CubeSat

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Client: Kennedy Space Center
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Goal and motivation: The goal of this project is to develop a platform to allow for astrobotany experiments to be conducted at a smaller scale. This is accomplished by a partnership between the Kennedy Space Center (KSC) and Florida Tech through the use of a CubeSat. The interior environment of the CubeSat will be monitored by a microcontroller with several sensors, monitoring moisture, oxygen, etc. Currently, there are several existing flight software frameworks but these are very generalized and would have to be curated to the specific needs of the mission. Also, the control systems for the sensors would have to be designed to be able to run for the duration of the mission. As a measure of success, I hope to be able to communicate from the CubeSat to a test version of mission control as well as be able to single out and identify brine shrimp with at least a 30% accuracy.

Approach:

Environmental Monitoring: The system will monitor and report back changes in the environment within the payload utilizing onboard sensors such as humidity sensors, temperature sensors, pressure sensors, as well as other environmental factors. These sensors will be read and analyzed by the onboard computer (OBC) and if there is a significant change to the parameters,

relay important information back to Ground Control as there is a limit on how much information that can be sent back to Earth.

Brine Shrimp Recognition/Vision: The system will also monitor the brine shrimp population onboard using an IR camera to isolate the separate heat signatures to be able to get an accurate count of the shrimp. This can be used to detect changes in the population to help determine the effects of low earth orbit on the shimp.

Specialization of Flight Software: Currently, there exists multiple open-source options for OBC control systems but they are all very general and only provide the framework. The System will build off of one of these currently available frameworks to provide a specialized system for the mission and allow for greater customization if more features are required later on. This will allow greater flexibility and customization for the future.

Novel Features:

One novel feature of the system is that it will employ the use of an Infra-red camera to identify the separate organisms to help keep track of the population at any given time.

Technical Challenges:

There will be many challenges in this project, mainly due to the effects of being in Low Earth Orbit (LEO) and the environmental difficulties that will bring about. For example, due to the massive potential changes in temperature that may occur, the OBC may be required to function at less than ideal temperatures and this may affect its performance which can impact data processing. Another challenge will be that of memory protection, as due to the high amount of radiation that the CubeSat is expected to incur. It has been found that high amounts of radiation to a system can affect the logic state of memory as well as output transistors, which can lead to the deterioration of bits, or at times bytes, of data. This can potentially be corrected by error-correcting code such as checksums or cyclic redundancy checks, although it will be hard to test under experimental conditions as the high levels of radiation it would be exposed to are not safely replicable. Finally, I have never used or experimented with the open source software that is commonly used on an onboard computer and will need to do a great deal of testing to learn how it functions.