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DETECTING MENTAL DISORDERS IN SOCIAL MEDIA THROUGH EMOTIONAL PATTERNS

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ABSTRACT

Millions of people around the world are affected by one or more mental disorders that interfere in their thinking and behavior. A timely detection of these issues is challenging but crucial, since it could open the possibility to offer help to people before the illness gets worse. One alternative to accomplish this is to monitor how people express themselves, that is for example what and how they write, or even a step further, what emotions they express in their social media communications. In this study, we analyze two computational representations that aim to model the presence and changes of the emotions expressed by social media users. In our evaluation we use two recent public data sets for two important mental disorders: Depression and Anorexia. The obtained results suggest that the presence and variability of emotions, captured by the proposed representations, allow to highlight important information about social media users suffering from depression or anorexia. Furthermore, the fusion of both representations can boost the performance, equaling the best reported approach for depression and barely behind the top performer for anorexia by only 1%. Moreover, these representations open the possibility to add some interpretability to the results.

INTRODUCTION:

A mental disorder causes different interferences in the thinking and behavior of the affected person [1]. These interferences could vary from mild to severe, and could result in an inability to live routines in daily life and ordinary demands [2]. Common mental disorders such as depression and anorexia affect millions of people around the world. They may be related to a single incident causing excessive stress on the person or by a series of different stressful events. It is also well known that mental disorders tend to increase in countries experiencing generalized violence or recurrent natural disasters. For example, in 2018 a study of

mental disorders in Mexicorevealed that 17% of its population has at least one mental disorder and one in four will suffer a mental disorder at least once in their life [3]. In another vein, in the modern world, we take for granted that social life could be experienced either in the physical world or in a virtual world created by social media platforms like Facebook, Twitter, Reddit, or similar platforms. This reality presents some challenges, but also great opportunities which, if properly addressed, could contribute to the understanding of *what* and *how* we communicate. In this regard, the goal of this study is to analyze, via the automatic identification of emotional patterns, social media documents [1] with the purpose of detecting the presence of signs of depression or anorexia in the population of that area [4]–[6]. Previous works have addressed the analysis of emotions of social media users by paying attention to their contrast and tone. They have mainly applied this analysis to predict users' age and gender as well as a range of sensitive personal attributes including sexual orientation, religion, political orientation [7], [8], income [9], and personality traits [10], [11]. According to these studies, the analysis of emotions in social media allows capturing important information related to users. This information presents an opportunity for us to extend the use of emotions in the detection of depression and anorexia in social media. Former studies focused on the detection of depression and anorexia have mainly considered linguistic and sentiment analysis [12]–[14]. Note that the use of sentiments, i.e. polarity, was the preamble for the later use of emotions for the same task [15]. This line of thought exposed the potential of using emotions as features, such as "anger", "surprise" or "joy", instead of linguistic features or general sentiments like positive and negative.

LITERATURE REVIEW

[1] **"Detecting depression and mental illness on social media: an integrative review,"**

Although rates of diagnosing mental illness have improved over the past few decades, many cases remain undetected. Symptoms associated with mental illness are observable on Twitter, Facebook, and web forums, and automated methods are increasingly able to detect depression and other mental illnesses. In this paper, recent studies that aimed to predict mental illness

using social media are reviewed. Mentally ill users have been identified using screening surveys, their public sharing of a diagnosis on Twitter, or by their membership in an online forum, and they were distinguishable from control users by patterns in their language and online activity. Automated detection methods may help to identify depressed or otherwise at-risk individuals through the large-scale passive monitoring of social media, and in the future may complement existing screening procedures.

The widespread use of social media may provide opportunities to help reduce undiagnosed mental illness. A growing number of studies examine mental health within social media contexts, linking social media use and behavioral patterns with stress, anxiety, depression, suicidality, and other mental illnesses. The greatest number of studies of this kind focus on depression. Depression continues to be under-diagnosed, with roughly half the cases detected by primary care physicians [1] and only 13–49% receiving minimally adequate treatment [2].

"Suicide note classification using natural language processing: A content analysislin heidelberg,"

Millions of people around the world are affected by one or more mental disorders that interfere in their thinking and behavior. A timely detection of these issues is challenging but crucial, since it could open the possibility to offer help to people before the illness gets worse. One alternative to accomplish this is to monitor how people express themselves, that is for example what and how they write, or even a step further, what emotions they express in their social media communications. In this article, we analyze two computational representations that aim to model the presence and changes of the emotions expressed by social media users. In our evaluation we use two recent public data sets for two important mental disorders: Depression and Anorexia. The obtained results suggest that the presence and variability of emotions, captured by the proposed representations, allow to highlight important information about social media users suffering from depression or anorexia. Furthermore, the fusion of both representations can boost the performance, equalling the best reported approach for depression and barely behind the top performer for anorexia by only 1 percent. Moreover, these representations open the

possibility to add some interpretability to the results.

[2] **"Understanding client support strategies to improve clinical outcomes in an online mental health intervention,"**

Online mental health interventions are increasingly important in providing access to, and supporting the effectiveness of, mental health treatment. While these technologies are effective, user attrition and early disengagement are key challenges. Evidence suggests that integrating a human supporter into such services mitigates these challenges, however, it remains under-studied how supporter involvement benefits client outcomes, and how to maximize such effects. We present our analysis of 234,735 supporter messages to discover how different support strategies correlate with clinical outcomes. We describe our machine learning methods for: (i) clustering supporters based on client outcomes; (ii) extracting and analyzing linguistic features from supporter messages; and (iii) identifying context-specific patterns of support. Our findings indicate that concrete, positive and supportive feedback from supporters that reference social behaviors are strongly associated with better outcomes; and show how their importance varies dependent on different client situations. We discuss design implications for personalized support and supporter interfaces. Mental illness is increasing in occurrence [39]. It presents the largest cause of disability worldwide and is the strongest predictor of suicide [64, 99]. This makes the prevention and treatment of mental health disorders a public health priority and has led to explorations of how the field of HCI, and the development of technology more broadly, can support access to, and increase the effectiveness of, mental health treatment [8, 76, 95, 86]. Over the last decade, this has brought forward developments of mobile apps [19, 29, 55], and computerized psycho-educational and psycho-therapeutic interventions [5, 17, 81, 103], or chat-based [27, 48, 88] programs to complement, and expand access to, psychotherapy. Most existing digital mental health services are based on Cognitive Behavioral Therapy (CBT); the most widely applied and most extensively empirically tested psychotherapy in Western Healthcare

[11]. CBT is solution-focused, teaches the person to attend to the relationships between their thoughts, feelings and behaviors, and is frequently used in treating depression, anxiety or post-traumatic stress. Its highly structured format makes it well suited for support by digital technology [18]. Further, extensive research has evidenced the clinical effectiveness of internet-delivered CBT (iCBT) with sustainable results comparable to face-to-face therapy [4, 5, 100, 103]. Despite these benefits, a key challenge for digital behavioral interventions like iCBT is sustaining the users' engagement with treatment [26, 43], where early disengagement and dropout from the therapy program can mean users may not get the desired benefits

EXISTING SYSTEM

Depression is a mental health disorder characterized by persistent loss of interest in activities, which can cause significant difficulties in everyday life [1], [17]. Studies focusing on the automatic detection of this disorder have used crowdsourcing as their main strategy to collect data from users who expressly have reported being diagnosed with clinical depression [18], [19]. Among these studies, the most popular approach considers words and word n-grams as features and employs traditional classification algorithms [13], [20], [21]. The main idea is to capture the most frequent words used by individuals suffering from depression and compare them against the most frequent words used by healthy users. This approach suffers because there is usually a high overlap in the vocabulary of users with and without depression.

Another group of works used a LIWC-based representation [22], aiming to represent users' posts by a set of psychologically meaningful categories like social relationships, thinking styles, or individual differences [18], [23]. These works have allowed a better

characterization of the mental disorder conditions, nevertheless, they have only obtained moderately better results than using only the words. Recent works have considered ensemble approaches, which combine word and LIWC based representations with deep neural models such as LSTM and CNN networks [24], [25]. For example, in [25], [26], the combination of these models with features like the frequencies of words, user-level linguistic metadata, and neural word embeddings offered the best-reported result in the eRisk- 2018 shared task on depression detection [27].

These works show that in social media texts exist useful information to determine if a person suffers from depression, but the results are sometimes hard to interpret. This is an important limitation since these types of tools are naturally aimed to support health professionals and not to take the final decisions. In [28] [29], the authors conduct studies to tackle this problem. They characterize users affected by mental disorders and provide methods for visualizing the data in order to provide useful insights to psychologists.

Disadvantages

1) The system doesn't implement Converting text to sub-emotions sequences techniques.

2) The system doesn't implement emotion based detection of mental disorders.

PROPOSED SYSTEM

The proposed static and dynamic representations, named as BoSE and _-BoSE respectively, are inspired in two hypotheses. The first one is that words assigned to coarse emotions in lexicons cannot capture subtle emotional differences, which in fact

are what provide the most important insights into the mental health condition of users. For example, the lexicon associated with the anger emotion includes words such as furious, angry and upset that represent different degrees of anger, however, they are tagged with the same emotion. Thus, our proposal is to represent each user by a histogram of sub emotions, which are discovered by clustering the embeddings

of words inside coarse emotions. The second hypothesis is that people with depression and anorexia tend to expose greater emotional variability than a healthy person. In this case, the idea is to represent each user by a set of statistical values that describe the frequency changes of the sub-emotions over time.

Advantages

1) The system further explores the BoSE representation and proposes a new representation based on sub-emotions that allow capturing the emotional variability of social media users over time.

2) The system proposes an approach to combine both static and dynamic representations using early and late fusion strategies to improve the detection of depression.

3) The system extends the use of these representations based on fine grained emotions for the task of anorexia detection and contrast the discovered emotional patterns with those obtained from the task of depression detection.

ALGORITHMS

SUPPORT VECTOR MACHINE?

The objective of the support vector machine algorithm is to find a hyperplane in an N-dimensional space(N — the number of features) that distinctly classifies the data points.

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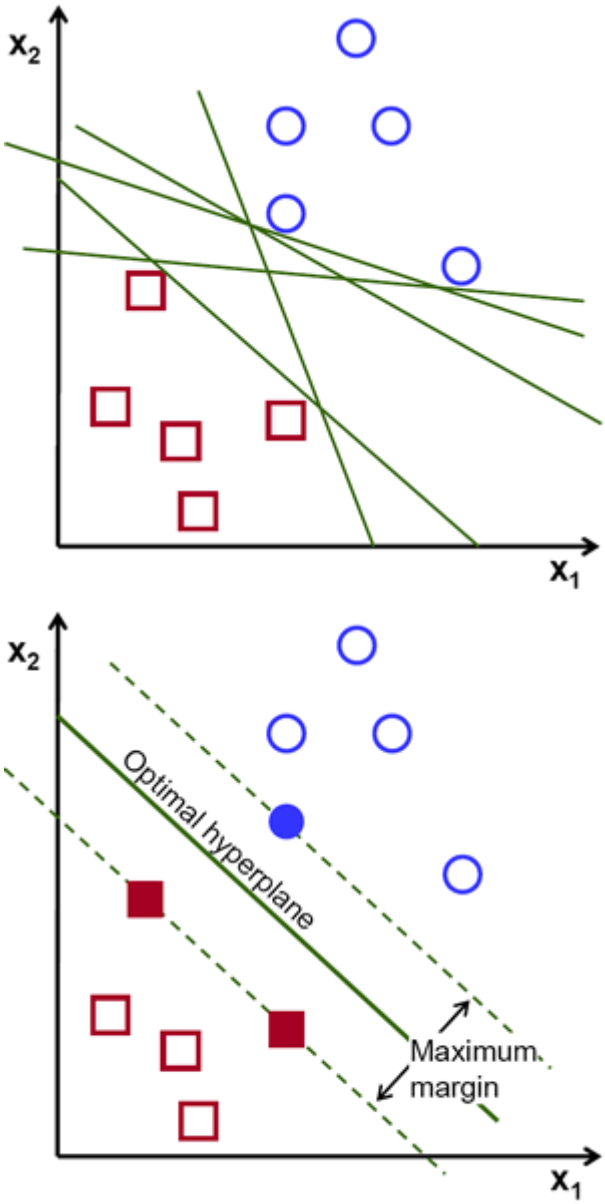

RANDOM FOREST ALGORITHM

Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in ML. It is based on the concept of **ensemble learning,** which is a process of *combining multiple classifiers to solve a complex problem and to improve the performance of the model.*

As the name suggests, ***"Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset."*** Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output.

CONCLUSIONS

In this work, we showed that representations based on fine grained emotions can capture more specific topics and issues that are expressed in social media documents by users that unfortunately experience depression or anorexia. That is, the automatically extracted sub-emotions present useful information that helps the detection of these two mental disorders. On the one hand, the BOSE representation obtained better results than the proposed baselines, including some deep learning approaches, and also improved the results of only using broad emotions as features. On the other hand, the inclusion of a dynamic analysis over the sub emotions, called _-BOSE, improved the

detection of users that presents signs of anorexia and depression, showing the usefulness of considering the changes of sub-emotions over time. It is worth mentioning the simplicity and interpretability of both representations, then creating a more straightforward analysis of the results. Finally, the capability to model the emotional behavior of users using their social media data presents an opportunity for future wellness facilitating technologies. This kind of technology can serve as warning systems that provide wide-area analysis and information related to a mental disorder respecting user privacy. This information could include the presence of mental disorders in certain areas, and the authorities could decide to create professional assistance or emotional support, that the users will decide whether to take or not. We believe that it is important to mention when we analyze social media content, we may have concerns regarding individual privacy or certain ethical considerations. These concerns appear due to the usage of information that could be sensitive, given the personal behavior and emotional health of the users. The experiments and usage of this data are for research and analysis only, and the misuse or mishandling of the information is prohibited.

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