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Game theory to improve strategic decision making for Ludo quest

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***Abstract*---**The research analysis is aimed to enhance the specific domain knowledge for Ludo which can be used for performance improvement in Dijkstra Algorithm networks or in evolutionary game analysis for ludo games. The Ludo game involves decision-making under fuzziness and uncertainty with more than two parties. It can serve as an excellent example of applying methods and concepts for automating resource management and real-time strategic decisions. Increase Logical Thinking Capability, development of Interpersonal Skills, dealing with Victory and Defeat & Other Cognitive Skills. And also, experimentation is focused on integrating the ludo with quizzes because quizzes will make this game more interesting, and it will also help us to increase our IQ levels. Ludo game concept is achieved by writing a computer program that allows players to roll a dice randomly, take decisions and move the pawn based on the outcome of the dice on a well-designed graphical interface.

***Keywords*---**strategic, Ludo game, Cognitive Skills.

I. Introduction

Ludo

Ludo is a board game played by Two to Four players. Each player is assigned four pieces of a specific color. In this board game 2 to 4, players race their pieces from start to finish according to the dice rolls. The way people play Ludo will vary from person to person. A Ludo board each arm being divided into three adjacent columns of six squares. The center squares are considered as the home column for each color and cannot be landed upon by other colors. In the middle of the cross is a large square which is the "Home" area and which is divided into four home triangles, one of each color. At each corner are different colored areas where the pieces are placed to begin. The colors seen in Ludo boards are green, red, yellow, and blue. Each player is assigned a color and has four pieces of matching color. The players put their pieces in the starting circle. The movement of the pieces is determined by the dice. During gameplay, the token piece moves clockwise from the starting square around the perimeter of the board, and up the player's home column to the finishing square. Players cannot move a piece out of the starting area unless they roll a 6 or 12 on the dice. In this game, players have to play their piece carefully or run the risk of sending it back to the starting point to start all over again. When player 1’s piece lands on a square that is already occupied by Player 2’s piece of different colors, Player 2’s piece is returned to its starting point. A player who brings all their pieces to the finish wins the game.

Quiz

It is not hard to find a quiz game on the Internet. But when the user wants that it should be something like this, the user wants to make sure what kind of things will you learn. Well, sometimes it’s difficult to know how many questions you need and how long the quiz will take until you're done with it. So, more than just having a few questions as most interactive quizzes have nowadays, the game plan here is about using things that are readily available on the Internet and its surrounding resources for making quizzes for people who want something different from the common games that are presently available.

Scratch

The MIT Media Lab created the "Scratch" in 2007 and also known as the visual programming language. It features a drag-and-drop interface with colorful blocks making it one of the most intuitive programming languages to learn. The traditional programming languages like Python and Java, the coder must write out the code, but Scratch empowers young people and adults alike to easily build interactive games and programs by connecting code blocks together. Scratch is a block-based programming language that helps to simplify coding.

Htmlifier

The Scratch file format is a .sb3 format. But we need an application format to run on android devices. Htmlifier is used to convert the scratch project into the web

browser. After that process, we can convert that HTML file into an apk file format using some software like Website2Apk.

II. Literature Review

Mr. Faisal Alvi etc.al [2011] [1] Ludo may be a two to four-player non-predictive race game with the target of moving players' items through a chosen board into a winning location, in accordance with die rolls. During experimentation, they tend to appraise the state-space quality of board games and propose and analyze ways to support four basic moves. They tend to conjointly give associate in experimental comparison of pure and mixed versions of those ways. The analysis aims to enhance the domain-specific data for board games and their variant race games. It might then be used for performance improvement in temporal distinction learning networks or in biological process game analysis for race games.

Veenus Chhabra etc.al [2015] [1] The Artificial intelligence board game provides an atmosphere for enjoying the artificial agents. Its main purpose lies within the space of computing. In one aspect, a board game is instead an awfully easy game and is evident however on the opposite aspect it contains many challenges because of the random and multiagent atmosphere. Therefore, it offers a decent balance between simplicity and complexity and is in a position to draw in a good audience and not solely professionals.

Majed Alhajry etc.al [2012] [2] The Analysis explains a thorough description of a game theory and its applications. Exploration about an AI and its four flagships, a briefing about the terminology used currently in games, and also gives a connection between search algorithms with hard combinatorial problems. Analysis grouped this connection under three things planning, duality, and randomization.

Arpit Bhatia etc.al [2021] [1] In addition to sports to party games, almost all types of games have been adapted into a digital computer game format. While previous research has studied player motivations and experiences in some categories of digital games, there has yet to be such a study on digital board games, especially within the modern context of smartphone apps. To handle this, they conduct a case study of a preferred board game, Ludo, to grasp players' opinions of its digital adaptation. Exploration of the study of the functionality and user reviews of 9 popular Ludo apps, to predict player opinions of how traditional gameplay has been re-designed. Based upon this analysis, they conclude with recommendations for improving Ludo apps and other apps, supported by random chance board games.

G. Keerthana etc.al [2020] [1] The simple GUI-based method board game that is understandable and makes use of. It is a GUI-based 2D multiplayer game. The game consists of a high score module where the winner is assigned specific points based on the ranking and is stored in the database. The individual score is stored from the variable in the SQL database. Initially, the player needs to chance. The main thing in this GUI-based game is that the player simply has to "Roll". On top

of the board, the dice number is displayed. The player needs to keep on rolling until there's a possible chance to relocate. All the game motions are to be handled by hand by the players. The 2D GUI is designed using Tkinter python libraries. The gameplay and GUI are designed in such a way that the user has no difficulty in locating and comprehending the contents of the gameplay. The GUI utilizes various photos as well as GIF documents to provide a real-time experience. At the end of the game, a GUI High score table displays the analysis of the player's performance.

Napsawati etc.al[2021] [1] Based on the results of the research, there is an increase in the activity of players' study groups after the implementation of the Ludo Board Game (LBG). Investigation shows that the ludo board game can be well received by students as a learning medium. The experimentation results that activeness is a condition in which students can carry out various activities such as paying attention to class learning, solving problems, working together in groups, and expressing opinions, to help gain understanding. This Ludo Board Game can make students not feel bored and indirectly this can foster student activeness in learning.

III. Modules

Player Module

Each player consists of four pieces. When the player's turn comes, the player can roll the dice. The player can move any one-pieces for their turn. Whenever the dice get "Six or Twelve" the player can move out the piece out of the yard. Before bringing the piece out of the yard, the player needs to answer the question correctly, or else the current player's turn will switch over to the next player.

Piece Module

The piece can be moved based on the dice-rolled a number. Whenever the dice gets "Six or Twelve" the piece can come out of the yard, if the answer is also correct. If the opponent's piece is in the same position, our piece can defeat the opponent's piece. After that opponent's piece goes to the yard again.

Board Module

The Board consists of 4 yards with each player having unique colors like yellow, blue, red, and green. Also has 4 pieces for each player and two dices.

Dice Module

For each dice, it consists of 6 numbers it will give the dice number based on the random method. Whenever the Go button is pressed, the two dices get to start to roll and display the random value from 1 to 12. Based on this value only the pieces can be moved on the board.

Quiz Module

Whenever the player attempts to get the piece out of the yard, it will pick up the random questions and ask the question to the player. If the player answers the question correctly, it will grant access to the player to get the piece out of the yard. It will ask the question for each piece by picking up the random question. Each question has four options (A, B, C, D). The player can answer the questions

simply only by typing the respective questions option. For example, Pick up the wild animal from this option? a) Cat, B) Dog, C) Hen, D) Lion). The correct answer is D) Lion. So, the player needs to type only the option "D", it may be a capital letter or a small letter both are right.

Multiplayer Module

The multiplayer module consists of three types of multiplayer modes. By using the first mode, two players can play and by using the second mode three players can play. Finally, using the third mode, four players can play the game.

Fig. 1. Multiplayer

Winning Module

Of the four players, which player is first reaching all of its pieces to the home is considered as winner. After the winner's position and there are two other positions, the one is runner-up 1 and another one is runner-up 2.

Dijkstra algorithm

Dijkstra Algorithm is designed to find the shortest paths between nodes in a graph. It allows us to find the shortest path between any two vertices of a graph. The Dijkstra algorithm was implemented by setting the initial node as the current node, and it does mark all nodes as unvisited. Always mark the initially selected node with the current distance of zero and the rest with infinity. The Dijkstra algorithm is also used in the routing protocols required by the routers to update their forwarding table. Dijkstra algorithm work in both directed and undirected graphs, you can simply add edges nodes into the Priority Queue when you have an edge to travel to from the adjacency list.

Fig. 2. Winner image for 4-Players

IV. Game Theory

The game-tree branching factor for Ludo is 24 corresponding to 4 pieces into 12 possible die rolls for each player. After a player has rolled two dice in his move, the player has four options to move his pieces. The game theory is classified into the basic types of moves that a player may choose during the game-play. Then, there are various strategies based on these types of moves.

Random

A player chooses to move his pieces completely at random. Sometimes such random moves may be undertaken when a player may see no advantage in moving a particular piece. However, a random strategy has some usefulness for winning games.

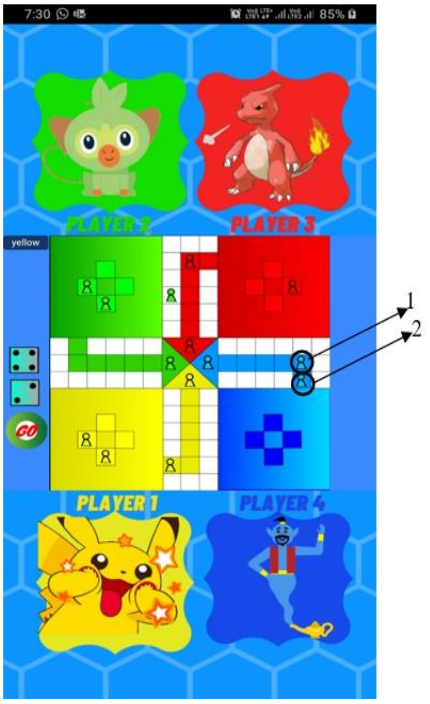

Fig. 3. Random

By choosing randomly 1 have chance to enter to their home and 2 have chance to move around the path.

Aggressive

In an aggressive move, a player prefers to move a piece that can knock out or eliminate the piece of another player, based on the die roll outcome. An aggressive move shows an attacked player in the sense that the attacked player now has to play his eliminated piece over the entire game board again. An aggressive move shows a definite advantage to the aggressor over its victim. However, a player may use another type of move (e.g., a random move), when there is no chance of attacking another player's piece.

Defensive

A player always defends his pieces against the attack from another player. That a piece is in danger of being eliminated when it is less than a distance of a double die roll of another piece, i.e., it is 1-12 squares away from another piece. This distance is known as an attacking range. Therefore, in a defensive move, a player moves his piece if it is within the attacking range of another player's pieces. If a defensive move is successful, gives an advantage to the defender against all players, because the defending player has avoided a loss against all other players by saving his piece. This strategy is used for defensive moves.

Decision Theory

It might be seen as a theory of one player or the player playing against nature. The formation of beliefs and preferences is the main focus. During this theory, we

can represent the uncertainty of outcomes and is represented by a probability theory, and to model the new information to revise the belief Bayes Law applied the frequently Decision theory is that the decision analysis to induce most of the data before any decision is being started.

Mixed

It is potential, and advantageous that a player could like better play different kinds of moves at totally different stages within the game. For instance, a player could play any combination of defensive, aggressive, fast, and random moves, which can produce a mixed or hybrid strategy. We tend to emphasize that the kinds of moves and methods and techniques given here by no means that several other strategies or sorts of moves could also be discovered at numerous stages within the game.

Safe Square

When we compare to normal Ludo game to Ludo Quest, we did something new for example normal ludo game has safe square in their board but in ludo quest there is no safe square because it's makes more interesting to play the game.

Fig. 4. Normal Board with Star Safe Square

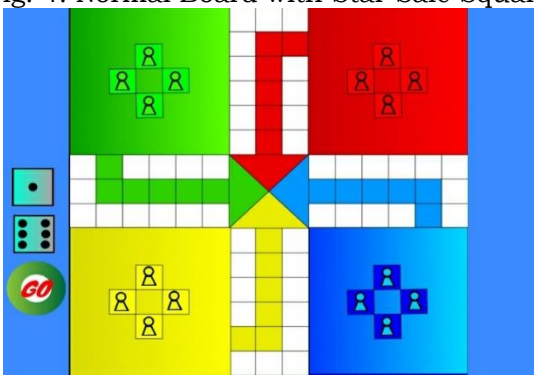

Fig. 5. Ludo Quest without Safe Square

Fast

In a quick move, a player chooses to play the piece that has touched the most distance in its circuit around the board. A quick move is predicated on the concept that the loss of a piece that has advanced the foremost within the game (i.e., the quickest piece) would be the foremost valuable for a player (in terms of the extra variety of moves required), thus it should be ideally affected 1st and sent to the ultimate home location. A quick move reorders the movement of a player's items inside the sport and so doesn't supply any comparative advantage over alternative players. However, the chance of piece elimination is somewhat reduced since a player's only 1 piece is active (moving) at any instant.

V. Result & Discussion

When the game is opened, the user prompts the game to be started. Then the game interface is displayed and by default, it is yellow's turn. The player must roll the die by clicking on the GO button on the left side of the board. Until the value is 6 or 12, no pieces can be moved. Then the control of the die shifts to the next colour and the same process goes on. When a player's piece overlaps the other piece, the latter piece is sent to the home box and the former piece's players get another chance to roll the die. The one who ensures all the pieces get inside the home wins the game. For each time come to get the piece out of the yard, the player needs to answer the question correctly, or else the turn will be switched to another player.

VI. Conclusion

The Ludo Quest application allows the user to play the game by simply clicking the GO button to roll the dice. The game interface is very simple and easy to understand by the user. Since the game is built in 2D the game performance is fast and efficient. Accordingly, the analysis identified four basic moves and developed several playing strategies using these moves: defensive, aggressive, and fast playing strategies. Theoretical and experimental results show that the defensive strategy performs better than the other strategies based on the percentage of wins. It is a user-friendly application it does not require any user's personal information. The quiz concept will enhance the user's knowledge gaining and also help to increase the user's IQ levels. In past, all the ludo games are based on only one dice. But this "Ludo Quest" game is different from the past. This is the next evolution of the ludo game. Ludo Quest implemented two dice and instead of 6, there is in addition to 6 or 12 dice numbers to get the pieces out of the yard. Also introduced a new concept called Quiz. The quiz concept will add additional spicy to this ludo game.

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