ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 3, September 2012

Building Evacuation Using Intelligent Agents

Harjot Kaur, Gurpreet Singh, Dr. Karanjeet Singh

Abstract: ***In the previous years, the applications of agents have been increased hastily due to their number of abilities such as they can act, sense and reason according to situation. Agents perceive their environment and do maximum actions in order to be successful in their attempt. In this paper, UML (unified modeling language) has been used to design a building evacuation system in which intelligent agents has been used for experimentation and simulation because in real life we cannot experiment it with human-beings. UML can be used to design multi agent system at agent level. It provides different agent level class diagrams to model architecture of multi agent system and for coordination amongst multiple agents. We also performed simulation of UML class diagrams using Path finder simulator.***

Keywords: **Agents, UML, Pathfinder, Building evacuation, Sensors, Detectors, Stairs.**

I. INTRODUCTION

Artificial intelligence is the intelligence of machines and branch of computer science that aims to create it is also concerned in making intelligent machines such as intelligent computer programs to behave like humans[1]. Artificial intelligence includes

- **Games playing**: Computer programs are now capable of defeating humans in game playing.
- **Expert systems** : Computer application programs that take decision in real life just as human beings. They are designed to solve complex problems in particular domain like human beings and are also designed to assist experts.
- **Natural language** : The goal of natural language processing is to enable humans and computers and to communicate in natural (human language) rather than in computer language.
- **Neural networks** : Systems that simulate intelligence by attempting to reproduce the types of physical connections that occur in animal brains.
- **Speech recognition**: It allows computers to understand human speech so that they can hear our voice recognize words which we speak it simplifies the process of communication between people and computers.
- **Robotics**: It deals with the design, construction, operation, manufacture and application of robots and computer. for their control, sensory feedback, and information that can take the place of humans in difficult and extreme situations where humans cannot work.[1]

Artificial intelligence is the branch of computer science that aims to create intelligent machines and these types of machines perceive their surroundings and take steps to increase their chances of success. Artificial intelligence is the study of how to make computers to do things in a better and best possible manner. Artificial intelligence is the study and designing of intelligent agents where an intelligent agent is an autonomous entity which has the ability to take decisions like humans. Intelligence is the computational part of the ability to achieve goals different kind and degree of intelligence occur in humans and as well as in machines [1] [9]. The concept of agents appeared recently in 1970's the reason behind the emergence of agents is divide the work load of humans by effectively working in extreme and difficult situations where human-beings cannot work efficiently and chances of failures are very less and moreover we can see agents can work more efficiently as they can act and think just like humans [3]. We can find number of agent applications in different fields and they can be classified by the type and the technology which they are using. Today agents have been widely used in different areas due to their efficiency and accuracy [4].

- **Manufacturing**

The need of agents in manufacturing unit is to efficiently manage the production process and agents can work efficiently where humans cannot such as at high temperature, in moving heavy loads from one section to other sections.

- **Air Traffic Controller**

Agents have been first used as air traffic controller at Sydney's Kingsford Smith in 1995 which was known as OASIS (Optimal Aircraft Sequencing using Intelligent Scheduling)Air traffic controller are ground based controllers they provide service from the ground by having the control on airplane while it is in air or on land its primary purpose is to prevent any collision among aircrafts.

- **Health care**

MYCIN was an expert system which was designed to identify bacteria causing severe infections, such as bacteraemia and meningitis, and it also recommend antibiotics, according to patient's body weight MYCIN was developed in the early 1970s at Stanford University.[13]

- **Games playing**

On May 11, 1997, an IBM computer called IBM Deep Blue beat the world chess champion it was a six-game match in which IBM wins two games one for the champion Garry Kasparov. [4]

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 3, September 2012

It depends upon agents and the amount of knowledge they are having, such as some agents have limited knowledge and some have complete knowledge depends on the type of agents because some agents have the ability to think and learn new things as per their experience in day to day work and some agents have limited knowledge as they do not have the ability to learn new things from their past experiences. Those agents which have the ability to think and learn new things from their experiences they are known as intelligent agents, they are autonomous entities means they are independent and they are capable to decide on their own without any interference from outside[16]. They look at situation and choose the best possible methods from number of available methods to solve it. In this paper, we have used the concept of multi agent system which is a network of problem solvers in which different multiple agents interact with each other in order to solve a problem collectively. In this every agent has a incomplete information and knowledge of the system [2]. The group of problem solvers interact with each other to solve a problem that is beyond the scope of individual agents. When co-dependent problem arises, the agents coordinate with each other to solve that particular problem but their purpose is to decompose the given problem and then solve it in order to interact successfully they required to cooperate, coordinate and negotiate or discuss with each other [16]. Multi-agent systems are collection of distributed autonomous intelligent agents capable of accomplishing complex tasks through interaction, coordination, collective intelligence and emergence of patterns of behavior [6] [8]. In this paper, UML has been used to build class diagrams for modeling intelligent agents in a multi agent system. Agent class diagrams describe the static structure of the system by showing the system classes, their attributes, operations and relationship among classes.

II. METHODOLOGY

In this paper, we have proposed a building evacuation system for a building, that is on fire and agents are trying to escape from the building. We are using UML for modeling the building, a running agent and its constructs. A class diagram in UML is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. Here, the class diagrams show the static structures of the building and agents [7] and simulator Pathfinder is used for simulating the class diagram by calculating the total time taken by agents to escape from the building, in case the building is on fire. The complete class diagram for modeling a building with multiple agents is beyond the scope of this paper. While designing buildings, this simulation can help in taking various architectural decisions like stair size, placement of doors and no. of exits for designing the building [10][11].

III. RESULTS AND DISCUSSIONS

UML stands for Unified Modeling Language. UML is a pictorial language used to make software blue prints. It is an industry-standard graphical language for specifying, visualizing, constructing, and documenting the artifacts of various software systems.

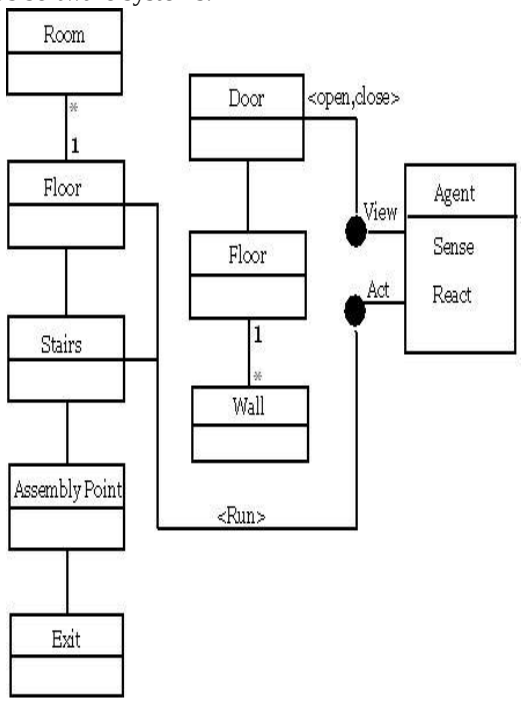

Fig 1: Class Diagram of Running Agent [5].

The class diagram in Figure1. is a type of static structure diagram that describes the structure of a system by showing the system's classes. Here is a class diagram of running agent, which has a Sensor (View) and Effectors (Act). The agents can sense doors, walls and other agents through its sensors and have the ability to open or close doors and act according to the situation. There may be a single floor with a door and there are multiple walls as indicated above by 1…*. Agents escape from building when the building is on fire by means of stairs. Agent's abilities are specified in agent class box, i.e. sense and react [5][12]. In our simulation, there is one room which is having an area of 6000.0 ft² and top floor of room is 30 feet high from ground and occupied by 350 agents with density (0.583 per/ ft²) which are trying to escape from building during emergency. The moving speed of agent is: 3.9 ft/sec, size of agent is 17.9449 inches. The room has one door on one side of it having width of 32 in, which is linked with one stair, with area 208.333 ft², length of stair is 50feet long, width of stair is 50inches., with riser 7 inches and tread 11inches, which at its end is connected to assembly point having an area of 300 ft² and exit of width 360in. We are assuming that stair entrance is not blocked by any obstacle or an agent or by fire.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 3, September 2012

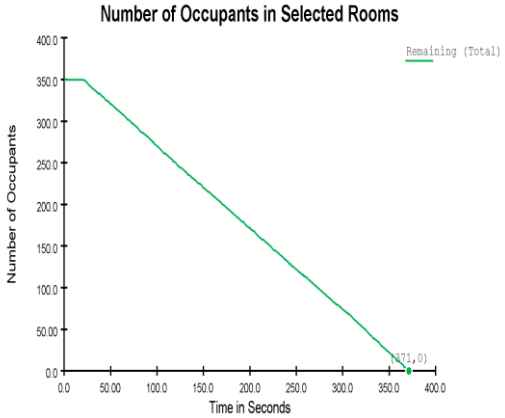

Fig 2: Indicates the Start of Simulation

In this simulation, there are total 350 agents which are trying to escape from top floor of the room in the building which is 30 feet high from the ground. This graph indicates the start of simulation i.e. when the first agent escapes from the building and after few seconds we can see the downward movement in the graph line which indicates the decline in the number of agents one by one and finally all the agents escape from the building in 371 seconds.

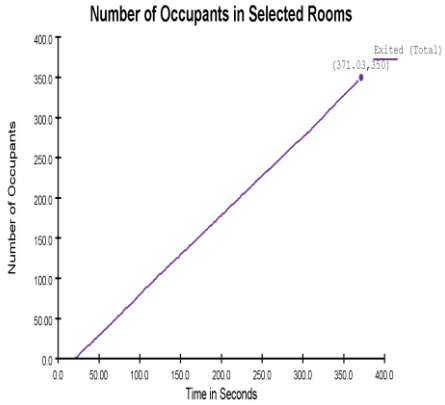

Fig 3: Total Time Taken By Agents for Their Exit.

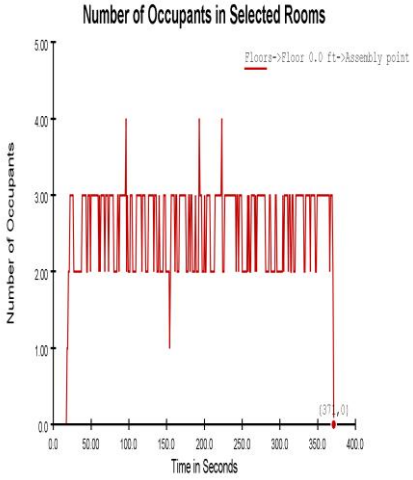

Fig 4: Time Taken By Agents in Moving From Ground Floor to Assembly Point.

The above graph indicates the time taken by agents in moving from ground floor to assembly point.

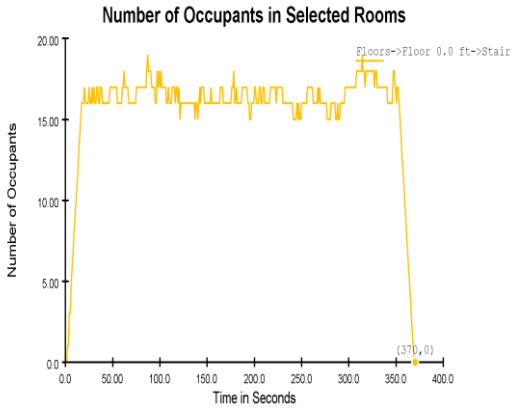

Fig 5: Indicating the Use of Stairs by Agents

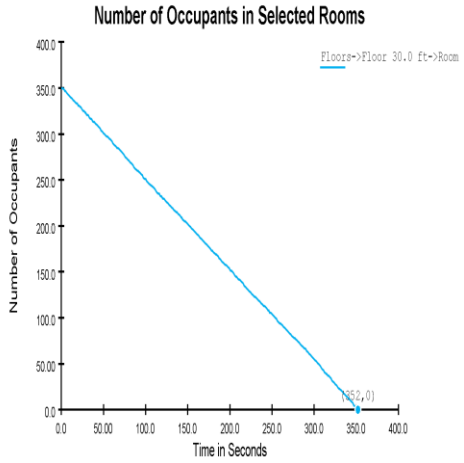

Fig 6: Indicates Time Taken By Agents To Escape From Top Floor Which Is 30 Feet High From Ground.

The above graph shows total time taken by agents to evacuate the room's top floor which is 30 ft high from ground.

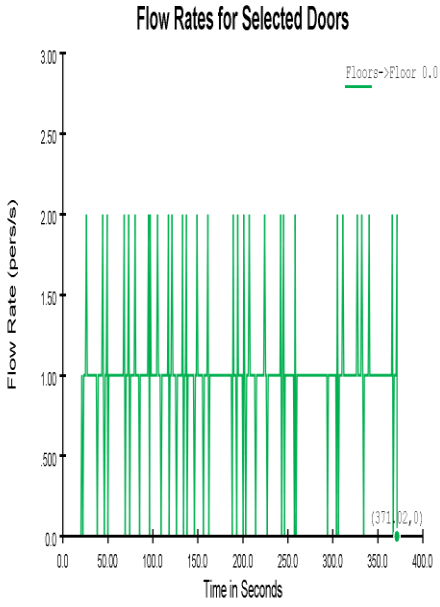

Fig 7: The Average Flow Rate of Persons from Ground Floor to Exit Door outside the Building.

This graph shows time taken by agents in moving from ground floor to exit door outside to the building.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 3, September 2012

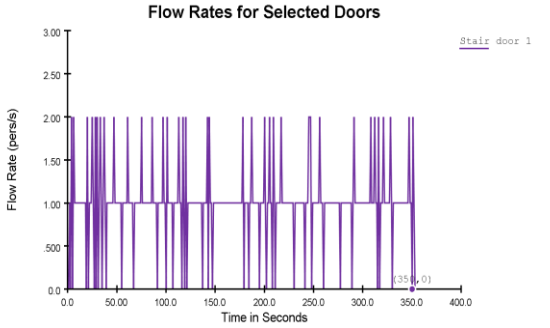

Fig 8: Flow Rate Of (Pers/S) From Stair Door 1 Located at Top Floor.

This graph indicates the flow rate of agents from the door1 which is located on the top floor at the starting point of stairs and it shows the total time taken by all agents in moving out from door1.

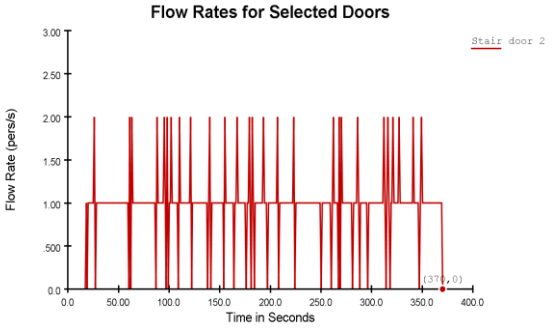

Fig 9: Flow Rate Of (Pers/S) From Stair Door 2. Located at Ground Floor.

The above graph shows the total time taken by agents in moving out from the door2 which is located at ground floor at the base of stairs.

TABLE 1: Parameter Values for Single Stair Exit.

Room/ Door	First In Time (s)	Last out (s)	Total use (person)	Flow average
Floor 0.0 ft->Assembly point	17.53	370.80	350	
Floor 0.0 ft->Stair	1.00	368.20	350	
Floor 30.0 ft->Room	0.00	351.68	350	
Floor 0.0 ft->Exit	20.13	370.80	350	0.99
Stair door 1	1.00	351.68	350	0.99
Stair door 2	17.53	368.20	350	0.99
SUMMARY	0.00	370.80	350	

III. RESULTS & DISCUSSIONS

In order to compare the results obtained by adding v The above are the readings when agents are escaping from the building floor which is 30 feet high from the ground and the agents are using single stair while moving out from the building. The above table shows the readings for agents while escaping from different parts of the building.

IV. CONCLUSION

This simulation and architecture can be used for evaluating the building security when any type of emergency occurs while designing various types of buildings. It gives an approximate idea, how much time people will take for their evacuation from any type of building (school, hospital, hotel etc.). Different types of graphs have been used to indicate the flow rate of agents from different places such as from floor, stairs, assembly point and exit.

V. FUTURE SCOPE

As in real life experiment cannot be performed by humans, So by performing the simulation one can have an idea about how much time it will take in real life to evacuate from this type of building moreover this can help in architectural decisions while constructing any new building, we can further make our evacuation system better and more effective further this simulation can be used and implemented on multiple floors of different constructional features and buildings to evaluate their security.

REFERENCES

[1] Stuart Russell and Peter Norvig, "Artificial Intelligence," Prentice-Hall, Inc, 1998.

[2] Simon Lynch, Keerthi Rajendran, "Design Diagrams for Multi-Agent Systems," In E. Dunican & T.R.G. Green (Eds). Proc. PPIG 16 Pages 66-78, 2003.

[3] Wooldridge M.J., Jennings N, "Intelligent Agents: Theory and Practice," Knowledge Engineering Review, 10, 115-152, 2005.

[4] N.R .Jennings and M. Wooldridge, "Applications of Intelligent Agents," 1999.

[5] Gurpreet singh, Menakshi sharma, Amitpal singh, "Using Intelligent Agents for Building Evacuation: An uml approach," International Journal of Computer Applications. (0975 – 8887) Volume 50– No.18, 2012.

[6] Gerhard Weiss, Multi agent Systems, "The MIT Press Cambridge,"1999.

[7] F. Bergenti, A. Poggi, "Exploiting UML in the design of Multi-Agent systems," Proceeding of the ECOOP Workshop on Engineering Societies in the Agents World 2000, pp. 96-103, 2000.

[8] Katia Sycara, "MultiAgent Systems," AI Magazine 19(2): Summer 79-92, 1998.

[9] Eduardo Alonso, "AI and Agents State of the art," .AI Magazine 23(3), fall 2002.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 3, September 2012

[10] Lidia Fuentes-Fernández and Antonio Vallecillo-Moreno, "An Introduction to UML Profiles," The European journal for the informatics professional Vol. V, No. 2, 2004.

[11] Ivan Trencansky and Radovan Cervenka, "Agent Modeling Language (AML): A Comprehensive Approach to Modeling MAS," Informatics 391–400, 2005.

[12] Juan De Lara, "Modelling agents with UML:An example in building security evaluation," Sponsored by the Spanish Ministry of Science and Technology (TIC2002-01948),2004.

[13] E.H. Shortliffe, MYCIN, "Computer-Based Medical Consultations," Elsevier, New York, 1976.

[14] Barker, D.J, Lynch, S., Simpson, D.S. and Corbett, W.A, "Speech driven natural language," Proceedings of the Joint European Conference on Artificial in Medicine, 1999.

[15] Luck, M., Marik, V., Stepankova,O. and Trappl, R. (Eds), "Multi-Agent Systems and Applications," LNAI 2086 1-16, Springer. 2001.

[16] Ira Rudowsky, "Intelligent Agents," Proceedings of the Americas Conference on Information Systems, New York, New York, August 2004.

[17] Zhiqi Shen, Robert Gay and Xuehong Tao "Goal-Based Intelligent Agents," International Journal of Information Technology, Vol. 9 No. 1.2002.