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An Efficient and Compact Industrial Gateway for Modbus Serial to Ethernet Protocols

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ABSTRACT:A gateway is device that connects two networks. The protocol of the networks may be same or different. The different type of gateways with different protocols are available. In this paper, it proposes a design of the energy-efficient, compact and reliable gateway, which can be used in industry. It connects two devices with different protocols, where one protocol is Modbus RTU and other is Ethernet based protocol like PROFINET & Modbus TCP. It provides the facility to customers for selecting instrument from any vendor/manufacturer without any restriction related to data communication. This will help to reduce the overall cost. The data from the all devices can be collected at one platform to monitor, store and analyse it later.

KEYWORDS: Protocol converter, Modbus Protocol, Efficient Communication, Ethernet Communication.

I.INTRODUCTION

To receive the data, at control room or at remote station, from the field device the various types of protocols and communication systems are used. Different instruments have different protocols for communication. The data acquisition through different devices having different protocol to one server is very complex task. Also sometimes the older instruments are not compatible with latest technology and the replacement of the instrument requires high cost. To solve these kinds of problems, different types of gateways are used. The currently available gateways are very costly and consumes high power. These gateways supports pre-defined protocols only, which are configured by manufacturer in device. And if the change in any protocol is required than customer had to buy another gateway. The programing of normal gateways is very tough ask and a person without high knowledge of protocols and programming language is not able to configure them.

In this paper, it proposes design of efficient, compact and low costgateways. Also the communication is very reliable and connection are simple. It uses netIC with preloaded firmware. It supports all real time Ethernet protocols. The netIC is a complete 'Single Chip Module' in the compact dimensions of a Dual-In-Line (DIL) 32 pin plugin module. It is based on the network controller netX and contains all components of a Fieldbus or Real-TimeEthernet interface with integrated 2-Port Switch and Hub.The gateways also contains MAX3485 CPE transceivers to communicate with Modbus RTU based instrument. The instrument can be connected via DB 9 connector. The Ethernet protocol based client or other devices can be connected via RJ-45 connector.The MAX3232 CPA can also be connected with netIC in gateway if the on-board configuration of the protocols are desired. The Modbus RTU based slave devices are connected at one port of the gateway while at second port the master device is connected.Here, MAX3485 CPE is used so up to 31 slave devices can be connected. All components used in the proposed gateway are worked within 0 to +5V range which helps to reduce power consumption as compare to conventional gateways. The netIC contains inbuilt web server which can be used to set the IP address, subnet address, DNS server etc. So if any non-technical person wants to change or set the IP then he can easily set it buy simply using web browser. For security purpose the webserver can be secured with user name and password.

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II.RELATED WORK

For the design of industrial gateway, knowledge related to the various protocols and communication standards is required. For the study of industrial Ethernet protocols published paper "Ethernet-Based Real-Time and Industrial Communications" by J.-D. Decotignie,in Proc. of the IEEE, vol. 93, no. 6, 2005 is referred.For details related to Modbus RTU protocol, “Modbus application protocol specifications v1.1b3” April 26, 2012 by Modbus Organization is referred. For netIC related information manual of netIC by hilscher is referred.

II.SYSTEM MODEL AND DESIGN

The data from the slave device is acquired through various Modbus commands, which are configured in netIC during Configuration, to the Gateway periodically. This data is stored in register image at netIC. When the new data arrive from the slave device to gateway then it automatically replaces old data. Thus data storage in gateway is not permanent and the memory type is volatile. When the gateway communicate with master device, this data transferred to master device via Ethernet communication. Data transfer process in gateway is shown in FIG.1 below.

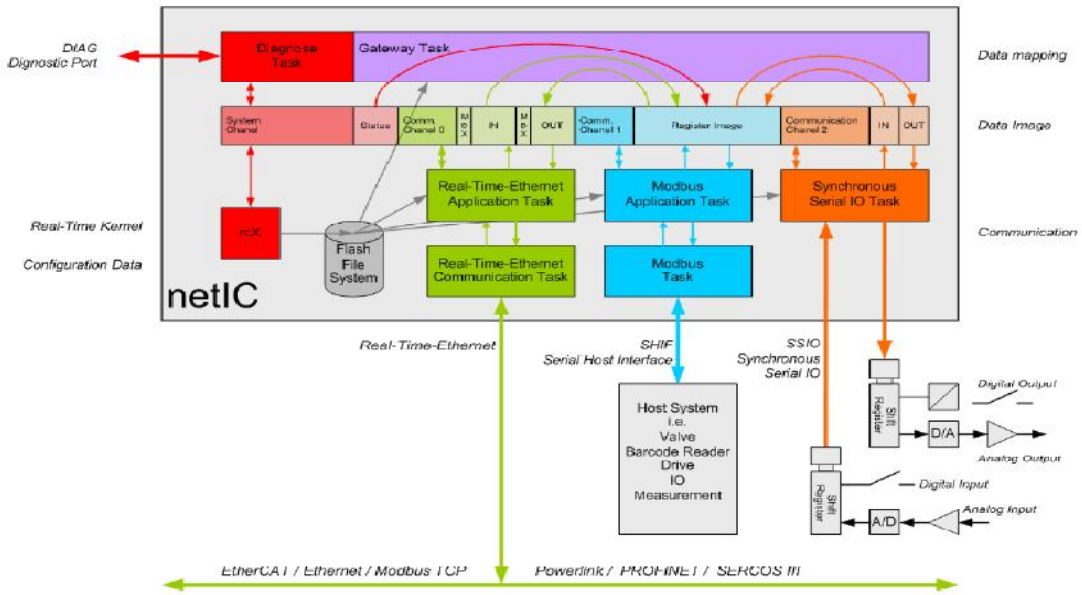

FIG.1 Data Transfer Process in Gateway

The configuration of netIC can be done by netX Configurator Tool. To configure the netIC the evaluation board is required. It can also be configured within the gateway via RS232 serial communication. The netIC can be connected to the PC via either of above two means. After connecting netIC to PC it can be configured by netX configurator. In the configurator the Real time Ethernet protocol can be selected. Other protocol is default Modbus RTU. In the configurator various Modbus commands can be selected to read/write data from/to the slave device. Baud rate and device ID can also be selected as per the slave device configuration. The serial connections like RS485, RS422 or RS232 for Modbus RTU protocol can be selected in configurator. After selecting all proper parameters, the configuration is downloaded in netIC.As shown in Fig. 1, when master device send the command to access any data or to write data, the data from master device is sent into netIC through real-time Ethernet communication and stored into register image via IN register. After that this data is sent to slave device or Host system via Modbus RTU. When data from the slave device is first stored into register image and then sent to Master device via OUT register and real-time Ethernet communication.

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V. RESULT AND DISCUSSION

The gateway is tested for PROFINET and MODBUS TCP protocol which are works on ethernet. The various slave devices with RS485 Modbus RTU communication is used for test the gatway. By using the gateway we are able to acquire data in scada and PLC simulatneously when we used PROFINET protocol for ethernet communication.

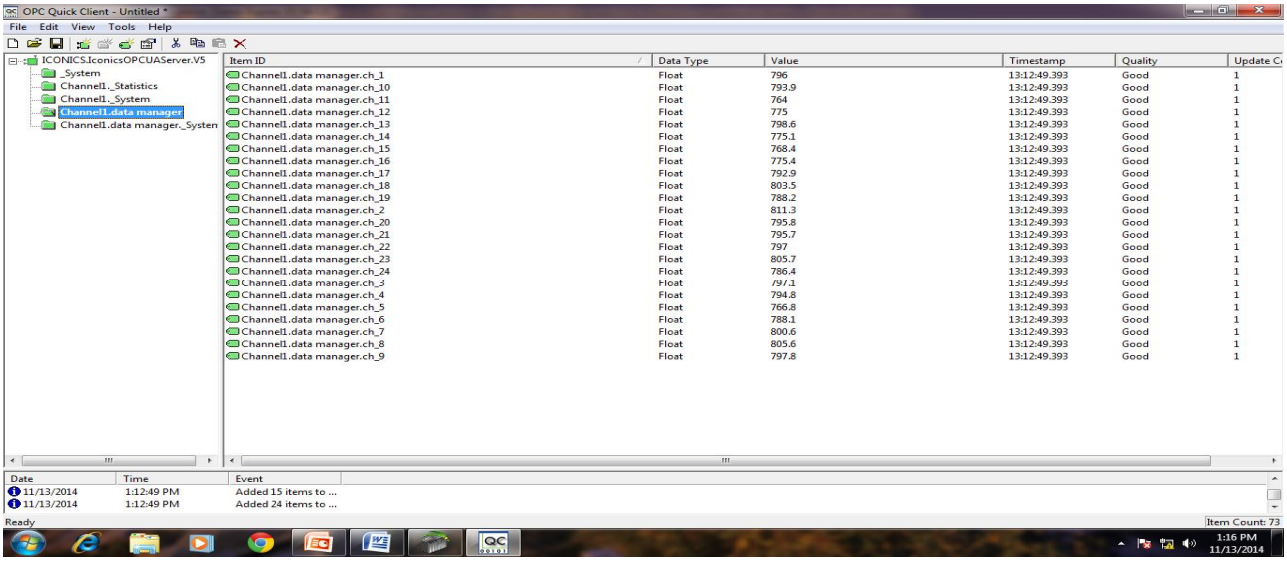

Fig.2 Data of RTD scanner acquired via Gateway

In FIG.2 data in the OPC serevr is shown. The slave device is 24 channel RTD scanner. In the fig the item id is the channel number of RTD scanner. Data type is the type of which is send by slave device and it can be changed as per specification of slave device. Value is the actual parameter data or temprature in degree celcious scanned by RTD scanner. Quality is related with communication. If the healthy connection is established then it will shownas “Good”. If the connection is with error it will show “Bad” and if the device is not connected then the quality will be “Bad(Out of service)”. Ethernet based Modbus TCP protocol is used to acuire this data.

VI.CONCLUSION

Thus this gateway can be used to connect two devices with different protocols i.e. Modbus RTU based slave device to Ethernet based device. Also it works on only +5V power supply thus it is power efficient. It supports all real time Ethernet based protocols as it was tested on two Ethernet based protocol. It’s very compact as it has very few components like three ICs and some resistors and capacitors.

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