Psychological Stress Detection using Ontologies with Analysis of Social Media

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Abstract- *The technological advancement and significant rise in the usage of social media has resulted in major psychological health problems such as stress, anxiety etc. These challenges can be analyzed and pre vention strategies can be formulated. To overcome these severe problems, the urgent need is to monitor the microblogs in social media as it is irrepressible by humans due to their strong desire towards SMEs (Social Media Environments). Traditional methods such as questionnaires and interviews were conducted by psychologists but these processes are time-consuming and hysteretic. In this paper we have surveyed various stress detection strategies and found to be ineffective to detect stress from social media. In this paper we proposed an Effective Stress Detection Framework (ESDF) to utilize the hybrid ontology for stress detection among individuals and taking necessary precautions to prevent the users from committing suicide. Hybrid ontology is the keyword matching search process used in social media to identify the stress-related messages sharedamong individuals with improved accuracy.*

Keywords- SME, OBIE, Probabilistic models, SNS, Ontologies.

I. INTRODUCTION

Stress among individuals is growing rapidly because of the trend among individuals towards social media. Stress is chronic which results in diseases such as mental health disorders resulting in anxiety [1]. Anxiety among individuals even results in suicide [2]. Psychological stress is becoming a major threat among individuals because of their social interaction with people mostly friends on similar social platforms. "Blue Whale Challenge" is an online suicide game aiming to destroy the lives of numerous people mostly children across the globe. A professor named Alexandra arkhipova, at the russian state University, when their team has entered the online groups they have found a strange thing that all of the curators are the children's of ages between 12 to 14 [3].This scenario is the outcome of technological advancement and addiction to social media. The microblogging is used pervasively. The users share their feelings in the form of text, images and videos [4].

The survey done by the organization New business reported that across the globe there is a significant rise in stress due to excessive usage of various technologies [5][6].

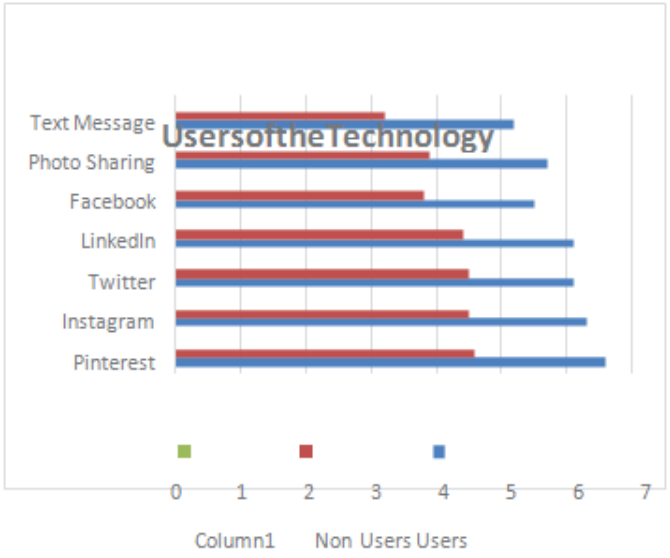

Figure 1: Depicts the usage of Social media by Users and Non Users

People using technology are well aware of events that are stressful in the lives of others, among them the pinterest users were on top in knowing the major stressful events in the lives of other individuals [6]. Traditional methods of stress detection conducted by psychologists are Interviews, questionnaires, etc., but these are time - consuming and hysteretic as these methods are dependent on answers given by people. Individuals may be feeling nervous and accurate results cannot be expected [33]. Another disadvantage is that the traditional methods require additional hardware thereby increasing cost [34]. Therefore it is the need of an hour to come up with advanced automated stress detection methods that are helpful for stress detection and ultimately develop the welfare of the society [7].

The awareness of an individual's stress state plays a vital role in the development of affective states which results in the form of enriched life of individuals [8]. The different emotions of people are analyzed including their mood, personality and sentiments. This information can be utilized for the well-being of people's life [8].

The user's stress state can also be identified by deep learning which is a branch of machine learning. The daily and weekly tweets posted by the users are analyzed and the social network websites can be analyzed to view how long the users are active and the details about the social interactions can be viewed. [9]

Ontologies are the branch of metaphysics which deals with the concepts of being. It is a description of knowledge with concepts within the domain and the relationships between them. The domain contains entities, attributes, rules, relationships and axioms [10].

The psychological state of the users can be analyzed using physiological computing as it employs the psychophysiology of the users [27]. The development of smart-technology can be achieved by innovating human- computer interaction and extending the communication bandwidth [27]. The stress detection based on physiological sensors is beneficial for research community to exp lore the technological transformation and its affect to users. The new applications are merged by the naïve users for the stress detection. The psychologist has considered emotions and physiology related to each other. Through heart rate, electrodermal movement, Heartrate Variability (HRV), Electromyogram (EMG), Pupil Diameter (PD) and Galvanic Skin Response (GSR) the stress can be detected. Other traditional methodologies include EEG Signals where the stress is reduced by involvement in the system.

Physiological signals are also used for mental stress detection where the process is hysteretic as the three signals such as Electrocardiogram (ECG), soft computing techniques helps in the analysis of pupil diameter and photoplethysmogram. The social website where the users share their social media for interactions are analyzed and the stress states of the users are detected, how long the users are active on the social website are recorded [28].The stress state is classified and the most improved features are selected using the Genetic Algorithms (GA) and loaded into Fuzzy Support Vector Machine [6].

The deep learning machine learning approach is used for analyzing the stress [28]. The strategy is that the single tweets and weekly tweets posted by the user is taken into consideration for analyzing the stress [28].

Sentiment analysis is a technique that helps identify people's attitudes, opinions, emotions and sentiments towards any specific person, organization, product, and services etc. [29][30]. Sarcas m is a sentimental word that is opposite in meaning to what is said, such as (irritation, insult, humor, etc.) that is mostly used between users of social media such as facebook, Whatsapp, twitter, etc. It is a new trend of posting sarcastic messages between peoples and organizations to avoid direct negativity. It's a challenge to detect sarcasm present in the text posted on social media using sentiment analysis. Sarcasm present in the texts posted on social media is detected using a supervised technique [29].

Severe physical and psychological health problems are the outcomes of stress. Previous stress detection methods include personal interviews, questionnaires, physiological signals, etc. Most of the traditional stress detection methodologies rely on a personal intervention that is time-consuming and employs labor and hysteretic. Due to technological advancement and globalization, the stakeholders are addicted to social networks for quick information about business deals. Messages are posted on microblogs that are shared among individuals spread across the globe. Necessity is the mother of invention. It is the need of the hour to come up with automated techniques of stress detection and reduction[33] [7].

SDF (Stress Detection Framework) is an ontology-based stress detection and prediction strategy proposed to analyze stress in microblogs. Stress detection framework is integrated with ontologies together with probabilistic models i.e. GSHL and tree alignment algorithms, set of knowledge-based predefined logical rules containing (text and linguistic words), visual features containing (images and emoticons) and social interactions among people with their preferences(similar and dissimilar). This strategy outperformed tensistrength with 94.2% of stress detection rate with enhanced features such as predefined logical rules comprising of linguistic stress lexicon words, emoji's and social interactions [13] and improved accuracy using hybrid ontologies [32][11].

Deep learning neural networks can also be used to explore the user's stress category where a single tweet and weekly tweets posted by the users are incorporated

[28]. These are analyzed from the social website created to identify the stress state and how long the user is active on the website sharing the social interactions [28].

In the proposed ESDs (Effective Stress Detection System), a database is used for storing information and ontology is used for extracting the stress words from the database [7]. The framework can be integrated for various instant messengers (Skype, GTalk, MSN, Yahoo, WhatsApp, etc.) and Social networking sites such as (Facebook, Instagram, Twitter, etc.)

II. LITERATURESURVEY

In this paper, we surveyed various techniques that were proposed earlier for the detection of stress using various methodologies namely psychological questionnaire-based interviews, electrodermal activity, electrocardiograph, predicting personality from twitter, sentiment Analysis, stress detection from cross-media microblog data, machine learning techniques, ANN and soft computing techniques.

Table 1: Depicts the various techniques of Stress Identification and Detection

S. NO.	Title	Objective	Strategy	Remarks
1	Psychological questionnaire -based Interviews to identify stress [12].	The main objective is to identify chronic stress	The strategy is through Continuous session	It requires user involvement
2	Identify stress using electrodermal activity [13]	The main objective is to identify acute stress	By conducting lab experiments and physiologi cal sensors	Time- consuming and requires labor
3	Predicting stress using electrocardio graph [14]	To identify acute stress	By conducting lab experiments and physiological sensors	Time- consuming and requires labor
4	Identify personality from twitter [15]	To identify the relation between stress and user personality	Feature extraction from text And utilizing personality test score and correlating using pearson correlation	Feature prediction is not efficient based on text and requires labor.
5	Sentiment strength detection [16]	Allocating strength to sentiments	Using sent strength Algorithm to exploit human- based classified sentiment strength	It's a manual process that requires labor.
	Detection of stress from cross-media microblog data [17]	To identify chronic stress	To utilize low level attributes to detect stress with the help of deep neural network	Psychological stress states changes over time.
7	Comparative study is of Psychological stress detection methods [18]	Very essential to detect stress before it becomes a health problem	Cross- media data, Social behavior, and social interaction	Requires additional hardware i.e. costly and requires labor
8	Detection of stress using Soft computing techniques [19]	The optimized features are selected by using the genetic Algorithms and signals are studied using Soft computing techniques.	Novel approach for Stress detection	
9	Stress identification using EEG signals [20]	Using EEG signals stress is identified and reduced by interventio ns into the system	K-means clustering	

10	Detection of sarcasm in textual data [21]	Supervised approach	Machine learning- based approach	Only for textual data
11	Psychologica l stress Detection from microblogs using predefined instructions and ontologies [22]	Compared to traditional models SDF is an advanced stress detection and prediction framework	Using OBIE probabilist ic models and predefined rules	Textual data, emoji's, and social interactions
12	Detection of sarcasm in sentiment analysis [23]		Machine learning approach lexicon based Approach feature selection	
13	Detection of stress based on Physiological sensors [24]	Physiologic al signals can help The computing system to detect stress		
14	Physiological computing [25]	It provides opportunities to Innovate HCI provided the complex issues must be tackled during the R&D phase	Human- computer interaction	Complex methodologies must be fully tackled
15	Analyzing stress using Deep learning [26]	A social website is created where the people interact with each other using social Media	Deep neural networks	Every tweet posted by the user is taken and weekly tweet posted are incorporated

III. PROPOSED METHODOLOGY

The word ontology refers to the branch of metaphysics dealing with the concept of being. It is a description of Knowledge with concepts within a domain and also the relationships among them. The domain contains the entities, attributes, relationships, rules, limitations, and axioms [10].

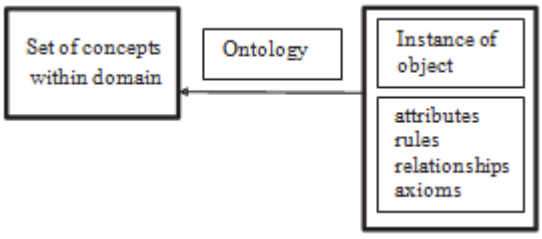

Figure 2: Illustration of Ontology to identify stem words

A. Description of Ontologies

i. Formal Ontology:

The formal ontology is defined by axioms, depicted differently when it is dealt with information systems where the formal language is used whereas when dealing with philosophy the informal language is used [27].

ii. Terminological Ontology:

The information infrastructure is an integral part of any organization, individuals, etc. The effective information retrieval system is the need of the hour for managing the information infrastructure and accessing the contents stored in the infrastructure [32]. The term ontology has been derived fro m philosophy for literature on artificial intelligence. The ISO 1087-1 defines terminology as "verbal designation of a general concept in a specific subject field" [32]. AN ontology is also produced by handcrafting a domain or by renaming an existing resource language: Euro wordNet and wordNet are the variants [35].

iii. Hybrid Ontology:

Ontology is the process of creation and illumination of concepts for an information domain common to a specific group of users. The keyword matching process with previous information domain or historical information is important for finding the best match.

The hybrid method is based on matching the extracted keywords with that of information domain instances [31]. In the hybrid ontology the stress words from chatting sessions are mapped with the predefined words which is internally assisted or guided with hybrid ontology. In this, the logical relationships for stress detection are automatically identified. Hence the accuracy is improved.

B. HODE (Hybrid Ontology Domain Extraction Process):
Extraction of words from unstructured text documents is shown in the below Figure 3. Messages may be erroneous, sometimes they are also stressful messages, with the string matching algorithms [36], and the messages can be spell checked. The messages in the Microblogs Database (MDB) are filtered and the extracted stress words are required to pass through information extraction retrieval technique [37] in search of final stem word. These words are stored in Stress Words Information Database (SWIDB). The ontology editor builds the knowledge base using the knowledge base generator. The stress words in SWIDB are matched with Set of Predefined Stress Words database (SPSWDB) to finalize the stem words. OBIE (Ontology Based Information Extraction) is used to find out the synonyms [38].

The ontology builds the knowledge base according to domain, line up the stem words of same domain with the existing domain and label the values. The Hybrid Ontology Domain Extraction (HODE) constructs the ontology according to the information i.e. matching within the topics i.e. Stress Words Information Database (SWIDB) and matching between the topics i.e. (SWIDB & SPSWDB).

The hybrid strategy of information extraction combines the aspects of information extraction that are considered opposite to each other or the aspects that are not considered, we aim to improve the IE by more accurate extraction and semantic error detection i.e. an added functionality.

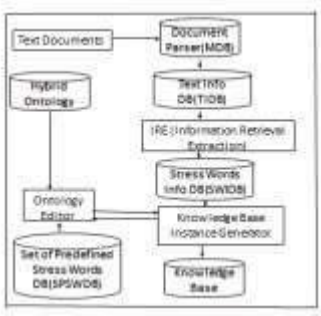

Figure 3: Hybrid Ontology Domain Extraction Process

IV. CONCLUSION

It is very much significant for any individual or organization to manage stress before problem arises as it is very much important for the well-being of people. Traditional stress detection strategies such as personal interviews, questionnaires, etc. are very much time consuming and requires additional hardware, thereby increasing the cost. This disadvantage has been overcome by proposing the methods of behavioral estimation but the efficiency is reduced. Using the probabilistic models such as GSHL and tree alignment algorithms, we can detect stress and accordingly the prevention strategies can be formulated. The future work is the integration of hybrid ontologies for stress detection, which improves the accuracy and was not used by any of the state-of-the-art systems. Future work also includes stress detection that can be done in multilingual languages.

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