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System for Prediction of Human Emotions and Depression level with Recommendation of Suitable Therapy

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Abstract **- In today's competitive world, an individual needs to act smartly and take rapid steps to make his place in the competition. The ratio of the youngsters to that of the elder people is comparatively more and also they contribute towards the development of the society. This paper presents the methodology to extract emotion from the text at real time and add the expression to the textual contents during speech synthesis by using Corpus , emotion recognition module etc. Along with the emotions recognition from the human textual data the system will analyze the various human body signals such as blood pressure, EEG signals , vocal prosody to predict the level of depression so that suitable therapy can be suggested using Prediction algorithm. In text analysis, all emotional keywords and emotion modification words are manually defined. To understand the existence of test was carried out on set of textual sentences and preliminary rules written for 34 different emotions. These rules are used in an automated procedure that assigns emotional state values to words. These values are then used by speech synthesizer to add emotions to speech & input sentence. Pitch detection algorithm has been implemented for pitch recognition.**

Keywords : **Emotions, Rule Based approach, Speech synthesis, Pitch detection, Depression, Musical therapy, Blood pressure, Voice prosody, EEG signals, decision fusion, optimal weighting, Prediction Algorithm.**

I. INTRODUCTION

Depression is a major disorder, it's like being caged without a key, one never knows when the end is going to be. Depression is one of the deadliest illnesses hitting about a major population around the globe. While everybody feels sad, moody or low from time to time, some people experience these feelings intensely, for long periods of time (weeks, months or even years) and sometimes without any apparent reason.

The survey shows that to survive in the competitive world seven amongst ten individuals face mental disorder called Depression. In this world which runs with a lightning speed, it is time consuming for a person to visit a psychiatrist and take traditional treatment.

Depression is more than just a low mood – it's a serious condition that affects your physical and mental health. Feelings associated with depression: Overwhelmed, guilty, irritable, frustrated, lacking in confidence, unhappy, indecisive, disappointed, miserable, sad. The literature shows that several factors, including speech patterns, voice prosody, eye movement, blood pressure, heart rate, Electroencephalogram (EEG) signals, and facial expressions can be taken into consideration for detecting the severity of depression. Various questionnaires can be found on the Internet which can give the severity of depression and also can suggest suitable remedies to fight it out. A better way is a user- friendly system which can serve as a first-aid at crucial times when going to the psychiatrist is not feasible.

This research work aims at giving on the spot relaxation to the patients to be at ease by suggesting them therapies like music, meditation, an interface to communicate to friends and in the worst of scenarios consultation of a psychiatrist. According to WHO report, Indians are the world's most depressed people with nearly 36 per cent suffering from Major Depressive Episode (MDE). The average age of depression in India is 31.9 years compared to 18.8 years in China, and 22.7 years in the US. WHO ranks depression as the fourth leading cause of disability worldwide and projects that by 2020, it will be the second leading cause. Women are twice as likely to suffer depression as men and the loss of a partner, whether from death or divorce, was a main factor, the study reveals. Major Depressive Episode (MDE) is characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy and poor concentration, besides feeling depressed. Depression affects over 120 million people worldwide. It can interfere with a person's ability to work, make relationships difficult, and destroy quality of life. In severe cases it leads to suicide, causing 850,000 deaths a year. Extreme weep-ness and severe melancholy are not the only calling cards of depression, a serious mental disorder that roughly affects. High-income countries tend to have higher rates of depression than lower income countries.

This research works toward the prediction of remedies like Musical therapy, Medication, Yoga therapy to reduce the level of depression. This work eventually will put a stop to traditional way of taking consultation from doctors thereby reducing the valuable time of an individual which is very time consuming.

II. RELATED WORKS

A complete general overview of the field of affective computing is a rare study in text based inference of sentence-level emotional affinity.

Proof of concept is a short or incomplete realization of a certain method or idea(s) to demonstrate its feasibility, or a demonstration in principle, whose purpose is to verify that some concept or theory is probably capable of being useful. In the field of applied research people working on a project or proposal will often undertake internal research initially, to verify that the core ideas are functional and feasible, before going further. This sometimes includes limited performance testing. This use of proof of concept helps establish viability, technical issues, and overall direction, as well as providing feedback for budgeting and other forms of commercial discussion and control. It is not related to a scientific proof. Expressions of emotions can be classified in network based conversations. Emotion detection of this nature is currently an active area of research [19,20].

One approach to it is that the textual messages are automatically converted into speech and then instance vectors are generated from frequency counts of speech phonemes present in each message. In combination with other statistically derived attributes, the instance vectors are used in various machine-learning frameworks to build classifiers for emotional content. Based on the standard metrics of precision and recall, reports are obtained with results exceeding 90% accuracy when employing k-nearest-neighbor learning. This approach has thus shown promise in discriminating emotional from non-emotional content in independent testing.

In the research related to "Text based emotion estimation" the main issue was how to interpret an input string, coming from either the speech recognition module or the output of the chat system in Saya, to one of the specific emotional gestures Saya is capable of. In order to do so they had to analyze the input text in a way that will allow multiple emotions in the input, and also to be able to deal with negation affecting any word that has relevant emotional value. Researchers needed to resolve the sense of the given input sentence and in case we found that the sentence had any emotional value, to act on it. The process described above gives us a word-by-word evaluation of the input text and the assignment of actual emotional value to words in the input that holds a semantic value that is of interest to us. Researchers have also shown that different dependencies can be analyzed and integrated into the input classification, and by that enrich the overall analysis capabilities of the module. [23]

The research "Text-to-Emotion Engine for Real Time Internet Communication" focused on latest version of an emotion extraction engine used for real time Internet text communication. The engine can analyze input text from a chat environment, extract the emotion being communicated, and deliver the parameters necessary to invoke an appropriate expressive image on screen to the communicating user display. The parameters include the emotion extracted from the text being typed and the intensity of the emotion. The measurement of duration of the expression displayed is also possible being an agreed function of the emotion intensity. Semantic analysis is used to extract emotional words. Analyzing the individual word position, the person the emotion is referred to, and the time the emotion occurred, identification of emotional words, as well as using of a set of grammatical rules allow the engine to perform satisfactorily. Static and dynamic tests were carried out in order to test the engine performance [24].

Self-executing depression examination has recently gained attention in the affective computing research community. In recent work, Jyoti Joshi Abhinav Dhall Roland Goecke Jeffrey F. Cohn modeled a paper named *"Relative Body Parts Movement for Automatic Depression Analysis"*[1]. In this paper, human body part movement is analyzed to relate it with depression analysis. Relative orientation and radiusare computed for the body parts detected using the pictorial structures framework. A histogram of relative parts motion is drawn. To analyze the motion on a holistic level, space-time interest points are plotted and a bag of words framework is studied. These two histograms are fused and a support vector machine classifier is trained. This method has effective results on clinical database.

"Content Based Clinical Depression Detection in Adolescents" was a research work conducted by Lu-Shih Alex Low, Namunu C. Maddage, Margaret Lech, Lisa Sheeber, Nicholas Allen[2]. This paper ellaborates on the speech content of adolescents to detect clinical depression. The paper reveals performance evaluation of acoustic features such as Mel Frequency Cepstral Coefficients (MFCC), Short Time Energy (Energy), Zero Crossing Rate (ZCR) and Teager Energy Operator (TEO) using Gaussian mixture models for depression detection. A clinical database of speech from 139 adolescents, which included 68 diagnosed as clinically depressed, was used in the experiments. Each subject participated in three brief interactions. The classification was first performed using the whole data and a smaller sub- set of data selected based on behavioral constructs defined by trained human observers (data with constructs). In the experiments, it was found that the MFCC + Energy feature outperformed the TEO feature. The results indicated that the use of construct based speech contents in the problem solving interactions (PSI) session improved the detection accuracy. Accuracy was further improved by 4% when the gender dependent depression modeling technique was adopted.

A paper presented by Marwa Mahmoud and Peter Robinson titled *"Towards automatic analysis of gestures and body expressions in depression"* proposes the investigate assessment of depression using automatic detection non-verbal body signals and other body gestures[3]. The system makes use of multimodal fusion of features to include body,

face and head for better results in predicting depression level. This automatic detection of body cues is of great help to the psychologists.

Analysis of Prosodic Speech Variation in Clinical Depression" by Elliot Moore II, Mark Clements, John Peifert and Lydia Weissert shows how someone is speaking can be equally important to what they are saying when analysis psychological disorders such as depression[4]. Acoustic speech signals are used to analyze the variations in prosodic feature statistics for those suffering from depression. From the collected data set, pitch, energy and speaking rate feature statistics are generated at a sentence level and grouped into series of observations for analysis. We investigate the merit of a series of statistical measures as a means of quantifying a subset of feature statistics to capture emotional variations from sentence to sentence within a single observation.

Survey done by Yashika Katyal, Suhas V Alur, Shipra Dwivede, Menaka R lead to *"EEG Signal and Video Analysis Based Depression Indication"*[5]. One of the ways to monitor the brain activity is the electroencephalogram EEG signals, which help us detect the parameter in the brain. It combines EEG signals along with the facial emotion through video analysis to categorize the depression into respective level. Here, we studied about depression detection and combining various results to obtain accurate and efficient results, which is a methodology we are going to adopt to land to our results.

"Eye Movement Analysis for Depression Detec-tion" by Sharifa Alghowinem, Roland Goecke, Michael Wagner, Gordon Parker, Michael Breakspear says that Eyes speak what heart wants to say. Eyes are the direct medium as far as emotions detection is concerned. Eye movement can be recorded to detect the level of depression. The eye movement patters are analyzed based on the video using Active appearance models. The system also studies the blinking rate between depressed and healthy people. It was found that the average duration of blinks are longer in depressed people which are a result of eye contact avoidance and fatigue.

Researcher Kuryati Kipli, Abbas Z. Kouzani, Matthew loordens published paper *"Computer-aided detection of depression from magnetic resonance images"[7]*. Magnetic resonance imaging (MRI) of the brain is used to detect depression disorder. However, a large number of MRI scans needs to be analyzed for such detection. Manual segmentation of the biomarkers in MRI scans by clinical experts can become time consuming and sometimes erroneous. This paper presents a study on computer-aided detection of depression from MRI scans. These systems have not yet been identified, categorized and compared in the literature. The paper covers fully automated to semi-automated detection systems. It also presents performance comparison for the considered systems.

"Multichannel Weighted Speech Classification System for Prediction of Major Depression in Adolescents" introduced by Kuan Ee Brian Ooi, Margaret Lech, and Nicholas B. Allen shows that acoustic speech analysis and classification can be used to determine early signs of major depression in adolescents, up to two years before they meet clinical diagnostic criteria for full-blown disorder. Individual contributions of four different types of acoustic parameters [prosodic, glottal, Teager's Energy Operator (TEO), and spectral] to depression related changes of speech characteristics were examined. The novel aspect of this methodology is in the introduction of multichannel classification with a weighted decision procedure. It was observed that single channel classification was effective in predicting depression with a desirable specificity-to-sensitivity ratio and accuracy higher than chance level only when using glottal or prosodic features. The best prediction performance was achieved with the new multichannel method, which used four features (prosodic, glottal, TEO, and spectral).

In this paper, *"Detecting Depression Severity from Vocal Prosody"* by Ying Yang, Catherine Fairbairn, and Jeffrey F. Cohn, Associate Member, IEEE[9] are investigating the relation between vocal prosody and change in depression severity over time, 57 participants from a clinical trial for treatment of depression were evaluated at seven-week intervals using a semi-structured clinical interview for depression severity (Hamilton Rating Scale for Depression (HRSD)). All participants met criteria for major depressive disorder (MDD) at week one. Using both perceptual judgments by naive listeners and quantitative analyses of vocal timing and fundamental frequency, three hypotheses were tested: 1) Naive listeners can perceive the severity of depression from vocal recordings of depressed participants and interviewers. 2) Quantitative features of vocal prosody in depressed participants reveal change in symptom severity over the course of depression. 3) Interpersonal effects occur as well; such that vocal prosody in interviewers shows corresponding effects. These hypotheses were strongly supported. Together, participants' and interviewers' vocal prosody accounted for about 60 percent of variation in depression scores, and detected ordinal range of depression severity (low, mild, and moderate-to-severe) in 69 percent of cases.

Working over, Beiming Sun and Vincent TY Ng tells that social network can also be useful for detecting depression in a person. Lots of effort has been conducted to analyze information of social networks, such as sentiment trend analysis of social network users. Our aim is to analyze the sentimental influence of posts and compare the result on various topics and different social media platforms. Large amounts of posts are generated on social networks every day. People are curious in finding the influence among them. Most researchers measured. The influence of a post through the number of replies it received. However, we are not sure if the influence is made positively or negatively on other posts if their sentimental information is not

considered. In this paper, three research questions are raised and methodologies are proposed for the measure of sentimental influence of posts. Finally, a preliminary experiment is designed and carried out with some interesting results found.

III. SYSTEM IMPLEMENTATION

A. System for Emotion Recognition

This research focused on textual data . The text to be converted into voice form is preprocessed to generate the tagged text. The tags are added to recognize the emotions in the text and are denoted as emotion tags. The emotions tags are derived from comparing the text from main contents with the database which contains the information about the words and their classification into specific emotion class. This will generate the effect, that emotions are automatically extracted from text just like the reader's emotional state transitions, in real-time mode and of expressions during speech synthesis.

This research proposed a Rule based approach (Knowledge based approach) for emotion extraction from text.
The steps followed in the research work are as follows:

1. For the given input text semantic analysis is performed to produces annotated text. This text contains various words which have emotional meaning & also additional information about various types of emotions present and details about sentence structure. For example: in the text if the sentence is 'I am happy ', then annotated text will add tag to adjective 'happy'. This will be considered as emotion in the text and context. The semantic analysis will also split the text in parts, so that further analysis is simplified
   For example: if the sentence is 'We were so lucky, that we won the match' will be split into two parts: 'We were so lucky' and ' that we won the match' and will also generate emotion 'lucky' for the context.
2. Mapping is done to Map the emotional values into speech prosodic variables in order to convey the hidden emotional state information of text into speech. For example: If the emotion in the context present in the text is 'sad', then prosodic variable for the context is set to 'sad' mood.

1.Data Acquisition

This research has for extracted emotions from the textual data by using Rule based approach . Thirty four (34) different emotional categories are considered in this research for extraction. The input to the system was a sentence which will undergo preprocessing stage first using prosodic rules.

2.Data Pre-Processing

System take string as an input (single sentence). String is broken down into list of words. Tagged corpus is created for words & emotion tagging. This will generate the effect, that emotions are automatically extracted from textual content just like the reader's emotional state transitions, in real-time mode and of expressions during speech synthesis.

3.The Working Module

Word Analysis of Emotional words: For the given sentence, preprocessing is performed to produces annotated text. This resulting text contains additional information about various types of emotions present and details about sentence structure. [17]

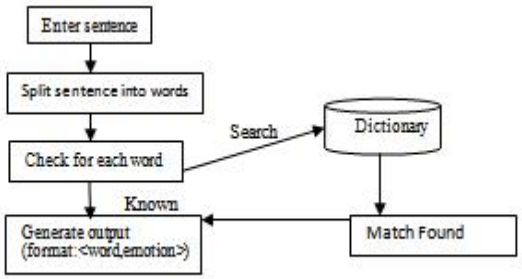

Fig.1 Word analysis

Fig.1 Word analysis

For example: in the text if the sentence is 'I am not happy', then annotated text will add tag to verb 'happy'. This will be considered as emotion in the text and context. The semantic analysis will also split the text in parts, so that further analysis is simplified.

Matching in tagged dictionary: After the preprocessing stage according to POS categories, the obtained tokens (words) were compared with tagged corpus .

TABLE I TAGGED CORPUS

Words	Tagged Emotions
Happy	Happy
Admire	Positive

Emotion Extraction:- Once the match for the token is found the tagged emotion is extracted from tagged corpus. If found emotional tokens are more than one then the created rule based is used for emotion recognition.[17]

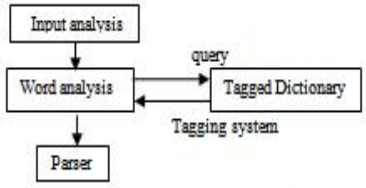

Fig. 2. Emotion Extraction Engine

Fig.2 Emotion Extraction Engine

For example: for the input sentence “we are happy and we accept this”, in this context happy , accept are emotional tokens, so rule based is applied & generated emotion is “Positive”.[17]

Speech synthesis: The obtained textual emotion is then converted into speech by TTS.

Pitch detection: For detecting the pitch of obtained emotion Auto-correlation algorithm has been applied .

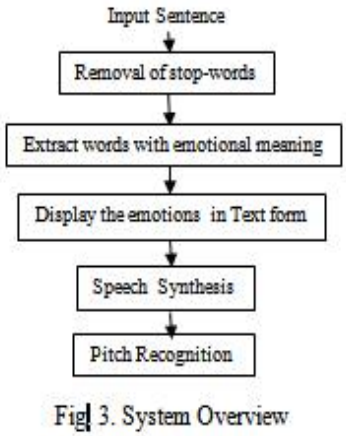

Fig.3 System Overview

B. System for Depression Prediction

With the Emotion recognition, this research system also has implemented results for prediction of depression level of the patient and module for predicted therapies like Musical therapy, Yoga therapy and “calling to friend” module. We named this system as “Healing Hand” for detecting the depression level of an individual to recommend a suitable therapy .

Evaluation Parameters Considered for Depression Prediction are:

1. Blood Pressure
2. Vocal Prosody
3. EEG signals

With respect to the evaluation parameters this system is working with variety of versatile hardware devices which possesses the capability to measure the body signals like blood pressure, EEG signals. This devices have a wireless connectivity, which will be used for transferring the measured values onto the system. This will prevent users from entering the values and hence inducing errors. For processing these values, a self-designed prediction algorithm will be used for better accuracy and precision. Apart from musical therapy, other remedies such as yoga, immediate contact to a near one are included in this system.

For example, System takes Blood Pressure as input and predicts whether the person is depressed or not. We make prediction based on the real time dataset provided to system. The severity of the depression is measured by the range of the Blood Pressure acquired. The Blood Pressure (Systolic/Diastolic) above/below the normal range is considered to be the symptom of depression. The digitized Blood Pressure level of an individual is further mapped with the clusters that informs us whether the same is depressed or not. If it falls under the depressed category then system provides with suitable depression relieving therapy.

1.Versatile Hardware device used to register input signals

1. EMOTIV Insight 5 channel Mobile EEG headset is used for EEG Analysis
2. Wireless Blood Pressure Monitor with Blue-tooth Connectivity used for BP signals analysis.

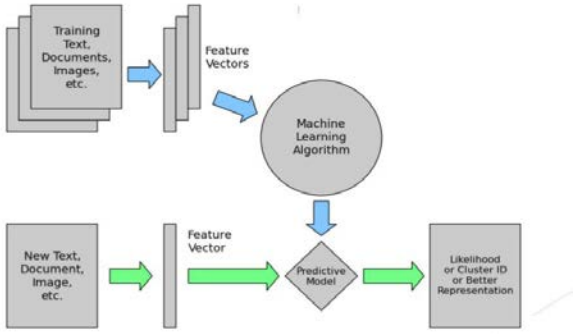

Fig.4 Depression Prediction System

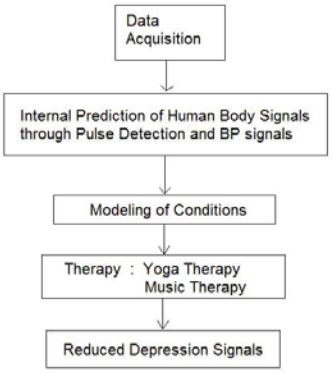

Fig.5 Sytem Flow diagram

2. Data Acquisition and Preprocessing

Downloaded data from the website arises from a large study to examine BP signals and EEG signals. This dataset is used to train the system . Further the versatile hardware devices are used to take the real time input from the patients (for testing purpose) [16, 18].

Taking the speech analysis into consideration it is under research. The acoustic speech analysis are classified into two classes AR and NAR.

Questionnaire is to be set to fire the questions to the patients to prepare the detailed analysis of the patients. And depending upon the analysis the conclusion can be drawn for the depressed condition of the patients. This module of Predicting Depression from Vocal prosody will work collaboratively with the "Emotion Extraction system module " stated earlier [21].

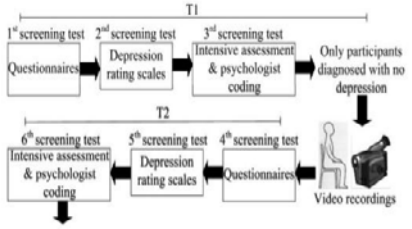

Fig.6 Longitudinal data collection procedure

The implementation of the module for Depression detection from vocal input is under process.

3.Method used for Prediction

We propose an self prediction algorithm for covering a high level of accuracy for our depression detection system. We induce to take input parameters like BP from an individual to map it with the real time dataset that has been provided to our system. This mapping will result into prediction an will provide us with suitable therapy. This also includes machine learning strategies by our algorithm. Under this research work we have referred k-means algorithm for clustering and classification .

K-means clustering algorithm:

K means is clustering algorithm where the input data samples get clustered which have more inter-cluster similarity and less intra-cluster similarity. In K means "K" stands for the number of clusters to be formed. The clusters are formed by assumption of the mean values from the initial given points. The points are then categorized by calculating the Euclidean distance. For the next iteration, new mean is calculated and the procedure for differentiating the points repeats. The algorithm stops when the new value of mean is similar to the mean in the previous iteration.

Input:
k: the number of clusters,
D: a data set containing n objects.

Output:
A set of k clusters.

Method:
1. Arbitrarily choose k objects from D as the initial cluster centers
2. Repeat
3. (re)assign each object to the cluster to which the object is the most similar, based on the mean value of the objects in the cluster;
4. Update the cluster means, i.e., calculate the mean value of the objects for each cluster;
5. Until no change;

IV. RESULT ANALYSIS

The system has the implementation results for Emotions extracted from the textual data. This system also has tested results for depression detection from the blood pressure signals. The dataset is under testing condition for depression prediction through EEG signals. The implementation of the module for Depression detection from vocal input is under process.
The result analysis of the modules is as follows :

A. Emotion Recognition Module

The testing has been conducted on sentences. The system was tested for various emotions. At the same time pitch detection algorithm is applied to check for emotion pitch.

In Information Retrieval, Precision and Recall are defined in terms of a set of retrieved documents and a set of relevant sentences. In the following sections we describe how we compute the Precision and Recall for our approach compared to the manually extracted text [23].

1. Precision (P) =
(#Correctly Retrieved Paraphrases by the algorithm) /
(All paraphrases retrieved by the algorithm)
= 88.88 %

2. Recall (R) =
(#Correctly Retrieved Paraphrases by the algorithm) /
(All paraphrases retrieved by the Human Judge)
= 80 %

3. Accuracy = (R * P) / ((1/2)(R+P)
= 84.20654 %

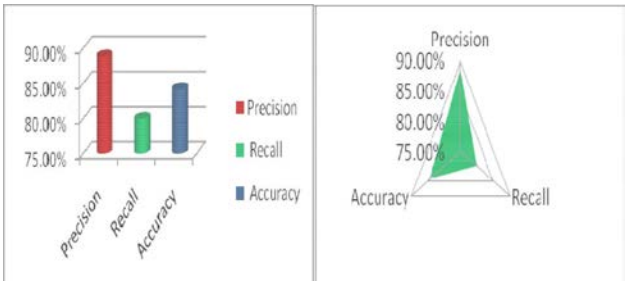

Fig.7 Accuracy of the Emotion Extraction module

B. Depression Prediction Module

Our system yields the level of depression and also recommends suitable therapy for the detected level for musical therapy, yoga or calling a close friend or informing to the nearest hospital. The system includes android application. The parameters such as blood pressure,EEG signals and voice prosody has taken input from the relative hardware device for the patient to be diagnosed for depression using Weka tool. The following figures will comprehensively describe about how the system works and what will be the results obtained.

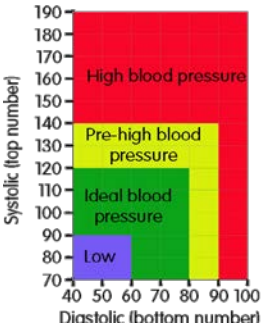

Fig.8 Blood Pressure Rate Chart

TABLE 2 DEPRESSION PREDICTIONS FROM SBP & DBP

Patient ID	Patient Age	BP rate		Predicted Depression level (Age, SBP, DBP)
		SBP	DBP	
50	62	210	120	High
101	57	120	80	Normal
105	52	180	110	Alarming (Pre-high)
244	45	160	100	Alarming (Pre-high)
250	42	140	90	low

TABLE 2 PREDICTED MUSIC RAGAS

Depression level (Age, SBP, DBP)	Predicted Music Therapy raga
High	GorakhKalyan, Bhimpalas, Puriya, Natnarayan,Raga Todi
Alarming (Pre-high)	Natnarayan,Raga Ahir-Bhairav (Chakravakam)
low	Raga Malkauns

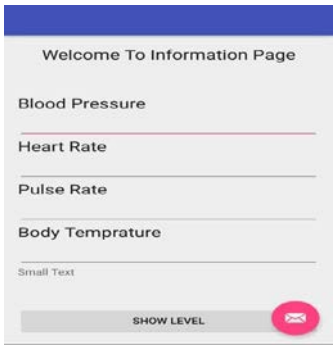

Fig.9 Input Signals Module

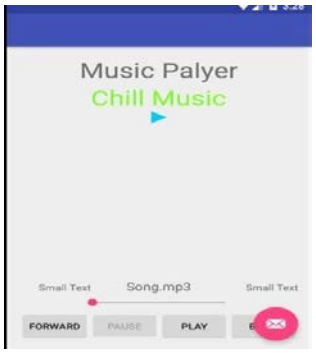

Fig.10 Predicted Music Raga Module

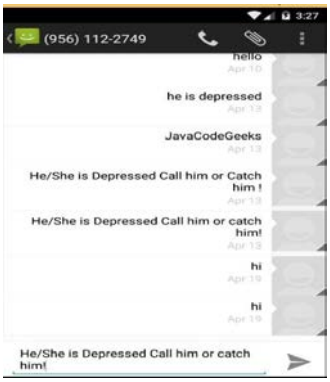

Fig.11 Call to Friend Module

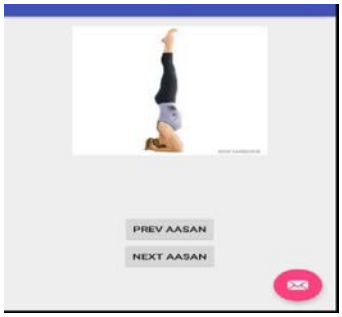

Fig.12 Yoga Therapy Module

V. CONCLUSION

Thus, we have conducted an extensive research on depression and also on the psychological condition of the mass affected by this psychological disorder. We have also studied the existing system for depression level detection. We have made a sincere attempt to consider all the loop holes in this existing system and improvise them in our proposed system. We design a system, which will give a better user experience and user interface. We realized that k-means prediction algorithm wouldn't suffice our needs of this medical domain. Hence, we propose a self-designed prediction algorithm which will be used to predict the sensitive issue i.e, depression for the patients. This algorithm will also be working towards the prediction of various therapies like *Yoga therapy, Musical therapy.* The system is also having module for *"Call to Friend"* which will help the patient for depression reduction. The system will work accurate, error-free, and precise with complete expertise of the training and testing datasets. The system will then accurately detect the level of depression and justify the remedy for the cure of given affected with expert inter domain. We thus make a sincere attempt to serve the cause of this psychological disorder and make world a better, healthier and happier place to live in.

REFERENCES

[1] "Analysis of Human Body Signals for Prediction of Depression Disorder " in *IJCTA* , Vol.10 No. :8, pp. 665-672,2017..

[2] " Healing Hands for Depressed People (D-HH) through Analysis of human body signals to predict the level of depression and recommendation of suitable remedy " *in ICCUBEA* 2016.

[3] Relative Body Parts Movement for Automatic Depression Analysis Jyoti Joshi Abhinav Dhall Roland Goecke Jeffrey F. Cohn, *IEEE* 2013.

[4] Content Based Clinical Depression Detection in Adolescents Lu-Shih Alex Low, Namunu C. Maddage, Margaret Lech, Lisa Sheeber, Nicholas Allen, *EUSIPCO* 2009.

[5] Towards automatic analysis of gestures and body expressions in depression Marwa Mahmoud and Peter Robinson, EAI International Conference 2016.

[6] Analysis of Prosodic Speech Variation in Clinical Depression Elliot Moore II, Mark Clements, John Peifert and Lydia Weissert, *IEEE* September 2013.

[7] EEG Signal and Video Analysis Based Depression Indication, Yashika Katyal, Suhas V Alur, Shipra Dwivede, Menaka R, *IEEE* 2014.

[8] Eye Movement Analysis for Depression Detection Sharifa Al-ghowinem, Roland Goecke, Michael Wagner, Gordon Parker, Michael Breakspear, *IEEE* 2013.

[9] Computer-aided detection of depression from magnetic resonance images Kuryati Kipli, Abbas Z. Kouzani, Matthew loordens, *ICME* 2012.

[10] Multichannel Weighted Speech Classification System for Prediction of Major Depression in Adolescents Kuan Ee Brian Ooi, Margaret Lech, and Nicholas B. Allen, *IEEE* February 2013.

[11] Detecting Depression Severity from Vocal Prosody Ying Yang, Catherine Fairbairn, and Jeffrey F. Cohn, Associate Member, IEEE 2013.

[12] Analyzing Sentimental Influence of Posts on Social Networks, Beiming Sun and Vincent TY *Ng IEEE* 2014.

[13] V. Knott, C. Mahoney, S. Kennedy, and K. Evans, "*EEG power, frequency, asymmetry and coherence in male depression*," 2010 .

[14] A. J. Calder, A. M. BUlton, P. Miller, A.W. Young, *A Principal Component Analysis of Facial Expressions Vision research*, 2011.

[15] J. Joshi, R. Goecke, S. Alghowinem, A. Dhall, M. Wagner, J. Epps, G. Parker, and M. Breakspear, "Multimodal Assistive Technologies for Depression Diagnosis and Monitoring," *Springer, Journal on Multi- modal User Interfaces*, 2013.

[16] J. Joshi, R. Goecke, M. Breakspear, and G. Parker, "*Can body expressions contribute to automatic depression analysis?*" , 2013.

[17] C. Mathers, T. Boerma, and D. M. Fat, "*The global burden of disease, 2004 update*," 2004.

[18]https://www.disabledworld.com/artman/publish/bloodpressurechart.shtml

[19] Swati D. Bhutekar, Prof. M. B. Chandak "Corpus Based Emotion Extraction To Implement Prosody Feature In Speech Synthesis Systems ",Ijcer, *International Journal of Computer & Electronic research*,Vol.1, No. 2, August 2012, ISSN 2778-5795, 67-75.

[20] https://kdd.ics.uci.edu/databases/eeg/eeg.html

[21] Curry Guinn and Rob Hubal," Extracting Emotional Information from the Text of Spoken Dialog", RTI International, 3040 Cornwallis Road, Research Triangle Park, North Carolina, USA, 27709

[22] Ze-Jing Chuang and Chung-Hsien Wu," Multi-Modal Emotion Recognition from Speech and Text", *Computational q Linguistics and Chinese Language Processing*, Vol. 9, No. 2 , August 2004, pp. 45-62 45 , The Association for Computational Linguistics and Chinese Language Processing

[23] Ying, Yamg, Catherine Fairbairn, and jeffery F. cohn,Associate Member,IEEE, "Detecting Depression Severity from Vocal Prosody", *IEEE Transactions on Affective Computing*,Vol 4, No. 2, April-June 2013

[24] Swati Bhutekar, Manoj Chandak, Ajay Agrawal, "Emotion Extraction: machine learning for text-based emotion",Proceedings published by *International Journal of Computer Applications®* (IJCA)ISSN: 0975 – 8887, MPGI *National Multi Conference* 2012 (MPGINMC-2012)7-8 April, 2012 ,"Recent Trends in Computing", pp.20-23.

[25] Itamar Chazanovitz,Meital Greenwald , "Text based emotion estimation", Ben-Gurion University of the Negev Department of Computer Science September 2008

[26] Xu Zhe, David John and Anthony C. Boucouvalas," Emotion Extraction Engine: Expressive Image generator",Multimedia Communications Research Group, School of Design, engineering and Computing, Bournemouth University.