International Journal of Advanced Technology & Engineering Research (IJATER)
National Conference on Recent Trends in Science, Technology & Management (NCRTSTM-2018)

EMOTIONAL MULTI-AGENTS SYSTEM FOR PEER TO PEER E-INTERROGATION

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Abstract

Intelligent Interrogating System (IIS) must enrich Interrogator-Criminal interactions with more personalized communications based either on cognitive and affective behaviour. This provides flexible tutoring process during interrogating process, context-sensitive help and explanation. In this context we propose a multiagent system with agents that manage both cognitive and affective model of the criminal, that are able to express emotions through emotional embodied conversational agents (EECA) and to recognize the victim's facial expression through emotional agents in peer-to-peer e-learning environments.

Introduction

In an interrogation Context to interact with the criminal most effectively, it is often useful for us to try to gain insight into "invisible" human emotions and thoughts by interpreting these non-verbal signals. Interrogator use these non-verbal signals to make judgments about the state to improve the accuracy and effectiveness of their interactions with criminal. In this approach, one privileges at the same time the contributions of a social intelligence to the shared knowledge between virtual communities. Moreover, the evolutionary and the emergence of services on demand within "peer to peer" communities becomes a strategic stake and consequently integration in the dialogue of another form of communication that the texts or the speech such as the emotions. Consequently, the question arises of knowing if one can dynamically build the protocols of "peer to peer" exchanges starting from the behaviors of the users. Therefore, we propose architecture for an intelligent emotional system. This system is called EMASPEI (Emotional Multi-Agents System for Peer to peer E-Interrogations), based on a multi agents architecture [11]; it thus makes it possible to recognize the emotional state running in the peer-to-peer network.

Multi agent's technology

Recently, distributed Artificial Intelligence techniques have been evolved towards multi-agents systems (MAS) where each agent is an intelligent system that solves a specific problem. All these agents work together, communicate, collaborate, and negotiate among them, to achieve common goals. The software agents can thus be seen as a quite appropriate platform to analyze and simulate human organizations and human teams. Recently, MAS are used to simulate human societies to analyze macro-societies (collective behavior). This is a multi-disciplinary approach where social science, psychology and cognitive science theories are implemented in a multi-agent environment. [5] According to (Hayes-Roth 1995) "Intelligent agents continuously perform three functions: perception of dynamic conditions in the environment; action to affect conditions in the environment; and reasoning to interpret perceptions, solve problems, draw inferences, and determine actions." [6] Now we are facing the challenge to emulate or simulate the way human act in their environment, interact with one another, cooperatively solve problems or act on behalf of others, solve more and more complex problems by distributing tasks or enhance their problem solving performances by competition. Multi-agent systems open a number of extremely interesting and potentially useful research avenues concerning inter-agent negotiation, persuasion and competition in agent societies. Thus multi-agent system technology seems very relevant for implementing these types of systems.

The architecture of EMASPEI

Over the past few years, peer-to-peer (P2P) networks have revolutionized the way we effectively exploit and share distributed resources. In contrast to the traditional client-server architecture, P2P systems are application level, collaborative systems where agents work together to perform certain tasks. The architecture of a peer in our P2P e-interrogation system is the following (figure 1).

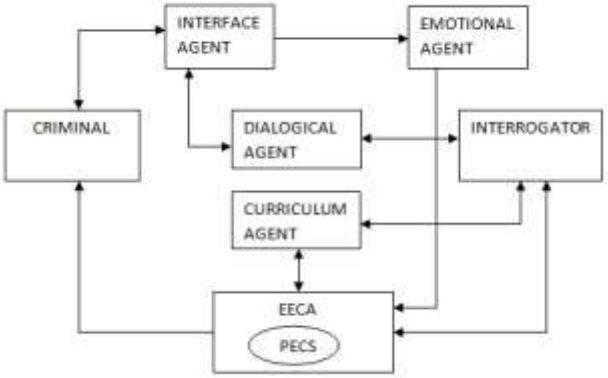

Figure 1: General architecture of EMASPEI

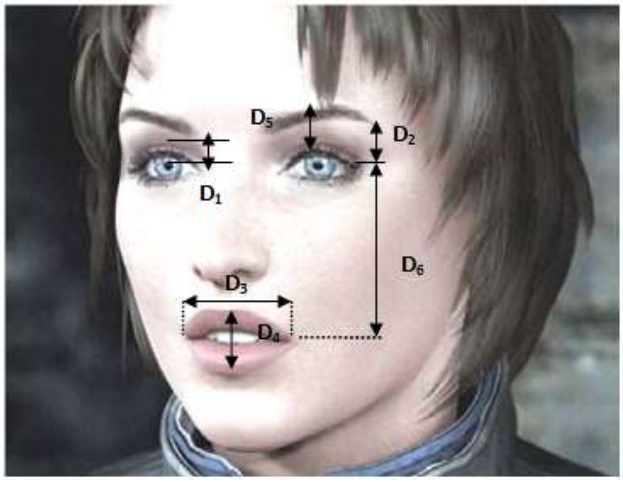

Figure 2: Definition of the distances Di

General architecture of EMASPEI

The proposed system includes five kinds of agents:

Interface Agent

- Transmit the facial information coming from the criminal to the other agents of the Multi Agents System (MAS).
- Assign the achieved actions and information communicated by the criminal, to agents Curriculum, EECA and the other agents of the MAS.

The agent interfacing is a merely reactive agent.

Emotional Agents

Extracting and validating emotional cues through analysis of criminal's facial expressions is of high importance for improving the level of interaction in man machine communication systems. Extraction of appropriate facial features and consequent recognition of the criminal's emotional state that can be robust to facial expression variations is the topic of these emotional agents.

- **Analysis of facial expression**

A machine system of analysis of the facial expressions by the emotional agents is generally carried out according to following stages: detection of the face, the automatic extraction of contours of the permanent features of the face to knowing: the eyes, the eyebrows and the lips. These features detected must be useful like basic information of an automatic system of recognition of the emotions on the face of one sitting in front of a PC. Extracted contours being sufficiently realistic, we then use them in a system of recognition of the six universal emotions on the face (joy, surprise, fear, disgust, anger, sadness).

- **Recognition and interpretation of facial expression**

•Recognition of the facial expressions [8]: classification of the structural deformations facial in abstract classes based on visual information.

• Interpretation of the facial expressions: bond with the basic emotions [14].

The expressions considered are the six universal emotions (smile, disgust, surprise, sadness, anger, fear) as well as the neutral. Classification is carried out while being based on the analysis of characteristic distances calculated on skeletons of expressions resulting from a segmentation of contours of permanent features of the face. The characteristic distances considered make it possible to develop an expert system (for classification) which is compatible with the description MPEG-4 of the six universal emotions. Contours of the eyes, the eyebrows and the mouth are extracted automatically by using the algorithms described in [2]. The segmentation leads to obtaining what we call skeleton of expression. Six distances were defined on these D1 skeletons: opening of the eye, D2: outdistance between the interior corner of the eye and that of the eyebrow, D3: opening of the mouth in width, D4: opening of the mouth in height, D5: outdistance between the eye and eyebrow and D6: outdistance between the corner of the mouth and that of the corner external of the eye (Figure 2). The objective of work presented is to set up a system of recognition of facial expressions starting from the analysis of these 6 distances.

- Joy: {D4 increase}, {D3 decrease and D6 decrease}, {the other distances remain constant}
- Sadness: {D2 increase and D5 decrease}, {D1 decrease}, {the other distances remain constant}
- Anger: {D2 decrease}, {D1 increase}, {D4 either decrease D4 increases}
- Fear: {D2 increase and D5 increase but more that D2}

- Disgust: {D3 increase AND D4 increase}, {the other distances remain constant}
- Surprised: {D2 increase}, {D1 increase}, {D4 increase}, {the other distances remain constant}

The table 1 gives a scripts of evolution of the distances Di for the six emotions (↑means increase, ↓means decrease and " = " translates the absence of evolution). Notice that fear, we don't make any hypothesis on the evolution of D1 because we don't know how to for the translate the condition {eyes are contracted and in state of alert}. Extracted contours being sufficiently realistic, we use them in a system of analysis and recognition of the six universal emotions on the face. The classification or recognition of an emotion is based on the temporal

evolution of the information contained in the "skeleton" resulting from this stage of segmentation (temporal evolution of six characteristic distances). For example, joy and disgust differ by the evolution of the distance D6. One notes that emotions (joy and surprise) differ by the evolution of distances D1, D2, D3 and D6. This permits a distinction between these two emotions.

Table 1: Di evolution for every emotion

	D1	D2	D3	D4	D5	D6
Joy	=	=	↑	↑	=	↓
Sadness	↓	↑	=	=	↓	=
Anger	↑	↓	=	↑or↓	=	=
Fear	?	↑	=	=	↑	=
Disgust	=	=	↑	↑	=	=
Surprise	↑	↑	=	↑	=	=

Curriculum Agent

The agent Curriculum saves the trace of the evolution of the system in interaction with the criminal. The trace constitutes the history of interaction. While analyzing the profile of the criminal, this agent proposes sessions of activities subsequently to apply.

Interrogator Agent

The interrogator has the role of ensuring the follow-up of the interaction of criminal. He has a role of support for the criminal in their activity, of simulative of interrogation. The role of the interrogator is to support the human relations.

Dialogical Agent

This agent should be able to interact with the criminal in natural language to answer questions of the interrogator. This agent will be responsible for communication between criminal and interrogator during the process of interrogation.

The emotional embodied conversational agent

Our objective is to produce an emotional visual entity be in charge of several software's able at the same time to enclose, evaluate, interrogate and react with the effort of the interrogator. Motivated by this principle, we have introduced the concept of an emotional embodied conversational agent (EECA). [10]

In the construction of embodied agents [4] capable of expressive and communicative behaviors, an important step is to reproduce affective and conversational facial expressions on synthetic faces.[1] Consequently and based on HUMAINE [12] that is investigates how emotions can be expressed by EECA systems we follow-up these steps:

- In the perception domain, an important pre-requisite for believable emotional interaction is an ECA capability to perceive the user, events, or other agents.
- At the level of interaction, rather than modeling the ECA merely as a speaker, it is important to attempt the generation of listener behavior
- On the generation side [9], six basic emotions are converted to facial expressions by a fuzzy rule based system.

The internal state of the EECA agent is based on the PECS architecture proposed by Schmidt (2000) and Urban (2001) [3]. The PECS architecture is a model of agent that aims to simulating the human behavior in a group. PECS stands for Physical Conditions, Emotional State, Cognitive Capabilities and Social Status. These are the four main building blocks of a particular PECS agent architecture adding a Sensor- Perception module and a Behavior-Actor module. (fig.3) The PECS reference model aims at replacing the so-called BDI (Belief, Desire and Intention) architecture. [13] Architectures, such as BDI, which conceive of human beings as rational decision makers, are sensible and useful to a very limited degree only. Restriction to the factors of belief, desire and intention is simply not appropriate for sophisticated models of real systems where human factors play an important role. [7]

The emotional agents aim at extracting the facial expressions (acquisition and facial alignment) and categorizing them (classification) using the evolution temporal of the Di distances while referring to the table1; The analysis of table 1 shows that it will be possible to differentiate between different emotions while being interested in priority in the Di distances

which undertake significant modifications. Indeed, there is always at least one different evolution in each scenario. The EECA first of all carries out an analysis of the emotional state of the learner. The purpose of this analysis

is to translate the meaning of the emotion in the training context. It is carried out while being based on several factors with knowing: emotion sent by the emotional agents, the current emotional profile, the history of the actions carried out before the appearance of the emotion, the cognitive state, the evolution of the emotion and the social context. The expressions in entry are “joy”, “fear”, “dislike”, “sadness”, “anger”, “surprised” and the analysis makes it possible to determine if the criminal is in state of “satisfaction”, “confidence”, “surprise”, “confusion” or “frustration”. The interpretation of the analyzed emotional state is then established. It will thus determine the causes having led to this situation.

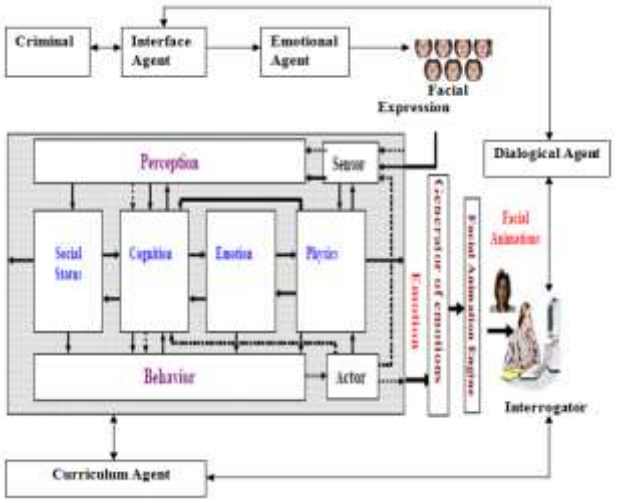

Figure 3: Architecture for Emotional Multi-Agents System for Peer to peer E-Interrogation

Conclusion and future work

In this paper we proposed the Emotional Multi-Agents System for Peer-to-peer E-Interrogation. This system is able to recognize the current emotion of the victim accordingly to their facial expression.

The future work involves the development of the complete architecture and its implementation.

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