SPRAWOZDANIE

Zajęcia: Grafika komputerowa
Prowadzący: prof. dr hab. Vasyl Martsenyuk

Laboratorium II
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Temat: ZadanieWebGL3d

Wariant 8 + 4

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Informatyka I stopień,
stacjonarne,
4 semestr,
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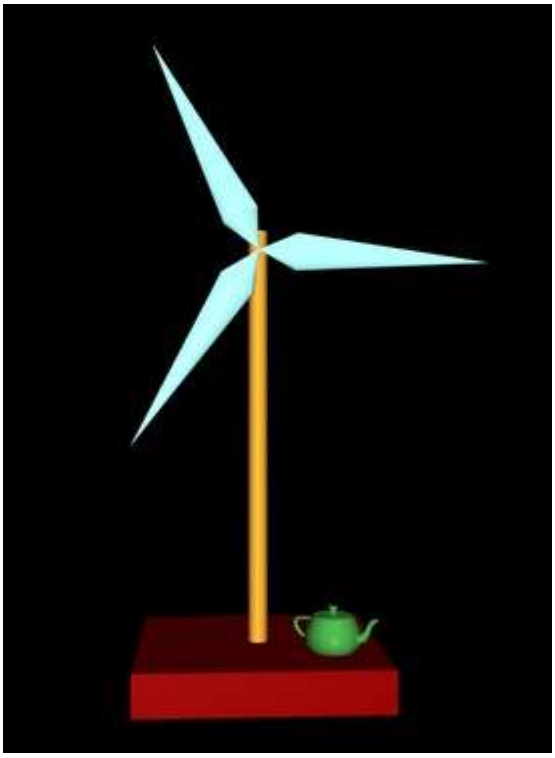
Polecenie

Plik lab12.html pokazuje mały sześcian, który można obrócić, przeciągając myszą na płótnie. Zadaniem jest zastąpienie sześcianu dużym wiatrakiem siedzącym na prostokątnej podstawie, jak pokazano na rysunku. Łopatki wiatraka powinny obracać się po włączeniu animacji. Każda łopatka wiatraka powinna być zbudowana z dwóch stożków. (Dodanie czajniczka, który znajduje się na podstawie, jest konieczne dla uzyskania oceny "5")
Program zawiera trzy zmienne instancji reprezentujące podstawowe obiekty: cube, cone, cylinder. Te zmienne mają metody instancji cube.render(), cone.render(), cylinder.render(), które można wywołać w celu narysowania obiektów. Obiekty nietransformowane mają rozmiar 1 we wszystkich trzech kierunkach i mają swój środek na (0,0,0). Oś stożka i oś cylindra są wyrównane wzdłuż osi Z. Wszystkie obiekty na scenie powinny być przekształconymi wersjami podstawowych obiektów (lub podstawowego obiektu czajnika).

1. Zdjęcie z Przykładu:



2. Wykorzystane komendy:

Link do github: https://github.com/Szeladin/grafika.git

Kod Programu:

Odpowiada za wiatrak z dwunastoma skrzydłami i czajnik

```
<!DOCTYPE html>
<html lang="pl">
<head>
    <meta charset="UTF-8">
    <title>Lab 12</title>
    <style>
        body {
            background-color: #EEEEEE;
        }
        label {
            white-space: pre;
            margin-left: 25px;
        }
    </style>


    <script type="x-shader/x-vertex" id="vshader-source">
    attribute vec3 a_coords;
    attribute vec3 a_normal;
    uniform mat4 modelview;
    uniform mat4 projection;
    varying vec3 v_normal;
    varying vec3 v_eyeCoords;
    void main() {
        vec4 coords = vec4(a_coords,1.0);
        vec4 eyeCoords = modelview * coords;
        gl_Position = projection * eyeCoords;
        v_normal = normalize(a_normal);
        v_eyeCoords = eyeCoords.xyz/eyeCoords.w;
    }
</script>

    <script type="x-shader/x-fragment" id="fshader-source">
    #ifdef GL_FRAGMENT_PRECISION_HIGH
       precision highp float;
    #else
       precision mediump float;
    #endif
    struct MaterialProperties {
        vec3 diffuseColor;      // diffuseColor.a is alpha for the fragment
        vec3 specularColor;
        vec3 emissiveColor;
        float specularExponent;
    };
    struct LightProperties {
        bool enabled;
        vec4 position;
        vec3 color;
    };
    uniform MaterialProperties material; // do two-sided lighting, but assume front and back
materials are the same
    uniform LightProperties lights[4];
    uniform mat3 normalMatrix;
    varying vec3 v_normal;
    varying vec3 v_eyeCoords;
    vec3 lightingEquation( LightProperties light, MaterialProperties material,
                                vec3 eyeCoords, vec3 N, vec3 V ) {
           // N is normal vector, V is direction to viewer.
        vec3 L, R; // Light direction and reflected light direction.
        if ( light.position.w == 0.0 ) {
            L = normalize( light.position.xyz );
        }
        else {
            L = normalize( light.position.xyz/light.position.w - v_eyeCoords );
        }
```

```
        if (dot(L,N) <= 0.0) {
            return vec3(0.0);
        }
        vec3 reflection = dot(L,N) * light.color * material.diffuseColor;
        R = -reflect(L,N);
        if (dot(R,V) > 0.0) {
            float factor = pow(dot(R,V),material.specularExponent);
            reflection += factor * material.specularColor * light.color;
        }
        return reflection;
    }
    void main() {
        vec3 normal = normalize( normalMatrix*v_normal );
        vec3 viewDirection = normalize( -v_eyeCoords);  // (Assumes a perspective projection.)
        vec3 color = material.emissiveColor;
        for (int i = 0; i < 4; i++) {
            if (lights[i].enabled) {
                if (gl_FrontFacing) {
                    color += lightingEquation( lights[i], material, v_eyeCoords,
                                                normal, viewDirection);
                }
                else {
                    color += lightingEquation( lights[i], material, v_eyeCoords,
                                                -normal, viewDirection);
                }
            }
        }
        gl_FragColor = vec4(color, 1);
    }
</script>


    <script src="gl-matrix.js"></script>
    <script src="basic-object-models-IFS.js"></script>
    <script src="teapot-model-IFS.js"></script>

    <script>

        "use strict";

        var gl;   // The webgl context
        var canvas;    // The canvas where gl draws

        var a_coords_loc;         // Location of the a_coords attribute variable in the shader
program
        var a_normal_loc;         // Location of a_normal attribute

        var u_modelview;       // Locations for uniform matrices
        var u_projection;
        var u_normalMatrix;

        var u_material;     // An object tolds uniform locations for the material.
        var u_lights;       // An array of objects that holds uniform locations for light
properties.

        var projection = mat4.create();    // projection matrix
        var modelview = mat4.create();    // modelview matrix
        var normalMatrix = mat3.create();  // matrix for transforming normal vectors

        var frameNumber = 0;  // frame number during animation

        var cone, cylinder, cube, teapot;  // Basic objects, created using function createModel
and basic-object-models-IFS.js.
                                    // The cube is 1 unit on each side and is centered at (0,0,0).
                                    // the cone and cylinder have diameter 1 and height 1 and are
centered at
                                    //     (0,0,0), with their axes aligned along the z-axis.

        var matrixStack = [];           // A stack of matrices for implementing hierarchical
graphics
```

```
        var currentColor = [1,1,1];   // The current diffuse color; render() functions in the
basic objects set
                                      // the diffuse color to currentColor when it is called
before drawing the object
                                      // Specular color properties, which don't change, are set
in initGL()

        var rotateX = 0, rotateY = 0;   // Overal rotation of model, in radians, set by mouse
dragging.

        /**
         * Draws the image, which consists of either the "world" or a closeup of the "car".
         */

        function vane() {
            pushMatrix();
            currentColor = [0, 0.8, 0];
            mat4.rotateY(modelview,modelview, Math.PI/2);
            mat4.scale(modelview,modelview,[0.5, 0.7, 3.1]);
            cone.render();
            popMatrix();

            pushMatrix();
            currentColor = [0, 0.8, 0];
            mat4.translate(modelview, modelview, [-2.3, 0, 0]);
            mat4.rotateY(modelview,modelview, Math.PI/2);
            mat4.rotateX(modelview,modelview, Math.PI);
            mat4.scale(modelview,modelview,[0.5, 0.7, 1.5]);
            cone.render();
            popMatrix();
        }

        var rotateEachFrame = 0;

        function draw() {
            gl.clearColor(0,0,0,1);
            gl.clear(gl.COLOR_BUFFER_BIT | gl.DEPTH_BUFFER_BIT);

            mat4.perspective(projection, Math.PI/4, 1, 1, 50);
            gl.uniformMatrix4fv(u_projection, false, projection );

            mat4.lookAt(modelview, [0,0,25], [0,0,0], [0,1,0]);

            mat4.rotateX(modelview,modelview,rotateX);
            mat4.rotateY(modelview,modelview,rotateY);

            pushMatrix();
            currentColor = [0.984, 0.156, 0.403];
            mat4.translate(modelview, modelview, [0, -5, 0]);
            mat4.scale(modelview,modelview,[5, 0.5, 5]);
            cube.render();
            popMatrix();

            pushMatrix();
            currentColor = [0.976, 0.847, 0.584];
            mat4.translate(modelview, modelview, [0, 0, 0]);
            mat4.rotateX(modelview,modelview, Math.PI/2);
            mat4.scale(modelview,modelview,[0.4, 0.4, 10]);
            cylinder.render();
            popMatrix();

            pushMatrix();
            mat4.translate(modelview, modelview, [0, 4.5, 0]);
            mat4.rotateZ(modelview, modelview, -Math.PI/2 - rotateEachFrame);
            for (var i = 0; i < 12; i++) {
                pushMatrix();
                mat4.rotateZ(modelview, modelview, i * 2 * Math.PI / 12);
                mat4.translate(modelview, modelview, [3, 0, 0.5]);
                vane();
```

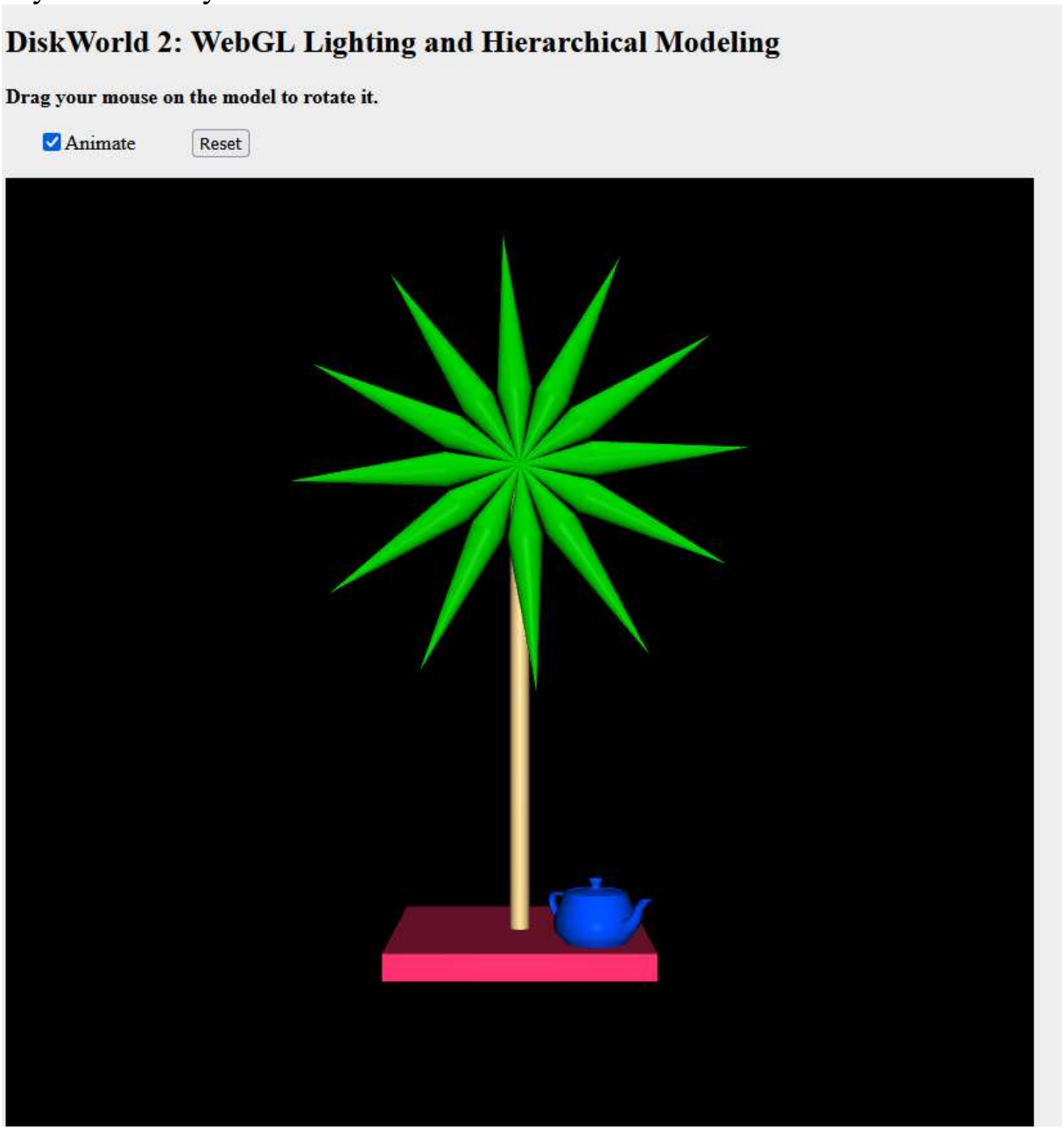
```
            popMatrix();
        }
        popMatrix();

        pushMatrix();
        currentColor = [0,0.3,1];
        mat4.translate(modelview, modelview, [1.5,-4.15,1.5]);
        mat4.rotateY(modelview, modelview, -Math.PI/4);
        mat4.scale(modelview, modelview, [0.08, 0.08, 0.08]);
        teapot.render();
        popMatrix();


    }
    function pushMatrix() {
        matrixStack.push( mat4.clone(modelview) );
    }
    function popMatrix() {
        modelview = matrixStack.pop();
    }
    function createModel(modelData) {
        var model = {};
        model.coordsBuffer = gl.createBuffer();
        model.normalBuffer = gl.createBuffer();
        model.indexBuffer = gl.createBuffer();
        model.count = modelData.indices.length;
        gl.bindBuffer(gl.ARRAY_BUFFER, model.coordsBuffer);
        gl.bufferData(gl.ARRAY_BUFFER, modelData.vertexPositions, gl.STATIC_DRAW);
        gl.bindBuffer(gl.ARRAY_BUFFER, model.normalBuffer);
        gl.bufferData(gl.ARRAY_BUFFER, modelData.vertexNormals, gl.STATIC_DRAW);
        gl.bindBuffer(gl.ELEMENT_ARRAY_BUFFER, model.indexBuffer);
        gl.bufferData(gl.ELEMENT_ARRAY_BUFFER, modelData.indices, gl.STATIC_DRAW);
        model.render = function() {  // This function will render the object.

            gl.bindBuffer(gl.ARRAY_BUFFER, this.coordsBuffer);
            gl.vertexAttribPointer(a_coords_loc, 3, gl.FLOAT, false, 0, 0);
            gl.bindBuffer(gl.ARRAY_BUFFER, this.normalBuffer);
            gl.vertexAttribPointer(a_normal_loc, 3, gl.FLOAT, false, 0, 0);
            gl.uniform3fv(u_material.diffuseColor, currentColor);
            gl.uniformMatrix4fv(u_modelview, false, modelview );
            mat3.normalFromMat4(normalMatrix, modelview);
            gl.uniformMatrix3fv(u_normalMatrix, false, normalMatrix);
            gl.bindBuffer(gl.ELEMENT_ARRAY_BUFFER, this.indexBuffer);
            gl.drawElements(gl.TRIANGLES, this.count, gl.UNSIGNED_SHORT, 0);
            if (this.xtraTranslate) {
                popMatrix();
            }
        }
        return model;
    }


    function createProgram(gl, vertexShaderID, fragmentShaderID, attribute0) {
        function getTextContent( elementID ) {
            var element = document.getElementById(elementID);
            var node = element.firstChild;
            var str = "";
            while (node) {
                if (node.nodeType === 3) // this is a text node
                    str += node.textContent;
                node = node.nextSibling;
            }
            return str;
        }
        try {
            var vertexShaderSource = getTextContent( vertexShaderID );
            var fragmentShaderSource = getTextContent( fragmentShaderID );
        }
        catch (e) {
            throw "Error: Could not get shader source code from script elements.";
```

```
            }
            var vsh = gl.createShader( gl.VERTEX_SHADER );
            gl.shaderSource(vsh,vertexShaderSource);
            gl.compileShader(vsh);
            if ( ! gl.getShaderParameter(vsh, gl.COMPILE_STATUS) ) {
                throw "Error in vertex shader:  " + gl.getShaderInfoLog(vsh);
            }
            var fsh = gl.createShader( gl.FRAGMENT_SHADER );
            gl.shaderSource(fsh, fragmentShaderSource);
            gl.compileShader(fsh);
            if ( ! gl.getShaderParameter(fsh, gl.COMPILE_STATUS) ) {
                throw "Error in fragment shader:  " + gl.getShaderInfoLog(fsh);
            }
            var prog = gl.createProgram();
            gl.attachShader(prog,vsh);
            gl.attachShader(prog, fsh);
            if (attribute0) {
                gl.bindAttribLocation(prog,0,attribute0);
            }
            gl.linkProgram(prog);
            if ( ! gl.getProgramParameter( prog, gl.LINK_STATUS) ) {
                throw "Link error in program:  " + gl.getProgramInfoLog(prog);
            }
            return prog;
        }



        function initGL() {
            var prog = createProgram(gl,"vshader-source","fshader-source", "a_coords");
            gl.useProgram(prog);
            gl.enable(gl.DEPTH_TEST);

            /* Get attribute and uniform locations */

            a_coords_loc =  gl.getAttribLocation(prog, "a_coords");
            a_normal_loc =  gl.getAttribLocation(prog, "a_normal");
            gl.enableVertexAttribArray(a_coords_loc);
            gl.enableVertexAttribArray(a_normal_loc);

            u_modelview = gl.getUniformLocation(prog, "modelview");
            u_projection = gl.getUniformLocation(prog, "projection");
            u_normalMatrix =  gl.getUniformLocation(prog, "normalMatrix");
            u_material = {
                diffuseColor: gl.getUniformLocation(prog, "material.diffuseColor"),
                specularColor: gl.getUniformLocation(prog, "material.specularColor"),
                specularExponent: gl.getUniformLocation(prog, "material.specularExponent")
            };
            u_lights = new Array(4);
            for (var i = 0; i < 4; i++) {
                u_lights[i] = {
                    enabled: gl.getUniformLocation(prog, "lights[" + i + "].enabled"),
                    position: gl.getUniformLocation(prog, "lights[" + i + "].position"),
                    color: gl.getUniformLocation(prog, "lights[" + i + "].color")
                };
            }

            gl.uniform3f( u_material.diffuseColor, 1, 1, 1 );  // set to white as a default.
            gl.uniform3f( u_material.specularColor, 0.1, 0.1, 0.1 );  // specular properties
won't change
            gl.uniform1f( u_material.specularExponent, 32 );

            for (var i = 1; i < 4; i++) { // set defaults for lights
                gl.uniform1i( u_lights[i].enabled, 0 );
                gl.uniform4f( u_lights[i].position, 0, 0, 1, 0 );
                gl.uniform3f( u_lights[i].color, 1,1,1 );
            }

            // Set up lights here; they won't be changed.  Lights are fixed in eye coordinates.
```

```
            gl.uniform1i( u_lights[0].enabled, 1 );   // light is a "viewpoint light"
            gl.uniform4f( u_lights[0].position, 0,0,0,1 ); // positional, at viewpoint
            gl.uniform3f( u_lights[0].color, 0.6, 0.6, 0.6 );

            gl.uniform1i( u_lights[1].enabled, 1 );  // light 1 is a dimmer light shining from
above
            gl.uniform4f( u_lights[0].position, 0,1,0,0 ); // diretionsl, from directino of
positive y-axis
            gl.uniform3f( u_lights[0].color, 0.4, 0.4, 0.4 );

            gl.uniform1i( u_lights[2].enabled, 0 );  // lightes 2 and 3 are not used.


        }
        function mouseDown(evt) {
            var prevX, prevY;
            prevX = evt.clientX;
            prevY = evt.clientY;
            canvas.addEventListener("mousemove",mouseMove);
            document.addEventListener("mouseup",mouseUp);
            function mouseMove(evt) {
                var dx = evt.clientX - prevX;
                var dy = evt.clientY - prevY;
                rotateX += dy/200;
                rotateY += dx/200;
                prevX = evt.clientX;
                prevY = evt.clientY;
                draw();
            }
            function mouseUp(evt) {
                canvas.removeEventListener("mousemove",mouseMove);
                document.removeEventListener("mouseup",mouseUp);
            }
        }
        var animating = false;

        function frame() {
            if (animating) {
                rotateEachFrame=rotateEachFrame+Math.PI*0.01;
                frameNumber += 1;
                draw();

                requestAnimationFrame(frame);
            }
        }

        function setIsAnimating() {
            var run = document.getElementById("animCheck").checked;
            if (run !== animating) {
                animating = run;
                if (animating)
                    requestAnimationFrame(frame);
            }
        }
        function init() {
            try {
                canvas = document.getElementById("webglcanvas");
                gl = canvas.getContext("webgl");
                if ( ! gl ) {
                    throw "Browser does not support WebGL";
                }
            }
            catch (e) {
                document.getElementById("message").innerHTML =
                    "<p>Sorry, could not get a WebGL graphics context.</p>";
                return;
            }
            try {
                initGL();  // initialize the WebGL graphics context
            }
```

```
            catch (e) {
                document.getElementById("message").innerHTML =
                    "<p>Sorry, could not initialize the WebGL graphics context:" + e + "</p>";
                return;
            }
            document.getElementById("animCheck").checked = false;
            document.getElementById("animCheck").addEventListener("change", setIsAnimating);
            document.getElementById("reset").addEventListener("click", function() {
rotateEachFrame = 0; rotateX = rotateY = 0; draw(); });
            canvas.addEventListener("mousedown", mouseDown);

            cone = createModel(uvCone());
            cylinder = createModel(uvCylinder());
            cube = createModel(cube());
            teapot = createModel(teapotModel);
            draw();
        }

    </script>
</head>
<body onload="init()">

<h2>DiskWorld 2: WebGL Lighting and Hierarchical Modeling</h2>


<noscript><hr><h3>This page requires Javascript and a web browser that supports
WebGL</h3><hr></noscript>

<p id="message" style="font-weight:bold">Drag your mouse on the model to rotate it.</p>

<p>
    <label><input type="checkbox" id="animCheck">Animate</label>
    <button id="reset" style="margin-left:40px">Reset</button>
</p>


<div>

    <canvas width=800 height=800 id="webglcanvas" style="background-color:blue"></canvas>

</div>
</body>
</html>
```

Wynik końcowy:



3. Wyniki i wnioski:

Na podstawie otrzymanych wyników i wykonanej pracy byłem wstanie zrozumieć podstawy WEBGL3d i zobaczyć, jak tworzyć animacje z wykorzystaniem 3d.