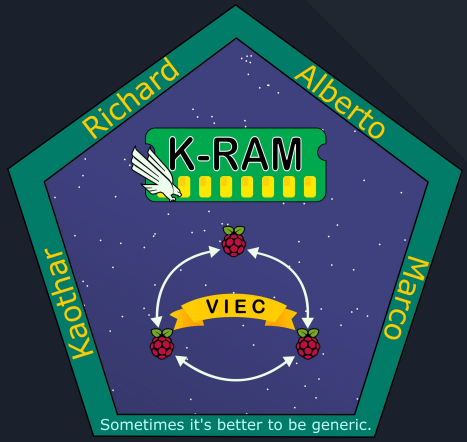

VIEC Network System

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Alberto Olvera, and Kaothar Sowemimo

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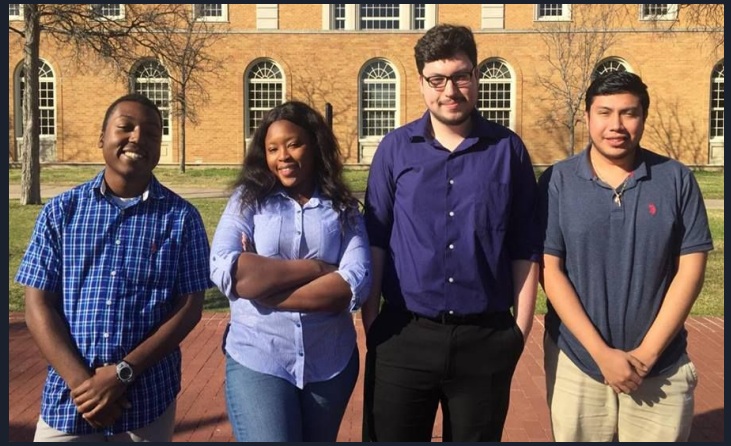


Introduction

- When Orion goes into space, a number of controllers will be needed to control the various systems in the craft.
- If a controller breaks, it will need to be replaced.
  - Take spare controllers in the initial launch
  - Request replacements to be sent from Earth
- Instead, build a controller that can reconfigure based on the application

Objectives

- Create a network of controllers (ICs) connected to a server.
- Use a common connector to facilitate IC interchangeability
- Develop an identification system for vehicular functions
- Test the system with three applications

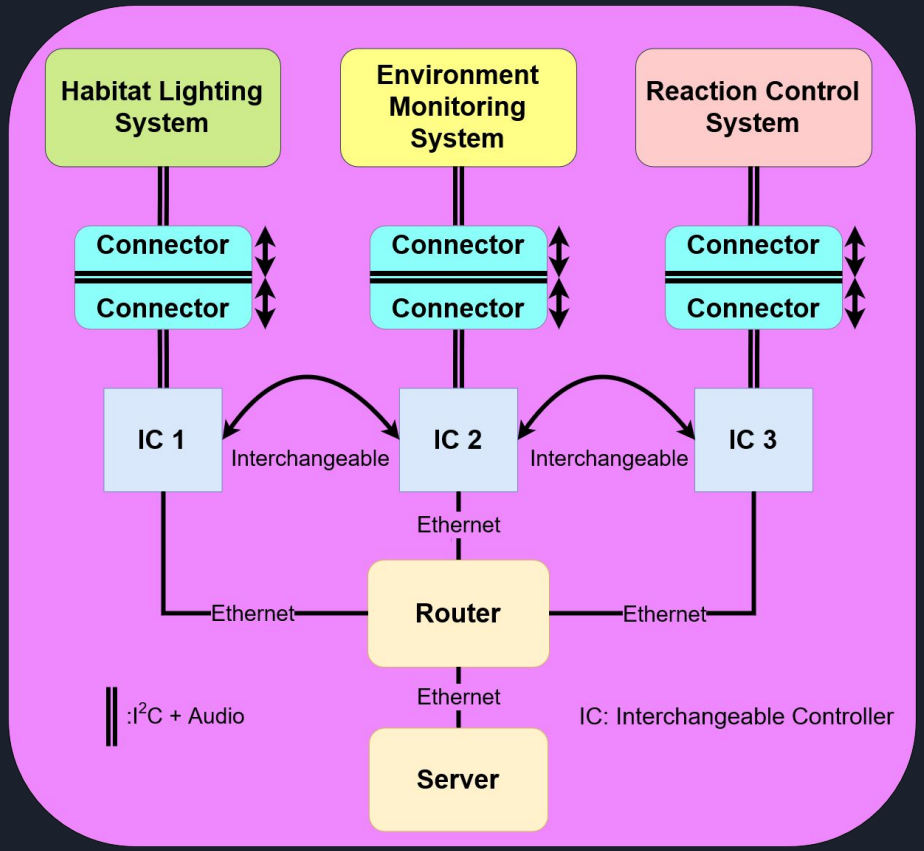
* IC - Interchangeable Controller

Design

- Use a server to manage the system
- ICs are connected to the server via Ethernet
- Using the universal connector via I^2C, the IC interfaces with the applications which include:
  - Habitat Lighting System
  - Environment Monitoring System
  - Reaction Control System

* I^2C - (Inter-Integrated Circuit) - Serial Bus
* IC - Interchangeable Controller

System Architecture



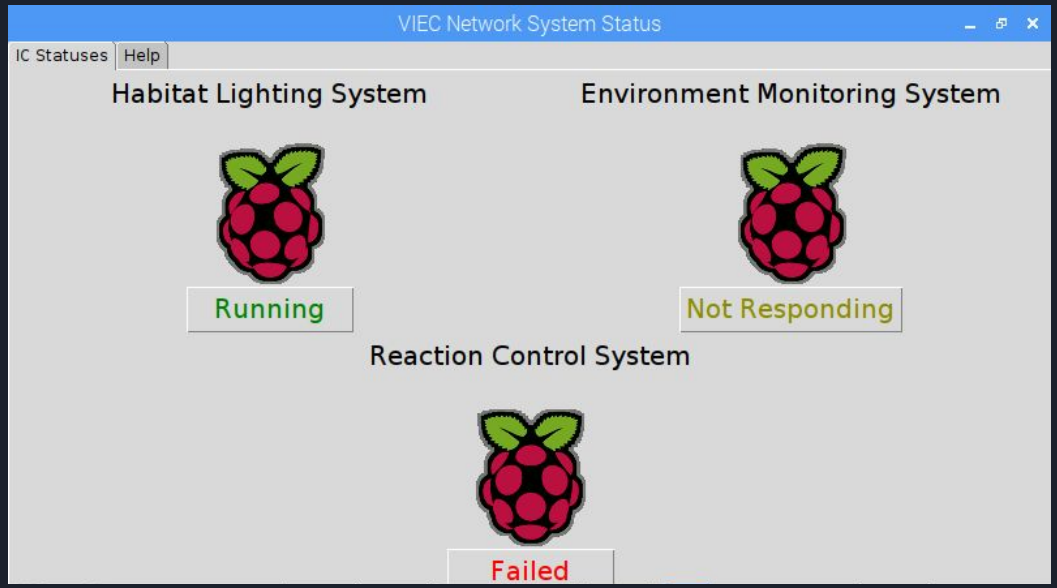
Server

- Major Functions:
  - Connect to each IC via SSH, SFTP, and SSL Socket
  - Detect the status of the IC
  - Detect that an IC has been replaced
  - Deploy an application to the IC via SFTP
  - Manage a SQLite database to keep track of connected devices

* IC - Interchangeable Controller
* SFTP - Secure File Transfer Protocol
* SSH - Secure Shell
* SSL - Secure Socket Layer

Server GUI

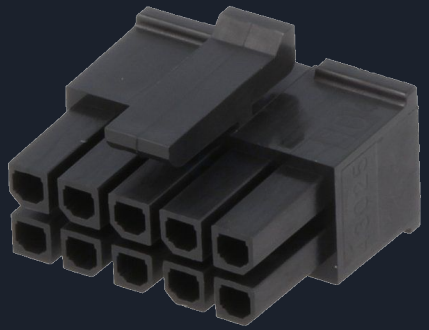
- Displays IC status read from database:
  - OFFLINE
  - RUNNING
  - NOT RESPONDING
  - FAILED
- Shuts Down ICs

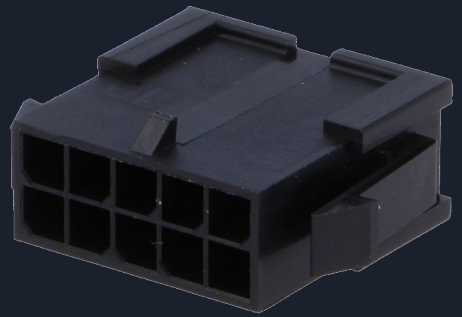


*IC - Interchangeable Controller

Universal Connector

- ICs use identical connector to interface with applications over I^2C
- Connectors can be plugged and unplugged allowing the IC to be interchangeable

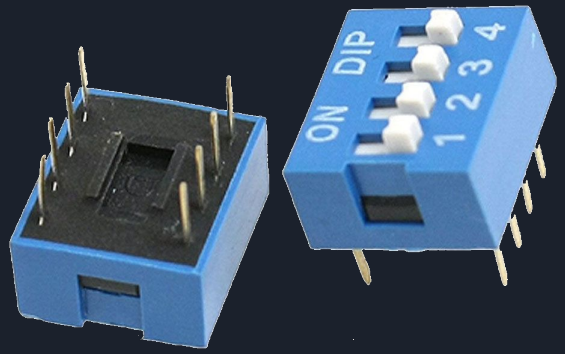




* I^2C - (Inter-Integrated Circuit) - Serial Bus
* IC - Interchangeable Controller

Application Identifier

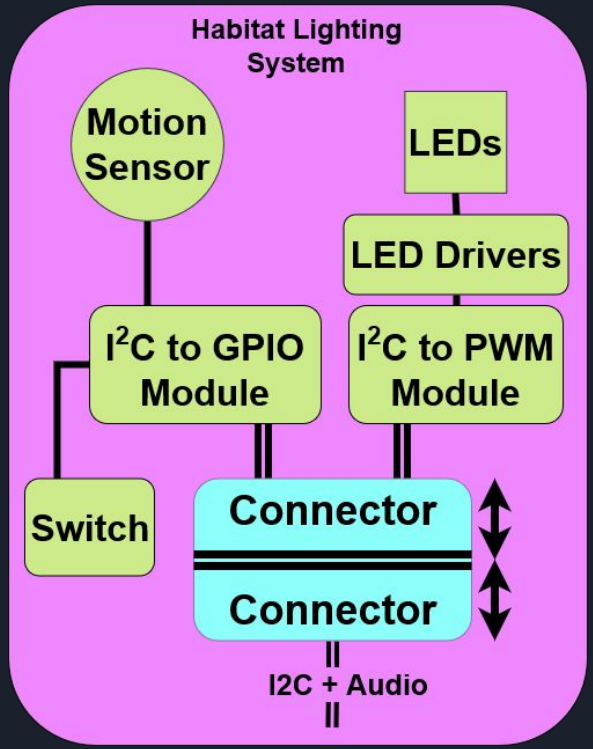
- Server needs to know where the IC is
- Each application has a switch that determines its position
- IC reads value and reports it to the server



*IC-Interchangeable Controller

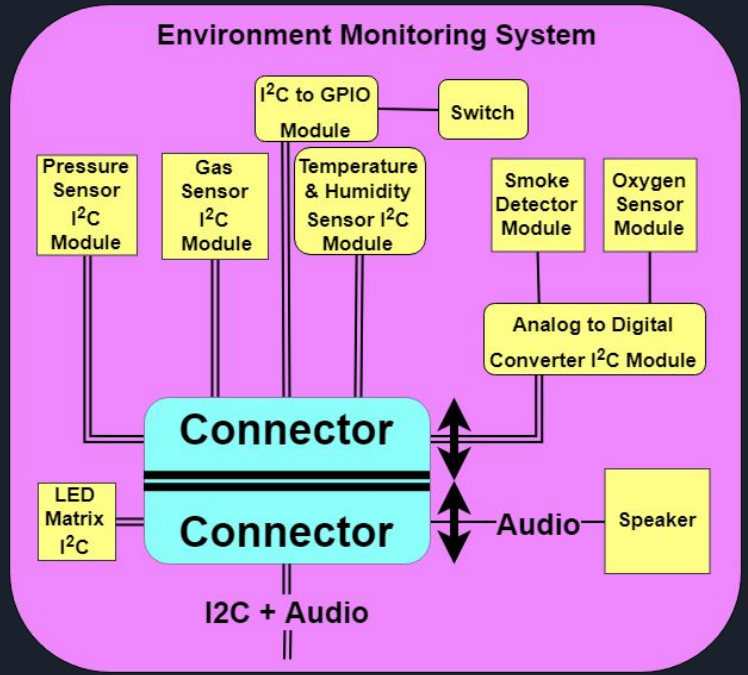
Habitat Lighting System

- Detects motion with a PIR sensor
- Lights remain at 10% brightness levels when no motion is detected
- On motion, controller raises the brightness of the LEDs to 100%



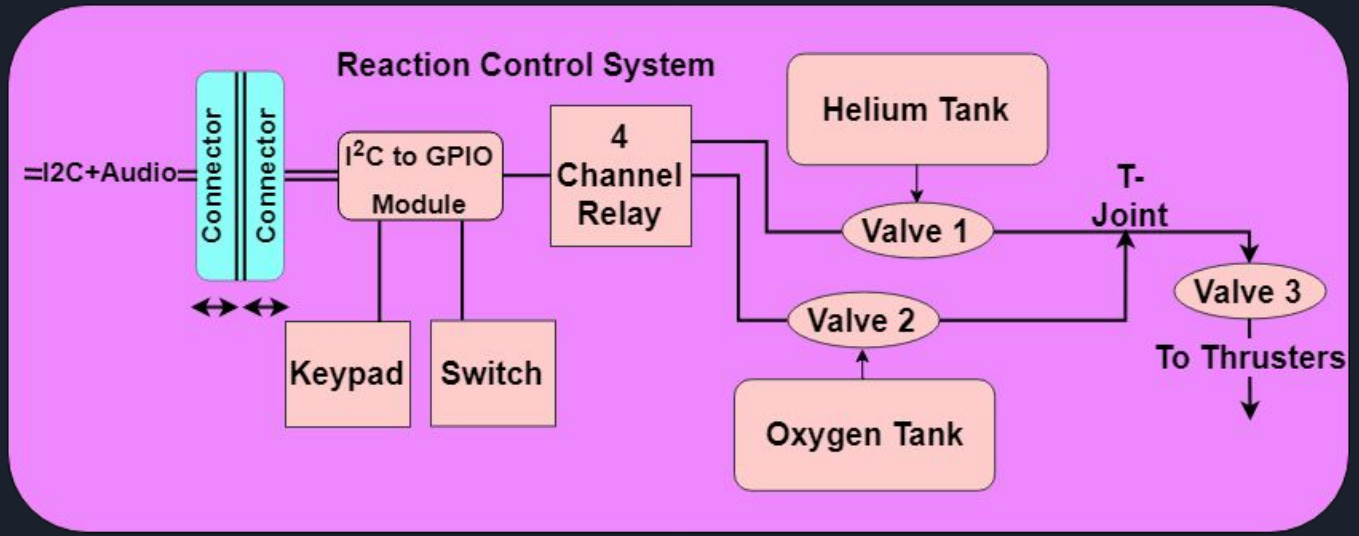
Environment Monitoring System

- Uses the following sensors:
  - Oxygen Sensor
  - Temperature Sensor
  - Humidity Sensor
  - Pressure Sensor
  - Smoke Detector
- If conditions enter dangerous levels, an alert is sounded.



Reaction Control System

- This system will demonstrate a reaction control system with 3 solenoid valves
- On correct code input, valves are opened



Test Results

Requirement	How it was Tested	What it Verifies	Results
Deploy applications	Check if IC has the file	Demonstrates that it is feasible to send needed programs to the ICs	PASSED
Application Identification	Check if value is the same as switch	Shows that it is possible to find the position of an IC in the network	PASSED
Simulate 2 or more vehicle systems	Swapping the IC into different systems and verified that they are executing	Reveals that multiple systems can be handled in the network	PASSED
Common Connector	Plugged the IC into different systems	Proves that the IC can interface with any system	PASSED

System Results

Activity	Time (sec)
Server Recognizes an IC is Offline	8.50
Shutting down an IC using the GUI	2.14
Swapping ICs	27.07
Server loads Application on IC and IC begins running	24.40
Total	62.11

Outreach

On February 23rd, high school freshman from a local high school visited the UNT Discovery Park campus for the *STEM @ the Park* event to learn about engineering through various hands-on activities.

Future Work

- Dynamic application identification
- Reduce CPU load
  - C over Python?
  - Stronger board
- Reduce offline state detection time

Summary & Conclusion

- VIEC Network System aims to reduce the number of spare parts needed to be sent on outer space missions
- Interchangeability of controllers allows less parts to be sent

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Acknowledgements

Special thanks to:

- Talia Jurgens & Dr. Tim Urban - TSGC Administrator
- George Salazar - NASA Mentor
- Dr. Robin Pottathuparambil - Faculty Advisor (UNT)
- Thomas Kanabay - Lab Manager (UNT)
- Office of the Dean - UNT

Questions?