A GPS Interface for 3D Worlds

Updates

Web3D Standards Meeting

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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
<?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" specularColor="0.5882 0.5882 0.5882"/>
            <ImageTexture url="cctv.bmp"/>
          </Appearance>
        </Shape>
      </Transform>
  </Scene>
</X3D>
```
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:
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;
    }
}
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;
Scene 1
Scene 2
Scene 3
...

Scenes imported

Center of an integrated scene

A physical distance
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
    SFFloat [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>
      </Shape>
    </Transform>
  </Scene>
</X3D>
Position of a Movable Object

FPS: 58.3
X: 201316.125000
Y: 50.500000
Z: -420293.562500

GPS DATA
Latitude: N38.473203
Longitude: E127.268937
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