# Drive On Mars: Cyberspace Meets Outer Space (sketches_0366)

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## 1 Introduction

In July of 1997, NASA's Mars Pathfinder mission drew the largest traffic to any single web site and allowed the public to track the daily wanderings of the Sojourner rover. The QuicktimeVR panoramas created from Pathfinder images created the greatest sense of spatial immersion for web visitors. In preparation for the Mars Exploration Rover (MER) surface operations, teams from DigitalSpace, Adobe and NASA decided to build on the legacy of Pathfinder and create a next-generation web experience for the public called "Drive On Mars" (www.driveonmars.com).

## 2 Elements of the Project

The project employed several elements that we felt would provide both an immersive and educational environment:

1. First person 3D virtual world analog of the Martian surface as seen by MER.
2. "Drive-able" virtual rover with the dynamics of MER including drive train performance and a physics engine mimicking Mars gravity and surface characteristics.
3. Mars time in which a simulated sun rise and set restricts rover operation to a 24 hr, 39 min diurnal cycle. Shadow casting and day/night transitions were implemented.
4. Game-like elements including the ability of the user to score points by successfully driving the rover to a target rock and deploying a simulated Rock Abrasion Tool.

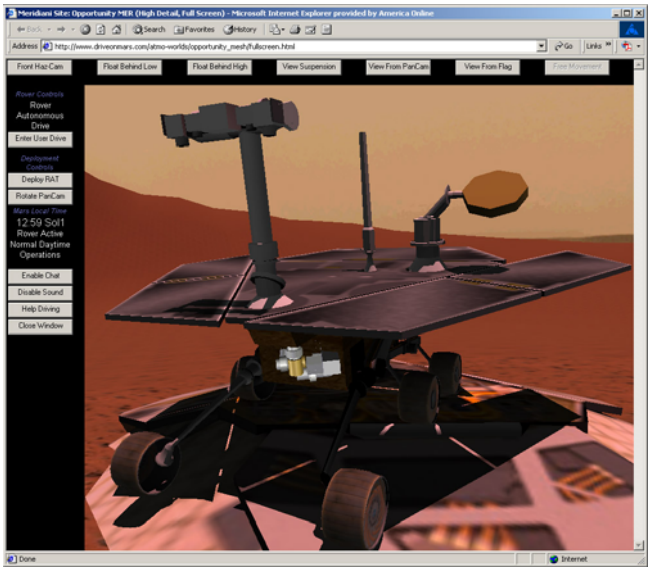

Figure 1: DriveOnMars web interface with virtual rover egress

The full version of DriveOnMars site (fig 1) was launched during the landing of the Spirit rover on January 4, 2004 and has been updated weekly with changes suggested by NASA MER team members, students, educators and the general public. This project was one of the first to deploy the full capabilities of Adobe's new Atmosphere™ web3D plug-in. Currently our team is converting polygon meshes from the Opportunity rover's panoramic camera to reproduce its landing crater locale and allow site visitors to traverse terrain models and virtually explore rock targets which Opportunity had to bypass.

## 3 Technical Implementation

Figure 2 illustrates the assemblage of web components, servers and communications protocols used to create the DriveOnMars application. The focus was the use of web-based plug-ins and standard languages and interfaces such as JavaScript, PHP/SQL and XML/HTTP. The complexity of the application far exceeds the simple web images and Quicktime VR of Pathfinder and yet we have experienced a high level of reliability in terms of access from late model personal computers on standard net connections.

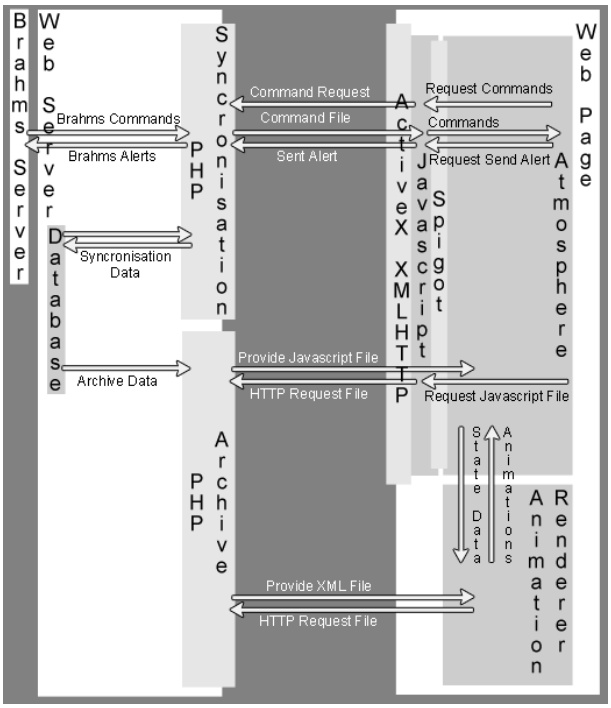


Figure 2: DriveOnMars client-server architecture

## 4 User Experience and Conclusion

Early users to the web site and using a walk-up installation at a NASA Ames event have been interviewed and while some reported difficulty with the concept of navigating a 3D space others spent hours within the environment attempting to learn to drive the virtual vehicle to targets with efficiency given the limited time available in each accelerated Mars day. We hope that this project has produced a valuable proof of concept for science outreach and may be a portent for the increased use of virtual environments in future mission operations.

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