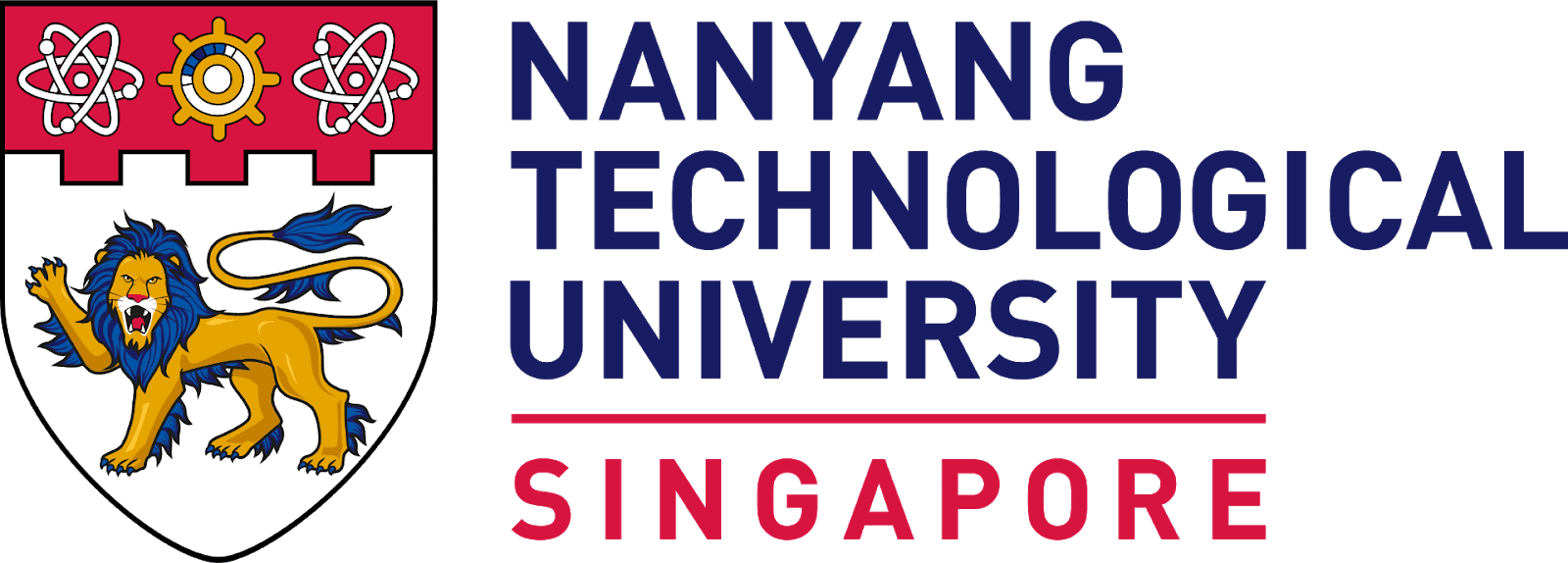
Nanyang Technological University

School of Computer Science and Engineering



Laboratory Report

CZ2003

Computer Graphics and Visualization

Lab 4

Implicit Solids

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# 1 Introduction

|  |  |
| --- | --- |
|  | A close up of a device  Description automatically generated |
| Figure 1 – Front View | Figure 2 – Back View |

A shape comprising of implicit solids, inspired by the “Nintendo Switch Joy-Con”, is created for the compulsory portion of this lab. Figure 1 illustrates the front/side view of the shape while Figure 2 illustrates the back view.

|  |  |
| --- | --- |
|  |  |
| Figure 3 – Screen Shape | Figure 4 – Right Joy-Con Shape |

A screen shot of a computer

Description automatically generated

Figure 5 – Nintendo Switch comprising of multiple transforms/shapes

Two additional shapes are also included as part of the optional portion of this lab, namely the “Screen” (Figure 3) and the “Right Joy-Con” (Figure 4). The shapes are wrapped in a Transform object such that the shapes may be translated along the X-axis. The “Left Joy-Con” (Figure 1) is translated to X = -1.4 while the “Right Joy-Con” (Figure 4) is translated to X = 1.4 to form the Nintendo Switch (Figure 5).

The individual, compulsory shape is defined in “Lab4\_Joycon\_Only.wrl” while the Nintendo Switch is defined in “Lab4.wrl”.

Note 1: When running “Lab4.wrl”, the screen is rendered first before the two joy-cons due to the simplicity of the shape. The two joy-cons will render after about 3 seconds. The individual shape renders after about 3 seconds as well, which fulfils the requirement of rendering below 5 seconds.

# 2 Left Joy-Con Shape Creation

This section briefly describes how individual geometries are created to form the left joy-con. Formulas for individual geometries have been omitted due to space constraints. Instead, a variable defined in the VRML files is provided as reference for each geometry. Reproduction of the geometries may be achieved by inserting a “return [variable\_name]” call right after the variable declaration or assignment in the VRML file.

The left joy-con is defined with a resolution of 100 each and with a bounding box size of 0.6, 1.45, 0.6. The left joy-con is individually defined in “Lab4\_Joycon\_Only.wrl”.

## 2A Diffused Colour

The material of the joy-con is defined using a FMaterial with the following formula:

* r = (u+1.25)/5
* g = (v+2.5)/5
* b = (w+2.5)/5

This gives the joy-con a colour gradient of teal (top) to blue (bottom).

## 2A Joy-Con Base

A picture containing remote, control, sitting, game

Description automatically generated

Figure 6 – Rounded edges circled in red

Two rounded-edge shapes are created for the joy-con, one for the top and one for the bottom of the joy-con (Figure 6). The edges are made with using a plane half-space, ellipsoid, and two plane surfaces.

|  |  |
| --- | --- |
| A picture containing table, drawing  Description automatically generated | Figure A:  A plane half-space is first defined.  Variable: edgeSurface |
| A picture containing drawing, ball  Description automatically generated | Figure B:  An ellipsoid is then defined.  Variable: edgeEllipsoid |
| A picture containing drawing, light  Description automatically generated | Figure C:  The intersection of Figure A and B is obtained.  Variable: edge1 & edge2 |
| A picture containing refrigerator, computer, street  Description automatically generated | Figure D:  A surface, the base of the joy-con, is defined.  Variable: surface |
| A picture containing refrigerator, computer, table  Description automatically generated | Figure E:  A cut version of the base is defined through the union of two shapes:   * Variable: surface1 * Variable: surface2 * max(surface1, surface2) [defined in mainSurface1 variable assignment] |
| A close up of a device  Description automatically generated | Figure F:  The final joy-con base is obtained through the intersection of 2 x Figure C (at different X and Y position) and Figure D each, union with Figure E:  Variable: mainSurface1 |

## 2B Circle Pad Base

A picture containing remote, control, sitting, game

Description automatically generated

Figure 7 – Circle pad base circled in red

An indent is made in the joy-con as the base of the circle pad (Figure 7). The indent is made using a cylinder + plane surface and subtracting the intersection from the joy-con base.

|  |  |
| --- | --- |
| A close up of a logo  Description automatically generated | Figure A:  A surface is defined.  Variable: indentSurface |
| A close up of a logo  Description automatically generated | Figure B:  A cylinder is defined.  Variable: indentCylinder |
| A close up of a logo  Description automatically generated | Figure C:  The intersection of Figure A and B is obtained:  Variable: indent |
| A close up of a device  Description automatically generated | Figure D:  Figure C is subtracted from the joy-con base from the previous section:  Variable: mainSurface |

## 2C Circle Pad

A picture containing remote, control, sitting, game

Description automatically generated

Figure 8 – Circle pad circled in red

The circle pad (Figure 8) is then created by attaching a cone and ellipsoid + surface onto the circle pad base.

|  |  |
| --- | --- |
| A close up of a device  Description automatically generated | Figure A:  An ellipsoid surface is defined using an ellipsoid and a plane surface:  Variable: circlePadSurface |
| A close up of a logo  Description automatically generated | Figure B:  A cone is defined.  Variable: circlePadCone |
|  | Figure C:;  A union of Figures A and B is obtained.  Variable: circlePad |

## 2D Round Buttons

|  |  |
| --- | --- |
|  | A close up of a device  Description automatically generated |
| Figures 9 and 10 – Round buttons circled in red | |

The round buttons are created using a similar method as the Circle Pad Base (section 2B), the only difference being the shape is unionised with the joy-cone base instead of subtracting it.

|  |  |
| --- | --- |
| A picture containing box  Description automatically generated | Figure A:  A surface is defined.  Variable: dPadSurface / buttonSurface |
|  | Figure B:  A cylinder is defined.  Variable: dPadCylinder / buttonCylinder |
| A picture containing light  Description automatically generated | Figure C:  The intersection of Figures A and B is obtained.  Variable: dPad[Up/Down/Left/Right] / unlockButton |

2E Miscellaneous Buttons

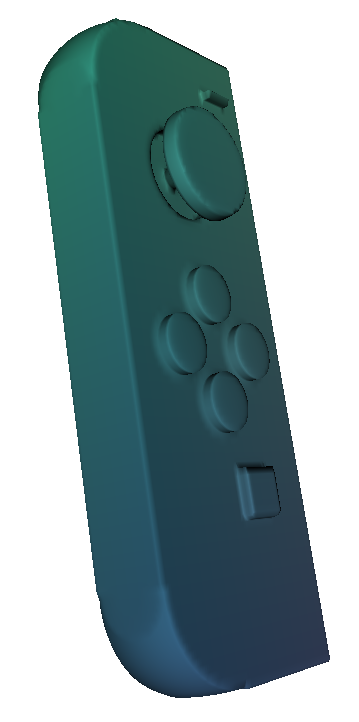


Figure 11 – Miscellaneous buttons circled in red

|  |  |
| --- | --- |
| A picture containing table  Description automatically generated | The bottom button is defined using a cube.  Variable: circleButton |
| A picture containing knife  Description automatically generated | The top button is defined using a surface.  Variable: minusButton |

## 2F Back Button

A close up of a device

Description automatically generated

Figure 12 – Back button circled in red

The back button is obtained similarly to how the rounded edges are obtained in section 2A, through the intersection of a surface and an ellipsoid.

|  |  |
| --- | --- |
| A picture containing box  Description automatically generated | Figure A:  A surface is defined.  Variable: backSurface |
| A picture containing bowl, drawing  Description automatically generated | Figure B:  An ellipsoid is defined, bounded by the bounding box (big Y position).  Variable: backEllipsoid |
| A picture containing stool  Description automatically generated | Figure C:  An intersection of Figures A and B is obtained, with Figure B defined with a different Z axis value.  Variable: backButton |

## 2G Top Button

A close up of a device

Description automatically generated

Figure 13 – Top button circled in red

The top button is obtained using the same method as the Back Button (section 2F).

|  |  |
| --- | --- |
|  | Figure A:  A surface is defined (smaller Z axis values compared to the Back Button).  Variable: topSurface |
|  | Figure B:  An ellipsoid is defined.  Variable: topEllipsoid |
|  | Figure C:  An intersection of Figures A and B is obtained.  Variable: topButton |

## 2H Unionising Individual Shapes

The individual shapes defined from section 2B to 2G are unionised to form the joy-con. The corresponding variable in the VRML file is “controller”, which is a series of nested max functions.

# 3 Right Joy-Con

The right joy-con is defined by mirroring the X axis values of the left joy-con. The material of the joy-con is defined using a FMaterial with the following formula:

* r = (u+4)/5
* g = (v+2)/5
* b = (w+2)/5

This gives the joy-con a colour gradient of orange (top) to red (bottom).

The right joy-con is defined with a resolution of 100 each and with a bounding box size of 0.6, 1.45, 0.6.

# 4 Screen

The screen is defined using a large surface with numerous indents and buttons using additional surfaces.

The colour of the screen is defined using an if-else clause in the FMaterial declaration of the shape as it is not bounded by the lab requirements:

if (z < 0.07) {

r = 0.2;

g = 0.2;

b = 0.2;

} else {

if ((abs(x) >= 1.07 || y >= 0.61 || y <= -0.66)) {

r = 0.2;

g = 0.2;

b = 0.2;

} else if ((abs(x) >= 0.92 || (y >= 0.53 || y <= -0.58))) {

r = 0.1;

g = 0.1;

b = 0.1;

} else {

r = 0.5;

g = 0.5;

b = 0.5;

}

}

A picture containing computer

Description automatically generated

A close up of a weapon

Description automatically generatedA close up of a gun

Description automatically generated

Figures 14, 15 and 16 – Indents circled in red and buttons circled in yellow

The screen comprises several indents to represent the charging port, air-vents, speakers, and ear-jack port, and several buttons representing the power button and volume buttons.

These indents and buttons are created using additional simple surfaces and performing subtraction and union respectively on the screen shape.

# 5 Conclusion

A Nintendo Switch has been created in VRML using three different shapes for this lab. The left joy-con of the switch is made in accordance with the lab requirements as the compulsory part of the lab. The screen and right joy-con is defined separately as optional parts without conforming to the lab requirements. The three shapes are created using intersection and union functions on various geometries defined implicitly, with each shape wrapped in a Transform object to define translations along the X axis to form the Switch object as a whole.