TEXAS SPACE GRANT CONSORTIUM
DESIGN CHALLENGE

TOPIC # - TDC - 45 – S22

VEHICLE INTERCHANGEABLE ELECTRONIC CONTROLLER(VIEC) NETWORK SYSTEM

BACKGROUND

As humans push their exploration further into space and spend more time in deep space, logistical aspects of providing spare spacecraft components becomes critical. Traveling a great distance away from earth makes it difficult in terms of obtaining timely replacements from the safety of the earth. Solutions such as flying many unique spare components are costly in terms of dollars, mass and volume. The cost aspects to including many unique spares on a vehicle compete against achieving primary mission objectives. Is there a better way? Is it possible there is another approach would not only reduce the logistical cost of spare components while potentially increasing mission flexibility and interoperability?

One approach to consider is a system that permits interchangeability vehicle controllers based on where the controller interfaces to the vehicle or habitat. For example, one controller performing a function could be used as a spare to replace a failed controller performing a different function occupying a different location on a vehicle. The new behavior for the controller in its new location is defined via networked interactions with other controllers (providing a server function) on the same vehicle. The results are that a common controller could be swapped around to different locations on the vehicle. This approach reduces controller sparing requirements for a vehicle, reduces the aforementioned costs that compete against primary mission objectives and increases the probability of achieving long-duration mission goals.

PROJECT DESCRIPTION

Develop a system of interchangeable controllers (ICs) configured via an interaction with a network server defining controller behavior via network server downloading the program implementing appropriate behavior to the IC-based upon the IC's reporting of a positional identifier supplied by the act of Interfacing the IC to the vehicle. For this technology demonstration, the vehicle's positional identification (I am an engine controller or I am a pressure vessel controller, etc.,) can be implemented through a variety of means such as an IC connector plug with a configured discrete code (ex: I am a lighting controller) or other means. The IC should be capable of interfacing to two more different physical simulated vehicle system applications containing both effectors (accepts digital or analog) and sensors that monitor the system. An example could be such as a vehicles lighting controller that controls the brightness of a solid-state lighting module and that monitors lighting intensity or light emitter temperature.

Another example could be an IC operating simulated vehicles valves and sensors measuring the pressure inside a simulated chamber (not suggesting a real-life pressure vessel is required). There are other potential creative examples that are left up to the students. Key to the successful demonstration will be the IC should take every opportunity to utilize common serial interfaces as SPI or I2C for controlling simulated vehicle system. The application is not as important as demonstrating the interchangeable aspect of the IC and its interaction with the vehicle's positional identifier and the server that supplies the appropriated behavior. Also, the IC should have a common interface connector for receiving for power, and interfacing to the vehicle (including the positional identifier). The network connection can be a separate interface or wireless. The swapping of ICs should be highly-reliable with better than 75% success, with each interchangeable/swapping is occurring on the first try. There should be a central graphics showing the system components and their status. All simulated vehicle systems should be in an enclosure with sensors neatly attached to boxes so that simulated conditions such as temperature, pressure, etc. can be applied to the exposed sensor. Each IC should contain LEDs to indicate the status of the unit—running, stopped, fault, connected to the network, etc. with labeling. At least four, simulated vehicle applications is desired for the demonstration. One stretch goal is to provide voice over internet protocol (VOIP)as one of the vehicle simulated applications.

DELIVERABLES

Hardware (Circuits in PCB form, enclosures for each simulated application, IC enclosure with connectors), Software for the IC, Software for the Server Application, software for the simulated applications,

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User/operations manual that includes block diagrams and flowcharts, schematics, bill of materials, any known issues/bugs

DESIGN TEAM PROFILE

NASA MENTOR:	George Salazar
LEVEL:	Upper Division Students [JR/SR]
MAJOR / DISCIPLINES:	Electrical Engineering, Chemical Engineering, Computer Science
TEAMS:	Willing to mentor 1-2 teams
DURATION:	Two-Semester Project

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