OpenGL Geometry Dash

Conceptul proiectului

Geometry Dash implementat cu ajutorul OpenGL

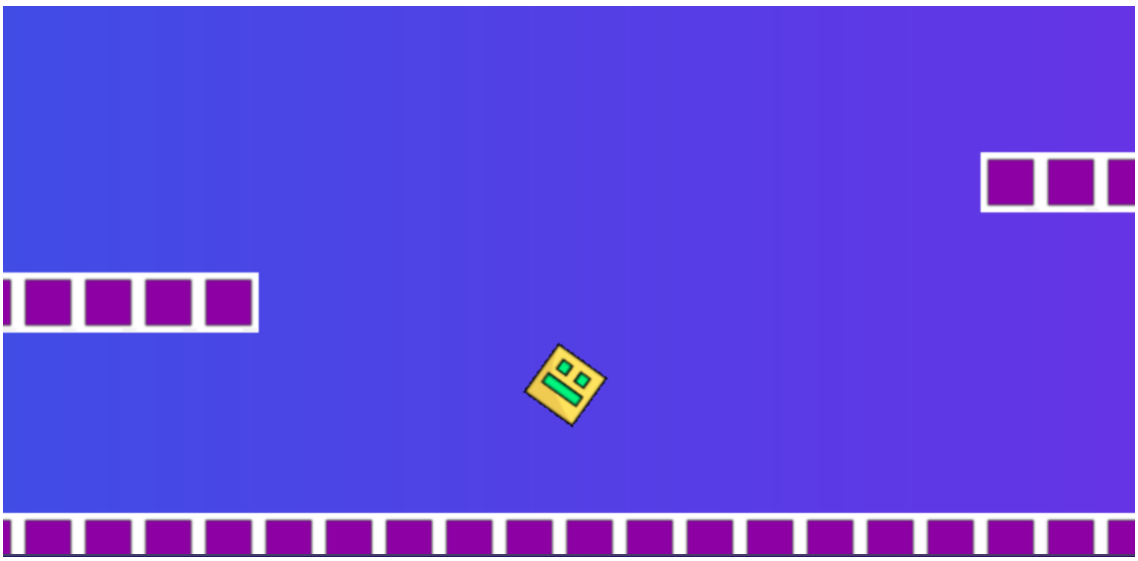
Transformari utilizate

- rotire (player)
- scalare (player, block)
- translatare (background, player, block)

Originalitate

- detectarea coliziunilor
- animatie pentru saritura/cadere
- harta infinita

Capturi de ecran



```
void Player::render() {
    shader->use();
    glm::mat4 scaleMatrix = glm::scale(glm::mat4(1.0f), glm::vec3(width, height, 1.0));
    shader->setMat4(scaleMatrixTag,scaleMatrix);
    glm::mat4 translateMatrix = glm::translate(glm::mat4(1), glm::vec3(xPosition, yPosition, 0));
    shader->setMat4(translateMatrixTag, translateMatrix);
    glm::mat4 rotationMatrix = glm::rotate(glm::mat4(1), rotationAngle, glm::vec3(0, 0, 1));
    shader->setMat4(rotationMatrixTag, rotationMatrix);

    texture->use();
    glBindVertexArray(this->VAO);
    glDrawArrays(GL_TRIANGLE_FAN, 0, 4);
}
```


```cpp
void World::showEndScreen() {
    glClear(GL_COLOR_BUFFER_BIT);

    std::string scoreString = "Score: " + std::to_string(score);

    glColor3f(1.0f, 1.0f, 1.0f);
    glRasterPos2f(0.0f, 0.2f);

    glUseProgram(0);
    glDisable(GL_TEXTURE_2D);

    std::string msg = "Game over";
    for (int i = 0; i < msg.size(); i++) {
        glutBitmapCharacter(GLUT_BITMAP_TIMES_ROMAN_24, msg[i]);
    }
    glRasterPos2f(0.0f, 0.0f);

    for (int i = 0; i < scoreString.size(); i++) {
        glutBitmapCharacter(GLUT_BITMAP_HELVETICA_18, scoreString[i]);
    }

}

```

Anexa

main.cpp

```cpp
#include <windows.h>  // Include libraries
#include <stdlib.h>   // For shader reading
#include <stdio.h>
#include <GL/glew.h>  // GLEW must be included before freeglut
#include <GL/freeglut.h>
```

```
#include "loadShaders.h"
#include "base/Shader.h"

#include "World.h"

int previousTime = 0;
const int FPS = 60;
const int frameDelay = 1000 / FPS; // Milliseconds per frame (16.67 ms for 60 FPS)

void TimerFunction(int value)
{
    // Schedule the next frame
    glutPostRedisplay();
    glutTimerFunc(frameDelay, TimerFunction, 0);
}

int main(int argc, char* argv[])
{

    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB); // Set up a double-buffered
display mode
    glutInitWindowPosition(100, 100);            // Initial window position
    glutInitWindowSize(1600, 960);                // Window dimensions
    glutCreateWindow("Grafica pe calculator - primul exemplu"); // Window title
    glewInit();

    World* world = World::getInstance();

    // Set up rendering and cleanup functions
    glutDisplayFunc(World::render);
    //glutCloseFunc(Cleanup);

    glutKeyboardFunc(World::input);

    // Initialize timer function to control frame rate
    glutTimerFunc(frameDelay, TimerFunction, 0);

    glutMainLoop();
}
```

World.h

```
#pragma once
#include "base/Shader.h"
#include "Texture.h"
#include "Background.h"
#include "Block.h"
#include "CollisionDetector.h"
#include "Player.h"
```

```
class World {
private:
    static World* instance;

    int ended = true;
    int score = 0;

    int startTime;
    int previousTime = 0;
    const int width = 80, height = 24;
    const float blockWidth = 2.0 / 40, blockHeight = 2.0 / 24;

    char map[24][80] = {

"................................................................................",

"................................................................................",

"................................................................................",

"................................................................................",

"................................................................................",

"................................................................................",

"................................................................................",

"................................................................................",

"................................................................................",

"................................................................................",

"................................................................................",

".....................xxxxxx.....................................................",

".............xxxxxx.............................................................",

".......xxxxx...................................................................",

"xxx.........................................................................xxxx",

"...........................................................xxxxxxxx.......",

"................................................................................",

"...........................................................x....................",

".....................xxxx.............................x....................",
```

```
    ".............xxxx..xxxx.............................x.......x...........",

    ".......xxxxx...xxxx..xxxx.................x.....................x...........",

    "xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx",

    "................................................................................",
        };

        Block* blocks[24][80];
        CollisionDetector* collisionDetector;

        float offset = 0;
        float speed = 0.01;


        Shader* playerShader;
        Shader* backgroundShader;
        Shader* blockShader;

        Texture* playerTexture;
        Texture* blockTexture;

        Player* player;
        Background* background;

        void loadShaders();

        void loadTextures();

        void createObjects();

        void loadBlocks();

        void renderBlocks();

        void update();

        void initCollisionDetector();

        World();

        void showEndScreen();
    public:
        static void render();

        static void input(unsigned char key, int x, int y);

        static World* getInstance();

        float detectCollisionDown();
```

```
    float detectCollisionRight();
};
```

World.cpp

```
#pragma once
#include "base/Shader.h"
#include "Texture.h"
#include "Player.h"
#include "Background.h"
#include "Block.h"
#include "CollisionDetector.h"

#include <ft2build.h>
#include FT_FREETYPE_H


void World::loadShaders() {
    playerShader = new Shader("player.vert", "player.frag");
    backgroundShader = new Shader("background.vert", "background.frag");
    blockShader = new Shader("block.vert", "block.frag");
}

void World::loadTextures() {
    playerTexture = new Texture("player.jpg");
    blockTexture = new Texture("block.png");
}

void World::createObjects() {
    player = new Player((World*)this, playerShader, playerTexture);
    background = new  Background(backgroundShader);
}

void World::loadBlocks() {
    for (int i = 0; i < height; i++) {
        for (int j = 0; j < width; j++) {
            if (map[i][j] == 'x') {
                blocks[i][j] = new Block(blockShader, blockTexture);
            }
        }
    }
}

void World::renderBlocks() {
    for (int i = 0; i < height; i++) {
        for (int j = 0; j < width; j++) {
            if (map[i][j] == 'x') {
                float x = (j - 20) * blockWidth + offset;
                if (x < -1) {
                    x += (width - 1) * blockWidth;
                }
```

```
                float y = ((height - i) - 12) * blockHeight;
                blocks[i][j]->setPosition(x, y);
                blocks[i][j]->render();
            }
        }
    }
}

void World::update() {
    int currentTime = glutGet(GLUT_ELAPSED_TIME); // Get current time in
milliseconds
    int deltaTime = currentTime - previousTime;
    previousTime = currentTime;

    offset -= speed;
    if (offset < -width * blockWidth) {
        offset += width * blockWidth;
    }

    player->update(deltaTime);
    background->update(deltaTime);

    if (detectCollisionRight() > 1e-5) {
        ended = true;
    }
}

void World::initCollisionDetector() {
    std::vector <Block*> blockArray;
    for (int i = 0; i < height; i++) {
        for (int j = 0; j < width; j++) {
            if (map[i][j] == 'x') {
                blockArray.push_back(blocks[i][j]);
            }
        }
    }
    collisionDetector = new CollisionDetector(player, blockArray);
}

World::World() {
    startTime = glutGet(GLUT_ELAPSED_TIME);
    ended = false;
    loadShaders();
    loadTextures();
    createObjects();
    loadBlocks();
    initCollisionDetector();
}

void World::showEndScreen() {
    glClear(GL_COLOR_BUFFER_BIT);

    std::string scoreString = "Score: " + std::to_string(score);
```

```
    glColor3f(1.0f, 1.0f, 1.0f);
    glRasterPos2f(0.0f, 0.2f);

    glUseProgram(0);
    glDisable(GL_TEXTURE_2D);

    std::string msg = "Game over";
    for (int i = 0; i < msg.size(); i++) {
        glutBitmapCharacter(GLUT_BITMAP_TIMES_ROMAN_24, msg[i]);
    }
    glRasterPos2f(0.0f, 0.0f);

    for (int i = 0; i < scoreString.size(); i++) {
        glutBitmapCharacter(GLUT_BITMAP_HELVETICA_18, scoreString[i]);
    }

}



void World::render() {
    glClear(GL_COLOR_BUFFER_BIT);

    if (instance->ended == false) {
        instance->update();
        instance->background->render();
        instance->player->render();
        instance->renderBlocks();
        instance->score = glutGet(GLUT_ELAPSED_TIME) - instance->startTime;
    }
    else {

        glColor3f(1.0f, 1.0f, 1.0f);
        instance->showEndScreen();
    }

    glutSwapBuffers();
}


void World::input(unsigned char key, int x, int y) {
    switch (key) {
    case ' ': {
        instance->player->jump();
        break;
    }
    }
}

World* World::getInstance() {
    if (instance == nullptr) {
        instance = new World();
    }
    return instance;
```

```
}

float World::detectCollisionDown() {
    return collisionDetector->detectDown();
}
float World::detectCollisionRight() {
    return collisionDetector->detectRight();
}

World* World::instance = nullptr;
```

Background.h

```
#pragma once
#include <GL/glew.h>
#include <GL/freeglut.h>
#include "base/Shader.h"

class Background {
private:
    Shader* shader = nullptr;
    float offset = 0;
    float speed = 0.001;

    float vertices[36] = {
        -1, -1, 0,
        1, -1, 0,
        -1, 1, 0,
        1, 1, 0,

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

        3, -1, 0,
        5, -1, 0,
        3, 1, 0,
        5, 1, 0
    };

    float colors[48] = {
        0.1, 0.4, 0.9, 1,
        0.6, 0.2, 0.9, 1,
        0.1, 0.4, 0.9, 1,
        0.6, 0.2, 0.9, 1,
        0.6, 0.2, 0.9, 1,
        0.1, 0.4, 0.9, 1,
        0.6, 0.2, 0.9, 1,
        0.1, 0.4, 0.9, 1,
        0.1, 0.4, 0.9, 1,
```

```
        0.6, 0.2, 0.9, 1,
        0.1, 0.4, 0.9, 1,
        0.6, 0.2, 0.9, 1,
    };

    unsigned int VBO_coords;
    unsigned int VBO_color;
    unsigned int VAO;

public:
    Background(Shader* shader);

    void update(int deltaTime);
    void render();
    void freeResources();
};
```

Background.cpp

```
#include "Background.h"
#include <iostream>

Background::Background(Shader* shader){
    this->shader = shader;

    glGenVertexArrays(1, &VAO);
    glBindVertexArray(VAO);


    glGenBuffers(1, &VBO_coords);
    glBindBuffer(GL_ARRAY_BUFFER, VBO_coords);
    glBufferData(GL_ARRAY_BUFFER, sizeof(vertices), vertices, GL_STATIC_DRAW);

    glVertexAttribPointer(0, 3, GL_FLOAT, GL_FALSE, 3 * sizeof(float), (void*)0);
    glEnableVertexAttribArray(0);

    glGenBuffers(1, &VBO_color);
    glBindBuffer(GL_ARRAY_BUFFER, VBO_color);
    glBufferData(GL_ARRAY_BUFFER, sizeof(colors), colors, GL_STATIC_DRAW);

    glVertexAttribPointer(1, 4, GL_FLOAT, GL_FALSE, 4 * sizeof(float), (void*)0);
    glEnableVertexAttribArray(1);
}

void Background::update(int deltaTime) {
    offset -= deltaTime * speed;
    if (offset < -4) {
        offset += 4;
    }
}
```

```
void Background::render(){
    shader->use();
    shader->setFloat("xOffset", offset);

    glBindVertexArray(this->VAO);
    glDrawArrays(GL_TRIANGLES, 0, 3);
    glDrawArrays(GL_TRIANGLES, 1, 3);
    glDrawArrays(GL_TRIANGLES, 4, 3);
    glDrawArrays(GL_TRIANGLES, 5, 3);
    glDrawArrays(GL_TRIANGLES, 8, 3);
    glDrawArrays(GL_TRIANGLES, 9, 3);
}

void Background::freeResources(){
    glDeleteVertexArrays(1, &VAO);
    glDeleteBuffers(1, &VBO_coords);
    glDeleteBuffers(1, &VBO_color);
}
```

background.vert

```
#version 330 core

layout (location = 0) in vec3 position;
layout (location = 1) in vec4 _color;

uniform float xOffset;

out vec4 color;

void main()
{
    gl_Position = vec4(position.x + xOffset, position.y, position.z, 1.0);
    color = _color;
}
```

background.frag

#version 330 core

in vec4 color; out vec4 out_Color;

void main(void) { out_Color = color; }

Texture.h

```
#pragma once
#include <GL/glew.h>
```

```
#include <GL/freeglut.h>
#include "SOIL.h"
#include <string>

class Texture {

private:
    unsigned int id;

public:
    Texture(std::string path);
    void use();
    void freeResources();
};
```

Texture.cpp

```
#include "Texture.h"

Texture::Texture(std::string path)
{
    glGenTextures(1, &id);
    glBindTexture(GL_TEXTURE_2D, id); // all upcoming GL_TEXTURE_2D operations now
have effect on this texture object
    // set the texture wrapping parameters
    glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_S, GL_REPEAT);   // set texture
wrapping to GL_REPEAT (default wrapping method)
    glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_WRAP_T, GL_REPEAT);
    // set texture filtering parameters
    glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_MIN_FILTER,
GL_LINEAR_MIPMAP_LINEAR);
    glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_MAG_FILTER, GL_LINEAR);

    int width, height;
    unsigned char* image = SOIL_load_image(path.c_str(), &width, &height, 0,
SOIL_LOAD_RGB);
    glTexImage2D(GL_TEXTURE_2D, 0, GL_RGB, width, height, 0, GL_RGB,
GL_UNSIGNED_BYTE, image);
    glGenerateMipmap(GL_TEXTURE_2D);

    // Eliberarea resurselor
    SOIL_free_image_data(image);
    glBindTexture(GL_TEXTURE_2D, 0);
}

void Texture::use() {
    glActiveTexture(GL_TEXTURE0);
    glBindTexture(GL_TEXTURE_2D, id);
    //glUniform1i(glGetUniformLocation(ProgramId, "myTexture"), 0);
}
```

```
void Texture::freeResources()
{
    glDisableVertexAttribArray(2);
}
```

Shader.h

```
#ifndef SHADER_H
#define SHADER_H

#include <GL/glew.h>
#include <GL/freeglut.h>
#include "glm/glm.hpp"
#include "glm/gtc/matrix_transform.hpp"
#include "glm/gtx/transform.hpp"
#include "glm/gtc/type_ptr.hpp"

#include <string>
#include <fstream>
#include <sstream>
#include <iostream>


class Shader {
private:
    // the program ID
    unsigned int ID;
public:
    // constructor reads and builds the shader
    Shader(const char* vertexPath, const char* fragmentPath);
    // use/activate the shader
    void use();
    // remove the shader
    void remove();
    // utility uniform functions
    void setBool(const std::string& name, bool value) const;
    void setInt(const std::string& name, int value) const;
    void setFloat(const std::string& name, float value) const;
    void setMat4(const std::string& name, glm::mat4& value) const;
};

#endif
```

Shader.cpp

```
#include "base/Shader.h"

Shader::Shader(const char* vertexPath, const char* fragmentPath)
```

```
{
    // 1. retrieve the vertex/fragment source code from filePath
    std::string vertexCode;
    std::string fragmentCode;
    std::ifstream vShaderFile;
    std::ifstream fShaderFile;
    // ensure ifstream objects can throw exceptions:
    vShaderFile.exceptions(std::ifstream::failbit | std::ifstream::badbit);
    fShaderFile.exceptions(std::ifstream::failbit | std::ifstream::badbit);
    try
    {
        // open files
        vShaderFile.open(vertexPath);
        fShaderFile.open(fragmentPath);
        std::stringstream vShaderStream, fShaderStream;
        // read file's buffer contents into streams
        vShaderStream << vShaderFile.rdbuf();
        fShaderStream << fShaderFile.rdbuf();
        // close file handlers
        vShaderFile.close();
        fShaderFile.close();
        // convert stream into string
        vertexCode = vShaderStream.str();
        fragmentCode = fShaderStream.str();
    }
    catch (std::ifstream::failure e)
    {
        std::cout << "ERROR::SHADER::FILE_NOT_SUCCESFULLY_READ" << std::endl;
    }
    const char* vShaderCode = vertexCode.c_str();
    const char* fShaderCode = fragmentCode.c_str();

    // 2. compile shaders
    unsigned int vertex, fragment;
    int success;
    char infoLog[512];

    // vertex Shader
    vertex = glCreateShader(GL_VERTEX_SHADER);
    glShaderSource(vertex, 1, &vShaderCode, NULL);
    glCompileShader(vertex);
    // print compile errors if any
    glGetShaderiv(vertex, GL_COMPILE_STATUS, &success);
    if (!success)
    {
        glGetShaderInfoLog(vertex, 512, NULL, infoLog);
        std::cout << "ERROR::SHADER::VERTEX::COMPILATION_FAILED\n" << infoLog <<
std::endl;
    };

    // fragment Shader
    fragment = glCreateShader(GL_FRAGMENT_SHADER);
    glShaderSource(fragment, 1, &fShaderCode, NULL);
    glCompileShader(fragment);
```

```
    // print compile errors if any
    glGetShaderiv(fragment, GL_COMPILE_STATUS, &success);
    if (!success)
    {
        glGetShaderInfoLog(fragment, 512, NULL, infoLog);
        std::cout << "ERROR::SHADER::FRAGMENT::COMPILATION_FAILED\n" << infoLog <<
std::endl;
    };

    // shader Program
    ID = glCreateProgram();
    glAttachShader(ID, vertex);
    glAttachShader(ID, fragment);
    glLinkProgram(ID);
    // print linking errors if any
    glGetProgramiv(ID, GL_LINK_STATUS, &success);
    if (!success)
    {
        glGetProgramInfoLog(ID, 512, NULL, infoLog);
        std::cout << "ERROR::SHADER::PROGRAM::LINKING_FAILED\n" << infoLog <<
std::endl;
    }

    // delete the shaders as they're linked into our program now and no longer
necessary
    glDeleteShader(vertex);
    glDeleteShader(fragment);
};

void Shader::use()
{
    glUseProgram(ID);
}

void Shader::remove() {
    glDeleteProgram(this->ID);
}

void Shader::setBool(const std::string& name, bool value) const
{
    glUniform1i(glGetUniformLocation(ID, name.c_str()), (int)value);
}
void Shader::setInt(const std::string& name, int value) const
{
    glUniform1i(glGetUniformLocation(ID, name.c_str()), value);
}
void Shader::setFloat(const std::string& name, float value) const
{
    glUniform1f(glGetUniformLocation(ID, name.c_str()), value);
}

void Shader::setMat4(const std::string& name, glm::mat4& value) const
{
    glUniformMatrix4fv(glGetUniformLocation(ID, name.c_str()), 1, GL_FALSE,
```

```
&value[0][0]);
}
```

Player.h

```
#pragma once

#include <GL/glew.h>
#include <GL/freeglut.h>
#include "base/Shader.h"
#include "Texture.h"
#include <string>
#include <vector>
#include "CollisionDetector.h"
#include "Collision.h"
#include "World.h"

class World;

class Player {
private:
    const std::string scaleMatrixTag = "scaleMatrix";
    const std::string translateMatrixTag = "translateMatrix";
    const std::string rotationMatrixTag = "rotationMatrix";

    World* world = nullptr;
    Shader* shader = nullptr;
    Texture* texture = nullptr;

    float xPosition = 0, yPosition = 0;
    float height = 2.0/24, width = 2.0/40;

    bool isInAir = true;
    float gravitationalAcceleration = 10, yVelocity = 0;
    float rotationAngle = 0, rotationSpeed = 0;

    float vertices[20] = {
        -0.5, -0.5, 0, 0, 1,
        0.5, -0.5, 0, 1, 1,
        0.5, 0.5, 0, 1, 0,
        -0.5, 0.5, 0, 0, 0,
    };

    unsigned int VBO;
    unsigned int VAO;

    float closestValue(float value, std::vector <float> set);

public:
```

```
    Player(World* world, Shader* shader, Texture* texture);

    void render();
    void freeResources();
    void update(int deltaTime);
    void jump();

    float getWidth() const;
    float getHeight() const;
    float getXPosition() const;
    float getYPosition() const;
};
```

Player.cpp

```
#include <GL/glew.h>
#include <GL/freeglut.h>
#include "base/Shader.h"
#include "Player.h"
#include "World.h"

# define M_PI  3.14159265358979323846


float Player::closestValue(float value, std::vector<float> set)
{
    float minDiff = 1e10;
    float closestValue = value;
    for (float s : set) {
        float diff = std::abs(s - value);
        if (minDiff > diff) {
            minDiff = diff;
            closestValue = s;
        }
    }
    return closestValue;
}

Player::Player(World* world, Shader* shader, Texture* texture) {
    this->world = world;
    this->shader = shader;
    this->texture = texture;

    glGenVertexArrays(1, &VAO);
    glBindVertexArray(VAO);
```

```
    glGenBuffers(1, &VBO);
    glBindBuffer(GL_ARRAY_BUFFER, VBO);
    glBufferData(GL_ARRAY_BUFFER, sizeof(vertices), vertices, GL_STATIC_DRAW);

    glVertexAttribPointer(0, 3, GL_FLOAT, GL_FALSE, 5 * sizeof(float), (void*)0);
    glEnableVertexAttribArray(0);


    glVertexAttribPointer(1, 2, GL_FLOAT, GL_FALSE, 5 * sizeof(float), (void*)(3 *
sizeof(float)));
    glEnableVertexAttribArray(1);
}

void Player::render() {
    shader->use();
    glm::mat4 scaleMatrix = glm::scale(glm::mat4(1.0f), glm::vec3(width, height,
1.0));
    shader->setMat4(scaleMatrixTag,scaleMatrix);
    glm::mat4 translateMatrix = glm::translate(glm::mat4(1), glm::vec3(xPosition,
yPosition, 0));
    shader->setMat4(translateMatrixTag, translateMatrix);
    glm::mat4 rotationMatrix = glm::rotate(glm::mat4(1), rotationAngle,
glm::vec3(0, 0, 1));
    shader->setMat4(rotationMatrixTag, rotationMatrix);

    texture->use();
    glBindVertexArray(this->VAO);
    glDrawArrays(GL_TRIANGLE_FAN, 0, 4);
}

void Player::freeResources() {
    glDeleteVertexArrays(1, &VAO);
    glDeleteBuffers(1, &VBO);
}

void Player::update(int deltaTime)
{
    float collision = world->detectCollisionDown();

    if (collision > 1e-7) {
        while (rotationAngle >= 2 * M_PI) {
            rotationAngle -= 2 * M_PI;
        }
        while (rotationAngle < 0) {
            rotationAngle += 2 * M_PI;
        }

        yPosition += collision;

        rotationAngle = closestValue(rotationAngle, { 0, M_PI / 2, M_PI, 3 * M_PI
/ 2, 2 * M_PI });

        yVelocity = 0;
        isInAir = false;
```

```
    }
    else if(isInAir){
        rotationAngle += rotationSpeed * deltaTime / 1000.0;

        yPosition += yVelocity * deltaTime / 1000.0;
        yVelocity -= gravitationalAcceleration * deltaTime / 1000.0;
    }
    else if (collision < 0) {
        isInAir = true;
    }
}


void Player::jump()
{
    if (!isInAir) {
        yVelocity = 2;
        rotationSpeed = -0.98 * M_PI / (2 * yVelocity /
gravitationalAcceleration);
        isInAir = true;
    }
}

float Player::getWidth() const
{
    return width;
}

float Player::getHeight() const
{
    return height;
}

float Player::getXPosition() const
{
    return xPosition;
}

float Player::getYPosition() const
{
    return yPosition;
}
```

player.vert

```
#version 330 core
layout (location = 0) in vec3 aPos;
layout (location = 1) in vec2 aTexCoord;

out vec3 ourColor;
```

```
out vec2 TexCoord;

uniform mat4 scaleMatrix;
uniform mat4 translateMatrix;
uniform mat4 rotationMatrix;

void main()
{
    gl_Position = translateMatrix * scaleMatrix * rotationMatrix * vec4(aPos,
1.0);
    TexCoord = aTexCoord;
}
```

player.frag

```
#version 330 core

in vec3 ourColor;
in vec2 TexCoord;

out vec4 FragColor;

uniform sampler2D ourTexture;

void main()
{
    FragColor = texture(ourTexture, TexCoord);
}
```

Block.h

```
#pragma once
#include <GL/glew.h>
#include <GL/freeglut.h>
#include "base/Shader.h"
#include "Texture.h"

class Block {
private:
    const std::string scaleMatrixTag = "scaleMatrix";
    const std::string translateMatrixTag = "translateMatrix";

    Shader* shader = nullptr;
    Texture* texture = nullptr;
    float speed = 0.001;

    float vertices[36] = {
        -0.5, -0.5, 0, 0, 1,
        0.5, -0.5, 0, 1, 1,
```

```
        0.5, 0.5, 0, 1, 0,
        -0.5, 0.5, 0, 0, 0,
    };

    float xPosition = 0, yPosition = 0;
    float height = 2.0 / 24, width = 2.0 / 40;

    unsigned int VBO;
    unsigned int VAO;

public:
    Block(Shader* shader, Texture* texture);

    void setPosition(float x, float y);
    void render();
    void freeResources();

    float getWidth() const;
    float getHeight() const;
    float getXPosition() const;
    float getYPosition() const;
};
```

Block.cpp

```
#include "Block.h"

Block::Block(Shader* shader, Texture* texture)
{
    this->shader = shader;
    this->texture = texture;

    glGenVertexArrays(1, &VAO);
    glBindVertexArray(VAO);


    glGenBuffers(1, &VBO);
    glBindBuffer(GL_ARRAY_BUFFER, VBO);
    glBufferData(GL_ARRAY_BUFFER, sizeof(vertices), vertices, GL_STATIC_DRAW);

    glVertexAttribPointer(0, 3, GL_FLOAT, GL_FALSE, 5 * sizeof(float), (void*)0);
    glEnableVertexAttribArray(0);


    glVertexAttribPointer(1, 2, GL_FLOAT, GL_FALSE, 5 * sizeof(float), (void*)(3 *
sizeof(float)));
    glEnableVertexAttribArray(1);
}

void Block::setPosition(float x, float y)
{
```

```
    xPosition = x;
    yPosition = y;
}

void Block::render()
{
    shader->use();
    glm::mat4 scaleMatrix = glm::scale(glm::mat4(1.0f), glm::vec3(width, height,
1.0));
    shader->setMat4(scaleMatrixTag, scaleMatrix);
    glm::mat4 translateMatrix = glm::translate(glm::mat4(1), glm::vec3(xPosition,
yPosition, 0));
    shader->setMat4(translateMatrixTag, translateMatrix);

    texture->use();
    glBindVertexArray(this->VAO);
    glDrawArrays(GL_TRIANGLE_FAN, 0, 4);
}

void Block::freeResources()
{
    glDeleteVertexArrays(1, &VAO);
    glDeleteBuffers(1, &VBO);
}

float Block::getWidth() const
{
    return width;
}

float Block::getHeight() const
{
    return height;
}

float Block::getXPosition() const
{
    return xPosition;
}

float Block::getYPosition() const
{
    return yPosition;
}
```

CollisionDetector.h

```
#pragma once
#include "Block.h"
#include "Player.h"
```

```
#include "Collision.h"
#include <vector>

class Player;

class CollisionDetector {
private:
    std::vector <Block*> blocks;
    Player* player = nullptr;
public:

    CollisionDetector(Player* player, std::vector <Block*> blocks);

    float detectDown();
    float detectRight();
    //Collision detectRight();
};
```

CollisionDetector.cpp

```
#pragma once
#include "Block.h"
#include "Player.h"
#include "Collision.h"
#include <vector>

#include <iostream>

CollisionDetector::CollisionDetector(Player* player, std::vector <Block*> blocks)
{
    this->player = player;
    this->blocks = blocks;
}


float CollisionDetector::detectDown() {
    float xPlayer = player->getXPosition();
    float yPlayer = player->getYPosition();
    float playerWidth = player->getWidth();
    float playerHeight = player->getHeight();

    for (const auto& block : blocks) {
        float xBlock = block->getXPosition();
        float yBlock = block->getYPosition();
        float blockWidth = block->getWidth();
        float blockHeight = block->getHeight();

        float xOverlap = -(std::abs(xPlayer - xBlock) - (playerWidth + blockWidth)
/ 2);
```

```
        float yOverlap = -(std::abs(yPlayer - yBlock) - (playerHeight +
blockHeight) / 2);

        if (xOverlap > 0 && yOverlap > 0) {
            if (yPlayer > yBlock && std::abs(yPlayer - yBlock) > std::abs(xPlayer
- xBlock)) {

                return yOverlap;
            }

        }
    }
    return -1;
}

float CollisionDetector::detectRight() {
    float xPlayer = player->getXPosition();
    float yPlayer = player->getYPosition();
    float playerWidth = player->getWidth();
    float playerHeight = player->getHeight();

    for (const auto& block : blocks) {
        float xBlock = block->getXPosition();
        float yBlock = block->getYPosition();
        float blockWidth = block->getWidth();
        float blockHeight = block->getHeight();

        float xOverlap = -(std::abs(xPlayer - xBlock) - (playerWidth + blockWidth)
/ 2);
        float yOverlap = -(std::abs(yPlayer - yBlock) - (playerHeight +
blockHeight) / 2);

        if (xOverlap > 0 && yOverlap > 0) {
            if (xPlayer > xBlock && std::abs(yPlayer - yBlock) < std::abs(xPlayer
- xBlock)) {

                return yOverlap;
            }

        }
    }
    return -1;
}
```