International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Efficient Intelligent Virtual Agents for Developing Game Application Using PRS Engine

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Abstract: ***Complex tasks that require much knowledge, it is necessary to employ several software agents. These agents need to share their knowledge among themselves. Sometimes the results of applying this knowledge together may fail. There are systems which tend to work without intervention from humans and are "self-organizing" systems. There is a need for intelligent system for any Multiagent application in the real world. But many real world systems related to multi agent scenario fails in the decision making. Combining artificial intelligence (AI) with a graphical representation, virtual agents are increasingly used in CRM(customer relationship management) to help people perform tasks such as locating information or placing orders and making reservations but fails in the performance related to some interaction and concentration factors. In the research, the system has been modeled by developing a theory of mind for gaming applications using PRS (procedural reasoning system) with better reasoning to the agent with extended capabilities. The behavior of the agents has been carried out by comparing the proposed solution with other familiar virtual agent system based upon certain criteria. Some tasks can be broken into sub-tasks to be performed independently by specialized agents. Such agents work independently in their environments and complete all their operations successfully. The multiple agents interact with each other to share information or barter for specialized services to affect a deliberate synergism. Decision tree learning algorithm has been successfully used in expert systems in capturing knowledge. The main task performed in these systems is using inductive methods to the given values of attributes of an unknown object to determine appropriate classification according to decision tree rules. In decision tree learning, ID3 (Iterative Dichotomiser 3) is an algorithm used to generate a decision tree from SUDOKU game data set. ID3 is typically used in the machine learning and natural language processing domains. The main advantages of the ID3 algorithm are that it is easily implemented, being quite a simple process, and its running time increases only linearly with the complexity of the problem. Procedural Reasoning System (PRS) is a framework for constructing real-time reasoning systems that can perform complex tasks in dynamic environments. It is based on the notion of a rational agent or intelligent agent using the Belief–Desire–Intention (BDI) software model. Each knowledge area provided to the Procedural Reasoning System is a piece of procedural knowledge that specifies how to do something. The last Non player charactertics agent uses a Theory of mind approach and explicitly uses a BDI model it has of the player. Procedural Reasoning System combined with a theory of mind approach allows the Non player charactertics agent to reason about the BDI model of the player and manipulate the player (i.e., the player's observations) in such manner that the player no longer performs actions that ultimately lead to winning the game.***

Keywords: Agent; Multiagent; decision making; dynamic information;

1. Introduction

An agent is a computing entity that performs user delegated tasks autonomously. The major characteristic of an agent is that it does something by itself or it acts on behalf of someone or something. An agent is the one that is authorized to act for another. Agents possess the characteristics of delegacy, competency, and amenability. Delegacy is the property of discretionary authority to autonomously act on behalf of the client. Actions include making decisions, committing resources, and performing tasks. Competency is the capability to effectively manipulate the problem domain environment to accomplish the prerequisite tasks. Competency includes specialized communication proficiency. Amenability is the ability to adapt behavior to optimize performance in an often non-stationary environment in responsive pursuit of the goals of the client. Amenability may be combined with accountability. A Software Agent is an artificial agent which operates in a software environment. Software environments include operating systems, computer applications, databases, networks, virtual domains. Delegacy for software agents centers on persistence. Software agents stay resident, or persistent, as background processes after being launched. By making decisions and acting on their environment independently, software agents reduce human workload by generally only interacting with their end-clients when it is time to deliver results. Competency within a software environment requires knowledge of the specific communication protocols of the domain. Protocols such as SQL for databases, HTTP for the WWW, and API calls for operating systems must be preprogrammed into the software agents, limiting their useful range. Amenability for non-intelligent software agents is generally limited to providing control options and the generation of status reports that require human review. Such agents often tend to be brittle in the face of a changing environment, necessitating a modification of their programming to restore performance. Intelligent Software Agent (ISA) is a software agent that uses Artificial Intelligence (AI) in the pursuit of the goals of its clients. Artificial Intelligence is the imitation of human intelligence by mechanical means. Clients can reduce the human workload by delegating the tasks to ISAs that normally would require human-like intelligence. Thus the word "agent" by itself generally connotes ISAs in the terms of the present-day research community. Agents should perceive their environment which may be the physical world, a user, a collection of agents, the Internet, etc. and respond in a timely fashion to the changes that occur in it. Agents should not simply act in response to their environment; they should be able to exhibit opportunistic, goal-directed behavior and take the initiative wherever appropriate. The agents should be able to interact, when they are found appropriate to work with other artificial agents and

humans in order to complete their own problem solving and to help others with their activities. Delegacy for ISAs is far more absolute. ISAs have the capability to generate and implement novel rules of behavior where human beings may never have the opportunity or desire to review such rules. Competency as practiced by ISAs adds higher order functionality to the mix of capabilities. In addition to communicating with their environment to collect data and actuate changes, ISAs can often analyze the information to find non-obvious or hidden patterns, extracting knowledge from raw data. Environmental modes of interaction are richer, incorporating the media of humans such as natural language text, speech, and vision. Amenability in ISAs can include self-monitoring of achievement towards the client goals combined with continuous, online learning to improve performance. Adaptive mechanism in ISAs means that they are far less brittle to changes in the environment and may actually improve. In addition, client responsiveness may go so far as to infer what a client wants when the client himself does not know or cannot adequately express the desired goals in definitive terms. In customer relationship management, a virtual agent is a chatterbot program that serves as an online customer service representative for an application. Because virtual agents have a human appearance and respond appropriately to customer questions, they lend automated interactions a semblance of personal service. Combining artificial intelligence (AI) with a graphical representation, virtual agents are increasingly used in CRM to help people perform tasks such as locating information or placing orders and making reservations but fails in the performance related to some interaction and concentration factors. In this research, the system has been modelled by developing a theory of mind for gaming applications using PRS with better reasoning to the agent with extended capabilities. The behavior of the agents has been carried out by comparing the proposed solution with other familiar virtual agent system based upon certain criteria. Some tasks can be broken into sub-tasks to be performed independently by specialized agents. Such agents work independently in their environments and complete all their operations successfully. The multiple agents interact with each other to share information or barter for specialized services to affect a deliberate synergism. While each agent may uniquely speak the protocol of a particular operating environment, they generally share a common interface language which enables them to request specialized services from their neighbor agents as required.

2. Problem Statement

At a certain level of abstraction, many of the above applications share common features. Individual agents are designed and built to enact particular roles. These agents are autonomous, goal directed entities, which are responsive to their environment. They interact with other agents in order to carry out their role. Such interactions are a natural consequence of the inevitable interdependencies which exist between the agents, their environment, and their design objectives. Two important observations have to be made about developing agent based applications. The first observed fact is that the detailed problem solving actions of the agent can only be determined at runtime. Individual behavior is regulated by a complex interplay between the agent's internal state and its external influences or its environment and the other agents. The research studies about a simple agent system which makes proper decisions in game application. Games have and for measuring how well they work. In addition, games can demonstrate that machines long been a popular area for research in artificial intelligence (AI). Because games are challenging yet easy to formalize, they can be used as platforms for the development of new AI methods are capable of behavior generally thought to require intelligence without putting human lives or property at risk. Modern video games provide complex artificial environments that can be controlled and carry less risk to human life than any real-world application. At the same time, video gaming is an important human activity that occupies millions of people for countless hours. Machine learning can make video games more interesting and reduce their production costs and, in the long run, might also make it possible to train humans realistically in simulated, adaptive environments. Current video games include a variety of high-realism simulations of human-level control tasks, such as navigation, combat, and team and individual tactics and strategy. AI is used to control the behavior of the non-player characters (NPCs, i.e., autonomous computer-controlled agents) in the game. The behaviors of NPCs, although sometimes impressive, are often repetitive and inflexible.

3. Related Work

Multiagent systems can be viewed as games where the artificial agents are bounded rational utility maximizers with incomplete information about the other agents in the system. Game theory is a useful tool because it predicts the strategies that rational agents will choose to play in a particular game. In game theory it is not enough for agents to choose strategies that are optimal, given their beliefs about each other's intended choices. Game theory could be formlly defined as a theory of rational decision in conflict situations. It addresses the mathematics of determing strategies for optimal play in a game, where a "game" is any situation involving multiple players and choice-dependent outcomes. Game theorectic models assume that each player is trying to maximize utility, and usually that the options and outcome utilities are knowledge common to all players. Each player's strategy determines one's course of action from a given position. A Game Master (GM) in table-top RPGs is a person in charge of organising engaging game sessions for cooperative multi-player experiences, usually in the range of 4-8 participants. The GM describes the events taking place in the game's actional world, she gives life to the characters populating it, and then communicates the outcomes of players' decisions, enforcing any game rules as needed. A table-top RPG game session is often regarded as an emergent theatrical production where players take the role of lead actors and the Game Master serves as the director that provides stage, scenery and a exible plot that adapts as a result of the interaction between players and the actional game world. Our design uses the Belief-Desire-Intention (BDI) model of agents to exibly pursue the goals of the plot. BDI agents are designed and implemented using mental attitudes such as beliefs, goals, plans and intentions. The use of such mental attitudes in software design allows developers to break complex decisions into smaller, more

intuitive components. This technology is most useful when building systems that operate in highly dynamic environments as it allows for real-time online reasoning. The design of such systems allows incorporating alternatives strategies for achieving the one task, thus enabling exible and robust systems. These traits make BDI agent technology ideal for developing an automated software GM.

4. Proposed System

The research proposes to improve the gaming experience through NPC agents attribute with theory of mind. The PRS engine is incorporated into the architecture with extended features of explicit theory of mind using default logic. Architecture is composed of simple reactive agent; memory based reactive agent and agent attributed with theory of mind. The proposed virtual agent has enhanced capability for longer duration of handling than they do to an actual person, perhaps because talking to a responsive, personalized computer program is a novelty. Virtual agents are usually scripted to respond to a wide variety of questions and remarks. Virtual agents works for longer duration in the better responsitive and attributed ways with many additional factors in bulided rather than current art of systems. They adapt to anticipation and various factors like consistency, Concentration. Performance reliably is better in terms of critical challenges, immersion, goals and feedback.

4.1 Construction of the Virtual Agent architecture

An agent-based model is a computational model in which every participant in a system or process is modelled individually. A system is modelled as a collection of autonomous decision-making entities called agents. Each agent acts autonomously, individually assesses its situation, and makes decisions on the basis of a set of internal rules. In agent-based modelling the word 'model' often means to specify 'the rules of the game': to specify exactly what kind of participants exist (the agents and their states) and how they interact (the rules).

4.2 Designing the Simple reactive agent to the mental models

The Simple Reactive Agent behaviour is implemented to assist the player to complete the SUDOKU game successfully. Simple Reactive Agent monitors each and every movement of the player and Each and every situation must be considered in advance. The agent is having set of actions to solve the game. The details of execution of the actions are delegated to an abstract interface to the virtual world, which is the same for all agents. The agent's goals are only implicitly represented by the rules, and it is hard to ensure the desired behavior.

4.3 Establishing the Procedural Reasoning System

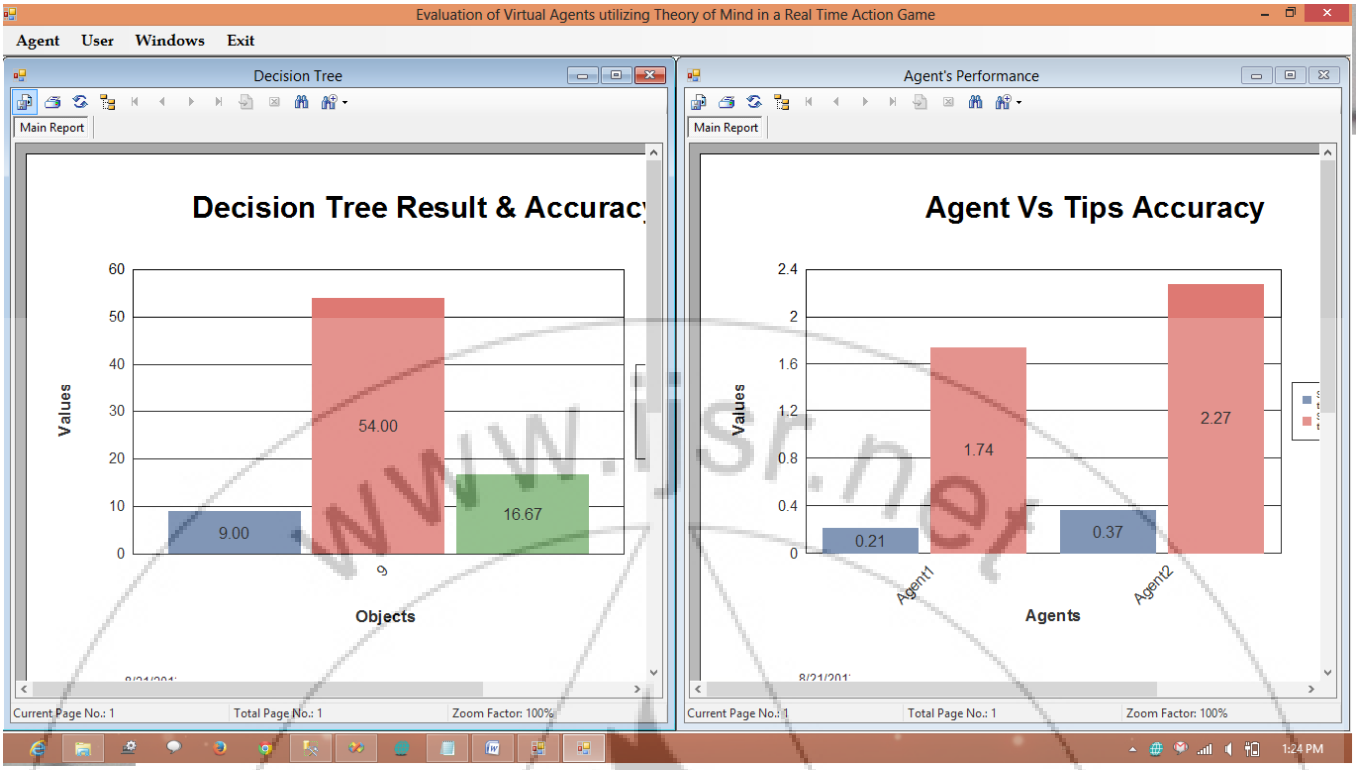
Procedural Reasoning System (PRS) is a framework for constructing real-time reasoning systems that can perform complex tasks in dynamic environments. It is based on the notion of a rational agent or intelligent agent using the belief–desire–intention software model. A user application is predominately defined, and provided to a PRS system is a set of knowledge areas. Each knowledge area is a piece of procedural knowledge that specifies how to do something.

4.4 Developing and incorporating Theory of mind Agent into PRS

The last NPC agent uses a Theory of mind approach and explicitly uses a BDI model it has of the player. To describe the development process, the required extension of the described PRS architecture is explained. Theory of mind combined with PRS. PRS combined with a theory of mind approach allows the NPC agent to reason about the BDI model of the player and manipulate the player (i.e., the player's observations) in such manner that the player no longer performs actions that ultimately lead to winning the game. This is realized by developing specific plans that manipulate the occurrence of certain observations of the player. Reasoning about the BDI model to derive which observations the player should have to avoid him from performing useful actions is done through a default logic approach.

4.5 Development and incorporating Decision Tree Algorithm

In decision tree learning, ID3 (Iterative Dichotomiser 3) is an algorithm used to generate a decision tree from SUDOKU game dataset. ID3 is typically used in the machine learning and natural language processing domains. This algorithm is a procedure for generating efficient discrimination trees for elements that have non-numeric values or attributes. The algorithm works on a set of training data, which has been sorted into classes, and creates a tree which divides the data based on common attributes. The tree can then be used to classify real-world data of the same variety. It is best used on very large sets of data where each element is made up of a long list of attributes. The algorithm works by dividing the given data based on each of the different attributes the elements have and determines the increase or decrease in mixed-class branches after each divide. The divide which produces the most sorted set of branches in terms of class is finalised and the algorithm moves onto the second stage to repeat the procedure on each of the branches. This continues until each lowest branch contains only elements of one class. The main advantages of the ID3 algorithm are that it is easily implemented, being quite a simple process, and its running time increases only linearly with the complexity of the problem.



5. Performance Comparison

The accuracy results on both experiments also did not show the same accuracy value. When comparing PRS with mind of theory and ID3, ID3 is getting better accuracy results. The direct relation between the increase of accuracy and the increase of training data can be seen. Therefore, the number of training data affects the exact percentage of accuracy, but the increased amount of training data would result in the increased percentage of accuracy.

Button Id	Agent Id	Winning Probability for agent	Winning Probability for decision tree
1	1	0.21	9.00
1	2	0.37	
1	3	0.60	
1	4	0.71	
4	1	0.71	8.63
4	2	0.63	
4	3	0.73	
4	4	0.79	

6. Conclusion

On this report, one of several important components on the domain connected with personal a agent, that is to be able to purpose having a theory mind, have been put on inside domain connected with activity games. The look of the adviser was changed all-around PRS. This agent's ambitions are just implicitly symbolized with the rules, and it is tough to ensure the desired behaviour. The final NPC adviser relies on a Hypothesis connected with theory mind technique as well as explicitly relies on a BDI design it offers of the player. Based on the outcomes, NPC adviser didn't turn out to carry out considerably superior. When you compare PRS using theory mind connected with concept as well as ID3, ID3 is getting superior accuracy outcomes.