# An Affective Agent for Studying Composite Emotions (Demonstration)

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## ABSTRACT

Using an affective agent to estimate humans' composite emotions is important for creating believable interactions in human-agent collectives. However, there is a lack of suitable platforms for building large scale datasets on this topic to help researchers improve the accuracy of estimations. In this paper, we design and implement an affective agent, which uses explicit emotion appraisals and a historical group emotion dataset to study a user's hidden emotion compositions.

## Categories and Subject Descriptors

I.2.11 [**Artificial Intelligence**]: Distributed Artificial Intelligence - *Intelligent Agents*

## Keywords

Affective agent; composite emotion; human-agent interaction; human-agent collectives

## 1. INTRODUCTION

In social interactions, peoples' actions are more driven by emotions (e.g., trust for someone [4, 9, 10]) than by logic. Hence, emotion is an important factor in human-agent interaction that needs to be closely studied. As computing devices become ubiquitous, artificial companions are becoming a viable emerging mode of human computer interaction [8, 11]. Endowing artificial companions with affective analysis and estimation capabilities has now become increasingly useful in many application domains [1, 2, 3, 7].

In this paper, we describe a demonstration of an Affective Agent (AA), its architecture, and its test-bed platform. Our work first focuses on the group emotion data collection and analysis. Then, the AA estimates a user's current composite emotion as a result of reading a given online article based on a combination of self-report emotions, qualitative appraisals of the events in the article, and historic emotion data.

## 2. THE AA ARCHITECTURE

The AA Architecture consists of four major components, including: 1) the Knowledge Base (KB), which stores historical emotional data; 2) the Sensory Processor (SP), which accepts the input of explicit emotion appraisals reported by users; 3) the Analytics Unit (AU), which executes the emotion estimation logic; and 4) the Emotional Space (ES), which presents the estimated composite emotion to user.

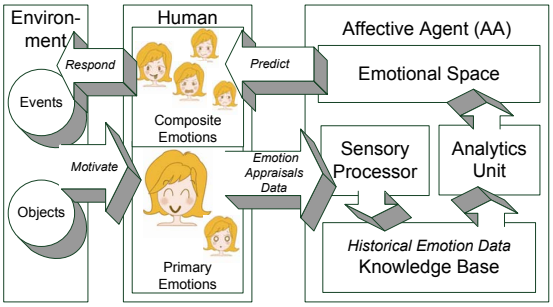


**Figure 1: The affective agent architecture.**

These components work together in a complex network of information gathering, processing, and decision-making. As shown in Figure 1, external events (e.g., reading a news articles) may cause composite emotions in a user. The agent implemented using the AA architecture receives those emotion triggers. It compares them with the internal historical emotion data in the KB and derives possible composite emotions the user is currently experiencing. The SP and the ES integrate the same types of emotion data into the agent's KB. Sensory inputs received by the SP activate AA's predefined goals and are processed by the AU to estimate the user's composite emotions. The appropriateness of the suggested composite emotions are then verified by the user.

## 3. THE DEMONSTRATION

An interactive platform has been developed to act as a gamified system for motivating users to provide labelled data on composite emotions triggered by news reports in order to facilitate affective computing research. We collected Sina society news articles from 1 Jan. 2013 to 30 Jun. 2013 as our data source[1]. Sina society news allows a reader to cast his/her vote for one of six basic emotion labels after reading. These six choices describe the feelings of Touched, Shocked, Curious, Angry, Funny, and Sad. Based on the OCC emotional model [5] and emotional space theory [6], we define a six dimensional emotional space.

For each news article, the strength of each emotion can be reflected by the percentage of votes it received among all six basic emotions. Based on this, we store the emotion votes

[1] `http://news.sina.com.cn/society/`

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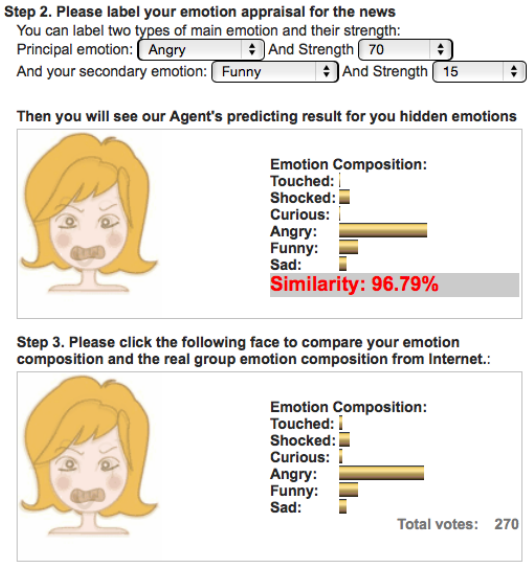


**Figure 2: The estimated composite emotions by the AA and the average of the past emotion responses.**

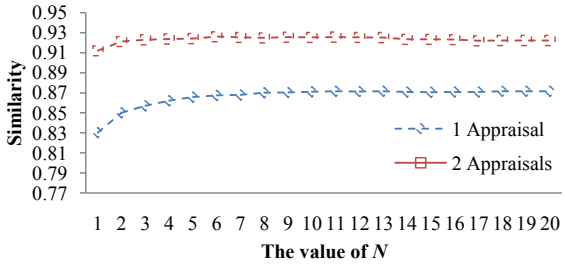


**Figure 3: The similarity curve (with $1 \leq N \leq 20$).**

for each news article as a composite emotion vector into the Agent's KB. The online test-bed platform[2] for demonstration and evaluation of the AA is shown in Figure 2. In the platform, a user first reads a society news article. Then, he/she can report the strengths of his/her principal emotion and another secondary emotion (optional). The emotion appraisal(s) will be used by AA to retrieve the top $N$ most similar news articles from the KB, according to the historical mood labels data, and then AA will calculate their average levels of the six basic emotions to estimate user's current composite emotion.

At the end of the interaction, the user can rate the correctness of the estimated composite emotion by clicking on the "Like" or "Dislike" button on the interface. In this way, the AA platform can produce a unique dataset of labelled data over time to help advance the research in generating composite emotions for human-like agents.

## 4. PRELIMINARY RESULTS

The AA uses Euclidean Distance-based Similarity to calculate the similarity between the estimated composite emotions and the group emotion components from the dataset. We randomly selected 100 Sina society news articles as the test dataset. Figure 3 shows the similarity curve when $N$ ranges from 1 to 20. The 1-Appraisal curve reflects the similarity of estimated composite emotions to real voting data for users who only reported the strength of one principle emotion. The 2-Appraisal curve reflects the similarity of estimated composite emotions to real voting data for users who reported the strength of two principle emotions. It can be observed that when $N > 8$, the similarity measure can reach 87% for 1 appraisal and 92% for 2 appraisals.

[2]`http://www.linjun.net.cn/affectiveagent/`

## 5. SUMMARY

Predicting user's composite emotions are important to designing believable artificial companions. In this demonstration, we showcase an Affective Agent, including its architecture and an online test-bed platform for this purpose. Compared with real emotion voting data collected from Sina society news website shows our AA can achieve high estimation accuracy.

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## REFERENCES

[1] Y. Cai, Z. Shen, S. Liu, H. Yu, X. Han, J. Ji, M. J. McKeown, C. Leung, and C. Miao. An agent-based game for the predictive diagnosis of parkinson's disease. In *AAMAS'14*, pages 1663–1664, 2014.

[2] B. Li, H. Yu, Z. Shen, and C. Miao. Evolutionary organizational search. In *AAMAS'09*, pages 1329–1330, 2009.

[3] J. Lin, H. Yu, Z. Shen, and C. Miao. Studying task allocation decisions of novice agile teams with data from agile project management tools. In *ASE'14*, pages 689–694, 2014.

[4] S. Liu, H. Yu, C. Miao, and A. C. Kot. A fuzzy logic based reputation model against unfair ratings. In *AAMAS'13*, pages 821–828, 2013.

[5] A. Ortony, G. L. Clore, and A. Collins. *The Cognitive Structure of Emotions*. Cambridge University Press, Cambridge, UK, 1988.

[6] Z. Wei, Z. Cui, and J. Zeng. Social emotional optimisation algorithm with emotional model. *International Journal of Computer Science and Engineering*, 7(2):125–132, 2012.

[7] Q. Wu, X. Han, H. Yu, Z. Shen, and C. Miao. The innovative application of learning companions in virtual singapura. In *AAMAS'13*, pages 1171–1172, 2013.

[8] H. Yu, Y. Cai, Z. Shen, X. Tao, and C. Miao. Agents as intelligent user interfaces for the net generation. In *IUI'10*, pages 429–430, 2010.

[9] H. Yu, Z. Shen, C. Miao, and B. An. Challenges and opportunities for trust management in crowdsourcing. In *IAT'12*, pages 486–493, 2012.

[10] H. Yu, Z. Shen, C. Miao, and B. An. A reputation-aware decision-making approach for improving the efficiency of crowdsourcing systems. In *AAMAS'13*, pages 1315–1316, 2013.

[11] H. Yu, Z. Shen, C. Miao, and A.-H. Tan. A simple curious agent to help people be curious. In *AAMAS'11*, pages 1159–1160, 2011.