

AIPlayer: A Platform of Intelligent Simulation of Virtual Human in Virtual Environment

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Abstract. The research of intelligent simulation of virtual human in virtual environment is an interesting direction in the domain of AI after the research of virtual human's behavior simulation. This paper presents a new research platform named AIPlayer in order to promote this work. Virtual environment is come close to the real world. Some characteristic in virtual environment can realistically represent the real world, at the same time it can provide some advantages to science research. This virtual environment may be MMORPG or virtual reality. The motive of the research is to simulate a virtual human who can autonomous live in the virtual environment. We named this research as intelligent simulation of virtual human in virtual environment. First, this paper argues the significance of this research in theory and application, then analyses the demand of the AIPlayer, the characteristic of its living environment, the aim of AIPlayer and some correlative research domain may be involved, then it describes the architecture of AIPlayer and the core of AIPlayer: BSOAA(based smart object agent architecture), at last a prototype of AIPlayer in virtual environment is introduced.

1 Introduction

Since 1950 while the paper of Turing's "Can machine think?"[1]has been published, people continuously inspired for this goal, however, even at present, when the computer operating speed is much higher than those days, can machine think? This question still caused the researchers to be puzzled. Although in some certain special domain such as game, some specific domain expert system and so on, we have obtained the significant achievement, but when we change the vision to the simple daily life, we are disappointed, some people even started to suspect, the machine really can think? Although some searchers already studied the robot which can simulate the person to stand and walk by his two legs or to dance, to go up and down the staircase or even to ride the bicycle, but in replying the question whether the machine can

think, similarly we lacked the enough evidence, although started from the Turing, we believed one day the machine may think[2].

Looking back the history of research on artificial intelligence, we can clearly find that according to the difference of research object and appliance scope, we divide it into three phases. The first phase is to take the machinery theorem prove as object and use it in the math axiom testifying; The second phase is to create some expert system fitted to some special scopes; The third phase is to take the realism world as study object[3].

Even nowadays we take realism world as study object, the researchers deeply study in some traditional scope. These domains involve chess, I-go, expert system, the construction of commonsense knowledge base, different chatting system etc.

The study of artificial intelligence comes into an odd circle: on the one hand we would like to bring the realism world into study scope; on the other hand we have to hunt for some means in traditional scope which can be used in realism world such as the methods of presentation knowledge, machine learning. The most important reason is that: the realism world is too complex to be studied.

This paper put forward a new research object which carrying on the research of the artificial intelligence in a virtual digital environment. It means that creating a virtual person who can be independent live in this virtual environment. In the meantime the really person will take part in this environment. This kind of virtual environment can be a MMORPG or perhaps virtual reality. Our target is to imitate a person, who can independently live in this environment. Possibly this is the most close to artificial intelligence research. In order to build a research platform, the author constructs AIPlayer.

The AIPlayer is a virtual human intelligence research platform, it can completely control a virtual role existing in a virtual environment, living independently and own an ability to communicate with the other roles in the virtual world.

Some scholars of the abroad carried on similar research. For example in California University research group carried on Gamebots in 2002, attempting to build an independent virtual player system in a virtual world. The virtual world is UT 2003. it is a first person action game[4][5].

The arrangement of this paper is that section 2 carries on AIPlayer demand analysis, including constitute of the virtual environment and the advantages of intelligence simulation, the target of the platform; section 3 introduces the AIPlayer's realization technology including a prototype of the core named BSOAA, and the AIPlayer total structure, section 4 summaries this paper.

2 AIPlayer Demands Analysis

2.1 AIPlayer Existing Environment Characteristics

(1)AIPlayer lives in the virtual world close to the mankind reality world, this similarities involve the society, cooperation and competition. A virtual social background, the demand living in the virtual society is including Common sense, basic ability, the ability of communication with others and the ability of study. This kind of context environment and common sense is limited and controlled, but to the artificial

intelligence it is really very beneficial through controlling the problem scale, so we can broaden the virtual human's intelligence gradually from easy to complex.

(2) Simulation of human's daily life. Compared with the real world, AIPlayer's environment is simple because it is abstract and imitation of reality life.

(3) A controllable and visual environment. The virtual environment is different from the real world because it consists of many controllable and visual items which are convenient for research.

The virtual environment is including story background, story rules, virtual objects, and other virtual players and so on. The virtual role controlled by the true player will complete various mission in the virtual environment such as acquiring various product, carrying out the true person's amusement purpose.

We will consider the difference between AIPlayer and the two kinds of simulation in the virtual environment: the artificial intelligence in the game[6] and the Bot which can control the role in the game[7].

Different from the artificial intelligence in general game, the AIPlayer is independent of the game. While the artificial intelligence used in the general game, mostly is aim to raise the intelligence of various role in the game, making its behavior more like a true player. By applying the artificial intelligence technique in the game, we can construct this environment more like the real world. But the AIPlayer's target is to control the role, product and other objects in this virtual world in order to acquire the feeling similar to the mankind.

Comparing with the Bot which can control the role in the game, the AIPlayer has two basic differences:

(1) the AIPlayer's behavior is more like human being's: observing environment by the video and sound, responding by the mouse and the keyboard to control a role. Most Bots acquire the environment information and control game role through the interface provided by the game or directly crack the data segment, so as to get all states of the game.

No matter what adopting legal methods controlling the game through interface provided by the game developer, for instance, GameBots project is connected with the game through interface which provides by UT2003 development group, thus Game Bots can completely control the game or illegal method cracking data segment about the game world, thus obtaining the entire game world condition understanding, for instance current majority network game automatically hanging machine software. The simulation world in the viewpoint of Bots is completely open, it is accurate and unmistakable, but AIPlayer obtains the simulation world condition information is incompletely, possibly makes mistakes, the ability of processing incomplete knowledge and the indefinite knowledge is AIPlayer and the general Bots basic difference.

(2) AIPlayer is different in the game goal with general Bots. Living in the simulation game world, to general Bots it does not have any special significance, but to AIPlayer, living in the game world, has the explicit goal. This kind of goal may be comes from AIPlayer in, also may be comes from exterior: Assigns instruction or goal. How to describe this kind goal coming from the AIPlayer interior is one of our research contents.

2.2 Target of AIPlayer

The Ultimate Target of AIPlayer. The requirements of exploring a virtual human who can independently survive in the virtual game environment are shown as following.

- (1) acts according to own hobby, the emotion choice hypothesized world;
- (2) initiatively gains about this hypothesized world knowledge;
- (3) like the humanity players, only can use the video frequency the way to observe the game picture, distinguishes the game advancement through the sound, according to plays the picture and the sound content, makes the corresponding decision-making;
- (4) like the humanity players, only can controls the hypothesized role in the game through the keyboard and the mouse;
- (5) like the humanity players, may be initiative, have the goal to play the game;
- (6) can do cooperation and the competition with other player;
- (7) like the humanity players, may finally leave the hypothesized world.

Obviously the AIPlayer's ultimate target is too complex to realize in current, it needs a long study process, although the author believes that this target certainly can be realized. Based on the present situation in the intelligent research as well as the computer hardware, the author suggests the basic target of AIPlayer.

The Basic Target of AIPlayer

- (1) firstly, assigns the hypothesized world;
- (2) obtains the knowledge of the hypothesized world under expert's instruction;
- (3) through the video frequency observe game, makes corresponding decision-making, temporarily does not consider the sound information obtaining;
- (4) controls the game through the keyboard and the mouse the hypothesized role;
- (5) beforehand assigns in the hypothesized world goal;
- (6) and other plays the family to carry on limited the cooperation and the competition which controls;
- (7) leaves the hypothesized world instruction to produce by exterior.

The Correlative Domain of AIPlayer. As the author pointed out above, the artificial intelligence research has faced a strange problem. On the one hand, people want to bring the realistic world into the research scope; on the other hand, people have to look for various methods applied to the realistic world in the traditional research realm, including the representation methods of knowledge...etc. The gap between the traditional research domain and realistic world is huge, therefore, it seems quite difficult to apply the traditional research achievement success in the realistic world.

The author provides a new research object: virtual artificial intelligence simulation in virtual environment trying to look for a breakthrough between the traditional research realm and the realistic world. On the one hand, it should abandon the complicatedly and the unpredictable facts of realistic world that is the very indetermination and incompleteness preventing the traditional research results from applying to realistic world. On the other hand it should abandon the too simple and idealized static state of traditional research realm that restricts the application of artificial intelligence technique. It should be taken place by virtual digital environment where all object can be

controlled. In this environment, from the simple problem to the complicated problem, the static state environment to the dynamic state environment, the assurance knowledge to indetermination knowledge, complete knowledge to incompletely knowledge etc., which are the opposite characteristic of tradition research realm and realistic world characteristic can be simulated. The virtual artificial intelligence has a process of evolution, it's a gradual evolution process from traditional research realm to realistic world.

In a word, AIPlayer's research realm is the transitional that lies between the tradition and reality. From the AIPlayer's target we can find that it involves several research domains of the artificial intelligence, such as :

(1) The pattern recognition

The main target of this research is: Identifying the state of environment and object from the video appearance; identifying the current environment state from the sound. We have accomplished various technology in pattern recognition, these methods are applied to realistic world in a certain degree, however, pattern recognition usually do correspondingly independent work as a independent system such as identifying fingerprint, identifying human's face, identifying action...etc. We have obtained many useful results in the machine vision research realm. However, As a system of integration, the research in robot with machine sense of vision which can exist in realistic world are still carrying on. Compared with the realistic world, the virtual world have many advantages. In AIPlayer the research of pattern recognition has more advantage because the environment reproduction is very good, image mass is controlled, sample book data acquisition is controlled, the problem scale is controlled and limited.

(2) Computer emotion

AIPlayer must contain the emotion representation in ultimate tartet. In AIPlayer basic goal, the emotion representation may be very basic. This kind of research is the hot domain in the field of artificial intelligence studies at present.

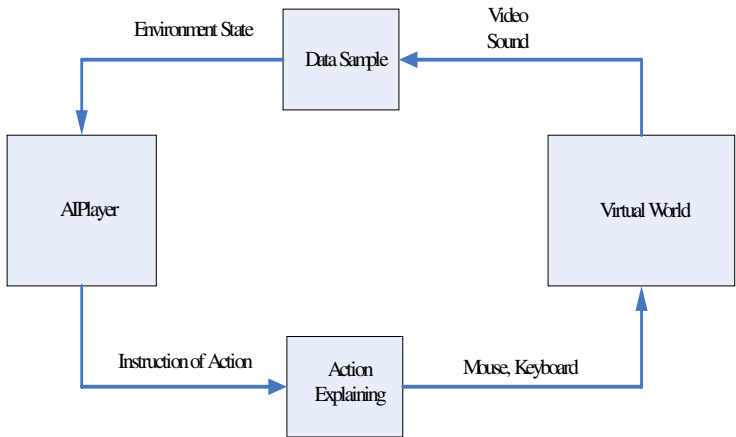


Fig. 1. AIPlayer and Virtual World

(3) Machine learning

In the current artificial intelligence research one of main barrier and development directions is the machine learning. The machine learning, the computer science, the psychology, the cognitive science and so on each discipline all has the closely relative, many theories and the technical questions are still in the progress of research. Having the independent learning ability is the AIPlayer ultimate objective [8]. AIPlayer in the machine learning aspect goal is to Integrate independent learning algorithm. AIPlayer can be regarded as a research platform to each kind of machine learning algorithm, simultaneously, AIPlayer itself also integrated the many kinds of learning algorithm. It is the symbol of succeed that AIPlayer has the independent learning ability.

3 AIPlayer Realization Technology

In this section the author will discuss AIPlayer's realization technology, including architecture of AIPlayer, BSOAA(the core of the AIPlayer), and a prototype system.

3.1 Architecture of AIPlayer

Fig 1 indicates the relation of AIPlayer and virtual worlds. The AIPlayer is constituted by the following components: AIPlayer core the data processing of video, explaining and execution of controlling action. AIPlayer core is a hybrid agent based on intelligent objects, taking charge of the representation and reasoning of knowledge, information obtaining, state analysis decision-making analysis etc. The data processing of video takes charge of obtaining video data, pretreatment, objects identification of virtual worlds. The input is the video data of the virtual worlds, and the output is the objects and their state. The explanation and executing of controlling action, changing the AIPlayer core's decision into the action of the mouse keyboard, and obtaining the mouse keyboard's action. The input parts are AIPlayer's decision-making action, the output is the operation sequence of the mouse keyboard. The total architecture of AIPlayer is shown as following fig 2.

Then the AIPlayer core named BSOAA will be introduced emphatically.

3.2 AIPlayer Core: BOSAA

As to increasing the ability of KR and reasoning, a new method named KR method based introspectional object has been introduced into BSOAA. This KR method provided by the author in other paper is KR method based smart object, which is an entity unit that can provide reasoning engine supporting decision. Those entity units can denote some abstract objects such as knowledge units. They can also represent object such as material entity in the world. Inside the smart object, data layer, knowledge layer, data processing layer and the reasoning engine methods are encapsulated. The only way to access smart object from outside is through methods and interfaces in it. In conclusion, smart object is an active object holding multi threads encapsulated lots of KR methods and reasoning engines. Limited by space of this paper, the more details of introspectional object based smart object will not be introduced.

Recently, agent researchers normally agreed to the idea that the behavior of agent was controlled by its mental states. In other words, it means that the mental fact of agent such as beliefs, desires, intentions, capability, etc. are key elements which controlling agent behavior. So, how to figure out the mental states of agent and how these mental states influent the agent behavior is most important. In the other hand, researchers are debating upon which mental facts are most necessary and basic in depicting agent autonomy. They presented lots of kind of agent model made up of different key mental states. Among those models, the most famous was BDI agent. This model pointed out that the behavior of agent was only controlled by its Beliefs, Desires, and Intentions. So, the most key fact in agent's mental were Belief, Desires and Intentions. But when using BDI agent in Open Environment , many problems there will normally be found . Some of them are as followed:

- 1) *Can't efficiently explain the agent's behavior in dynamic environment*: Though BDI agent ever successfully adapted to static environment, the performance of this kind of agent in dynamic environment was not as good as formerly. Because BDI agent didn't involve the effect of the agent's behavior, neither involved the capability of its action, this defect limited its development.
- 2) *Can't resolve the adaptability to the change in Open Environment*: As some important fact in mental such as instinct, sensibility, or philosophy didn't involve in BDI agent, the autonomy of this kind of agent was greatly limited in some extreme situation.

In this paper, some key mental facts will be added to BDI agent, include instinct, sensibility or philosophy and all kinds of knowledge relative to agent, especially some knowledge about the effect of the agent's behavior.

So, the definitions of the mental states in BSOAA are as followed:

Definition 1: the mental states of agent is a 8 tuples as $M=(SSmtOs, ESmtOs, InstDesires, SenseDesires, Philosophy, Hacts, Lacts, Evts)$:

- 1) *SSmtOs*: Implying Self Smart Object set, including all facts and knowledge about agent itself.
- 2) *ESmtOs*: Implying Environment Smart Object set, including all facts and knowledge about environment surrounding agent.
- 3) *InstDesires*: Implying agent's instinct desires set.
- 4) *SenseDesires*: Implying agent's sense desires set which reasoning from facts and knowledge agent has been known.
- 5) *Philosophy*: Implying agent's sensibility desires set.
- 6) *Hacts*: Implying agent's high layer actions set.
- 7) *Lacts*: Implying agent's atomic actions set.
- 8) *Evts*: Implying event set, including inside events and outside events.

Based smart object KR method, BSOAA is defined as followed:

Definition 2: BSOAA is 8 tuple as $(M, SOManager, Upd_InstDisire, Upd_SenseDisire, Upd_Philosophy, Desire_SelHAction_SelLAction_Sel)$:

- 1) *M*: Implying agent's mental states.
- 2) *SOManager*: Implying Smart Object Manager.

- 3) *Upd_InstDisire*: Implying the function which update instinct desires.
- 4) *Upd_SenseDisire*: Implying the function updates rational desires.
- 5) *Upd_Philosophy*: Implying the function updates agent's philosophy.
- 6) *Desire_Sel*: Implying the function that selects which desire is active.
- 7) *HAction_Sel*: Implying the function that selects high layer action.
- 8) *LAction_Sel*: Implying the function that selects atomic action.

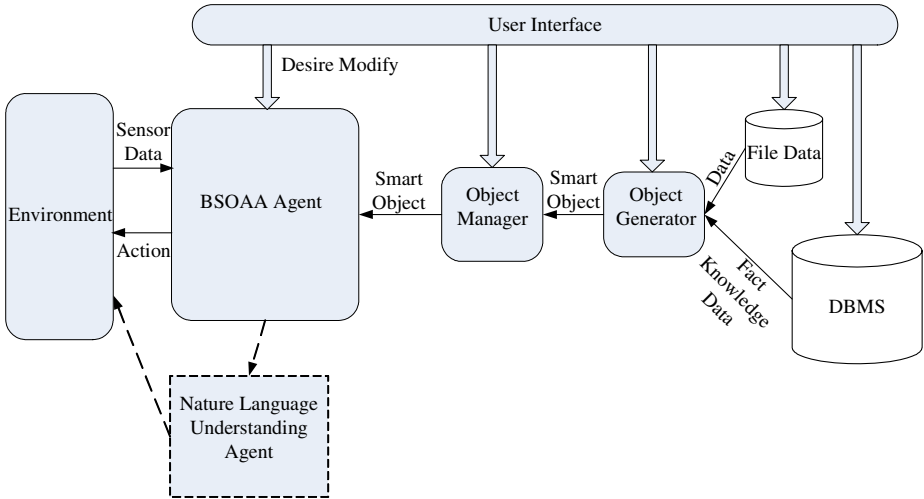


Fig. 2. Architecture of AIPlayer

3.3 Overview of AIPlayer

The author of this paper has structured an application based BSOAA aimed at simulation of virtual human intelligence named AIPlayer that has been shown in figure 2. The purpose of AIPlayer is to simulate the intelligence of virtual human, that means it should have more higher autonomy, more higher adaptability in Open Environment than normal agent. In fact, AIPlaer is living in a digital virtual world. The outstanding characteristic is that AIPlayer will completely ignore geometry character, even the simulation of movement when comparing with other type of virtual human. AIPlayer will focus on simulating intelligence behavior when environment states changing, include interacting with the other agents in the virtual world, collaborating with them. Especially AIPlayer has philosophy, that means its behavior will entirely controlled by itself, live for itself. The architecture of AIPlayer has been shown in figure 2.

The core component is BAOAA agent . The technology of object-oriented will be applied in AIPlayer. The rule of virtual world, knowledge and facts about environment will be saved in database or files according to their properties. When AIPlayer is starting up, Object Generator will be in charge of drawing knowledge or data from the knowledge source or data source. Object Generator will generate all smart objects needed by AIPlayer. Once generated in Object Generator, smart object will be sent to Object Manager. The states of smart objects and the behavior of those will be effect by Object Manager through message. AIPlayer will receive picture taken by video

camera every a certain time, it will reason the situation, then take action like a real player. Through user interface the mental states of AIPlayer could be modified, thus instinct desire and philosophy of AIPlayer may be changed. At the same time, data, facts and knowledge in files or in database also may be updated. Even the function of the Object Manager and Object Generator may be modified by script. In figure 2, the dashed rectangle implies future work: Nature Language Understanding Agent (NLU Agent) who can talk with other players in nature language. That will be a new challenge.

4 Conclusion and Future Work

Under the digital, virtual environment, this paper provides a research platform named AIPlayer that can make the study of virtual human's intelligence simulation more convenient. The BSOAA which is core of AIPlayer has also been introduced. In future we will gradually consummate each part of AIPlayer, expands BSOAA's function, and make it to support natural language understand in a certain context environment.

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