DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

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Dal-VOS System Controller

Introduction

The Dalhousie Volunteer Observing Ships (Dal-VOS) program takes scientific measurements from surface layer ocean water samples along the route of an existing vessel.

Currently, data processing is done by a Programmable Logic Controller (PLC). Unfortunately, the PLC is failing intermittently, and when operational, data is sporadically lost. To ensure validity of the scientific measurements, the system must be reliable.

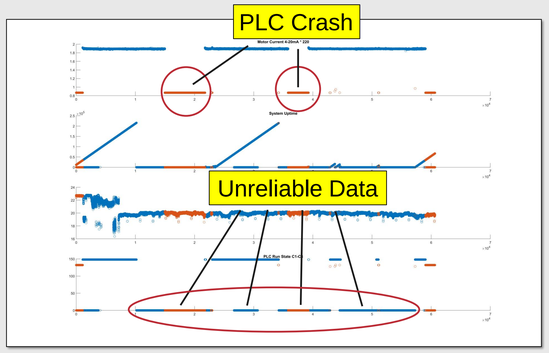

Figure 1: Matlab data loss analysis

Details of Hardware Design

- The TI TM4C1294 processor was chosen because of its 8 UARTs, 15 GPIO blocks and 24 12-bit ADCs encompass the design specifications.
- Two boards will be designed in order to separate the 120/220 VAC, 7 A water pump circuitry from the main PCB. The main will support the serial connections, voltage regulators and user interface.

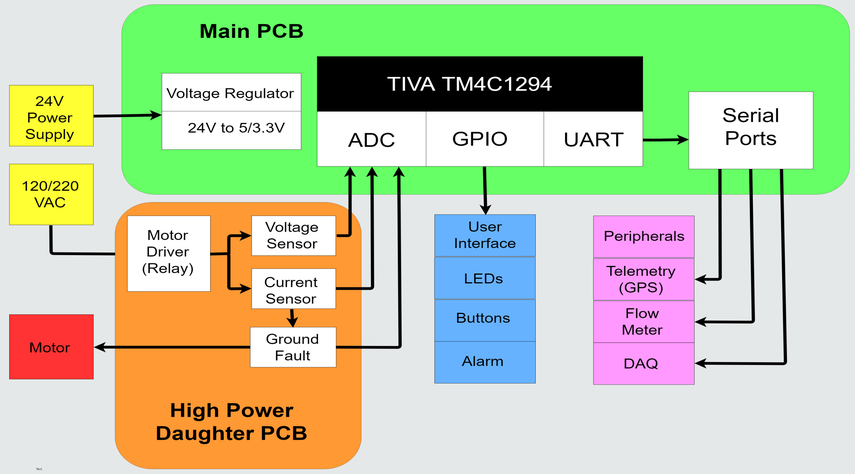

Figure 2: Conceptual Hardware Design

Future Work & Initial Conclusions

- Develop a PCB from the schematic completed in Term 1
- GPS Geo-Fence testing to be completed in Term 2
- Initial Software Design to begin prototyping in Term 1.
- Unit Testing of completed software components will be completed in Term 2 before testing the final delivered software.
- The new design will condense the current system (left) into a much smaller footprint and simplify system wiring.

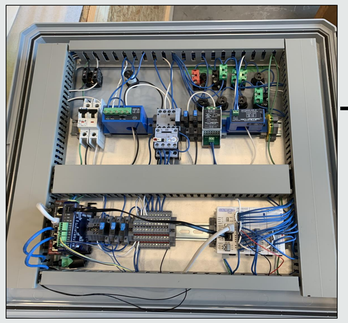

Figure 5: TI TM4C1294
Source: Digikey.ca

Figure 4: Current PLC & Monitoring Equipment

- Term 2 Objectives
  - PCB Design - Altium
  - PCB Printed – Manufacturer TBD
  - PCB Testing
  - Software Completion & Testing
  - Full design implementation of system

Design Considerations

- Our objective is to replace the PLC with a custom-built microcontroller. The new system must run the pump, gather GPS positioning data, control the user interface, and monitor system safety.

Performance Goals

- Continuous operation for months on end.
- Serviceability of motor drivers and sensors.
- Programmability of Microprocessor.
- Software fault checks to restore system to an operational state. (ie. WatchDog Timer, etc.)
- Implement hardware safety systems to monitor operation and shutdown operation when faults occur.

Details of Software Design

- The initial software concept is designed to be easily altered and expanded upon. The current design is a sequential flow which could be easily implemented as a ground up software or upon a Real Time Operating System (RTOS).
- The benefits of a Real Time Operating System are enticing due to the easy implementation of additions to the software and the preemptive flow control allowing us to set precedence on fault detection over other tasks.

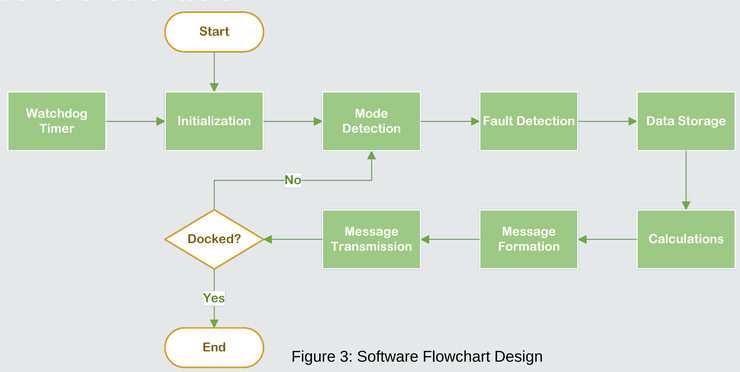

Figure 3: Software Flowchart Design

References

- CERC.Ocean, “Dal-VOS System Design”, [Online], Available: https://www.dal.ca/diff/cerc/research/volunteer-observing-ships/VOS-system-design.html [Accessed: March 1, 2019].
- Texas Instruments, “Tiva Microcontroller”, TM4C123GH6PM Datasheet, Jul, 2013 [Revised Jun. 2014].