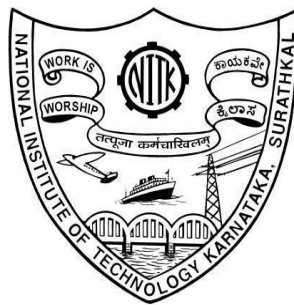


IT-303 MINI PROJECT MERGE BLOCKS GAME

Software Engineering Report
Submitted in partial fulfillment of the requirements for the degree of
BACHELOR OF TECHNOLOGY

In
INFORMATION TECHNOLOGY
by

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DECLARATION

I hereby *declare* that the *IT303 Report* entitled *Software engineering* which is being submitted to the National Institute of Technology Karnataka Surathkal, in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in the department of Information Technology, is a ***bonafide report of the work carried out by Gaurav Kumar ,Rakshith Jain &Aditya Rama Hegde***. The material contained in this report has not been submitted to any University or Institution for the award of any degree.

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Date : 02 Nov,2022

Abstract

The game 2048 is a popular and fashionable mobile telephone game and also played on laptop, which is characterized by the strong uncertainty. In recent years, the computer games have made remarkable achievements, especially it has really attracted and sought attention from kids and youths. Many youths spend a lot of time in games in this digital era. We need some of the games which will entertain them as well as increase their thinking capacity. Many attempts are made for same and many games are also developed for fulfilling the need of hour. Logical Based Puzzles are becoming more and more popular these days. These games improve logical ability and Thinking power. Instead of wasting time on games like PUBG, these kind of logical games have to be played for the betterment of logical thinking. The 2048 game involves tiles labeled with powers of two that can be merged to form bigger powers of two; variants of the same puzzle involve similar merges of other tile values. For variants of 2048 using tile values for which greedy change-making is suboptimal, it is the greedy strategy, not the optimal representation as sums of tile values, that controls the length of the game. In particular, the game will always terminate whenever the sequence of allowable tile values has arbitrarily large gaps between consecutive values.

Introduction

The solitaire game 2048 was developed in 2014 by Gabriele Cirulli, based on another game called Threes developed earlier in 2014 by Asher Vollmer [28]. It is played on a 16-cell square grid, each cell of which can either be empty or contain a tile labeled with a power of two. In each turn, a tile of value 2 or 4 is placed by the game software on a randomly chosen empty cell. The player then must tilt the board in one of the four cardinal directions, causing its tiles to slide until reaching the edge of the board or another tile. When two tiles of equal value slide into each other, they merge into a new tile of twice the value. The game stops when the whole board fills with tiles, and the goal is to achieve the highest single tile value possible.

As most players of the game quickly learn, it is not possible to keep playing a single game of 2048 forever. At any step of the game, there must be at least one tile for each nonzero bit in the binary representation of the total tile value. For total tile values just below a large power of two, the number of ones in the binary representation is similarly large, eventually exceeding the number of cells in the board.

The rules of 2048 game are very simple, control all the squares to move in the same direction every time, two squares of the same number bump together and merge into their sum, after each operation will randomly generate a 2 or 4 in the blank square, finally get a "2048" square is the victory. If all 16 squares are filled and none of the adjacent squares are identical and cannot be moved, the game is over. If the position and size of all numbers do not change after moving in a certain direction, the move operation is invalid. When the move operation in four directions is invalid, the game ends completely and the sum of all the numbers in the board is the final score of the game. The rules of the game 2048 are relatively simple, but it is very difficult for game players to get a large final number with its strong flexibility and randomness.

The game 2048 is very challenging though its rules are relatively simple. First, the game state space is huge. Although there are only four movement options of up, down, left or right in each step of the game at most, the randomness of the position of the new number 2 after moving greatly increases the complexity of the game. In the process of searching the game tree, the number of nodes in the search tree will increase dozens of times on the basis of the previous layer every time the search depth is increased entirely. For example, the search depth is set to 6 and so the number of nodes in the search tree will reach hundreds of millions or even billions.

Secondly, the game 2048 is difficult to assess the situation of the board plate. Each step of the game 2048 needs to choose the best moving direction, which requires an accurate assessment of the board situation. However, in the process of evaluating the chessboard, many factors need to be considered, such as the combination of numbers, the position relationship between numbers, and the flexibility of the situation, so it is difficult to find an effective situation evaluation function. To sum up, the game 2048 is very complex and difficult in total.

Literature Survey

In this paper it is shown that the answer to these questions is no. 2048-like games are not controlled by the shortest representations of numbers as sums of tile values, but rather by their greedy representations, representations generated by a greedy heuristic for the problem of making change using the smallest number of coins from a given coinage system. For the powers of two, the Fibonacci numbers, and the numbers used by Threes and Fives, these greedy representations coincide with the shortest representations, but that is not true for many other natural sets of numbers including the practical numbers and the 3-smooth numbers. The lengths of greedy representations, in turn, are controlled by the lengths of the gaps between consecutive tile values.[1]

In the paper, an optimization algorithm based on MCTS is designed and proposed for a single mobile game 2048 which is characterized with uncertainty. At the same time, a parallel computer games system of the game 2048 is developed and coded by using the C++ language. Through a large number of experiments, the influence of algorithm parameter selection on algorithm performance is studied comprehensively and thoroughly to verify the effectiveness of the algorithm and the effect of optimization strategy on algorithm performance improvement. According to the actual investigation, most players define that the success rate of up to 2048 score is no less than 95% and the success rate of up to 4096 score is no less than 60% as the high level of the game 2048. Therefore, the algorithm designed in the paper has reached the level of advanced players.[2]

Problem Statement

We have to develop a logical number based game similar to the standard 2048 game with certain novelty and modifications. We are going to make the game interesting by using photos as tiles or blocks instead of numbers .We will be having a leaderboard and the highest score will be stored for a user .We are going to add music in the game so that users can enjoy the game by listening to the music.

Objectives

- To develop an error-free code
- To give the players a good playing experience
- To develop fast and responsive game
- To make a global game with score visibility to all

Methodology

The game is being implemented as a simple website using HTML, CSS, Javascript and PHP. We tried to keep as many less pages as possible. Hence, the website contains 6 pages as follows:

- ❖ Home Page
- ❖ Dashboard Page
- ❖ Game(Easy) Page
- ❖ Game(Medium) Page
- ❖ Game (Difficult) Page
- ❖ Leaderboard Page

PAGES

1. Home Page

This is the very first page of the project. It has input for signing in. It has links to leaderboard and dashboard pages

2. Dashboard Page

The page after signing in is done. Instructions of the game and links to start the game and viewing the leaderboard are present

3. Game Pages

These are the pages where the game is actually played. This page also shows the score and best score of the player. Modes of the game can be changed here

4. Leaderboard Page

Table of top 10 players along with their scores are listed here

USE-CASE

A few important features have been incorporated into this game . Many more were planned , but due to constraints on time, few of them could not be incorporated . These will be implemented in future work

As per Fig 1 given blow, the use-case of the player can be described as follows:

- ★ User can change the settings of game to change the difficulty level
- ★ User can start and restart the game
- ★ If the user is not playing game, he can access the leaderboard
- ★ User can read instructions
- ★ User can login with username
- ★ While playing the game, user can
 - Pause game
 - Resume game
 - Quit game(by going back to dashboard page)
 - Restart game
 - Rotate table (if the table gets filled up)

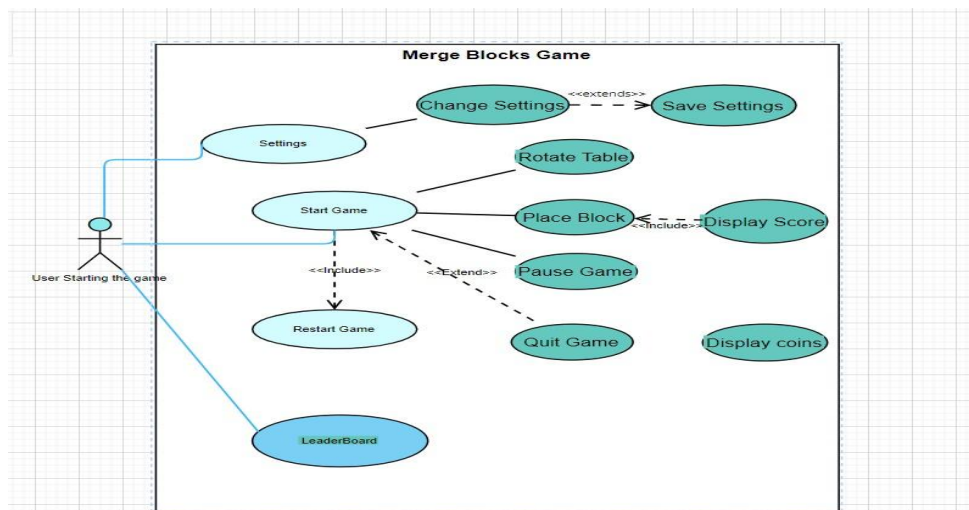


Fig 1. Use Case Diagram

BACKEND

When the game is running, the state of the board changes after each move. A 2-D Array(Matrix) is used to represent the board. Based on the player's move, tiles are added in that direction. Then the new state of the board is reflected in the matrix. Tiles are merged into one if :

- They have the same value
- They are adjacent
- Enough Space is left in the board for all tiles to get accommodated

Score and Best score are updated after each move which in the backend are stored in variables.

The players' score data is stored in a MySQL database with two columns- name and score. Using SQL queries, data is retrieved and displayed as a HTML table. Once the player ends the game, the scores are updated in the database. Also, a new user's entry into the database is taken care of.

Results And Analysis

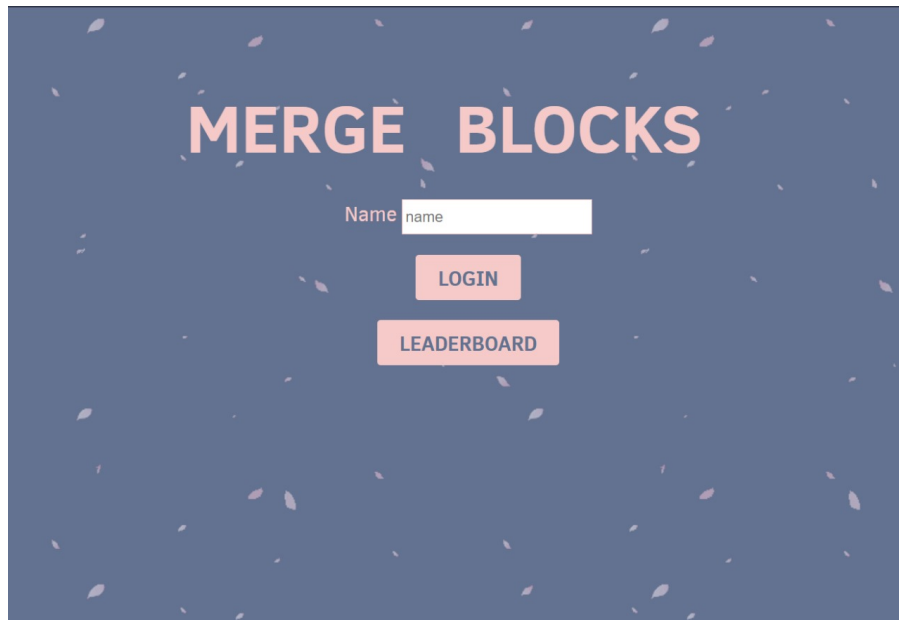


Fig 2. Home Page

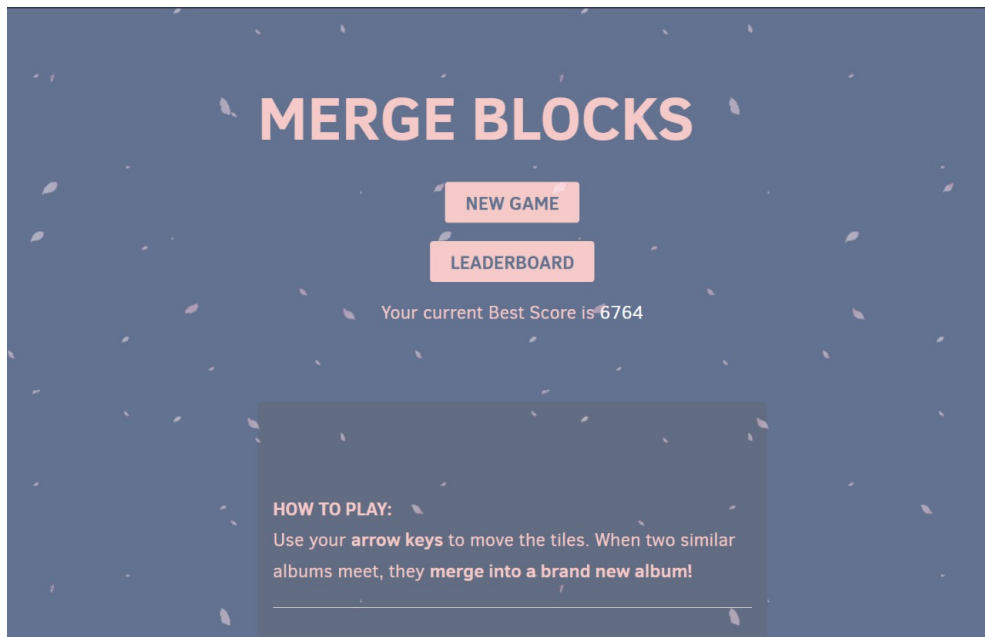


Fig 3. Dashboard Page-

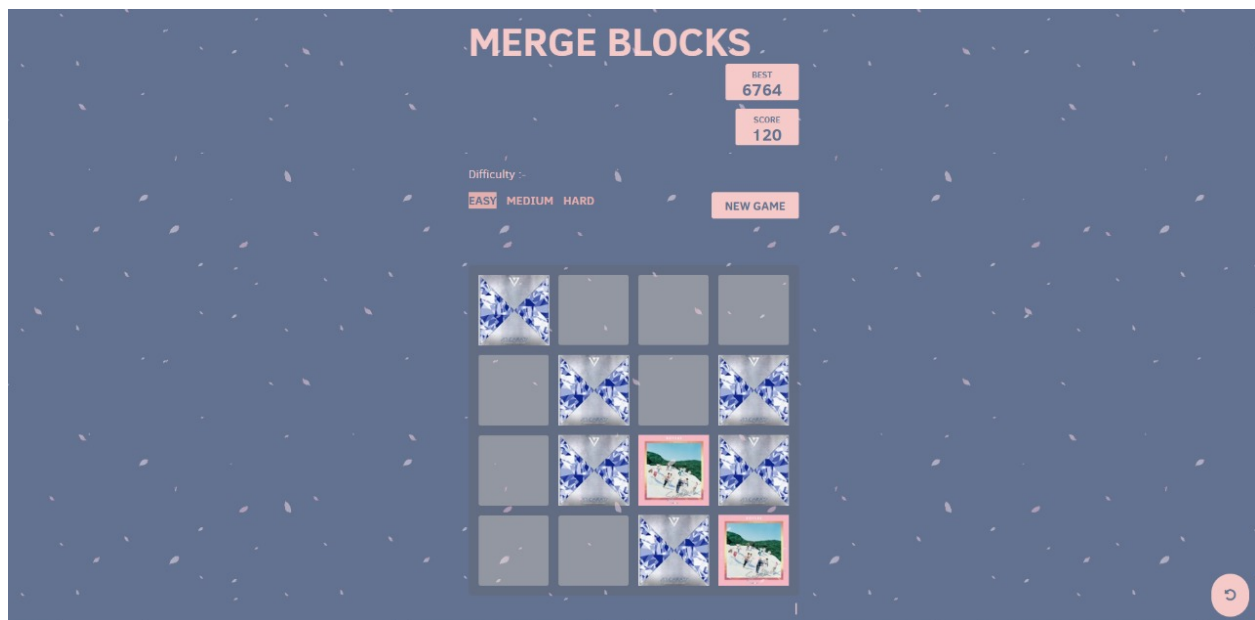


Fig 4. Game Page(Easy)

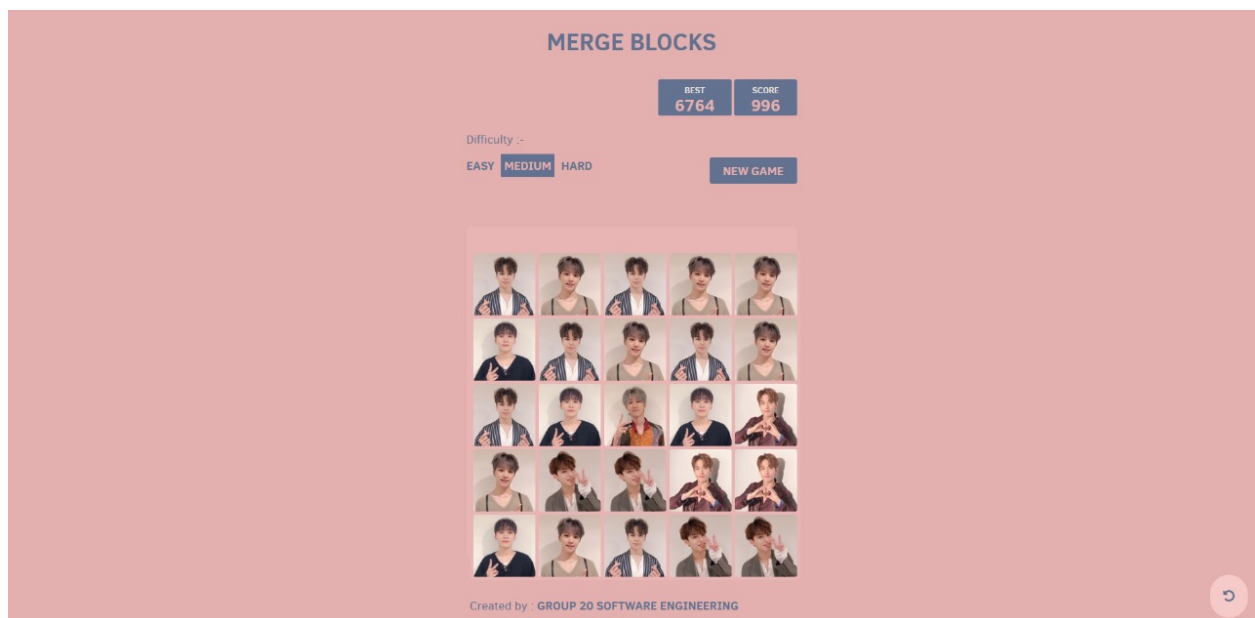


Fig 5. Game Page(Medium)

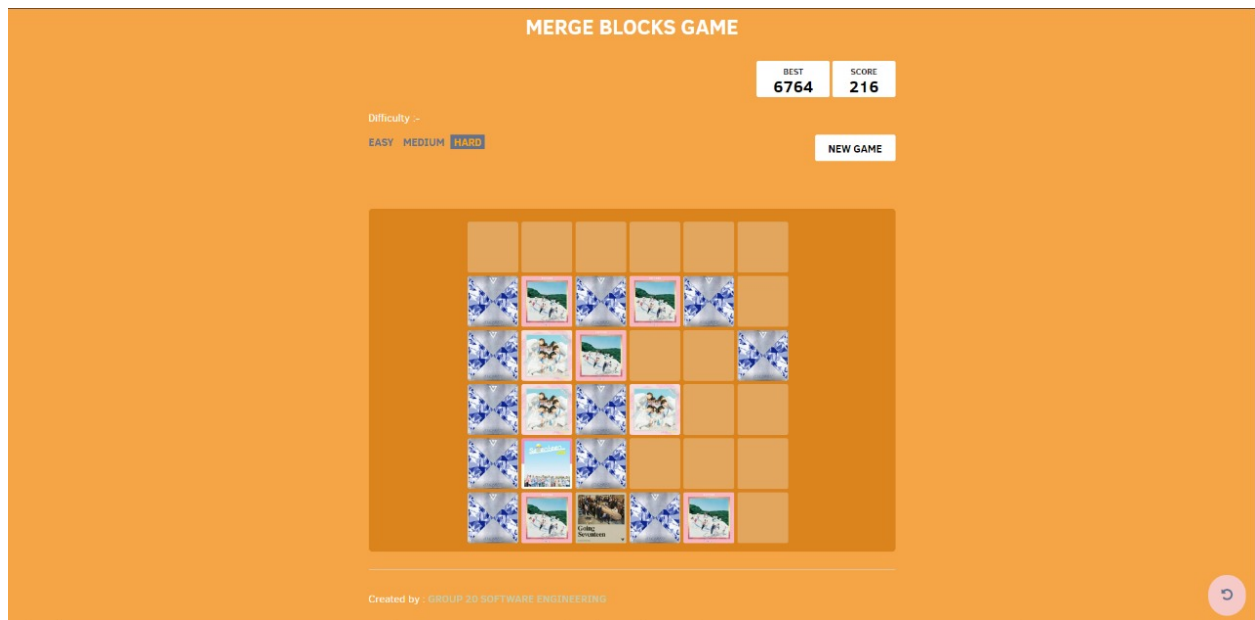


Fig 6. Game Page(Difficult)



Fig 7. Leaderboard Page

After designing the game, it was played many times to check the correctness and efficiency of the project. It can be declared that the code is error-free after a large number of trials. Few screenshots of the website are attached above(Fig 2-7) for reference

Leaderboards and settings pages were working as expected , with music being played during the game.

Conclusion

In this project, Project was made an advanced version of 2048 game based on merging of blocks. This game will be played on a website .Game was added with some interesting features such as leaderboard of the users ,best score of the user ,difficulty level of the game i.e. easy,medium ,hard. To make the Game to more interesting we used the pictures in frontend for calculating the score rather than the same number but numbers will be used for calculating the score in the backend. This game also contains the feature of playing music.

This Game gets a better user experience if it is developed for android and can be available at different platforms such as google play store so that maximum people can enjoy the Game. In this Game even more interesting features can be added in future such as giving the rewards for best score ,animations for better user experience or more interest in the game,rotating and flipping of the table if the user is about to finish the Game.

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