A Virtual Human Simulator for Social Behavior to Evaluate Information Flow

Daniel Costa de Paiva

***Abstract*— A virtual human simulator that deals with the relationship between agents, and with the transmission and publishing of information (by TV, Radio, etc.) is presented. The modeling is performed by using ontology that is a formal representation, in which we can share knowledge among agents. Cognitive aspects are considered for them; therefore, the agents can understand the environment, talk to each other and use cognition to make decisions in a better way. Moreover, the reception and transmission of information, reasoning evaluation, and the evolution of society are considered. Two possibilities are important during the simulations, (1) when the agents talk to each other or (2) when the information is just made available and the agents can perceive it. The results show the evaluation of the influence of a social network communication and of the means of mass communication activity at the dynamics of information.**

***Index Terms*— Communication, Ontology, Social Network, Virtual Human Simulation.**

I. INTRODUCTION

As a starting point, a previous master's degree research [12] carried out at UNISINOS (University of Vale do Rio dos Sinos) was used, in which a simulator for crowd behavior in real life situations had been developed. The model was developed using ontology [5, 11]. In that prototype, the agents have movements according to the population and environmental configurations as defined by the user. The decision on where the agents have to go is performed in accordance with a probabilistic algorithm.

Yet now, the aim is to consider cognitive aspects, aggregating them to the agents and making more realistic simulations, so that, the agents can understand the environment, talk to each other and use cognition to take decisions in a better way. One important aspect is that the simulations should be coherent when one analyzes the behavior of a single agent, or of a society.

Using simulations, the main objective is to understand how communicational activities influence in the dynamics of the information flow. In this way, two approaches are contemplated: in the first, the agents can talk to each other, and in the second, the information is just made available by means of mass communication.

The agents then receive the information based on their interest for the embedded subject, or due to its impact. Then, based on their cognitive capabilities, they may assimilate, and understand the new information, deciding, for instance, whether to propagate it or not. This text is divided into four sections; in the next are presented the Involved Areas and which part of each one are important for this work. After that, some details of the Model and characteristics of the developed prototype version are presented. In the fourth section results, and the analysis are shown and their importance for future steps in this work is identified. The Final Remarks and proposed activities conclude this paper.

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II. INVOLVED AREAS

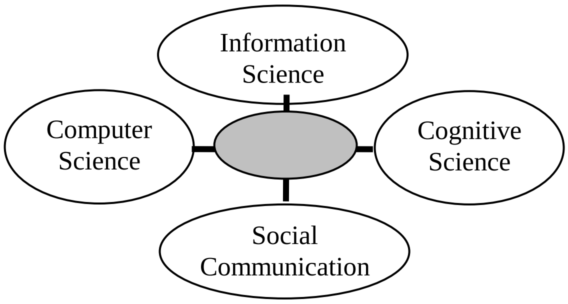

FIGURE. 1
INVOLVED AREAS

Four areas are important as seen in Figure 1. In the horizontal part, there are the areas related to the simulator and the agent's configuration. The first is Computer Science, in which Artificial Intelligence [18] and Multi Agent Systems [16] are considered and the second, Cognitive Science [17], is being used to provide more realistic characteristics to the agents through which they can receive, understand and talk about some subjects. In the vertical part, there are the areas related to the dynamics of the simulation and they are also important for the focused application and case studies.

Communication is an important aspect in our simulation, because information can be provided in two ways: in the first, it can be transmitted by means of mass communication [1, 4]; in the second, members of a relationship group can talk using culture, interests or others. This relation is called Social Network [8, 9, 15], which is also important here.

Considering related works, two research lines are important: Cognitive Aspects Simulation [1, 2, 3, 10] and Behavior Animation [6, 13, 14]. The first helps to understand knowledge acquisition, perception and mental processes in order to develop models as a base for our simulations. In Behavior Animation, different lines of research are found. A large group of researchers are concerned with reproducing realistic visual aspects and their application to games and movies. Another group intends to develop game-oriented reasoning and decision techniques [7]. A third group focuses on utility, developing robots and other machines to facilitate task solving.

In addition to the above-mentioned groups, our purpose is to simulate social behavior, as in [12]. With special consideration to virtual humans, two approaches are found.

The first and most frequent is the simulation of emergency situations to define urban environment characteristics and to reduce the number of affected people in such situations [6, 13]. Another group of simulations is related to "normal behavior", when the agents have to perform everyday life activities [14]. The present project deals with the second approach to virtual human simulation. In this way the ontology concept is used as well as modeling cognitive aspects such as information reception, reasoning, decision-making and talking action. Thus, the modeling and development performed so far partially include characteristics of the urban environment and the agent's "mind".

III. Model

In an artificial urban environment, there is a society of agents and here we are focused on the simulation of the interaction between different virtual entities representing real characters. These agents have goals and they can share resources under common rules according to [16].

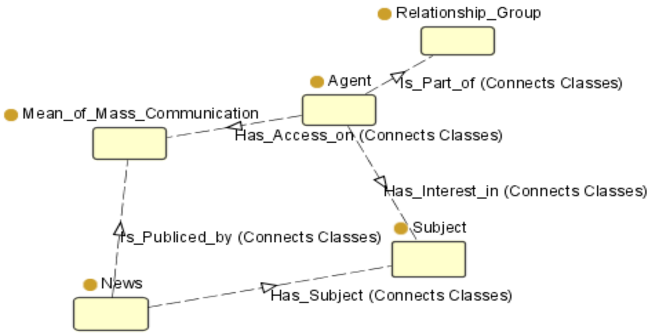

FIGURE. 2
ONTOLOGY MODEL

In this work, there are two main approaches; in the first, the agents can receive the information from a friend (as part of a Relationship_Group, top right in Figure 2), and in the second, the information is just made available on a Means_of_mass_Communication (Figure 2) and the agents that access them, can assimilate the information or not.

As part of this type of simulation, the agents were regarded as having parts responsible for specific capacities. The cognitive part is where the inputs are processed and decisions are made; and a communicative part, through which information is received and the agents can exchange it.

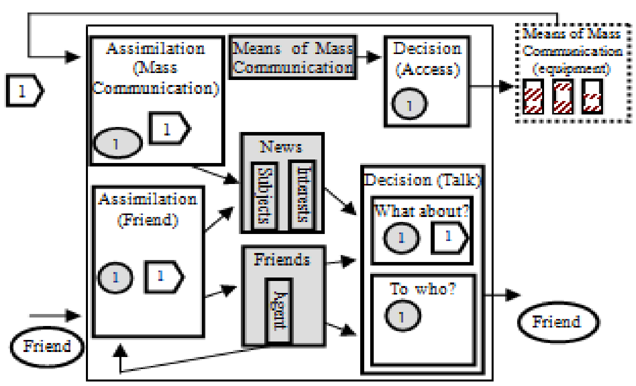

FIGURE. 3
AGENTS' "MIND"

For this work, these two parts were divided into four components (white boxes in Figure 3). In the same picture, the gray boxes represent the agent's memory, the gray circles represent the agent' interest level and the polygon represents the news impact that was defined by the user in an input file.

The Decision (Access) component is responsible for the decision making process, defining when and which Means of Mass Communication (gray box) the agent should access. The Assimilation (Mass Communication) component is activated after the access and is where the evaluation occurs by using the agent's and the news characteristics, and the assimilation, updating the News list (gray center box).

So far, the evaluating process is being conduct by using the agent Has_Interest_in (Figure 2) "level" (*) the news impact level (+) a default memory value).

The news impact is defined by the user in an input file, and here the interest is checking which is the influence of the default memory value and which is its better value (this is presented in the next section - Results).

As members of a social network, the agents can talk to friends. The two white boxes at the bottom of Figure 3 are important to this process. Then, communication is considered by having a speaker, a message, and a receiver. First, the speaker has to decide to talk. This is done using the memorized news list (gray box); he chooses "What About" and "To Whom" (right-bottom in Figure 3) talk. On the other hand, the receiver, "hears" the message, evaluates it using the Assimilation (Friend) component and updates his news list. The assimilation process occurs according to his Has_Interest_in (Figure 2) "level" (*) the news impact level (+) a default memory value). Finally, it should be clarified that the language, which the agents are using to talk, is being taken into account only as a tool for symbol exchange (boolean values), which allows them to know or not about some subject.

Another point is that in all of these cases, each character is individual, which is made possible because of different life experiences, as well as personality, subjects that they are interested in and the interest levels.

IV. Results

In order to evaluate "How much information received by the agents is memorized?" and "What is the influence of communicational activities in the dynamics of the information flow?" in this section, some graphs are presented, and they provide the possibility to analyze and compare some changing simulator configuration values. The important aspect is that all the graphs present the average value obtained from 10 simulations, using the same number of subjects, and changing only the value mentioned.

In the first step the times configuration values were changed. They interfere with the frequency of information reception. The Accessing Time (Figure 4) is related to means of mass communication access, and the Friends Speak Time (Figure 5) is related to the exchange of information between members from the same social network.

In both cases, it is seen that the configuration value alteration increases the global average of how many agents know all of the subjects.

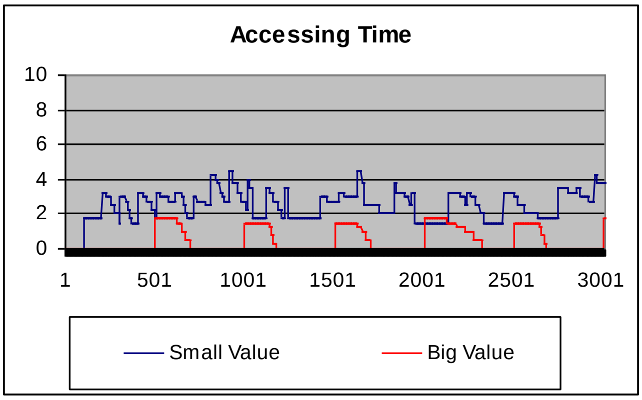

FIGURE. 4
ACCESSING TIME GRAPH

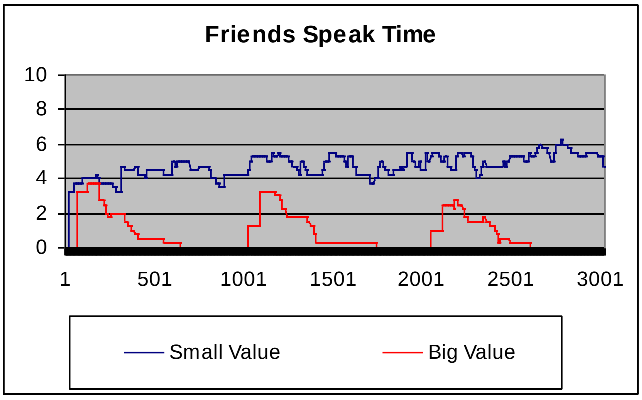

FIGURE. 5
FRIENDS SPEAK TIME GRAPH

In the second step, each one of the approaches mentioned in the Model section was chosen, and the evaluation of how many agents know the subjects are presented. In Figure 6 the broadcast using means of mass communication reach a large number of agents that receive the information. In opposition to this, observing the dynamic of information in a social network (Figure 7), the maximum value is lower, but the number of subjects that the agents know is greater. Looking at these examples, one can see that the accessing time (AT) and the default memory (DM) value interfere with the frequency at which the agents know the information. Using large AT and DM values, the number of agents that know about some subject stabilize very fast (Figure 8), hence, to present most of the results here the choice was to prioritize the dynamics on information exchange.

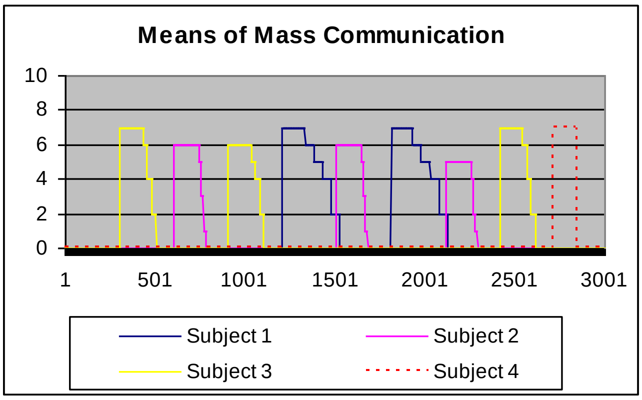

FIGURE. 6
THE DYNAMICS BY USING ONLY BROADCAST BY MEANS OF MASS COMMUNICATION

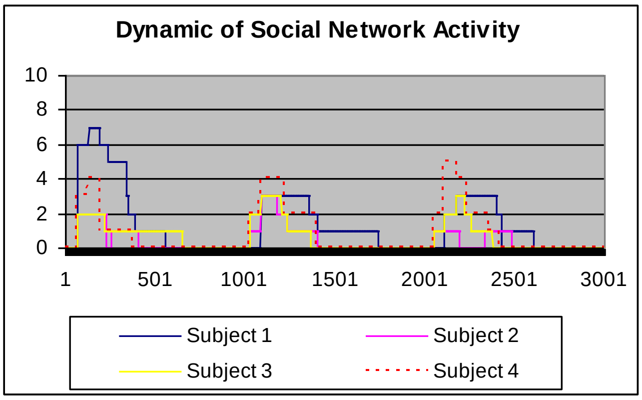

FIGURE. 7
DYNAMIC USING ONLY SOCIAL NETWORK

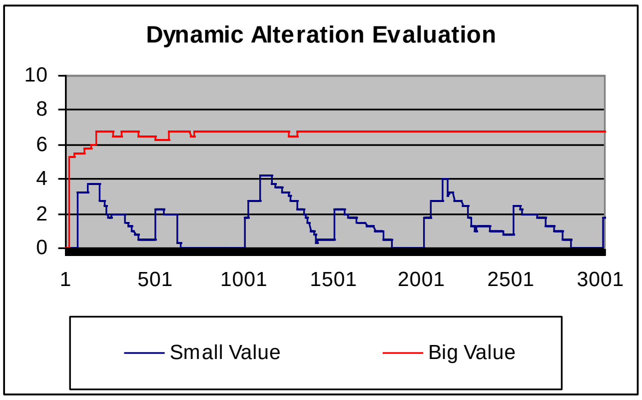

FIGURE. 8
ALTERATION OF THE DEFAULT MEMORY VALUE AND THE ACCESSING TIME VALUE

Figure 9 is related to the density of the social network connection. It shows that the alteration in a configuration of the relationship density interferes in the average number of agents that know any of the subjects. The lines in the figure show the maximum number of friends each agent has. One important aspect in this result is that the difference between 30% and 100% on social network connection is lower than expected. This occurs in accordance to the agents' characteristics that are defined in the beginning of the simulations. These are related to the fact that one agent can only talk about the subjects that he has interested in and because of the consideration of 4 subjects. In addition, who are the agent's friends and what subjects he has interests, are defined by a probabilistic algorithm according to the user configuration, thus, this interferes in the result.

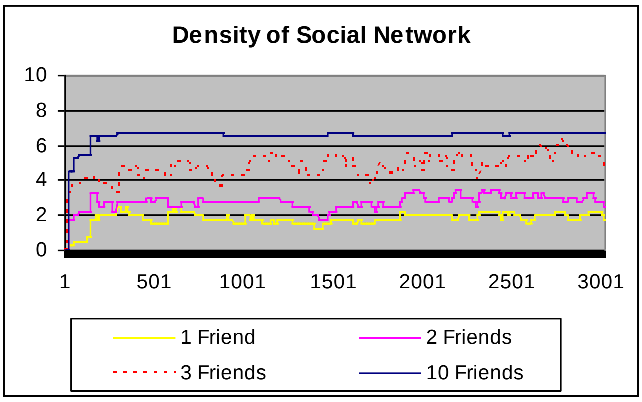

FIGURE. 9

THE INFLUENCE OF THE SOCIAL NETWORK DENSITY CONFIGURATION MODIFICATION

Finally a group of configuration values is set and Figure 10 shows an example of a combined version result. To do this, the agents were considered to have at least 3 friends, an intermediate Friend Speak Time, a smaller value of the Accessing Time, and 4 subjects. In this graph it is seen that the simulation considering only social network or only broadcast, shows a big range of values, in opposition to the stable average result obtained using a Complete Version.

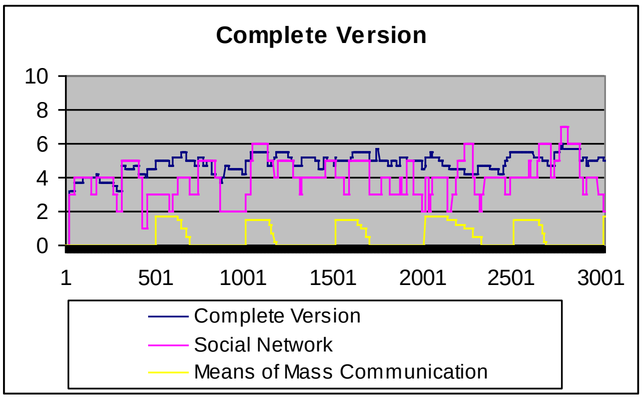

FIGURE. 10
COMPLETE VERSION GRAPH

V. FINAL REMARKS

In the beginning of this paper, the involved areas were presented. After this, a model was proposed and a virtual human simulator is being developed that deals with the relationship between agents, and with the transmission and publishing of information. The modeling is performed by using ontologies that, as a model to describe the world, have been used to achieve system interoperability regarding conceptual standardization and terminological definition. In order to make the ontology, Protégé® is been used since my master's degree program.

So as to understand the agents' participation, considering their interests (in a subject), and the impact associated with a successful advertising company, the prototype should be used to define which subject news is better to broadcast by using means of mass communication and how many people receive and understand the news. In addition, using the present version we can see the dynamics of information flow.

The results show an evaluation of some configuration values and their influence on the number of agents that know some subject over the simulation time.

A study to choose the most appropriate parameterization for the means of mass communication is currently being performed. Also, the agents' mind is being studied and defined considering more cognitive aspects and detailing the considered ones. Another option for future work concerning the relationship between agents, defining, for example, hierarchy aspects between parents and their children, bosses and employees, and the evaluation of the impact that comes from the values alteration.

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