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SUICIDAL IDEATION DETECTION: A REVIEW OF MACHINE LEARNING METHODS AND APPLICATIONS

N.Anjali[1], M SRIJANTH REDDY[2], P.TARUN[3], BHANU PRASAD[4]

ASSISTANT PROFESSOR[1], UG SCHOLAR[2,3&4]

DEPARTMENT OF CSE, CMR INSTITUTE OF TECHNOLOGY, KANDLAKOYA VILLAGE, MEDCHAL RD, HYDERABAD, TELANGANA 501401

ABSTRACT - Suicide remains a critical and urgent issue in contemporary society, demanding effective early detection and intervention strategies to prevent loss of life. This article provides a comprehensive survey of the current methods used for suicide ideation detection (SID), which can be broadly categorized into clinical and machine learning-based techniques. Clinical methods typically involve direct interaction between social workers, mental health professionals, and individuals at risk, whereas machine learning (ML) and deep learning (DL) techniques have emerged as advanced tools for automatic detection of suicidal ideation, leveraging online social content. This survey covers both domains in detail, with a focus on their respective data sources, including questionnaires, electronic health records, suicide notes, and online user content from social media platforms, forums, and blogs. The use of various data sets for SID tasks is also explored, providing insight into the diversity of available resources for model training and evaluation. The paper highlights key tasks in SID such as classification, sentiment analysis, and pattern recognition, which aim to identify subtle cues in data that can indicate suicidal thoughts or behaviors. Various datasets, such as social media posts, online interactions, and patient health records, are reviewed in terms of their utility and challenges, offering a foundation for future research. Despite the progress made in these areas, the article also outlines significant limitations in the existing literature. One of the primary challenges is the quality and accessibility of labeled data, which is essential for training accurate and robust machine learning models. Furthermore, ethical concerns surrounding privacy, consent, and the potential harm caused by misclassification are also critical issues that need to be addressed. Finally, the article offers an outlook on the future of SID research, suggesting that a multidisciplinary approach combining clinical expertise with advanced computational methods could provide more reliable and scalable solutions. Research in this field is poised to benefit from advancements in natural language processing, better understanding of risk factors, and improved datasets, ultimately leading to more effective suicide prevention strategies.

I. INTRODUCTION Mental health issues such as anxiety and depression are increasingly becoming a major concern in modern society, with a significant rise in severity in both developed countries and emerging markets. These disorders can have devastating consequences if left untreated, potentially leading to suicidal ideation and even suicide attempts. Among the factors contributing to this crisis, online interactions and social media play a crucial role in exacerbating mental health issues. Many online platforms are used to express negative emotions, and this can lead to phenomena such as cyberbullying and cyberstalking, which often amplify feelings of

hopelessness and despair in vulnerable individuals. Research has established a strong link between cyberbullying and suicide, with victims subjected to prolonged exposure to negative online content being at a heightened risk of developing depression and suicidal thoughts. Suicidal ideation detection (SID) has therefore emerged as a critical field in identifying individuals at risk before they act on these thoughts. SID involves detecting signs of suicidal ideation in individuals, whether through direct communication such as questionnaires or more complex methods like analyzing textual content. In the age of social media and digital communication, people increasingly turn to online platforms to express their mental health struggles, making it vital to mine social content for early warning signs. Several alarming online trends, such as the "Blue Whale Game," where members are encouraged to engage in self-harm and eventually commit suicide, highlight the dangerous intersection between social media and suicidal tendencies. Detecting suicidal ideation early is paramount, as it allows for intervention and the potential to prevent tragic outcomes. Machine learning (ML) and artificial intelligence (AI) have proven to be powerful tools in enhancing SID by automating the detection process and analyzing large volumes of social content, including online posts, social media interactions, and health records. AI and ML techniques such as sentiment analysis, deep learning, and feature engineering offer promising approaches to identifying subtle patterns in text that indicate suicidal thoughts. Despite these advancements, there are significant challenges, including privacy concerns, the interpretability of machine learning models, and the need for better datasets to train these systems. As the need for suicide prevention grows, applying AI-driven techniques to detect and intervene in suicidal ideation offers a promising solution, though it requires careful consideration of ethical issues and further development to improve accuracy and effectiveness.

II. LITERATURE SURVEY

A) A. E. Aladaˇg, S. Muderrisoglu, N. B. Akbas, O. Zahmacioglu, and H. O. Bingol, "Detecting suicidal ideation on forums: Proof-of-concept study," J. Med. Internet Res., vol. 20, no. 6, p. e215, Jun. 2018.

It explores the potential of using online forums to detect suicidal ideation, offering a proof-of-concept study for an automated detection system. The study highlights the growing issue of mental health, particularly suicide, and the increasing reliance on online platforms for individuals to express their emotional distress. Given the anonymity and accessibility of online forums, these platforms have become venues where people often discuss their personal struggles, including suicidal thoughts. The authors focus on developing a system that analyzes text from online forums to identify users who may be experiencing suicidal ideation. Using a combination of natural language processing (NLP) techniques and machine learning models, the study tests various methods for detecting key indicators of suicidal thoughts in forum posts. The model was trained on a large dataset of forum posts, employing supervised learning algorithms to identify patterns of language associated with suicidal ideation. The results of the study show that the system could effectively identify forum posts containing suicidal ideation, providing a promising tool for early intervention and suicide prevention. The authors emphasize that such automated detection could serve as a useful supplement to traditional methods of monitoring and intervention, such as clinical evaluations. However, the study also points out limitations, such as the need for more comprehensive datasets and the importance of addressing ethical concerns, particularly regarding privacy and consent. This paper contributes to the field of mental health research by offering a new approach for detecting suicidal ideation using online

forums, presenting a scalable and efficient solution that could be integrated into existing mental health monitoring systems.

B) D. N. Milne, G. Pink, B. Hachey, and R. A. Calvo, "CLPsych 2016 shared task: Triaging content in online peer-support forums," in Proc. 3rd Workshop Comput. Lingusitics Clin. Psychol., 2016, pp. 118–127

It presents the shared task of triaging content in online peer-support forums as part of the 3rd Workshop on Computational Linguistics and Clinical Psychology (CLPsych 2016). This study addresses the critical issue of mental health support in online communities by utilizing natural language processing (NLP) and machine learning techniques to analyze and triage peer-support forum posts. The goal was to develop automated systems that could classify and prioritize posts from online forums based on the urgency of the mental health issues expressed, facilitating timely intervention. The shared task involved developing models that could automatically detect posts expressing varying levels of psychological distress, including those that may indicate suicidal ideation or self-harm. The study presented a variety of approaches for tackling this problem, including feature extraction from text, machine learning classification techniques, and evaluating models on a dataset of real-world online forum posts. The authors highlight the challenges of this task, such as handling noisy and informal text, and the ethical implications of intervening in sensitive conversations within peer-support communities. The paper reports on the methods submitted by various participants in the shared task, comparing the effectiveness of different algorithms in classifying posts and ranking their urgency. The findings show that while automated systems can successfully triage content based on the level of distress expressed, further improvements are needed in model accuracy, especially in terms of sensitivity to nuanced expressions of mental health issues. The authors emphasize the importance of developing such technologies to assist mental health professionals and online communities in providing better support for individuals in crisis, while also acknowledging the ethical concerns associated with privacy, consent, and the potential for misclassification.
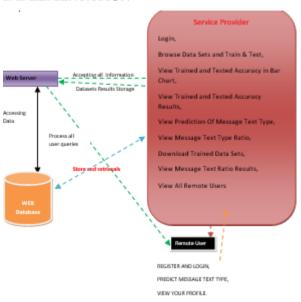
C) K. Haerian, H. Salmasian, and C. Friedman, "Methods for identifying suicide or suicidal ideation in EHRs," in Proc. AMIA Annu. Symp., American Medical Informatics Association, 2012, p. 1244.

It explores various approaches to detecting suicide or suicidal ideation in electronic health records (EHRs). The study focuses on the challenge of identifying individuals at risk of suicide using the vast amount of medical data available in EHRs. The authors discuss several methodologies for recognizing suicide-related patterns in clinical records, which may include diagnosis codes, medication prescriptions, and notes entered by healthcare providers. They emphasize the importance of accurately detecting subtle signals of suicidal ideation, as early intervention can significantly reduce the risk of suicide. The paper provides a detailed review of existing techniques for identifying such patterns, including natural language processing (NLP) to analyze unstructured clinical notes, as well as structured data mining methods for processing coded clinical data. The authors highlight the potential of combining both structured and unstructured data sources to improve the accuracy of suicide risk prediction. They also examine the ethical considerations and limitations of these methods, noting the need for sensitive handling of patient data and the importance of privacy in suicide prevention efforts. The paper concludes with a call for further research into refining these methods, including the development of more sophisticated algorithms capable of detecting at-risk individuals in real-time. By leveraging the power of EHR data, the authors argue, healthcare

providers could improve early detection of suicidal ideation and take appropriate preventive measures before tragic outcomes occur.

IMPLEMENTATION

Modules

Service Provider

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as   Login, Browse Data Sets and Train & Test,   View Trained and Tested Accuracy in Bar Chart,   View Trained and Tested Accuracy Results,   View All Antifraud Model for Internet Loan Prediction,   Find Internet Loan Prediction Type Ratio,   View Primary Stage Diabetic Prediction Ratio Results,   Download Predicted Data Sets,   View All Remote Users.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like REGISTER AND LOGIN, PREDICT PRIMARY STAGE DIABETIC STATUS,   VIEW YOUR PROFILE.

CONCLUSION

Suicide prevention remains a critical issue in modern society, and early detection of suicidal ideation (SID) is a key strategy for preventing suicides. This survey has provided a comprehensive review of the existing methods for SID, spanning a variety of approaches, including clinical techniques, textual content analysis, feature engineering, and deep learning-based methods. It has highlighted how psychological experts have utilized statistical analysis, while computer scientists have contributed through machine learning and deep learning

approaches, such as CNN- and LSTM-based text encoders. The paper has discussed four primary domain-specific applications: questionnaires, electronic health records (EHRs), suicide notes, and online user content, underscoring the importance of each domain in identifying suicidal ideation. In addition, the survey has identified key tasks currently being explored and proposed new directions for future research. Despite the progress made, significant limitations in current research persist, including challenges related to data interpretation, the lack of real-time detection systems, and ethical considerations in automated systems. The discussion has led to several promising future research avenues, such as the use of emerging learning techniques, the development of interpretable models to understand the intentions behind suicidal ideation, improving temporal detection capabilities, and exploring proactive conversational interventions. One of the most crucial aspects of this research is the increasing role of online social content in detecting suicidal ideation, as online platforms have become a primary channel for individuals to express their distress. Moving forward, it will be essential to bridge the gap between clinical mental health detection methods and automated systems that analyze online content. Developing advanced methods that can efficiently detect and understand suicidal ideation in online texts could play a pivotal role in suicide prevention. As the field continues to evolve, the integration of new technologies, data sources, and interdisciplinary collaboration between clinicians and technologists will be crucial in improving early detection and ultimately saving lives.

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