

Implementation of Computer Games with Artificial Intelligence Approach

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Abstract—Game is the widely famous industry in which nothing is constant, it is technically increasing its level back then from 1997 where the first time successful chess AI (Deep Blue) was made and it has proven the importance as well as what AI can do in the game development. So that is how the AI entered in the gaming field though it was only for the board games, strategy games but that was just the start and during these days one can easily see the real progress in gaming like in everything NPC player now can think and can take the decision on their own, this is all possible just because of the AI. The perfect example would be the games build by ACTIVISION how are they using AI for the real experience that we get after playing their games, This is how the AI has changed the complete scenario of game development and took this industry to the next level. So it is very obvious that the AI is enhancing the experience and it is only possible because of the various algorithms which are based on AI.

Index Terms—Keywords: Deep Blue, Activision, Npc (Non Play-ing Character).

I. INTRODUCTION

The AI has not entered the gaming field directly. There was too much struggle to enter in the field of gaming. The first successful chess engine was made by IBM in early 1990s and even before it, the very first example of AI like in the very beginning is the game of computerized Nim made in 1951, and published in 1952. So this is how the AI started its approach in the game industry. But it was just the board games and had like negligible graphics and even after 1997, the successful attempt of a chess engine there has been much more research on how to make other games with AI, how one should add graphics and make the experience real for the ones who are playing. Nvidia has built the first video game demo with the help of AI generated graphics, as graphics are very crucial factor in getting the real world experience so with the help of AI generated graphics there has been a tremendous effect on the games and that is in good way of course. Also gaming field motivate students and attracts them, thus students learn about this field joyfully and have curiosity about the Artificial Intelligence approaches towards gaming [8].

So anytime when someone interacts with the AI made NPC or bot so feeling of interaction is like we are interacting with a human level intelligent person or maybe beyond human level intelligence [7], and that's the reason this field is making unimaginable progress and hence this field has become one of the most famous fields. As it is still in progress, we can expect many impossible things that would be possible in the gaming field just because of AI. When defining AI back then it was an expert system which has human level intelligence but it is not the same case right now, while defining, AI is an expert system which has beyond human level intelligence. Generally, AI is an umbrella term used for a branch of computer science. It

stands for the enhancing the ability to acquire and apply knowledge, and perform naturally like a human or smarter than human [4]. For example, planning, problem solving and reasoning.

II. LITERATURE SURVEY

a) : Artificial Intelligence plays very essential role in gaming for its success as well as failures. So it is very important aspect while designing games. The successful starting of Artificial Intelligence in gaming was in year 1997. First chess engine was developed by Deep Blue in 1997, this engine won against the GM Garry Kasparov. So after that this technology kept on growing by minimizing the flaws that were in the corresponding previous engines. The main advantages of this is that the engines can play beyond our human capability as well as imagination. Not only in chess but also in Go game Artificial Intelligence has done incredible work. So there are lots of games that has been affected in good way that can be played with intelligence.

b) : Some of the famous games based on Artificial Intelligence technology :

1. Minecraft: Minecraft is ideal for artificial intelligence research because it offers endless possibilities, ranging from simple tasks like walking around looking for treasure to complex

ones like building a structure with a group of teammates.

2. F.E.A.R : In F.E.A.R., Artificial Intelligence use cover more tactically, coordinating with squad members to lay suppression fire while others advance. Artificial Intelligence only leave cover when threatened, and blind fire if they have no better position.

3. The Last of US : companion Artificial Intelligence-Ellie, the teenage girl, the key to the survival of all humanity, is the star of the game, and it's mainly because of an excellent Artificial Intelligence, so we have to play along with Artificial Intelligence girl which is the main character.

4. Halo 5 - Guardians : One of the top most games which adapted Artificial Intelligence technology.

5. Far Cry 5 : When you hit hard, the enemy's gonna hit back harder. Far Cry 5's dynamic Artificial Intelligence tracks the effect which is in the game, and alters the enemy's strategy against us. The cult (Artificial Intelligence bot) will boost their efforts when you become less of a nuisance and more of a threat.

III. NOTABLE ARTIFICIAL INTELLIGENCE ALGORITHMS

a) : Minimax-

Minimax algorithm is a recursive or backtracking algorithm which is used in decision making and game theory. The minimax provides an optimal move, in short the best move to a particular situation for the player assuming that opponent is also playing optimally. This algorithm uses recursion to search through the game-tree and uses DFS. Min-Max algorithm is mostly used for game playing in Artificial Intelligence, such as Chess, Checkers, tic-tac-toe, go, and many games that are being played by two players. This algorithm computes the minimax decision for the current state of the game. In this algorithm, two players play the game, out of which one is called MAX and the other one is called as MIN. The two players compete against each other and each one tries to benefit itself. Each player of the game is the opponent of each other, where MAX will select the maximized value and on the other hand, MIN will select the minimized value. This algorithm is completely based upon a depth-first search algorithm for the exploration of the complete game tree. The minimax algorithm travels all the way down till the leaf node, and then backtracks the tree as the recursion [6].

b) : Alpha-Beta Pruning - Alpha-Beta Pruning The advanced and upgraded version of minimax is said to be the Alpha-beta pruning. It is an optimized and upgraded version of the minimax algorithm where we avoid to explore the nodes which are unnecessary. In the traditional minimax search algorithm, the number of game states it has to examine are strictly exponential in depth of the tree. We can cut it to half for the sake of convenience and to save time. Since we cannot eliminate the exponent, hence the technique alpha-beta pruning was developed so that without checking each node of the game tree we can easily compute the correct minimax decision, and this technique is called pruning, the result of this algorithm is same as the minimax gives but the difference is in less time by avoiding visiting unnecessary nodes. This involves two major parameters which are called as alpha and beta for future expansion, so it is called alpha-beta pruning.

It is also called as Alpha-Beta Algorithm. So the Alpha-beta pruning can be applied at any depth of a tree, and sometimes it not only prunes the tree leaves but also entire sub-tree that are not useful or not beneficial for us and we don't need to travel the part which is not required. Hence, the alpha beta pruning is being used.

The two parameters can be defined as follows: Alpha: The best (highest value) move we have found so far at any point along the path of Maximizer. The initial value of alpha is $-$. Beta: The best (lowest value) choice we have found so far at any point along the path of Minimizer. The initial value of beta is $+$. The Alpha-beta pruning to a standard minimax algorithm returns the same move as the standard algorithm does there is not a difference on the output that we get, but it removes all the nodes which are not really affecting the final decision and are not useful to us but making algorithm slow. Therefore by pruning these nodes, the pruning makes the algorithm very fast. This is the main advantage of using alpha beta pruning [1].

c) : Monte Carlo Tree search Method: Game Artificial Intelligence often amounts to pathfinding and finite state machines. The Pathfinding gets the Artificial Intelligence from point one point to other point, usually in the most direct way possible or the way which has less obstacles. State machines permit transitioning between different behaviors. The Monte Carlo Tree Search algorithm provides us a more engaging game experience by creating additional obstacles for the player to overcome. The MCTS consists of a tree diagram in which the Artificial Intelligence essentially plays tic-tac-toe. Depending on the outcome situation, it selects a pathway yielding the next obstacle for the player. In many of the complex computer games, these trees may have more branches than one could count, provided that the player can come up with several strategies to surpass the obstacle.

Many board games like checkers, tic-tac-toe, and chess that can arguably be solved with the help of minimax. However, oftentimes in some situations can get a little tricky and complex when there are a large number of potential actions to be taken at each state and every state and it is very difficult to handle this kind of situation. The main reason is that the minimax travels each and every node of the tree even the ones which are not necessary and can be avoided to visit as some nodes are not important but even so minimax explores all the nodes. It can become very difficult to solve a complex game like Go in a finite amount of time as it usually requires a large amount of time.

IV. APPROACH FOR GAME DESIGN

One of the most popular ways of starting out to create a game design is to choose a theme that is interesting, attractive and at the same time can have a huge impact in the gaming market, if these things are followed then only we can get the best game in the market. This is a wide, open and includes many ways to design. For an instance

we could choose to design paratroopers rescuing civilians, like whatever theme that will have the huge impact on gaming market designer have to choose that. Designer could design like almost anything what he feels interesting. Going Theme First allows designer to choose whatever he wants the game to be about played. Once the theme has been chosen designer can then begin to consider the mechanics that might fit best with the theme.

The designer might come up with a really interesting way to play a game. Mechanics could be a new component, a new way of using a component, a new combination of mechanics that have been used before, or other things that haven't been done before. Or designer could pick a mechanic that has been done before and add a twist that is more effective than before. Designer could also make a very interesting mechanic by taking feedback from the gamer on how they would want to play the theme that has been built, this is the most effective way to design mechanic as we are getting directly feedback from user but it can lead to the complexities as each gamer would wish to have different mechanics.

Once the designer has figured out the main mechanics and made it playable he can try to figure out what type of theme might fit with the mechanic that has been created because theme and mechanics should make sense and should be interrelated to each other. This way of designing assures the designers that their game will utilize a game play mechanic that they like and everyone who plays should appreciate it as well as finds it interesting. This is a path that is used less for designing games. Some abstract games are designed with the scoring condition as the driver for the design as it can be very useful. This is essentially a specific variant of Mechanic First design, but the difference is to put the end-game in mind while choosing this path. Designers choose how they want the scoring to work like after particular action the score should have given. Then designer will fill in the design with the mechanics and slap on a theme if necessary and combine them all.

This is one of the tough one to do and include in design process because most designers don't design around a "final product" type component. But oftentimes there are times when the designer may make a game from the components that he has available. So while designing components first designer would often choose a component or components that he really wants in the game and makes the game more interesting and seemingly playable and attractive as well. So after this the designer would choose a theme or mechanic that will work with those components well and is well fitted with it. This can be pretty awesome and perfect way if designer has a great component in mind that can be implemented. If designer wants to go with this approach, it is probably best to be innovative and use either new components that haven't been used in games before or to utilize existing components in new ways that will make the game very playable and interesting.

V. METHODOLOGIES

A. The term Artificial Intelligence

a) : Oftentimes, terms artificial intelligence (Artificial Intelligence) and machine learning are used interchangeably but, the actual fact is that they are not the same. Artificial Intelligence is basically the umbrella concept, or the whole major part, or the super set and machine learning is a subset of artificial intelligence. Artificial Intelligence and machine learning can be divided into two categories: supervised and unsupervised learning. Supervised learning is when the output is known by the supervisor and the training data is labelled as such. Supervised learning contains methods such as decision trees and classification, which, as the name suggests, classifies data into meaningful categories. This form of artificial intelligence is used continuously through game development.

B. Unsupervised Learning

a) : In unsupervised learning, data is not labelled in a single format, and the output is not known. Unsupervised learning, contains methods that are usually interested in input patterns and the meaning of these patterns. The data that is gathered, in unsupervised learning, is grouped with similar data, in which it is easier to identify patterns. This is called clustering which is mostly used in Machine Learning [5].

C. Reinforcement learning

a) : There is also Reinforcement learning, that is a hybrid technique. The general idea of Reinforcement Learning or teaching is to reward or discipline something or someone after they perform a desired or undesired action. However, in relation to machine learning, Reinforcement Learning is machine learning by interaction in which the learner is reinforced according to which action they take in a specific situation. Therefore, the machine learns the best possible action to take in a certain situation or to a particular situation.

D. Neural Network

a) : Neural Networks are a form of Artificial Intelligence algorithm that have a greater capacity to mimic how the actual human brain works and to self-teach. Neural Network consists of layers (input, output, sometimes hidden layers), nodes (each layer contains nodes), connections (connection between nodes, connections start at the input layer, to the hidden layer, and then to the output layer), weight (nodes can contain different weights which have different impact on the network), and the node's net input (how the strength of the connection between two nodes affects the output of other nodes connected to it). There are many Artificial Intelligence methodologies and topologies that are used for creating the perfect machine or one can say an expert system. Deep learning algorithms such as Neural Networks are also used in creating 'players' of famous video games in order to complete the game or rival human players. Video games provide an excellent testing field for developing Artificial Intelligence as there are no

boundaries as well as limits or consequences as to what we can do as it is an endless possibility.

E. Finite State Machine(FSM)

a) : Finite state machine(FSM) are also used in gaming and can be very useful to perform a particular action when certain condition arrives. FSMs are commonly used to organize and represent an execution flow that is nothing but a loop that goes on and on when the same condition arrives, which is useful to implement Artificial Intelligence in games. The "brain" of an enemy, for instance, can be implemented using a FSM, every state represents an action, such as attack, evade, run or can be anything [2].

b) : Whole cycle of finite state machine can be used in Artificial Intelligence gaming. The Artificial Intelligence character can change its state according to the need as if let's the character is attacking, it can suddenly change its state and can move for searching health[6].

F. Key Technologies Of Game Artificial Intelligence

The term Artificial intelligence technology is completely based on computer [3]. Artificial Intelligence studies the activity of transforming the knowledge into artificial intelligence through electronic technology that is currently available. The main goal of Artificial Intelligence is to design, show intelligence and achieve the work that human intelligence can accomplish or in some cases cannot be accomplish. Nowadays, there is a clear difference between the type of artificial intelligence in commercial games and the type of artificial intelligence as a player playing games. Most of the problems in the game development can be solved perfectly by traditional qualitative Artificial Intelligence techniques such as state diagram search and regular script. The main application or the main purpose of using Artificial Intelligence technology in games is mainly to design immersive and interesting scenes for gamers, so that players can immerse themselves in this relatively real situation and they get the real experience. Normally, the computing capacity and storage capacity of the general computer CPU are very limited and not enough to adopt Artificial Intelligence technology.

In the most of the games the Artificial Intelligence technology in the game should not be too smart like the games which has been built for the only purpose of entertainment, at least not more than half of the player's level, otherwise the player will lose interest in the game as it's of no point how hard he try he will not be able to beat the perfect Artificial Intelligence bot. Therefore, when artificial intelligence technology is applied in games or for making Artificial Intelligence bots, on the one hand, it should limit its effectiveness, intelligence and prevent players from being frustrated, on the other hand, it should also increase the development process and application of intelligent technology in games. Advanced artificial intelligence has better original computing ability and thinking of course, or the machine has to face the solution thinking, or the like, but in the game, the designer hardly pays attention to it at all and yet these are

the most important things but are to underrated

. The main things that game designers actually want is for players to have a good as well as the real experience after playing games. Generally, while designing games, designers want to design an experience for players like a real experience. Designers want to know what players will experience when they reach some interesting point in the game. So, if an artificial intelligence is to be placed, it is strictly expected that the Artificial Intelligence is has to be predictable.

While designing games, game designers need to balance the virtual game world and has to keep many things in mind. On the one hand, they should attract players interest in games, and on the other hand, they should make games challenging but not frustrating. Hence, all this things leads the design of artificial intelligence in games towards complication and it becomes so much difficult to built the games, also the the designer should focus on the quality of games. Therefore, to design a balanced and difficult game, the application of artificial intelligence technology is very important.

G. Conclusion

a) : The advancement of game development is done by Artificial Intelligence and it is still in progress as there is a lot of ongoing work. There has been a lot of changes in gaming experience that players get is quite astonishing as they get real world like experience when having interaction with Artificial Intelligence based bots. So from this paper we can conclude that Artificial Intelligence Algorithms are being applied in almost every games as they hold the many applications in gaming like making a decision, finding a path, finding best moves, etc. Also, we can do impossible things with Artificial Intelligence, example chess is on a whole another level as the engines have beyond 3300 rating, so that is how Artificial Intelligence can take something to whole another level and can make unbelievable things possible. Though it is very costly to adopt the Artificial Intelligence technology, a lot of work can be done in this field so that every firm whether it is a large or small should be able to adopt this amazing technology.

b) : Gaming and Artificial Intelligence have been bed-fellows for many years. It has been a staple of gaming since day one and will never go away. As long as there are players competing against a computer in any game genre, it will be around, constantly growing and adapting to different gaming styles that exist and will lead the gaming industry ahead. With a rich history and a beautiful and impressive set of behaviors that can immerse the player and his/her experience in the game, Artificial Intelligence is clearly the future of gaming. As the Artificial Intelligence algorithm advances the game can take the game to furthest possible level.

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