

Oribit Simulation for SAMPEX Spacecraft

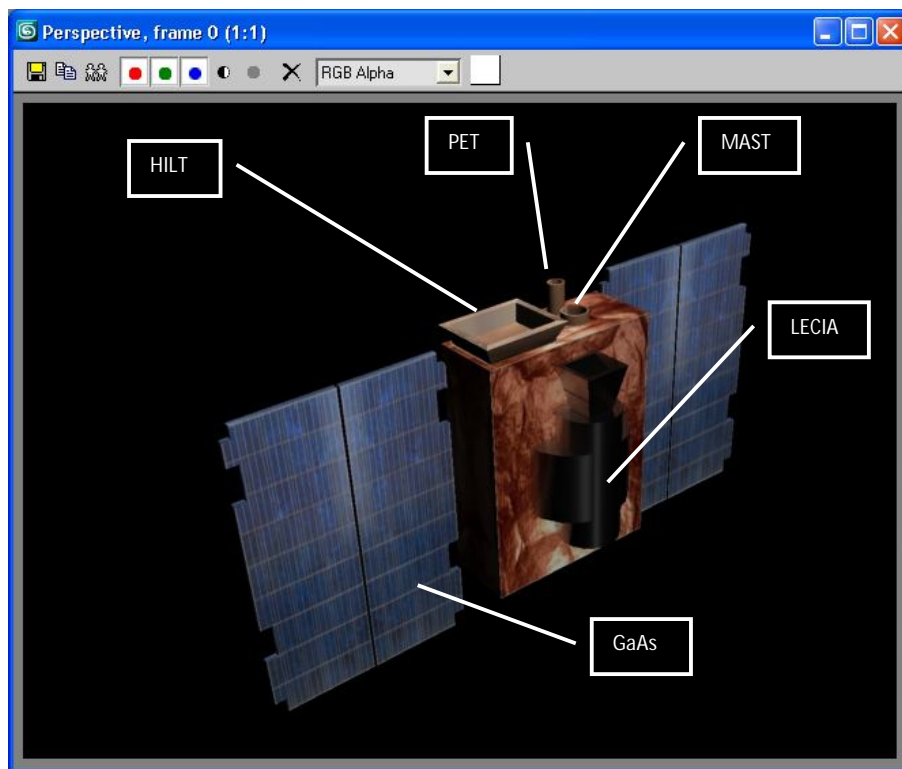
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COSC 729 - Virtual Reality and its Applications

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As well as being a Model Institution for Excellence in the sciences, Bowie State University was the first University to have its own satellite. The Solar Anomalous and Magnetospheric Particle Explorer (SAMPEX) is designed to detect solar energy particles, precipitating energetic electrons, anomalous cosmic rays and galactic cosmic rays throughout a solar cycle. SAMPEX is monitored and controlled at the Bowie State University Satellite Operations Control Center (BSOCC).

SAMPEX's orbit is a momentum-biased, sun-pointed spacecraft that maintains the experiment-view axis in a zenith direction as much as possible. It points its solar array at the Sun by aiming the momentum vector toward the Sun and rotating the spacecraft one revolution per orbit. The satellite consists of five instruments: MAST (Mass Spectrometer Telescope), PET (Proton/Electron Telescope), HILT (Heavy Ion Large Area Proportional Counter Telescope), LECIA (Low Energy Ion Composition Analyzer), and GaAs Solar Array panels.



#### Goals and Objectives:

The GOAL of this project was to create a realistic model of this spacecraft and its orbit for use by the BSOCC team during informational sessions with visitors in order to give an idea of what the satellite does during its space flight. The idea was to model the satellite to simulate its transmission with ground stations as it collects and transfers data. The environment includes outer space, satellite, earth and moon.

#### Lighting:

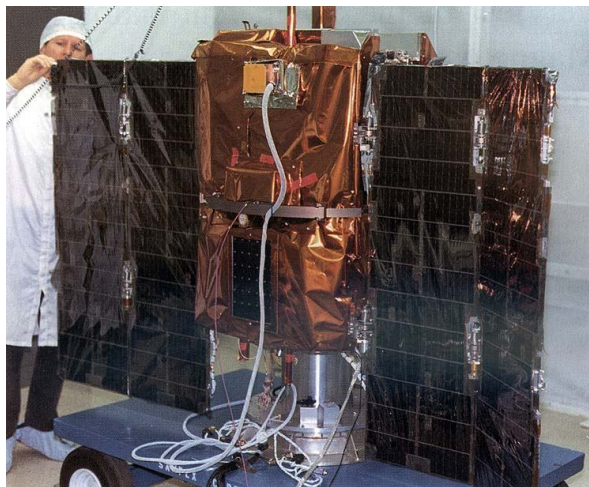
The light source is simulating the sun as a point light was implemented in VRML.

### Interpolators:

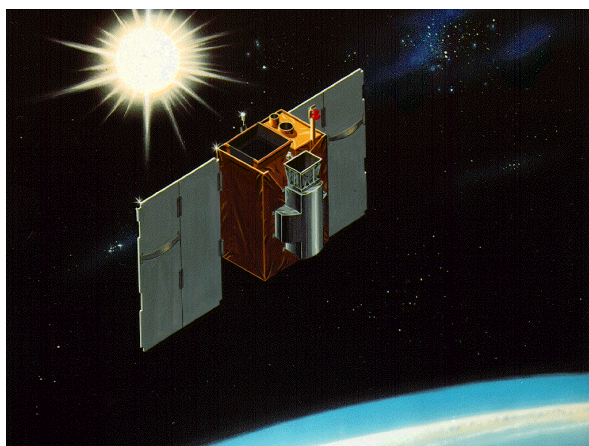
There are several interpolators used in VRML to create the orbital motion for the objects in this project. The Earth uses an orientation interpolator for its rotation. The spacecraft also uses an Orientation interpolator along with scripting for orbital rotation in order to rotate around the Earth and rotate in its orbit. The moon also has a rotation around the Earth using scripting. The Solar System model was created using 3D studio Max.

### Technology:

SAMPEX was modeled using 3D Studio Max. Figure 1 above is the final image. There were textures assigned to the various areas of the spacecraft to simulate the copper colored metal that covers the real spacecraft as well as solar array panels to cover the GaAs panels. Picture 1 below is a rear view of the spacecraft so the model was based on the image in Picture 2.



[http://nssdcftp.gsfc.nasa.gov/photo\\_gallery/image/spacecraft/sampex.jpg](http://nssdcftp.gsfc.nasa.gov/photo_gallery/image/spacecraft/sampex.jpg)



<http://istp.gsfc.nasa.gov/istp/outreach/images/mission/sampex.gif>

The modeling of the Earth was done in 3D Studio Max also. The earth model is comprised of a sphere with two texture maps simultaneously mapped to the surface. The day view of the earth would be

present when the earth was present in the part of the sphere that was visible in the light while the night view of the earth was rendered while away from the light source (fig. 2).

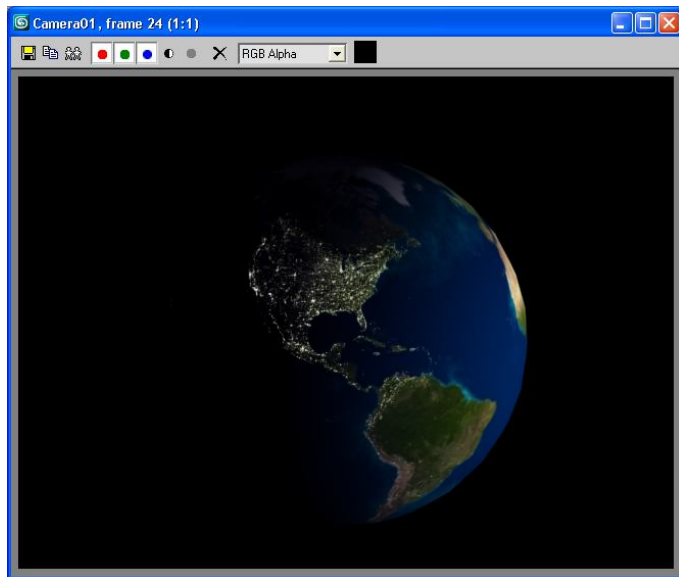


fig.2

When exporting the files from 3D studio max to VRML several mapping properties were lost, one being the day/night mapping for the earth; the other being the metallic properties of the LECIA instrument (fig.3). The size of the earth is 1280,  $1/10^{\text{th}}$  of the true size in km.

The final project was simulated in VRML on the Dell Precision T3400's in the Virtual Reality lab. SAMPEX orbits the Earth at 550 x 625 km altitude so the Satellite is orbiting at 62.5,  $1/10^{\text{th}}$  scale of the real orbit. The size of the SAMPEX spacecraft was not scaled in order to make it visible for the project.

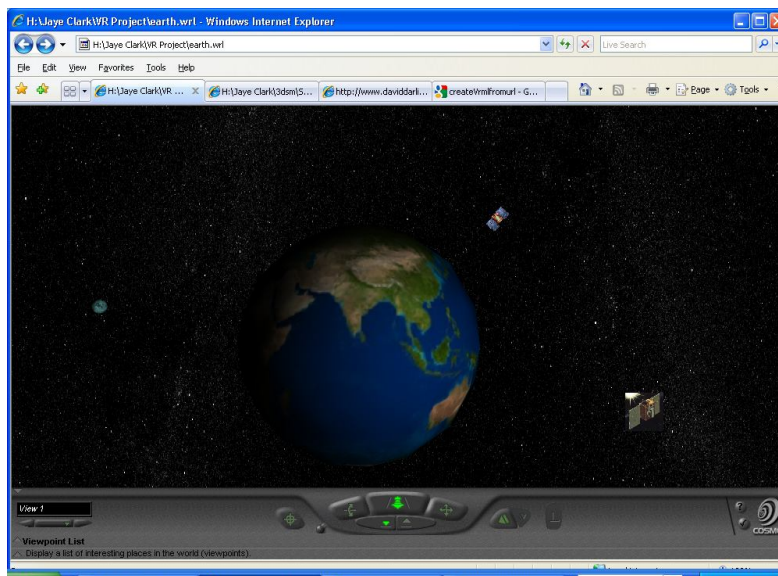


fig.3

View one shows the moon and satellite rotation around the earth.



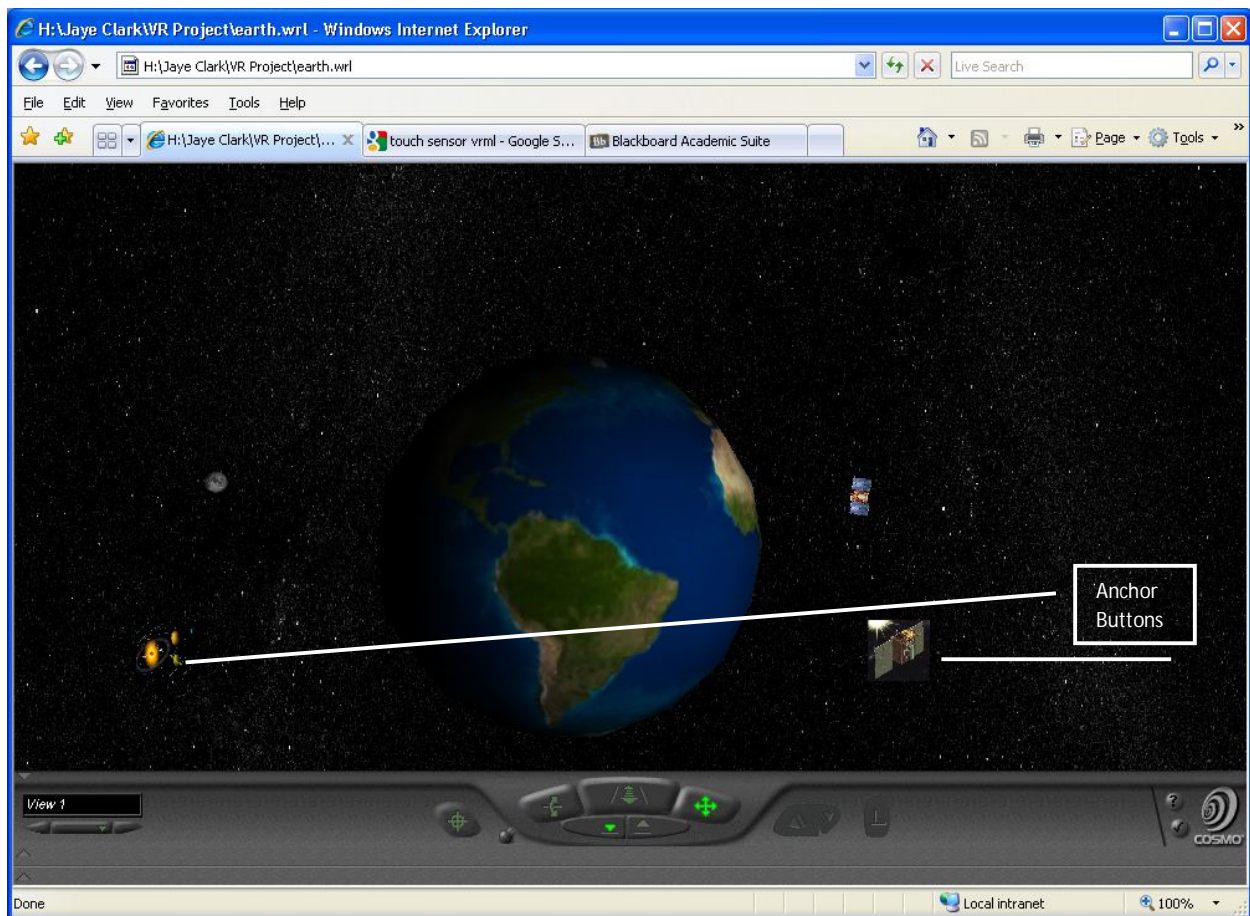


fig.4

The daylight view shows the earth partially covered in Daylight and partially covered by nightfall

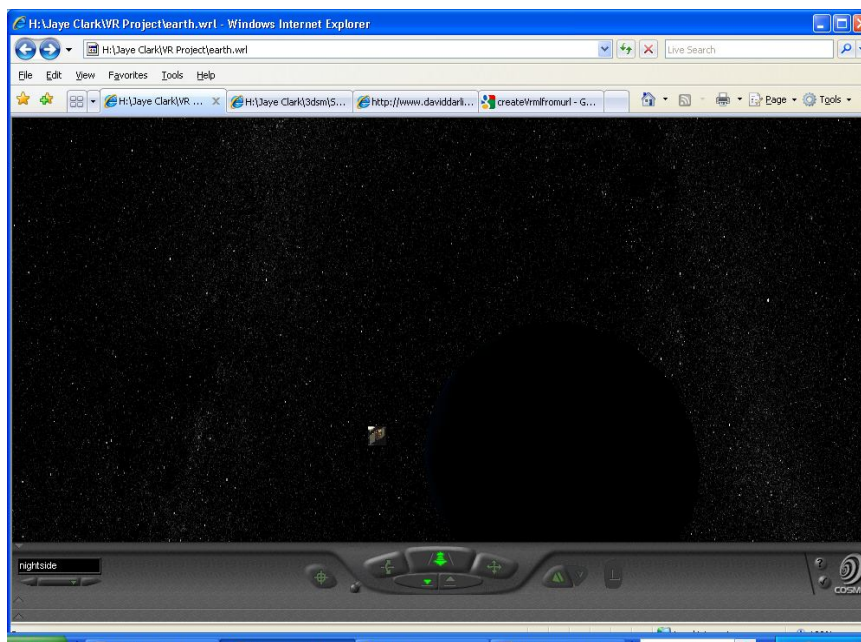


fig.5

The nightside view shows the dark side of the planet. The satellite always faces the sunny side of the planet.

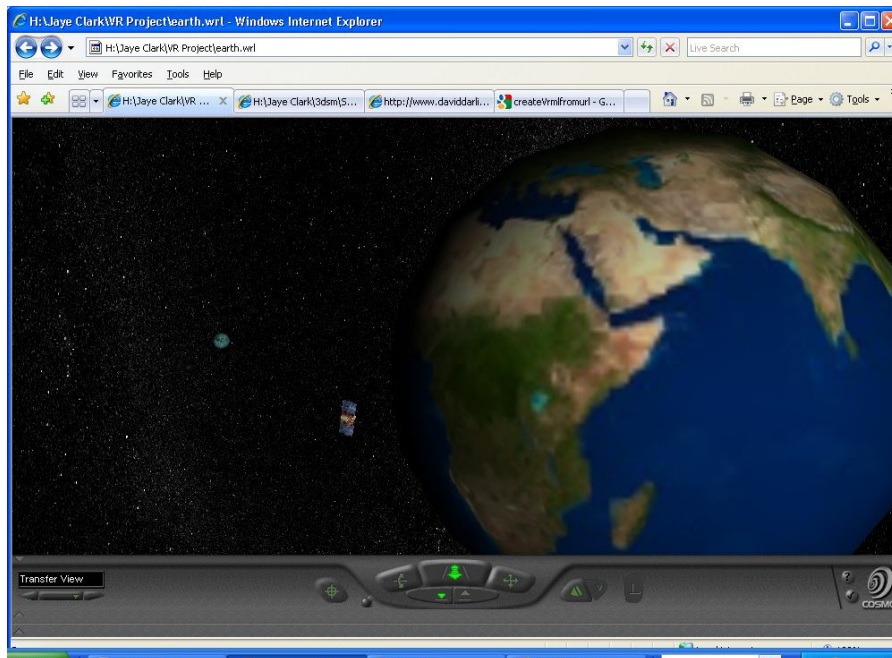


fig.6

The transfer viewpoint was created for future functionality.

Routing:

The current functionality includes an Anchor node button that is located to the right of the Earth image.



When you click this button you are transferred to a file of the satellite (SAMPEX.wrl). The file loads (see fig.7)

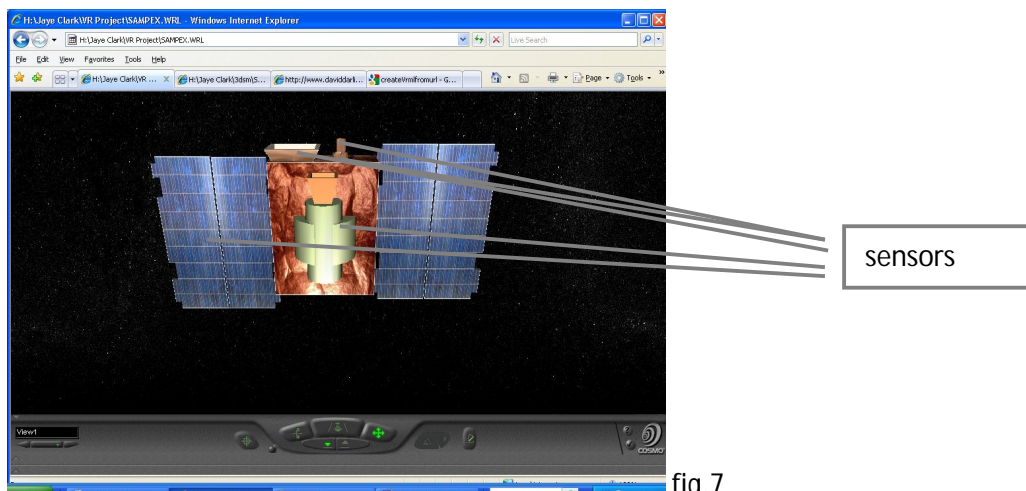


fig.7

Sensors:

There are several touch sensors located at each of the instruments. When you click on the sensors, a box will open that describes information about that instrument and its functionality.

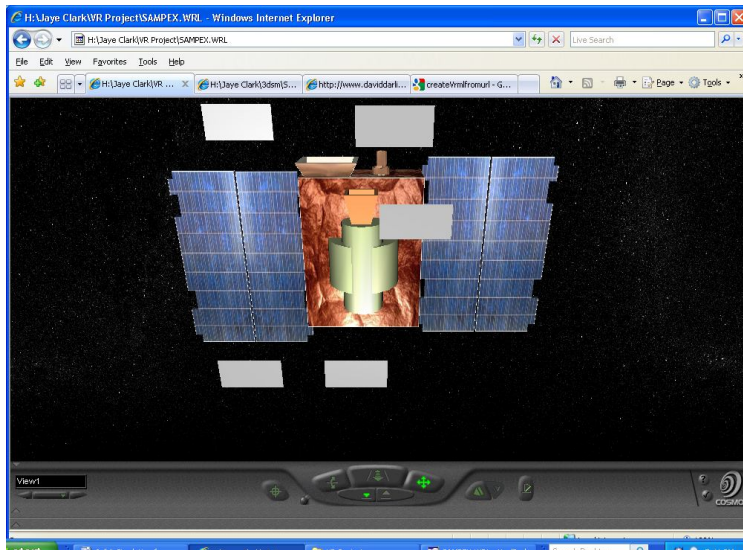
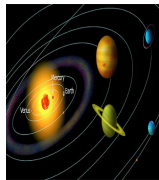
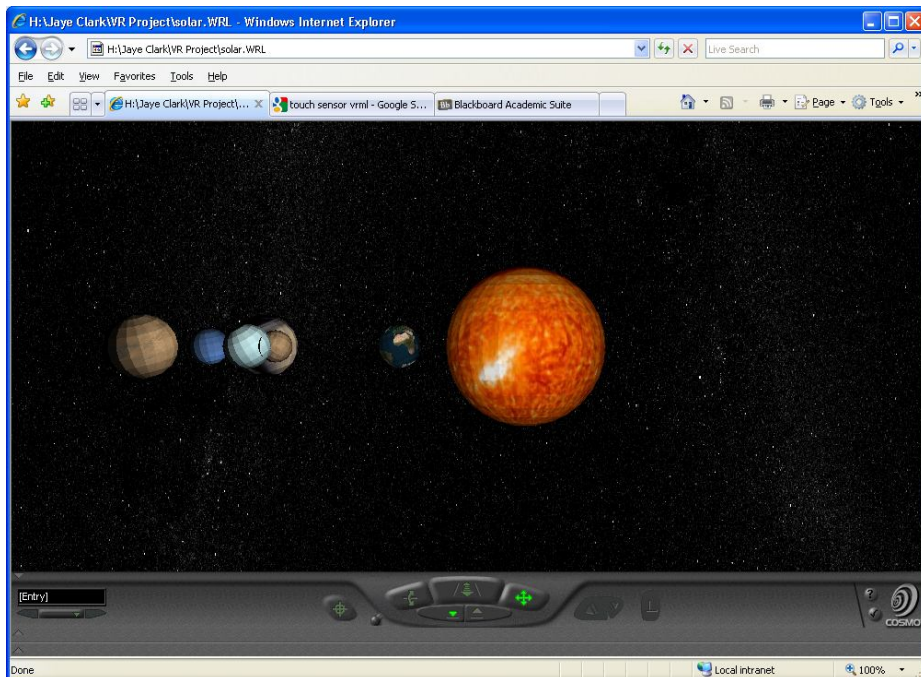


fig.8



The anchor node to the left of the Earth opens a file of the complete solar system orbit.





#### Content:

The problems encountered by this project include loss of data when transitioning from 3DSM to VRML. Also the modeling involved in this project was extremely time-consuming. It was not applicable to use readymade models because of the specific nature of this project. Also many of the functionality we wanted to incorporate into this project were not possible with the limited knowledge of scripting in VRML. When incorporating the touch sensors there were no examples available on how to insert a text box using the touch sensor, so I needed to map the text data onto a geometry (Box) as seen in fig.8. Another problem encountered is the Anchor button is not static. We used the Group Button as suggested by the professor in his assembly program, with no success. The button was not remaining static on the screen.

#### Recommendations:

It is recommended that this project be continued to include animations for ground station transmission. If this is complete this project would be very useful by the BSOCC for informational presentations at conferences and during site visits.



Sources:

<http://sunland.gsfc.nasa.gov/smex/sampex>

<http://msl.jpl.nasa.gov/QuickLooks/sampexQL.html>

[www.buining.com](http://www.buining.com) – earth texture map (day)

<http://dynamics.org> – earth texture map (night)

<http://nineplanets.org> – venus, mercury, mars, sun, Saturn, Neptune texture maps

<http://solarviews.com> – Uranus texture map