Research Article

WEB BASED ONLINE MACHINE CONTROLLING AND MONITORING USING PLC VIA MODBUS COMMUNICATION

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ABSTRACT

In this modern world, the industrial sector has been shifted from the classical methods of control and automation all the industrial sectors are moving towards Automation and Control to the state of art technique. This turned the industrial sector to reach high growth and production. Over the past, Ethernet is used for communication with the microcontroller. But it caused collision/traffic in data compression while transferring data and also it is not suitable for real-time application. In the proposed system, PLC (Programmable Logic Controller) with MODBUS (Modicon) protocol is used to overcome those issues. The machine is controlled with the PLC and VFD (Voltage Frequency Drive) alerts the user when a fault arises. The data is controlled and monitored through a webpage and the webpage is developed using SQL YOG. Reliable transmission of data is achieved and process/target completion will be indicated automatically. Real-time applications are continuously monitored anywhere at any time and problems are easily diagnosed using the web. The system developed will be efficient and well secured.

Keywords : PLC; MODBUS; VFD; Webpage

INTRODUCTION

Today's increase in the competitive world all the industrial sectors are developing their product with good quality and high standard to attract the customers. They improved their designs and integrate automated devices in parallel. Industrial Automation facilities to increase the Product Quality, reliability and production rate and it helps to reduce production cost by new and innovative technologies. Automation takes industries to a new generation by manual operation of machinery which depends on human decision making. This technology results in automatic control and operation of industrial machines without the intervention of a human. In an industrial automation system, communication networks are the most prominent which provides data transfer from one level to the next level with a continuous flow of information. Some of these networks includers232,rs485,can bus, device net, foundation field bus, modbus, profibus, etc. The automation has turned the industrial sector to reach a high growth and production, which accordingly gives the products as a cost-effective one. But the use of ethernet will lead to data loss [1].supervisory control and data acquisition(scada) system is not a full control procedure but rather focuses on supervisory level[2]. As such, it is a total software package that is positioned on top of hardware to which it is interfaced in general via plcs or other communication hardware modules. The data to be logged and the rate at which it should be logged it must be dynamic and allowed to be changed by the assigned operator of the scada system[3].the remote monitoring of industrial machines with the features of analysis of the machine data to detect any abnormality in their operations and generating a report according to this analysis can be done. A centralized pc based remote multi-machine system has been developed, which measures different parameters viz. Input voltage, stator current, speed& supply frequency of electrical machines [4].various research teams have been developing their personal remote monitoring, maintenance and diagnostic units on engineering systems of their own choice with greater security in communication. Now-a-days, in corporate security system a vital role takes by physical access control [5-6] embedded systems. This spawned the development of software to capitalize on the electronic hardware and made it possible to more fully automate individual machines to supplement or replace operators. in ref. [7] it deals with the drive condition monitoring, diagnosis, research and development, highlighting analytical and technical considerations as well as various issues related to different failures. The online direct condition monitoring of different parameters of induction motor will help in diagnosis a prior of any failure of motor. Industry 1.0 is introduced in 1800, it is used in water and steam powered machines. Due these production capabilities, business growth can be increased. Industry 2.0 is developed at the beginning of 20th century. It is used in electricity production.

These machines were designed with their own power sources, making them more portable. Industry 3.0 is developed at the last few decades of 20th century; it is used in manufacture of electronic devices such as transistors. Industry 4.0 is current trend of automation in manufacturing industry .it includes internet of things, cloud computing, cognitive computing. Industry 4.0 is called as smart factory. Iot and iiot have similar characteristics like intelligent, availability and connected devices. The main difference between them is where they used. Iot is most commonly used for general purpose and iiot is used for industrial purpose. Iiot is developed to handle critical machines on the contrary iot uses a simpler application with low risk impact.in olden days, controlling and monitoring of industrial machines are microcontroller based. But now they are done through plc (programmable logic controller).plc is a ruggedized computer used in industrial automation. Controller controls the machine based specification given in the program.plc is used to monitor the crucial parameters and adjust the process accordingly.plc have major advantages such as high speed of operation when compared to other systems, high reliability and it can be used in harmful environment. Ethernet is not suitable for real time and interactive applications. In ethernet it is difficult to troubleshoot the problem. So, we go for modbus rtu protocol. The modbus rtu is a communication protocol based on master/slave model. Modbus rtu widely used in industries because it is an open protocol and this allows manufactures to use general purpose with a customized design.

Table 1: Specification of DVP14SS211R-PLC

| 32-bit CPU	
Max.I/O	480 points
Program Capacity	8k steps
Built-in Ports	RS-232,RS-485
Execution Speed	LD-0.35us,MOV-3.4us
Data Register	5k words
Support MODBUS ASCII/RTU protocol	
4 points of 10kHz pulse output -Transistor type(PNP)	
8 points of high speed counters:20kHz/4 points,10kHz/4 points	

Proposed Method
In this work, a webpage is developed to remote monitoring of multi-machines, which estimates different parameters such as voltage, output current, target, frequency, speed and fault occurrence in the electrical motors. Each motor is interfaced with the Programmable Logic Controller (PLC), which measure the above defined parameters with the help of Voltage Frequency Drive (VFD).All the parameters are communicated to a PC with the use of MODBUS protocol. The data from PC will be uploaded in the

database through which remote monitoring can be achieved.

Block Diagram
Various components are integrated into this section such as SMPS, Push buttons, Sensor unit, Testing Machines, Driver VFD, PLC, RS485, and RS232 serial communication buses.
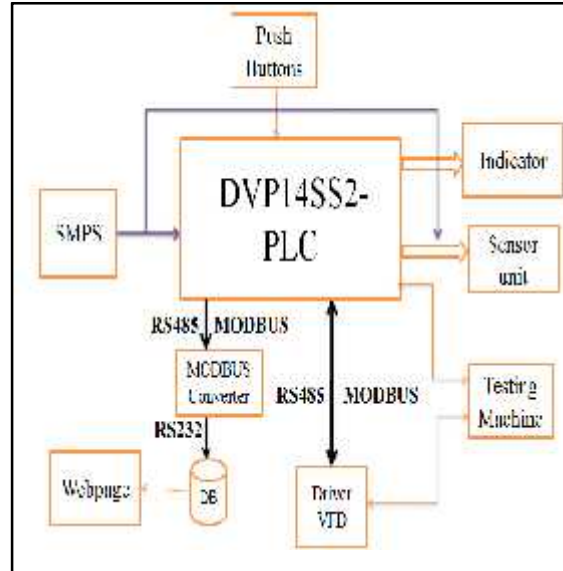
Fig.1: a block diagram of web-based online machine controlling and monitoring using PLC via MODBUS communication

Hardware Description

a. DVP14SS211R-PLC
b. VFD
c. RS485, RS232
d. MOTOR
e. SENSOR UNIT

DVP14SS211R-PLC
DVP14SS211S-PLCis a delta product. PLC is a specially designed computer used to control machines and processes. The three main core areas of PLC are: Power supply and Rack, Central processing unit, Input/output sections. PLC's replace thousands of relays and it is immune to noise and used in rugged environment. A set of instructions are programmed and executed by the user. Controller controls the machine based specification given in the program.PLC is used to monitor the crucial parameters and adjust the process accordingly.PLC have major advantages such as high speed of operation when compared to other systems, high reliability and it can be used in harmful environment.

VFD (Voltage Frequency Driver)
A Variable Frequency Drive is a motor controller. By varying the frequency and voltage supplied to the electrical motor it drives an electric motor. Other names are: Speed drive variable, Adjustable speed drive, Adjustable frequency drive, AC drive, Micro drive, Inverter. It is a power conversion device which converts the fixed voltage, fixed frequency of the

input power to the variable voltage, variable frequency output to control motor. Frequency is directly proportional to motor's speed. In other words, the increase in frequency increases the RPM. If an application requires an electric motor to run at particular speed, the VFD can be used to control the frequency and voltage to meet the requirements of the electric motor's load. As the application's motor speed requirements change, the can simply turn up or down the motor speed to meet the speed requirement.
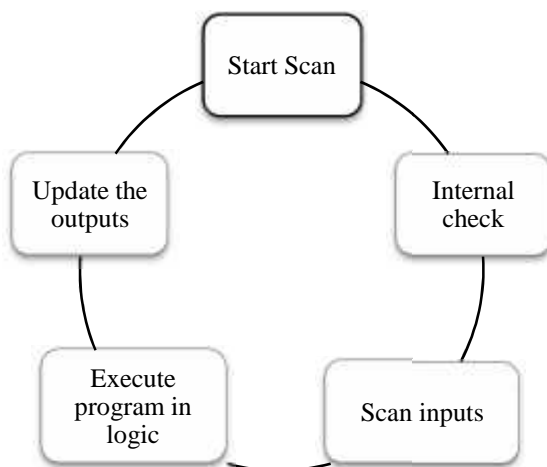

Fig. 2: PLC

Fig.3: Operation of PLC

Modbus

The Modbus ASCII/RTU is a communication protocol based on master/slave model. It uses RS485 and RS232 as communication medium. Modbus RTU widely used in industries because it is an open protocol and this allows manufactures to use general purpose with a customized design. The master initiates the task. To perform this task, master send request to slave and then slave performs particular task. The Modbus slaves measures system parameters and controls on/off devices in the system. The slave address ranges from 0-255.The usable range of slave address is 0-247 and addresses from 248-255 are reserved.

Fig.4: Delta VFD

Rs485

RS485 is used in serial communications system which defines the electrical characteristics. RS485 is used for long distance and in noisy environment. The data rate of RS485 is up to 10Mbps and distance up to 1200m or 4000ft.At higher data rates, cable length is reduced. RS485 specifies only electrical characteristics of generator and receiver. RS485 has one master and 256s slave. The master itself enables the communication. In RS485, the master send request to slave and it waits for response and then next request will be sent, so this avoid collision of data.RS485 is full duplex communication. The master itself enables the communication. In RS485, the master send request to slave and it waits for response and then next request will be sent, so this avoids collision of data. In Ethernet however have no built-in methods to avoid collision of data. With help of repeaters and multi-repeaters very large RS485 network is formed.RS485 is not protocol it is an electrical interface. It is used in Aircraft for low speed data communication. It is used in building automation for joining the remote devices. In theatre it is used to control lighting. It is used in model railways.

Rs232

RS 232 is a sequential correspondence information exchange link. It is a point to point game plan. It interfaces one gadget to another and the separation between two gadgets ought to be under 50 feet or 15 meters. This standard characterizes electrical flag qualities, for example, voltage level, flagging rate, timing and most extreme burden capacitance. The information is transmitted sequentially one way over a solitary information line. It pursues offbeat correspondence convention for example there is no clock flag to synchronize transmitter and collector. These days RS232 has been substituted by USB for nearby correspondence. RS232 is utilized in servo controllers, CNC machines, PLC and some microcontroller sheets which utilize RS232 convention.

Motor

Testing machine is single phase capacitor start and run motor. In this motor two capacitors are used. One is used for starting purpose and another capacitor is used for running purpose. Due to these capacitors high starting torque is obtained. The value of starting capacitor is larger compared to running capacitor. The running capacitor is permanently connected in series with auxiliary winding. When the motor speed pickups 75%of synchronous speed, the centrifugal switch is opened and the starting capacitor is disconnected from the circuit. The starting capacitor is used for developing high torque and the running capacitor is used to improve power factor. The capacitor start-run induction motor provides high starting torque, high efficiency up to 70%. It is used for low noise and high starting torque applications such as conveyors, compressors and refrigerators.

Sensor Unit

Proximity sensor is a sensor ready to identify the nearness of adjacent articles with no physical contact. It sends Electromagnetic Radiation. In view of the adjustment in field quality it will restore the flag. Types: Inductive, Capacitive, Ultrasonic and Photoelectric Proximity sensor. With the assistance of proximity sensor, we can examine whether the objective is accomplished or not.

Software Description

a.   PHP (Hypertext Preprocessor)
b.   MySQL

PHP(HYPERTEXT PREPROCESSOR)

PHP is a universally useful open source scripting language. It utilized for web improvement and it tends to be installed into HTML. The PHP code is encased in exceptional begin and end handling directions. For instance,
<? php and ?>

MySQL

MySQL is an open source social database the board framework (RDBMS).SQL represents Structured Query Language. MySQL is written in C and C++.The execution plot that gathers and totals measurements about server execution and inquiry execution for checking reason. It manufactures replication support with one ace for every slave numerous slaves per ace. It gives full messaging and seeking.

Working

The system controls and acquires data from the remote modules across long distance or from hazardous locations for endless monitoring. A power supply is provided with the help of SMPS which will distribute a regulated power to all the modules of the system. When the push button is clicked, the process begins. Machine/Motor starts to operate. Communication setup was established between PLC (Programmable Logic Controller) and PC using MODBUS ASCII protocol, where RS485 and RS232 serial communication buses were used to transfer data. Communication between PLC and VFD was established via MODBUS RTU. PLC is programmed with the help of Ladder Logic in such a way that Real-time machines performances were monitored solidly. If any contrast occurs, the process will be put to halt. All the data are stored in the database. The state of machine can be monitored by web interface .The web page is developed by using PHP and MYSQL. By using the webpage, machines can be controlled. Parameters like output voltage, current, speed, fault detection, torque and frequency can be monitored and controlled. The target value should be initialized first and once the target is reached the process will set to halt and the whole system will be re-initialized. When the system works, verification of its parameter and its value are displayed in both web interfaces and in PC.

Result And Discussion

The developed system has been tested with the motor. The remote monitoring of parameters of machine system was generated. The list box's are for the display of the samples data of instantaneous voltage and current, where the calculated values of speed, frequency. Once the target is achieved, it is intimated to the user with the help of web interface.

Conclusion

With this system, remote collection of data about the machine condition can be obtained. Solid monitoring of current and voltages of industrial machines were realized. Data retrieved from hazardous location or from remote area and verified using web interface.

Fig. 5: Experimental setup

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Fig.6: Webpage of machine control and monitoring system