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Automatic mood detection tool: Self Response Inventory

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Abstract – *Depression is a mood disorder in which negative mood of a person prolonged more than 2 weeks The World Health Organization list depression as major cause of disability. More than 370 million people suffer from it. Proper concern is not given to such burning issue globally. Psychological and clinical treatments are available but quality and availability of clinical professional associated to domain are limited. to resolve this issue an automated ML based approach is suggested for mood detection. Person can check its present mood automatically by its own at no cost. The accuracy of approach is above 90%. Person can repeat the test and if negative mood result continues then person can say to converge toward depressed mood.*

Key Words: **Depression, Positive mood, Negative mood, Psychology, PHQ-9, BDI, CES-D, MOS, SDDS-PC, QIDS, DMI-10, Mild Negative, Depressive disorder**

1. INTRODUCTION

Depression is leading cause of disability globally in all age groups which severely affects the global health index. It is complex and an ongoing problem which may resolve with proper care but may reoccur via various risk factors. The medical community does not fully understand the causes of depression but mostly known various risk factors like environmental factors, psychological, social factors, financial factors, drug addictions change in genetic features, brain's neurotransmitter levels, accidental events like head major head injury and many more. Early detection plays a crucial role as by positive counseling, various physical and mental exercises like meditation and proper medication may resolved depression else situations become worst up to suicidal tendency. Depression can be detected through various behavioral symptoms and during clinical interview by medical expert but the rate of the affected person reach at right time with right medical professional is very low so many researchers from physiological, pattern matching, computer vision have tried to detect depression features from behavior verbal and nonverbal channels with help of various of machine learning algorithms under Artificial Intelligence domain. Neural Network has shown shows great potential to resolve this burning issue of human health care domain to serve mankind.

1.1 Clinical Interview

Psychological and clinical based interview to evaluate depression symptoms are carried out since last 60 years. Initially interviews were taken place in person or on telephone lines where question is assessed on time scale of months. After decades scenario was changed with modifications of question and examination period was in weeks. In present situations where technology had made great impact on our life style the risk of depressed mood increase [6],[13],[14],[15],[16],[17],[28].

1.2 Audio Channel approach

Person having depressed mood speech can be identified so speech processing domain deal with such task and classify normal, mild depressed and major depressed person from vocal features [5],[11],[18],[19].

1.3 Visual Channel approach

Person having depressed mood can be identified from its visual features since long time person's expressions are recognized into seven prototypic class and they can further classify as positive and negative expression. Happy is positive emotion or expression where sad, disgust, angry, contempt are negative expressions. Surprise may lead to positive or negative expression according to the association of it with event [4],[7],[8],[9],[20],[21].

1.4 Social Media approach

In era of social networking technology person spare time more on screen so social media like Facebook, twitter, snap are identified person's mood and emotions so based on status, text message and updates like picture, snap person's data in which Text data in various levels and categorize with positive or negative broadly and much specific like emphatic, glad etc. databases for textual emotion analysis [18].From uploaded pictures, emojis updated on various social media platforms person's mood behaviour can be examined.

1.5 Bio -sensor approach

There are various bio sensors are available to check the person's mental activity and associated parameters like EEG based approach physiological signals receive from brain are measured which are real time in nature and cannot suppress or hide like facial expressions, audio and textual emotions so it is more authentic and precise only drawback is the cost and complexity associate with this approach [18].The result of such sensors is efficient only drawback is the cost and complexity of setup, evaluation and examination criteria in such modalities[19].

1.6 Multi-modal approach

Many contributors used fusion of above approaches called multi-modal data in which persons reflect their feelings through multiple channels [19], [20], [21]. Which are more accurate and reliable than focusing only on a single modal like audio, video, text, or EEG etc. [18],[22].

2. Classical Interview

In clinical approach person is assessed critically by medical mental health expert of psychology based on response of one-to-one interaction and real time observation by medical expert decision is made and psychological treatment and/or medication is applied [6]. Major problem with this approach is quantity of such assessment as person doesn't accept such mental health issues and because of social stigma they have tendency to conceal such issues so approximately 10% actually affected get benefits of this approach.

Hamilton Rating Scale for Depression (HRSD): popular as HAM-D which is MCQ type questionnaires which medical professional use for depression severity assessment [13].

Beck Depression Inventory (BDI): The BDI is 21 questions which are multiple option types self-report which calculate the severity of depression symptoms and feelings based on the response given [14].

Patient Health Questionnaires (PHQs): The PHQ-9 has nine questions about person's mood and daily activities like appetite, watching Television which helps Doctor come to a depression diagnosis [15]. The PHQ-2 asks the first two questions of the PHQ-9. Which is a screening test guide doctor for further processing.

Zung Self –Rating Depression Scale: It is again short surveys which identify depression levels [16].

Centre for Epidemiologic Studies-Depression Scale (CES-D): is a self-reported scale with 20 questions designed for caregivers to measure how often they have depression symptoms. A higher score can help doctor to identify risk level of depression [17].

By Analyzing all above approaches proposed System questionaries are design in such a way that it fuse the physical, mental and cognitive health emotion with blend of colour psychology also to generate positive and negative mood classification task easier later negative mood further classified as mild, moderate and severe negative mood respectively.

Table -1: Comparative study of existing Approach

Comparison of existing Approach			
Tool with Year	Type	Questions	Scoring Levels / Severity
Beck Depression Inventory (BDI)1961	Self-Report	21	0–13: Min,14–19: Mild,20–28: Moderate,29–63: Severe
Beck Depression Inventory – Short Form (BDI-Short) 1978	Self-Report	13	0–4: Minimal, 5–7: Mild, 8–15: Moderate, ≥16: Severe
Center for Epidemiologic Studies Depression Scale(CES-D)1977	Self-Report	20	<16: Normal,16–26: Mild–Moderate, ≥27: Severe
Center for Epidemiologic Studies Depression Scale – Short Form (CES-D-Short)1997	Self-Report	10	<10: Normal10–14: Mild≥15: Severe
Medical Outcomes Study – Depression Scale (MOS) 1992	Self-Report	8	Low score: Normal, High score: Higher depression
Self-Diagnostic Depression Scale – Primary Care (SDDS-PC)1994	Self-Report	7	0–2: Normal3–4: Mild5–7: Severe
Patient Health Questionnaire – 9 (PHQ-9) 2001	Self-Report	9	0–4: Minimal,5–9: Mild10–14: Moderate,15–19: Mod-Severe20–27: Severe
Quick Inventory of Depressive Symptomatology (QIDS) 2003	Clinician/ self	16	0–5: None6–10: Mild,11–15: Moderate16–20: Severe
Depression Measure Inventory – 10 (DMI-10) 2004	Self-Report	10	0–7: Normal,8–14: Mild15–20: Moderate>20: Severe
Proposed	Self-Report	21	0–4: Normal,5-9: Mild,10–14: Moderate,>15: Severe

Self –Response Inventory (S.R.I): Quiz based questionaries approach in which person is required to respond quiz-based questions mainly deal with habit of food, sleep, rest concentration, decision making related to healthy life style on the best knowledge of truthfully based on response each question generate number and based on additive score mental health is decided. As mental health is depended primarily on our physical health which again rely on pattern of food, rest, exercise etc. and various psychological affective domain related aspects like communication, positive attitude towards life, concentration, decision making, colour selection depending on colour psychology where colour is used as tool for emotion identification not only as selection depending on psychology of colour [12] are truly responded represent true picture of our mental health in normal, mild negative, moderate negative and highly negative classes. The questions which are most important given twice weightage compare to others.

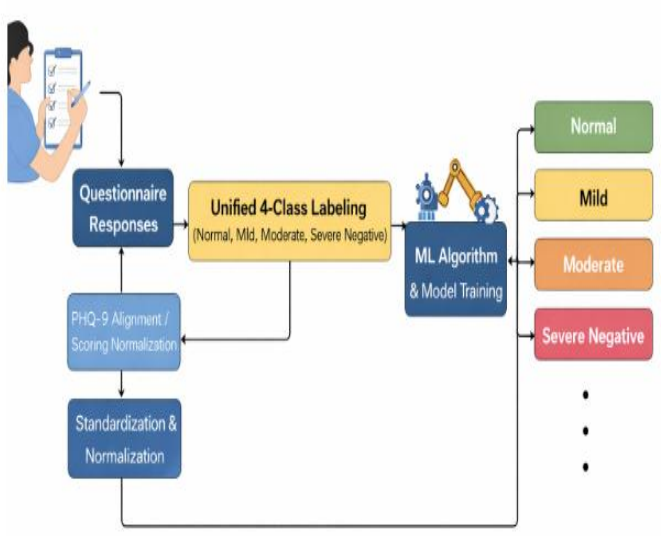

Fig -1: ML based model for S.R.I.

Data Analysis:

Total 150 person's response recorded on three options as Yes, No and not decided basis. Where 0-identifies not sure (neutral), Yes reflect the affirmation to question response while no reflect negative confirmation to the question. Questions are mixed with positive and negative form and mixed with generalized simple questions where person simply respond it and mood score is created automatically.

Table -2: Confusion Matrix of Proposed System

Confusion Matrix					
Predicted → Actual ↓	Normal	Mild Negative	Moderate Negative	Severe Negative	Total
Normal	85	3	2	0	90
Mild Negative	4	29	2	0	35
Moderate Negative	1	2	14	1	18
Severe Negative	0	1	1	5	7
Total	90	35	19	6	150

Table -3: Class- wise Performance of Proposed System

Confusion Matrix			
Class	**Precision**	**Recall**	**F1-score**
Normal	0.94	0.94	0.94
Mild Negative	0.83	0.83	0.83
Moderate Negative	0.74	0.78	0.76
Severe Negative	0.83	0.71	0.77
Average	0.84	0.82	0.83

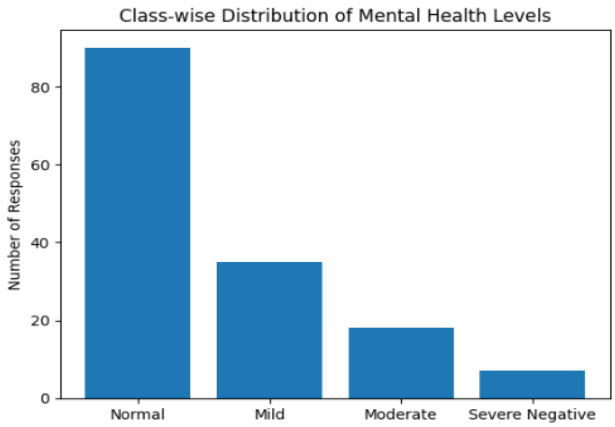

Chart -1: Bar graph of Proposed System classification

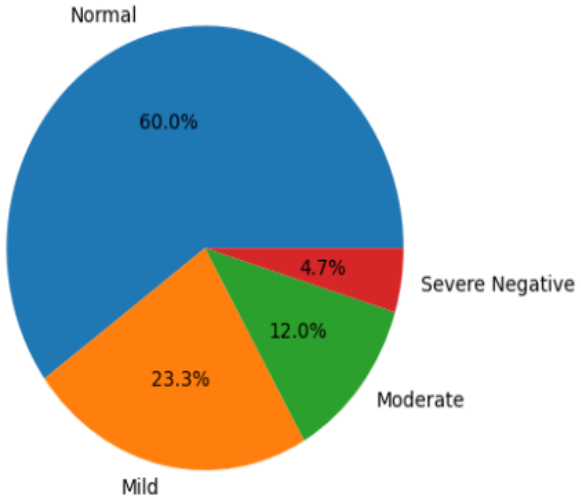

Chart -2: Pie chart of Proposed System Classification

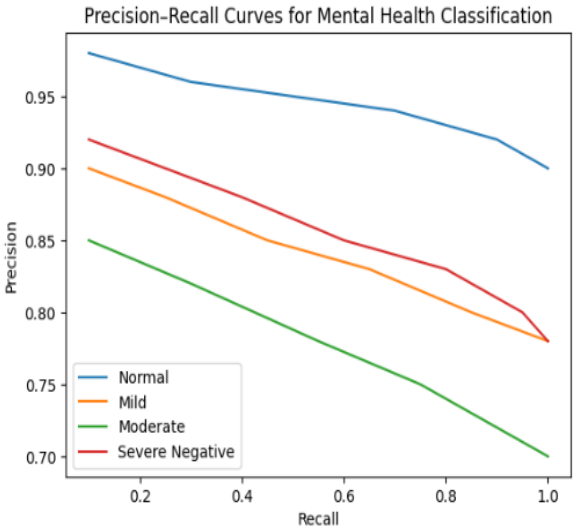

Chart -3: Precision-Recall Graph of Proposed System

Table -4: Mapping of Proposed System with PHQ-9

PHQ-9 range	Score Severity (PHQ-9)	Proposed System
0-4	Minimal	Normal Mood
5-9	Mild Depression	Mild Negative
10-14	Moderate Depression	Moderate Negative
>= 15	Moderately Severe Depression	Severe Negative Mood

Above mapping represent alignment of Proposed System with PHQ-9 which is clinically proven standard for depression which clearly reflect the clinical validity and acceptability of Proposed System as diagnosis tool in mental health care domain.

3. CONCLUSION

Number of researchers has contributed their work to identify depression which closely related with psychology, affective, computer and clinical domains so in real time it's a multi-challenging task. As domain start with Psychology, Computer Science and Clinical domain and last long to social domain the major key challenges are mentioned as under to map psychological domain to computer and validate it with behavioral/clinical predictions [22]. Human are expressive through verbal and nonverbal communication channels both channels are important to express feelings [3], [4]. Person can remain silent to suppress verbal communication and by fake expression or conceal expression can hide real scenario, biological sensor-based assessment of various biological parameters are complex to setup, execute and evaluation point of view and not user friendly. The person who is already in negative mind set not ready for any complex examination. In this approach no third person intervention or participation required person by own can check the mood automatically. All the modalities have its own pros and cons but classical approach of Questionaries in automated version remain ultimate choice to validate mental health status. This automated mood detection tool which effectively identified mood via a set of quiz related to psychological, physical and general routine questionnaires person's mental health is estimated. If test continuously give negative mind state mood result the quiz can be repeated after 2 or 3 days as fresh version and evaluation of mood should carry out up to 2 weeks at various time like morning, afternoon, evening, night but if negative mood is reflected as outcome in all test results, then such person is advice to take care of mental health visit for clinical advice for further treatment.

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