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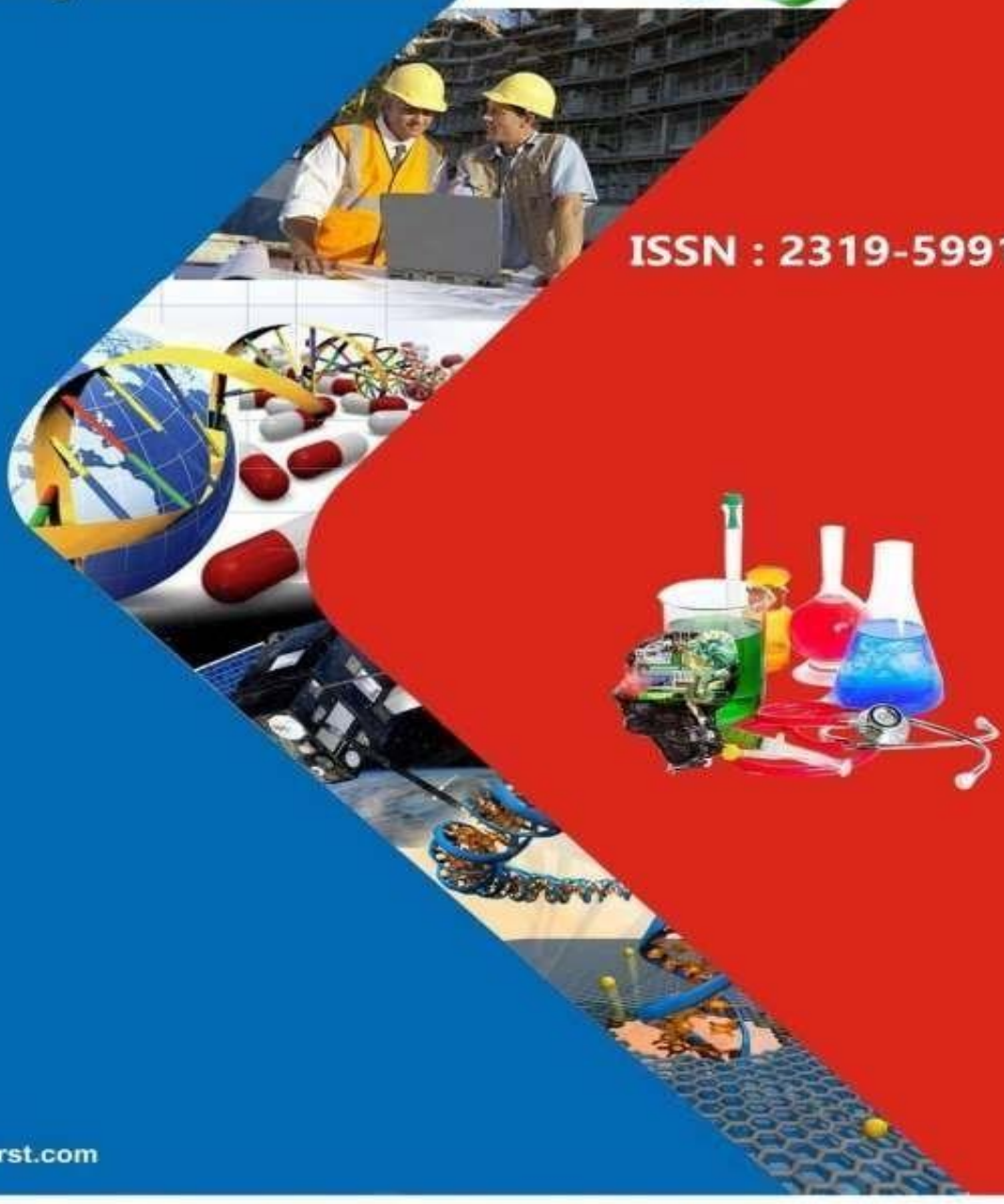

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SUICIDAL IDEATION DETECTION: USING MACHINE LEARNING METHODS AND APPLICATIONS

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ABSTRACT

A major problem in today's culture is suicide. In order to save lives, it is important to address the problem of early suicide attempt identification and prevention. Methods for detecting suicidal thoughts now range from clinical approaches centered on the engagement of social workers or specialists with the person in question to automated detection using machine learning techniques augmented with feature engineering or deep learning applied to social media information. To our knowledge, this is the first survey to address all of these strategies in such depth. The data sources used to identify domain-specific applications of suicidal ideation detection are examined in this research. The data sources include online user content, suicide notes, electronic health records, and surveys. We provide and summarize a number of particular projects and datasets to help with future study. Last but not least, we provide a summary of the present work's shortcomings and a prognosis on future research prospects.

1.INTRODUCTION

Anxiety and depression are major societal concerns in the contemporary era, and they manifest to a disproportionate degree in both industrialized and developing economies. Suicidal thoughts or even suicide attempts may develop in people with severe mental problems who do not get good therapy. Problematic phenomena like cyberspeak and cyberbullying may arise from postings that include a great deal of negative material.

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The use of such inaccurate information is often associated with social cruelty, which may cause rumors or even psychological harm, and the resulting consequences can be serious and even dangerous. Suicide is associated with cyberbullying, according to the research [1]. When people are constantly bombarded with bad news, it may lead to depression, hopelessness, and even suicide for some. People commit suicide for a variety of complex causes. Although suicide is more common among depressed people, many people do not suffer from sadness but nevertheless have thoughts of ending their lives [2]. Health, the environment, and history are the three main types of suicide risk factors identified by the American Foundation for Suicide Prevention (AFSP) [3]. According to Ferrari et al. [4], variables contributing to suicide include mental health difficulties and drug use disorders.

In their comprehensive study of the field, O'Connor and Nock [5] identified personality and individual variations, cognitive characteristics, social factors, and adverse life experiences as psychological hazards associated with suicide. Suicidal ideation detection (SID) uses a person's tabular data or written material to assess whether they have suicidal thoughts or ideas. More and more people are turning to online interactions as a result of developments in social media and the ability to remain anonymous when browsing the web. More and more, individuals are turning to online platforms to talk about their struggles, sentiments, and thoughts of suicide. This has led to the natural evolution of online channels into a monitoring tool for suicidal thoughts, and the mining of social material has the potential to enhance suicide prevention efforts [6].

Weird new social phenomena are cropping up, including virtual groups coming to a consensus on self-mutilation and copycat suicide. As an example, in 2016, there was a social media fad known as the "Blue Whale Game"1 that ultimately led to the death of its participants via the utilization of various chores, including self-harm. The yearly death toll from suicide is in the hundreds, making it a major societal problem. As a result, identifying suicidality and intervening to stop people from taking their own lives is crucial. One of the best methods to stop someone from trying to kill themselves is to catch them early and treat them. Potential victims who

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are contemplating suicide may act out their ideas in ways such as pretending to commit suicide, making preparations to commit suicide, or experiencing transient impulses. Using SID, we can identify potential dangers in people's plans or actions before they cause harm.

In their meta-analysis, McHugh et al. [7] shown the statistical limits of ideation as a screening tool while simultaneously noting that individuals' expression of suicidal ideation is a reflection of their psychological suffering. By identifying those who are contemplating suicide and opening a line of contact with them, social workers may help alleviate their mental health problems, early warning signs of suicidal thoughts can save lives. Many variables interact in intricate ways, and this complexity is what makes the causes for suicide so difficult to pin down [5, 8]. Numerous psychological and clinical investigations [9] and questionnaire classifications [10] have been performed by researchers in an effort to identify suicidal thoughts.

Machine learning and artificial intelligence (AI) can analyze people's social media data to determine the probability of suicide [11]. This might help us understand people's intentions and intervene early if needed. When it comes to social media content detection, the main areas of interest are feature engineering, sentiment analysis, and deep learning [12–18]. In order to learn rich representation, these approaches often use heuristics for feature selection or ANN architecture design.

A current line of inquiry is to build neural networks that can better recognize language associated with suicidal thoughts and to extract more relevant data from patients' medical records. The Black Dog Institute's I Bobbly [19], a mobile suicide intervention app, is one example of a study and use of mobile technology to the prevention of suicide.2 Woebot and Samaritans Radar3 are just two of many more suicide prevention technologies that have been built with social networking platforms in mind.4 Concerns over user privacy led to the removal of the former, a Twitter plugin. This later Facebook chatbot uses cognitive behavioral therapy and natural language processing (NLP) methods to alleviate people's anxiety and despair; it is designed to monitor postings that are considered disturbing.

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There are certain to be ethical and privacy considerations when using state-of-the-art AI technology for SID [20, 21]. The impact of prejudice on ML algorithms, suicide prediction, and the moral and legal concerns caused by erroneous positive and negative predictions are the three ethical concerns put forward by Linthicum et al. [22]. Since AI ethical challenges need algorithms to strike a balance between conflicting values, concerns, and interests, they are not easily answered [20]. Artificial intelligence has being used to address several complex societal issues.

If we are serious about making a difference in people's lives, we need to find ways to use artificial intelligence to identify when they are having suicide thoughts. Feature selection for tabular and text data, as well as representation learning for natural language, are among the study issues. Classifying suicide risks has been approached using a number of AI-based approaches. Having said that, there are still obstacles. In order to train and evaluate SID, there is a dearth of benchmarks. Models driven by AI can sometimes pick up on statistical cues but still can't decipher human intentions.

Furthermore, interpretability is a problem with many neural models. From the vantage point of artificial intelligence and machine learning, as well as particular domain applications with societal significance, this overview examines SID approaches. Figure 1 shows the classification from both of these angles. This article offers a thorough overview of SID using machine learning techniques, a rapidly growing area of study. A synopsis of ongoing research and a plan for future endeavors are presented.

What follows is an overview of the results of our survey.1) As far as we are aware, this study is the first of its kind to provide a thorough evaluation of SID, its techniques, and its machine learning applications. 2) We present and explore the traditional methods of content analysis as well as contemporary machine learning approaches, along with their use in survey data, electronic health record information, suicide notes, and social media posts. 3) We go over the constraints of both well-known and less-explored jobs.

Additionally, we provide a summary of current data sets and a look at where this area of study may go from here in the future. The following is the structured rest of the

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article. The second section provides an overview of the methods, while the third section summarizes them. Tasks and data sets are listed in Section IV. Section V concludes with a discussion and some suggestions for the future.

2.LITERATURE SURVEY

Title: Machine Learning and Ensemble Methods for the Identification of Suicidal Thoughts on Twitter

Authors: Syed Tanzeel Rabani, Qamar Rayees Khan and Akib Mohi Ud Din Khanday

The literature survey for the project addresses the severe global issue of suicidal ideation, emphasizing the importance of early detection and prevention. It explores common risk factors like depression and social isolation, highlighting the role of social media platforms in providing a space for expression. The methodology involves collecting and annotating data from Twitter, followed by machine learning techniques to distinguish between Suicidal and Non-Suicidal tweets. Experimental results demonstrate the feasibility of this approach, though limitations exist in predicting genuine suicidality. Ethical considerations are discussed regarding direct intervention with individuals showing suicidal behavior. Overall, the study contributes to understanding distress-related expressions on social media and suggests avenues for future research.

Title: The potential of developing a standard dataset for studies on the identification of suicide risk via the use of artificial intelligence

Authors: Mahboobeh Parsapoor , Jacob W. and Anthony C.

The literature survey focuses on the development of suicide risk screening tools, emphasizing the need for interdisciplinary research and the incorporation of influential suicide theories. It explores the role of artificial intelligence (AI), particularly text-based systems, in revolutionizing suicide risk detection. However, it highlights the limited integration of suicide theories into existing AI-driven systems. In response, the survey suggests a new method based on language and speech-based systems, and it calls for the creation of a standard dataset and study designs that distinguish between variables that increase the likelihood of suicidal thoughts and those that increase the

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likelihood of suicide attempts. The end goal is to create reliable suicide risk detection systems using machine learning or deep learning. This will pave the way for more effective methods of suicide prevention that rely on speech or text.

Title: Using Reddit to Identify Suicidal Thoughts: An Analysis of Machine Learning and NLP Methods

Authors: Lee Kien Foo, Eldar Yeskuatov, and Sook-Ling Chua

This research review delves into the topic of using machine learning and natural language processing methods to identify instances of suicide thoughts on the Reddit community. Early identification of suicidal ideation is critical for suicide prevention, since suicide is a major global public health problem. When researchers encounter problems with traditional screening techniques, they typically go to Reddit and other social media sites where people talk about their problems. Data collecting, annotation, preprocessing, model construction, and assessment methodologies are detailed in the most current research reviewed, which cover the years 2018–2022. Presented below are a number of datasets that were sourced from Reddit and used to build detection models. At its end, the study delves into the present state of suicidal ideation detection, touching on its limits and offering suggestions for further research.

3. EXISTING SYSTEM

Add In the existing work, the system is Traditional suicide detection which relies on clinical methods, including self-reports and face-to-face interviews. This system is analyzed word frequencies in suicide notes using a fuzzy cognitive map to discern causality which is less effective.

3.1 PROPOSED SYSTEM

The proposed system introduces and discusses the classical content analysis and modern machine learning techniques, plus their application to questionnaires, HER data, suicide notes, and online social content. The proposed system enumerates existing and less explored tasks and discusses their limitations. We also summarize existing data sets and provide an outlook of future research directions in this field.

4. OUTPUT SCREENS

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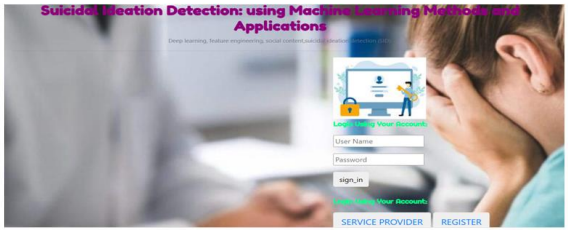
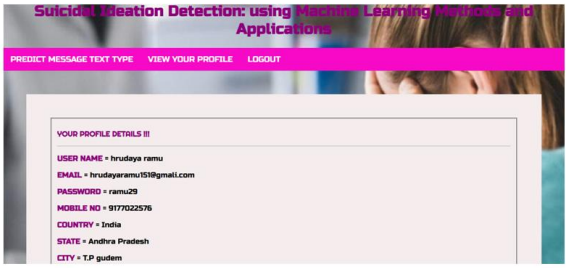
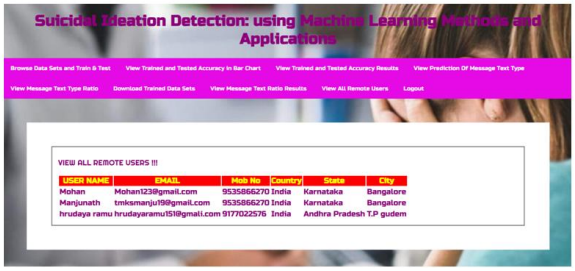
Home page: Detect suicidal ideation using advanced machine learning methods and applications - our platform is dedicated to leveraging technology for mental health awareness and intervention.



View profile page: The view profile page presents personalized assessment results and provides access to tailored resources and support for individuals grappling with suicidal ideation.



View Remote Users: The "View Remote Users" page provides real-time insights and risk assessments to swiftly identify and support individuals showing signs of suicidal ideation in the Suicidal Ideation Detection application**.**



Browse Data Sets And Train&Test: The "Browse Data Sets" page offers exploration of diverse datasets relevant to suicidal ideation detection.

View Trained And Tested Accuracy Result: In the "View Trained And Tested Accuracy" section of the Bar Chart page, the effectiveness of different machine learning methods in detecting suicidal ideation is visually displayed, offering insights into their respective accuracy scores for informed decision-making.

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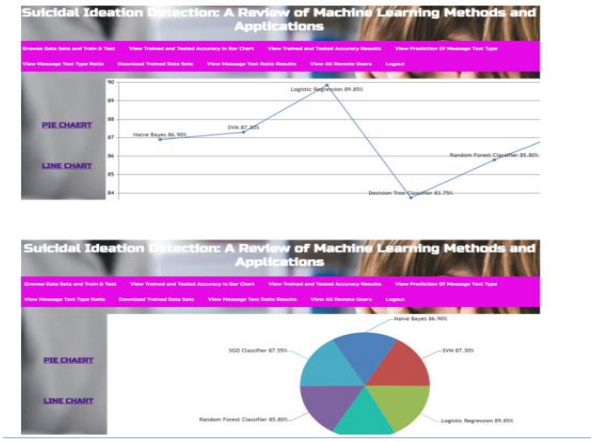

Output: The View output page of the Suicidal Ideation Detection project provides a comprehensive display of predictions, confidence scores, and feature importance, aiding users in understanding and interpreting the model's assessments efficiently.

5. CONCLUSION

In today's world, preventing suicide is still a top priority. A crucial and efficient method of preventing suicide is the early identification of suicidal thoughts. Clinical methods, such as patient-clinician interaction and medical signal sensing, are covered in this survey of existing methods for SID. On the other hand, textual content analysis, including lexicon-based filtering and word cloud visualization, feature engineering, including tabular, textual, and affective features, and deep learning-based representation learning, including CNN and LSTM-based text encoders, are also covered. We present four primary domain-specific applications on electronic health records (EHRs), online user content, suicide notes, and surveys. The majority of the research in this area has been carried out by psychologists using statistical analysis, while computer scientists have used deep learning for representation learning and feature engineering for machine learning. We summed up current duties and suggested new ones based on the latest research. Finally, we go over some of the shortcomings of the existing literature and suggest a number of ways forward, such as making use of new learning methods, recognizing intentions in a way that is interpretable, detecting temporal patterns, and actively intervening in conversations. Sooner rather than later, SID will mostly disseminate via online social material. With the goal of preventing suicide, it is crucial to find ways to identify online

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messages that include suicidal thoughts. This requires innovative approaches that can bridge the gap between clinical mental health diagnosis and automated machine detection.

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