Mood Board: An IoT based Group Mood Evaluation Tool

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Abstract—The proposed tool, Mood Board extends the *Mood Meter*, a tool for social and emotional learning, by offering a platform for group's mood evaluation. Mood Board is a portable and independent hardware evaluation unit for real-time evaluation of group mood. This tool finds imminent application in schools to aid educators in cultivating better learning environment and inculcating emotional literacy among students.

Index Terms—mood, social and emotional learning, group behavior, IoT, embedded systems, human computer interface

I. INTRODUCTION

Creativity, learning capability and academic or workplace performance of students and groups are affected by emotional intelligence, mood, emotions and sentiments [1], [2]. Therefore, for applications ranging from improving team dynamics to effective learning environments, a requirement of tapping into each individual's emotional spectrum in his work space, and in general cannot be disregarded.

To quantify this emotional space and imbibe Social and Emotional Learning (SEL), [3] proposed an Emotional Index (EI) ruler, commonly referred to as the *Mood Meter*. It is based on two psychometric parameters, namely *Energy* and *Pleasantness* to determine the emotional status (mood) of an individual in the emotional space into hundred definite values. Moreover, these values are distributed in four quadrants each emulating four broad emotional patterns namely *Angry*, *Happy*, *Sad* and *Calm*, thus harboring twenty-five sub-emotions in them. In a setup such as classroom or work-group, the academic performance or work-efficiency, is not just dependent on an individual but also to the overall group's mood or emotion. [4], [5] supports these claims by indicating that individual temperament's at different instances add up and are the critical influencers that effect the group mood. Even vital processes like group decision making, are affected by current mood of each individual [6] in the group. Thus, for improving work-group's performance, there is a compelling need for a method to be developed for evaluation and analysis of group emotion. In order to solve these problems, an interactive IoT based application to evaluate group - mood is proposed in this literature, named *Mood Board*, which further extends the domain of Mood Meter.

II. BACKGROUND

Social and Emotional Learning, accounts for developing social and emotional literacy, which broadly super sets one's ability to recognize, understand and manage emotions [3]. SEL, is one of vital yet neglected role in student's development. [7] details that emotional tendencies vitally impact apart from the learning styles, in students' academic and workplace performance. Mood Meter is a self-evaluation tool for SEL which can be used in a guided (classroom or workplace) or unguided (self-development) environment to gauge one's emotional patterns and create a general emotional awareness [3], [8].

This tool aids educators in developing their students Emotional Intelligence (EI) and understand how and which emotions affect creativity, learning and quality decision making.

The four quadrants are based on two axis of core values, which are: valence (Pleasantness, represented by the X axis) and arousal (Energy, represented by the Y axis) [3]. The overall emotional spectrum can be represented by hundred values, which implies $x \in [-5,5]$ and $y \in [-5,5]$. Moreover, the value ranges are distinctly defined for emotional spectrum's *Happy* ($x \in [-5,0)$, $y \in (0,5]$ i.e. Istquadrant), *Angry* ($x \in [-5,0)$, $y \in (0,5]$ i.e. IIndquadrant), *Sad* ($x \in [-5,0)$, $y \in (0,5]$ i.e. IIIrdquadrant) and *Calm* ($x \in [-5,0)$, $y \in (0,5]$ i.e. IVthquadrant), based on these core values. Refer 1 for values assigned to each sub-emotion in every emotional spectrum. Thus, for example one is feeling *Joyful*, this implies $x = 2$ and $y = 2$ and similarly, if we consider *Enraged* $x = -5$ and $y = 5$.

Mood Meter, is a quality tool for SEL, yet it suffers some inherit disadvantages, such as:

1) Lacks ability to indicate overall group emotion, to the educator/manager.
2) Observation of each student needs to be taken manually by the educator if he/she intends recording the group's emotional expression. Also, no absolute reference system exists for analysis.
3) No inherit systematized record, for student's emotional distribution, leading to improper teaching or supervision method adopted.
4) For accessing students input, the educator is required

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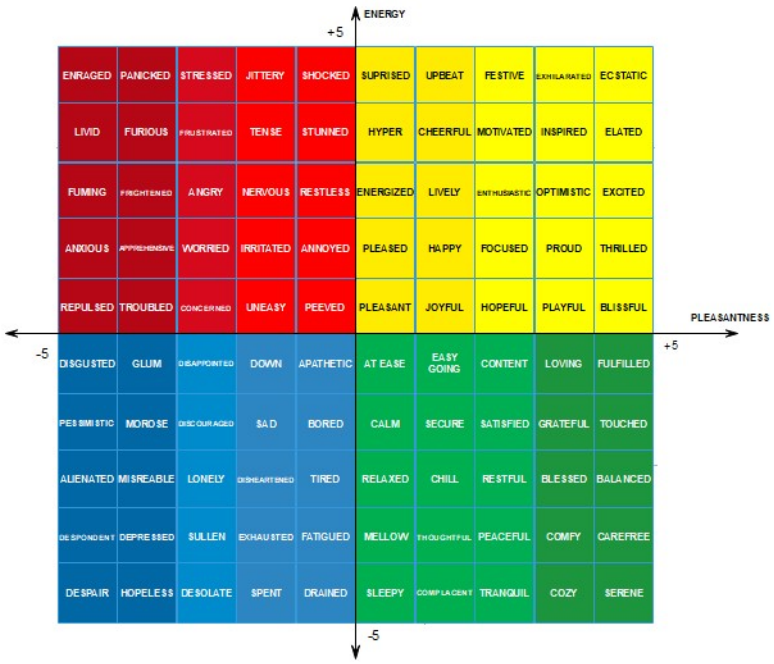

Fig. 1: Mood Meter Cartesian Representation
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Fig. 2: Mood Board: CAD Model

to access a standalone software application. Thus, there is no hardware that the educator can observe at glance while teaching/educating which can improve classroom efficiency.

To cater to the needs above, Mood Board, an IoT tool for evaluation of group dynamics has been developed.

III. MOOD BOARD

A. Introduction

The Mood Board is a portable hardware tool that extends *Mood Meter* with the enhanced ability to calculate the current group mood. It consists of four 3 × 3 matrices of LED's, representing the four emotional spectrums of the Mood Meter, which with aid of distinct reference patterns emulate the twenty-five sub-emotions. Moreover, a Liquid Crystal Display (LCD) is attached which displays the current most entry, overall group mood and entries corresponding to each emotional quadrant. The input to the Mood Board is given through a *Mood Board App* [9] via. Bluetooth. 2 presents the proposed model of the Mood Board Tool, designed on TinkerCAD [10].

B. Evaluation of Group Dynamics

The group mood value is calculated using the vector decomposition of the data entries existing on the Mood Board. As, each data entry on the mood meter is based on two core parameters, *Pleasantness* and *Energy* [3], they can be considered as the projections on the X and Y axis, respectively. Based on these arguments, the overall group mood can be equivalently understood as the vector addition of the all the data points on the Argand Plane. As, the summation can be equivalently represented as the addition of all the abscissa and the ordinate values, it can be represented in an equation form as follows:

$$X_G = \sum_{i=0}^{N} X_i \quad (1)$$

$$Y_G = \sum_{i=0}^{N} Y_i \quad (2)$$

where, N = Total Entries and (x_i, y_i) are the co-ordinates of the i^{th}entry.

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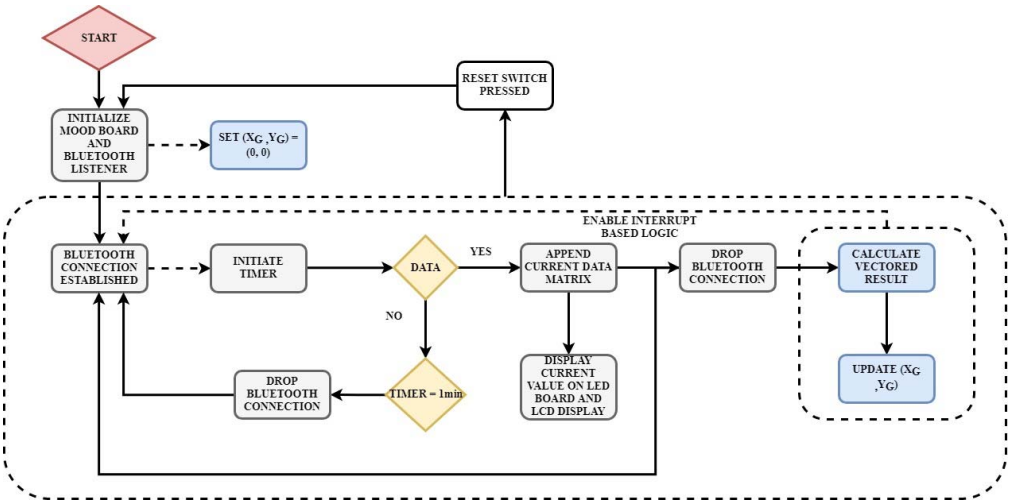

Fig. 3: Proposed Algorithm

C. Algorithmic Work Flow

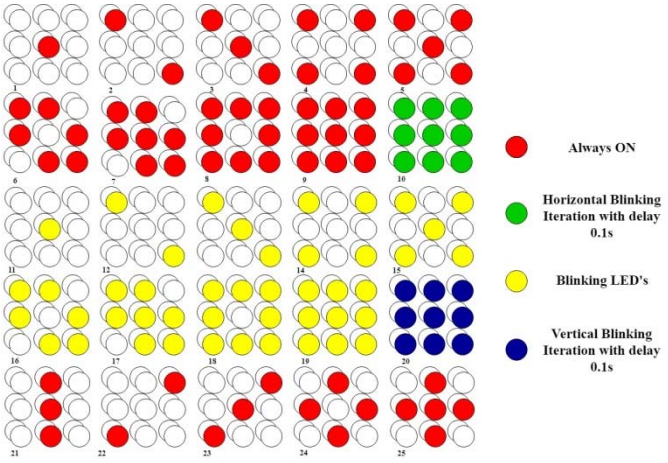

Fig. 4: LED Patterns

1) At *Power-ON*, the Bluetooth Module is initialized, an empty data record is created and $(X_G, Y_G) \rightarrow\!\!-\ (0,0)$.
2) Following this, if a Bluetooth connection is established with the Mood Board, a timer is initialized. If no data stream is received from the Mood Board app for one minute, the connection is dropped. However, if a input is received the current data entries are appended.
3) Intermediate State: After this, the current entry is displayed on the LCD screen and pattern corresponding to 4 is displayed in the quadrant corresponding to entered emotion.
4) The Bluetooth connection is dropped after this, clearing way for other devices. The internal interrupt for a new Bluetooth connection is enabled.
5) If no interrupt observed, new values of X_G and Y_G are calculated from (1) and (2), respectively.
6) Static State: The quadrant in which the X_G and Y_G lies, the nine LED's light up. However, if (1) or (2) are zero then the quadrants which align with Y_G and X_G, respectively blink alternatively. An example of this is given in 6d. If both X_G and Y_G are zero, then all quadrants light up, indicating the net-emotional spectrum as neutral Moreover, number of entries corresponding to each emotional spectrum equivalent quadrant is displayed on the LCD.
7) A hardware reset option is present, as a button on the Mood Board, as shown in the CAD Model in 2 (the orange button), pressing which the Mood Board comes to the initial state and the data record is emptied.

D. Technical Details

The current prototype is based on Arduino Nano (ATmega328P), 16 × 2 LCD, HC-05 (Bluetooth trans-receiver) and nine LED's of color's *Red*, *Yellow*, *Blue* and *Green*. The schematic layout utilized for prototyping the Mood Board is presented in 5. To input data to Mood Board, an android application was developed on APP Inventor platform [11], and is available at [9].

E. Application Demonstration

Input	(x_{val}, y_{val})	(X_G, Y_G)	Quadrant
HYPER	(1,4)	(1,4)	HAPPY
DESOLATE	(−3,−5)	(−2,−1)	SAD
PEEVED	(−1,1)	(−3,0)	ANGRY/SAD

TABLE I: Sequential inputs to Mood Board (top to bottom)

6a represents the initial state of the Mood Board. Three inputs *HYPER*, DESOLATE and *PEEVED* were given to the Mood Board sequentially. For these inputs, their corresponding location on EI Ruler, calculated values of X_G and Y_G and quadrant in which they belong are shown in the I. The intermediate state for the first entry *HYPER* is shown in 6b. Static state results of the Mood Board to *DESOLATE* and *PEEVED*, are shown in 6c and 6d respectively.

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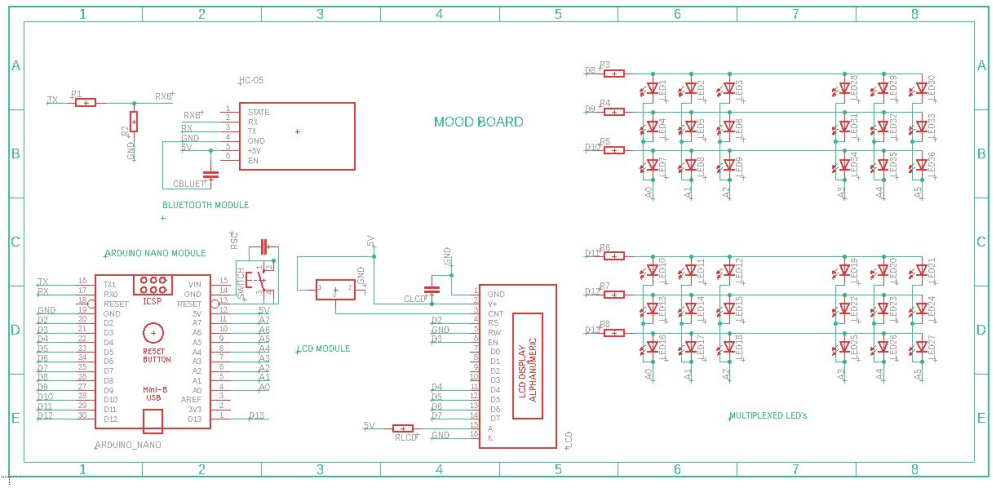
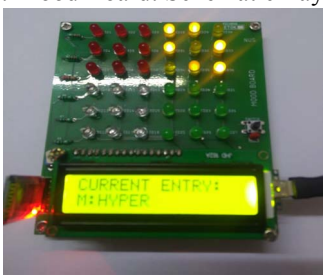


Fig. 5: Mood Board: Schematic Layout

(a) Mood Board at initiation



(b) Intermediate State: HYPER

(c) Static State: DESOLATE

(d) Static State: PEEVED

Fig. 6: Mood Board Application Demonstration

IV. CONCLUSION

Work group's performance depends on a myriad of factors such as emotional intelligence, sentiments, moods and emotions than just the bounds of adopting effective team work-flow balancing methods. Moreover, majorly the overall performance accounts on the group's mood remark during different tasks, as the underpinning to evaluate the overall performance. Thus, there is a need for an application that enables quantification and mapping of individual to group mood. In this paper, we have presented a novel IOT based group mood evaluation tool, that further extends the domains and reach of the Social and Emotional Intelligence Learning. The principle of this tool is based on *Mood Meter*, an application developed based on the Emotional Index Ruler. Mood Board is an independent hardware computation unit, to which inputs can be given from the *Mood Board App*. These inputs are mathematically decomposed to evaluate and indicate the group's overall mood. This tool is extremely simple to use, thus, finding an imminent application in platforms such as schools and work groups to gauge the group dynamics and thus, improve creativity, learning and overall performance.

V. FUTURE SCOPE

Extended features for pushing the database entries from the Mood Board to a cloud, for a comprehensive record-based analysis can be constructed in future. Moreover, the proposed tool is currently in a prototype stage and requires further evaluation and testing in schools/work-groups.

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