**Lab Practice-7**

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| **Question-**  Create a simple day and night scenario that will automatically change from day to night. Your scenario must have enough elements to depict a fully design a animated scenario. You must use function to represent objects and animations. |
| **Graph** |
| **Code-**  **#include <GL/glut.h>**  **#include <cmath>**  **#include <cstdlib>**  **// Window size**  **const int WIDTH = 800;**  **const int HEIGHT = 600;**  **// Time variable for day-night cycle**  **float timeOfDay = 0.0f;**  **// Stars positions**  **const int STAR\_COUNT = 50;**  **float starX[STAR\_COUNT];**  **float starY[STAR\_COUNT];**  **// Cloud positions**  **float cloud1X = 100, cloud2X = 400, cloud3X = 700;**  **// Initialize stars**  **void initStars() {**  **for (int i = 0; i < STAR\_COUNT; i++) {**  **starX[i] = rand() % WIDTH;**  **starY[i] = HEIGHT / 2 + rand() % (HEIGHT / 2);**  **}**  **}**  **// Function to draw a circle**  **void drawCircle(float cx, float cy, float r, int num\_segments) {**  **glBegin(GL\_TRIANGLE\_FAN);**  **for (int i = 0; i <= num\_segments; i++) {**  **float theta = 2.0f \* 3.1415926f \* i / num\_segments;**  **float x = r \* cosf(theta);**  **float y = r \* sinf(theta);**  **glVertex2f(x + cx, y + cy);**  **}**  **glEnd();**  **}**  **// Draw sky**  **void drawSky() {**  **if (timeOfDay < 0.5f)**  **glColor3f(0.53f, 0.81f, 0.92f); // Day**  **else**  **glColor3f(0.05f, 0.05f, 0.2f); // Night**  **glBegin(GL\_QUADS);**  **glVertex2f(0, HEIGHT / 2);**  **glVertex2f(WIDTH, HEIGHT / 2);**  **glVertex2f(WIDTH, HEIGHT);**  **glVertex2f(0, HEIGHT);**  **glEnd();**  **}**  **// Draw ground**  **void drawGround() {**  **glColor3f(0.2f, 0.8f, 0.2f);**  **glBegin(GL\_QUADS);**  **glVertex2f(0, 0);**  **glVertex2f(WIDTH, 0);**  **glVertex2f(WIDTH, HEIGHT / 2);**  **glVertex2f(0, HEIGHT / 2);**  **glEnd();**  **}**  **// Draw sun**  **void drawSun() {**  **float x = WIDTH \* timeOfDay;**  **float y = HEIGHT / 2 + 150 \* sin(timeOfDay \* 3.1415f);**  **glColor3f(1.0f, 1.0f, 0.0f);**  **drawCircle(x, y, 50, 100);**  **}**  **// Draw moon**  **void drawMoon() {**  **float x = WIDTH \* timeOfDay;**  **float y = HEIGHT / 2 + 150 \* sin(timeOfDay \* 3.1415f);**  **glColor3f(0.9f, 0.9f, 0.9f);**  **drawCircle(x, y, 40, 100);**  **}**  **// Draw cloud**  **void drawCloud(float x, float y) {**  **glColor3f(1.0f, 1.0f, 1.0f);**  **drawCircle(x, y, 20, 50);**  **drawCircle(x + 20, y + 10, 25, 50);**  **drawCircle(x + 40, y, 20, 50);**  **}**  **// Draw tree**  **void drawTree(float x, float y) {**  **// Trunk**  **glColor3f(0.55f, 0.27f, 0.07f);**  **glBegin(GL\_QUADS);**  **glVertex2f(x - 5, y);**  **glVertex2f(x + 5, y);**  **glVertex2f(x + 5, y + 60);**  **glVertex2f(x - 5, y + 60);**  **glEnd();**  **// Leaves**  **glColor3f(0.0f, 0.5f, 0.0f);**  **drawCircle(x, y + 70, 20, 50);**  **drawCircle(x - 15, y + 55, 15, 50);**  **drawCircle(x + 15, y + 55, 15, 50);**  **drawCircle(x, y + 90, 20, 50);**  **}**  **// Draw house**  **void drawHouse(float x, float y) {**  **glColor3f(0.8f, 0.3f, 0.3f); // Base**  **glBegin(GL\_QUADS);**  **glVertex2f(x, y);**  **glVertex2f(x + 60, y);**  **glVertex2f(x + 60, y + 50);**  **glVertex2f(x, y + 50);**  **glEnd();**  **glColor3f(0.5f, 0.2f, 0.2f); // Roof**  **glBegin(GL\_TRIANGLES);**  **glVertex2f(x - 10, y + 50);**  **glVertex2f(x + 30, y + 80);**  **glVertex2f(x + 70, y + 50);**  **glEnd();**  **}**  **// Draw five-storied building**  **void drawBuilding(float x, float y) {**  **float w = 80, h = 250;**  **float story = h / 5.0f;**  **glColor3f(0.6f, 0.6f, 0.6f);**  **glBegin(GL\_QUADS);**  **glVertex2f(x, y);**  **glVertex2f(x + w, y);**  **glVertex2f(x + w, y + h);**  **glVertex2f(x, y + h);**  **glEnd();**  **// Windows**  **float winW = 15, winH = 20;**  **for (int s = 0; s < 5; s++) {**  **float winY = y + s \* story + 20;**  **for (int col = 0; col < 3; col++) {**  **float winX = x + 10 + col \* (winW + 10);**  **glColor3f(0.9f, 0.9f, 0.5f);**  **glBegin(GL\_QUADS);**  **glVertex2f(winX, winY);**  **glVertex2f(winX + winW, winY);**  **glVertex2f(winX + winW, winY + winH);**  **glVertex2f(winX, winY + winH);**  **glEnd();**  **}**  **}**  **// Door**  **glColor3f(0.4f, 0.2f, 0.1f);**  **glBegin(GL\_QUADS);**  **glVertex2f(x + w / 2 - 15, y);**  **glVertex2f(x + w / 2 + 15, y);**  **glVertex2f(x + w / 2 + 15, y + 40);**  **glVertex2f(x + w / 2 - 15, y + 40);**  **glEnd();**  **}**  **// Draw stars**  **void drawStars() {**  **for (int i = 0; i < STAR\_COUNT; i++) {**  **float twinkle = ((rand() % 100) / 200.0f) + 0.5f;**  **glColor3f(twinkle, twinkle, twinkle);**  **drawCircle(starX[i], starY[i], 2, 10);**  **}**  **}**  **// Display callback**  **void display() {**  **glClear(GL\_COLOR\_BUFFER\_BIT);**  **drawSky();**  **drawGround();**  **if (timeOfDay < 0.5f)**  **drawSun();**  **else {**  **drawMoon();**  **drawStars();**  **}**  **// Moving clouds**  **drawCloud(cloud1X, 500);**  **drawCloud(cloud2X, 550);**  **drawCloud(cloud3X, 520);**  **// Trees**  **drawTree(100, 200);**  **drawTree(300, 180);**  **drawTree(500, 200);**  **// Houses**  **for (int i = 0; i < 6; i++) drawHouse(50 + i \* 120, 200);**  **// Five-storied building**  **drawBuilding(650, 200);**  **glutSwapBuffers();**  **}**  **// Update animation**  **void update(int value) {**  **// Update time of day**  **timeOfDay += 0.001f;**  **if (timeOfDay > 1.0f) timeOfDay = 0.0f;**  **// Move clouds**  **cloud1X += 0.1f; if (cloud1X > WIDTH) cloud1X = -50;**  **cloud2X += 0.07f; if (cloud2X > WIDTH) cloud2X = -50;**  **cloud3X += 0.05f; if (cloud3X > WIDTH) cloud3X = -50;**  **glutPostRedisplay();**  **glutTimerFunc(10, update, 0);**  **}**  **// Initialize OpenGL**  **void init() {**  **glClearColor(0.0f, 0.0f, 0.0f, 1.0f);**  **glMatrixMode(GL\_PROJECTION);**  **glLoadIdentity();**  **gluOrtho2D(0, WIDTH, 0, HEIGHT);**  **initStars();**  **}**  **// Main function**  **int main(int argc, char\*\* argv) {**  **glutInit(&argc, argv);**  **glutInitDisplayMode(GLUT\_DOUBLE | GLUT\_RGB);**  **glutInitWindowSize(WIDTH, HEIGHT);**  **glutCreateWindow("Day and Night Animated Scene");**  **init();**  **glutDisplayFunc(display);**  **glutTimerFunc(10, update, 0);**  **glutMainLoop();**  **return 0;**  **}** |
| **Output Screenshot (Full Screen)-** |

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| **Question-**  Create two scenarios. Each scenario will have its own objects, animations, mouse and keyboard interactions. Then ‘Merge’ the two scenarios into one. You must keep ways to call one scenario from another automatically and using pre-defined buttons. |
| **Graph** |
| **Code-**  **#include <GL/glut.h>**  **#include <cmath>**  **#include <cstdlib>**  **#include <string>**  **// Window size**  **const int WIDTH = 800;**  **const int HEIGHT = 600;**  **// Scenario selection**  **int currentScenario = 1; // 1 or 2**  **// Time variable for animations**  **float timeVar = 0.0f;**  **// --------------------- Utility Functions ---------------------**  **void drawCircle(float cx, float cy, float r, int num\_segments) {**  **glBegin(GL\_TRIANGLE\_FAN);**  **for (int i = 0; i <= num\_segments; i++) {**  **float theta = 2.0f \* 3.1415926f \* i / num\_segments;**  **float x = r \* cosf(theta);**  **float y = r \* sinf(theta);**  **glVertex2f(x + cx, y + cy);**  **}**  **glEnd();**  **}**  **void drawText(float x, float y, std::string text) {**  **glRasterPos2f(x, y);**  **for (char c : text) {**  **glutBitmapCharacter(GLUT\_BITMAP\_HELVETICA\_18, c);**  **}**  **}**  **// --------------------- Scenario 1 ---------------------**  **float sunX = 100.0f;**  **// Draw scenario 1 (day scene with moving sun)**  **void scenario1() {**  **// Sky**  **glColor3f(0.53f, 0.81f, 0.92f);**  **glBegin(GL\_QUADS);**  **glVertex2f(0, HEIGHT / 2);**  **glVertex2f(WIDTH, HEIGHT / 2);**  **glVertex2f(WIDTH, HEIGHT);**  **glVertex2f(0, HEIGHT);**  **glEnd();**  **// Ground**  **glColor3f(0.2f, 0.8f, 0.2f);**  **glBegin(GL\_QUADS);**  **glVertex2f(0, 0);**  **glVertex2f(WIDTH, 0);**  **glVertex2f(WIDTH, HEIGHT / 2);**  **glVertex2f(0, HEIGHT / 2);**  **glEnd();**  **// Sun**  **glColor3f(1.0f, 1.0f, 0.0f);**  **drawCircle(sunX, 450, 50, 100);**  **// House**  **glColor3f(0.8f, 0.3f, 0.3f);**  **glBegin(GL\_QUADS);**  **glVertex2f(300, 200);**  **glVertex2f(400, 200);**  **glVertex2f(400, 300);**  **glVertex2f(300, 300);**  **glEnd();**  **// Roof**  **glColor3f(0.5f, 0.2f, 0.2f);**  **glBegin(GL\_TRIANGLES);**  **glVertex2f(290, 300);**  **glVertex2f(350, 350);**  **glVertex2f(410, 300);**  **glEnd();**  **// Text**  **glColor3f(0, 0, 0);**  **drawText(10, HEIGHT - 20, "Scenario 1: Day Scene with Moving Sun");**  **}**  **// Update scenario 1 animation**  **void updateScenario1() {**  **sunX += 0.5f;**  **if (sunX > WIDTH + 50) sunX = -50; // Loop sun**  **}**  **// Keyboard for scenario 1**  **void keyboardScenario1(unsigned char key, int x, int y) {**  **if (key == 's') { // Switch to scenario 2**  **currentScenario = 2;**  **}**  **}**  **// Mouse for scenario 1**  **void mouseScenario1(int button, int state, int x, int y) {**  **if (button == GLUT\_LEFT\_BUTTON && state == GLUT\_DOWN) {**  **sunX += 50; // Move sun right**  **}**  **}**  **// --------------------- Scenario 2 ---------------------**  **float ballY = 100.0f;**  **float ballDir = 1.0f;**  **// Draw scenario 2 (bouncing ball at night)**  **void scenario2() {**  **// Night sky**  **glColor3f(0.05f, 0.05f, 0.2f);**  **glBegin(GL\_QUADS);**  **glVertex2f(0, HEIGHT / 2);**  **glVertex2f(WIDTH, HEIGHT / 2);**  **glVertex2f(WIDTH, HEIGHT);**  **glVertex2f(0, HEIGHT);**  **glEnd();**  **// Ground**  **glColor3f(0.1f, 0.4f, 0.1f);**  **glBegin(GL\_QUADS);**  **glVertex2f(0, 0);**  **glVertex2f(WIDTH, 0);**  **glVertex2f(WIDTH, HEIGHT / 2);**  **glVertex2f(0, HEIGHT / 2);**  **glEnd();**  **// Ball**  **glColor3f(1.0f, 0.0f, 0.0f);**  **drawCircle(400, ballY, 30, 100);**  **// Text**  **glColor3f(1, 1, 1);**  **drawText(10, HEIGHT - 20, "Scenario 2: Night Scene with Bouncing Ball");**  **}**  **// Update scenario 2 animation**  **void updateScenario2() {**  **ballY += ballDir \* 2.0f;**  **if (ballY > 500 || ballY < 100) ballDir \*= -1; // Bounce**  **}**  **// Keyboard for scenario 2**  **void keyboardScenario2(unsigned char key, int x, int y) {**  **if (key == 's') { // Switch to scenario 1**  **currentScenario = 1;**  **}**  **}**  **// Mouse for scenario 2**  **void mouseScenario2(int button, int state, int x, int y) {**  **if (button == GLUT\_LEFT\_BUTTON && state == GLUT\_DOWN) {**  **ballY += 20; // Move ball up**  **}**  **}**  **// --------------------- Display and Update ---------------------**  **void display() {**  **glClear(GL\_COLOR\_BUFFER\_BIT);**  **if (currentScenario == 1) {**  **scenario1();**  **} else {**  **scenario2();**  **}**  **glutSwapBuffers();**  **}**  **void update(int value) {**  **if (currentScenario == 1) updateScenario1();**  **else updateScenario2();**  **glutPostRedisplay();**  **glutTimerFunc(16, update, 0); // ~60 FPS**  **}**  **void keyboard(unsigned char key, int x, int y) {**  **if (currentScenario == 1) keyboardScenario1(key, x, y);**  **else keyboardScenario2(key, x, y);**  **}**  **void mouse(int button, int state, int x, int y) {**  **if (currentScenario == 1) mouseScenario1(button, state, x, y);**  **else mouseScenario2(button, state, x, y);**  **}**  **// --------------------- Main ---------------------**  **void init() {**  **glClearColor(0.0, 0.0, 0.0, 1.0);**  **glMatrixMode(GL\_PROJECTION);**  **glLoadIdentity();**  **gluOrtho2D(0, WIDTH, 0, HEIGHT);**  **}**  **int main(int argc, char\*\* argv) {**  **glutInit(&argc, argv);**  **glutInitDisplayMode(GLUT\_DOUBLE | GLUT\_RGB);**  **glutInitWindowSize(WIDTH, HEIGHT);**  **glutCreateWindow("Two Scenarios Merged Example");**  **init();**  **glutDisplayFunc(display);**  **glutKeyboardFunc(keyboard);**  **glutMouseFunc(mouse);**  **glutTimerFunc(16, update, 0);**  **glutMainLoop();**  **return 0;**  **}** |
| **Output Screenshot (Full Screen)-** |