
A GPS Interface for 3D Virtual Worlds

August 11, 2011

The University of Suwon

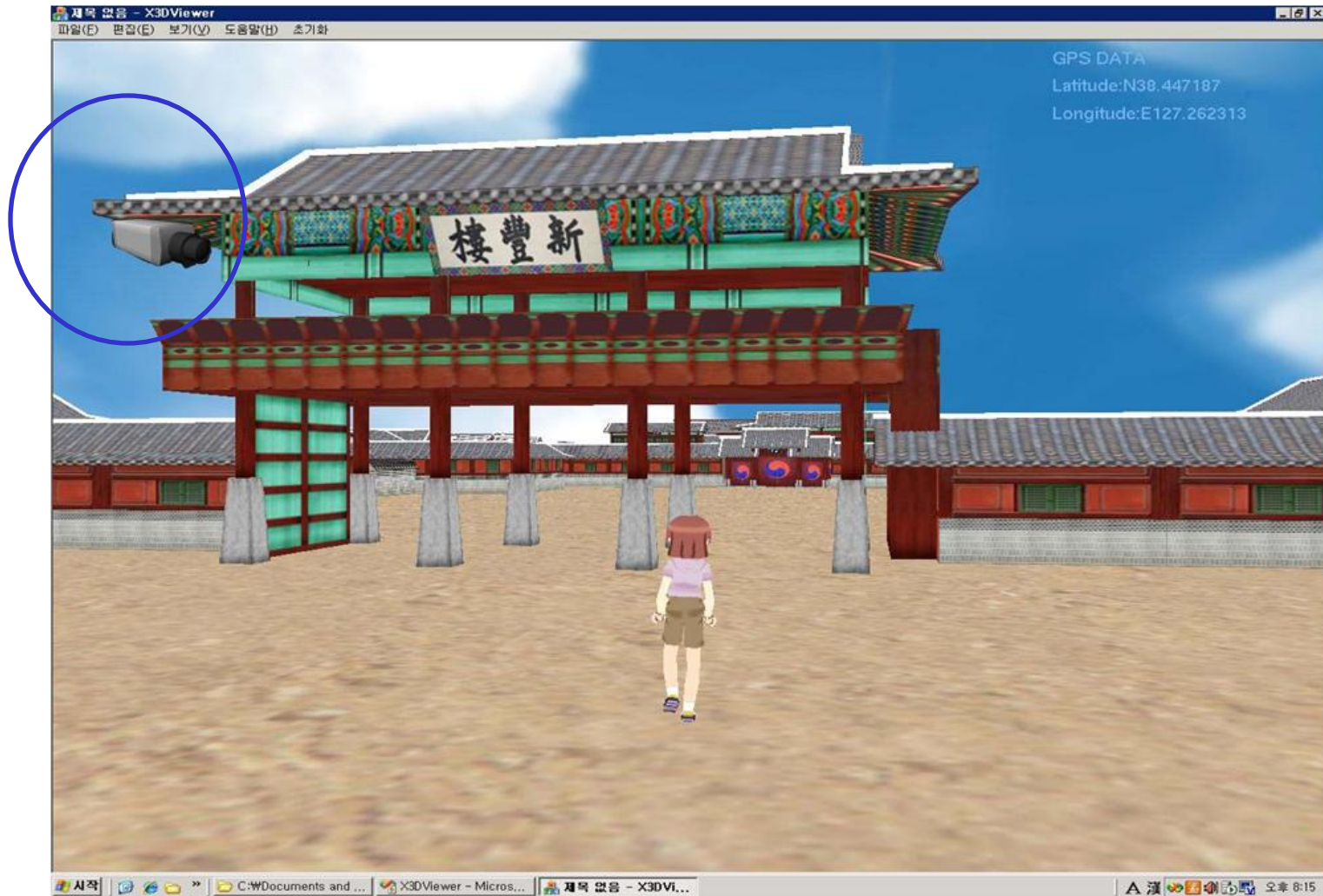
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Real 3D Scene + GPS (Video)



Hwaseong Fortress – UNESCO list of World Heritage

3D Scene and Movable Facilities (1)



3D Scene and Movable Facilities (2)



A 3D Scene Management System

- 3D facilities monitoring and user interface control
 - Creation of 3D environments and buildings
 - Creation of 3D facilities
 - Arrangement of facilities in 3D environments
 - GPS based environments and facilities management
- Application: CCTV management system

Viewer Capability

- Attach movable facilities (CCTV) to a GPS defined location in a scene
- Arrange 3D fixed and movable facilities in a scene
- Viewing and navigating 3D scenes
- Managing facilities and their information

GPS Node Definition (1)

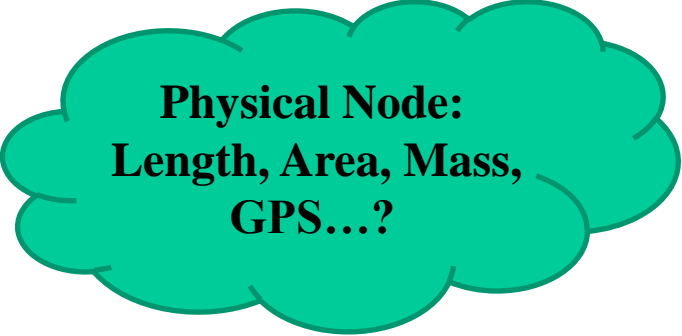
- NMEA Protocol
 - The National Marine Electronics Association (NMEA)

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

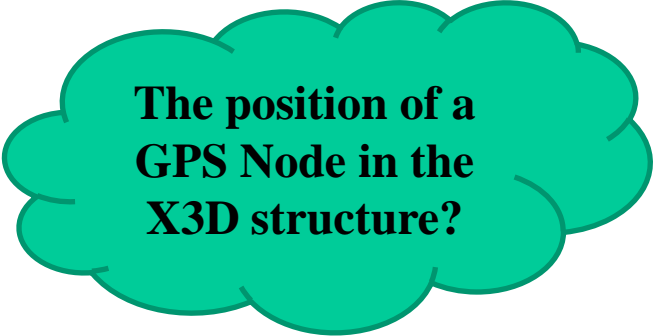
- A: Reliability of GPS signal (A = yes, V = no)
- 3735.0079: Latitude
- N: North (South)
- 12701.6446: Longitude
- E: East (West)
- 0.000000: Velocity (knots)
- 121.61: Progression angle (degree)
- 110706: Date
- *0A: Checksum

GPS Node Definition (2)

```
GPS_Node {  
    SFFloat    time  
    SFBool     availability  
    SFFloat    latitude  
    SFFloat    longitude  
    SFFloat    speed  
    SFFloat    trackAngle  
    SFFloat    date  
    SFFloat    checksum  
}
```



**Physical Node:
Length, Area, Mass,
GPS...?**

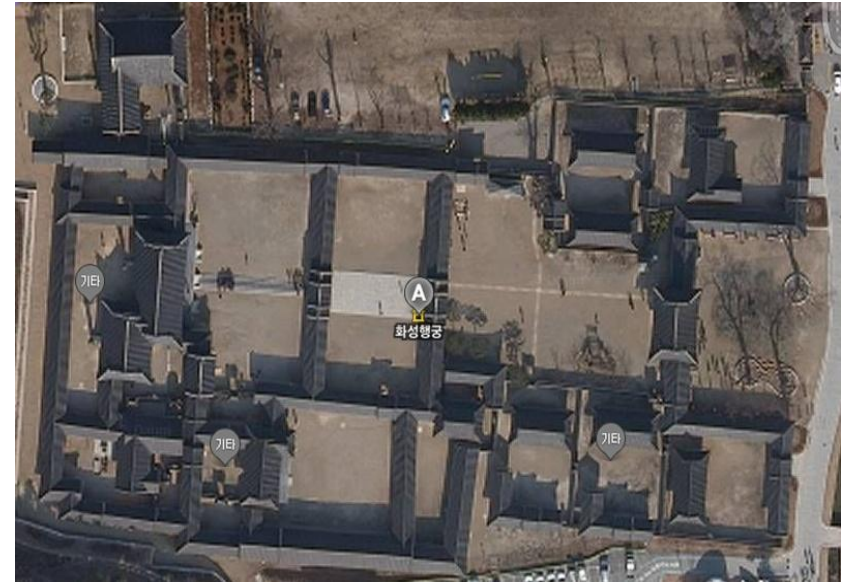
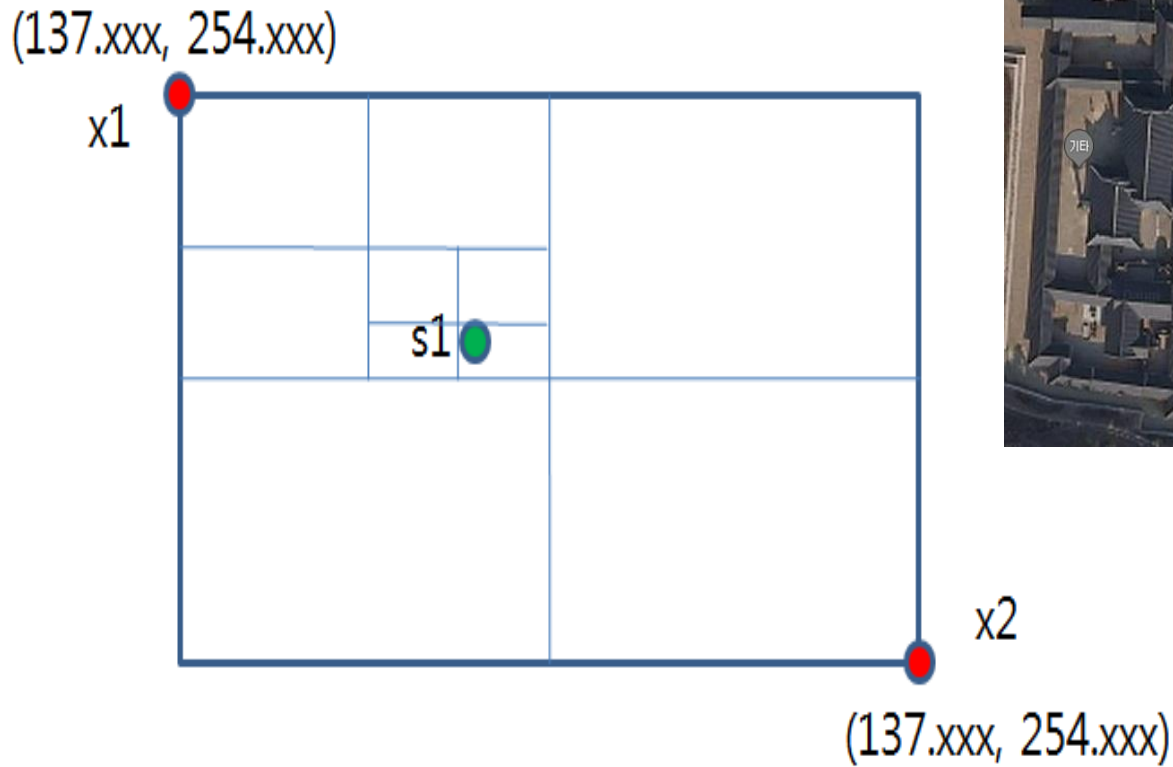


**The position of a
GPS Node in the
X3D structure?**

GPS Nodes in X3D

- Definition
 - A GPS node is located just below a scene node
 - A scene node has maximum and minimum GPS values
 - Each movable object has positional GPS data
 - Each movable object is located according to the GPS values

GPS Synchronization with a 3D Scene



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(From satellite)

A GPS Node for a Scene

```
<X3D profile="Immersive" version="3.0">
```

```
<Scene>
```

```
<GPS-Bound max-latitude = "38.445484" max-longitude = "127.168188"  
min-latitude = "38.315381" min-longitude = "127.015138" />
```

```
<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"/>
```

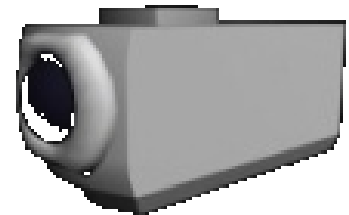
```
</Appearance>
```

- No single specific GPS position data
- A range of GPS information for a scene



A GPS Node for a Movable Object

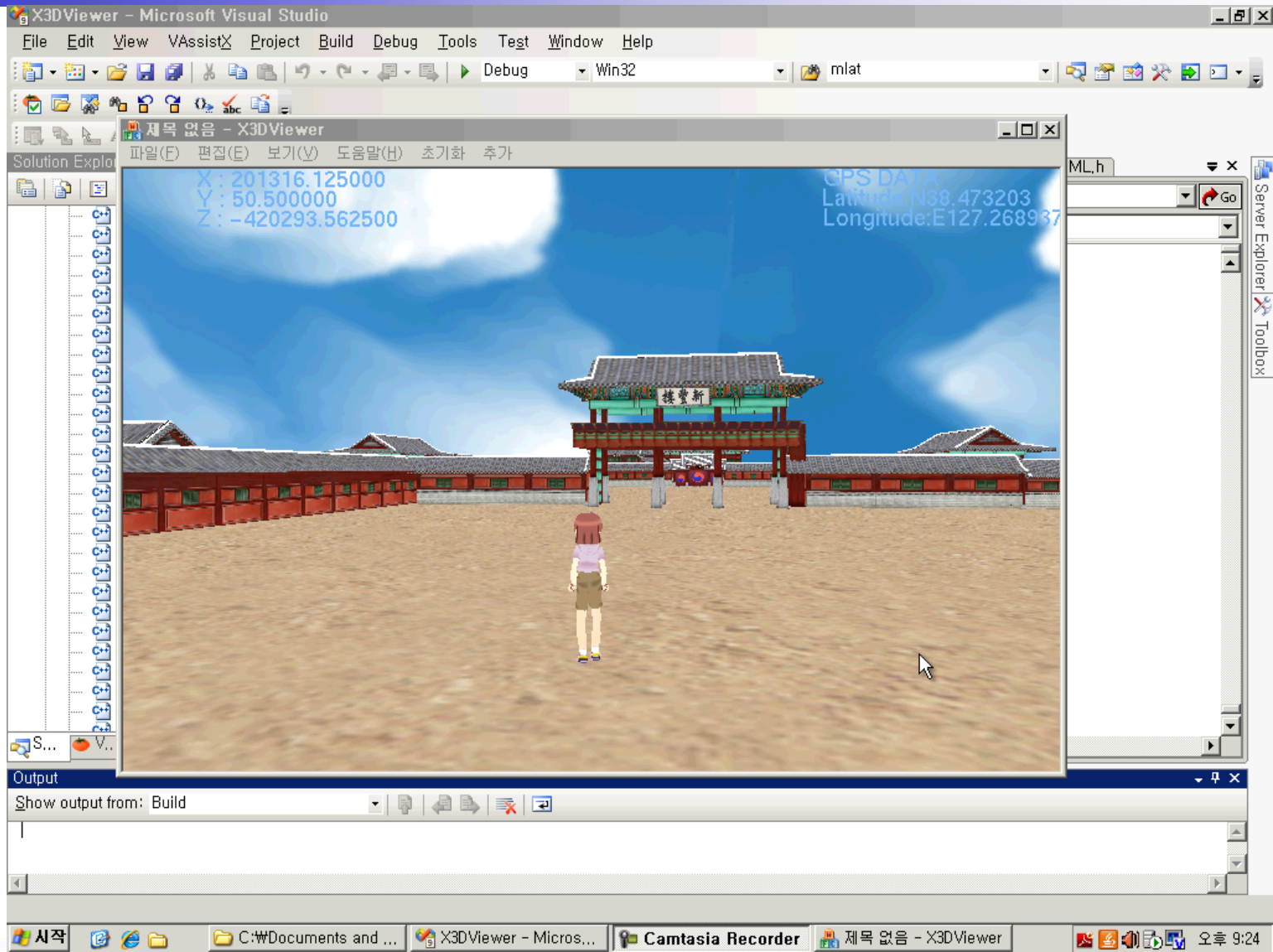
```
<X3D profile="Immersive" version="3.0">  
  <Scene>  
    <GPS-Node time = "0831" available = "true" latitude = "38.445484" longitude =  
"127.168188" speed = "0"  
      trakAngle = "0.0" date = "20101208" checkSum = "0" />  
    <Transform DEF="body" translation="201274 54.7559 -420296" scale="0.013904  
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

- Synchronization of GPS data in relation to the scene's GPS range
- A movable object is located according to the GPS information
- The GPS values of a movable object can be variable and stored in its X3D file through the GPS interface

Position of a Movable Object (Video)



GPS Implementation for Movable Objects (Video)



Implementation

- Programming (Windows)
 - Visual C++
 - OpenGL
 - X3D
 - Windows
- Programming (Mobile)
 - Android
 - Java
 - OpenGL ES
- Modeling
 - 3ds Max

Conclusions

- A standardization item
 - A real world synchronization interface for virtual worlds
 - A GPS node definition
- Issues
 - The position of the GPS node inside the X3D specification
 - Units and scaling problems
 - Methods of combining multiple X3D scenes or multiple X3D objects