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2018

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Alambo, A., Gaur, M., Kursuncu, U., Thirunarayan, K., Schumm, J., Pathak, J., & Sheth, A. P. (2018). Personalized Prediction of Suicide Risk for Web-based Intervention. . https://corescholar.libraries.wright.edu/knoesis/1156

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Personalized Prediction of Suicide Risk for Web-based Intervention

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Motivation and Objective

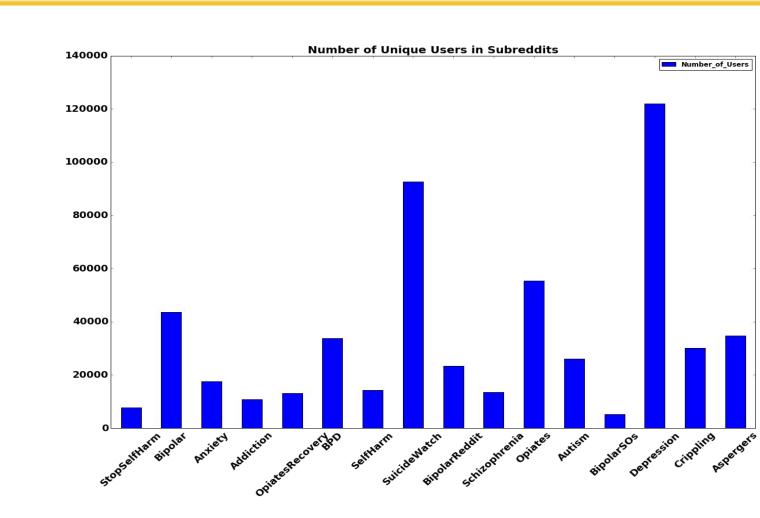
- According to SAMHSA, 80% of patients diagnosed with Borderline Personality Disorder report a history of suicide attempts, with deaths ranging between 8-10%.
- Similar trend noticed in patient population suffering from depression, schizophrenia, and other mental health conditions.
- Transition from a mental health condition to suicide is slow. Suicide is a major public health concern and second leading cause of death in US for people aged 15-34.
- "Social Stigma" associated with mental health issues and suicide deter patients from sharing their experiences with others. Social media provides free and open forum for voluntary expression that can be analyzed to obtain insights into suicide ideation and self-destructive behavior.
- Reddit is a widely used and highly relevant social-media platform where users share their experiences on specific subreddits. The privacy, convenience, and freedom to share, without fear of social ostracization, have lead to eight-fold growth in users from 2008 to 2017.
- We employ a suicide severity questionnaire called Columbia Suicide Severity Rating Scale (C-SSRS). We propose to adapt C-SSRS for social media to help prevent suicide and improve resiliency.
- Our study develops a framework for the prediction of suicidal risk from social media content by conducting a user-level analysis supervised by C-SSRS and using medical knowledge bases, and obtain actionable insights for intervention.
- Our approach extracts linguistic, temporal, homophily-based, metaphorical, and intent-based information from the dialogues of 93K users interacting on r/SuicideWatch and other related subreddits to characterize users' vulnerability to suicide.
- Conventional healthcare system where a patient reports to a clinician of their depressive or suicidal symptoms can be augmented with content available on social media for early web-based intervention.

Contributions

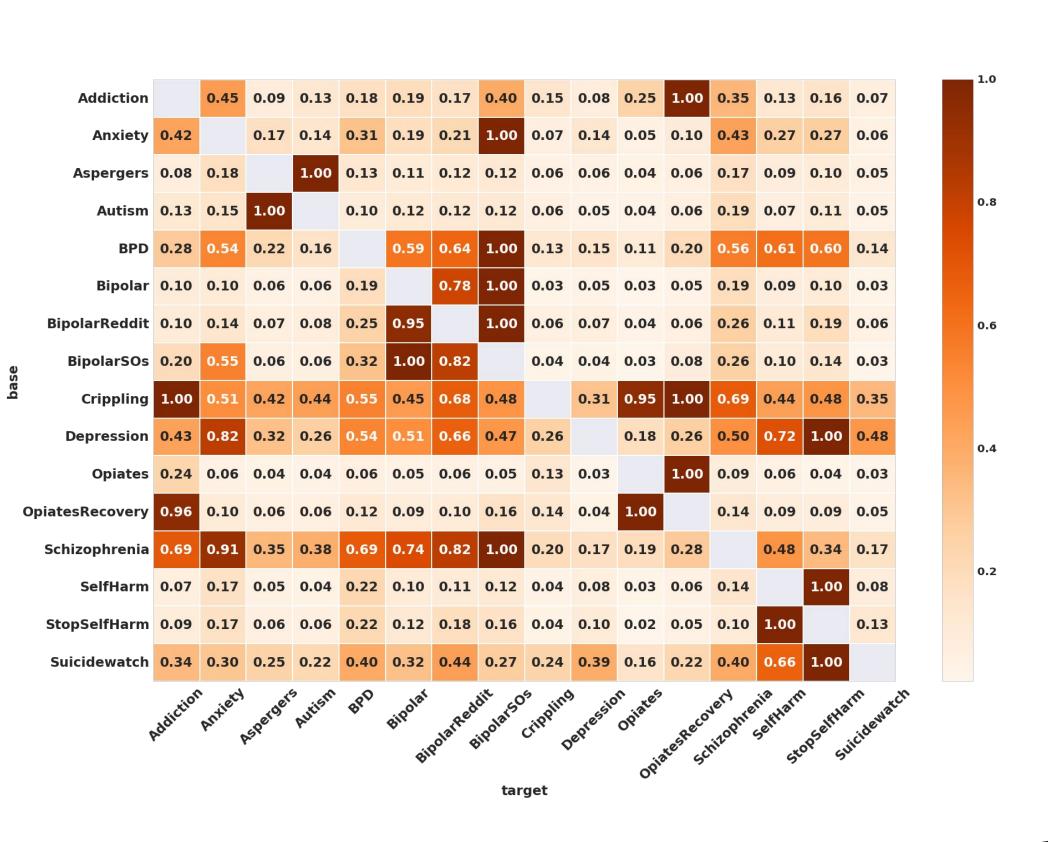
- Creation of Dataset of 2181 users who potentially show suicidal tendencies on Reddit.
- Extraction of 500 users from this cohort and annotation of content following the guidelines of C-SSRS. We assess the suicidal dynamics for randomly selected 10 users.
- Development of a comprehensive lexicon of suicide-related symptoms using C-SSRS categories as labels with help from domain experts.
- Development of an extractive summarization module for generating semantic summaries of textual content ranked by relevance to C-SSRS.
- Development of a question answering module that utilizes the summaries of a user and questions from C-SSRS to fill the questionnaire.

Exploratory Data Analysis



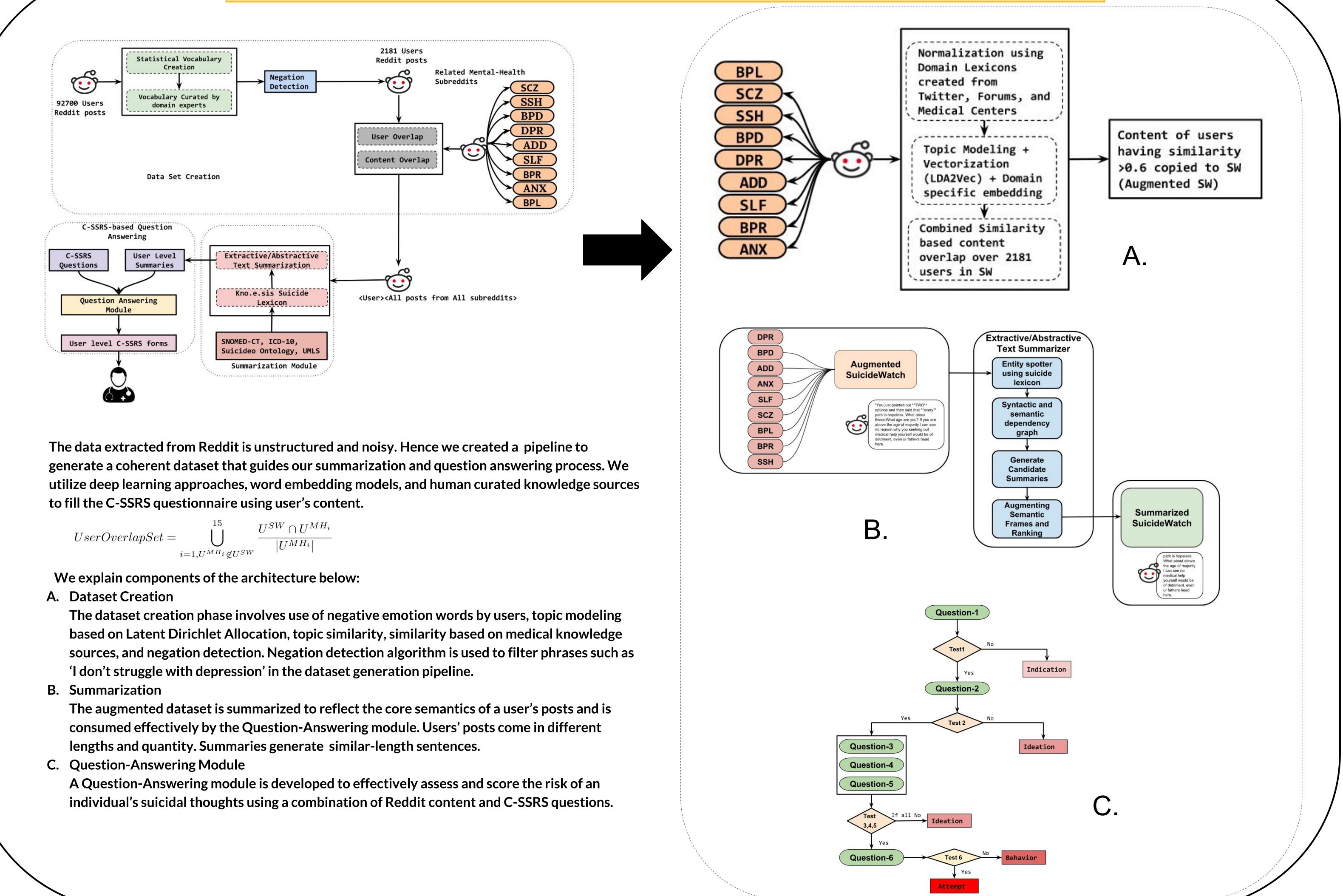


- Sample users' posts defining suicide indication, suicide ideation, suicidal behavior or suicide attempt on social media. We observed higher proportion of terms like hopelessness, sorrow, sadness, loneliness, commit suicide, gun, kill, death, trans (referring to transgender), and therapy in the content. Such terms helped us in identify at risk candidates. Some of the celebrity profiles associated with these keywords were: Robin Williams, Kate Spade, and Freddy E.
- The data obtained from Reddit comprises of posts from 550,000 users across 16 mental health subreddits. A subreddit is like a forum within Reddit that involves conversation on topics that are related to the title of the subreddit. For example, Addiction subreddit contains posts from users who are likely addicted to alcohol, drugs, or have joined Alcohol Anonymous for recovery and tend to share their experiences and opinions
- to support other users. Our dataset comprises of posts from 2002 to 2015.
 Comorbidity in users suffering from mental health disorders is common.
 So, we have analysed users participating in multiple subreddits to study suicidal thought progression for precise risk assessment.
- The heatmap is read as follows:
- Subreddit 'CripplingAlcoholism' referred to as 'Crippling' has a score of '1.00' against subreddits 'Addiction' and '0.95' against 'Opiates' implying that users in 'Crippling' overlap more with 'Addiction' than with the users in 'Opiates'.

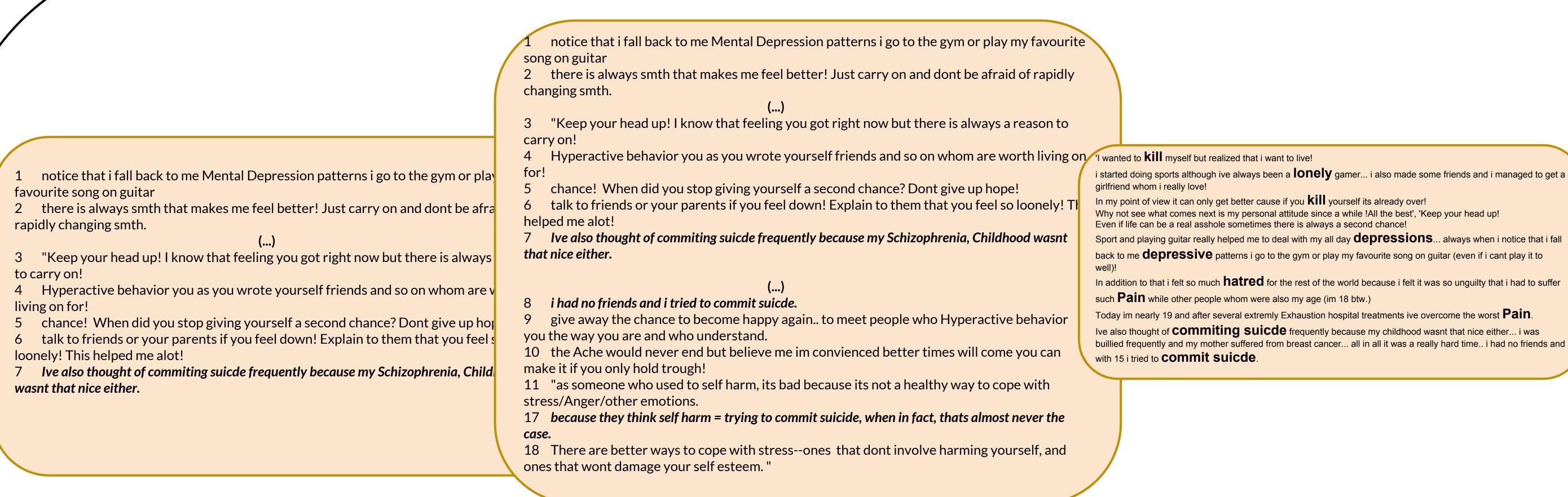


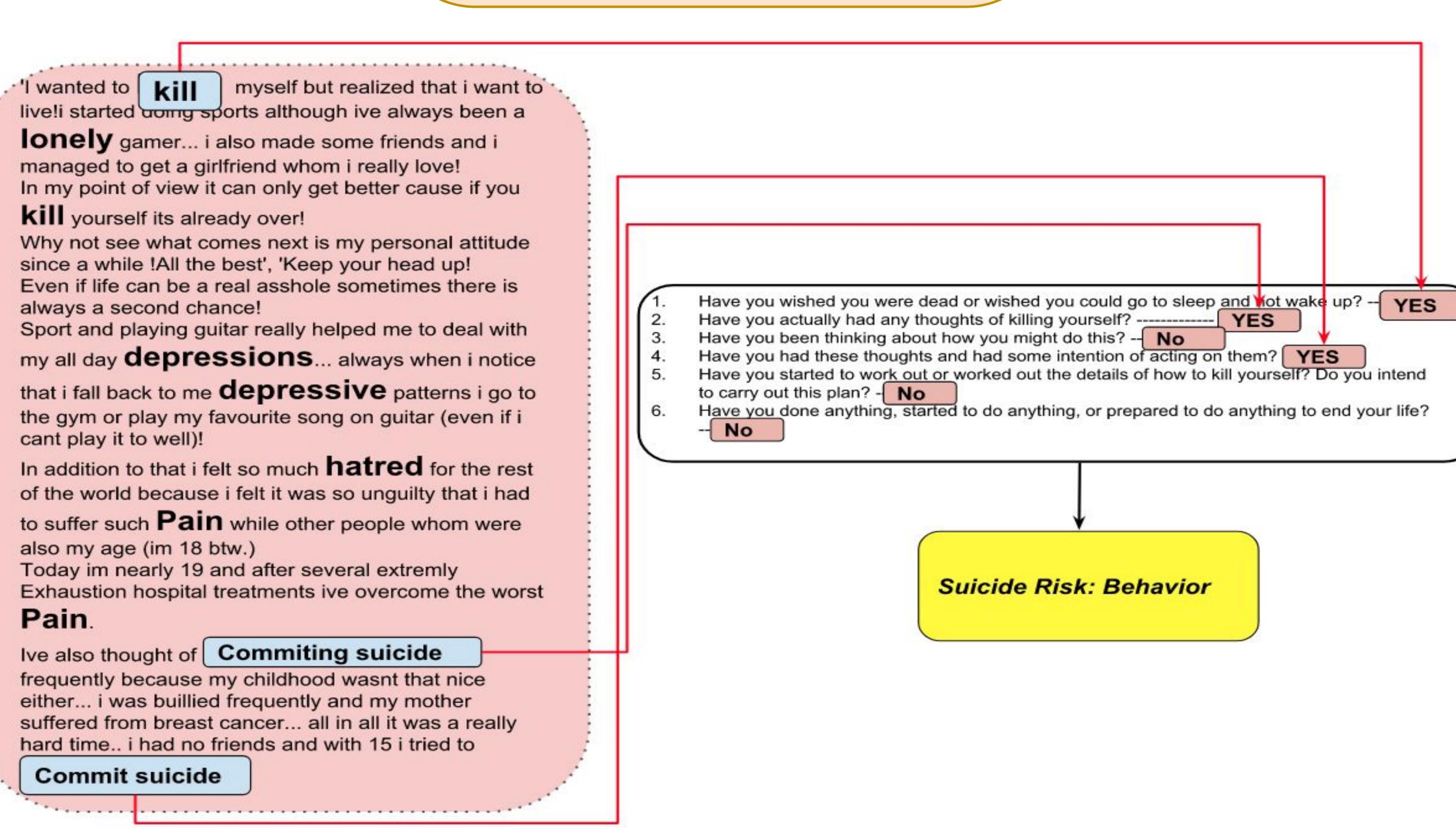
- The content of 500 randomly selected users posting in suicidewatch and other related mental-health subreddits were evaluated for suicide risk against the C-SSRS scale. Results show 9% of these users have had suicide attempts.
- A time-series sentiment analysis of a user's post is shown that illustrates the different stages of suicide risk over a period of 10 years before attempting suicide.
 Several users post to mental-health subreddits and 'SuicideWatch' subreddit giving insight into comorbidity. For instance, users in subreddits 'StonSelfHarm' and 'SelfHarm' more
- Several users post to mental-health subreddits and 'SuicideWatch' subreddit giving insight into comorbidity. For instance, users in subreddits 'StopSelfHarm' and 'SelfHarm' more actively engage in subreddit 'suicidewatch' as compared to other subreddits.
- Different mental-health subreddits have varying degree of user content overlap with subreddit 'SuicideWatch'. Content overlap is determined by considering topical similarity. Superimposed bars represent subreddits with larger content overlap with subreddit 'SuicideWatch'. For example, subreddits 'BPD' and 'Schizophrenia' score high on content overlap.

Architecture and Approach



Preliminary Outcome





Conclusion and Future Work

- In our current study, we have utilized state-of-the-art deep learning, and word embedding techniques supported by medical knowledge bases and a lexicon to automate C-SSRS fill-up in real-time.
- We have generated C-SSRS scores for users to be evaluated by Psychiatrists. This can lead to gold standard dataset adapting C-SSRS for social media content.
- In future, we plan to evaluate our approach using ROUGE metric and expand our user cohort.

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