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A System to Predict and Monitor the Severity of Depression in the User, with the help of a Text and Image Questionnaire followed by Recommendation of Suitable Remedies

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Abstract: ***Depression is a common mental disorder that presents with depressed mood, disturbed sleeping patterns, poor concentration, feelings of low self-esteem, etc. These problems can become chronic if left untreated due to it being undetected, most of the times. We propose to develop a system here, which will help the users have a self-assessment done for themselves to get an idea of the severity of their depression, if they are found to be suffering from it.***

Questions related to symptoms of depression will be asked by the system, to the user, in text as well as through images. Based on the scores of this assessment which was taken by the user, the system will predict the severity of depression.
If the user is found to be depressed, according to the system's rating scale, a set of tasks will be recommended through notifications to the user for a span of 10-15 days after which the user will be asked to take up another similar assessment test, with a predefined set of questions. Now, the comparative results of these tests will help the user get an idea his depression level.
Keywords: Questionnaire, Depression, Hamilton depression rating scale, PHQ-9

I. INTRODUCTION

The increasing competitions worldwide and the current lifestyle being followed have affected the mental health of people leading to a mental illness, known as depression. A mental health disorder characterised by persistently dull mood or loss of interest in activities, disturbed sleeping patterns, poor concentration, feelings of low self-esteem, etc. which cause significant impairment in daily life, is known as depression. These problems can become chronic if left untreated. Most of the time depression goes undetected because of wrong assumptions, such as, the symptoms being just a low phase in life. But, a person is said to be depressed if the symptoms of depression, which have been mentioned above, persist for a period of two weeks of more and seem to get worse day after day. The system which we intend to develop here is mainly meant to help the user know about the severity of his/her depression. Such a system will give the user some privacy and at the same time predict what the
severity of their depression with the help of a set of questions, relating to the symptoms of depression. This questionnaire is followed by a collection of predefined tasks, which will act as a remedy by making the user feel better once these tasks are done by him/her. These daily tasks will be notified to the user day-by-day over the span of 10-15 days.
After these tasks, which are provided by the system, are completed, the user is asked to take a similar questionnaire to check whether their situation has improved or not. Incase, there are no improvements in the user's depression level, the user is suggested to consult a certified clinician and get some professional help.

II. STANDARD QUESTIONNAIRES

Since depression is a commonly known problem being experienced by many people around the world, there exist a few medically certified standard tests, in the form of questionnaires which can be taken by the users to check whether they are depressed or not.
Two of the most commonly known tests are: Hamilton depression rating scale (HDRS) and PHQ9.

A. Hamilton depression rating scale (HDRS)

The Hamilton Depression Rating Scale (HAM-D) has proven to be useful for many years as a way of determining a patient's level of depression.

The original version contains 17 items (HDRS17) pertaining to symptoms of depression experienced over the past week. Although the scale was designed for completion after an unstructured clinical interview, there are now semi-structured interview guides available.

The HDRS was originally developed for hospital inpatients, thus the emphasis on melancholic and physical symptoms of depression.

A later 21-item version (HDRS21) included 4 items intended to subtype the depression, but which are sometimes, incorrectly, used to rate severity.

A limitation of the HDRS is that atypical symptoms of depression (e.g., hypersomnia, hyperphagia) are not assessed.

Although the HAM-D has 21 questions, the scoring is based on the first 17. A score of 0-7 is considered as normal, i.e not depressed. Scores of 20 or above indicate moderate, severe, or very severe depression, and are usually recommended to go ahead for entry into a clinical trial.

HAM-D is said to have sensitivity of exactly 86.4% and specificity of 92.2%, while detecting the severity of depression in a person. This test has been used for a long period of time and due to its preciseness and has proven to be very useful, so far.

B. Patient Health Questionnaire-9(PHQ-9)

PHQ-9 is an instrumental test for screening, diagnosing, monitoring and measuring the severity of depression in a particular user who chooses to take up the test.

This tool rates the frequency of the symptoms which factors into the scoring severity index. The total of all 9 responses from the PHQ-9 aims to predict the presence and severity of depression.

The PHQ-9 is brief and useful in clinical practice, used by many clinicians. The PHQ-9 test can be completed by the patient in minutes and is rapidly scored by the clinician.

The PHQ-9 questions are based on diagnostic criteria of depression from DSM-IV and ask about the patient's experience in the last 2 weeks.

Questions are about the level of interest in doing things, feeling down or depressed, difficulty with sleeping, energy levels, eating habits, self-perception, ability to concentrate, the speed of functioning and thoughts of suicide.

A change of PHQ-9 score to less than 10 is considered a “partial response” to treatment and a change of PHQ-9 score to less than 5 is considered to be “remission.

Similar to the HAM-D, PHQ-9 is also a verified standard test meant for predicting the severity of depression with up to 97% sensitivity. The PHQ-2 is a shortened version of the PHQ-9. The PHQ-8 consists of all of the PHQ-9 instruments except for the last question (suicidal thoughts). The PHQ-15 is the 15-question scale from the PHQ that asks about 15 symptoms relating to somatoform disorders. A clinical interview must be given to determine the presence and type of anxiety. Thus, the PHQ-9 test is said to be like a reliable self-report.

III. LITERATURE SURVEY

1) *Proposal Of A Depression Detector* which was published by Wei Tong Mok, Rachael Sing, Xiuting Jiang, Swee Lan See, states that due to such rapid advancements in today’s technology, coupled along with the increasingly widespread usage of social media, it has brought about various impacts on the psychological health of almost all the people, especially the middle-aged population. Although it can be said that not only a specific age group has been affected, but the major crisis seems to have obviously arisen amongst the middle-aged population.

It can be clearly observed that now-a-days, social media has become an indispensable part of almost everyone’s life. Social media are sites with networking, gaming and virtual world elements that allow social interaction. Social media sites are now easily accessible to almost everyone, thus the positive and negative effects are experienced by all the users with such access.

While we may say, it has brought about many positive impacts by increasing quality of life substantially and bringing about greater efficiency, it has also resulted in many negative effects. And these negative effects can most certainly not be be overlooked.

In the past, many researchers have conducted research on Singaporeans and ascertained the relationship between frequency of social media usage and depression levels in teenage girls.

Apart from their more sensitive nature and response to social-media induced stress, female teenagers are at a high risk of depression because they do not receive the guidance needed as they start to face symptoms. Rather, some of them turn to risky internet sites and blogs for “help” that may promote behaviours that worsen their condition.

Therefore, this research aims to propose a smartphone application targeted at teenage girls to detect depression and provide reliable advice so that early treatment can be sought.

This research mainly aims to investigate the relationship between depression and characteristics of voice namely, pitch, loudness and the number of pauses taken during a conversation, so as to determine markers for depression.

These markers were then incorporated into a smartphone game application designed to detect depression level through the analysis of these voice related features. The likelihood of an individual suffering from depression was found to increase with loudness and frequency of pauses and to decrease with the frequency of an individual's voice.

A mock up of the smartphone application was created on *Justinmind* and *Powerpoint.*

Based on the depression videos, a louder voice, lower frequency of speech, and higher number of pauses are features that one can look out for as symptoms of depression.

The game was mainly designed, to target females of age 13-19 as the target audience of the game app, and using the above features to help detect for depression in these youths who have a high-risk of going through depression.

2) *Sad: Social Anxiety And Depression Monitoring System For College Students*, which was published by Philip Chowy, Haoyi Xiongz, Karl Fuay, Wes Bonelli, Bethany A. Teachmany, Laura E. Barnesz, looks into the Mental health problems which are are highly prevalent and increasing in frequency and severity amongst the college going student population.

The upsurge in mobile and wearable wireless device and technologies are capable of intense, longitudinal tracking of individuals, provide enormously valuable opportunities in mental health research to examine temporal patterns and dynamic interactions of key variables.

The intense support of longitudinal, dynamic tracking of anxious and depressed college students is useful to evaluate how their emotions and social behaviours change in the college campus environment. This data will provide crucial information about how student mental health problems are maintained and, ultimately, how these student patterns on campus shift, following treatment. By observing the changes in the emotions of the subject under observation, with the help of the longitudinal dynamic tracking feature support, it may eventually lead to finding the root cause of the depression which has affected the subject.

According to the American College Health Association, 27 percent of college students felt too depressed to function properly even in day-to-day tasks and 40 percent reported feeling overwhelming anxiety at least once in the preceding year. Beyond these high prevalence rates, social anxiety and depression also share common symptoms and similar underlying factors causing it. In particular, a Major Depressive Episode is characterised by many symptoms that overlap with social anxiety , such as high negative emotionality, social withdrawal, and avoidance of human interaction.

In situ data was previously collected from many patients. This mostly consisted of a standard set of questions asked by a caregiver, and the patients response was noted. But this person to person interaction ws proven to be not so effective due to certain reasons.

In this paper, by using a combination of actively and passively collected *in situ* data, each of the designed studies will allow researchers and clinicians to understand the temporal links between emotions, stressors, and social interaction, in order to optimise prediction and interventions.

3) *World Health Organisation: Background Paper 6.15 Depression:* This paper is an update of the background paper for Chapter 6.15 of the 2004 *Priority Medicines for Europe and the World.* (Which was Published at*:* http://archives.who.int/prioritymeds/report/*background/depression.doc.*)

This background paper describes the demographic trends and the burden of major depression disorder (MDD) as a disease for the European Union Member States and the world as a whole. It also assesses the current treatment options available for MDD as well as the treatments under development and makes recommendations on future research priorities.

Since this background paper describes specific groups within the entire society who have been affected thus giving the caregivers a specific insight into the afflicted depressed persons. This plays a key role in determining the type of treatment for depression required to be administered in that specific case, since the symptoms may vary from one case to another, as well as the response to each type of treatment.

The paper demonstrates data and trends derived from the recently published 2010 Global Burden of Disease study. It specifically addresses the epidemiology, the burden of disease, treatment options, and the economic impact of MDD. Furthermore, this background paper describes particular groups within the society that are often misdiagnosed and/or under-treated, nor diagnosed neither treated at all.

It has been found that Europe alone accounts for more than 13% of the total DALYs (Disability-adjusted life year) caused by MDD worldwide. This proportion of burden of disease for major depressive disorder in all three European regions is higher than the global burden proportion. This demonstrates that Europe has a relatively higher burden of disease due to MDD than the rest of the world. In terms of years lived with disability (YLDs), MDD increased globally with 37% in just two decades between 1990 and 2010. MDD is ranked second by global and European YLDs ranking.

Depression usually begins in early adulthood, with likely recurrences. It affects women more often than men, and unemployed people are also believed to be at higher risk. A depressive episode may be characterised by sadness, indifference or apathy, or irritability. It is usually closely associated with change in a number of neurovegetative functions, (such as sleep patterns, appetite and weight, motor agitation or retardation, fatigue, impaired concentration and decision-making) as well as feelings of shame or guilt, and thoughts of death or suicide.

A small proportion of patients will experience psychotic symptoms, which are believed to be an extreme case of MDD. The duration of an untreated crisis ranges from nine months to several years.

This paper also consists of a histogram detailing on "Burden of disease frequency by age group in the world." from the Source, "Global Burden of Disease Study 2010 (GBD 2010) Results by Cause 1990-2010. Data downloaded from Institute for Health Metrics and Evaluation (IHME)", which gives us a fair idea about the frequency of the diseases affecting various age groups all across the globe.

The economic impact of depression on patients and society is well documented. The average annual health expenses for depressed patients, including medical, pharmaceutical and disability costs, may be 4.2 times higher than those incurred by the general population.

The first step for providing effective treatment for depression is the recognizing the problem and a correct diagnosis. The first point of access is usually primary care, but evidence suggests that many cases go unrecognized at the level of the general practitioner. Diagnostic criteria and methods of classification of depressive disorders have changed substantially and operational diagnostic criteria have improved the reliability of the diagnosis for MDD.

It has been found that the degree of the depression is determined primarily by the presence of the following symptoms:

a) Disturbed sleep
b) Poor concentration or indecisiveness
c) Low self-confidence
d) Poor or increased appetite
e) Suicidal thoughts or acts
f) Agitation or slowing of movements
g) Guilt or self-blame

The total of these symptoms determines the degree of the depression. For the treatment of depressive disorder, there exist several methods which have been specified in the paper. These consist of:

a) Antidepressant medicines: Monoamine oxidase inhibitors (MAOIs), Tricyclic antidepressants (TCAs), Selective serotonin reuptake inhibitors (SSRIs), Serotonin and Noradrenaline Reuptake Inhibitors (SNRIs), Noradrenergic and specific serotonergic antidepressants (NaSSAs)
b) Psychotherapy
c) Electroconvulsive therapy (ECT)
d) Transcranial magnetic stimulation (TMS)

Athough the above mentioned treatments have been proven clinically, to be effective, the effects and extent of improvement in the patient may vary from one case to another. Also, in the case of Antidepressant medicines, there have been many incidents of side-effects associated with the type and the dosage being administered to each patient, of antidepressant medicine being consumed by the patient.Our poor understanding of the neurophysiology of mental disorders like major depressive disorder (MDD) affects our ability to diagnose in a more efficient way, predict clinical outcomes in patients and our capacity for producing newer highly efficacious and safe antidepressants. To date there is no evidence for positive diagnostic or predictive MDD biomarkers. A specific biomarker of treatment response for MDD might lead to less misdiagnoses and, would also affect our capacity to delineate MDD from other neurodegenerative disorders.

Although study results have been contradictory, many prevention programmes implemented across the lifespan have provided evidence on the reduction of elevated levels of depressive symptoms. Effective community approaches are crucial to prevent depression focus on several actions based on the strengthening of protective factors and reduction of risk factors.

It has been explained in the paper that, the amount of pharmaceutical research that is done on (new) antidepressants is voluminous, but might shrink in the near future since some major pharmaceutical companies have announced a scale back of their research for some

psychiatric disorders, like depression.

The paper thus concludes by stating that depression causes a large burden of disease worldwide and is a leading cause of high health care costs. Effective prevention of MDD has the potential to reduce its enormous burden and high costs considerably. While the recent increase in treatment is encouraging, inadequate treatment is a serious concern. Currently, research on depression and antidepressants, mainly in adults, is abundant. Specific age groups, however, have not been studied enough and the effectiveness of different treatment strategies for these patients is still not well known. When it comes to improvement in the treatment of depression in terms of efficacy, effectiveness, safety and adherence, more (comparative) research on different treatment strategies are needed, specifically aimed for these subgroups of patients(children, adolescents, adults and the elderly).

4) *Medical Interview Training Using Depressed Patient Robot In Psychiatric Education*, which was published by Takuya Hashimoto, Hideyuki Nakane, Hiroshi Kobayashi, Ryo Kurimoto, talks about a psychiatric patient robot that can be used for medical interview training in psychiatric education field. The patient robot is developed based on an android robot technology. Generally, medical interview training in psychiatric field is conducted by employing human simulated or standardized patient (SP) who has been trained to reproduce a set of symptoms of intended mental disorder, by veteran psychiatrists.

But, in the use of a unaffected normal person as a SP there are some problems such as mental burden, time-consuming, the lack of human resources, and so forth. In contrast, the merit of the use of a patient robot is to offer standardized and reproducible interview training to psychiatric trainees.

Furthermore, it is expected that psychiatric trainees are able to experience realistic medical interview as if they face to a real human SP. As the first step, the patient robot was particularly designed to simulate a set of symptoms of unipolar depression, it being a common mental disorder worldwide. The interview scenario, that

is, the question and answer process between an interviewer and the patient (robot), was prepared based on the “Structured Interview Guide for the Hamilton Depression Rating Scale (SIGH-D)” which is widely used for interview training and clinical studies. HAM-D includes 17 rating scales, e.g. “Depressed Mood”, “Work and Activities”, “Genital Symptoms”, and so forth, which have been soecified in the paper.

The Android Robot SAYA that has been developed is used as a patient robot by taking advantage of its human-like presence. A characteristic capability of the robot is to express human-like facial expressions based on FACS. It includes different facial expressions using eye movement, head and neck movement which vary to certain degrees based on the expression it wishes to convey.

After the interview training, the students were asked to answer a questionnaire concerning the interview training using the patient robot.

Thus this reasearch consisted of two parts:

1)Result of severity assessment based on SIGH-D

2)Results of questionnaire investigation of students

Finally, as the results of questionnaire investigation, it was revealed that students’ high motivation to medical interview training with the patient robot although an educational aspect and robot’s expressiveness of target depressive symptom should be improvised. On the other hand, it was also noted by the students that the robot’s appearance, behavior, and conversation capability are required to be improved. In addition, it was confirmed that most of students focused on verbal information of the patient robot, and some of them paid attention to non-verbal information, such as facial expression, etc.

5) *Internet Improves Health Outcomes In Depression* which was published by Gordana Culjak and Dr Mark Spranca, states that, through the Theory of Behavioural Change how the Internet provides pathways to care through widespread access and awareness of depression and related psychological disorders than previously possible through traditional media.

It furthermore goes on to reveal how such access to internet and such awareness created will influence individual behaviour and increases the motivation of depression sufferers to reach out and get the help that they need, at that time, desperately. It identifies how changes in behaviour can lead to a decrease in the incidence, severity and longevity of depression.

One in eight people will be treated for depression during their lifetime . Globally, depression affects about 121 million people. It is the third major cause of disability, following cancer and heart disease. It causes
extensive non-fatal disability worldwide and the problem is predicted to increase in some span of time.
Mental illness may not be a direct cause of death; however, it is reported to cause vast amounts of disability globally.
The main focus is on the Theory of Behaviour Change with a particular focus on how it applies to Internet self-help websites for depression and related problems.
According to a survey the prevalence of depression in the young adult (20-24 year old) population is approximately 10%. Thus, they are the main focus in this case.
The results show that the use of Internet self-help sites for depression does influence health behaviour and that this influence is positive. This will potentially help people earlier, which will decrease the prevalence, severity and longevity of depression. Mild to moderate depression sufferers have easier access, more interest, and a greater likelihood of compliance to a Cognitive Behavioural Therapy Program than was previously available.
These features of the internet along with the additional advantage of privacy as well as personalization to the user, makes the internet an attractive and effective platform for the affected persons. The only risk that may be possessed here is the false information that may be available alongside the authentic data present on various websites on the World Wide Web.
Evidence shows that these features of the Internet has affected health outcomes in a positive direction by lowering depression scores in numerous cases, to a good extent.

6) *Empath: A Continuous Remote Emotional Health Monitoring System For Depressive Illness* which was published by, Robert F. Dickerson, Eugenia I. Gorlin, John A. Stankovic, states that since depression is a major health issue that aafects almost 21 million men and women all over America each year, and often goes either untreated or it becomes difficult to monitor the effectiveness of the treatment, particularly for those subjects who avoid visiting a doctor or therapist due to social stigmas or due to lack of energy, this paper has been proposed. Currently, depression diagnosis is often based on subjective screening questionnaires(such as PHQ-9 or HAM-D) or structured clinical interviews that rely on timely in-person visits to the thrapist as well as accurate recollections by the patient, which are more stressful for the afflicted patients.

Here, a real-time depression monitoring system for the home has been created. This system runs 24/7 and can potentially detect early signs of a depressive episode. It also helps manage and keep track of the advancements taking place in the subject under observation.
A cohesive set of integrated wireless sensors, a touch screen station, mobile device, and associated software deliver the above specified capabilities. The data collected are multi-modal, spanning a number of different behavioral domains including sleep, weight, activities of daily living, and speech prosody. The reports generated by this aggregated data across multiple behavioral domains are used to provide caregivers, helpers and researchers with more accurate and thorough information about the client's current functioning, thus helping in their diagnostic assessment and therapeutic treatment planning as well for patients in the management and tracking of their symptoms.
Depressive episodes are also commonly characterized by lack of social interaction and signs of anhedonia, i.e. the lack of pleasure in doing things previously enjoyed by one and the withdrawal from one's usual activities of daily living. Appetite changes and resulting weight gain or loss are some of the other commonly observed symptom or criterion for depression.
Behavioral changes associated with depression onset also include reduction in gross motor activity and slowing of gait. Each of these components, on their own, do not give caretakers a complete picture of an individual's condition, since depression is syndromatic. Thus, observing the combination of several behavioural markers can aid in the correct classification of the overall phenomenon as depression and in the prevention of false positives. In the paper, it is believed that by monitoring several factors together, and taking advantage of systematic temporal patterns of change across different behavioral domains, we can help clinicians and researchers to predict and reliably detect the onset of depression and the advancements taking place.
Here an integrated system of sensors and analysis code called Empath, an abbreviation for Emotional Monitoring for PATHology has been implemented.
The system architecture consists of : Sleep monitoring system, Weight monitoring system, Speech analysis, Activity detection system, Patient display and subjective scores and finally the caregiver display.
Finally as conclusion, it has been stated that a week long deployment shows that from all the factors Empath which have been generated, presenting its usefulness to both to the patient and to caregivers looking to get more data about depression conditions.

7) *Reliability And Validity Of Patient Health Questionnaire: Depressive Syndrome Module For Outpatients*, a research paper by Cuidong Bian, Chunbo Li, Qianglin Duan and Heng Wu. It checks the reliability, validity and detection rate of the Depressive Syndrome module of the Patient Health Questionnaire (PHQ-9) in general hospital outpatients.

During the research, a total of 600 general hospital outpatients were evaluated using the PHQ-9. The internal reliability, test-retest reliability and validity were examined. Cronbach's α coefficient of PHQ-9 was 0.857 and the test-retest reliability was 0.947. The correlation coefficient of the nine items with the total score of the scale was 0.588 - 0.784. The sensitivity, specificity of PHQ-9 and Kappa value was 91, 97% and 0.884, respectively. The detection rate was 16.3% (95% CI: 13.4 - 19.3%). The Chinese version PHQ-9 was shown to have good reliability and validity forscreening of depressive syndrome in general hospital outpatients.

Among the 600 patients that completed the PHQ-9, there were 273 (45.5%) males and 327 (54.5%) females with a mean age of 51.5 ± 16.4 years (range: 18 – 77 years).

IV. EXISTING METHODS

Many researchers aimed at the correlations between depression and some particular facial features at early age. A lot of experiments have been conducted to reveal the relevance and correlation between depression and various acoustic features, like prosodic features (e.g., pitch, jitter, loudness, speaking rate, energy, pause time, intensity, etc.), spectral features (e.g., formants, energy spectrum density, spectral energy distribution, vocal tract spectrum, spectral noise, etc.)

Many of such these features are closely related to human cognition and have been widely studied for years. Not just this, but also, some people turned to seek new different voice features, like glottal waveform and Teager Energy Operation (TEO).

The human eyes speak and expresses what heart wants to convey. Eyes are the direct medium as far as emotion detection is concerned. Eye movement, can be recorded to detect the severity of depression. The eye movement patterns are analyzed based on the recorded video using Active appearance models. The system also studies the blinking rate between depressed and healthy people.

The majority of aphasia research from a speech-Processing perspective has been limited to analysis at the phoneme level and is often used to diagnose aphasia itself, not the effect of stress and depression associated with living with aphasia. Le et al. developed automatic speech intelligibility tracking for patients with aphasia, and others have focused on diagnosis of aphasia subtypes.

Also there are questionnaires which have been proposed previously and have been used clinically for a long period of time in the past. A notable few are the Hamilton depression rating scale (HDRS) which consists of 21 questions, required to be answered by the person who is to be tested for depression.

Another such a test is the Patient Health Questionnaire-9 (PHQ-9), within which there are many variations such as PHQ-8, PHQ-2, PHQ-15, etc which are similar to PHQ-9 but the way to analyse the subject is different based on the type of questions used in each of these variations.

Generalized Anxiety Disorder 7 (GAD-7) is a self-reported questionnaire for screening and severity measuring of generalized anxiety disorder (GAD). GAD-7 has seven items, which measure severity of various signs of GAD according to reported response categories with assigned points. Assessment is indicated by the total score, which made up by adding together the scores for the scale all seven items. GAD-7 is a sensitive self-administrated test to assess generalized anxiety disorder.

V. PROPOSED WORK

Statistics point out clearly that depression has come to affect such a large population throughout the globe, its important to develop more effective and accurate methods that help prevent depression and cure it.

The system that is being proposed here is mainly meant to help the user understand what he/she is actually going through and to let them know about the severity of his/her depression. Since most the time, depression is not taken too seriously or is brushed off as just a “low feeling”, this system will remove all doubt whether the symptoms that the user is experiencing is normal or serious. Once this has been confirmed, actions can be taken accordingly.

Such a system will provide the user with some privacy and an easy accessibility to take up a test which will predict what the severity of their depression is, with the help of a set of questions, relating to the symptoms of depression.

The symptoms of depression begin to show obviously after 3-5 days. But, it is proven scientifically that the symptoms of depression must be experienced by a person, continuously for at the least of two week’s time to be concluded that it is the symptom of depression itself and not just a low phase in life.

The standard questionnaires that exist already also ask whether the user has been experiencing a particular symptom for atleast a period of two weeks, continuously. The indication that there have been symptoms for the past two weeks indicates that the user is most likely to be going through depression.

The set of questionnaire that we provide here will consist of both text and image based question. The text based questions, which have been adapted from standardized questionnaire including PHQ-9 and Hamilton-depression-rating-scale(HAM-D), are such that there are options presented to the user on the screen of the application, from which the user is expected to select any one, according to what he/she is going through.

These questions in the questionnaire, may be given a individual weightage depending on the severity of the symptoms. Some symptoms such as suicidal thoughts, sadness due to loss of a loved one, etc are considered to be more severe than the symptoms like apitite loss , low energy levels, etc. This weightage is decided by consulting a psychiatrist and other references from the internet with authentic data. The system may also ask the user to type a line or two, to express his/her feelings and thoughts regarding a particular subject to convey his/her sentiments.

Similarly, the image based questions will require that the user has to respond for the question that has been put before the user by the system. The images can further be classified as two categories: Colour theory based images and perspective based images.

The colour theory based images consist of a palette of six colours in each question, three of the colours
indicate a positive outlook and the remaining three indicate a negative outlook. The user must select any one colour, out of the provided palette of colours. Since each of these colours have a specific rating, this choice will impact the severity prediction process, which is carried out later.

The perspective based questions consist of an image which can be viewed with different perspectives, in this case, a positive, a negative or a neutral perspective. The user is expected to observe the image displayed on the application screen. Then scroll down to check the options and recollect what they noticed first in the image and proceed to selecting one of the options available. Each of the option is given weightage which gets added to the test data to fine the end result.

The results of this test are processed using the Naive Bayes classifier, which takes up the combined results of all the three modules specified above, plots the data points from the training dataset and when any new data point gets generated by the user, the classifier will find the class label using the training data. The class labels that are predefined and generated for the new data point finally are: No depression, medium depression and high depression. This questionnaire, which was described above is followed by a collection of predefined tasks, which will act as a remedy by making the user feel better once these tasks are done by him/her, on a daily basis. These tasks are simple and involve very little effort.

The task set for medium level and high level depression are slightly varied, because in the case of high depression, more help is needed and it would be suggested that the user gets some expert help.

These daily tasks will be notified, by the system, to the user, day-by-day over the time span of 10-15 days. Although the set of tasks that are assigned and being notified to each user may be similar, yet it will vary depending on the severity of depression that is being experienced by the user.

After these tasks, which are provided by the system,
are completed, the user is asked to take a similar questionnaire to check whether their situation has improved or not. In the case that, there are no improvements in the user's depression level, then the user is suggested to consult a certified clinician and get some professional help.

The application also consists of a "SOS" button option. If the user is suddenly afflicted by breathlessness or palpitations, then they simply need to press the "SOS" button which will immediately send a text message(SMS) to their close friends or family. It will pass on the latitudinal and longitudinal Co-ordinates of the user, using the Global Positioning System(GPS) present within the device where the application is installed and running. This becomes a very useful feature in cases of emergency situations.

VI. COMPARATIVE STUDY

The existing systems are based on questions which are only in text format and the user has to select an option from the given options. Each of these options has a rating.

The system that we propose here, is such that it incorporates the features of the existing systems but the improvement we make here is in the image based questions(Colour theory based images and perspective based images), which help us understand the perspective of the user, thus helping in making an accurate decision about the severity of depression. It also consists of a continuous monitoring system with recommended tasks that need to be completed by the user. This will help in making the depressed person feel better by doing simple tasks.

Thus the questionnaire systems that have been developed previously are based only on text and here we develop a system which is more precise and accurate in predicting the emotions of the user. Also the usage of Naive Bayes classifier will provide more validity to the class label that has been found, to which the user belongs.

VII. CONCLUSION

In today's era where many people have access to the internet and a continuous exposure to social media sites, they are more vulnerable to go through mental illnesses and depression. Many people fear being cornered by the society, if they are identified to be depressed. Due to this, depression may go undetected. Hence it is crucial that depression is identified at the earliest and cured as soon as possible. This is the main intention of developing such a system.

VIII. FUTURE SCOPE

For the future, although it is very difficult to truly understand what a depressed person is actually going through, it is very important to devise more accurate and precise methods that help us understand the symptoms of depression and these systems must also be useful to the user in overcoming those symptoms and get through such a phase of their lives.

We already have systems which use voice recordings and videos of the depressed person which can be processed to understand the severity of their depression. But, as we know, it is a famously known saying that, "Prevention is better than cure", so a method needs to be devised which will help predict how likely a particular person is to get into the mental illness of depression.

In the future, a system should be developed which will process the current lifestyle habits of the user and his/her daily eating and sleeping patterns.

The system will have to be completely integrated with the user and his everyday activities. All this everyday data should be recorded continuously by the system. And, once this data has been accurately collected and stored into the database of the system, it can be effectively used to predict the likeliness of that particular user going through depression.

Furthermore, there should be tips and tricks that the system should suggest, in order to prevent the user from increasing the frequency of activities that are more likely to put him/her into depression.

The system can be trained to analyse how a particular lifestyle may impact one's mental health. A collection of such individual cases may be gathered by the system from its database and it can be analysed to find patterns, such as, a particular age-group of people who are more vulnerable, or a particular kind of food which puts the people who consume such foods at the risk of going through depression, or the addiction to a certain technology which can harm their mental health.

Such a system, which will soon be developed, can prove to be very useful in preventing many such cases of depression by suggesting preventive and precautionary measures, not blindly, but by thorough understanding of the vulnerabilities, and drastically reduce the number of cases in the various parts of the world, who go through this common yet deadly mental disorder, known as Depression.

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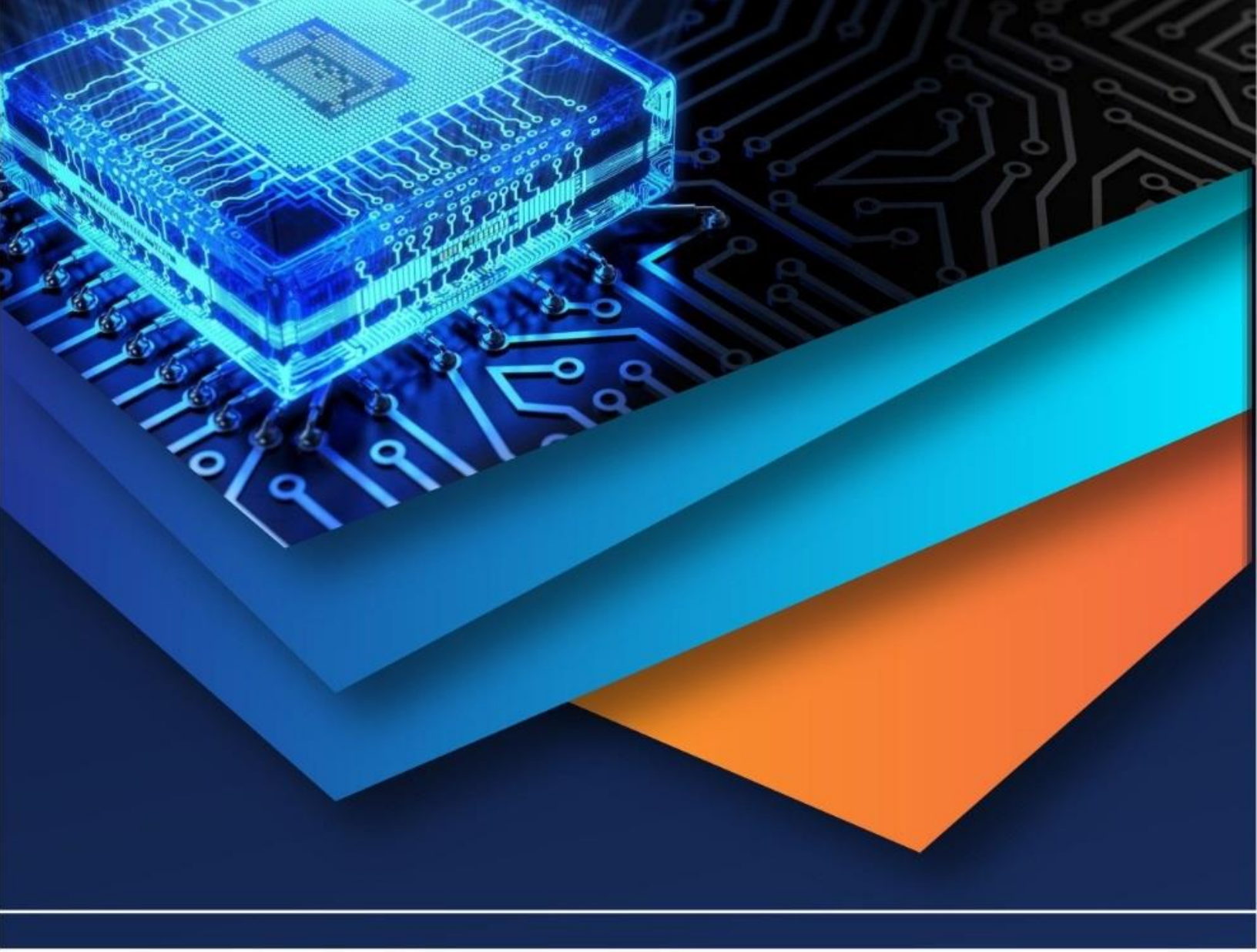

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