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PLC based Interlocking Management for high current DC Power supply and Monitoring with MODBUS

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ABSTRACT:

In this paper the digitization of power supply system is demonstrated. The benefits of digitization of power supply, in terms of fault detection and condition based monitoring is also proposed and presented. The remote monitoring of the system condition is done with the help of MODBUS protocol and Visual Basic. The interlocking logic has been implemented in Allenbreadly PLC.

I. INTRODUCTION:

Analog systems are bulky in nature and it is cumbersome to troubleshoot the Analog system. So, the digitization in existing system makes it easier to operate and easier to troubleshoot [1].

To develop the system integrity with PLC digitization is require. When any fault occurs in Analog system it is very difficult to identify and troubleshoot. So, digitization of the system will be the best solution. In this study only the interlocking and remote monitoring of the one power supply is considered among three power supplies[3].

The system consists of three power supplies as mentioned below:

1. Power supply - I
2. Power supply – II
3. Power supply-III

The capacity of Power supply –II is 20 KA. This Power supply is more complex rather than other power supplies. In any complex system it is necessary to maintain certain conditions to operate the system properly [2]. In this system it is also required to do interlocking like,

1. H.V. breaker off/on signals
2. Transformer faults
3. Pulse faults
4. Commutation faults
5. Earthing faults

6. Rectifier trip
7. Rectifier alarm
8. Pulses free command
9. Firing amplifier faults
10. Freewheeling Thyristor firing faults
11. Overload faults
12. Over protection faults
13. Control and pulses block
14. Earthing and DC isolators ON/OFF for both positive and negative converter and many more [6].

The objective of this paper is to reduce human efforts and how to make optimum testing and monitoring of the system through MODBUS. In this technique control cards and PLC's were used to show the status of system. The paper is arranged as follows, section I demonstrates the block diagram of the system, section II and III describes hardware and software, section IV explains results and section V represents conclusion and future scope.

II. BLOCK DIAGRAM OF SYSTEM

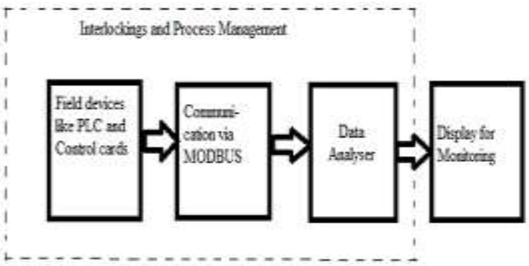

Fig (a): Block Diagram of system

Fig. (a) shows the block diagram of the system. It consists of field devices having PLC and control cards. Performance of the system is monitored through MODBUS communication .Data analyser is used to analyse data collected as date and timewise.

III. HARDWARE

The following hardware is used in this technique:
1. PLC.
2. LCD display.
3. Raspberry pi module.
4. Relay cards.
5. Control cards.

1. PLC: Programmable logical controller is used to interlock different faults which occurs in power supply system. In this study Allenbreadly's PLC, Micro Logix 1766 L32BXB is used. It consists of 32 digital and analog input/outputs [9].

Fig (b). Allenbreadly's PLC [9]

Technical specifications of PLC [9].

- Expandable up to 7 extension I/O modules.
- High speed counter up to 100 kHz for 6 channels.
- Two serial ports for DF1/DH485/MODBUS RTU/ASCII protocol.
- Ethernet port for serial communication.
- For monitoring purpose it has LCD with backlight.
- Input power: 24VDC.
- Memory: Non-volatile battery backed RAM.
- Serial port: 10/100 Ethernet/IP port.
- Floating point Math : yes
- Online editing : yes
- Operating temperature : -20°C to +60°C
- Storage temperature : -40°C (or -30°C) to +85°C

2. LCD Display:

Liquid crystal display is used to monitor and observe all the status of faults and all the readings. LCD is used to display analysed data also.

3. Raspberry pi module:

In this study raspberry pi module as shown in Fig. (c) is used as an intermediate stage. For acquiring data there is need of some hardware which can collect data to monitor and display [5].

4. Relay and control cards:

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Relay cards are the combination of transistors, resistors and LEDs. In this device 24vdc relay is used, that will provide normally open and normally close contacts. Control cards are used for various industrial applications.

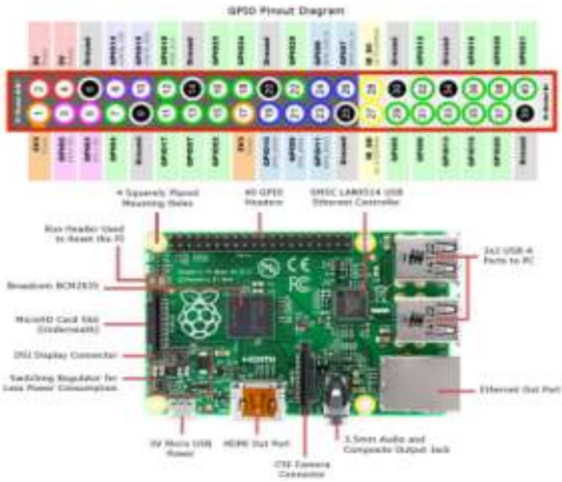

Fig (c) Raspberry pi 3 module

IV. Software

1. RS Logix 500.
2. RS emulator.
3. RS Linx.
4. Node JS
5. MODBUS Communication.
6. Visual Basic.

In this technique package of Rockwell software which consists RS Logix 500, RS emulator, RS Linx are used to develop programs.

Node JS

This is the latest environment which is used JAVA script for programming. Database can be developed to analyse all the data with date, time and for specific particular interval. So if user want to check the data time wise or date wise then that they can use this software [4].

MODBUS Communication

In this technique MODBUS protocol is used to communicate data server to client[8]. Status of the Faults and other conditions can be checked in Visual Basic software using MODBUS Protocol.

Visual Basic

This is the software which is used to develop GUI of the faults. GUI consists of number of faults which can occur in the Power Supply System.[7] By clicking on that particular faults it will show its inputs and outputs which are used to detect the fault and current status of that particular fault can also be seen.

V. Simulation Results:

1. Response in Visual Basic using MODBUS:

Fig. (d) shows the GUI of the system and current status of the fault can be shown using MODBUS. For example, Fig. (d) shows the rectifier ON/OFF fault which also includes its inputs and outputs in its separate screen. Status of the inputs and outputs of the rectifier ON/OFF can be seen according to the signals coming from PLC using MODBUS.

Fig (d): Main screen of faults

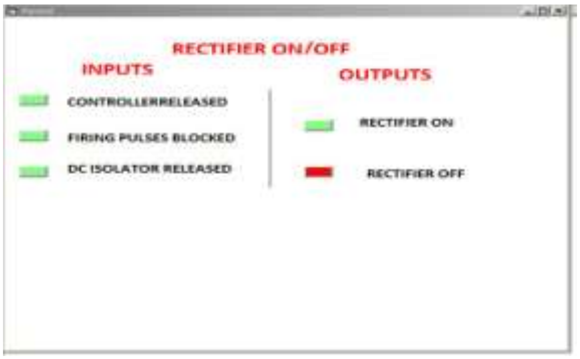

Fig (e): Inputs and Outputs

2. Response in NodeJS using MODBUS

Here simulations are available in Fig. (f) that shows how server will ask to client for data and server will provide particular asked data. Simulation results are shown below:

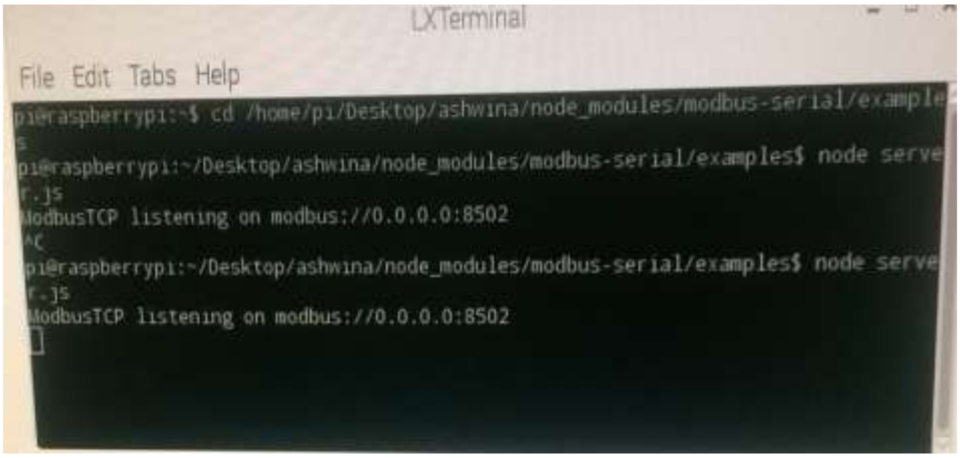

Fig (f) Server query

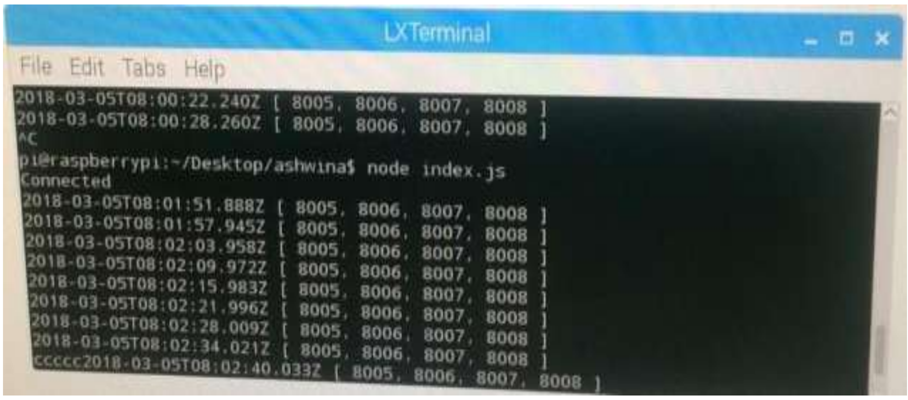

Fig (g) Client Response

VI. CONCLUSION:

In this paper interlocking of various power system faults has been implemented and monitoring of the power supply system has been carried out. The continuous monitoring of the power system can be done as well as data log also available for further investigation of the system performance.

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