Dalhousie Ships of Opportunity (Dal-SOOP) System Controller

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Background

The Dalhousie Ships of Opportunity System can be installed on a ship to autonomously collect ocean water data. The proposed project is to replace the system's current unreliable PLC controller with an embedded solution.

Scope of Work

Control Panel

- The new controller must integrate with the same implementation as the PLC controller.
- This includes detecting the mode selector switch position, button presses and controlling LED indicators.

User Interface

- The user must be able to connect to the controller via a terminal for debugging.

GPS

- Receive GPRMC sentences and determine if the ship is outside a pre-defined geofence.
- If the ship is outside the geofence, the pump is safe to turn on.

Pump Control

- Control a pump via a relay.
- Detect motor faults and measure instantaneous currents via hall sensors and filters.

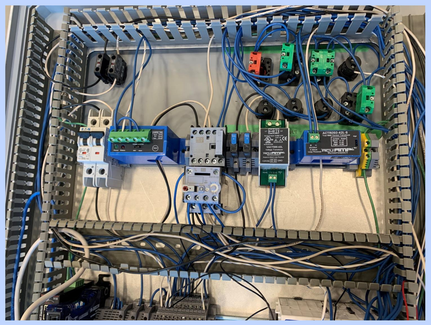
SmartGuard Instrument Hub

- Send diagnostic strings to the SmartGuard via UART.

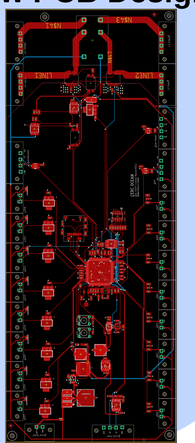
SD Card

- Send diagnostic strings to the SD card that is on the controller board (new feature).

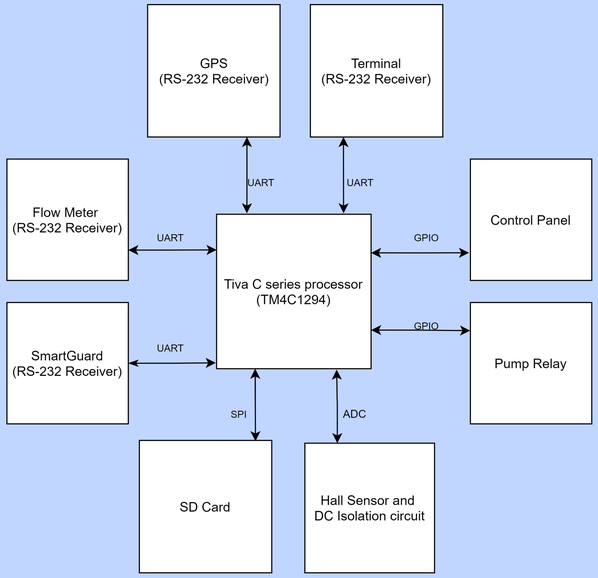
Old PLC Controller



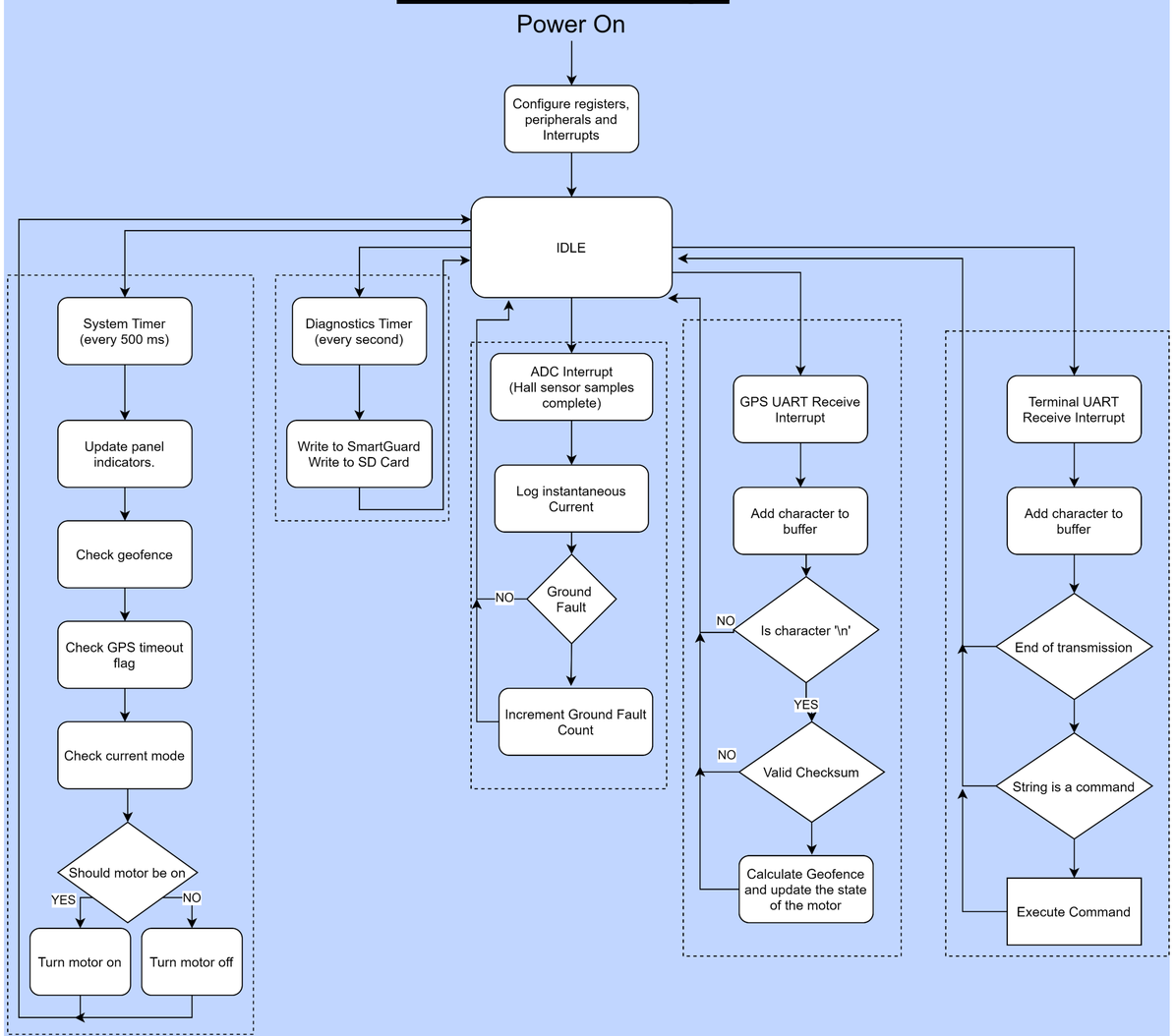
New PCB Design



Controller Peripherals

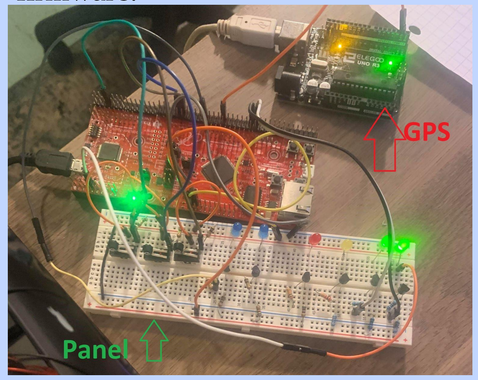


Firmware Design



Firmware Testing

- A GPS emulator was created and used to unit test the GPS firmware.
- A breadboard equivalent of the panel was created to unit test the panel firmware.



- An SD Card development board was used to unit test the SD Card firmware.

Hardware Testing

- Testing on the first prototype revision revealed several bugs that have been fixed in the latest revision.
  - Added multiple supports leg to reduce PCB flex.
  - The enable pin on the 5 V regulator was left floating
  - Modified the second order DC Isolation filter for less output ripple.
  - Isolated the high AC voltage signals from the DC ground.

Future Work Considerations

- Perform system level testing in real environment (with actual panel, GPS, pump).
- Revise software after system testing.
- A 4-layer PCB stack up could be considered.

References

- CERC.Ocean, "Dal-VOS", [Online], Available:https://www.dal.ca/diff/cerc/research/volunteerobserving-ships/VOS-system-design.html [Retrieved: March 26, 2021].