" was more frequently linked to a lifelong desire to commit suicide. In order to ascertain the level of fear expressed in posts linked to suicide, O'Dea et al. [13] employed ,in order to classify TF-IDF variables, both manual and automatic ML(LR and SVM) classifiers are used . Wood et al. [14] identified 125 people on Twitter and followed them until they committed suicide. Using simple and linear classifiers, they were able to accurately determine the gender of the users with a 91.9% accuracy rate and found that 70% of them had made at least one attempt at suicide.

### 3.Materials and Methods

This section presents the main components of the proposed suicidal ideation detection system (SIDS) [23] framework using linguistics, signs, and activities on Suicide Watch, which is a sub-platform of the Reddit social media news aggregation platform. Figure 1 presents the steps of this framework.

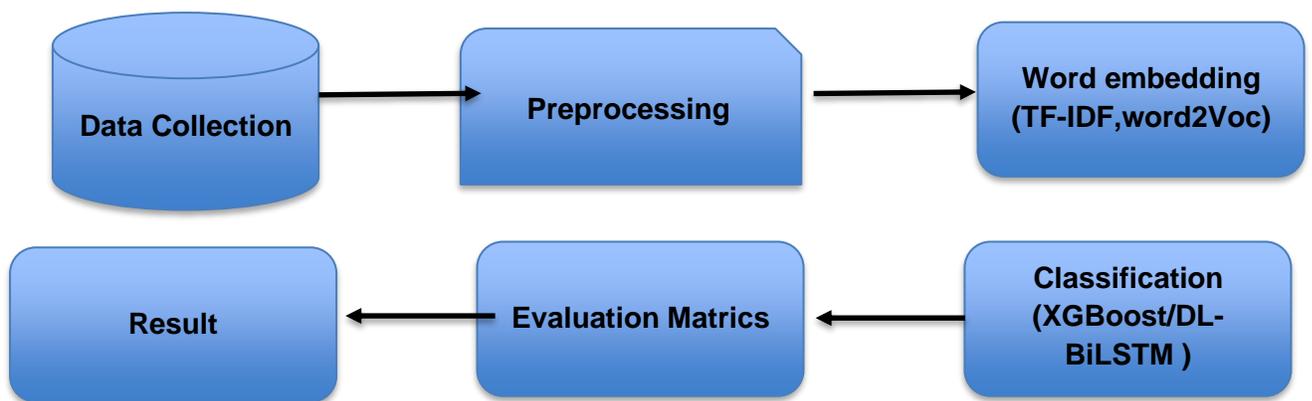


Fig-1. Framework of the proposed suicide ideation detection system.

#### 4. Datasets

Our classification algorithms are developed using a dataset from the social media platform Reddit, where users may express their opinions through various links, text posts, or voting mechanism postings. This dataset is used to identify suicidal ideation.

A compilation of suicide-related quotations was initially compiled from subreddits where people requested support from other members. Since the authors of these articles frequently have suicidal tendencies, their posts can be viewed as suicide-related expressions. Standard postings about friends, family, and entertainment are also gathered from several other subreddits.

#### 5. Methodologies

##### 5.1 Data Collection

Since the raw data from online social media contains a lot of noise, it cannot be used directly for feature extraction. Word matching and semantic analysis become problematic as a result. The issue is made worse by the possibility that data from online social media sites contains typos, misspellings, emoticons, and other undesired characters. Preparing the data is necessary to guarantee that computer model performs accurate predictive analysis. The data is subjected to the following data preprocessing procedures:

- Since URL links in user posts don't convey any meaning or polarity, they are eliminated as part of preprocessing.
- Stop words like "a," "an," "the," etc. are eliminated because they don't discriminate or serve a purpose in our approach.
- Non-ASCII characters are eliminated to improve text quality.

The method of tokenization involves reducing long phrases to collections of single words.

- Each word stemmed to reveal its underlying meaning.
- To make it easier to understand the words, POS (part of speech) tagging is used.

##### Examples of postings from various classes on Reddit.

Label	Reddit posts
No Risk	<ul style="list-style-type: none"> <li>• So when I came across this little man online and discovered that no one has put him here, my heart melted.</li> <li>• ZOINKS! Help with a new haircut, I just realised how much Scooby-shaggy-like I'm starting to look? Doo's</li> </ul>
Low Risk	<ul style="list-style-type: none"> <li>• I had a difficult upbringing. I hope no child ever has to go through this.</li> <li>• I made the decision to change my life a long back. I wanted to maintain my fitness level and do well on tests. But everything was just words. Reading or watching movies won't really motivate you. It took me three years to realise that you hold everything.</li> </ul>
Moderate Risk	<ul style="list-style-type: none"> <li>• I made up a story to get out of a mental hospital because I felt suicidal. just so I can finish it when I go home and do it right this time. to r/suicidewatch, x-posted EDIT: I'm probably asleep if I don't respond. I'm quitting booze to detox.</li> <li>• I'm really sorry that this is taking place to you. I always wish I could do something to help when I hear something like this. But I'm powerless. I'm not looking to assist anyone. I only want to go quickly, in peace.</li> </ul>

**Severe Risk**

- Looks like alcohol won't be able to relieve my discomfort any longer. That stinks. If I'm drunk I'll be much worse, and I worry that I'll talk badly of myself in front of my pals. Ices, it's time to give up. Even though I am aware that my father was an alcoholic, I am still really upset about this.
- I gave it my all today, but I was ultimately unsuccessful.

## 5.2 Feature extraction

High precision must be attained in detecting suicidal ideation, A critical step in gathering thorough user data is feature extraction. In this study, many characteristics from tweets were extracted, incorporating topic-based features, topic-based emoticons, emotion analysis, TF-IDF, statistics, and temporal features.

A social media talent, the exact information extracted from a particular person' profile and displayed in this feature area includes things like their name, language, friend count, profile description, country, profile creation date, time zone, profile photo, follower count, and following.

## 5.3 Word2Vec

In language modelling and feature learning, Word2Vec is a further technique for getting word embeddings, or to extract words from a text and display them numerically. The two-layer neural network structure of this method, created by Google, allows it to forecast the Words in a text's context and extract vector representations of that word.

## 5.4 Classification Models

After utilising TF-IDF and Word2Vect to Word embeddings should be made for each post's content. supervised machine learning algorithms— For classification, a hybrid CNN-bidirectional LSTM (BiLSTM) DL algorithm and Extreme Gradient Boosting (XGBoost) were used. In this work, we evaluated the performance of XGBoost employing TF-IDF word features to CNN-performing BiLSTM's using Word2Vec word embeddings.

Model XGBoost The supervised ML method XGBoost is popularly utilised in classification and regression tasks. The algorithm for gradient decision trees, which performs quickly, has a structure that is comparable to this one. Its architecture seeks to make efficient use of memory and processing power. Several qualities are involved in its implementation. It uses sparse awareness and automatically fills in values for missing data. To enable simultaneous tree generation, it makes advantage of a block architecture.

### CNN–BiLSTM Model

Using the CNN-BiLSTM model, this research consists of bidirectional LSTM layers, a softmax classification layer, a max pooling layer, an embedding layer, and a convolutional layer.

### Integrating layer

The hidden neural network's top layer is represented by this. Its foundation is the CNN-BiLSTM architecture length of the input sequence, embedding size, and maximum features.

### Constellation layer

Word-embedding matrices are used as source data for this layer, they are subsequently combined using a convolutional

technique to create feature maps. [16]. An embedding layer sends an input-embedding matrix to the convolutional layer, which uses it to compute for a subset of words. Layers BiLSTM LSTMs are a kind of RNN used in NLP, image processing, sequence mining, text mining, and other processes. [17].

## 6. Conclusions and Future Work

By investigating at internet resources that promote suicide, this effort hopes to better understand the perspective on suicide that is most often held. We collect and analyse information from Reddit postings to add to our knowledge of suicidal ideas and actions. Experimental evidence shows that all of the features successfully distinguish between suicidal and non-suicidal postings after being retrieved from the data set. According to the study's findings, carefully choosing attributes can lead to high prediction performance.

To assess Reddit users' psychological conditions, we created and tested a system for ML and DL-based suicidal ideation detection. In our studies, Using textual features, the CNN-BiLSTM model fared better than the XGBoost model in identifying suicidal thoughts, obtaining 92 percent accuracy as opposed to the latter's 91.5%. Our data shows that suicide postings score worse on cognitive processes, perception, sociality, and attention than non-suicidal people postings while scoring higher on emotional sadness, melancholy, negativity, mindset, anxiety, and honesty.

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