Artificial Intelligence in Games

Raju, Nitin Sikka, Sanjeev Kumar, Rahul Gupta

Abstract- Based on the recent surge in interest in the both academic and games industry in character- based artificial intelligence. Although the games are mainly related with entertainments, but with this there are other serious applications of gaming, including military training, educational games, driving training, medical training and games that reflect social consciousness or advocate for a cause. Artificial intelligence in games is a concept of taking game applications beyond the limits of interactive gaming. Such system learn about the player's behaviours during game play and beyond the pre-programmed set provides and interactively develop and provide a best experience to the players.

General Terms The main aim of our research is to develop such artificial intelligence techniques that can have a substantial impact in the game industry. In the following research paper we are going to study about Case Based Reasoning (CBR), automatic behaviour adjustment for believing characters, drama management and user modelling for interactive stories and strategic behaviour planning for real time strategy games. We include problems in adopting artificial intelligence in games and some algorithms for respective games. Future aspect of artificial intelligence in games is also mentioned in the paper.

Keywords-
1. Need of Artificial Intelligence
2. Problem in Computer Games Artificial Intelligence
3. Behavior Adaption for Believing Characters Artificial Intelligence
4. Action transformation System
5. Case Base Planing For Strategy Games
6. Drama Management In Intractive Stories
7. Integrate user modelling In with drama management

I. INTRODUCTION

The computer games are the surprisingly enhancing their quality in today's era. The art of game recreate real life environment with a high level of detailing. The environment is usually populated with different characters that require human intelligence and exhibits believable behaviours. However there are enormous advancement in computer graphics, animation and audio for games, most of the games contain very basic level of artificial intelligence. Artificial intelligence in computer games covers the behaviour and decision- making process of game-playing opponent. Richer experience requires a great deal of engineering efforts on the part of game development.

In recent years, interest in applying Artificial Intelligence technique to computer games has seen notable increase. The vast majority of his work, however, focuses on small sub problems with in the computer games. As computer game is develop by the increasing large project teams with increasingly tight timelines, game developer do not have the necessary cycles needed to try and transition efforts needed in applying academic Artificial Intelligence for computer games to make them more adaptive and appealing to the player.

The research described in this paper is a first step towards this objective. This report is focusing on the reasoning and learning techniques toward making games. We are more focus on adaptive games. These are the games which are adopting themselves to unforeseen situations. It reduces the development efforts, since if a game is able to adapt itself, the developers require less effort trying to foresee all possible situations.

Parts on which we are discussing on this report are as follows. First, we present a brief analysis of the requirement of different game genres from an artificial intelligence perspective. We also identify a set of challenges that computer games present for the artificial intelligence community. Next we discuss CBR approach for adaptive games: automatic behaviour adaption for believing characters, drama management and user modelling for interactive stories and strategic behaviour planning for real-time strategy games. We finish with conclusions and future research direction.

II. NEED OF ARTIFICIAL INTELLIGENCE IN GAMES

In different games genre we find the artificial intelligence is challenge present in each of them. Games like action, role playing, adventure, strategy games, god games, individual and team sports games all finding difficulty because of poor artificial intelligence. Some games like interactive drama and educational games also came in consideration for requirement of artificial intelligence. In interactive drama the player assume the role of the first person character in a dramatic story. The person does not sit above the story, watching it as a simulation, but is immersed in the story. The key difference with the classical "adventure" genre is that adventure have a script plot, while interactive dramas are more open ended and adopt to the player interaction as the story unfolds. Educational games have an additional rhetorical goal of teaching some particular content to the player.

By analyzing all genres, we conclude that we can apply artificial intelligence on 2 different levels, which are as follows

1) Individual character artificial intelligence, with a goal of producing intelligent or believing behaviour.

2) A global artificial intelligence that watches over the games or games player interaction, influencing the direction that the game is taking.

We can also say it is a character level artificial intelligence and game level artificial intelligence.

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Raju, Pursuing Bachelor of technology degree from Dronacharya College of Engineering, Gurgaon, Haryana.

Nitin Sikka, Pursuing Bachelor of technology degree from Dronacharya College of Engineering, Gurgaon, Haryana.

Sanjeev Kumar, Pursuing Bachelor of technology degree from Dronacharya College of Engineering, Gurgaon, Haryana.

Rahul Gupta, Pursuing Bachelor of technology degree from Dronacharya College of Engineering, Gurgaon, Haryana.

Artificial intelligence is not same for all games genre, it varies with genres. Real strategy games rely mainly on a game-level artificial intelligence that control all the units, while the individual unit behaviours can be scripted, while in role playing games character level artificial intelligence is required to provide interesting player experience. Interactive drama requires a mix of both kinds of artificial intelligence: individual character that is believable and drama manager that leads the plot by guiding the individual characters to take actions that can make the drama advance. Educational level gaming also requires artificial intelligence, similar to the drama manager. In god games usually require the game-level artificial intelligence to solve resource allocation problems and solve long term strategy problems.

III. PROBLEMS IN COMPUTER GAME ARTIFICIAL INTELLIGENCE

In this following section, we summarize a list of interesting challenges that computer games pose in general to the artificial intelligence. These challenges are not exhaustive, but it is problems that real computer games pose to the artificial intelligence community.

I. **Complex decision spaces:** most state-of the-art computer games involve complex strategic or believable behaviours. Both kind of behaviours share the characteristics of having huge decision spaces, thus traditional search based techniques cannot be applied. Traditionally computer games use hand-craft strategies coded by the game developers, but these tend to be repetitive, and player easily finds holes and exploits them.

II. **Learning and Memory:** this section is somewhat of a misnomer, since almost every section so far dealt in some way with problem of learning. As should already be obvious, “learning” does not refer to any one process, but rather to many individual adaption processes that occurs throughout a character brain.

III. **Emotion Modelling:** in much of the work done in character, emotion modelling has been used primarily as a diagnostic channel. Emotions, after all convenient indicator of overall system state. Emotions should be used to their full effect, influencing the way that action selection functions, what that plans are formed, the salience of the different sensory stimuli, and so on. A very interesting use of emotions is found in where a curiosity emotion is used to influence exploration/exploitation decision made by the character.

IV. **Authoring support:** hand craft behaviour is, ultimately, software code in a complex programming language, prone to human errors. The behaviour error could be in the form of the form of programme “bugs” or not achieving the desired result. Tools are typically not artificial intelligence experts, to author behaviours in a computer programming language.

V. **Unanticipated situations:** it is not feasible to anticipate all possible situations and player strategies that can encountered during game play. This makes it difficult to craft believe behaviour that react in an appropriate manner to these unforeseen circumstances and player actions.

VI. **Learning through Episodic Memory:** There are many forms of memory. Procedural memory allows us to practice and improve specific skills over time. Short-term memory is a recent perceptual history of the world and working memory is a slightly higher-level recent history of the objects relevant to the current task or behavioural context. Episodic memory, in which explicit sequences of events are stored for later conscious recall. This memory is lacking very much. The advantage of this learning is speed: usable hypotheses about casualty models that are formed could be accompanied by specific remembered instances in which the hypothesis succeeded or failed, thereby providing a pool of data to support generalization or discrimination of the cause and effect models.

VII. **User-specific adaption*:*** different player may enjoy different strategies to fight against or different style of storytelling, different type of story developing, different kind of character behaviour and interaction or different educational problems. As game designer begin to include user modeling strategy and behaviour must, in turn, be adaptable based on the user model.

VIII. ***Replay ability and variability:*** A player a might get bored of seeing the same strategies and behaviours again and again. Although simple variability can be achieved through stochastic selection of behaviour or strategies from a large repository, this increases the authoring burden. Further-more, random selection begs the question of true interestingness.

From previous list we get that mot only games benefit from better artificial intelligence techniques, but artificial intelligence can also benefit from the challenges that computer games provide. We provide 3 projects in last of this paper to overcome these problems (a) easing the efforts involved in developing computer games artificial and (b) making them more adaptive and appealing to the player.

IV. BEHAVIOUR ADAPTATION FOR BELIEVABLE CHARACTERS ARTIFICIAL INTELLIGENCE.

In interactive games, embodied characters typically have their own personalities, affecting the way they act in the game. Author usually creates such characters by writing behaviours or scripts that describe the characters reaction to all imaginable circumstances within the game world. This approach of authoring characters presents several difficulties. First, when authoring character s behaviour set, it is hard to imagine and plan for all possible scenarios it might encounter. Given the rich, dynamic nature of game worlds, this can require extensive programming efforts. Static behavioural repertoire may result in repetitive behaviour. Such repletion harms the believable of the characters. Third, when behaviours fail to achieve their desired purpose, characters are unable to identify such failure and will continue to exhibit them. Ideally we want a self-adapting behaviour set for characters, allowing character autonomously exhibit their author-specified personalities in new and unforeseen circumstances, and relieving authors of the burden of writing behaviour for every possible situation.

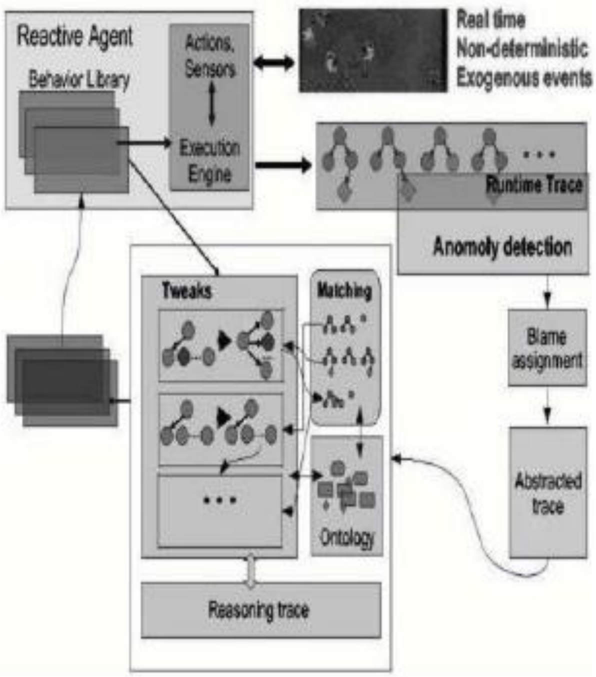
To address this issues, we have develop an approach in which agents keep track of the status of their executing behaviours, infer from their execution trace what might be wrong, and perform appropriate revisions to their behaviours. This approach to routine behaviour transformation enables character to autonomously adapt during execution to changing game situations, taking a first step towards automatic generation of behaviour that maintains desired personality characteristics.

V. ACTIONS TRANSFORMATION SYSTEM

Our game scenario of consists of two embodied characters named jack and Jill. They are involved in a game of tag, implemented in unreal tournament, where they have to chase the character who is "It" around the game area. This system is composed of a reactive layer which handles the real-time interaction and reasoning layer responsible for monitoring the character's state and making repairs as needed.

We use A Behaviour language (ABL) as a reactive layer. ABL is explicitly designed to support programming language idioms for the creation of reactive, believable agents. ABL's fast running execution module makes it suitable for real-time scenarios. The run-time execution module constantly senses the world, keeps track of the current game state. Initiates and monitors primitive action in the game world.

The reasoning layer consists of two components. The first component tracks long- term patterns in the character's behaviour execution and detect violations of the author specified behaviour contract. The second component applies behaviours that modification operators so as to repair the offending behaviour modification operator so as to repair of the offending behaviours identified during blame assignment i.e. generated when character violated author's script.



We need to a way for author to specify contracts about long-term character behaviour modification is to detect when the contract is the behaviour library. To accomplish this, we use a simple emotion model based on Em, an OCC model of emotion. The author specifies personality constraints on behaviour by specifying normal bounds for emotion values. When the emotion value exceeds the bound specified by the author, this tells the reasoning layer that the current behaviour library is creating inappropriate long-term behaviour and that it should seek to assign blame and change its behaviour. At the runtime, a character's emotional state is incremented when specified behaviour is defined by the author as part of specifying the character personality.

The second requirement of the reasoning module is to determine the behaviour(s) that should be revised in tin response to a violation of the personality contract (in case emotion values extend bound). This assignment process involves the analyzing past execution trace and identifying the behaviour with the maximal contribution to the out-of-bound emotion value, amortized over time, as the responsible behaviour.

Once the reasoning module has detected the behaviour that needs to be modified, the behaviours are modified using a set of modification operators. The applicability of modification operator depends on the role the problematic behaviour plays in the execution trace. On an implementation level, these Failure patterns are encoded loosely as finite state machines that look for patterns in the execution trace.

At runtime, the system detects when the author-provided behaviour contract has been violated. Once blame assignment has determined the offending behaviour, the system uses the failure patterns to explain the behaviour's role in the contract violation. This machines associated with the failure pattern against the execution trace. The set of matching failure patterns provide a linked set of applicable behaviour modification operators to try on the wrong behaviour. The system tried one modification at a time. The modified behaviour is complied and loaded into the agent, allowing to game continues.

VI, CASE BASE PLANNING FOR STRATEGY GAMES

AI techniques have been successfully applied to several computer games such as checkers, chess or Othello. However, in many computer games traditional Artificial intelligence techniques fail to play at a human level because of the characteristics of the vast search spaces this game require. For that reason, game developers need to invest significant effort in hand-coding specific strategies that play at a reasonable level for each new game.

The thought there was to define a set of high level actions, and let a CBR system learn when each of the has to be applied. In this section, we discuss a different approach which addresses the complication of this domain by extract behavioural knowledge from expert demonstrations (i.e., an expert plays the game and our system observes). Then, at performance time, a case-based planning engine retrieves suitable behaviours observed from the expert and adapts them to the current game state. One of the main contributions of this approach is that it enables the game developers to specify the AI behaviour just by exhibition, i.e., instead of having to code the behaviour using a programming language, the signifying it to the system. If the system shows an incorrect behaviour in any particular situation, instead of having to find the bug in the program and fix it, the game developers can simply exhibit the correct action in the particular state of affairs.

VII. FUTURE WORK

We plan to incorporate learning during performance by retaining those adapted behaviours that succeeded when applied. This will enable the system to learn with experience. The goal is to use the behaviours extracted from the expert as the starting point, and slowly improve the behaviour library with experience. At any time, if the game developers see that the system is unable to succeed in a particular situation, an expert demonstration for that situation can be provided.

VIII. DRAMA MANAGEMENT IN INTERACTIVE STORIES

A emblematic problem in creating compelling story-based games, such as the interactive drama, is to provide the player with a sense of agency during the interaction while at the same time giving the whole Experience an overall narrative structure. There is a rising interest in developing Drama Manager (DM) components that gently guide the player towards a story ending that exhibits a narrative arc. The goal of these components is to allow the player to have significant impact on what happens during the interaction, rather than following along with a pre-written script or being in control at only a few decision points.

Previous approaches to Drama Management development have used an author-specified evaluation function to measure interestingness and narrative coherence of a particular story path and have employed a simulated player model to predict the next player action during the interaction. However, in experiential interactive systems, the player's references must be taken into account. This requires player models constructed during actual game play based on observations of real human players interacting with the game. In this section we will present a drama management approach that takes into account the player by using a case-based user modelling approach, using the learned models as input to the drama manager. The technique is implemented with the well-known interactive fiction Anchorhead.

IX. INTEGRATE USER MODELLING WITH DRAMA MANAGEMENT

Our advance to drama management consists of three modules (shown in below Figure), namely: a game engine, responsible for actually running the game and interacting with the player; a player modelling module, responsible for analyzing the actions of the current player and budding a player Model; and a drama management module, influencing the development of the game and making it more appealing to the player (represented as the player model)

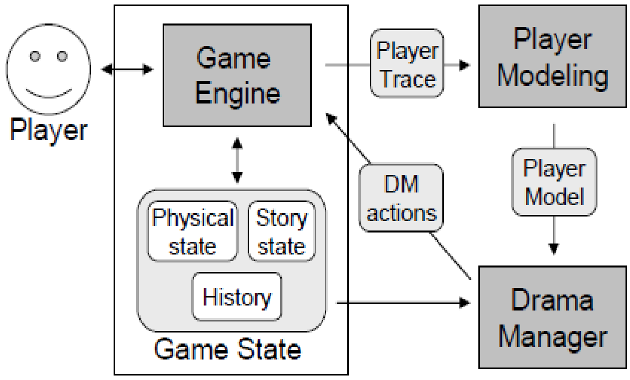


Figure. 3: Basic scheme of the three modules that compose a game in the proposed approach.

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The Player Modelling Module (PMM) constructs player models based on the reaction provided by players at the end of each game. This feedback contains player opinions on the game, including the parts they enjoyed and those that were not interesting from their viewpoint. The goal is to capture the interestingness rating for the story elements encountered by the player during the game episode. At the end of each interaction, the PMM stores this player reaction along with the corresponding trace of player actions during the game. In particular, we use a case-based reasoning approach for this module, with each player experience being stored as a separate case in a case base.

During a particular game occurrence, the PMM utilizes this information to compare the ongoing player trace maintain by the game engine with player traces collected during previous interactions with different players. The feedbacks from players with the closest similar traces are combined to form an estimate of the stories that the current player is most likely to prefer. The underlying assumption behind this approach is that if the current player's actions follow a pattern that closely resemble those of certain players who have before played this game, then their interestingness rating for stories would also closely match. The PMM uses this assumption to estimate the stories the current player is likely to enjoy. In general the player model stored in the PMM contains information about a player's ratings for the location, plot points, or sequences of plot points in the game.

Once the player module is generated, it is given to the Drama Management Module (DMM), whose goal is to select a drama manager action (if any) to perform at any instant in the game so that the story develops according to both the player model and the author-specified story guidelines. In the same way that the game author specifies a set of actions that the player might take at each moment of time in the game (player actions), he also specifies a set of drama manager actions (DM actions). These actions represent the things that the drama manager can carry out to influence the game, e.g. "prevent the player from entering the library by locking the door" or "hinting the player that an object is important by making one of the characters in the game talk about it". Given the set of the possible directions in which the story might unfold (as a function of the player's selected actions), drama manager plans a set of DM actions to guide the player toward story directions that are likely to be more appealing to him, according to the player module and to author specified story guidelines.

Future Work

We plan to perform extensive player evaluation to validate the case-based player modelling module and the drama manager module. We also plan to expand the player modelling module to generate player action models that can predict the actions a particular player is likely to take in given situations. Finally, we plan to move from the text-based game Anchorhead to real-time 3D systems, where the complexity of drama manager is increased considerably.

X. CONCLUSION

In this paper, we discussed a set of challenges and budding Artificial Intelligence techniques that can deal with the density of computer games is a big challenge, but has the potential to have a big impact in several areas including entertainment, education and training. Our main goal is to develop Artificial Intelligence techniques that can ease the effort of incorporating AI in computer games to make them more adaptive and appealing to the player. We call such games adaptive games. In this paper, we introduced three of our current research thrusts aimed at creating adaptive games via the application of case-based reasoning techniques.

The main conclusion we can draw from our experiments is that Drama Management techniques are applicable to real-time games, and that Drama Management generally improves player experience. Moreover, our user evaluation reinforced the fact that the DM should take into account player experience when deciding how to influence the story and also when deciding which hints to provide to the player.

We believe that computer game Artificial Intelligence will be the next uprising in the gaming industry. After the impressive advances in the audiovisual presentation the networking capabilities, the next step in computer games is to incorporate advanced Artificial Intelligence techniques that can achieve the goal of having truly adaptive games, increasing the level of believability and immersion. To achieve this goal, the gaming community needs new techniques, approaches and tools that allow them to easily specify, develop, and incorporate Artificial Intelligence in their games.

XI. ACKNOWLEDGEMENT

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Raju, Pursuing Bachelor of technology degree from Dronacharya College of Engineering, Gurgaon, Haryana. My present degree is of 71%. I am member of community ISTE. At present I am working on another paper of title Concept Net. I will complete it soon. I am the coordinator of cultural and placement cell of my college. And working hard towards it also.

Nitin Sikka, Pursuing Bachelor of technology degree from Dronacharya College of Engineering, Gurgaon, Haryana. My present degree is of 61%. I am member of community ISTE. At present I am working on another paper of title Concept Net and cryptography. I will complete it soon. I am the coordinator of cultural of my college. And working hard towards it also.

Sanjeev Kumar, Pursuing Bachelor of technology degree from Dronacharya College of Engineering, Gurgaon, Haryana. My present degree is of 60%. I am member of community ISTE. At present I am working on another paper of title Concept Net. I will complete it soon. Working on a project related to intelligence system. And working hard towards it also.

Rahul Gupta, Pursuing Bachelor of technology degree from Dronacharya College of Engineering, Gurgaon, Haryana. My present degree is of 71%. I am member of community ISTE. At present I am working on another paper of title Concept Net. I will complete it soon. I am working on a project related to solar system. And working hard towards it also.