# A GPS Interface for 3D Worlds Updates

Web3D Standards Meeting

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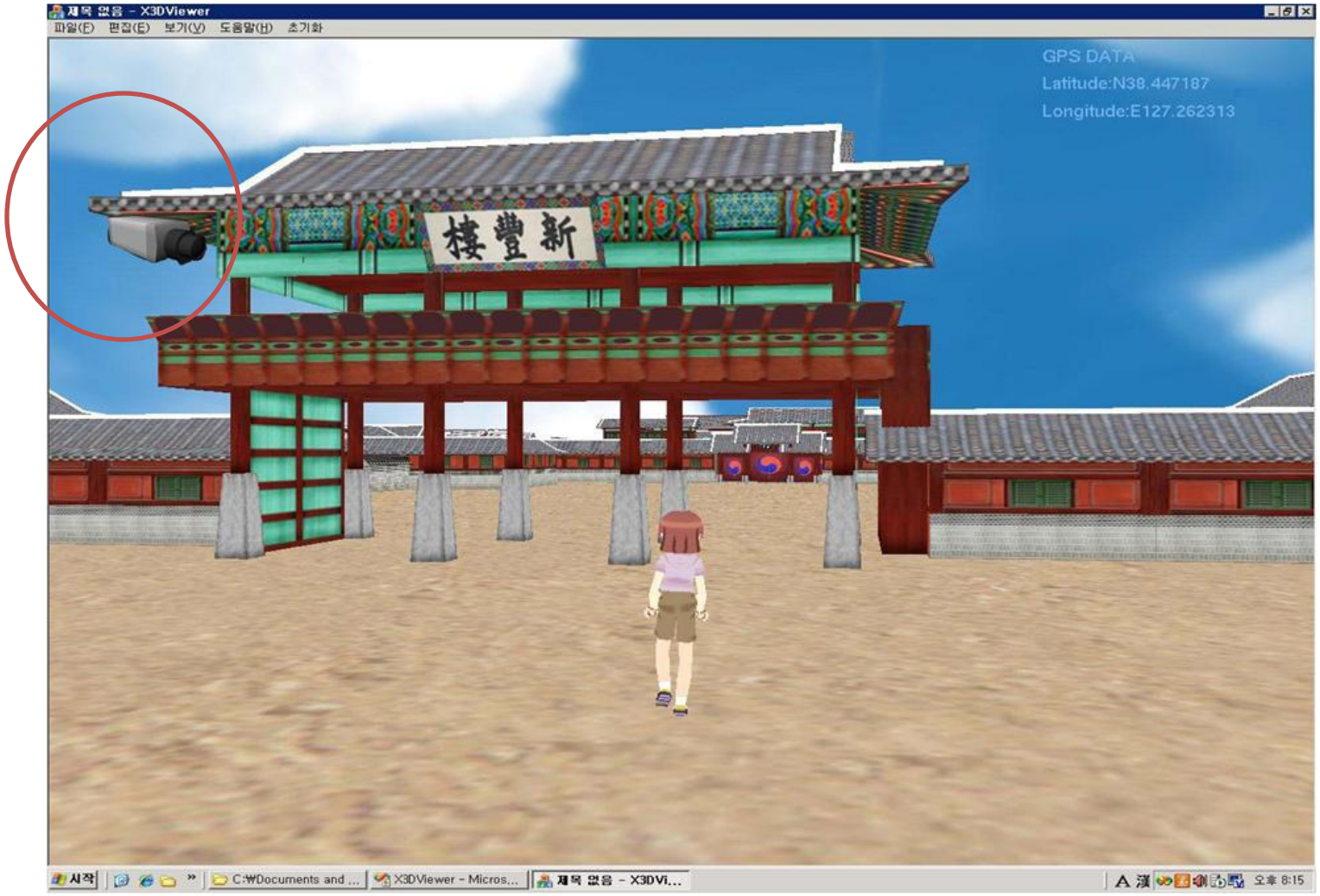
Myeong Won Lee
The University of Suwon

# 3D Scene + GPS


Hwaseong Fortress – UNESCO list of World Heritage

# Real Scene: Hwaseong Fortress

# 3D Scene and Movable Facilities (1)



# 3D Scene and Movable Facilities (2)

# GPS Data Definition

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<!--VrmlMerge ver. 0.5, Copyright (c) Michal Drapiewski <mdk@gazeta.pl> (c) 2005-->
<!--<!DOCTYPE X3D SYSTEM "x3d-3.0.dtd">-->
<X3D profile="Immersive" version="3.0">
    <Scene>
<GPS-Node available="true" latitude="38.436234" longitude="127.260313" speed="0" trakAngle="0.0" checkSum = "0"/>
        <Transform DEF="ID3584967_0" translation="0.0 0.0 0.0">
            <Shape>
                <Appearance>
                    <Material ambientIntensity="1.0" diffuseColor="0.5882 0.5882 0.5882" shininess="0.145" specular0
                    <ImageTexture url="cctv.bmp"/>
```

# GPS Info in Mesh data

```
class MeshData
{
public:
	MeshData()
	{
		Latitude = Longitude = 0;
		Translate.x=Translate.y=Translate.z = 0;
		Scale.x = Scale.y = Scale.z = 1;
		Rotate.x = 0; Rotate.y = 1; Rotate.z = 0;
		RotateValue = 0;
		ScaleOrientation.x = 0; ScaleOrientation.y = 1;
		ScaleOrientation.z =
	0;
		SOValue = 0;
	}
	~MeshData()
	{
		delete []Vertices;
		delete []ChangedVertices;
		delete []Indices;
		delete []TexCoord;
	}
	MeshData* prev;
	MeshData* next;

	BBox bbox;
```

```
		GLfloat *Vertices;
		GLfloat *ChangedVertices;
		GLubyte *Indices;
		GLfloat *TexCoord;
		GLfloat *Normal;
		GLuint Tex;

		GLuint count;

		GLfloat Latitude;
		GLfloat Longitude;

		Vector Translate;
		Vector Scale;
		Vector Rotate;
		GLfloat RotateValue;
		Vector ScaleOrientation;
		GLfloat SOValue;

		CString texFileName;
};
```

# X3D Parser for GPS Nodes (1)

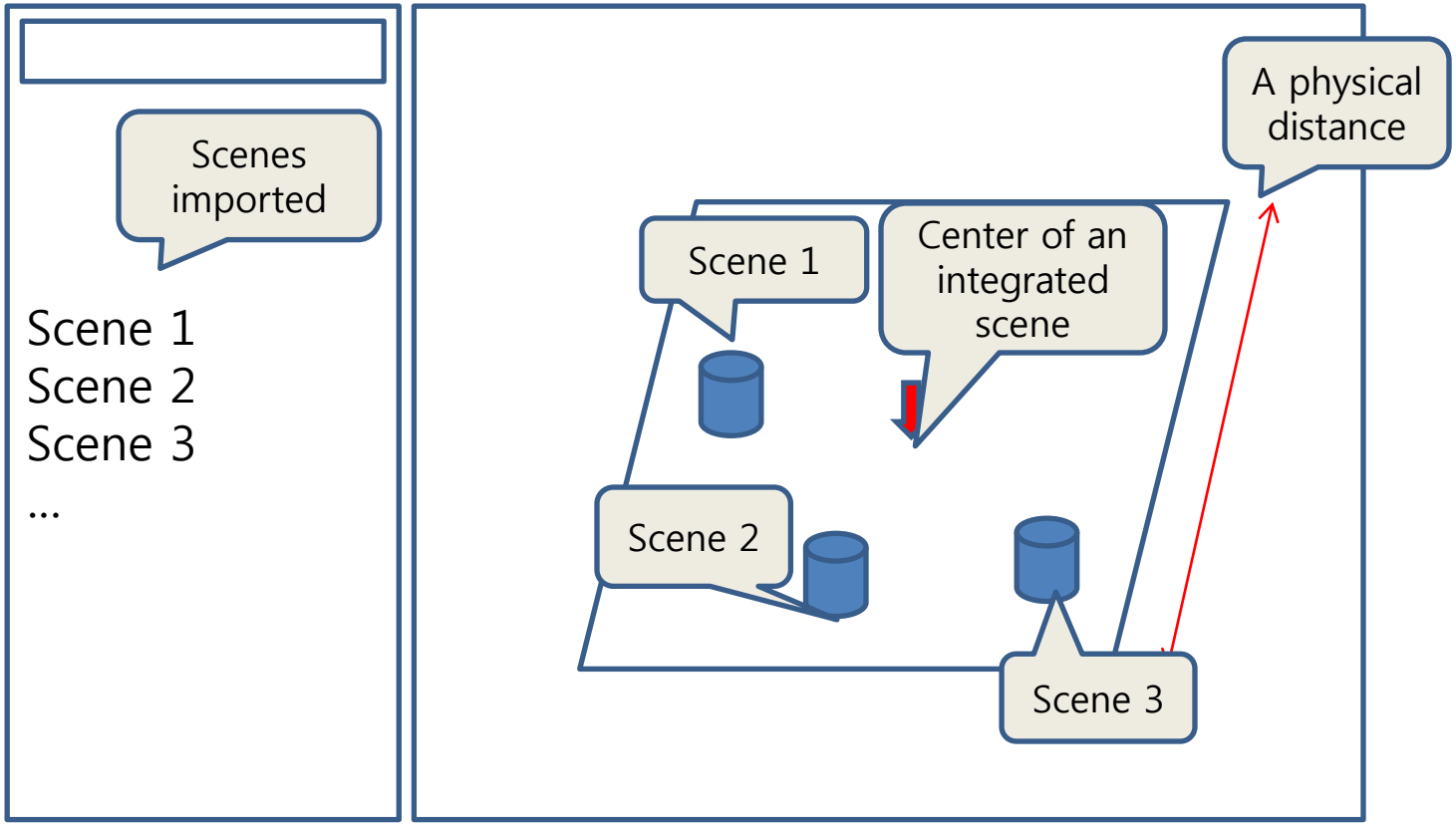
```
Node* XMLParser::CreateObject(int element)
{
	Node *node;
	X3DChildNode *X3DChild;
	switch(element)
	{
	case X3DID_X3D:
		node = new X3DNode();
		node->setID(X3DID_X3D);
		break;

	case X3DID_SCENE:
		node = new Scene();
		node->setID(X3DID_SCENE);
		break;
	case VMLID_GPS_NODE:
		X3DChild = new GPSNode();
		node = X3DChild;
		node->setID(VMLID_GPS_NODE);
		break;

	case VMLID_Transform:
		X3DChild = new Transform();
		node = X3DChild;
		node->setID(VMLID_Transform);
		break;
```

```
case VMLID_Shape:
		X3DChild = new
Shape();
		node = X3DChild;



		node-
>setID(VMLID_Shape);
		break;

	case VMLID_Appearance:
		node = new
Appearance();
		node-
>setID(VMLID_Appearance);
		break;

	case VMLID_Material:
		node = new Material();
		node-
>setID(VMLID_Material);
		break;
```

# X3D Parser for GPS Nodes (2)

```
            case VMLID_Box:
                        node = new Box();
                        node->setID(VMLID_Box);
                        break;
              case VMLID_ImageTexture:
                        node = new ImageTexture();
                        node->setID(VMLID_ImageTexture);
                        break;

            case VMLID_IndexedFaceSet:
                        node = new IndexedFaceSet();
                        node->setID(VMLID_IndexedFaceSet);
                        break;

            case VMLID_Coordinate:
                        node = new Coordinate();
                        node->setID(VMLID_Coordinate);
                        break;

            case VMLID_TextureCoordinate:
                        node = new TextureCoordinate();
                        node->setID(VMLID_TextureCoordinate);
                        break;

            }

            return node;
}
```

# GPS VR Editor



# X3D Geospatial Component

- GeoCoordinate
- GeoElevationGrid
- GeoLocation
- GeoLOD
- GeoMetadata
- GeoOrigin
- GeoPositionInterpolator
- GeoProximitySensor
- GeoTouchSensor
- GeoTransform
- GeoViewpoint

Problem:
-Not easy to locate a 3D sensor
-Only GPS Info is needed and enough
- Satellite image is not needed
- Only GPS synchronization is needed
- Real location and orientation for 3D sensors is needed

# NMEA Protocol

- The National Marine Electronics Association (NMEA)

```
$GPRMC,114455.532,A,3735.0079,N,12701.6446,E,0.000000,121.61,110706,,*0A
```

- 114455.532: Time (11 hour, 44 minute, 55.532 second)
- Five characters: talker(two characters) and the type of message (three characters)
- 114455.532: Arrival circle entered
- A: Reliability of GPS signal (A = yes, V = no)
- 3735.0079: Latitude
- N: North (South)
- 12701.6446: Longitude
- E: East (West)
- 0.000000: Velocity (knots)
- 121.61: Progression angle (degree)
- 110706: Date
- *0A: Checksum

# GpsSensor Node (X3D Earth, Jan. 2012)

```
GpsSensor : X3DSensorNode {
  SFString  [in,out]   description      ""
  SFBool    [in,out]   enabled          TRUE
  SFBool    [out]      isActive
  SFNode    [in,out]   metadata         NULL       [X3DMetadataObject]
  MFString  []         geoSystem        ["GD","WE"] [see 25.2.3]

  SFVec3d   [out]      geoCoord_changed      (-∞,∞)
  MFString  [in,out]   url              []   [URI]
  SFString  [out]      data_changed     ""   NMEA format
  SFTime    [out]      timeStamp

  SFVec3d   [in,out]   geoCenter        0 0 0 (-∞,∞)
  SFVec3f   [out]      position_changed      (-∞,∞)
  SFBool    [in,out]   clampAltitude    FALSE
}
```

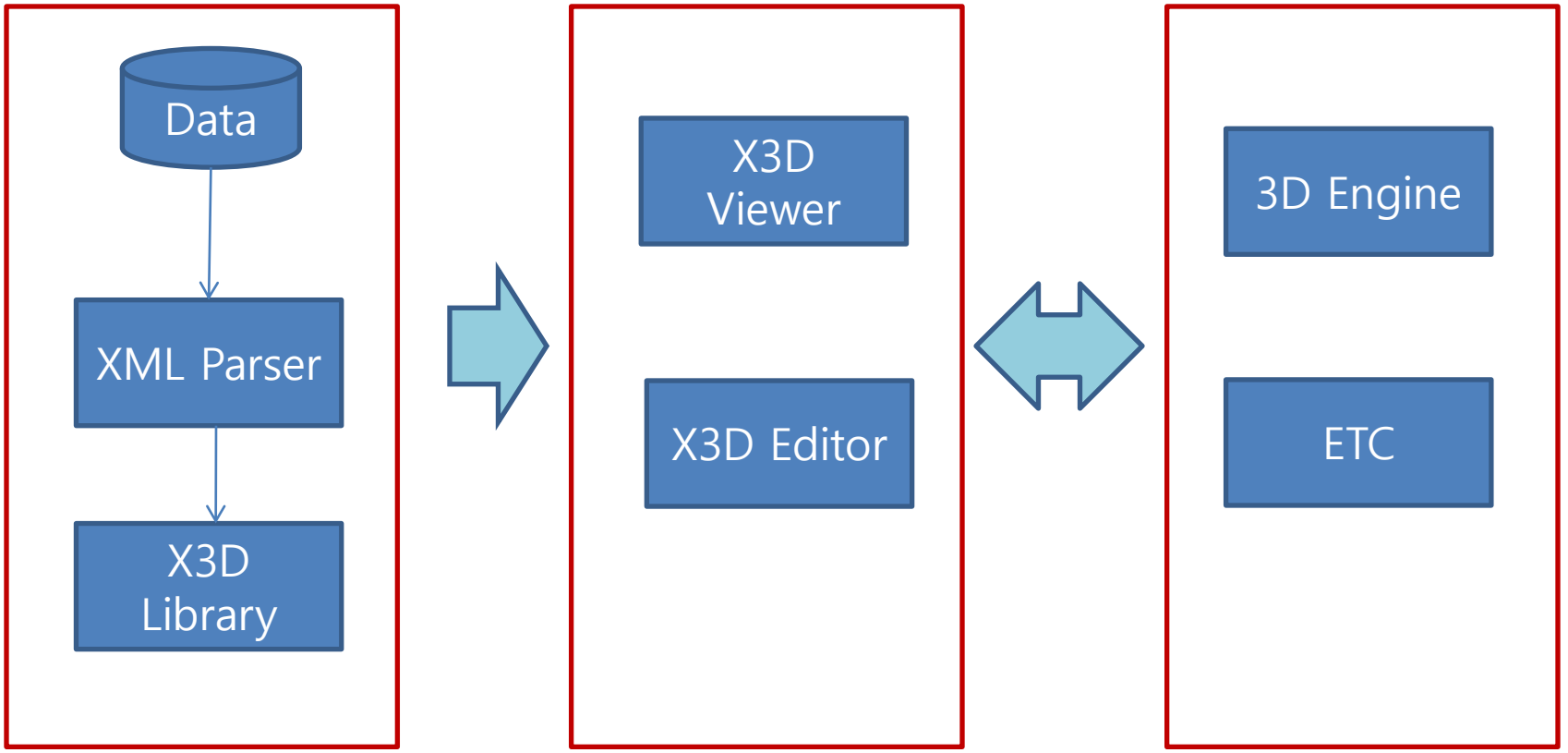
# GPS Node Definition

```
GpsSensor:PhysicalSensorNode {
    SFString      [out]      data_changed      " "   // NMEA 0183
    SFBool        [in, out]  enabled                     FALSE
    SFVec3f       [out]      position_changed
    SFRotation    [out]      orientation_changed
    SFFloat       [out]      latitude
    SFFlaot       [out]      longitude
    SFFloat       [out]      altitude
}
```

Position of a GPS Node in X3D :
- One GPS node per an X3D object

GPS Node :
- GPS info
- X3D object orientation info

# GPS 3D System Organization



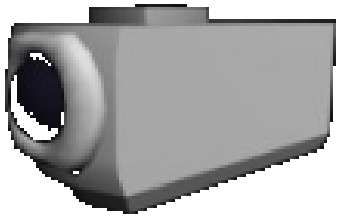

- X3D document parsing
- Generate X3D geometric data for 3D representation using X3D library

- Display X3D geometric data
- Edit GPS X3D

- Include all libraries for displaying X3D data
- Physical sensors interface
- UI library

# A GPS Node for a 3D Sensor or a 3D Scene

```
<X3D profile="Immersive" version="3.0">
   <Scene>
      <GPS-Node time = "0831" available = "true"  latitude = "38.445484" longitude =
"127.168188" speed = "0"
         trakAngle = "0.0" date = "20101208" checkSum = "0" />
      <Transform DEF="body" translation="201274 54.7559 -420296" scale="0.013904
0.013904 0.013904">
         <Shape>
            <Appearance>
               <Material ambientIntensity="1.0" diffuseColor="0.5882 0.5882 0.5882"
shininess="0.145" specularColor="0.0 0.0 0.0" transparency="0.0"/>
               <ImageTexture url="map.bmp"/>
            </Appearance>
```



# Position of a Movable Object

# Conclusions (1)

- A GPS node per a 3D scene
  - A 3D scene or a movable 3D object
- GPS node definition
  - GPS protocol input stream (NMEA), flag, GPS info (latitude, longitude, altitude), GPS center position, orientation of a scene or an object
- When obtaining GPS information
  - A 3D scene
    - Determined at modeling time by GPS synchronization between the 3D scene and the real world
  - A movable object in the 3D scene
    - Determined at modeling time or
    - Can be changed during navigation time

# Conclusions (2)

- Modeling and rendering 3D objects with GPS information
  - Graphics tools or modelers should provide with GPS information when modeling a 3D scene or an object
  - BIM and CAD systems should generate models with GPS information
  - Browsers should represent 3D objects in their GPS locations and orientations