# Design of Tetris Game

## Section 1: Introduction

Tetris is a classic game that has been enjoyed by people of all ages for decades. The game involves manipulating falling shapes to create complete rows, which are then cleared to make room for more falling shapes. While Tetris is often played for entertainment, research has shown that playing the game can also offer cognitive and physical benefits such as improving hand-eye coordination and spatial reasoning skills. The purpose of this program is to create a Tetris game using MATLAB that can provide entertainment to users while also offering benefits such as improving hand-eye coordination and spatial reasoning skills. Additionally, the program can be used for educational purposes to teach academic concepts such as geometry and programming.

In designing the Tetris game using MATLAB, several considerations were taken into account. One of the primary considerations was creating a user-friendly interface that is easy to navigate and manipulate. This was accomplished by incorporating intuitive controls for moving and rotating the falling shapes, as well as providing clear feedback to the player regarding their progress and score. Another consideration was incorporating features such as scorekeeping and increasing speed as the player progresses. These features help to maintain player engagement and motivation, while also providing a sense of accomplishment and progress.

### Benefits of playing Tetris

Research has shown that playing Tetris can offer a range of benefits beyond mere entertainment. For example, studies have found that playing Tetris can improve hand-eye coordination and spatial reasoning skills (Green & Bavelier, 2003; Kühn et al., 2013). These cognitive benefits have been demonstrated in both children and adults and may have implications for improving academic performance and cognitive functioning in various populations.

In addition to its cognitive benefits, Tetris has also been used as a therapeutic tool for individuals with certain conditions. For example, Tetris has been used to help reduce symptoms of post-traumatic stress disorder (PTSD) by providing a distraction, promoting cognitive restructuring, and Tetris has been used to help treat amblyopia (lazy eye) by promoting visual processing and enhancing visual acuity (Holmes et al., 2009; Taub et al., 1993).

The cognitive and physical benefits of playing Tetris have been studied extensively in the past few decades. One study conducted by Stickgold et al. (2000) found that playing Tetris for just a short period of time can improve spatial reasoning skills, which are essential for activities such as reading maps and assembling complex machinery.

Overall, the goal of the program is to provide an enjoyable and beneficial gaming experience for users. By incorporating features such as scorekeeping and increasing speed, the program not only provides entertainment but also encourages users to improve their skills and cognitive abilities. It can be used by a wide range of individuals and populations for both entertainment and educational purposes In conclusion, the Tetris game developed using MATLAB has the potential to offer a range of benefits to users, including improved hand-eye coordination and spatial reasoning skills, as well as entertainment and educational opportunities. By incorporating these considerations in the design of the program, it has been optimized for maximum user satisfaction and potential benefits.

### Definition of the Problem

Developing a Tetris game using MATLAB can address several problems and challenges:

1. Cognitive Development: Playing Tetris has been shown to improve cognitive development and brain plasticity, particularly in areas such as spatial reasoning, working memory, and problem-solving skills. By developing a Tetris game using MATLAB, users can benefit from these cognitive advantages.
2. Hand-Eye Coordination: Playing video games such as Tetris can improve hand-eye coordination and reaction time, which can have real-world applications in areas such as sports, driving, and other activities that require quick reflexes.
3. Stress Relief: Playing video games can be a great way to relieve stress and unwind. Developing a Tetris game using MATLAB can provide users with a fun and engaging way to relax and destress.
4. Education: Games can be used as educational tools to teach concepts such as geometry, physics, and problem-solving. By incorporating educational elements into the Tetris game using MATLAB, users can learn while having fun.
5. MATLAB Application Development: Developing a Tetris game using MATLAB can showcase the potential of MATLAB for game development and inspire others to explore the use of MATLAB for similar projects.

In summary, developing a Tetris game using MATLAB can address several problems and challenges, including cognitive development, hand-eye coordination, stress relief, education, and MATLAB application development.

## Section 2. Design Schematics and Programs

### Design

Chart

Description automatically generated with medium confidence

**Playgame.m**

function PlayGame(speed)

close all;

global Parts PartStack hstack Rotationbalance

if (nargin == 0)

speed = 1;

end

clearedlinestotal = 0;

score = 0;

figure('Position',[3243 42 597 954], 'keypressfcn',@fh\_kpfcn);% [920 42 446 642]

ax1 = axes('Position',[0.80,0.05,0.15,0.90]);

rectangle('Position',[0, 0, 7, 25], FaceColor = 'w', LineWidth = 3)

axis([0,7,0,25]); axis off; box on; daspect([1,1,1]); hold on;

ax2 = axes('Position',[0.02,0.05,0.80,0.90]);

rectangle('Position',[0.5,0.5, 10, 25], FaceColor = 'w', LineWidth = 3)

axis([0.5,10.5,0.5,25.5]); axis off; box on; daspect([1,1,1]);

types = 'ZLITS';

Names = {'Blue.png', 'Red.png', 'Yellow.png', 'Green.png', 'Black.png', 'White.png'};

hstack = zeros(1,10);

m = randi(5); c = Names{randi(6)}; flp = randi(10);

axes(ax1); Parts1 = []; txt1 = []; txt2 = []; PartStack = cell(25,10); Rotationbalance = 0;

[Parts1, txt1, txt2] = UpdatesideInfo(Parts1, txt1, txt2, types(m), c, speed, mod(flp,2), score);

while(max(hstack) < 25)

m1 = m; c1 = c; flp1 = flp;

m = randi(5); c = Names{randi(6)}; flp = randi(10); axes(ax1);

[Parts1, txt1, txt2] = UpdatesideInfo(Parts1, txt1, txt2, types(m), c, speed, mod(flp,2), score);

axes(ax2); Parts = Shape(types(m1),c1, mod(flp1,2));

speed = floor(clearedlinestotal/10) + 1;

maxY = 1;

while(maxY)

Moveshape(Parts,[0;-1]);

drawnow;

pause(1/speed);

maxY = VertDist;

end

clearedlines = StackParts(Parts);

clearedlinestotal = clearedlinestotal + clearedlines;

score = score + speed\*clearedlines\*20;

end

text(5, 17, 'Game','VerticalAlignment','middle',...

'HorizontalAlignment','Center','FontSize',65, 'FontWeight','bold','interpreter', 'latex');

text(5, 14, 'Over',...

'HorizontalAlignment','Center','FontSize',65, 'FontWeight','bold','interpreter', 'latex');

if exist('HighestScore.mat', 'file')

load('HighestScore.mat')

else

HighestScore = 0;

end

text(5, 11, num2str(score),'VerticalAlignment','middle',...

'HorizontalAlignment','Center','FontSize',65, 'FontWeight','bold','interpreter', 'latex');

if(score > HighestScore)

text(5, 8, 'Highest','VerticalAlignment','middle',...

'HorizontalAlignment','Center','FontSize',37, 'FontWeight','bold','interpreter', 'latex');

HighestScore = score;

end

save HighestScore HighestScore

**fh\_kpfcn.m**

function fh\_kpfcn(H,E)

global Parts

try

switch E.Key

case 'control'

pause;

case 'rightarrow'

Moveshape(Parts,[1;0]);

case 'leftarrow'

Moveshape(Parts,[-1;0]);

case 'uparrow'

Rotateshape(Parts);

case 'downarrow'

Moveshape(Parts,[0;-1]);

end

drawnow;

catch

end

**Moveshape.m**

function moved = Moveshape(Parts, del)

global PartStack

XY = zeros(2, numel(Parts));

for n = 1:numel(Parts)

XY(:, n) = [sum(Parts{n}.XData)/2;sum(Parts{n}.YData)/2];

end

XY = XY + del\*ones(1, numel(Parts));

%% || Check Wall Collision

if(any(XY(1,:) < 1) || any(XY(1,:) > 10))

return;

end

%% \_ Check Wall Collision

if(any(XY(2,:) < 1))

return;

end

%% Check collision with others

for n = 1:numel(Parts)

i = XY(2, n); j = XY(1, n);

if(~isempty(PartStack{i, j}))

return;

end

end

for n = 1:numel(Parts)

Parts{n}.XData = [-0.5,0.5] + XY(1, n);

Parts{n}.YData = [-0.5,0.5] + XY(2, n);

end

moved = 1;

**Rotateshape.m**

function Rotateshape(Parts)

global PartStack Rotationbalance

M = [0,-1

1, 0];

XY = zeros(2, numel(Parts));

for n = 1:numel(Parts)

XY(:, n) = [sum(Parts{n}.XData)/2;sum(Parts{n}.YData)/2];

end

Centroid = mean(XY,2)\*ones(1, numel(Parts));

XY = M\*(XY - Centroid) + Centroid;

if(mod(Rotationbalance, 2) == 0)

XY = floor(XY);

else

XY = ceil(XY);

end

if(any(XY(1,:) < 1) || any(XY(1,:) > 10))

return;

end

if(any(XY(2,:) < 1))

return;

end

for n = 1:numel(Parts)

Parts{n}.XData = [-0.5,0.5] + XY(1, n);

Parts{n}.YData = [-0.5,0.5] + XY(2, n);

end

Rotationbalance = Rotationbalance + 1;

**Shape.m**

function Parts = Shape(type, clr, flp)

Shift = [1, 0, 1, 0, 1, 0, 1, 0, 1, 0

2, 0, 2, 0, 2, 0, 2, 0, 2, 0

2,-1, 3, 0, 3, 0, 2,-1, 1,-1

3,-1, 3,-1, 4, 0, 3, 0, 2,-1];

index = [9, 10];

switch type

case 'Z'

index = [1,2];

case 'L'

index = [3,4];

case 'I'

index = [5,6];

case 'T'

index = [7,8];

end

point = [5;25];

M = eye(2);

if(flp)

M = [-1,0

0, 1];

end

Points = point\*ones(1,4) + M \* Shift(:,index)';

del = point - mean(Points, 2);

XY = floor(Points + del\*ones(1,4));

img = flipud(imread(clr));

Parts = {};

for n = 1:size(Points,2)

sq = image('CData',img,'XData',[-0.5 0.5] + XY(1, n),...

'YData',[-0.5 0.5] + XY(2, n));

Parts = [Parts, {sq}];

end

**StackParts.m**

function clearedlines = StackParts(Parts)

global hstack PartStack

clearedlines = 0; maxY = max(hstack);

for n = 1:numel(Parts)

part = Parts{n};

point = [mean(part.XData), mean(part.YData)];

maxY = max(maxY,point(2));

hstack(point(1)) = max(hstack(point(1)), point(2));

if(point(2)<=25)

if(~isempty(PartStack{point(2),point(1)}))

error('overlap');

else

PartStack{point(2),point(1)} = part;

end

end

end

if(maxY>25)

return

end

somecomplete = 1;

while(somecomplete)

ycomplete = [];

for ny = maxY:-1:1

complete = 1;

for nx = 1:10

if(isempty(PartStack{ny,nx}))

complete = 0;

break;

end

end

if(complete)

ycomplete = [ycomplete,ny];

end

end

somecomplete = ~isempty(ycomplete);

if(somecomplete)

for ny = 1:numel(ycomplete)

for nx = 1:10

delete(PartStack{ycomplete(ny),nx});

for n = ycomplete(ny)+1:maxY

movepartdown(n,nx);

end

end

end

drawnow;

end

clearedlines = clearedlines + numel(ycomplete);

end

hstack = zeros(1,10);

for nx=1:10

for ny = 25:-1:1

if(~isempty(PartStack{ny,nx}))

hstack(nx) = max(hstack(nx), ny);

end

end

end

function movepartdown(ny, nx)

global PartStack

part = PartStack{ny,nx};

if ishandle(part)

part.YData = part.YData - 1;

PartStack{ny-1,nx} = part;

PartStack{ny,nx} = [];

else

PartStack{ny-1,nx} = [];

end

**UpdatesideInfo.m**

function [Parts, txt1, txt2] = UpdatesideInfo(Parts, txt1, txt2, type, clr, speed, flp, score)

point = [3;6];

Shift = [1, 0, 1, 0, 1, 0, 1, 0, 1, 0

2, 0, 2, 0, 2, 0, 2, 0, 2, 0

2,-1, 3, 0, 3, 0, 2,-1, 1,-1

3,-1, 3,-1, 4, 0, 3, 0, 2,-1];

index = [9, 10];

switch type

case 'Z'

index = [1,2];

case 'L'

index = [3,4];

case 'I'

index = [5,6];

case 'T'

index = [7,8];

end

M = eye(2);

if(flp)

M = [-1,0; 0, 1];

end

Points = point\*ones(1,4) + M \* Shift(:,index)';

del = point - mean(Points, 2);

XY = Points + del\*ones(1,4);

img = flipud(imread(clr));

if(ishandle(txt1))

txt1.String = num2str(speed);

txt2.String = num2str(score);

for n = 1:numel(Parts)

delete(Parts{n})

Parts{n} = image('CData',img,'XData',[-0.5 0.5] + XY(1, n),...

'YData',[-0.5 0.5] + XY(2, n));

end

else

text(2.5, 23, 'Speed',...

'HorizontalAlignment','Center','FontSize',12, 'FontWeight','bold','interpreter', 'latex');

txt1 = text(2.5, 21, num2str(speed),...

'HorizontalAlignment','Center','FontSize',12, 'FontWeight','bold','interpreter', 'latex');

text(2.5, 16, 'Score',...

'HorizontalAlignment','Center','FontSize',12, 'FontWeight','bold','interpreter', 'latex');

txt2 = text(2.5, 14, num2str(score),...

'HorizontalAlignment','Center','FontSize',12, 'FontWeight','bold','interpreter', 'latex');

text(2.5, 9, 'Next',...

'HorizontalAlignment','Center','FontSize',12, 'FontWeight','bold','interpreter', 'latex');

Parts = {};

for n = 1:size(Points,2)

sq = image('CData',img,'XData',[-0.5 0.5] + XY(1, n),...

'YData',[-0.5 0.5] + XY(2, n));

Parts = [Parts, {sq}];

end

end

drawnow;

**VerDist.m**

function maxY = VertDist

global PartStack Parts

maxY = 25;

for n = 1:numel(Parts)

V = [mean(Parts{n}.XData);

mean(Parts{n}.YData)];

V(2) = min(25,V(2));

if(V(2)) == 1

maxY = 0;

break;

end

maxY = min(maxY, YDiff(PartStack, V(2), V(1)));

end

**YDiff.m**

function Y = YDiff(PartStack, y, x)

Y = y - 1;

for n = 1:y

if(~isempty(PartStack{n,x}))

Y = y - n - 1;

end

end

## Section 3: Proposed Test Procedure

## Testing Methodology

Unit testing: Each function and code was tested individually to ensure that they perform the intended tasks accurately and efficiently. This testing involved feeding the functions with different inputs and comparing the outputs with the expected results.

Integration testing: Once each code or function has been tested individually, they were integrated to ensure that they work together as intended. This testing involved testing the interaction between different code and functions and identifying any potential conflicts or issues.

System testing: Once the individual modules and the integrated system have been tested, the entire system was tested to ensure that it meets the functional and performance requirements. The testing involved testing the game's functionality, performance, and user interface.

## Data Gathering Structure

User feedback: User feedback was collected after every type of test. The recorded data helped to identify any issues with the game's usability, interface, or functionality.

Testing scenarios: Different testing scenarios were used to simulate different user interactions and game scenarios. This data helped to identify any potential issues or bugs that may arise during actual gameplay.

Error logs: Any errors or exceptions that occur during testing will be logged and analyzed to identify any underlying issues or bugs that may need to be addressed.

## Testing Phase

After every testing period, the following questions can be asked to evaluate the progress of the Tetris game development:

1. Did the tests achieve their goals?
2. Were any unexpected errors encountered during testing?
3. Were any performance issues identified during testing?
4. Were any changes made to the code after the previous testing period?
5. Were any new features or functionality added since the previous testing period?
6. Was the user feedback positive or negative?
7. Were any issues identified during testing resolved?
8. Are there any new issues that need to be addressed before the next testing period?
9. Is the game meeting its functional requirements?
10. Are the project milestones and timelines being met?

By asking these questions after every testing period, I was able to identify any issues or areas for improvement, ensure that the game is meeting its requirements and goals, and keep the project on track.

## Section 4. Data and Results

### Table 1a. Testing Phase

|  |
| --- |
| Overall responses after testing period |
| 1. Did the tests achieve their goals? The tests achieved their goals and were able to identify any bugs or issues in the program. 2. Were any unexpected errors encountered during testing? There were a few unexpected errors encountered during testing, such as blocks not stacking properly or disappearing unexpectedly. 3. Were any performance issues identified during testing? There were some performance issues identified during testing, such as the game slowing down when the blocks started to stack too high. 4. Were any changes made to the code after the previous testing period? Some changes were made to the code after the previous testing period to address the issues that were identified. 5. Were any new features or functionality added since the previous testing period? Some new features and functionality were added since the previous testing period, such as the ability to increase the speed of the blocks as the player progresses. 6. Was the user feedback positive or negative? User feedback was mostly positive, with some minor suggestions for improvement. 7. Were any issues identified during testing resolved? most of the issues identified during testing were resolved before the next testing period. 8. Are there any new issues that need to be addressed before the next testing period? There were a few new issues that need to be addressed before the next testing period, such as refining the collision detection algorithm to ensure the blocks stack properly. 9. Is the game meeting its functional requirements? The game meets its functional requirements and is able to be played as intended. 10. Are the project milestones and timelines being met? The project milestones and timelines are being met, with some adjustments made as needed to address any issues that arose during testing. |

## Section 5. Conclusion

The Tetris game offers an engaging and entertaining gaming experience for players. Through the development process, various problems were identified and addressed, including issues with collision detection, speed control, and scorekeeping. By implementing features such as block movement, rotation, stacking, score tracking, and speed control, the game provides a range of challenges that can help to improve hand-eye coordination and problem-solving skills. Furthermore, the game can be used for entertainment purposes and as a stress reliever.

Throughout the development process, it was important to consider the target user, their needs, and the overall goals of the project. By taking a systematic and iterative approach to testing and development, I was able to identify and address any issues as they arose, resulting in a functional final product. Overall, the development of the Tetris game using MATLAB highlights the importance of careful planning, effective testing, and user feedback in creating successful software projects. By continually evaluating and addressing problems throughout the development process, I was able to create a game that offers value to users and meets the project goals.

# Bibliography

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# Annex A. Gantt Chart

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Activity | Project Work Days | | | | | | | |
| 1 | 6 | 8 | 10 | 13 | 14 | 17 | 19 |
| Proposal | Done |  |  |  |  |  |  |  |
| Design Schematic |  | Done |  |  |  |  |  |  |
| Program |  |  | Done |  |  |  |  |  |
| Initial Simulation Tests |  |  |  | Done |  |  |  |  |
| Test Evaluation |  |  |  |  | Done |  |  |  |
| Report Writing |  |  |  |  |  |  | Done |  |
| Submission of Project |  |  |  |  |  |  |  | Done |