

A Machine Learning Framework For Prognostication Of Suicidal Ideation And Detection In Online Social Content

Ed Gowhar Hafiz Wani¹, Samiah jan Nasti²

¹Research Scholar Department of Computer Science, Bhagwant University, Ajmer, India.

²Lecturer Department of Computer Science, University of Kashmir, South Campus, Anantnag, India.

Abstract

Every year, almost 800,000 people commit suicide. Suicide remains the second leading cause of death among a young generation with an overall suicide rate of 10.5 per 100,000 people. Suicide ideation is viewed as a tendency to end ones' life ranging from depression, through a plan for a suicide attempt, to an intense preoccupation with self-destruction. Suicide ideation expressed in social media has an impact on language usage. Many at-risk individuals use social forum platforms to discuss their problems or get access to information on similar tasks. With the widespread emergence of mobile Internet technologies and online social networks, there is a growing tendency for people to talk about their suicide intentions in online communities. This online content could be helpful for detecting individuals' intentions and their suicidal ideation. Some people, especially adolescents, choose to post their suicidal thoughts in social networks, ask about how to commit suicide in online communities, and enter into online suicide pacts. The anonymity of online communication also allows people to freely express the pressures and anxiety they suffer in the real world. Thus, one possible approach to preventing suicide effectively is early detection of suicidal ideation. In this research paper, we investigate the problem of suicidal ideation detection in online social websites, with a focus on understanding and detecting the suicidal thoughts in online user content (tweets/posts) and then apply machine learning techniques to automatically classify them into different categories of risk.

Keywords- Suicide, Suicide Attempts, Suicide Ideation, Machine Learning

1. Introduction

Use of internet technology has increased at a great pace in the last decade. The reports reveal that currently more than 4 billion people are using internet. The purpose of using internet varies from learning new things, having entertainment, discovering the opportunities by applying for job at ease, getting treatment online and various other uses. As of 2018, 2.62 billion people are using the social media and its number could increase up to 3.02 billion in 2021. The steep increase as predicted is analyzed by the fact that in 2010, only 0.97 billion people were using the social media. Another interesting fact is that more than 71 percent internet users are also

reported to be socially networked and this figure may likely grow fast in coming years. Social media is the most dominant innovation of internet which connects the people all over the globe. By using the social network sites, people can communicate without looking for boundaries by updating the status, commenting on other's posts and sharing photos and videos. Huge number of social media sites exist. Among them Facebook and Twitter are two most popular social networking sites. As of January 2019, Twitter and Reddit had 326 and 330 million active users respectively, and Facebook recorded highest of 2.27 billion monthly active users reflected in Fig. 1.

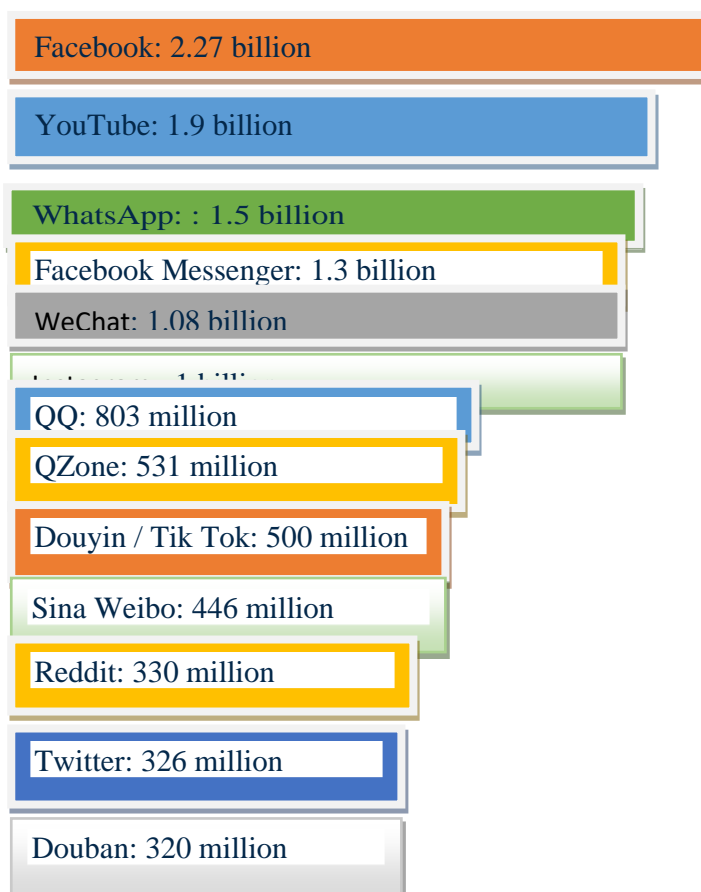


Fig1: Top Social Networks.

The data generated through the social media is massive and provide rich information. Social media has a big advantage of easy data collection and socially relevant information in large quantity which was otherwise difficult to attain from various other traditional resources. This data can be used virtually by anyone who wish to take information from it. Moreover, this data doesn't require any time for publication as is the case in traditional media. The data can be leveraged for various purposes. In 2009, United States Geological Survey (USGS) investigated the possibility of using social media to detect earthquakes in real time. Similarly, the forecasting of Civil unrest as well as riots and protests can be monitored. The well-known EMBERS is a system that predict the timing and location of a protest and the reasons behind it beforehand. Much research has been done to detect the sentiment in reviews and recommendations. Politicians also get benefited by analyzing the feelings of common people about their political campaigns and debates.

Researchers have started to use Social media to predict various issues related to mental health which include distress and depression. Suicidal ideation is another area which can be predicted using social media analysis as a social media provides the massive information about one's daily feelings which was otherwise unimaginable by using the traditional approaches. As a real-life event are reflected on social media, the data can be used to predict the future. The paper is organized as follows : Section II shows the review of the work already done and Section III explains the proposed methodology in detail followed by the conclusion.

II Literature Review

Lehavot, K et. al [1] reviewed a case report in which a clinician discovers suicidal ideation on Facebook (in the form of both photos and explicit statements) by a client with serious mental illness. In using social media to obtain information about clients, they have highlighted potential benefits and harm, including harm to the therapeutic alliance, the difference and consequent impact of actual versus perceived privacy violations, and the necessity of obtaining the client's informed consent.

Fu, K. et al. [2] examined written reactions of a group of Chinese micro bloggers exposed to the post containing a self-harming message and photo. In addition, they investigate the pattern of information diffusion via a social network.

Kailasam, V., & Samuels, E. [3] analyzed two cases that showed the ideation of suicide by a person. High risk monitoring methods were proposed to discover the different ways and opportunities to prevent the suicide on Social media.

Huang, X., [4] introduced a novel dataset of Chinese social media accounts of 130 people who committed suicide between 2011 and 2016. They described the demographic and geographic composition of the users, then conduct a longitudinal text analysis of their post histories, showing observable changes in content leading up to the time of death with encouraging exploratory findings.

Vioules, M. J.[5] presented a new approach that uses the social media platform Twitter to quantify suicide warning signs for individuals and to detect posts containing suicide-related content. The main originality of this approach is the automatic identification of sudden changes in a user's online behavior. To detect such changes, they combine natural language processing techniques to aggregate behavioral and textual features and pass these features through a martingale framework, which is widely used for change detection in data streams.

Joseph, A., & Ramamurthy, B. [6] created a prediction model for individuals who are at higher risk of suicide by studying the different predictors of suicide such as depression, anxiety, hopelessness, stress etc. by using data mining techniques for the prediction.

Shahreen, N. et al. [7] adopted an approach of machine learning and neural network for their research. Support Vector Machine (SVM) is one of the best machine leaning algorithm for text analysis and neural network is also well known for performance in complex cases. In case of neural network they used three types weight optimizers namely Limited-memory BFGS,

Stochastic gradient descent and an extension of stochastic gradient descent which is Adam to attain maximum accuracy.

Killgore, W. D et al. [8] surveyed during the first months of the COVID-19 pandemic, most communities across the U.S. engaged in some form of stay-at-home restrictions or lockdowns that limited social interaction and movement outside the home. To determine the effect of these restrictions on suicidal ideation, a total of 3,120 individuals completed the Patient Health Questionnaire (PHQ-9) at one of three time points from April through June 2020. The percentage of respondents endorsing suicidal ideation was greater with each passing month for those under lockdown or shelter-in-place restrictions due to the novel coronavirus, but remained relatively stable and unchanged for those who reported no such restrictions.

III. Proposed Framework For Suicide Detection

Research in Social media is gaining much attention. People express their feelings by publishing about their daily life on social media. Recent research indicates that Social networks help in predicting the feelings of depression which in turn can help in preventing the suicide. Our Study will also focus on Social networking websites to analyze the public tweets/ posts and detect the type of risk involved. The study will also focus on replicating the accuracy of human coders by using an automatic classifier. Thus, this study will be very much helpful in preventing a lot of potential suicides which was otherwise impossible due to social stigma and lack of willingness to consult the mental health experts.

Figure 2 depicts the framework and key activities to be performed for our work .The work is divided into four parts: First part is related to the construction of vocabulary for different themes of suicide and using various extraction mechanisms like API to extract the relevant data. Second part is to label the dataset. Third part is about pre-processing the dataset such that it may be ready for training purposes. Forth part is about implementing machine learning algorithms to automatically classify the tweets. The last part is concerned with the Evaluation and Validation of the results.

Social Media

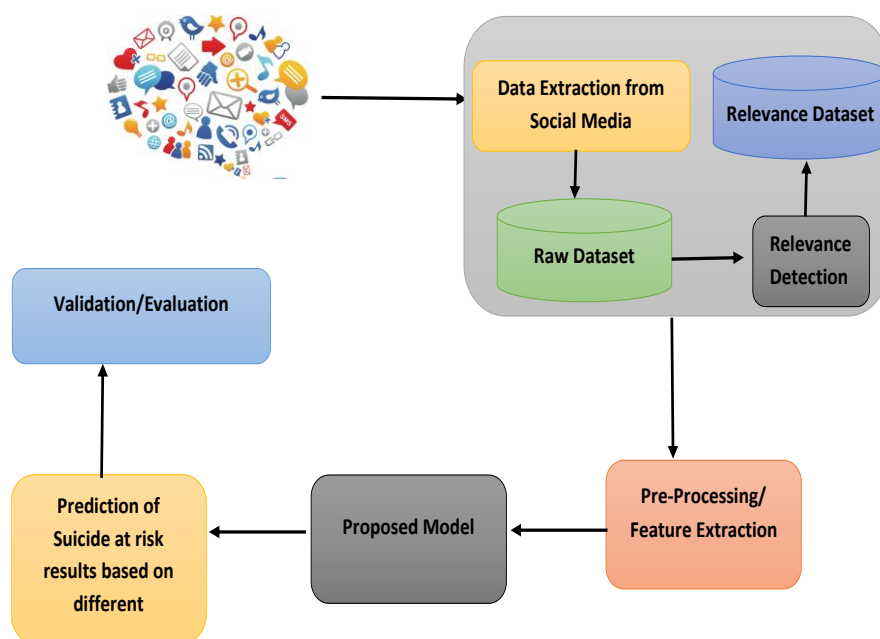


Fig. 2: Proposed Framework

The major modules of our proposed methodology are as follows:

- **Designing of Vocabulary of Suicide act:-** This will define a vocabulary associated with different themes related to suicide (fear, anger, sadness). Vocabulary is defined in English as many posts are published using this particular language.
- **Data Extraction and Collection :-** The Extraction of data from social media is one of the important and challenging part of our work. Data will be collected from social media. Majority of the data will be collected from Twitter using an Application program interface by using the different search terms based on warning signs and risk factors identified by American Foundation for suicide Prevention (AFSP) and also the search words defined in manual vocabulary which will be formulated by consulting the mental health experts and different suicide forums. Extraction will be performed several times.
- **Human Annotation:** - Human coding is needed to analyze the extracted data manually and conceptualize the task of classifying the relevant data into different levels of concern. Human coding will be done in consultation with mental health experts.
- **Pre-Processing:** - The data need to be filtered by excluding irrelevant posts and then removing the noise in tweets/posts such that the dataset will be ready for training using Machine Learning Algorithms
- **Feature extraction:** - After the extracted data from social media sites is processed, it shall be represented as a vector of features. A number of feature extraction methods like Unigrams, Weighting Term Frequency weighted by inverse document frequency (TFIDF), Bag of words. Will be used as and when the need arises.
- **Machine Learning:** - Machine Learning is a set of algorithms that is used in automating the construction of classification using the training data. Supervised or unsupervised learning will be used. Based upon the need, several classification

algorithms or machine techniques like Support vector machines (SVM)/NLP, Maximum entropy or Naïve Bayes etc. will be used. Deep learning techniques will also be used as and when the need arises.

IV. Conclusion

Suicide prevention remains an essential task in our modern society. Early detection of suicidal ideation is an important and effective way to prevent suicide. Online social content is very likely to be the main channel for suicidal ideation detection in the future. Therefore, it is essential to develop new methods, which can heal the schism between clinical mental health detection and automatic machine detection, to detect online texts containing suicidal ideation in the hope that suicide can be prevented.

References

- [1] Lehavot, K., Ben-Zeev, D., & Neville, R. E. (2012). Ethical considerations and social media: a case of suicidal postings on Facebook. *Journal of Dual Diagnosis*, 8(4), 341-346.
- [2] Fu, K. W., Cheng, Q., Wong, P. W., & Yip, P. S. (2013). Responses to a self-presented suicide attempt in social media. *Crisis*.
- [3] Kailasam, V., & Samuels, E. (2015). Can social media help mental health practitioners prevent suicides? *Current Psychiatry*, 14(2), 37-51.
- [4] Huang, X., Xing, L., Brubaker, J. R., & Paul, M. J. (2017, August). Exploring timelines of confirmed suicide incidents through social media. In *2017 IEEE International Conference on Healthcare Informatics (ICHI)* (pp. 470-477). IEEE.
- [5] Vioules, M. J., Moulahi, B., Azé, J., & Bringay, S. (2018). Detection of suicide-related posts in Twitter data streams. *IBM Journal of Research and Development*, 62(1), 7-1.
- [6] Joseph, A., & Ramamurthy, B. (2018). Suicidal Behavior Prediction Using Data Mining Techniques. *International Journal of Mechanical Engineering and Technology*, 9(4).
- [7] Shahreen, N., Subhani, M., & Rahman, M. M. (2018, September). Suicidal trend analysis of twitter using machine learning and neural network. In *2018 International Conference on Bangla Speech and Language Processing (ICBSLP)* (pp. 1-5). IEEE.
- [8] Killgore, W. D., Cloonan, S. A., Taylor, E. C., Allbright, M. C., & Dailey, N. S. (2020). Trends in suicidal ideation over the first three months of COVID-19 lockdowns. *Psychiatry research*, 293, 113390.