



OPEN INNOVATION AND WEB BASED MONITORING BY THE USE OF EMOTIONAL MODEL

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Abstract: *The work combines the research of the following universities: Technical University of Sofia, Bulgaria (in the field of Web based Integrated Systems); Tokyo Metropolitan University, Tokyo, Japan (in the field of Human Mechatronic Design and Emotional Modeling) and University of Novi Sad, Serbia (in the field of Mass Customization and Open Innovation).*

It aims to help to the Open Innovation implementations by the development of an experimental Web-based system to create (generate) the appropriate emotional models and the usage of the system for monitoring and determination of the customers' behavior.

The possibilities for capturing of creative (innovative) information from the monitoring system, based on Emotional Model, are discussed. An experimental Web-based system is developed and its usage for the needs of the Open Innovation is proposed and described.

Key Words: *Emotional Model, Monitoring, Internet, Mass Customization, Open Innovation*

1. INTRODUCTION

The automatic detection and study of human emotions has always been an area of interest within the scientific community. Technologies are used increasingly to observe human-to-human and human-machine interactions, such as customer emotions monitoring and use of the captured information for different needs. Many experimental systems were created for the recognition of the emotions after processing biomedical signals (electromyogram, electrocardiogram, respiration rate and galvanic skin response).

The paper is privy to the development of an approach for rational usage of such systems within the Web. The Web is becoming ubiquitous, interactive, and multimodal, technology and needs to deal increasingly with human factors, including emotions. So, in our work we propose an approach for implementation of emotions

monitoring for the needs of Open Innovation by the development of a Web-based environment for easy creation (generation) of appropriate emotional models and environments and usage of the environment for monitoring and determination of the customers' behavior.

2. CONTEMPORARY APPROACHES AND MEANS

Different approaches and means have been used for the recognition of emotions: fully automatic facial expression recognition system, automatic speech and speaker recognition and etc.

One interesting and relatively new tool is the "Mirror of Emotions" [1] (Rationalizer emotion awareness for online investors shown of Fig.1) - ABN AMRO and Philips have joined forces in the development of Rationalizer, a concept targeted at investors who trade online. Investors are typically driven by two emotions, fear and greed, which can compromise their ability to take an objective, factual stance. The system consists of two components: the EmoBracelet and the EmoBowl. The bracelet measures the arousal component of the user's emotion through a galvanic skin response sensor. This arousal level is rendered as a dynamic light pattern on either the EmoBracelet itself or on the EmoBowl. Higher arousal level correspond to more intense light: the number of elements increases, the speed increases and the colour shifts from a soft yellow via orange to a deep red.

From the viewpoint of cooperative work, we can distinguish people as individuals or groups, we can distinguish machines as information machines or working machines, and we can distinguish information machines as recording medium or processing machines. This collaboration is itself ordered in time and space. Although the historical trends in cooperation between people and machines may be divided by type of



Fig. 1. Rationalizer - emotion awareness for online investors

information machine, represented by computers and working machines with power, the following five phases may be applied to both [2] (Table 1)

Table 1. Cooperation (knowledge transfer) phases

Phases	Characteristic	Form of collaboration
1	Direct	Man---Man
2	Paper	Man---Paper---Man
3	Working machine	Man---Working machine
4	Computer	Man---Computer ---Working machine
5	Network	Computer Man----- -----Man Computer--- Working machine

The Internet ages began with this premise, providing a basis for performing more advanced creative activities in a global environment.

The adoption of new techniques and methods for modeling and representing the information on Internet is a very important issue for the creation of such one environment as proposed above. We focus on XML (eXtensible Markup Language) document [3]. XML technology has a lot of possibility for the development of active documents. XML allows creation of new languages depending on the needs of the designed system, assures extensibility of the models and also we need XML to interoperate with the Web.

Another proof of scientific interest in emotions is offering new XML based language EmotionML (Emotion Markup Language) - W3C Working Draft 29 July 2010 [4].

For the experimental application shown below we use XML and create our language for the description of emotional models and generated over this description environment, as a future research we are planning to use EmotionML.

3. EMOTIONAL MODEL

As it is described above for our survey we adopted an emotional model as the represented in [5]. They applied the concepts of emotion, feeling, and mood based on a time scale, assuming that emotions change temporally based on the perceptual internal-state information and the external environment. Emotion is considered an intense relatively short-term mental state based on perceptual information and used as intermediate input from the perceptual system to the emotional model (Fig.2).

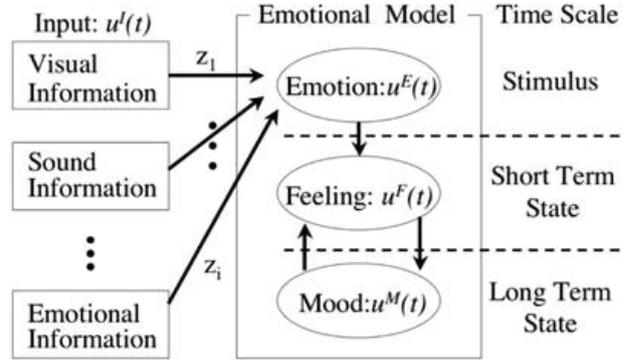


Fig. 2. Emotion model concept

Emotion depends on specific perceptual information, and each feeling is updated as the summation of emotions.

The i -th emotional input $u_{j,i}^E(t)$ is generated based on j -th perceptual input as follows:

$$u_{j,i}^E(t) = z_{j,i} u_j^I(t) \quad (1)$$

where $z_{j,i}$ is the degree of contribution from the j -th perceptual input to the i -th emotion, $u_j^I(t)$ is 1 if the j -th perceptual information is validated ($u_j^I(t) = \{0, 1\}$), and N^I is the number of perceptual inputs.

Viewed from bottom up, state of i -th feeling $u_i^F(t)$ is updated by input from emotions, and top-down constraints from mood $u^M(t)$:

$$u_i^F(t) = \kappa u_i^E(t-1) + (1 - \kappa) \sum_{j=1}^{N^E} u_{j,i}^E(t) \quad (2)$$

$$\kappa = \frac{\gamma^F}{1 + u^M(t-1)}$$

where γ^F is the discount rate of feelings ($0 < \gamma^F < 1.0$).

Mood is a relatively long-term state updated by a change in feelings, and governs changes in feelings. The short-term state of the feeling is updated by a change in emotion. The mood state is updated by the sum of feelings:

$$u^M(t) = \gamma^M u^M(t-1) + \frac{1 - \gamma^M}{N^F} \sum_{i=1}^{N^F} u_i^F(t) \quad (3)$$

where γ^M is the discount rate and N^F is the number of feelings (Fig. 3).

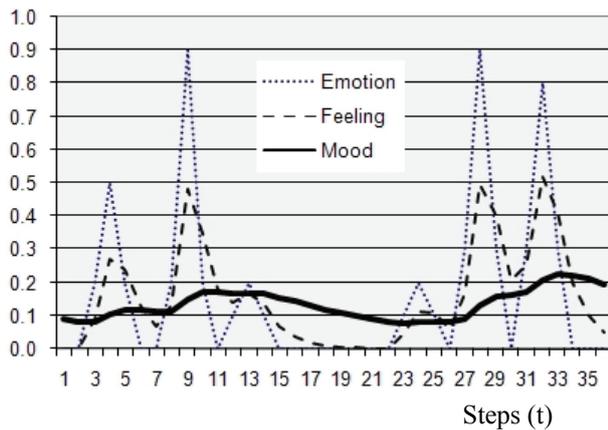


Fig. 3. Example of emotional model change

4. EXPERIMENTAL APPLICATION

The framework of our proposal is shown of Fig. 4.

Proposed Web environment consists of three kinds of units, which we call:

CU - “Creative User” (creator of the model and environment): initiates creation of monitoring environment and receives the results.

SERVER - “Main Unit” (working place of the environment): Web server with installed system for

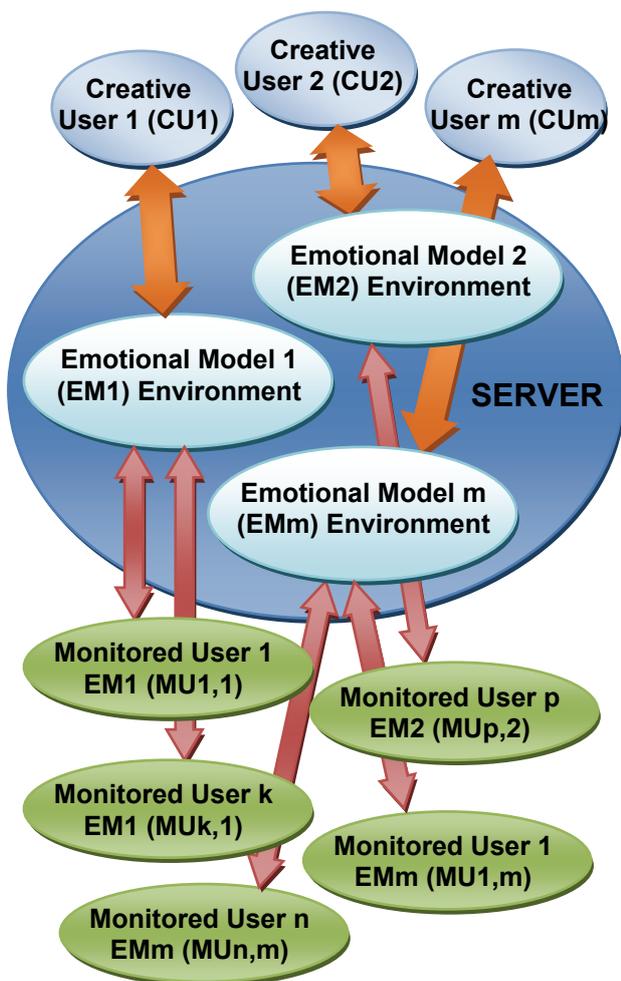


Fig. 4. Web based monitoring - framework

remote creation of emotional models and generation of working environments.

MU - “Monitored Users” (Users under emotional monitoring): monitored persons, which are observed for their emotions and which can also receive information of their own monitoring.

Our task is the development of such one “easy” system: with easy creation of models, easy operation and maintenance, easy extensible and easy integrable.

By the use of HTML, XML [3], VML [6], VB Script and Java Script an experimental Web application has been created. The working name of the application is “Web based Monitoring by the use of the Emotional Model”. It allows to the users to create emotional models and after capturing the data about the emotions values in different time points (scanned points) to calculate the values of feelings and moods, and to represent their changes by the graphic charts. It also allows the definition of the main parameters of the graphical presentation of results: size and colors. A working screen of the developed application is shown on Fig. 5.

Web based monitoring by the use of the Emotional Model:

Width - maxX:	550
Height - maxY:	350
Number of Emotions:	5
Number of Feelings:	3
Scanned time points:	30
Discount rate of Feelings (YF between 0 and 1.0):	0.7
Discount rate of Mood (YM between 0 and 1.0):	0.7

Get saved data! Create data! Calculations-Results!

Emotion No	Name	Color	Initial Value
1	Emotion 1	Red	0.00
2	Emotion 2	Green	0.00
3	Emotion 3	Blue	0.00
4	Emotion 4	Yellow	0.00
5	Emotion 5	Orange	0.00

Feeling No	Name	Color	Initial Value	FI
1	Feeling 1	Dark Red	0.00	1.00
2	Feeling 2	Dark Green	0.00	0.80
3	Feeling 3	Dark Blue	0.00	1.00

Mood No	Name	Color	Initial Value	FI
1	Mood	Black	0.00	1.00

Fig. 5. Remote creation of emotional model (parameters)

On the figure above is shown dynamical created form (based on initial data - see on Fig. 5 above the buttons) for parameters for creation of emotional model (numbers of emotions and feelings; names and initial values of emotions, feelings and mood; rates of participation of each emotion and feeling, discount rate

of feelings and mood) and graphical presentation (width; height of the graphic; shown scanned time points; colors of emotions, feelings and mood). On Fig.6 is represented working screen with a part of captured data (see below) and grafical presentation of calculations result.

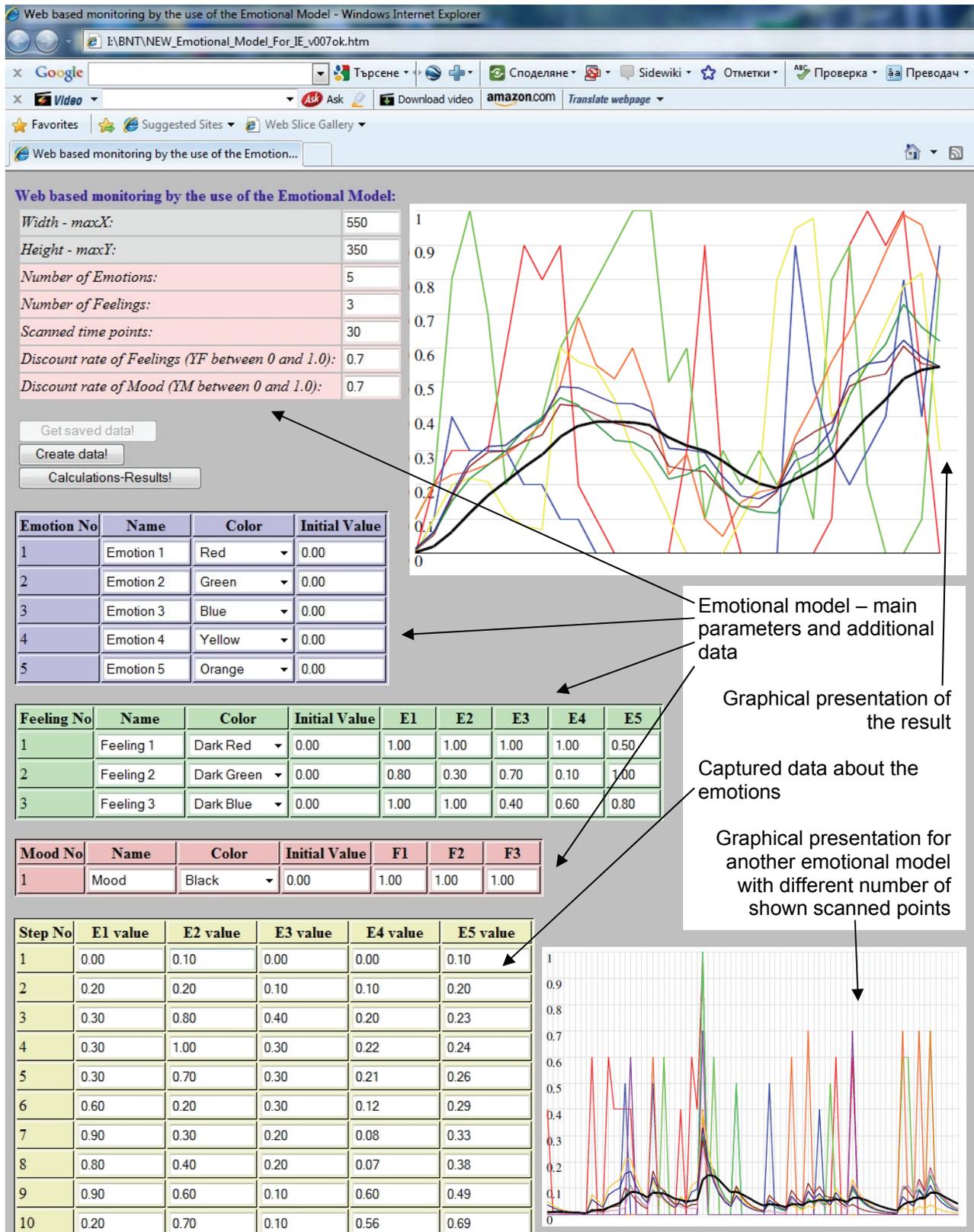


Fig. 6. A working screen with explanations

5. CONCLUSION

Involvement of users in the open innovation process through monitoring of their emotions is an very interesting and really topical task.

We can define the following results from the represented here research:

- Contemporary approaches and means for recognition of emotions are discussed and the usage of XML for the realization of the integrated system is motivated.
- A framework of a Web monitoring system based on emotional model is proposed.
- An experimental Web-based system for easy remote creation (generation) of the appropriate emotional models and corresponding environment for monitoring and determination of the customers' behavior is realized.

We plan as related future work:

- To develop the used emotional model, because it is very simple and can be more complex and précised in the future research.
- To develop a wider Web based system for emotional modelling and to implement EmotionML.
The work can be used more widely:
- The feedback to the individual user is very important. For example, if each user watches the Olympic games on the TV, the mood parameter of the people in the same country or different countries can be calculated and broadcasted. And also, we can put on the data of mood parameter with the TV program or movie in real time. So, humans will be able to decide whether or not to watch the broadcasting program by referring to the mood and feeling parameters. We can extract the feeling parameters from the reaction of the watching people.
- We can share the mood with other people even if people are far away each other.
- Similar one system can be used for remote learning purpose. For example if a robot play the violin or other musical instrument he can not hear his music, but he can use as feedback the emotions of the remote music teacher or public.
- Emotional model is very simple and easy applicable and can be used for monitoring not just of emotions, but also it can be used for monitoring of some health parameters. On this way the proposed system will allow to doctors to realize personal regimes of monitoring for their patients and to define the warnings depending of the values of parameters and etc.

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