

Computational Model for Sri Lankan Board Game Nerenchi

RGUI Meththananda^{1#} and B Hettige²

¹University of Colombo School of Computing, Colombo 7, Sri Lanka

²Faculty of Computing, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

#umameththananda@gmail.com

Abstract— People play games for entertainment or to show the superiority of strength and which co-existed with humans since the start of mankind. A board game is a game that involves counters or pieces moved or placed on a pre-marked surface or "board", according to a set of rules. Unlike the other games these games are played to show the intellectual superiority without being concerned over serious logistics and resources. Nerenchi is one of the oldest board games which has been discovered in Sri Lanka (c. AD 10). Nerenchi board has diagonal lines joining the corners and horizontal and vertical lines joining the midst of three concentric squares. Nerenchi has mainly two phases. In the first phase, pieces have to be laid on the board. In this phase, 22 pieces must be placed from the 11 pieces each player has. When three pieces are placed in a straight line horizontally, vertically or diagonally, player is rewarded with a bonus chance called 'nerenchi'. When either the number of pieces on the board reaches 22 or one player placed all his/her 11 pieces on the board, second phase of the game begins where the players can move and capture each other's pieces when the player is rewarded with a nerenchi. Behaviour of each of these phases is governed by a set of simple rules. The Nerenchi game has been implemented through the web based architecture. Computational model for game Nerenchi has been implemented with 2 matrices to control the user errors and set of rules governed. It is undertaken by using mathematical models. 3x9 and 4x6 matrices which hold the status of positions, optimize the resources in attaining this goal. In addition to the above Human-Computer version has been implemented through the Prolog based search algorithms. The system has been successfully tested in a laboratory environment.

Keywords— Board Game, Nerenchi

I. INTRODUCTION

Board games were the early choice to be implemented as computer games since 1950s, almost after the invention of the computer. Then, with the popularity of PC and Internet, board games became popular among general game players as well. Even though the game industry has, to a great extent, been dominated by 3-D games with real-like graphics and characters, board games have been

able to maintain its position as it challenges the intellect of humans. Board games have been an interesting research area in computer science and artificial intelligence since 1950s as many computer scientists have dreamt of challenging human intelligence and AI (Artificial Intelligence) researches too have shown their keen interest in this particular area for decades due to the characteristics that it gives new insights into human rationality and tests new ideas in problem solving, readily applicable to other related fields like mathematics.

The board game known as "Nerenchi", have been discovered in Sri Lanka (c. AD 10) has only a slight difference from Nine Men's Morris game, one of the oldest games discovered around Egyptian temple in Kurna in Egypt dated around 1440 BC. The boards in the two games differ from each other. Nerenchi board has diagonal lines joining the corners of the squares in contrast to Nine Men's Morris and its rules. In Sri Lanka, the evidence in this regard of these boards have found on the steps leading to the sacred hill at Mihimitali and on a rock near Lankarama dagaba. More over this game has been one of the favourite games among Sri Lankan women and girls often in teams, with the members of each team taking turns.

This traditional game belongs to the Sri-Lankan Culture though popular among the pre generations, with the development of the technology and the change of Sri-Lankan lifestyle, this game does not bare that much popularity among the citizens. It is a known fact that, today a game becomes popular due to its accessibility and availability as computer games or phone apps for example. With the advent of new technology, improved processing power and memory capacity, computers excel in many board games such as Chess, Checkers. The engines in these games increase its performing strength every year partly due to the increase in processing power that enables calculations to be made to ever greater depths in a given time. In addition, programming techniques have improved, enabling the engines to be more selective in the lines that they analyse and to acquire a better positional understanding. Kings Row is a strong checkers and draughts engine nearly unbeatable due to search functionality in the endgame database. An

endgame database is a collection of all possible endgame positions which identify the absolute best move in all positions. Since Nerenchi board game hasn't been previously implemented as a computer game this paper presents the design and the implementation of the Nerenchi game through web based architecture.

The rest of this paper is as follows. The section 2 describes the overview of the Nerenchi game. The section 3 gives the design of the computational model and the implementation of the game. The section 4 demonstrates the Nerenchi game in action. The final section, 5 concludes the paper with a note on further work.

II. NERENCHI GAME: A BRIEF INTRODUCTION

As board games has a pure form of platform in general in order to allow two (or more) players to compete against each other not having worries with regard to tedious logistics, Nerenchi has also been designed on a simple board with two different set of counters with diagonal lines joining the corners and horizontal and vertical lines joining the midst of three concentric squares (as shown in Figure 1) which provides space for two players to compete against each other.

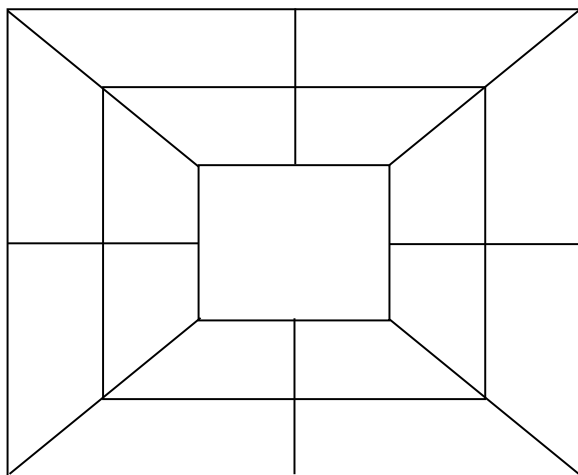


Figure 1: Overview of the Nerenchi board

A. Phase 1 – Placing phase

The game Nerenchi has two main phases. In the first phase (i.e. Placing phase), counters are to be laid on the board. In this phase, 22 counters must be placed at the 12 counters hosted by each player. When three counters of a particular player are on a straight line horizontally, vertically or diagonally, the player is rewarded with a bonus chance called 'nerenchi'. This bonus chance allows the player to play again disturbing the alternation of turn.

This phase continues while the number of counters on the board reaches 22 or one player placed all his/her 12 counters on the board. Then, the turn changes to opponent (even the current player has 3 consecutive counters on board by his/her last move). This is marked by the end of phase 1 and the beginning of the phase 2.

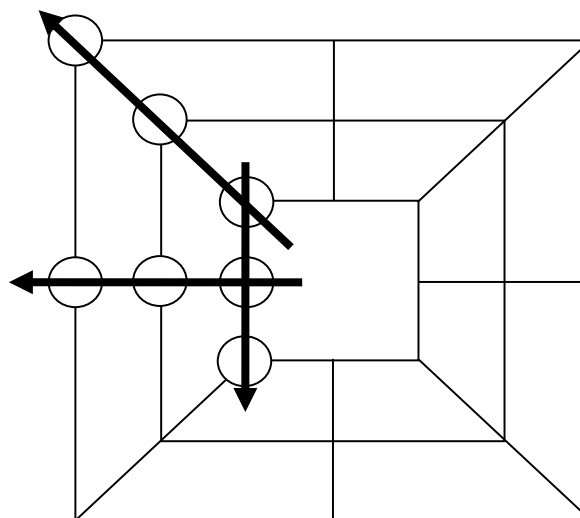


Figure 2: Three consecutive counters in a line (vertically, horizontally and diagonally)

B. Phase 2 – Moving phase

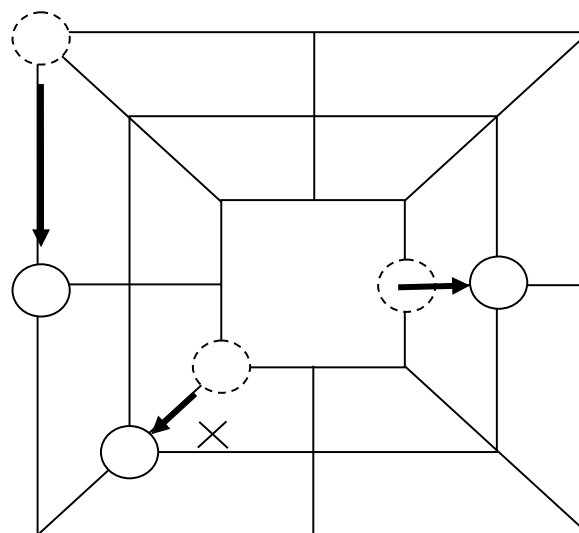


Figure 3: Available Moves

The second phase (i.e. Moving phase), of the game allows the players to move vertically or horizontally along the line to an adjacent joint but not diagonally as shown in Figure 3. In this phase, players get the opportunity to

capture the counters of the opponent acquiring 3 counters of its peculiar in a straight line vertically, horizontally or diagonally with the most recent move. Then, the player has the ability to capture any counter the opponent has and after the capture, the opponent gets the turn to move.

C. *Winning conditions*

At the end of the second phase, the winning criterion of the game is declared. One may win the game either by capturing all the counters except two which belong to opponent or by eliminating all the possible moves of the opponent (i.e. if the opponent doesn't have any legal moves, the current player wins).

III. DESIGN and IMPLEMENTATION OF THE BOARD GAME NERENCHI

This section briefly describes the design and the implementation of the Nerenchi game. The figure 4 shows the top level of the design of the system. The system consists of 4 modules namely the Game engine, the Database, and the PROLOG engine and the client side user interface.

The Game is to be played in two modes such as the Human-Human mode and the Human-Computer mode. The PROLOG engine accommodates the Human-Computer mode of the Game. At this stage, the PROLOG engine works as a human and plays with other user.

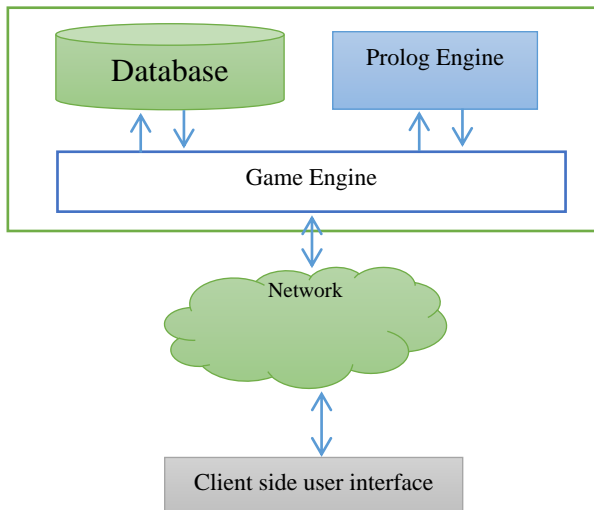


Figure 4: Design diagram

A. *Human - Human mode*

Human-Human mode is the multiplayer mode of the system that provides user interface of the two players

and play through the network. The Figure 5 shows the data flow diagram of the system. The proposed system has been developed in .NET framework with MySQL platform in order to launch in web based architecture.

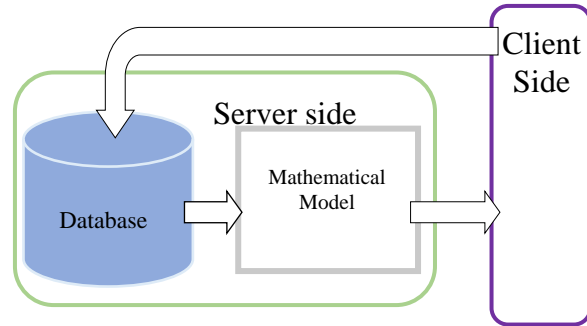


Figure 5. Data flow design

The system has been designed utilizing Unified modelling language which enables developers to create blueprints of the system as shown in Figure 6 and Figure 7.

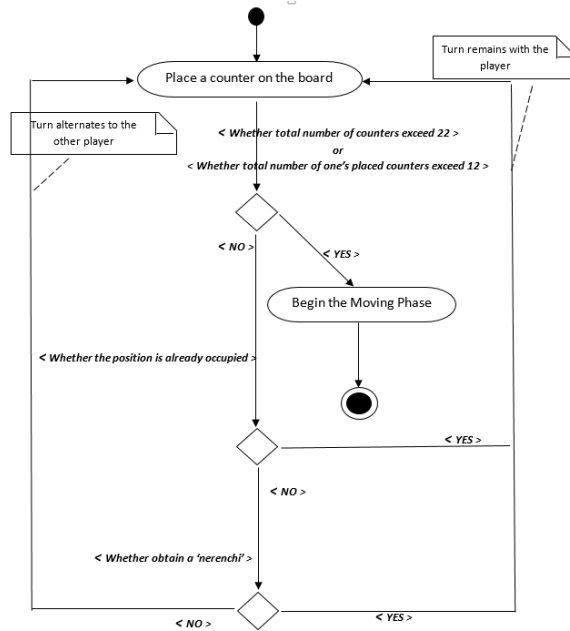


Figure 6. Data flow in phase 1

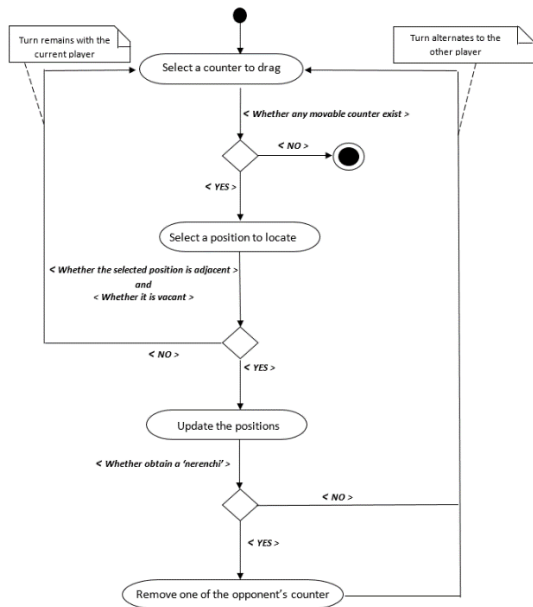


Figure 7. Data flow in phase 2

B. Mathematical model

Human-Human mode is the multiplayer mode of the system. The above functionalities have been implemented on a base of Mathematical model. This computational model for game Nerenchi has been implemented with 3 matrices to control the user errors and set of rules governed.

The joining points of the board has been model by indexing from 0 to 23 and the status of those positions are hold by the database which assists the client side data generation in web based architecture. Matrix arithmetic is used in server side for data manipulation to optimize the resources. The three matrices 3 x 9, 6 x 4 and 3 x 6 holds the status of the position where row summations and column summations efficiently and effectively detects the occurrence of a bonus chance.

As to effectively detect the occurrence of bonus chance, the model is designed to denote 0, 1 and 5 as the vacant, possessed by player1 and possessed by player2 respectively. The 3 x 9 matrix holds the 24 different position status 0 to 8th column and the last column has been design to duplicate the first column in order to effective data manipulation.

| | | | | | | | | |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| 0 th | 1 st | 2 nd | 3 rd | 4 th | 5 th | 6 th | 7 th | 0 th |
| 8 th | 9 th | 10 th | 11 th | 12 th | 13 th | 14 th | 15 th | 8 th |
| 16 th | 17 th | 18 th | 19 th | 20 th | 21 st | 22 nd | 23 rd | 16 th |

The 3 x 9 matrix is designed to trace the bonus occurrences in diagonally and horizontally and vertically through the midst lines joining three concentric squares.

In order to optimize the resources and minimize the lengthy computations another matrix of 6 x 4 is developed to trace the horizontal Nerenchi within squares while a 3 x 6 matrix accomplish the vertical nerenchi detection.

In spite of the Nerenchi detection, the 3 x 9 matrix allows the system to effectively check the vacant positions with respect to the selected counter. The system is capable of identifying vacant adjacent cells within one square and between the squares.

```
i As Integer = Int(clickedIndex / 8.0)
j As Integer = clickedIndex Mod 8
```

```
For k = 0 To 1
```

```
    m = If (j - 1 + 2 * k = -1, 7, j - 1 + 2 * k )
```

```
    If arrPlaces3by9 (i, m) = 0 Then
        canMove = i * 8 + If (m = 8, 0, m)
    End If
```

```
Next
```

In this regard the odd positions of innermost and outermost squares have one adjacent joint, while the middle ones have two adjacent joints.

```
If (j Mod 2 <> 0) Then
```

```
    For k = 0 To 1
```

```
        If (i - 1 + 2 * k >= 0) And (i - 1 + 2 * k <= 2) Then
```

```
            If arrPlaces3by9(i - 1 + 2 * k, j) = 0 Then
                canMove = (i - 1 + 2 * k) * 8 + j
            End If
```

```
        End If
```

```
    Next
```

```
End If
```

C. Human- Computer Mode

The Human- Computer implementation of the Nerenchi game is in client server architecture. Nerenchi server has been developed with the support of the PROLOG Sever pages (PSP). In this attempt three item placement rules are introduced with the intention of

- Creation of 'nerenchi'
- Avoidance of the possibility of creation of 'nerenchi' by the opponent
- Identification of new places to get easy access to 'nerenchi'.

More over PROLOG based rules have been used here to find the most suitable next solution through the state space searching.

IV.GAME IN ACTION

With the enrolment of the player to the Game, the user is categorized by the system in to two groups in general. They are the groups: the novice or the engaged. When the player in engaged mode, enters to the system, he/she is directed to the Game where he/she was to be. Then, the player is able to either declare the Game or continue if the opponent is available at the same time. When a novice player logs in to the system, the player is enlisted into the 'logged players' category and may get the opportunity to play only if the request made by the player is accepted by the opponent. Then both are qualified to proceed .In spite, the player could select the Human – Computer mode.

The Game begins with allowing the most senior player (i.e. seniority is considered by the enrolment ID) to play first in the phase1. Figure 7 shows an intermediate screen of phase 1. When the player place a counter, the peculiar deck gets updated. The proper error messaging system keeps the user friendliness and minimizes the frauds.

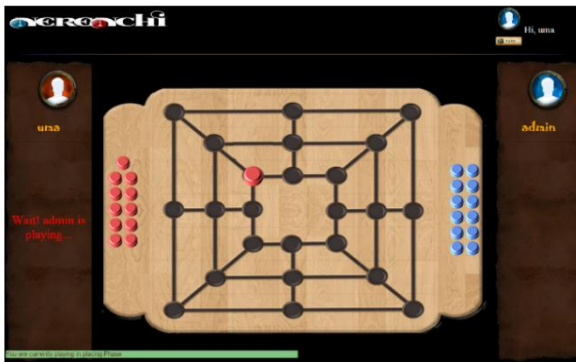


Figure 7. Intermediate situation at phase1

Phase 1 continues until the number of counters on the board reaches 22 or one of the player placed all his/her 12 counters on the board. Then the phase 2 begins and the players are instructed by the messaging system. When a nerenchi appears the system separately conveys the players that one is going to lose one of the counters and other one is rewarded with Nerenchi, therefore he/she can remove one of the opponent's counters as shown in Figure 8.

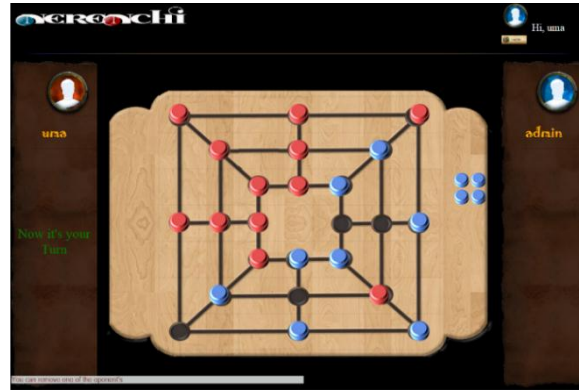


Figure 8. a. Remind the player to remove one of the opponent's

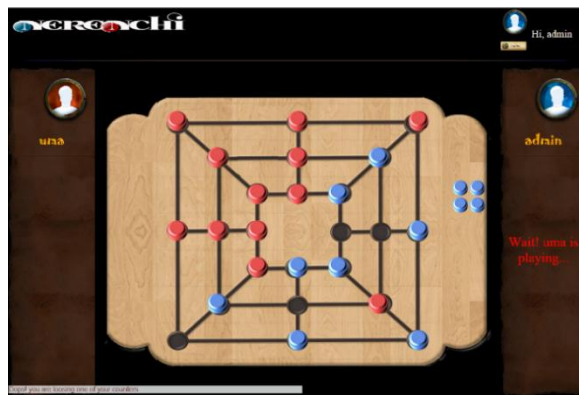
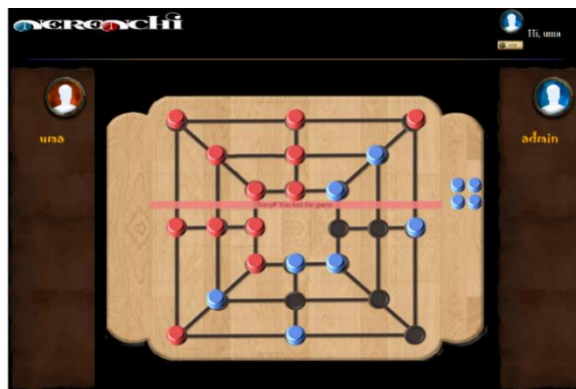


Figure 8. b. Opponent gets a message: a counter loosing

Winning criteria of the game has been declared at the end of the phase 2. Player can win a Nerenchi game either by capturing all the counters except two or by eliminating all the possible moves of the opponent as shown in Figure 9.



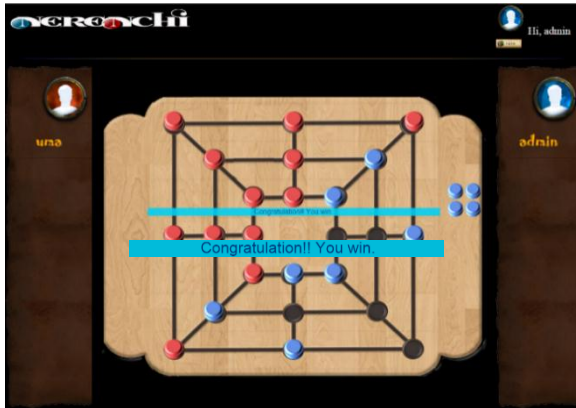


Figure 9. Winning and losing the game

All the events are functioned in the server side by the mathematical model and database stores data for the client side to retrieve it directly from the database.

V. CONCLUSION AND FURTHERWORK

This paper is about one of the ancient Sri Lankan games after having been designed, tested, improved and implemented through the web based architecture under laboratory conditions.

The System consists of 4 modules namely the Game engine, the PROLOG engine, the Database and the user interface. Further, the game exploits two modes in its execution: the Human-Human mode and the Human-Computer mode. The PROLOG engine is used only for the Human-Computer mode. Further, this version of the Nerenchi game consists of limited capabilities of the Human-Computer mode. Therefore, the updated PROLOG engine with more rules and upgraded with user interfaces are apt for further research.

ACKNOWLEDGEMENT

I would like to express my gratitude to University of Colombo School of Computing for allowing me to conduct this research under their guidance and authority.

REFERENCES

Zaslavsky C. (1998). *Math Games and Activities from Around the World*. Chicago Review Press Incorporated Chicago Illinois.

Henry Parker (1909). *Ancient Ceylon*. Asian Educational Services Publications (Pvt) Ltd New Delhi India.

University of Waterloo Home Page (2010). <<http://www.gamesmuseum.uwaterloo.ca/virtualExhibits/rowgames/nerenchi.html>>, *Elliott Avedon virtual museum of games*. Accessed 06 January 2015.

UC Berkeley (2008). <<http://gamescrafters.berkeley.edu/games.php?game=ninemensmorris>> game crafters. Accessed 10 May 2015.

Dicey Goblin (2014). <<https://diceygoblin.com/blog/the-full-history-of-board-games/>> The Full History of Board Games. Accessed by 13 April 2015

Astral Castle (2003). <<http://www.ccg.com/games/>> A History of Board Games. Accessed by 19 June 2015

BIOGRAPHY OF AUTHORS



RGUI Meththananda is currently a probationary lecturer attached to the department of Spatial Sciences, General Sir John Kotelawala Defence University. She received her Bachelor of Science degree in Mathematics from the University of Sri Jayewardenepura in 2013. Her research interests include computational mathematics and modelling.



B Hettige is a PhD student of the Faculty of Information technology, University of Moratuwa, Sri Lanka. At present he is a probationary lecturer of the department of Computer Science, faculty of Computing, General Sir John Kotelawala Defence University. His research interests include Multi-agent technology, Natural Language processing and Sinhala Computing. He has produced more than 25 referred international and local publications to his credit.