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Emotionally Motivated Artificial Intelligence (EMAI) Model

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Abstract- We have proposed an emotion model for life-like agents with emotions and motivations. The model uses a mechanism that generates low-level instantaneous responses to external stimuli (coming from the real world and virtual worlds) and on emotions. A basic idea of the model is coming from the cognitive theory. The cognitive and emotional processes interact with each other. A multi- module architecture may be employed in order to carry out the interactions. The model also has a learning mechanism to diversify behavioural patterns. These features are effective in giving users the illusion of life. The proposed model can be applied to characters in a virtual world and show the results obtained from the experiments with users.

Keywords- EI (Emotional intelligence) AI (Artificial intelligence)

I. INTRODUCTION

While us humans continue to struggle to understand each other, emotionally intelligent AI has advanced rapidly. Cameras in phones are ubiquitous and omnipresent, and face-tracking software is already advanced enough to analyse the smallest details of our facial expressions. The most advanced ones can even tell apart faked emotions from real ones [1].

Big data gives an edge to emotionally intelligent AIs. Unlike people, AI can leverage your whole online history, which in most cases is more information than anybody can remember about any of their friends. Some of the most advanced machine learning algorithms developed at Facebook and Google have already been applied on a treasure trove of data from billions of people. These algorithms already know what your desires, biases and emotional triggers are, based on your communication, friends and cultural context. In many areas, they understand you better than you know yourself [2].

The progress of algorithms has gone so far that Facebook and Google are now accused of creating a scenario that can affect public opinion, rapidly change political landscapes and sway elections. People have a lot of biases, which cloud our judgment. We see the world as we wish it to be, not as it is. Algorithms today, being made by people, incorporate some hints of our biases too. But if we wanted to remove such biases, it would be relatively easy to do.

As artificial intelligence gets better at manipulating us, people happily submit their lives to the algorithms. We can already see it in practice. Just look around yourself in public—almost everyone is glued to their smartphones. We are approaching an era, when artificial intelligence uses humans as organic robots to realize its goals. To make that happen, thousands of engineers are already building an API to humans.

The most successful artificial intelligence (AI) systems will be those comprising an emotional intelligence almost indistinguishable from human-to-human interaction. While the concept of AI is not new, in 2017 van der Merwe expects emotional intelligence to emerge as the driving force behind what she called the next generation in AI, as humans will be drawn to human-like interaction.

Currently, 52 percent of consumers globally interact via AI-powered live chats or mobile apps on a monthly basis. With consumer appetite for AI expected to continue to grow at a rapid pace, it is predicted that emotional intelligence will be the critical differentiator separating the great from the good in AI products, especially given that by 2020 one expects the average person to have more conversations with chat bots than with human staff.

Emotional intelligence (EI) is the ability to monitor one's own and other people's emotions, to discriminate between different emotions and label them appropriately, and to use emotional information to guide thinking and behaviour. There are following three models of EI:

(1) The ability model (focuses on the individual's ability to process emotional information and use it to navigate the social environment)
(2) The trait model (encompasses behavioural dispositions and self-perceived abilities and is measured through self-report)
(3) The mixed model (a combination of both ability and trait EI).

There are several studies which have shown that people with high EI have the following characteristics:

- greater mental health
- exemplary job performance
- more potent leadership skills.

Markers of EI and methods of developing it have become more widely coveted in the past few decades. In addition, studies have begun to provide evidence to help characterize the neural mechanisms of emotional intelligence.

There exist life-like agents which can effectively communicate with humans. It is true that all the people communicate with each other by simulating their partner's mental processes in their mind. This paper argues that an agent communicating with people should have an ability to simulate their mental processes, and proposes an agent with an artificial mind.

The word agent is used within the AI (Artificial Intelligence) domain to refer to a number of different applications. The most popular use of the term pertains to an autonomous artificial being that has the ability to interact intelligently within a temporally dynamic environment. Just how the agent achieves its intelligent interaction has become a popular research topic. In the mid 1990s a small group of researchers became convinced that true human-like intelligence could not be modelled successfully in artificial beings without the inclusion of emotion-like mechanisms.

Humans, however, sense their environment with many senses for detecting external stimuli and others for tracking their internal states. Artificial agents must also implement a number of mechanisms that track not only their external environment but also their internal states in order to interact intelligently with their environment and other agents.

II. FEATURES OF ARTIFICIAL MINDS

There are several interesting features of an artificial mind. Some of them are discussed below:

(1) Artificial minds understand emotions because people communicate with each other via expressing and estimating emotions. It has been emphasized that emotion is the predominant operation, mediating both cognition and action [3] and AI should have the ability of processing emotion [4]. Therefore, a machine should be able to process information about a user's emotions so that it can understand the user's goals as well as other information. To achieve this, it is crucial to build computational models of emotion.

(2) Artificial minds understand motivation. People interpret the meaning of matters according to their desires and concerns [5]. People consider others' motivation when they estimate their emotion and intention, explain their action, predict their future action. Therefore, it is necessary for user interface agents to understand user's motivation. Conversely, it will be easy for users to predict agent's behaviour which is based on its motivation.

(3) Agents should be adaptable to their environment and users' preferences. Agents that lack these abilities have limitations of satisfying their users. An electronic secretary repeats the same error if she cannot learn.

(4) Resources for computation, such as the number of processors and the capacity of working memory, are limited. Selective attention is required for the agent to process the most important matter in a given situation.

The integration of the behaviour-based AI (i.e. bottom-up approach) and the symbolic-based AI (i.e. top-down approach) is crucial in life- like behaviour.

III. EMOTION MODEL

A mind model for life-like agents should have the following features:

- expressing emotion
- generating behaviour based on motivation
- learning
- selective attention
- generating reactive behaviour

Information processing with emotions is not only important but also useful for many applications such as electronic secretaries, tutoring systems, and autonomous characters in entertainment [6-7]. For instance, children tend to be under the impression that characters in Disney animation have minds. A reason for this phenomenon is that the characters express rich emotions and personalities. Character's behaviours with emotions and personalities facilitate anthropomorphic view [8]. There is no switch in the brain that can be thrown to distinguish the real and mediated worlds [9]. These are some of the reasons why people personify behaviour of a machine and have illusions that cartoon characters have human-like mind. Artificial agents with emotions give such illusions to the users by utilizing these

human characteristics. There is strong need of combining artificial intelligence with emotional intelligence [10-12].

Implementation issues and model configuration concerning the model will be presented elsewhere.

IV. EVALUATION

We have conducted an experiment to evaluate the emotion model and the characters for their life-like behaviours. The intended emotions displayed by the model were compared with the users' observations on the characters' expressional states. The emotions and their situation are given in Table 1.

Table 1: Emotions and their situation examples

Emotion	Example of Situation
Happiness	An agent eats something when hungry.
Anger	Another agent steals eatables.
Sadness	A user's hand goes away when an agent wants to be petted.
Fear	Another agent threatens of attacks.
Disgust	Disliked object approaches.
Surprise	A loud noise is heard suddenly.
Boredom	An agent goes for sleeping
Hope	An agent expects good things

The other issues like (1) the users after interacting with the characters in virtual world, reporting their impression about the characters and (2) the users evaluated the characters' emotions and personalities in certain dimensions will be reported subsequently.

Prior to the experiments, the participants were only given the information about the virtual world as the following:

- There are three characters in the world and they behave autonomously.
- The characters drink water at the puddle if thirsty and eat a mango that the user puts in the environment if hungry.
- The user can pet or beat the characters with the emotions are also similar.

V. DATA COLLECTION: COMPARISON BETWEEN EXPRESSED EMOTION AND USER ESTIMATION

The procedure for the data collection is as follows: The participants verbally described their observations about each character's emotional states as they viewed a five-minute video segment of the virtual world. The user's protocol was recorded.

A total of 300 reports were collected; 100 from ITI students, 100 from BCA students and 100 from MA students. The protocol data were analysed and classified into eight emotional states. The observed emotions were compared to the intended emotions displayed by the characters. Table 2gives the results of the comparison analysis. The ratio was obtained using Eq. (1).

Ratio = Number of matched emotions/Number of user utterances (1)

The results in general showed high matching rates between the observed emotions and the intended emotions.

- Happiness showed high matching rate. The rate of happiness goes up as the knowledge of understanding goes up. This is evident from the results (Fig.1). The rate of happiness for MA students is 100.0% whereas for ITI students is 98.5%. One reason for this is that their expressions and situation is easy to understand.
- Anger showed an especially high matching rate for all the three categories of the students considered. One reason for this is that their expressions and situation is easy to understand.
- Sadness goes down as the level of knowledge increases (Fig. 2).
- Surprise had the lowest matching rate (Fig. 3). Most of the misinterpretations were confusions with Fear. This can be explained by similarity of the situations in which these emotions are displayed. If one character is yelled at by another, which tries to receive attention, it feels Fear (Fig. 4). On the other hand, if one character suddenly hears a loud noise while paying attention to something else, it displays Surprise at the noise. In addition, the facial expressions for these emotions are also similar.
- Disgust had the second lowest rate and was often misinterpreted as Anger or Pain(Fig. 5).

- The boredom had the third lowest rate. The boredom rate decreases with the level of students whereas the rate of hope increases with the level of students Fig. 6-7).

These results suggest that the users based their interpretations of the character's emotions on the situations in which they were displayed. This implies that the design of the emotion mechanisms should integrate the context.
The average values for all class of students are shown in Fig. 8. It can be seen that boredom has the lowest rate whereas anger has the highest rate.

Table 2: The result of comparison between the expressed emotions and the user estimation (%).

Category	Happiness	Anger	Sadness	Fear	Disgust	Surprise	Boredom	Hope
ITI	98.5	100.0	80.2	89.0	67.9	63.8	61.2	85.0
BCA	99.5	100.0	79.2	86.0	66.9	65.8	60.4	88.0
MA	100.0	100.0	75.2	83.0	65.9	67.8	59.6	90.0
Average	99.3	100.0	78.2	86.0	66.9	65.8	60.4	87.7

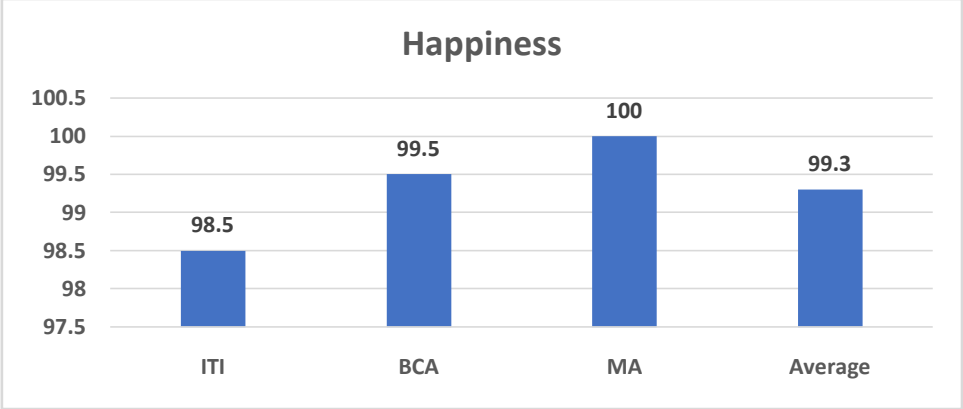

Fig.1: Happiness with level of students

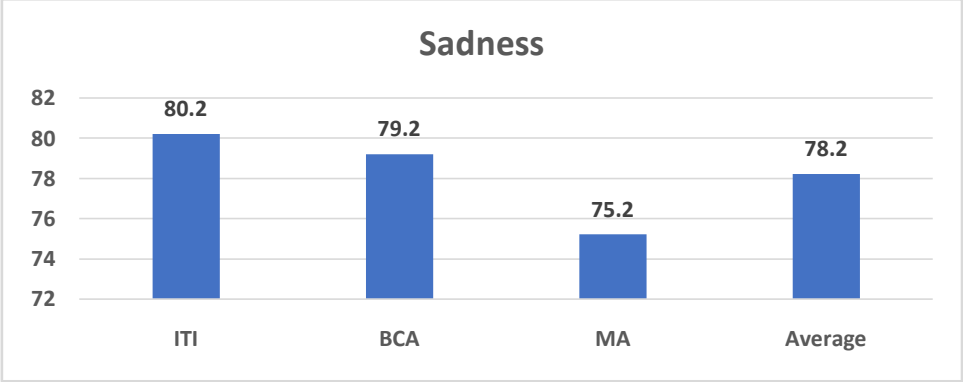

Fig.2: Sadness with level of students

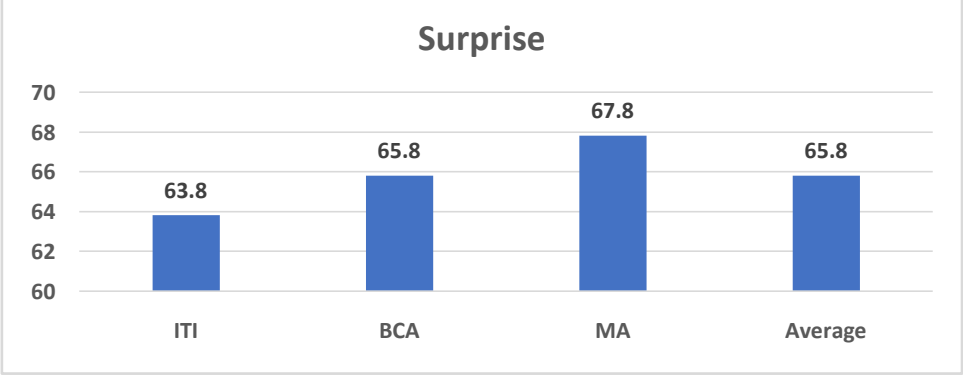

Fig.3: Surprise with level of students

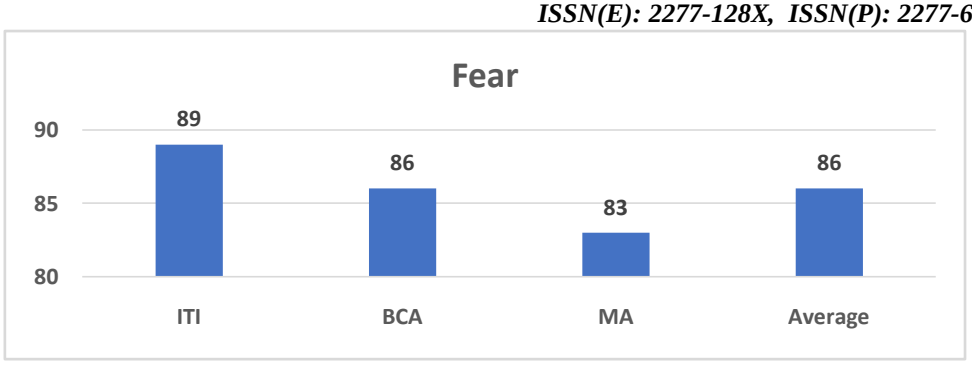

Fig. 4: Fear with level of students

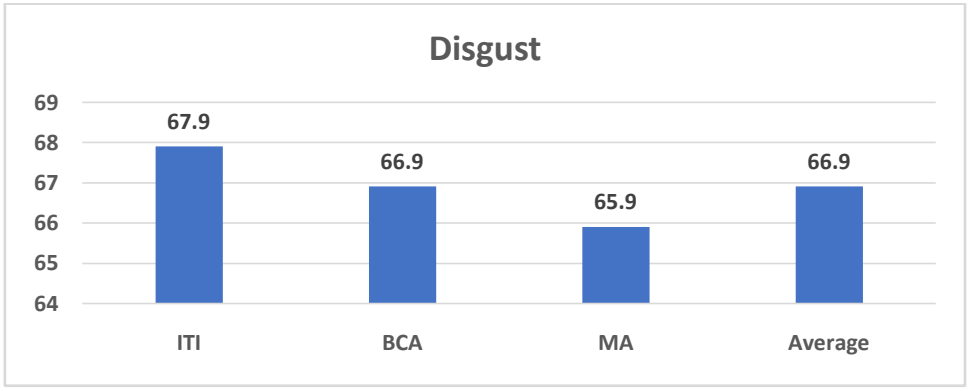

Fig.5: Disgust with level of students

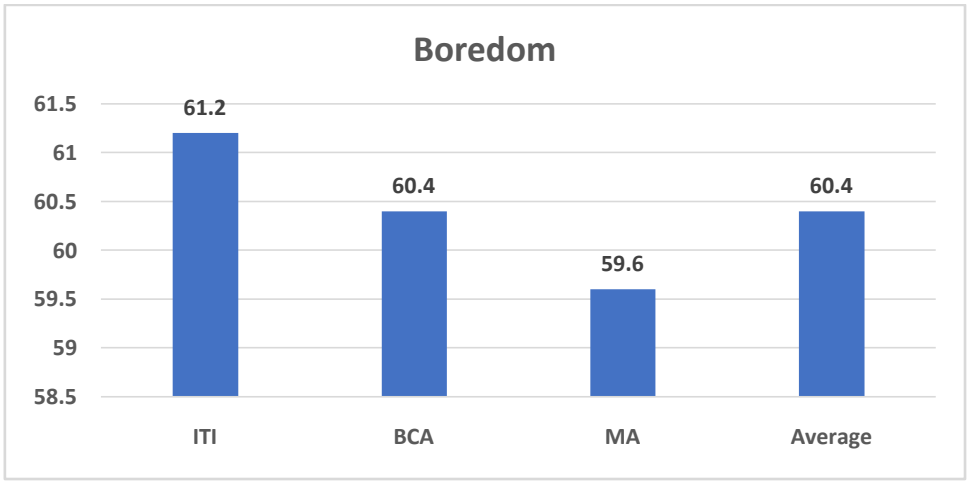

Fig.6 :Boredom with level of students

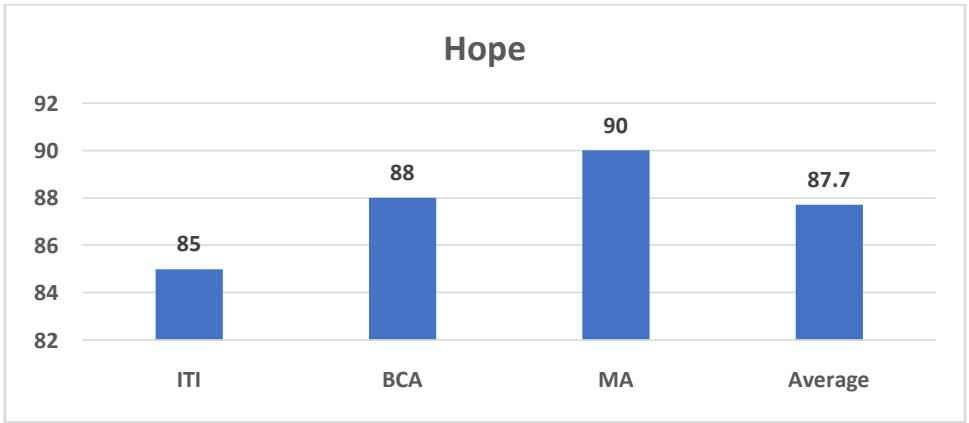

Fig.7: Hope with level of students

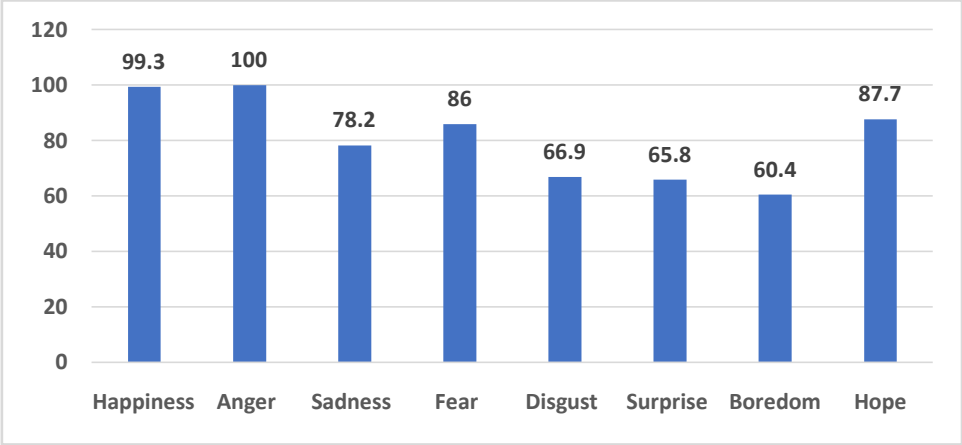

Fig.8: Average rate for all the emotions

VI. CONCLUSION

An emotion model for life-like agents is analysed. The model consists of mechanisms that generates low-level instantaneous responses to stimuli that come from the real and virtual worlds as well as mechanism especially focused on emotions and personalities.

The concept of the theory is based on interactions between cognitive and emotional process in a mind. The model realized life-like agents with motivations and emotions. The results showed that the proposed method is effective to give users the illusion of life.

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