

The Role of Shologuti in Artificial Intelligence Research: A Rural Game of Bangladesh

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Abstract

Shologuti has three major component: move generation, search and evaluation. Each components are pretty much necessary, though evaluation with its quiescence analysis is the main part which makes each program's play unique. To make this game more striking, most reliable algorithms and its many supporting aids are used here. Main components of the game tree search and pruning are analyzed here and the performance refinements such as aspiration variation search, assists like transposition and history table are compared here.

Index terms— artificial intelligence. design, game, extinct, shologuti.

1 Introduction

hologuti is very famous and popular game in Bangladesh and some of the Indian regions. It actually a checker type game which basically played between two players. So from that view, it can be called as a rural version or innovation of chess. The local people play this game for passing their leisure period even sometimes they arrange tournament of this game. Generally the board of this game is very simple like the people can draw it in table or ground and use stones, dry branch or a small piece of cane as pawns. After drawing, two players take their place at the opposite direction of the board with their 32 guti's altogether of which everyone try to achieve opponent's sixteen beads. After placing 16 pawn from the edge of the board, the game starts by making a move on the empty space. The pawn can move right, left, forward, backward and crosswise where each opponents actually try to take or occupy others pawns. If any player's pawn can cross opponent's pawn, then the pawn will be out of the board. After that, only that pawn has the ability to have a bonus move if that pawn can find out opponents pawn can be crossed over. By this process, which player can take or capture all the pawns of opponents, he or she will be the winner. Now a days, computer has become a part of our life and almost everyone like to play game in it. This led us to develop this attractive game of Shologuti. Due to lack of well-designed boards in market, city's people can't play it or don't even actually well known about the game. So, the problem can be solved by developing this game with an attractive UI. After designing the basic part of this research [16], we are intended to push artificial intelligence part in this program to make it more fascinating.

2 II.

3 Literature Review

In general, this research cover the literature review from different sources which is targeted various aspect of designing game, installation & learning.

Whitby et.al [1] concerned in his research about the creation of a game installation and a reviewed a case study to test the game. Coleman et.al [2] described the initiatives they took to develop & design a game for improving their skills. Symborski et.al [3] & Martey et.al. [5] also showed the game development and design strategy guided by experimental test and evaluation. Sethi et.al [4] described "Don't just play a game, design a game & build a game and improve your programming skills". Amory et.al [9], Cheng et.al [10] & Dondlinger [12] developed a game which is actually a part of social & mental development. Schrier et.al [11] designed a game

which was filled with moral scenarios & moral choices. Nergiz et.al [13] & Strzalkowski et.al [14] described the experiences from the implementation of a computer game development that it could help a student to improve in problem solving, the application of previously learned knowledge, the utilization of independent learning and learning by doing.

Then Reidl et.al. [15], Thune et.al. [16], Nasr et.al. [17] and Harrison et.al. [18] described in their research that Artificial intelligence has long been an important part of game design and development practices ?? Treanor et.al. [19], Eladhari et.al. [20] and Magerko et.al. [21] identified design patterns for AI in games like AI-based games put AI in the foreground of the player experience in their research.

After that, we (Nawshin et.al. [22]) developed and reviewed the development part of Shologuti in our research document where we wanted to describe and analyze a computer based game (Player vs Player) which will help our culture to save an extinct rural game. So, in extension, we are intended to use more interesting algorithms to develop the AI vs player environment which will increase the performance to make this game more accurate, unique and enjoyable.

In the coming chapters we will discuss about system architecture of the developed game in Chapter III, Chapter IV deals about the physical implementation and results and finally Chapter V shows us the conclusion.

4 III.

5 System Architecture

To explain the entire system as well as the game, an effective architectural system needs to be designed. This section will represent the basic design part. The control flow of the program among various functions is shown using a single flowchart. Each function in the program is well defined and their pseudo codes are given for better understanding of the program. This section contains Control flow diagram, Function description and Pseudo code which will represent a clear understanding about move generation, search and evaluation part of this game.

6 a) Control flow diagram

PvAI Algorithm Workflow in fig 1 shows the entire execution sequence of functions in the program. In this program, two players can play continuously that is PvP (Player vs. Player) which is already developed [16]. In this game, a single player can also play by a good contribution of AI.

7 b) Function description i. Handover

Handover is the starting function for AI part of the game. When the player complete his turn handover function is called. First of all this function clears the array named points to make it ready to use again. Then it calls AI_Moves, Sorting, sets up AICsp (the starting position of AI's best move) and AICep (the ending position of AI's best move) based on the sorting and finally AI_Pawn_Loc.

8 Pseudo code:

Step 1: Clear array "Points"

Step 2: Call AI_Moves ()

Step 3: Call Sorting() Step 4: Set AICsp = points[0,0,0] AICep = points[0,1,0]

Step 5: Call AI_Pawn_Loc(AICsp, AICep)

The Role of Shologuti in Artificial Intelligence Research: A Rural Game of Bangladesh ii. AI_Moves AI_Moves function along with some other functions acts as the mini-max mechanism of the game. This function particularly focuses on each available AI's pawns adjacent positions. First it checks for all the available pawns on the board and store them in the array. Then takes a pawn each time, and searches its adjacent positions. Checks each adjacent positions value. If the value is 0 (represents open position). It stores that position as possible end point on array and calls Capture_Check with parameter as that position. if the adjacent position is 1 (represents enemy pawn), it calls AI_Capture function with parameter of starting position and that position. The function ends when each adjacent position for each pawn is calculated and points are distributed.

9 Pseudo code:

Step 1: Call AI_Reset()

Step 2: Set x=0

Step 3: For every position on the board Set z=0

Set points[x,0,z]=current position

Step 4: For every current position Check every adjacent positions value Step 5: If value of current adjacent position is = 0 Set points[x,1,z] = current adjacent position Call Capture_Check(points[x,0,z], points[x,1,z]) z=z+1, AI_Reset()

Step 6: If value of current adjacent position is 1 Call AI_Capture with parameter points[x,0,z] and points[x, ??,z] z=z+1, AI_Reset()

Step 7: x=x+1

98 iii. `AI_Reset` `AI_Reset` function is very important function for the AI part of the game. To calculate and
99 distribute points to each possible moves to evaluate the best move, we have to manipulate the variables that
100 represents pawn on the board. But original variables can't be manipulated directly or the game would become
101 a chaos. So a dummy board or replica is needed. This function replicates the board and lets the needed change
102 happen for calculation. This provides with the ability to calculate using the same info as the board but not
103 change it in the process.

104 **10 Pseudo code:**

105 ? Copy every positions value to similar AI variables | `ai0 = a0`, `ai2 = a2` etc.

106 **11 iv. Capture_Check**

107 This function is the first function that sets points as the mini-max mechanism. This function checks if an AI
108 pawn is moved to a new position, is there any chance that it would be captured by an enemy pawn or not. If
109 there is a chance the pawn may be captured, this will subtract 4 points from the array for that move. If not, it
110 will add three points into it.

111 **12 Pseudo code:**

112 Step 1: Check for each possible enemy capture for this move.

113 Step 2: If there is a possible enemy capture Set points `points[x,2,z] = points[x,2,z] -4`;

114 Step

115 **13 Pseudo code:**

116 Step 1: Get starting and capture position from `AI_Moves` vi. `Future_Capture` This function is used to detect
117 any possible bonus capture moves. As per Sholo-Guti rules, a player can make several capture moves at a time
118 with a single pawn if possible. If possible it adds 5 points to the array for that move, and recurses using the
119 future endpoint for this bonus move. The recursion continues till there is no more bonus moves possible and then
120 calls the `Capture_Check` function with the parameter of captured location (FSP) and ending position (FEP) it
121 gets at the final recursion.

122 **14 Pseudo code:**

123 Step 1: Set `FSP = null` & `FEP = null`

124 Step 2: Check if any capture move is possible After the mini-max part is done, the array is full with each
125 possible move and their respective points. The array then is sorted. Firstly the best move for each pawn is sorted
126 out and brought to the top, i.e. `z=0` of the array. And then the best move between all the pawns is sorted and
127 brought to the beginning column i.e. `x=0` of the array. After this process the first column of first page of the
128 array holds the best moves starting position, ending position and its points. The array is string type array so to
129 manipulate numeric value. After this the control returns to handover function.

130 **15 Pseudo code:**

131 ? Sorts the array using Bubble sort technique and ascends the best move based on the points assigned during
132 previous function operation.

133 viii. `AI_Pawn_Loc` `AICsp` is usually set as the first starting point and `AICep` is set as first ending point on
134 the array by the function `Handover`. In case of multiple capture, this function is called again using modified
135 `AICsp` and `AICep`. This function then finds out the X & Y coordination for both the `AICsp` and `AICep` positions
136 and put them in `SPx`, `SPy`, `EPx` and `EPy` accordingly. Then it starts the timer function.

137 **16 Pseudo code:**

138 Step 1: Get `AICsp`, `AICep`

139 **17 Pseudo code:**

140 Step 1: If `SPx < EPx` `SPx = SPx + 4` Else `SPx = SPx -4`

141 Step 2: If `SPy < EPy` `SPy = SPy + 4` Else `SPy = SPy -4`

142 xi. Next After the mini-max mechanism and sorting happened, AI has the best move to make. Timer
143 function moves the pawn to the desired position but the value of the board has to change. `AI_Make_Move`,
144 `AI_Make_Capture` functions make that happen. After these functions are called and executed, the control again
145 returns to next function and player swap function is called to swap the program control to the pvp part of the
146 game for player to make his move. And the game progresses.

147 **18 Pseudo code:**

148 Step 1: Call `AI_Make_Move(AICsp,AICep)`

149 Step 2: Call AI_Make_Capture(AICsp,AICep)
150 Step 3: Call Player_Swap()

151 19 xii. AI_Make_Move

152 AI_Make_Move function is used to change the value in board when AI makes a normal move.

153 20 Pseudo code:

154 Step 1: Move pawn from AICsp position to AICep position
155 Step 2: Set AICep positions value as AICsp positions value
156 Step 3: Set AICsp positions value as default 0.

157 21 xiii. AI_Make_Capture

158 AI make capture function is used when AI makes a capture move. It sets AICep positions value as AICsp positions
159 value. And AICsp positions value is set as default 0. The position in between value is set as default 0. Captured
160 pawn count is increased by 1 and enemy pawn count is decreased by 1. Then the function calls Next_Capture
161 function using parameter AICep.

162 22 Pseudo code:

163 Step 1: Move pawn from AICsp to AICep
164 Step 2: Hide pawn between AICsp and AICep Count enemy pawn = pawn -1
165 Step 3: Call Next_Capture using parameter AICep xiv. Next_Capture Next_Capture function checks each
166 adjacent position of AICep position for enemy pawn, if found, it checks if capture move is possible. If possible it
167 sets AICsp as AICep, AICep as new ending position, and calls function AI_Pawn_Loc using these parameter.
168 This process keeps repeating till there is no more capture move possible. And returns control to function next.

169 23 Implementation and Results

170 24 a) Selecting the Game Type

171 When the game starts if it detects a previously saved game, the game is loaded with previously saved properties.
172 If not, a window shows up like this and asks the player to select a game type, either a PvP or PvAI.

173 25 b) Player vs. Computer

174 If the player selects to play a new game of PvAI, the board is loaded with pawns set in their default starting
175 position and then the player gets to play the first move always. When a move is made by the player, AI will take
176 a move automatically. Fig. 3. is the screenshot of Player vs. Computer.

177 26 ii. AI Pawn

178 When a move is made by the user AI will make a move to best possible location among all of its own pawn and
179 after making a move AI will hand over the game to the player.

180 If there is any capture move possible AI will take that move. And then if another capture is possible with that
181 pawn again, AI will take that move too and will be looking to capture more pawns with that pawn if possible.
182 Else, AI will hand over the game to the player.

183 27 e) New Game

184 On dropdown menu there is a submenu named as "New Game" which contains two options to start a new game,
185 "Player vs. Player" and "Player vs. Computer". On the click to one of those menu option specific game starts
186 with default board. Fig. ?? is the screenshot of how to create a new game.

187 28 f) Setting Wining Point

188 On dropdown menu there is a submenu named as "Set Wining Point". On the hover to this control, it shows five
189 different numbers. Clicking on any of them sets particular value. Which indicates how many pawns have to be
190 captured by users/computer to win the current game. Fig. ?? is the screenshot of how to set wining point on a
191 game.

192 29 g) Winning the Game

193 When the specified numbers of pawn is captured by player/ computer, a message box appears on the screen
194 showing the winners name on it. And then another message box is showed up if the player/players wants to start
195 a new game on the current game mode. Fig. ?? is the screenshot of what happens when a game is won by the
196 AI and fig. 10. is the screenshot of what happens when a game is finished.

30 h) Save & Exit

When the close button on the top right is pressed or "Exit" is clicked from the dropdown menu, a message box appears to ask player if he wants to save the current game to play it later from the current state. If the button "Yes" is clicked then the game will be saved with current properties. And user can play the game from that saved state when he runs the game next time. Fig. 11. is the screenshot of what happens when a close button is pressed during the gameplay.

V.

31 Conclusion

Different person thinks in different way. This game is developed from a specific point of view and analysis. For developing or designing this game, many problems or difficulties actually came out. So there is a chance that the problems can be solved in a much more easy way by using advanced techniques.

32 a) Challenges to overcome

It is true that the development environment is totally unpredictable. Many things went wrong while working on the real project. Firstly, any well-defined structure of the game haven't found. Secondly, Some problems arose while developing the system like creating database cost us more time fetching data from database for this a three dimensional array is used instead of using database. Finally, faced some problem in .NET platform but managed to fix it all.

33 b) Future scope

We need to apply more algorithms in future to make it more efficient and effective. In future this research can be enhanced into a more intelligent system.

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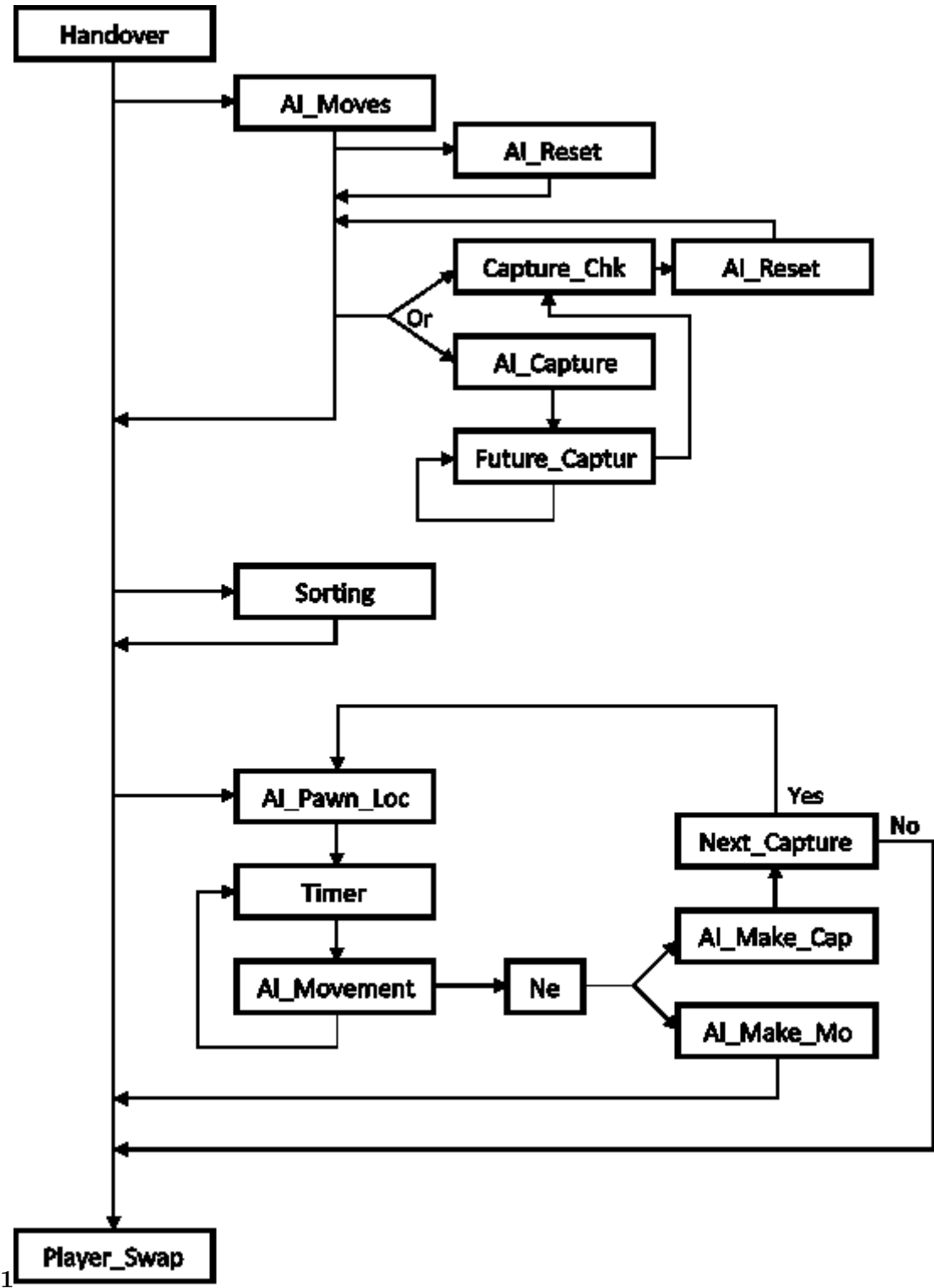


Figure 1: Fig. 1 :



Figure 2: 3 :

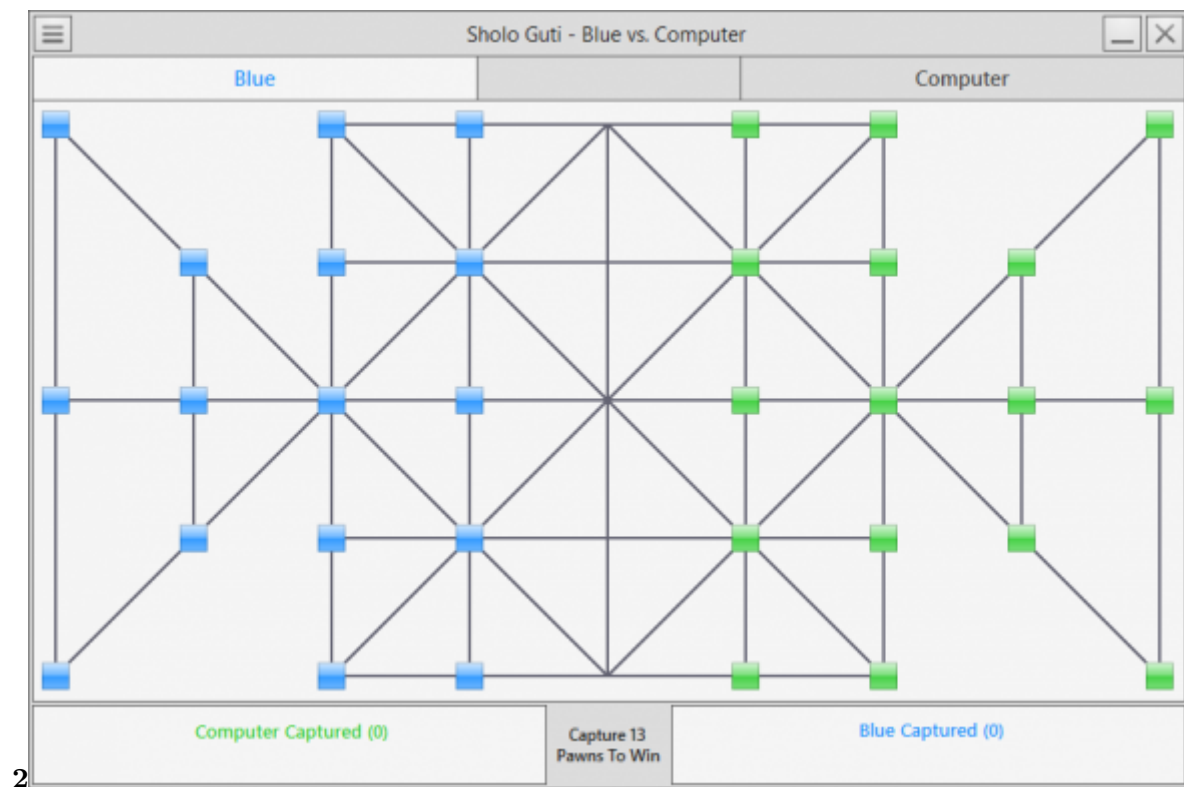


Figure 3: Step 2 :

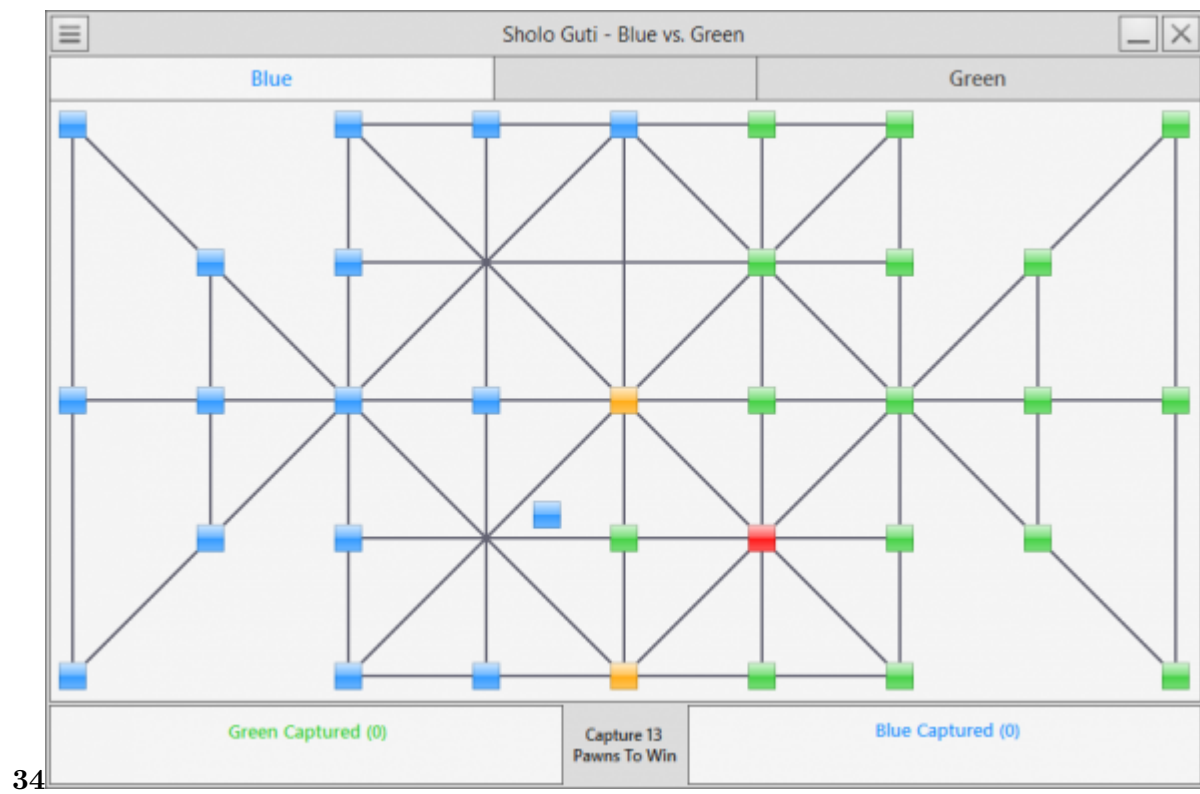


Figure 4: Step 3 : 4 :

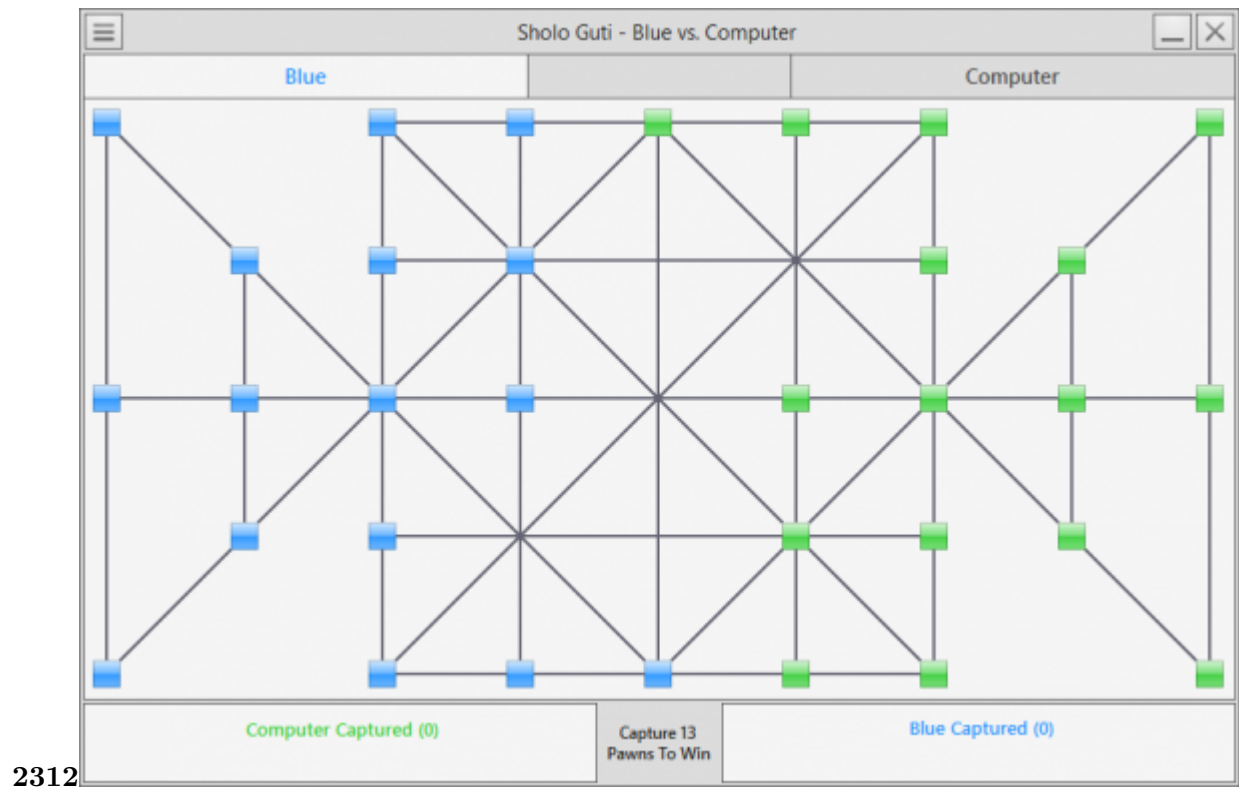


Figure 5: Step 2 : 3 :Step 1 : 2 :

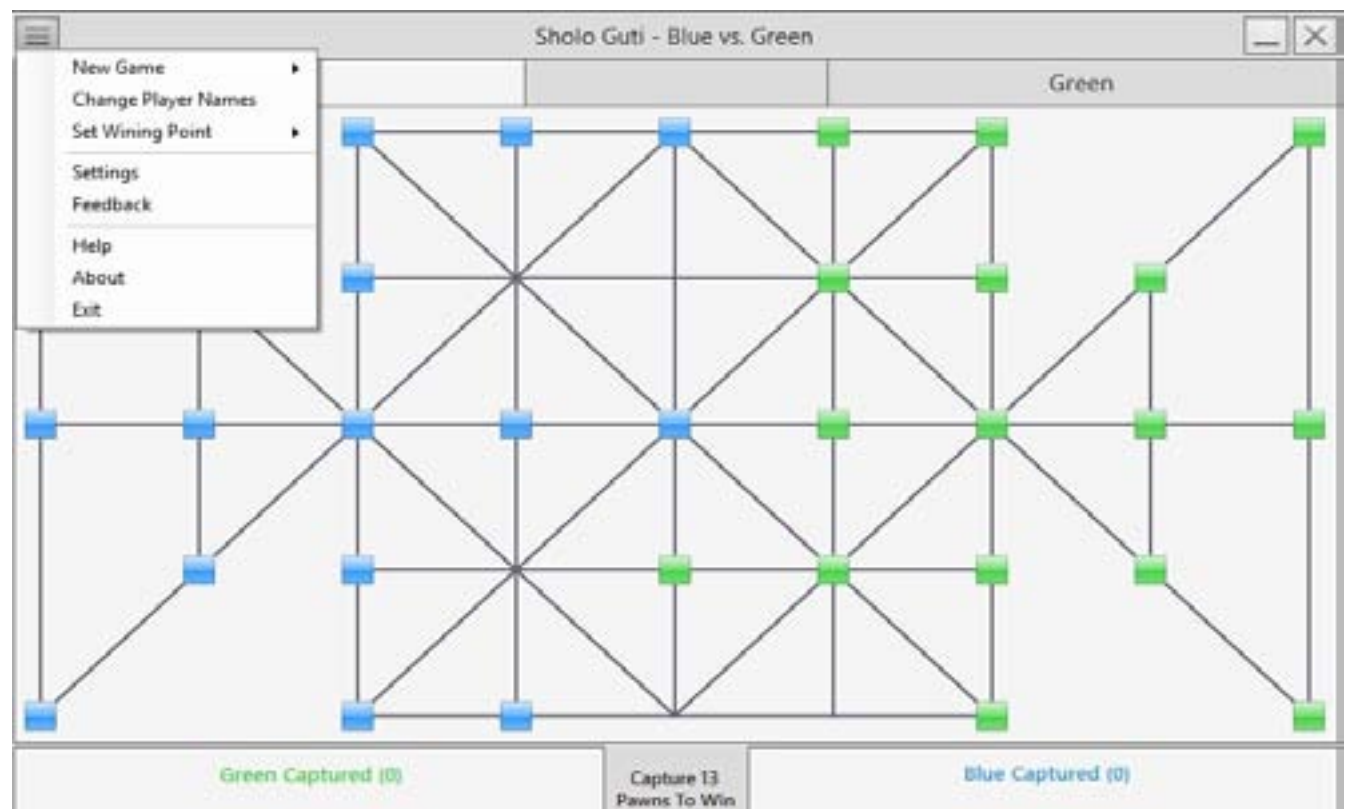


Figure 6:

3

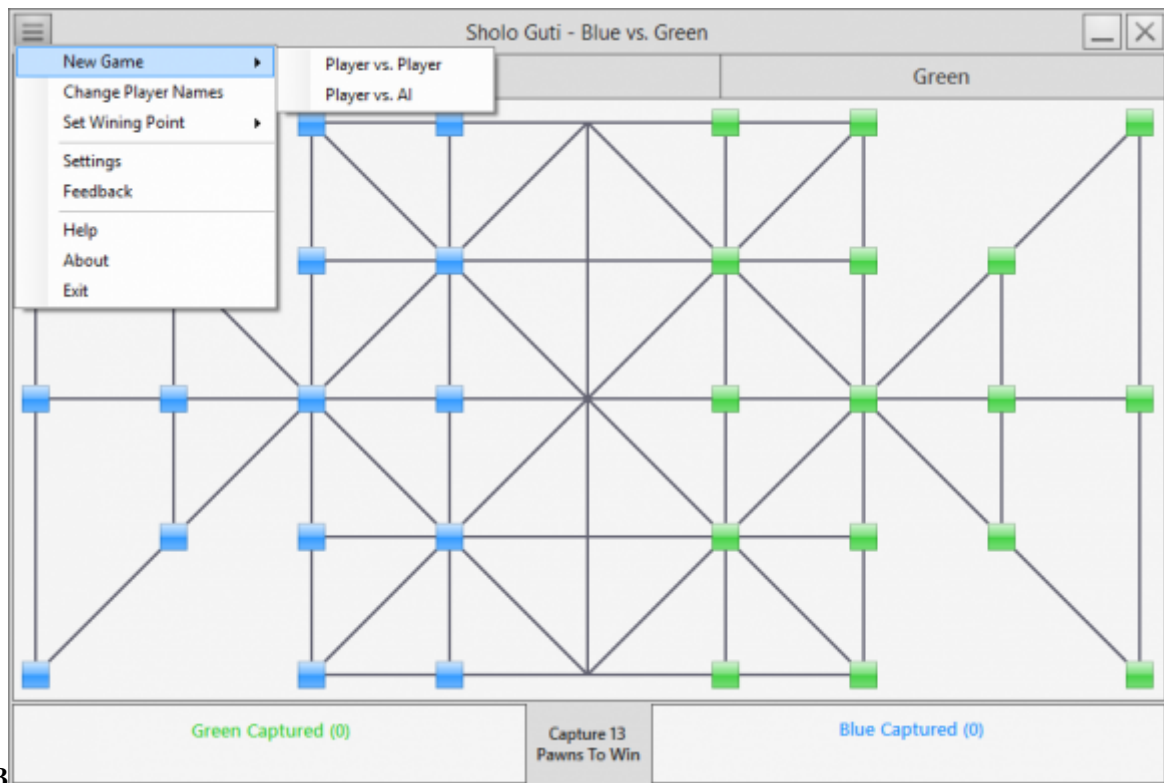


Figure 7: Fig. 3 :

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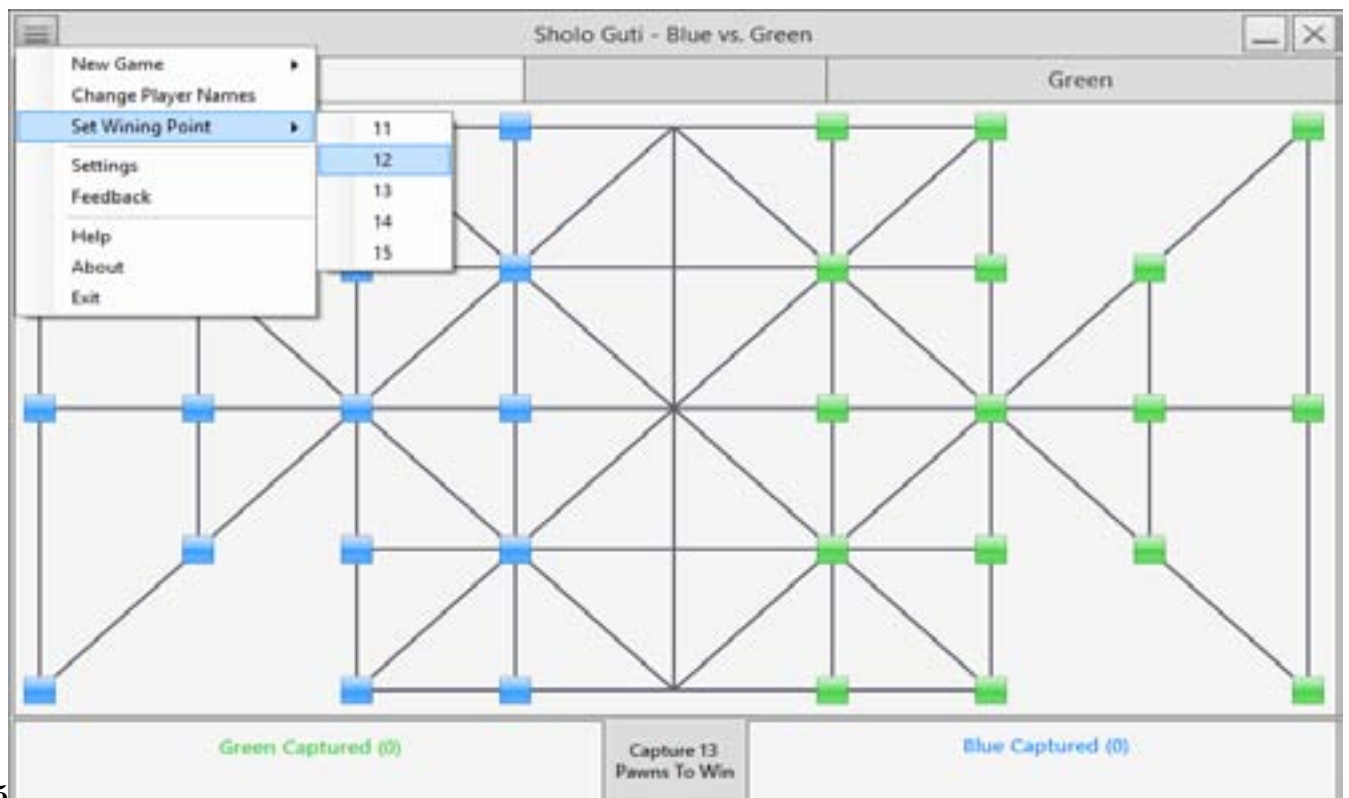


Figure 8: Fig. 5 .

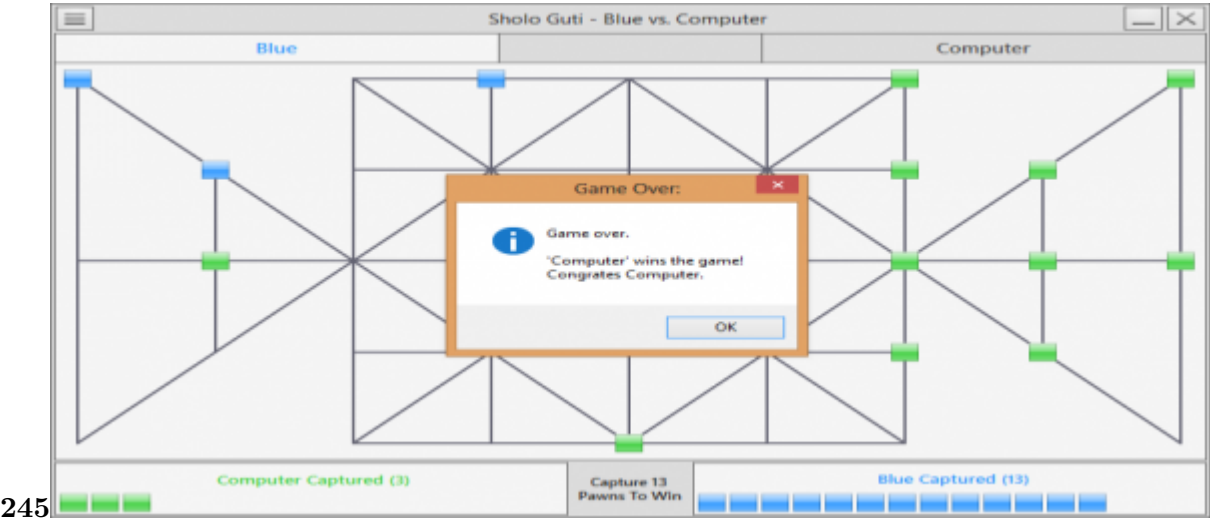


Figure 9: Fig. 2 :Fig. 4 :Fig. 5 :

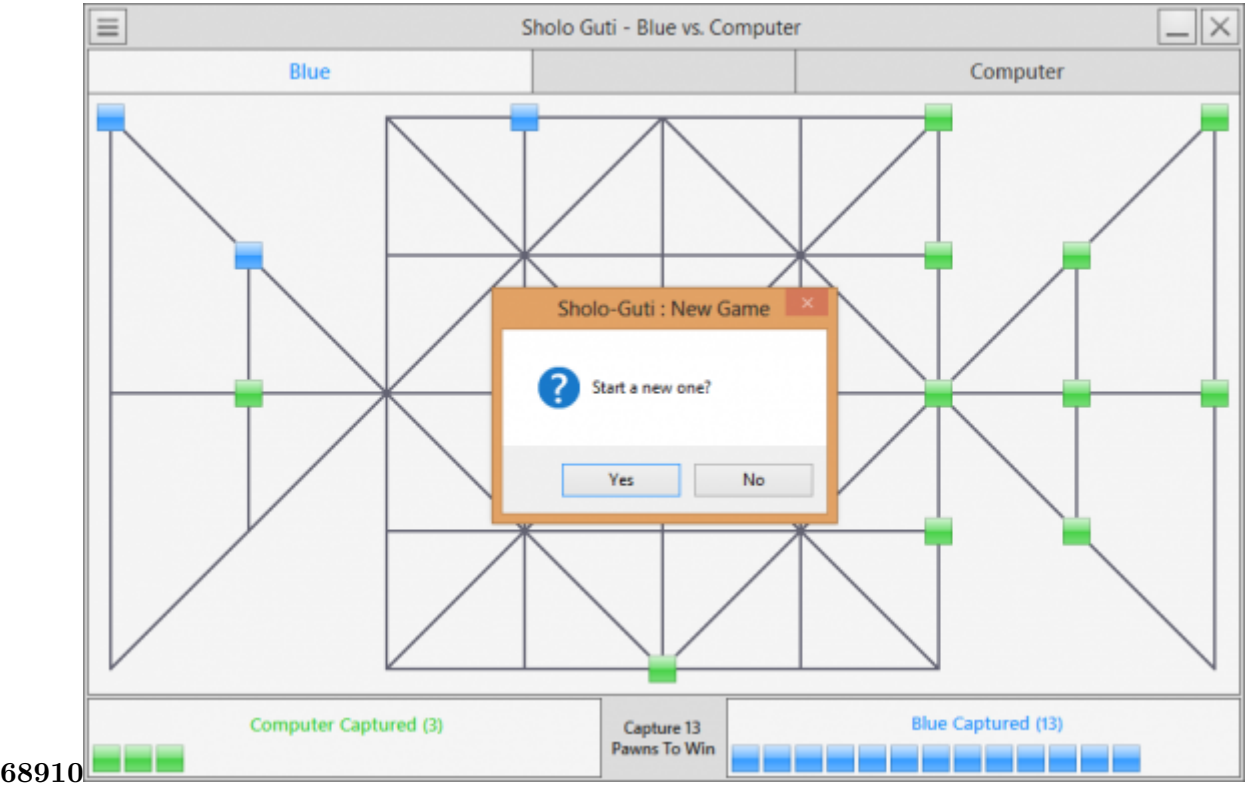


Figure 10: Fig. 6 :Fig. 8 :Fig. 9 :Fig. 10 :

- [Cheng and Ho Su ()] 'A Game-based learning system for improving student's learning effectiveness in system analysis course'. C H Cheng , C Ho Su . 10.1016/j.sbspro.2011.12.122. <https://doi.org/10.1016/j.sbspro.2011.12.122> *Procedia -Social and Behavioral Sciences* 2012. 31 p. .
- [Riedl and Zook ()] 'AI for game production'. M O Riedl , A Zook . *Computational Intelligence in Games (CIG), IEEE Conference*, 2013.
- [Treanor ()] 'AI-based game design patterns'. Treanor . *10th International Conference on the Foundations of Digital Games*, 2015. p. 19.
- [Magerko et al. ()] 'An Overview of Computational Cocreative Pretend Play with a Human'. B Magerko , J Permar , M Jacob , M Comerford , J Smith . *Proceedings of the Playful Characters workshop at the Fourteenth Annual Conference on Intelligent Virtual Agents*, (the Playful Characters workshop at the Fourteenth Annual Conference on Intelligent Virtual Agents) 2014. 2014.
- [Martey et al. ()] 'Balancing Play and Formal Training in the Design of Serious Games'. R M Martey , J S Galley , A Shaw , B Mckernan , T Saulnier , E McLaren , M Rhodes , J Folkestad , S M Taylor , K Kenski , B Clegg , T Strzalkowski . *SAGE Journals: Games and Culture* 2016. 12 (3) p. .
- [Sethi ()] *Computer Game and Simulation Programming*, M Sethi . 10.1109/ICVR.2007. <https://www.amazon.com/Game-Programming-Teens-ComputerSimulation/dp/1598635182> 2008. (Game Programming for Teens)
- [Samia et al. ()] 'Design and Implementation of Shologuti: A Rural Game of Bangladesh'. N Samia , M Saifuzzaman , M Abdullah Al Mamun , M Muzahid . 10.5120/ijca2017. *on International Journal of Computer Applications* 2017. 176 (8) p. .
- [Whitby ()] 'Designing and Creating a Game Installation'. M Whitby . 10.1007/s40869-017-0039-2. *The Computer Games Journal* 2017. 6 (3) p. .
- [Schrier ()] 'Designing Games for Moral Learning and Knowledge Building'. K Schrier . 10.1177/1555412017711514. <https://doi.org/10.1177/1555412017711514> *SAGE Journals: Games and Culture*, 2017.
- [Dondlinger ()] 'Educational Video Game Design: A Review of the Literature'. M J Dondlinger . https://www.researchgate.net/publication/238444705_Educational_Video_Game_Design_A_Review_of_the_Literature *Journal of Applied Educational Technology* 2007. 4 (1) .
- [Eladhari ()] M P Eladhari . *{{AI}-Based} Game Design: Enabling New Playable Experiences*, 2011.
- [El-Nasr Drachen Canossa (ed.) ()] *Game Analytics*, M El-Nasr, A Drachen, A Canossa (ed.) (London) 2013. Springer.
- [Coleman et al. ()] 'Game design & programming concentration within the computer science curriculum'. R Coleman , M Krembs , A Labouseur , J Weir . 10.1145/1047124.1047514. *ACM SIGCSE Bulletin* 2005. 37 (1) p. .
- [Goude et al. ()] 'Game Design in Virtual Reality Systems for Stroke Rehabilitation'. D Goude , S Björk , M Rydmark . *Stud Health Technol. and Inform* 2007. 125 p. .
- [Flores et al. ()] 'Improving patient motivation in game development for motor deficit rehabilitation'. E Flores , G Tobon , E Cavallaro , F I Cavallaro , J C Perry , T Keller . *ACE '08 Proceedings of the 2008 International Conference on Advances in Computer Entertainment Technology*, 2008. p. .
- [Thue et al. ()] 'Interactive storytelling: A player modelling approach'. D Thue , V Bulitko , M Spetch , E Wasylishen . *3rd AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment*, 2007.
- [Strzalkowski and Symborski ()] 'Lessons Learned About Serious Game Design and Development'. T Strzalkowski , C Symborski . 10.1177/1555412016673524. <https://doi.org/10.1177/1555412016673524> *SAGE Journals: Games and Culture* 2016. 12 (3) p. .
- [Cagiltay ()] 'Teaching software engineering by means of computer-game development: Challenges and opportunities'. N E Cagiltay . *Fig. 11: Save & Exit*, 2007. 38 p. .
- [Symborski et al. ()] 'The Design and Development of Serious Games Using Iterative Evaluation'. C Symborski , M Barton , M M Quinn , J H Korris , K S Kassam , C K Morewedge . 10.1177/1555412016673262. <https://doi.org/10.1177/1555412016673262> *SAGE Journals: Games and Culture* 2017. 12 (3) p. .
- [Cameirao et al. (2007)] 'The Rehabilitation Gaming System: a Virtual Reality Based System for the Evaluation and Rehabilitation of Motor Deficits'. M S Cameirao , S B Badia , L Zimmerli , E D Oller , P F M J Verschure . 10.1109/ICVR.2007.4362125. <http://doi.acm.org/10.1109/ICVR.2007.4362125> *Virtual Rehabilitation* 2007. 2007. September 27-29. p. .
- [Amory et al. ()] 'The use of computer games as an educational tool: Identification of appropriate game types and game elements'. A Amory , K Naicker , J Vincent , C Adams . doi:10.11 11/1467-8535.00121. *British Journal of Educational Technology* 1999. 30 (4) p. .
- [Harrison and Roberts ()] 'Using sequential observations to model and predict player behavior'. B Harrison , D L Roberts . *6th International Conference on the Foundations of Digital Games*, 2011.