**Fieldbus Solution Design**

1. Overview

This project aims to design a Profinet-based fieldbus system employing a star topology to connect Siemens distributed IO modules, load cells, and controllers (Siemens T7 PLC and KRC2 robot controller) through a centralized Profinet switch.

1. Requirements
   1. Functional Requirements:

|  |  |
| --- | --- |
| Requirement ID | Requirement |
| 2.1.1 | The system shall be able to interface with Distributed IO. |
| 2.1.2 | The system shall be able to interface with Sunrise Instrument Load Cells (M4347D) and Control Box (M8128) |
| 2.1.3 | The system shall be able to interface with a Keyence LJ-V7000 Controller |
| 2.1.4 | The system shall be able to interface with Kuka KRC2 robot controllers |
| 2.1.5 | The system shall be able to interface with a PLC |
| 2.1.6 | The system shall be able to interface with a Workstation |
| 2.1.7 | The system shall be scalable for future expansion |
| 2.1.8 | The system shall operate with highspeed |
| 2.1.9 | The system shall have network security |
| 2.1.10 | The system shall be able to perform 24 hours a day with minimal downtime |

1. System Design
   1. System Components:
      1. Field Devices

|  |  |  |  |
| --- | --- | --- | --- |
| Device | Model | IP Address | Profinet device Name |
| PLC | Siemens S7-1200 | 192.168.110.101 | PNet\_PLC\_101 |
| Distributed IO | SIMATIC ET 200SP | 192.168.110.102 | PNet\_IO\_Mod\_1 |
| Distributed IO | SIMATIC ET 200SP | 192.168.110.103 | PNet\_IO\_Mod\_2 |
| Load Cell | M4347D  M8128 | 192.168.110.104 | PNet\_Load\_Cell\_1 |
| Load Cell | M4347D  M8128 | 192.168.110.105 | PNet\_Load\_Cell\_2 |
| Laser Profile Controller | Keyence LJ-V7000 | 192.168.110.106 | PNet\_KeyenceCtrl |
| Robot Controller | KUKA KRC2 | 192.168.110.107 | PNet\_KRC2\_RobotArm |

* + - 1. IO Module

The system will utilize distributed IO. IO Module 1 will be Rack 1, IO module 2 will be rack 2. The IO modules accept 24V to be able to communicate with field devices.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tag | Description | Type | Rack | Slot | Channel | Connection to Field |
| XS-01A | Active when the tool plate senses a tool is locked in place | DI | 1 | 1 | 0 | Prox switch |
| XS-02A | Active when the tool plate senses a tool is unlocked | DI | 1 | 1 | 1 | Prox switch |
| ZSO-A-01 | Clamp A, open limit switch, cell 1 | DI | 1 | 1 | 2 | 9.4 mm DIN |
| ZSC-A-01 | Clamp A, closed limit switch, cell 1 | DI | 1 | 1 | 3 | 9.4 mm DIN |
| Spare | Spare | DI | 1 | 1 | 4 | N/A |
| Spare | Spare | DI | 1 | 1 | 5 | N/A |
| Spare | Spare | DI | 1 | 1 | 6 | N/A |
| Spare | Spare | DI | 1 | 1 | 7 | N/A |
| XV-A-02A | Spindle Air Cooling Valve A Command | DO | 1 | 2 | 0 | 11 mm DIN |
| XV-A-02B | Spindle Air Cooling Valve B Command | DO | 1 | 2 | 1 | 11 mm DIN |
| XV-A-03 | Spindle Coolant Line Valve Command | DO | 1 | 2 | 2 | 9.4 mm DIN |
| Spare | Spare | DO | 1 | 2 | 3 | N/A |
| Spare | Spare | DO | 1 | 2 | 4 | N/A |
| Spare | Spare | DO | 1 | 2 | 5 | N/A |
| Spare | Spare | DO | 1 | 2 | 6 | N/A |
|  |  | DO | 1 | 2 | 7 |  |
| XS-01B | Active when the tool plate senses a tool is locked in place | DI | 2 | 1 | 0 | Prox switch |
| XS-0B | Active when the tool plate senses a tool is unlocked | DI | 2 | 1 | 1 | 9.4 mm DIN |
| ZSO-B-02 | Clamp B, open limit switch, cell 2 | DI | 2 | 1 | 2 | 9.4 mm DIN |
| ZSC-B-02 | Clamp B, closed limit switch, cell 2 | DI | 2 | 1 | 3 | N/A |
| Spare | Spare | DI | 2 | 1 | 4 | N/A |
| Spare | Spare | DI | 2 | 1 | 5 | N/A |
| Spare | Spare | DI | 2 | 1 | 6 | N/A |
| Spare | Spare | DI | 2 | 1 | 7 | N/A |
| XV-B-01 | Clamp B, Hydraulic Valve Command | DO | 2 | 2 | 0 | 9.4 mm DIN |
| XV-A-02A | Spindle Air Cooling Valve A | DO | 2 | 2 | 1 | 11 mm DIN |
| XV-A-02B | Spindle Air Cooling Valve B | DO | 2 | 2 | 2 | 11 mm DIN |
| XV-B-03 | Spindle Coolant Line Valve Command | DO | 2 | 2 | 3 | 9.4 mm DIN |
| Spare | Spare | DO | 2 | 2 | 4 | N/A |
| Spare | Spare | DO | 2 | 2 | 5 | N/A |
| Spare | Spare | DO | 2 | 2 | 6 | N/A |
| Spare | Spare | DO | 2 | 2 | 7 | N/A |

* + 1. Connectivity:

This system will utilize a star topology. This is to minimize any local outages causing any global outage for the system.

* + 1. Data Flow:

All field devices will communicate directly to the Profinet Managed switch

|  |  |
| --- | --- |
| Device | Model |
| Switch | MURR Elektronik 58825 |

* 1. Implementation
     1. Device Configuration:

Profinet Device Names (PDN): Each participating device will be labeled with a unique PDN for network recognition.

IP Addresses: Depending on necessity, static IP addresses can be assigned to each device, or DHCP can be enabled.

1. Security:

Firewalls: Set up firewalls to block redundant ports, allowing only Profinet and essential protocols.

The 110 Vlan has been delegated to the system by IT.

1. Conclusion:

With a star topology, this Profinet-based system is designed for efficient, secure, and reliable communication among Siemens distributed IO modules, Siemens T7 PLC, KRC2 robot controller, workstation and the central Profinet switch. This layout ensures direct communication routes and minimizes the impact of any single device failure on the entire network. Proper configuration and security provisions will establish a resilient and efficient industrial communication system.

1. Suggestions for future improvement

The hydraulic pump is foot operated, meaning an operator is required to for the system to get hydraulic power. In the future, a pump can be utilized on the PLC, giving it a run command and run status removes the need for an operator.