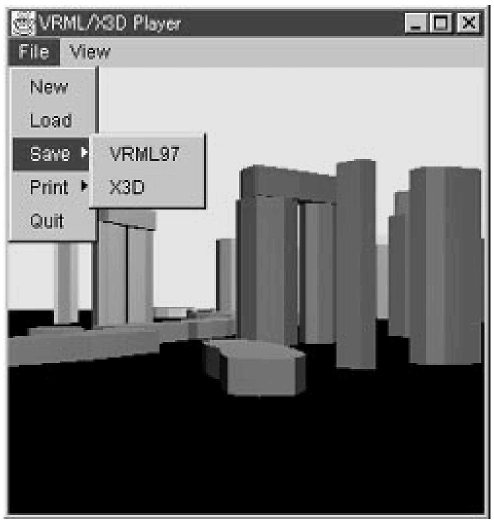

CyberX3D for Java

User's Guide

Document Revision History

Modified	Description
Oct 19, 2003	The first release.

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Introduction

CyberX3D for Java is a development package for VRML97/2.0 and Java3D programmers. Using the package, you can easily read and write the VRML files, set and get the scene graph information, draw the geometries, run the behaviors easily.

Setup

System Requirements

To use the CyberX3D, you have to install the following packages. If you want to use only the parser functions, you don't have to install Java3D pakcage.

Package	URL
Java 2 Platform, Standard Edition (J2SE)	http://java.sun.com/j2se/
Java3D	http://java.sun.com/products/java-media/3D/

Installation

To use the package, copy the package into your JDK and JRE library directory. For example,

```
copy cx3dr???.jar C:¥jdk1.x¥jre¥lib¥ext¥
copy cx3dr???.jar C:¥Program Files¥JavaSoft¥JRE¥1.x¥lib¥ext¥
```

Otherwise add the package into your CLASSPATH environmental variable. For example,

```
set CLASSPATH=.¥;c:¥src¥java¥cx3dr???.jar
```

Scene Graph

In the CyberX3D, the scene graph is correction and hierarchical arrangement of VRML nodes.

There are two ways to build a scene graph dynamically, you can load it from a VRML file, or you can create new VRML node and add the node into the scene graph.

Loading Scene Graph

Use SceneGraph::load() to load a scene graph from a VRML file. The load() clears all VRML nodes in the current scene graph.

```
SceneGraph sg = new SceneGraph();
sg.load("world.wrl");
```

If your scene graph has some VRML nodes and you want to add a new scene graph from a VRML file into the current scene graph, use SceneGraph::add().

```
SceneGraph sg = new SceneGraph();
        ..........
sg.add("world.wrl");
```

If your scene graph has some VRML nodes and you want to add a new scene graph from a VRML file into the current scene graph, use SceneGraph::add().

```
SceneGraph *sceneGraph = new SceneGraph();
        ..........
sceneGraph->add("world.wrl");
```

If ScneGraph::load() or SceneGraph::add() can't read your VRML file normally, the methods return false. To know the error in more detail, use SceneGraph::getParserErrorMessage(). The following example shows the parser error when the loading is failed.

```
SceneGraph sg = new SceneGraph();
boolean result = sg.load("world.wrl");
if (result == false) {
   String errMsg = sg.getParserErrorMessage();
   System.out.println(errMsg);
}
```

The CyberX3D supports PROTO defines of VRML97 using the preprocessor, but the preprocessor is inactive by default. If you want to use the preprocessor, use SceneGraph::setOption() with USE_PREPROCESSOR before loading. For example,

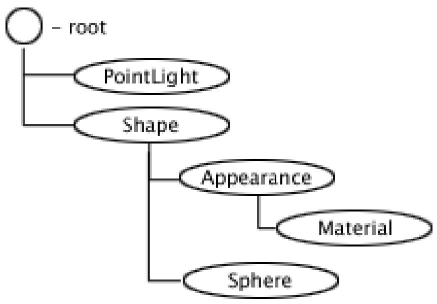
```
SceneGraph sg = new SceneGraph();
sg.setOption(SceneGraph.USE_PREPROCESSOR);
sg.load("world.wrl");
```

Building Scene Graph

The CyberX3D has all C++ classes of VRML nodes, you can add and remove the all nodes dynamically. Use SceneGraph::addNode() to add a new node as a root node of the scene graph. Use Node::addChildNode() to add a new node as a child node of the other node.

The following example adds a PointLight and Shape node that has an appearance and a geometry node into an empty scene graph.

```
SceneGraph sg;
// Add a PointLight node
PointLightNode plight = new PointLightNode();
 // Add a Shape node as a root node
ShapeNode shape = new ShapeNode();
sg.addNode(shape);
// Add an Appearance node as a child node of the Shape node
Appearancenode app = new AppearanceNode();
shape.addChildNode(app);
// Add a Material node as a child node of the Appearance node
MaterialNode mat = new MaterialNode();
mat.setDiffuseColor(1.0f, 0.0f, 0.0f); // Red
app.addChildNode(mat);
// Add a Sphere node as a child node of the Shape node
SphereNode sphere = new SphereNode();
shape.addChildNode(sphere);
sphere.setRadius(10.0f);
```



Use Node::remove() to remove a node from the current scene graph. The following example uses Node::remove() to remove a PointLight node from a loaded scene graph.

```
SceneGraph sg;
sg.load("world.wrl");
// Remove first PointLight node
PointLightNode plight = sg.findPointLightNode();
if (plight != null)
    plight.remove();
```

Scene Graph Output

Use SceneGraph::save() to save a current scene graph into a VRML file.

```
sceneGraph.save("newworld.wrl");
```

Use SceneGraph::print() to output a current scene graph into a default console.

```
sceneGraph.print();
```

Scene Graph Traversal

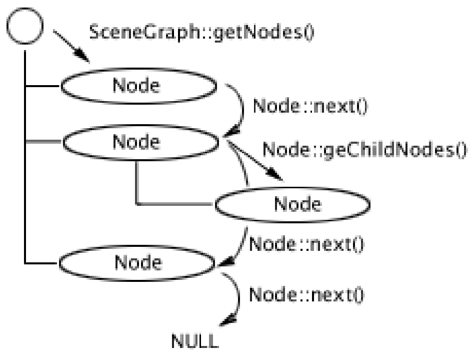
The scene graph has the VRML information as a collection of Node class instances. The Node class is a super class of all VRML node classes of CyberX3D. There are two ways to access the nodes.

The first way is to use SceneGraph::getNodes() with Node::next() and Node::getChildNodes(). For example, if you want to get all viewpoint nodes in a scene graph …..

```
void GetViewpointInfomation(Node node)
{
   if (node.isViewpointNode()) {
      ViewpointNode view = (Viewpoint)node;
      // Get a viewpoint information
      ..........
   }
   for (Node cnode=node.getChildNodes(); cnode; cnode=cnode.next())
      GetViewpointInfomation(cnode);
}

void main()
{
   ..........
   SceneGraph sg = new SceneGraph();
   sceneGraph.load("world.wrl");
   for (Node node=sg.getNodes(); node; node=node.next())
      GetViewpointInfomation(node);
   ..........
}
```

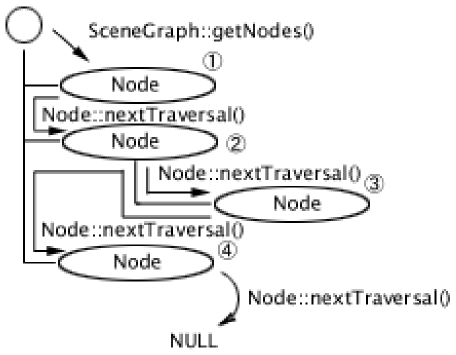
SceneGraph::getNodes() returns a first node that are added into the scene graph root. Node::next() returns a next node in the same hierarchy, Node::getChildNodes() returns a first child node that are added into the parent node. The methods returns null if the next node does not exist.



The other way is to use SceneGraph::getNodes()with Node::nextTraversal(). The way is handier than the first one. For example, if you want to get all viewpoint nodes in the scene graph .....

```
void main()
{
   ..........
   SceneGraph sg = new SceneGraph();
   sg.load("world.wrl");
   for (Node node=sg.getNodes(); node; node=node.nextTraversal())
      if (node.isViewpoint()) {
         ViewpointNode view = (ViewpointNode)node;
         // Get a viewpoint information
         ..........
      }
      }
      ..........
   }
```

Node::nextTraversal() is similar to Node::next(), but Node::nextTraversal tries to get a next node from the parent node when the next node does not exist. This Node::nextTraversal() is overridden in the sub classes, too.



If you want to get only same type nodes, use SceneGraph::find<nodetype>Node() instead of SceneGraph::getNodes() with Node:: nextTraversalSameType() that returns a next same class node. For example, if you want to get only all viewpoint nodes in the scene graph .....

```
      SceneGraph sg = new SceneGraph();
      sg.load("world.wrl");
      for (ViewpointNode view=sg.findViewpointNode(); view; view=(ViewpointNode)view.nextTraversalSameType())) {
         // Get a viewpoint information
         ..........
      }
```

Finding Node

Use SceneGraph::findNode() to find a named node by DEF keyword or Node::setName(). The following example loads a VRML file, “world.wrl”, and gets a node that is named as “MountFuji”.

```
   SceneGraph sg;
   sg.load(“world.wrl”)
   Node node = sg.findNode(“MountFuji”);
```

Use SceneGrahp::get<nodetype>Nodes() to get a specified first node from the root hierarchy. For example, you want to get a viewpoint that is a first viewpoint node in the scene graph root, use SceneGraph::getViewpointNodes();

```
   SceneGraph sg;
   sg.load(“world.wrl”)
   ViewpointNode defaultView = sg.getViewpointNodes();
```

Node

The CyberX3D node name is identical to the VRML node name. For example, you would use the BoxNode class if you want to use the Box node.

Creating Node

The node class has the default constructor only. Use the default constructor to create the new node, and set the field property. The following example creates a sphere and set the property.

```
SphereNode spNode = new SphereNode();
spNode.setRadius(10.0);
```

Node Type

If you want to know the node type, use Node::getType() or Node::is<nodetype>Node();

Node::getType() returns the node type as a string, Node::is<nodetype>Node() returns true when the node is the specified type. For example, you want to know whether a node is ViewpointNode.

```
SceneGraph sg = new SceneGraph();
sg.load("world.wrl");
for (Node node=sg.getNodes(); node; node=node.nextTraversal())
   String nodeType = node.getType();
   if (node.isViewpoint() || nodeType.equals(“Viewpoint") == 0)
      System.out.println(“This node is ViewpointNode !!”);
}
```

Node Name

If you load a VRML file that has some named nodes by DEF keyword, you can get the name using Node::getName(); Use Node::setName() to name a node.

```
SceneGraph sg;
sg.load(“world.wrl”)
ShapeNode mtNode = sg.getShapeNodes();
mtNode.setName(“MtFuji”);
```

The named nodes are output using DEF keyword when you save the scene graph.

```
#VRML V2.0 utf8
..........
DEF MtFuji Shape {
   ..........
}
..........
```

Accessing Fields

The node class has set<fieldname>() and get<fieldname>() to access to the VRML fields, and has getN<fieldname>s() if the field is multi field, MFString etc.. For example, the AnchorNode class has the following methods.

```
class AnchorNode {
        void     setDescription(String value);
        String   getDescription();
        void     addParameter(String value);
        int      getNParameters();
        String   getParameter(int index);
        void     addUrl(String value);
        int      getNUrls();
        String   getUrl(int index);
        void     setUrl(int index, String urlString);
};
```

The Node classes has only basic field access methods. Use get<fieldname>Field() to access the field in more detail. The method returns the field class itself. You can operate the field in more detail to the field class. The following example gets a color field of a Color Node in an IndexedFaceSet node, and changes all the colors to red.

```
IndexedFaceSetNode idxNode = ……
ColorNode colNode = idxNode.getColorNodes();
MFColor colField = colNode.getColorField();
int colCnt = colField.size();
for (int n=0; n<colCnt; n++)
   colField.set1Value(n, 0xff, 0x00, 0x00) // Red
```

Adding to Scene Graph

Use SceneGraph::addNode() to add the node as a root node of the scene graph. The following example creates a transform node add the node to the scene graph root.

```
SceneGraph sg;
TransformNode transNode = new TransformNode();
sg.addNode(transNode);
```

Adding Child Node

Use Node::addChildNode() to add the node as a child node of the other node. The following example creates a shape and a box, add the shape to the scene graph root, and add the box to the shape.

```
SceneGraph sg;
ShapeNode shapeNode = new ShapeNode();
BoxNode boxNode = new BoxNode();
sg.addNode(shapeNode);
shapeNode.addChileNode(boxNode);
```

Getting Child Node

There are two ways to get child nodes. The first way is to use Node::getNChildNodes() that returns a count of child nodes, and Node::getChileNode() that returns a selected child node. The following example shows the name and the type of all child nodes.

```
void PrintChildNodes(Node node)
{
   int childNodeCnt = node.getNChildNodes();
   for (int n=0; n<childNodeCnt; n++) {
      Node childNode = node.getChildNode(n);
      char nodeType = childNode.getType();
      char nodeName = childNode.getName();
      System.out.println("[" + n + "] = " + nodeType + ", " + nodeName);
   }
}
```

The other way is to use Node::getChildNodes() that returns a first child node with Node::next() returns a next child node in the same parent node. The Node::getChildNodes() and the Node::next() returns NULL if the node does not exist. The way is handier and faster than the first one. The following example shows the name and the type of all child nodes.

```
void PrintChildNodes(Node node)
{
   Node childNode = node.getChildNodes();
   while (childNode!= NULL) {
      String nodeType = childNode.getType();
      String nodeName = childNode.getName();
      System.out.println("[" + n + "] = " + nodeType + ", " + nodeName);
      childNode = childNode.next();
   }
}
```

Removing from SceneGraph or Parent Node.

Use Node::remove() to remove a node from the scene graph root or the parent node. The following example removes a point light from the scene graph.

```
SceneGraph sg;
   ..........
PointLightNode plight = sg.findPointLightNode();
if (plight != null)
    plight.remove();
```

Instance Node

You can create an instance of a node like USE keyword of VRML97. Use Node::createInstanceNode() to create the instance node.

```
SceneGraph sg;
ShapeNode shape = new ShapeNode();
shape.setName("BOX");
BoxNode box = new BoxNode();
box.setSize(10.0, 20.0, 30.0);
sg.addNode(shape);
shape.addChildNode(box);
Node shapeInstance = shape.createInstanceNode();
sg.addNode(shapeInstance);
```

The scene graph is output as the following when you save the scene graph.

```
DEF BOX Shape {
   geometry Box {
      size 10 20 30
   }
}
USE BOX
```

Field

The node has several fields and the field is a property or attribute of a node. The field is identical to the VRML field name. For example, you would use the SFBool class if you want to use the SFBool field.

Use get<fieldname>Field() to get the field. The following example gets a color field of a Color Node in an IndexedFaceSet node, and changes all the colors to red.

```
IndexedFaceSetNode idxNode = ……
ColorNode colNode = idxNode.getColorNodes();
MFColor colField = colNode.getColorField();
int colCnt = colField.size();
for (int n=0; n<colCnt; n++)
   colField.set1Value(n, 0xff, 0x00, 0x00) // Red
```

File Formats

The CyberX3D can import the following geometry file formats. Use SceneGraph::load() to import the geometry files. The CyberX3D converts from the imported information into VRML97 nodes add the nodes into the scene graph when the file format is not VRML2.0/97.

VRML2.0/97 (*.wrl)

The CyberX3D can import all information in a VRML2.0/97 file.

Autodesk 3DS (*.3ds)

The CyberX3D imports only the following information from a 3DS file, and ignore the other information.

Chunk ID	Description
0xA010	Material Ambient Color
0xA020	Material Diffuse Color
0xA030	Material Specular Color
0xA040	Material Shininess
0x4100	Triangle Set
0x4110	Triangle Point Set
0x4120	Triangle Fase Set

Autodesk DXF (*dxf)

The CyberX3D imports only the polylines and face3Ds information from a DXF file.

Wavefront OBJ (*.obj)

The CyberX3D imports only the following information from the specified OBJ file, and ignore the other information. The CyberX3D doesn't read the map files and the material files.

Chunk ID	Description
v	Vertex Position
vn	Vertex Normal
f	Face Index

SENSE8 NFF (*.nff)

The CyberX3D imports only the vertex positions and the polygon indices with the color from the specified NFF file, and ignore the other information.

STL (*stl)

The CyberX3D supports the ASCII format.

X3D (*x3d / *.xml)

The CyberX3D supports to only read and write the following draft X3D format files. but the geomety nodes aren't implemented the drawing using OpenGL and the behavior. The VRML97 nodes of X3D are supported all, and the other X3D and XML nodes are loades as XMLNode instances.

X3D

The CyberX3D supports to only read and write the following draft X3D format files.

Package	URL
X3D Specification (ISO/IEC 19775)	http://www.web3d.org/technicalinfo/specifications/ISO_IEC_19775/index.html

Supported Nodes

The following X3D nodes are supported, but the geomety nodes aren't implemented the drawing using OpenGL and the behavior. The VRML97 nodes of X3D are supported all, and the other X3D and XML nodes are loades as XMLNode instances.

	Section	URL
9	Networking component	LoadSensorNode
10	Grouping component	StaticGroupNode
11	Rendering component	ColorRGBANode
		TriangleSetNode
		TriangleFanSetNode
		TriangleStripSetNode
12	Shape component	FillPropertiesNode
		LinePropertiesNode
14	Geometry2D component	Arc2DNode
		ArcClose2DNode
		Circle2DNode
		Disk2DNode
		Polyline2DNode
		Polypoint2DNode
		Rectangle2DNode
		TriangleSet2DNode
18	Texturing component	MultiTextureNode
		MultiTextureCoordinateNode
		MultiTextureTransformNode
		TextureCoordinateGeneratorNode
19	Interpolation component	CoordinateInterpolator2DNode
		PositionInterpolator2DNode
21	Key device sensor component	KeySensorNode
		StringSensorNode
30	Event Utilities component	BooleanFilterNode
		BooleanToggleNode
		BooleanTriggerNode
		BooleanSequencerNode
		IntegerTriggerNode
		IntegerSequencerNode
		TimeTriggerNode
	Route	RouteNode

Loading Scene Graph

Use SceneGraph::load() to load a scene graph from a X3D file along with a VRML97 file. The file format is recognized automatically.

```
SceneGraph *sceneGraph = new SceneGraph();
sceneGraph->load("world.xml");
```

Scene Graph Output

Use SceneGraph::saveXML() to save a current scene graph into a X3D file.

```
  sceneGraph->saveXML("newworld.wrl");
```

Use SceneGraph::printXML() to output a current scene graph into a default console as X3D format.

sceneGraph->printXML();

Rendering / Behavior

The CyberX3D can draw shape nodes with the behaviors automatically with Java3D. Using the feature, you can create your original VRML browser with Java3D easily. To use the feature, you have to create an instance of vrml.j3d.SceneGraphJ3dObject class with a target Canvas3D, and set the instance to the scene graph. For example,

```
public class ViewerJ3D extends Frame implements Constants {
   private Scene Graph sg;
   private SceneGraphJ3dObject sgObject;
   public ViewerJ3D(){
      super("VRML Simple Viewer");
         ...................
      sg = new SceneGraph(SceneGraph.NORMAL_GENERATION);
      setLayout(new BorderLayout());
      Canvas3D c = new Canvas3D(null);
      add("Center", c);
      sgObject = new SceneGraphJ3dObject(c, sg);
      sg.setObject(sgObject);
         ...................
      setSize(400,400);
      show();
    }
    ...................
}
```

The CyberX3D supports the following nodes in the current release.

Anchor (*1)	Fog	PositionInterpolator
Appearance	Group	ProximitySensor
Background (*2)	ImageTexture	ScalarInterpolator
Billboard	IndexedFaceSet	Script
Box	IndexedLineSet	Shape
Collision (*3)	Inline	Sphere
Color	LOD	SpotLight
ColorInterpolator	Material	Switch
Cone	Normal	Text
Coordinate	NormalInterpolator	TextureCoordinate
CoordinateInterpolator	OrientationInterpolator	TextureTransform
Cylinder	PixelTexture	TimeSensor
DirectionalLight	PointLight	Transform
ElevationGrid	PointSet	Viewpoint
Extrusion		

*1) Not support the URL field jump, *2) Support only the first skyColor, *3) Not support the collision detecting.

There are two ways to execute the behaviors. If you want to execute the behaviors as background tasks (threads), you should use SceneGraph::startSimulation() and SceneGraph::stopSimulation(). Otherwise, If you want to execute the behaviors when you want, you should use SceneGraph::update(). The SceneGraph::update() executes the behaviors at once. The following example executes execute the behavior as the background tasks.

```
Scene Graph sg = new Scene Graph();
sg.load("world.wrl");
sg.startSimulation();
```

File Loader

The CyberX3D supplies some file loader classes for Java3D to load the following file format. The loader classes implements "com.sun.j3d.loaders".

File Format	Loader Class (cv97.j3d.loader)
VRML2.0/97 (*.wrl)	VRML97Loader.
Autodesk 3DS (*.3ds)	A3DSLoader
Autodesk DXF (*dxf)	DXFLoader
Wavefront OBJ (*.obj)	OBJLoader
SENSE8 NFF (*.nff)	NFFLoader
STL (*.stl)	STLLoader

The following example loads an OBJ file using the OBJLoader class, and gets the scene group.

```
import cv97.j3d.loader.*;
  ....................
OBJLoader objLoader = new OBJLoader();
Scene s = objLoader.load(filename);
SceneGroup sgGroup = scene.getSceneGroup();
```

The constructors have no parameter, but you can set a parameter of Canvas3D to the constructor of the VRML97Loader if you want to load images files of ImageTextureNode.

```
Canvas3D c3d = ……
VRML97Loader wrlLoader = new VRML97Loader(c3d);
Scene s = wrlLoader.load(filename);
```

The VRML97Loader in the current release converts the following VRML97 nodes into Java3D nodes.

Anchor (Group)
Appearance (Appearance)
Billboard (TransformGroup)
Box (QuadArray)
Collision (Group)
Color
Cone (TriangleArray)
Coordinate
Cylinder (TriangleArray)
DirectionalLight (DirectionalLight)
ElevationGrid (IndexedTriangleArray)
Extrusion (IndexedTriangleArray)
Fog (ExponentialFog or LinerFog)
Group (Group)
ImageTexture (Texture2D)
IndexedFaceSet (IndexedTriangleArray)
IndexedLineSet (IndexedLineArray)
Inline
LOD (Switch)
Material (Material)
Normal
PixelTexture (Texture2D)
PointLight (PointLight)
PointSet (IndexedPointArray)
Shape (Shape3D)
Sphere (TriangleArray)
SpotLight (SpotLight)
Switch (Switch)
Text (Text3D)
TextureCoordinate
TextureTransform (TextureAttributes)
Transform (Transform)

File Saver

The CyberX3D can export a scene graph of Java3D to a VRML97 file using the VRMLSaver class. The following example exports a BranchGroup of Java3D into a VRML97 file.

```
import cv97.j3d.*;
   ....................
BranchGroup j3dBranchGroup = .......
VRML97Saver saver = new VRML97Saver();
saver.setBranchGroup(j3dBranchGroup);
saver.save("j3dworld.wrl");
```

The VRML97Saver in the current release exports the following Java3D nodes into the VRML97 nodes.

AmbientLight (PointLight)	PointLight (PointLight)
Appearance (Appearance)	PointArray (PointSet)
Background (Background)	Shape3D (Shape)
Billboard (Billboard)	SpotLight (SpotLight)
BranchGroup (Group)	Switch (Switch)
DirectionalLight (DirectionalLight)	Text3D (Text)
ExponentialFog (Fog)	Texture2D (PixelTexture)
Group (Group)	TransformGroup (Transform) (*1)
IndexedTriangleArray (IndexedFaceSet)	TriangleArray (IndexedFaceSet)
IndexedQuadArray (IndexedFaceSet)	TriangleFanArray (IndexedFaceSet)
LineArray (IndexedLiseSet)	TriangleStripArray (IndexedFaceSet)
LineStripArray (IndexedLiseSet)	QuadArray (IndexedFaceSet)
LinearFog (Fog)	View (Viewpoint)
Material (Material)	

*1) Not support all matrix information

Transitioning From CyberVRML97 To CyberX3D

Package

CyberX3D changes the pakcage name from "cv97.*" to "org.cybergarage.x3d.*". Your program should have the following include statement instead of "cv97.*".

```
import org.cybergarage.x3d.*;
```

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