JOINT INSTITUTE 交大密西根学院

VM450 • Design and Manufacturing III & VE450 • Major Design Experience

中烟机械 CHINA TOBACCO MACHINERY

Research on SC Data Interactive Modules and HMI under Domestic Linux Operating System

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Problem Statement

The tobacco packing line control system consists of servo controllers(SCs), programmable logic controllers(PLCs) and an HMI. The interoperability between different SCs and PLCs is achieved via various communication protocols. This project is to develop a software application that enables the connected machines to exchange information via multiple protocols, and provides the functionalities of data monitoring, diagnostics and alarming.

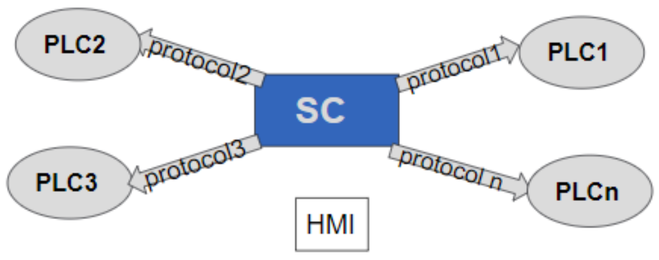

Fig. 1 The machinery structure of the tobacco packing line control system

Concept Generation

Integration of three communication protocols: OPC UA, Modbus and ADS is determined to satisfy the functional requirements. The programming language C# and the framework angular.js with electron are decided to stay in line with industrial trends and the corporation convention.

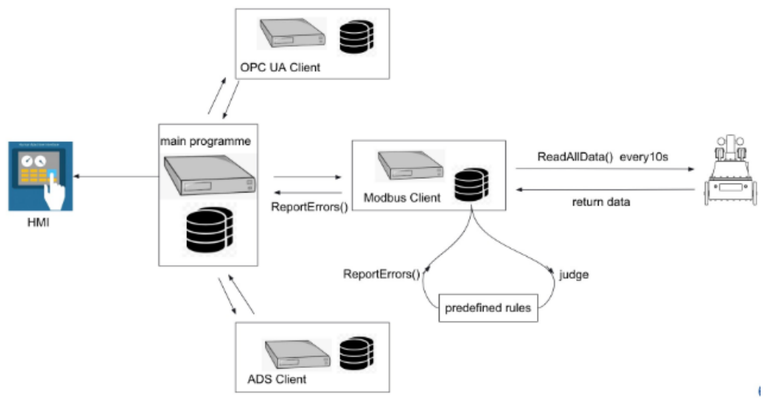

Fig. 2 Concept Diagram

Design Description

The design includes a STMC style front-end interface and a back-end server which communicates with the machine simulators. SignalR features are used to enable the front-end to monitor and get data from the back-end in real time, without sending the slow HTTP requests[1], so that users can subscribe to the protocol server and update the data without unnecessary delays. The back-end main program consists of three client programs, each working under different protocols, reading data from the corresponding machines and storing the data locally. It then judges whether there are any data anomalies based on predefined rules and send any error messages to the main program. The front-end then timely renders the reported errors on the interface.

Modeling and Analysis

To reduce redundant code and also for the sake of code readability and maintenance, we make abundant use of inheritance architecture in our back end code.

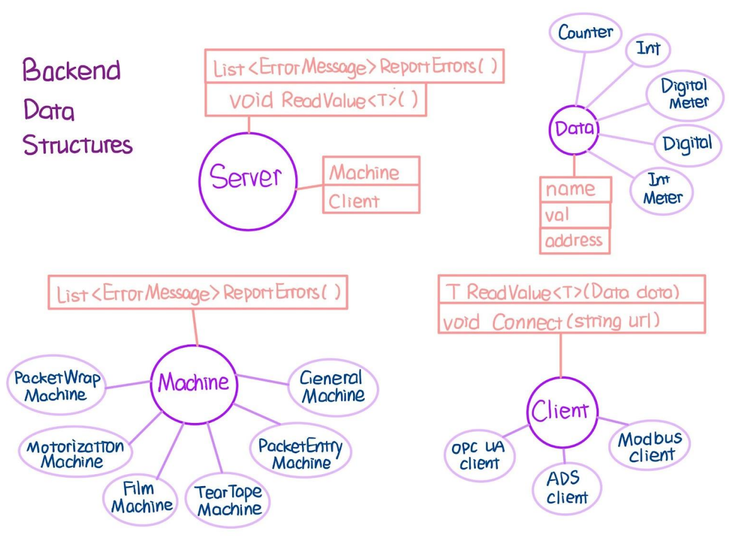

Fig. 3 The back-end data structures

Validation

Validation Process:
We will use pairs of server and client simulators for all three protocols to simulate the data change on actual machines. We use the client to write abnormal data to addresses on the corresponding server, and check whether the HMI can successfully render the error messages with correct information provided, as well as the total delay of the error messages. We will also manually examine the functionality of the UI components.

Validation Results:
According to validation part, most specifications can be met.

- ✓ Number of protocols supported = 3
- ✓ Delay of error messages < 10s
- ✓ Error reporting rate = 100%
- ✓ Error message time stamp accuracy <=1ms

√ means having been verified and · means to be determined.

Conclusion

C# has a rich library for OPC UA, Modbus and ADS protocols. SignalR helps the program to provide the expected functionalities of data subscription and monitoring. Selecting and connecting to the right protocol servers is the key to achieving the goal of multi-protocol communication.

Acknowledgement

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Reference

[1]http://dotnet.Microsoft.com/en-us/apps/aspnet/signalr