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# Wind Turbine Control Interface Upgrade

## Introduction

- Molen Services, located in Dartmouth, Nova Scotia, has tasked us with configuring a PLC which will be implemented into a wind turbine's control system.

- The control system is currently equipped with an outdated PLC that is limited in both its capabilities and customization. It's graphical user interface (GUI) is also outdated, making it slower and more cumbersome to use.

- These issues are solved with the implementation of the new PLC model, whose components allow for the system to run more efficiently.



## Design Objectives

- The structured coding logic used by the current PLC must be implemented into the new model before it can be used in the wind turbine's control system. The configuration of the PLC is done with DirectSOFT5 ladder logic based software.

- The new GUI will have various features such as:
  - Higher Resolution
  - Touch Screen
  - Multiple Displays
  - Real-time monitoring



## PLC Performance Design

### Durability

- The components of the PLC are enclosed within a hard plastic chassis and are mounted to ensure as little movement as possible in order to protect the device's internal components.

### Lifespan

- Since the internal components are long lasting and built for sustainability / reliability the PLC is expected to be able to last for upwards of 25 + years, although it will likely be replaced sooner due to obsolete tech and eventual repair part shortages.

- Due to this, we could expect that the PLC would be updated sooner, potentially within ~10 years.

### Maintenance & Serviceability

- While many older PLCs can operate effectively, many lack quality of life features that are present in newer models.

- Newer PLC modules (such as the one we are tasked with configuring) can show the operation of various device features such as motor speeds, temperatures, fault sections, and more.
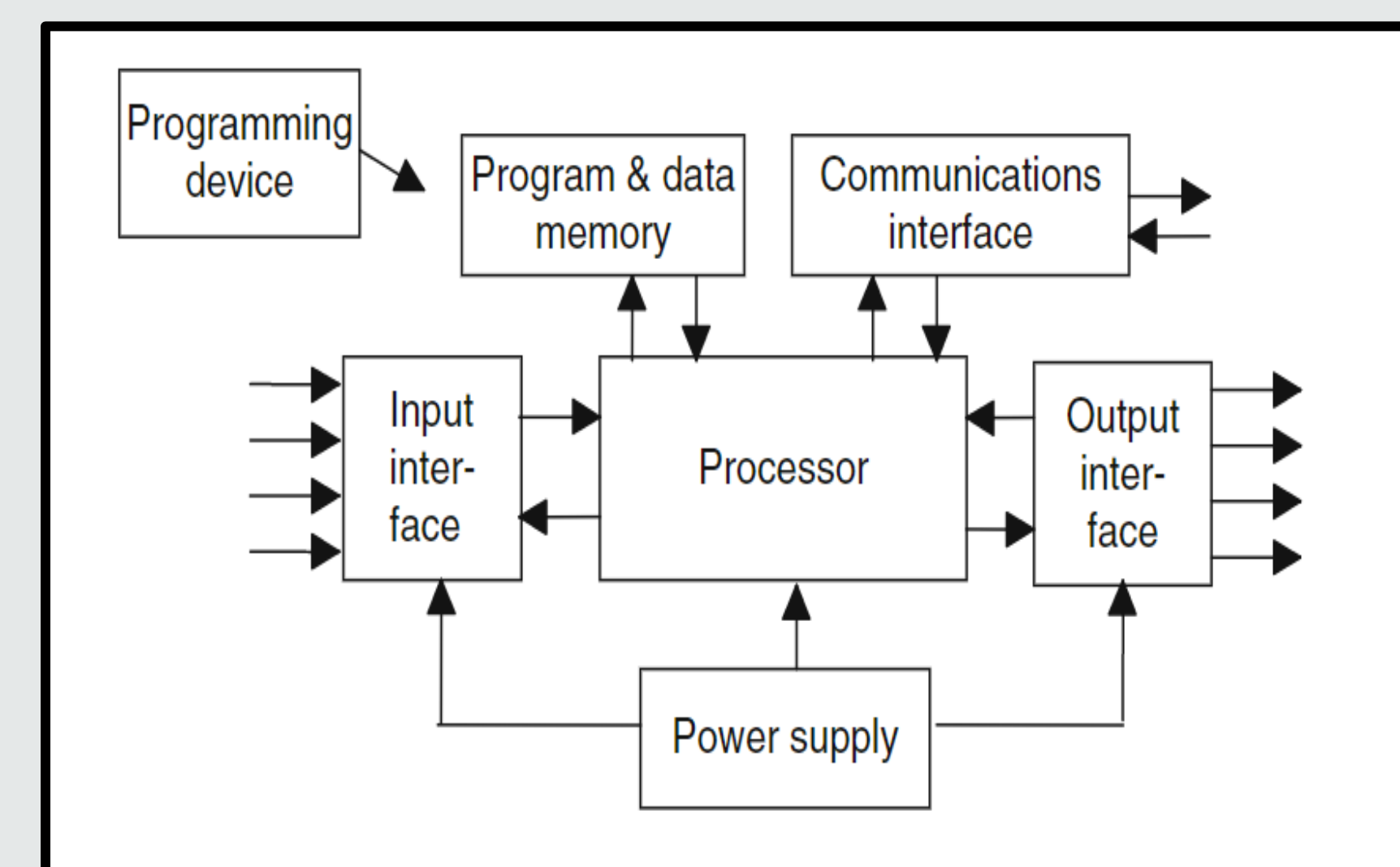


## Custom Graphical Interface

- The PLC's operator panel (C-more EA3-S3ML-R) is coded using the C-more Micro Programming software on Windows.

- Using the software for this model we can specify different screen states measuring various wind turbine components and create different graphics that are able to be interacted with using the physical keypad inputs, or custom touch zones on the panel. (below is an example EA3-S3ML-R screen state)



## Safety Features

- The PLC itself should not be the main factor of preventing any potential damage to the operating environment or maintenance personnel, and as an additional precaution should use external electromechanical devices (relays, limit switches, etc.) independent of the PLC's operation to monitor processes.

- PLC contains an orderly shutdown sequence to not cut active processes off during critical operation or create hanging errors within the code. This allows the system to be successfully reset and powered on safely following a potential need to have the wind turbine powered off.

## Task Assignments

- Our Project team is small (only 2 members), so it proved beneficial to share majority of tasks between both members, rather than dividing tasks among individuals.

| Assigned Task | Tasked Member |
|---|---|
| Analysis | W. Day, C. MacP. |
| Ladder Logic Fundamentals and Operation | W. Day, C. MacP. |
| Design Requirement Memo | W. Day, C. MacP. |
| Design Review Presentation | W. Day, C. MacP. |
| DirectSOFT 5 Implementation and understanding | W. Day, C. MacP. |
| Ladder Logic Implementation | W. Day, C. MacP. |
| PLC Interface Renewal | C. MacP. |
| PLC Testing and Applications | W. Day |

## Restrictions

- As a result of Covid-19 safety precautions, all team meetings are held virtually, and bug testing cannot be done off site.

- Alternative workarounds include bug testing code in a simulated environment, or (preferably) having Molen Services transport a PLC workstation to team members.

## Conclusion & Recommendations

- This project is scheduled to be completed by December 2021, however this could be concluded sooner with adequate testing available.

- For future reference, when configuring a PLC, it is very important to have a workstation. Without an effective means of testing the implemented coding logic, it is very difficult to make significant progress in successfully configuring the PLC.

## References

- Automation Direct. Directsoft5 User Manual. © 2007

- Molen Services. Project History © 2021. [https://molenservices.com/projects]

- C-more. EA3 Hardware User Manual. © 2021