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THE MARSSIM PROJECT

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INTRODUCTION

The MarsSim project consists of an online collaborative educational simulation of a manned mission to Mars. A Mars Simulator is being built at Cardinal Newman College, in San Isidro, Buenos Aires, Argentina. This K12 bilingual school will be coordinating the project and hosting the simulator that will be connected to the Internet. In this way, both a physical and a Virtual Mission Control (through a web-based simulation) will be carrying out the mission simulations.

The educational goals of the project are to foster the learning of Math Science and other disciplines through a hands-on approach, in a natural way that allows students to interact with each other in a fun environment and using state of the art technology.

THE MISSION ARCHITECTURE

In order to provided a working base for the mission, a baseline design was selected. It is important to emphasize that the mission design does not attempt to be original but only accurate enough to provide data for a realistic simulation.

The mission will be a Mars Direct type mission, that has been proven as the most effective and convenient. The spacecraft will be propelled by an Ares class booster, four Space Shuttle Main Engines, Advanced SRBs and a Nuclear Thermal Reactor for the Trans Mars Injection.

There will be four crewmembers and only six Mission Control stations for simplicity. The mission will also include artificial gravity of 0.38G generated by rotating the spacecraft with a tether joining the spent NTR module and the rest of the spacecraft.

Mars Descent will be accomplished by initially aerobraking with a biconic shell, parachutes and finally a powered descent phase using four RL 10 engines.

Mars Surface Rendezvous will be done with the fully fueled Earth Return Vehicle, which will take the 4 person crew back home.

In a long duration mission, the Life Support System's job is crucial. The basic function are to remove carbon dioxide, to generate air, to remove air contaminants and to produce vital water. Carbon Dioxide will be removed with a CRS system, which uses carbon dioxide and

hydrogen to produce water and methane, thus solving two problems ate the same time, Carbon Dioxide removal and water generation, as well as urine and wastewater purification. As regards oxygen generation an Oxygen Generation System will be used, which uses water and produces oxygen and hydrogen. To remove air contaminants a TCCS (Trace Contaminants Control System) shall be used.

EDUCATIONAL PROJECT SYNOPSIS

This project is based on an educational simulation, not a high fidelity one. The difference between these two lies in the complexity of the sims. A high fidelity simulation aims for the highest amount possible of details to emulate as accurately as possible the real mission. In an educational simulation, such as ours, many processes and data have been simplified to make the project understandable and enjoyable for high school students with no special background or education on the subject. The layout of the spacecraft and mission control, which are currently being built in the Robotics room in our school consist of a spacecraft replica and mission control stations. The spacecraft itself will be about three meters high and two meters in diameter. It will have two levels, the top one for mission operations and the lower one for experiments. It will have panels connected to a PC. This PC will be connected to a Server, which will also connect to Mission Control. Mission Control will be in the same room, it will have fours stations for simplicity with one computer per station.

A unique variant on the simulation will be the Virtual Mission Control, which basically consists of people in other places or countries being able to act as the physical mission control by means of the internet and a website specifically designed for this purpose.

INFORMATION FLOW

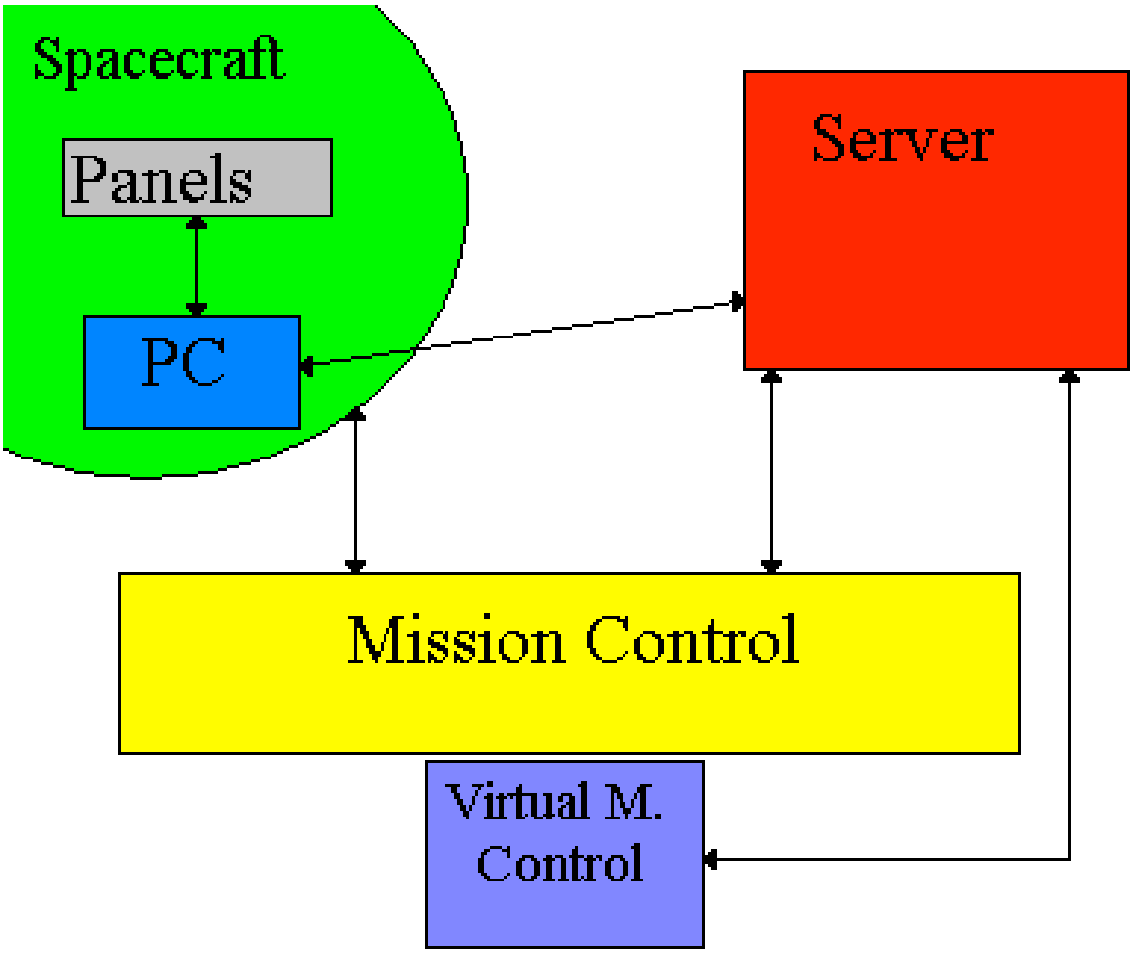
The information flow through the whole simulation will be: from the panels of the spacecraft to the PC via parallel port. A Visual Basic application will regulate the flow. Between the PC on the spacecraft and the server, and from the server to Mission Control and vice versa, a Flash application will control data transfer. The Server application will constantly check for any changes in the panels on the spacecraft and the computers in Mission Control (either physical or virtual) and update any change taking into account the time lag due to long distances in this type of missions.

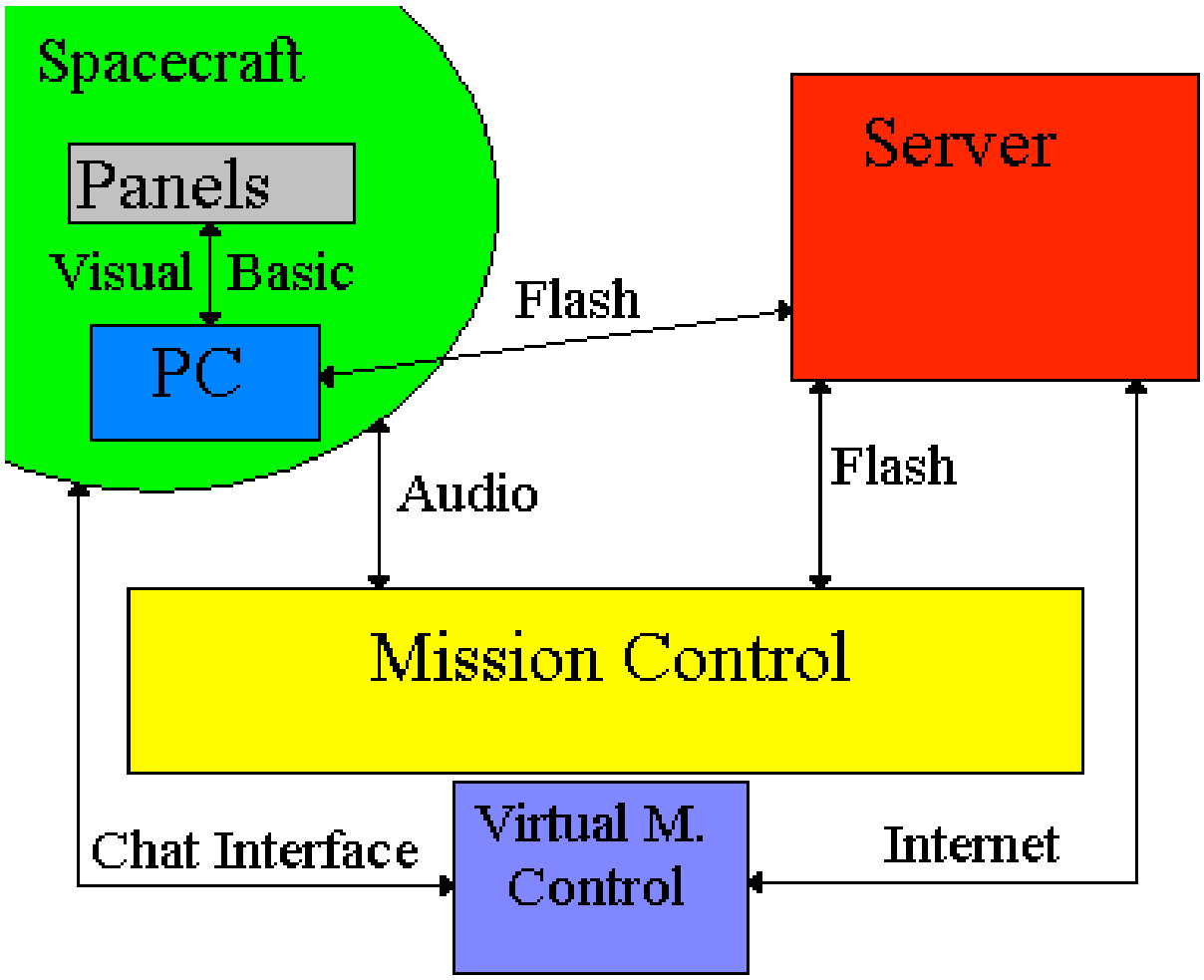
There will also be a direct audio link between Mission Control (physical) and the spacecraft to allow for direct contact with the astronauts during solution of problems. The link between the spacecraft and Virtual Mission Control will be conducted through a chat interface. The information transfer between Virtual Mission Control and the server shall be via Internet. Other features will be built-in web cams that will allow visual recording of the mission that will be updated after a certain period of time and the inclusion of the time lag in every data transfer from the spacecraft to Mission Control to emulate the actual time lags due to distance in the real missions.

THE SIMULATIONS

For the actual simulations previous training will be provided, both in situ for people who are interested in coming to our school, and online for those who are far away. There will also be practice runs with the crews to allow them to familiarize themselves with the equipment. “Real”

simulated missions shall be planned and implemented, using the same time schedules and real data from Mars missions. The characteristics of these simulations will be the inclusion of problems of different nature during the mission that the crew will have to solve on the march. These problems will be of non-catastrophic or time critical nature. There will be no nuclear reactor meltdowns or meteorite collisions because there is simply no way for the crew to solve them. There will be plenty of consultation among the crew and mission control (physical or virtual). Consultation and collaboration between each of these people will be crucial for the solving of these problems. This simulation is designed in such a way to allow students with little training on the subject to get a glimpse at what an actual mars mission might be like and learn form this experience. Future developments include simulated experiments that will take place on the lower floor of the spacecraft. These experiments will be designed and implemented by actual students from other schools, thus allowing other students to bring their own ideas to this project, which will allow them to make significant contributions to the project.

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