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Role of Various Techniques to Identify the Emotional Intelligence: A Review

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***Abstract*— Emotional intelligence has become a crucial factor in solving human's problems. Researchers in various fields have studied emotional intelligence and found that the construct is related to various intrapersonal and interpersonal factors, such as mental health, relationship satisfaction and job performance. This article provides an overview of current research on emotional intelligence and the many scientific techniques for capturing and analyzing emotion. In the psychological approach, various case studies based on psychometric tests are used to analyze emotional intelligence.**

***Index Terms*— EEG, Scientific Approach, Psychological Approach, Behavioral Problems, Linear Discriminant Analysis, cognitive activity**

I. INTRODUCTION

The primary objective of this paper is to understand Emotional Intelligence (EI) as it has different interpretations for different authors due to their individual findings that are based on different situations. These differences have led to the development of various models and techniques that are used to identify EI and measure EI. Accordingly the secondary objective of this paper is to study the scientific and psychological approaches in identifying emotional intelligence. With these objectives, our paper aims to develop a model that shows the EI Acquisition Techniques and present the important findings of previously published papers with respect to various human qualities and their association with EI under different parameters. The paper is an attempt to present some of the related best and most promising research in the EI field. A review of such research can help understand EI along with the approaches of identifying EI and accordingly present a model or a tabular review.

The concept of Emotional Intelligence (EI) was contrive by psychologists Peter Salovey and John Mayer (Mayer & Salovey, 1990), who defined it as “the ability to monitor one’s own and other's feelings and emotions, to discriminate among them and to use this information to guide one’s thinking and actions”. Later, the authors revised the definition of EI as the ability to perceive emotion, integrate emotion to facilitate thought, understand emotions and regulate emotions to promote personal growth (Mayer & Salovey, 1997). This conceptualization represents the ability model of EI. Mayer & Salovey (1990) are recognized for their great contribution in the emergence of EI.

A. Approaches to Emotional Intelligence

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The literature on Emotional Intelligence (EI) often identifies three main models: the ability model, the trait model, and the mixed model. Here's a brief overview of each of these models

- *Specific-Ability Approaches to EI:*

Specific-ability models focus on particular aspects or abilities related to emotional intelligence, such as perceiving emotions in faces or understanding subtle emotional meanings. These models assess EI in-depth in a specific area, allowing a better understanding of how individuals reason about that particular subject matter. They may involve assessments that measure specific aspects of EI, like recognizing emotions in facial expressions.

- *The Four-Branch Model of Emotional Intelligence:*

The Four-Branch Model of EI, proposed by Mayer and Salovey, presents emotional intelligence as an integrative approach.It categorizes emotional abilities into four branches:Perception and Appraisal of Emotion: Involves the ability to recognize and evaluate emotions, such as perceiving emotions in facial expressions.
Using Emotions to Promote Thinking: This branch includes using emotional experiences to enhance cognitive processes, like using a low-energy emotion to focus on a task. Understanding and Reasoning About Emotions: Involves the ability to comprehend and describe emotions using language and understanding rule-governed emotional experiences. Management and Regulation of Emotion: Focuses on controlling and regulating one's own emotions and helping others manage their emotions.
The model predicts various implications for an individual's life, such as their ability to cope with emotions effectively and develop expertise in specific emotional areas.

- *Mixed-Model Approaches to EI:*

Mixed-model approaches to EI have broad definitions and encompass a wide range of qualities, capabilities, and dispositions related to emotional and social intelligence. These models may include "non-cognitive capabilities" or "competencies," as well as traits from the personality domain.Measures in this category assess various EI attributes but may also incorporate other factors like happiness, stress tolerance, self-regard, adaptability, impulsiveness, social competence, creativity, flexibility, and intuition. These approaches interpret EI in a more inclusive and mixed manner than the specific-ability models.
In summary, specific-ability models focus on assessing particular aspects of emotional intelligence in depth, while mixed-model approaches take a broader perspective by including a wide range of emotional and social attributes, competencies, and traits in their assessments of EI. Both approaches offer valuable insights into understanding and measuring emotional intelligence.

II. Emotional Intelligence Through Scientific Approach

The term EI was first coined more than 25 years ago and, as the name suggests, it refers to a form of intelligence that is not about how we process information or think, but how well we deal with our emotions. It is a combination of two aspects ie. Emotions and intelligence. There are scientific methods available for identifying the emotions in a person. Our paper focuses on the details of the scientific approach as shown in figure 2 by way of classifying the various techniques through electronic equipment in order to identify the emotions. Emotions are known to have a prominent role in analyzing the state of mind of a person and in the interaction and communication among people. In recent times recognition and classification of human emotions from Electroencephalogram (EEG) has led to the development of brain computer interfaces which empowers computers in understanding human emotions [30].
Numerous studies on engineering approaches to automatic emotion recognition have been performed in the past few decades. They can be categorized into three main approaches. The first kind of approaches focuses on the analysis of facial expressions or speech. These audio-visual based techniques allow non contact detection of emotion, so they do not give the subject any discomfort. However, these techniques might be more prone to deception, and the parameters easily vary in different situations. The second kind of approaches focuses on peripheral physiological signals. Various studies show that peripheral physiological signals changing in different emotional states can be observed on changes of autonomic nervous system in the periphery, such as electrocardiogram (ECG), skin conductance (SC), respiration, and pulse.
In comparison with audio-visual based methods, the responses of peripheral physiological signals tend to provide more detailed and complex information as an indicator for estimating emotional states. The third kind of approaches focuses on brain signals captured from central nervous system such as electroencephalography (EEG), electrocorticography (ECoG), and functional magnetic resonance imaging (fMRI). Among these brain signals, EEG signals have been proven to provide informative characteristics in response to the emotional states. Since Davidson et al. suggested that frontal brain electrical activity was associated with the experience of positive and

negative emotions, the studies of associations between EEG asymmetry and emotions have been received much attention.

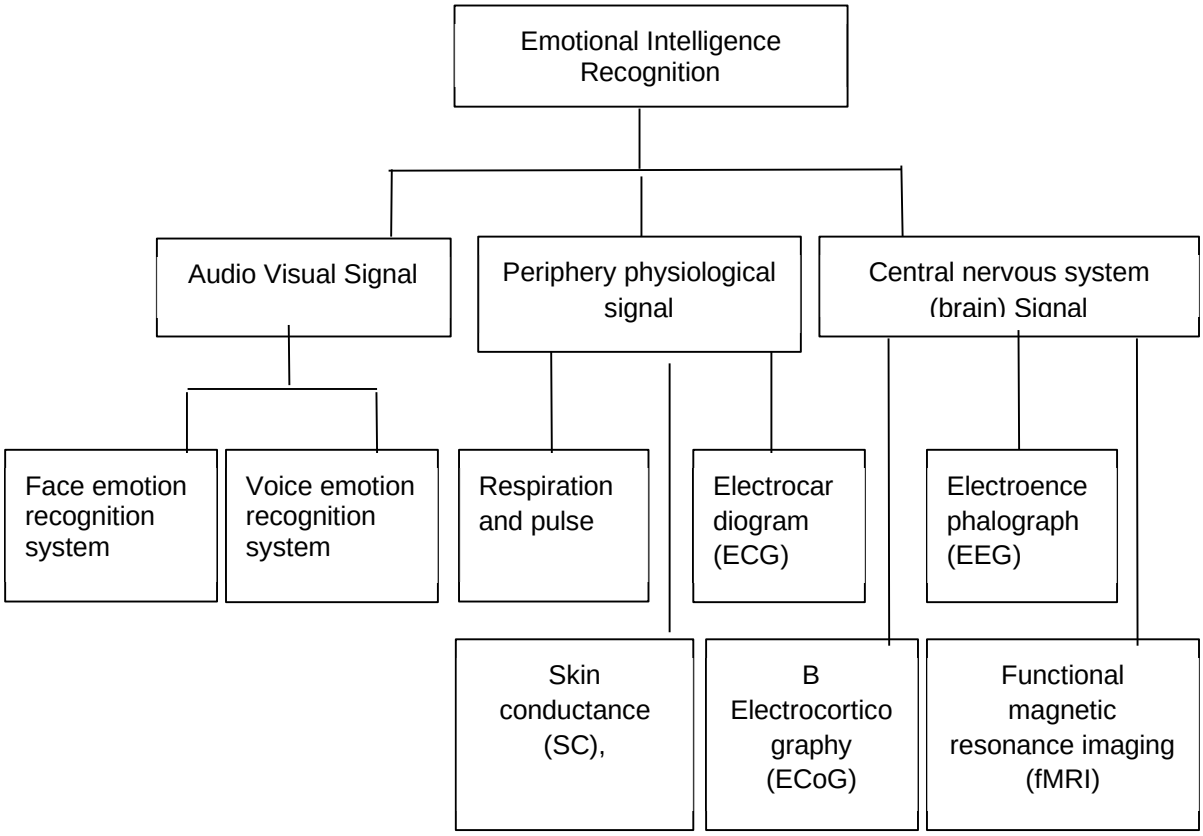

Fig 1.Different Scientific Techniques used in EI

III. Literature Review

The concept of emotional intelligence has become so popular in the management literature that it has become imperative to understand and leverage it for the sake of enhancing the capacity of human capital in organizations. As the pace of change is increasing and world of work is making ever greater demands on a person's cognitive, emotional and physical resources, this particular set of abilities are becoming increasingly important. Since majority of the concerns in organization involve people in different roles, emotional intelligence must become a determining factor for their effective management. It has also been found that ultimately it is the emotional and personal competencies that we need to identify and measure if we want to be able to predict performance at workplace resulting in its effectiveness, thereby enhancing the worth of the human capital.

In this scenario the competencies possessed by the people will have a bearing on the extent to which they can actualize their emotional intelligence. This paper discusses two approaches for EI, for which we propose two different types of reviews ie scientific approach review and psychological approach review; as follows.

A. Literature Review of Scientific Approach

The existence of challenges and problems faced by today's young generation has been corroborated through various papers. Also the fact that EI has been acknowledged as a scientific way of dealing with the situation, makes it a tool to identify, analyze and cognize the children's problems for further psychological suggestions and advice. For the cognizance of children's problems, the scientific approach as discussed above is instrumental in identifying six types of emotions such as happy, surprise, disgust, fear, anger and sad. Various scientific approaches, like Trait Emotional Intelligence Questionnaire-Child, audio visual signal like audio segmentation and speaker tracking

front-end along with an emotion recognition back-end, periphery physiological signal and central nervous system signal with this EEG signals are used for the purpose.
In paper [7] the author is conducting a longitudinal study in primary school children to investigate how personality traits relate to resting state EEG patterns. This research aims to fill gaps in understanding the developmental aspects of this relationship and extend the investigation beyond fMRI to explore the electrophysiological underpinnings. By combining EEG data and parental assessments of personality, the study seeks to gain a more comprehensive understanding of the interplay between personality and brain activity in young individuals.
The authors [9] explored various methods to analyze the textual content of student-tutor dialogues to predict emotions such as boredom, engagement, confusion, and frustration. The findings indicated that certain linguistic, psychological, and cohesion-based features in the text were highly predictive of students' emotional states, demonstrating the potential for using natural language processing and machine learning techniques to understand and predict emotions in educational settings.
Numerous studies on engineering approaches to automatic emotion recognition have been performed in the past few decades. They can be categorized into three main approaches. The first kind of approaches focuses on the analysis of facial expressions or speech [11]; the second kind of approaches focuses on peripheral physiological signal and the third kind of approaches focuses on brain signals captured from central nervous system such as electroencephalography (EEG), electrocorticography (ECoG), and functional magnetic resonance imaging (fMRI).
In paper[14] the categories of recognition of emotions with three different modalities they are:
• Uni-modal
• Bi-modal
• Multimodal
The uni-modal emotion recognition includes only one modality as input to the system. The bimodal emotion recognition included two modality as input to the system, were as multimodal can include more than two modalities for recording the signals as input to the system [14]. Study of emotion is a part of behavioral science which comes under the umbrella of cognitive neuroscience. Brain being central processing unit of human body its study through various techniques helped researchers to understand cognition.
In the paper[17] authors have determined the systemic correlation between the indicators of cognitive activity and the parameters and development of emotional intelligence (EI) and the formation of typical behavior strategies in older preschool children of three functional types (FT-1, FT-2, and FT-3), including subjects with low (LHPA), medium (MHPA), and high (HHPA) levels of habitual physical activity. They revealed the EI features typical of each functional group of children and observed a strong negative correlation between the indicator of habitual physical activity HPA and the total EI score.
A variety of life functions and cognitive processes (CPs) have been identified in cognitive informatics, psychology, cognitive science, and neurophilosophy. This paper [18] attempts to develop a layered reference model of the brain (LRMB) that formally and rigorously explains the functional mechanisms and CPs of natural intelligence.
In the paper [19]authors found that children with higher reported externalizing behaviors exhibited significantly greater relative right frontal EEG activity at rest compared with children with little to no externalizing behavioral problems. There was, however, no relation between emotional intelligence and the pattern of resting frontal EEG activity. Thus, emotional intelligence and the pattern of frontal EEG activation at rest are independent predictors of externalizing behaviors in children. Findings also suggest that individual differences in emotional intelligence may not be based on differences in levels of emotional regulation or the generation of positive affect as reflected in frontal EEG asymmetries, but rather other social and cognitive competencies required for adaptive behavior. Externalizing behaviors such as aggression and delinquency are a pervasive form of childhood maladjustment which are costly to the individual, family, and society.[19]
In paper [25], they propose a system that detects second-level emotional states of children using hour-level audio recordings. The proposed system consists of an audio segmentation and speaker tracking front-end along with an emotion recognition back-end. Supervised support vector machine is used in the front-end to improve its robustness to short and inconsistent child speech pattern and end-to-end deep learning is used in the emotion recognition back-end to improve its robustness to noise and segmentation error. They observed that the overall correct segmentation and classification rate is 93.76%.
In this work [28] authors describe an interactive life-like facial display (FACE) and a supporting therapeutic protocol that will enable us to verify if the system can help children with autism to learn, identify, interpret, and use emotional information and extend these skills in a socially appropriate, flexible, and adaptive context. The therapeutic setup consists of a specially equipped room in which the subject, under the supervision of a therapist, can interact with FACE. The android display and associated control system has automatic facial tracking,

expression recognition, and eye tracking. This survey [29] is the result of a research carried out among students in the first grade of primary school concurrently with a training program intended to develop emotional abilities in children. The following methods were applied during this study: observation, talk, questionnaire, pedagogical experiment.

In this paper[30] the author the preprocessed signals from the DEAP dataset are used for classifying human emotions. The classification accuracy using an SVM classifier with RBF kernel and a 10 fold cross validation for different electrode combinations. It is found that the classification accuracies vary upon choosing different combinations of electrodes. A maximum classification accuracy of 74.062 % was obtained using the 16 electrode combination.

In their paper[31] the author compared the performance of linear and nonlinear classifiers for emotion classification. The authors observed that the nonlinear classifiers produce better classification results. They obtained and an average classification accuracy of 66% using Linear Discriminant Analysis (LDA), 69.4% using Neural Networks (NN) and 72% using Support Vector Machine (SVM). Soleymani et al.

TABLE I: SUMMARY OF DATABASES FOR STUDYING EMOTIONAL INTELLIGENCE

Sr.No	Name of database	Total Samples
1	DEAP Dataset [11]	32
2	Enterface Dataset[12]	122
3	PhysioNet[13]	109
4	BCI Competition IV[14]	20

TABLE II: THE VARIOUS TECHNIQUES OR METHODS USED TO STUDY EMOTIONAL INTELLIGENCE.

Sr. No	Technique	Result
1	Linear Discriminant Analysis	69.4% %
2	Support Vector Machines	66.51%
3	Fuzzy Integral Fusion	87.59%
4	Filter Bank Common Spatial Pattern algorithm	71.30%

Table 1 and 2 summarizing techniques and databases related to the study of emotional intelligence

B. Literature Review of Psychological Approach

The review of previous research paper emphasizes on the relationship between ET and human qualities as is shown in Table 3. The study indicates that there are various human qualities as a result of adverse situation which make a person more emotional in nature.

TABLE III: LITERATURE REVIEW OF VARIOUS HUMAN QUALITIES AND THEIR ASSOCIATION WITH EI UNDER DIFFERENT PARAMETERS.

Sr. no	Title of paper	Aim	Result
1	The Relationship between depression and emotional intelligence among a sample of Jordanian children	To examine the relationship between depression and emotional intelligence among children.	Studies indicated that depressed male tend to have higher emotional intelligence than females.
2	Emotional intelligence, victimization, bullying behaviors and attitudes	To examine the relationship between Emotional intelligence, victimization,	Results revealed significant associations between bullying, victimisation, pro-victim attitudes and the EI dimensions Emotion

		bullying behaviors and attitudes	Recognition and Expression, Emotion Management and Control, Understanding the Emotions of Others and Emotions Direct Cognition
3	The effects of the growth environment on the adolescents' self-esteem, general intelligence and emotional intelligence	This paper aims to investigate the level of self-esteem, general intelligence and emotional intelligence of adolescents raised in foster care compared with a group of adolescents raised in normal family environments.	The results are showing differences between the two categories: adolescents raised in a normally family environment had higher marks at self-esteem, general and emotional evaluations.
4	Emotional intelligence mediates the relationship between insecure attachment and subjective health outcomes	This study investigated the mediating role of emotional intelligence in the relationship between adult insecure attachment and subjective ill health.	Results support a model in which insecure attachment is associated with deficits in emotional intelligence, which in turn is related to poorer health outcomes.
5	Behavior problems of children with autism spectrum disorder ASD and perceived stress in their caregivers: The moderating role of trait emotional intelligence?	This study is, we believe, first to examine whether Trait emotional intelligence might moderate the effect of child behaviour problems (CBP) on caregivers' psychological functioning.	Data yielded a direct relationship between child behaviour problems and Trait emotional intelligence, and caregivers' perceived stress scores ;however, no interaction effect was observed. These data reflect the fact that caregivers of children with more behaviour problems are at greater risk for psychological distress, as are caregivers with lower TEI
6	The Relationship Between Spiritual Intelligence and Emotional Intelligence with Life Satisfaction Among Birjand Gifted Female High School Students	This research determines the relationship between Spiritual Intelligence (SI) and Emotional Intelligence (EI) with Life Satisfaction (LS) among gifted female high school students in Birjand.	The results revealed that there is generally no meaningful relation between SI and LS, but a meaningful relation between EI and LS does exist.
7	Relationship between Emotional Intelligence and Educational Achievement	The research purpose is to look into the relationship between emotional intelligence and academic achievement.	Significant relation was found between emotional intelligence (self awareness, self management, social awareness and relationship management) and academic achievement.
8	Studying the relation between emotional intelligence and self esteem with academic achievement	It is a descriptive-correlative study and it is aimed to study the relation between emotional intelligence and self esteem with academic achievement.	Results showed that emotional intelligence and self esteem of students had no effect on their academic achievements.
9	Perfectionism and emotional intelligence: A test of the 2 × 2 model of perfectionism	The current study tested the interactive and main effects of two key aspects of perfectionism – personal standards and evaluative concerns – on emotional	Results from moderated regression analyses revealed similar patterns: both PS and CM were associated with emotional self-regulation (ERS), appraisal of others' emotions (AEO) and appraisal of self-emotions (AES), but only PS was associated with utilization of emotions for problem solving (UEPS).

10	Emotional intelligence, alexithymia, and interpersonal problems	The aim of this study was to examine the relations of emotional intelligence with alexithymia and interpersonal problems in a sample of students.	The results revealed that emotional intelligence was negatively associated with both alexithymia and different aspects of interpersonal problems including assertiveness, sociability, intimacy,and responsibility.
11	Relation between emotional intelligence and perceived stress among female students	The purpose of this study was to examine whether emotional intelligence is associated with perceived stress.	Regression analysis also revealed multiple correlations between TEI and perceived stress. Regression coefficient showed that emotional intelligence significantly predicted perceived stress.
12	Disruptive behaviour of students in primary education and emotional intelligence	This study analyses the relation between disruptive behaviours and the emotional abilities of children in primary education.	In conclusion, the lack of emotional abilities is a factor involved in disruptive behaviours, especially the capacity for emotional self regulation and self control.
13	Human Abilities: Emotional Intelligence	discuss the origins of the EI concept, define EI, and describe the scope of the field today.	Pivotal in this review are those studies that address the relation between EI measures and meaningful criteria including social outcomes, performance, and psychological and physical well-being.
14	Pivotal in this review are those studies that address the re- lation between EI measures and meaningful criteria including social outcomes, performance, and psychological and physical well-being.	The aim of the present study is to offer an exploration of the predictive validity of cognitive ability and emotional intelligence (EI) on scholastic achievement in a sample of Italian school-aged children (8–11 years).	results showed that trait EI had a unique power to predict math performance. Similarly, the analyses showed an interaction between emotion recognition ability and cognitive ability in predicting both language and math performance. Differences between the two emotional measures were discussed.
15	Classroom emotional intelligence and its relationship with school performance	The aim of this work was to develop a questionnaire for measuring group EI (G-TMMS) in educational contexts.	The G-TMMS showed a one-factor structure.It also demonstrated to have adequate internal consistency, temporal stability, and convergent validity. Moreover, group EI was associated with higher group school performance.
16	Connecting Emotional Intelligence and Academic Achievement in Adolescence: A Systematic Review	paper focuses on the connection between emotional intelligence (EI) and academic performance in compulsory education, by examining the existent research.	The results refer to the aims of research,models and measures of EI, measures used to assess academic achievement, dimensions of EI related with academic performance and potential influential factors on EI- academic achievement relationship. Studies generally aimed to take a more in-depth look at the relationship between different dimensions of EI and academic achievement in adolescents.
17	Ability emotional intelligence, trait emotional intelligence, and academic success in British secondary schools: A 5 year longitudinal study	This study examines the long-term effects of ability- and trait EI on academic performance for British adolescents.	Results show that the importance of ability EI resides in the fact that it moderates the effect of cognitive ability on performance in Year 11. Trait EI has a direct effect on Year 11 performance for boys only. This suggests that initiatives that help to develop ability EI and increase trait EI offer educators opportunities to improve educational achievement.

18	The relationship of trait emotional intelligence with academic performance: A meta-analytic review	aimed to assess the validity of trait emotional intelligence (trait EI) for predicting academic performance.	This meta-analysis has provided the first quantitative review of the association between trait EI and academic performance. The meta analysis yielded robust evidence of modest to moderate validity of trait EI for predicting academic performance.

Table 1 lists eighteen papers that have well defined aim and result. This listing has been crucial for our work and defining the future course of action. The cognition of emotions and intelligence with psychological approach along with its correlation to various factors, gives an insight into the areas of application and its benefits.

IV. CONCLUSION

The challenges and problems faced by today's young generation have been well-documented in various studies. Emotional Intelligence (EI) has emerged as a valuable scientific tool to address these challenges, providing a systematic approach to identifying, analyzing, and understanding children's emotional issues

The scientific approach discussed in this context focuses on recognizing six fundamental types of emotions: happiness, surprise, disgust, fear, anger, and sadness. To achieve this, researchers employ a range of scientific methodologies and tools, including the Trait Emotional Intelligence Questionnaire-Child, audio-visual signal analysis, physiological signal monitoring, and most notably, Electroencephalogram (EEG) data.

In essence, the integration of emotional intelligence assessment with EEG-based emotion recognition techniques represents a promising avenue for better understanding and addressing the emotional needs and challenges of today's youth, ultimately contributing to their overall psychological well-being.

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