SIMULATION OF HUMAN BEHAVIOR IN SITUATION OF EMERGENCY

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ABSTRACT
Multi-agent systems are used to study the complex natural and social phenomena. In this context, simulations are based on agent-oriented representation to describe the characteristics of the situation that all actions can be performed by actors. These tools have been used in situations of crises that are usually very difficult to manage, because of their complexity or the damage on help. In this paper. We propose a new approach for simulating multiple agents in a medical emergency based on practical reasoning of human and using the notion of simulation of complex systems.

Keywords: Multi agent systems, simulation, simulation of complex systems, medical emergency

1. INTRODUCTION

In a Multi-Agent System (MAS), agents interact and cooperate to perform a task or to achieve a common goal.
In this paper we present our simulation of a medical emergency that is 'heart attack', because if no action is taken immediately in emergency assistance and if do not act soon, the victim's life is in danger in a short term. We describe the features which we've featured in our simulation, by determining the scientific value of the project and identifying our agents, their roles and interactions between them.

2. CONCEPT OF MULTI-AGENTS SIMULATION

The multi-agent simulation is a simulation that employs the concept of multi-agents systems in the conceptualization, specification and implementation. A multi-agents system simulated living in a simulated environment; the multi-agents simulation directly represents the people, their behavior, their actions in the environment and their interactions. The multi-agents simulation is Interactions, Agents and Environment [1]. Ferber [2] notes that the multi-agents simulation allows the study of complex systems.

It represents the complexity of a phenomenon through the interaction of a single set of entities called agents. Each agent can:
- Communicate with other agents to exchange information.
- Perceive and act on all or part of the environment
- Apply knowledge, skills and other resources to perform their individual personal goals.

The objective of the multi-agents simulation is :
-to Infer the nature of the functioning of the entities of a complex system.
-System Analysis.
Simulator knows two phases of use :
- A research phase in which the simulator acts as an incubator model.
- An operational phase: once the model is validated, the simulator becomes a tool in the field.

2.1. Simulation of complex system

Simulate a complex system is to model its components, their behaviors and interactions between them and with their environment and then run the model obtained numerically. A feature of these systems is that one cannot predict the evolution of the modeled system without going through this phase of simulation. The approach "experimental" simulation makes it possible to reproduce and to observe complex phenomena (eg biological or social) in order to understand and anticipate their evolution [3]

3. MULTI AGENT SIMULATION SYSTEM FOR RAPIDLY DEVELOPING INFECTIOUS DISEASE MODELS IN DEVELOPING COUNTRIES (IDESS) [4]

3.1. Model Overview and context

IDESS (Infectious Disease Epidemic Simulation System) is a system able to build a simulation model to detect infectious diseases from the existing data in a geographical area.
IDESS is characterized by:
- The ability to create a simulation model for any location worldwide.

- Uses existing data to generate the simulation model.
- The ability to view the results in several ways.
-From a software engineering perspective, it can change the behavior of agents and interactions with others.

3.2. IDESS Implementation

They have implemented the approach in a multi-agent system application-specific. At the heart of this simulation, they used the agent person (Person Agent PA) that acts like a normal person; the PA interacts with other PA in the model simulation and the environment in terms of Agent City (Town Agent TA). PA and TA have parameters and interactions that are associated with each agent. TA agents vary according to their consciences on the changes in the population of the city. The agent TA has connections with other agents TA and PA. The interaction between the TA may change if a containment strategy was invoked by isolating and TA officer concerned.

IDESS was used to quickly build a simulation model based on agents that can be used in the investigation of the spread of disease in a given geographic.

This approach is flexible in its ability to model any geographic location by processing the unpredictable nature of the spatial location where an outbreak of an infectious disease will occur.

This system is dynamic because you can edit and add new agents and information to the model.

4. AGENT-BASED SYSTEM FOR THE EVACUATION OF THE BUILDING IN CASE OF FIRE (IFI) [5]

3.1. Model Overview and context

This system is designed to simulate agent-based building evacuation in an emergency, and more specifically they simulated the building of the IFIs in the case of the fire.

In this work, they modeled and simulated fire. They built the model with the map of the IFI building (3 floors with 18 rooms, two staircases, and 3 outputs). The initial state is that all agents are in the rooms. When the program starts, an emergency occurs.

All agents try to leave the room. They determine the nearest door to get out of them. When moving they have to avoid obstacles. If they want to pass the door is full (many agents want to spend, there is more room) they have to go to another door if available. After leaving the room, the agents determine the direction to move. With agents who know the plan of the building, they measure the distance between them is the stairs. They take the stairs closest to you. The strategy is that all agents who know the plan always use the shortest path to the exit. In the event that there are many agents who pass the stairs, congestion occurs, some agents waiting at the tail end will choose another staircase. If agents do not know the plan and around them there is no agent who knows the plan, they move according to two strategies: always running to the west or east still running, if they meet they descend the stairs, for if cons in their neighborhood, an agent knows the plan, then they follow it.

When agents encounter a fire, they change their direction, increasing their speed and find another way out. The strategy to choose another way is to take the stairs or the nearest fire is not yet declared. Other agents that meet these agents will learn the information lights and follow them.

4.2. IFI Implementation

This work aims to build a simulation that is closest to reality as possible so the authors used the BDI architecture (Belief, Desire and intention) because pedestrians must communicate and reason to find the way to the exit, and then Agents are getting smarter.

In this model, the environment is the building of the IFIs and the fires are considered an agent. There are two types of agents:

1) Agents who know the plan of the building.
2) Workers who do not know the plan of the building.

Each agent type has a different algorithm, but they have the same process to observe, to update the world (the state building and state of the stairs that wants to spend). If an agent is affected by the fire that minimal heat, it will be hurt, and the heat of fire is greatest, the agent will die.

The application is flexible; we can change the building plan by modifying the xml file. You can also change the number of agent in each room, the number and position of obstacles, fire, and the percentage of agent type and percentage rate of agent.

The reactions of the agents respond to environmental changes, they are reasonable, they can avoid congestion, avoid fire and teach others. The reasoning of the agents is following the reasoning of real people.

The application meets one important limitation: The information exchanged between agents are small, there is little communication. If agents communicate and exchange much more information, the model becomes more real.

5. MULTI-AGENTS SIMULATION IN THE CASE OF HEART ATTACK

5.1 The heart attack [6]

A heart attack is a serious problem caused by a blood clot in a coronary artery or one of the chambers of the heart. Cardiac arrest is the sudden stoppage of the heart that pumps more blood.

5.2. Signs of heart attack [6]

Defibrillation and cardiopulmonary resuscitation (CPR) quickly can save lives. Prompt treatment to break up clots can greatly increase the chances of survival of the person who suffers of heart attack. Since prompt treatment can make a difference, it is important to know the early signs of heart attack.

In case of heart attack, you may experience one or more of the following:

• Discomfort in the center of the chest that lasts more than 5 minutes or comes and goes. It takes the form of an uncomfortable pressure, tightness, a feeling of heaviness or pain.

• Discomfort in other parts of the body, such as pain or discomfort in one or both arms, neck, at the jaw or stomach.

• Shortness of breath is often accompanied by chest discomfort but can occur before the discomfort. Among other signs, call the cold sweats, nausea and a sensation of floating.

Women who are a heart attack may not experience the usual symptoms, which can delay their care. Among the symptoms: an atypical or unusual pain in the chest, abdominal pain, nausea, shortness of breath and unexplained fatigue.

5.3. Mobile-Learning [7]

Mobile-learning is a logical extension of e-learning. In this sense it refers to the provision of courses or learning objects through mobile devices such as PocketPC, cell phones or the PalmPilot Users will have lessons in reduced format, but the main advantage of such a solution is accessible at any time of day and from any location with a network is nearby. Today the knowledge of students in mobile technology (accessibility, ease of use, speed of adaptation) makes the m-learning possible.

5.4. Complex SIMUL

The main objective of our project (Complex SIMUL) is to simulate an emergency based on the simulation of complex systems. Complex SIMUL includes reactive agents that will work in a complementary way and deliberative agents (BDI type) that will incorporate the concept of practical reasoning in humans. Our system includes three different types of agents (figure1):

5.4.1. Victim Agent

It is a passive actor, it can take three different cases (a patient with a blue face, red or a deceased victim), it is reactive, and it reacts to the actions of the agent rescuer (move, help him ...).

5.4.2. Environment Agent

it is the agent that identifies the location of the accident, it is reactive type and it is dynamic (the road, the greenery ...).

5.4.3. Succourer Agent

It is the active player of our emergency; there are three types of agents:

• The emergency agent and the doctor agent: aid workers are expert-like agent, they are reactive agents.

• The no-expert agent: an agent's type BDI (Belief, Desire and intention), the agent has beliefs about the world in which it operates, it must meet the desires by making intentions).

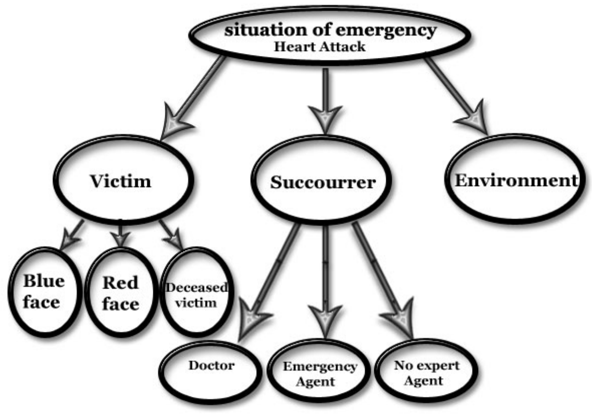

Figure1: Architecture of Complex SIMUL.

5.4.4. Why a BDI agent type?

This architecture is the most valued. In theoretical point of view, a BDI agent can perform any type of task, The architecture allows the agents to solve complex problems.

In this architecture, agents have a feature that allows evaluating the utility of each action. Contrary to the cognitive architecture of agents, the agents ask random actions when they were not able to achieve their goals. BDI agents can determine the action (or actions) to be performed to get as close as possible goal. This means that when an agent can achieve its goal by setting an action, then it will select the action as close as possible to the goal or action which will achieve this goal as quickly.

5.4.5. The operation of our Succourer Agent like a BDI agent (figure2)

Our agent includes an event queue (the actions of the agent to whom he rescued victim) by storing the internal events of the system, the beliefs (knowledge of the agent), a library of plans (know-how of the agent), a battery of desires (goals of the agent) and a stack of intentions (instantiated plans to achieve goals). The BDI interpreter cycle begins by updating the event queue and beliefs of the agent. It then activates new desires by selecting the plans of the library, so our agent has the opportunity to decide by running the first selected action stack of intentions, and so on.

This agent must:

1. Observe the environment agent and the victim agent for the possible risks.
2. Report a warning (phone call).
3. Select a plan (and it depends on his desires).

4. Select a plan by running the corresponding plan of action (the ABC of first aid).

Our no-expert agent is going to learn during the simulation using his mobile phone through the M-Learning. During the M-Learning, our BDI agent will learn along the ABC of first aid.

We used the concept of priority for emergency agents, the doctor agent has the highest priority then the emergency agent but no-expert agent will take the lowest value of priority zero boots (0) then after every successful in emergency and in the same case this value will increment to 1 and so on.

The priority of the no-expert agent is less than or equal to the priority of the emergency agent but the last two priors are always less than that of the doctor agent.

The BDI agent will protect the victim agent and his self from danger (the middle of a road) then it will use the ABC of first aid.

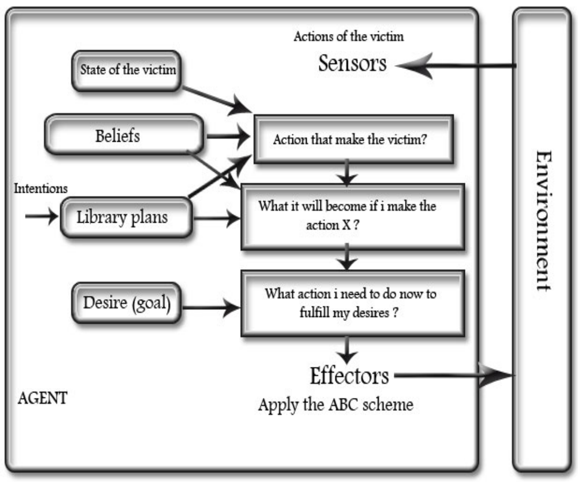

Figure2: The BDI agent of Complex SIMUL.

6. THE ABC OF FIRST AID

The priorities of first aid are…

A AIRWAY

B BREATHING

C CIRCULATION (and bleeding)

We will explain only the first operation and the Cardiopulmonary resuscitation CPR

Airway

The airway of an unconscious person may be narrowed or blocked, making breathing difficult and noisy or impossible. This happens when the tongue drops back and blocks the throat. Lifting the chin and tilting the head back lifts the tongue away from the entrance to the air passage. Place two fingers under the point of the person's chin and lift the jaw, while placing your other hand on the forehead and tilting the head well back. If you think the neck may be injured, tilt the head very carefully, just enough to open the airway [9].

CARDIOPULMONARY RESUSCITATION (CPR)

The CPR is a combination of chest compressions with rescue breathing done on the victims is believed to be in cardiac arrest. When cardiac arrest occurs, the heart stops pumping blood. CPR can support a small amount of blood flow to the heart and brain to "buy time" to restore normal heart function [9].

8. CONCLUSION

In this paper, We have tried to show the methodology for the design of our simulation, we have implemented a multi-agent simulation and an application of M-Learning which is flexible and intuitive enough to allow the rescuer to the first aid to save the life of a victim of a heart attack because the speed of treatment is very important in this case.

We currently implement the agents of our simulation and integrate them into a learning application.

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Dr. Fatima Bendella is a Senior Lecture in the Department of Computer science in USTO; she got an engineer diploma in computer science at the University of Oran in 1988, a magister of USTO in 1995 and a doctorate in 2005. She directs several theses of magister and doctorate in the application of multi-agent systems in software development. She is responsible of many research projects and a national research project (PNR) approved in May 2011.