PLC and SCADA Based Automation in Textile Industry

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Highlights

This Paper reviews how the **PLC** and **SCADA** systems are being used in industry, which is helping the industries to improve their productivity and quality of products. This paper will give you a brief idea about how the actual implementation of an automation system is done using Programmable Logic Controllers (PLCs).

Graphical abstract

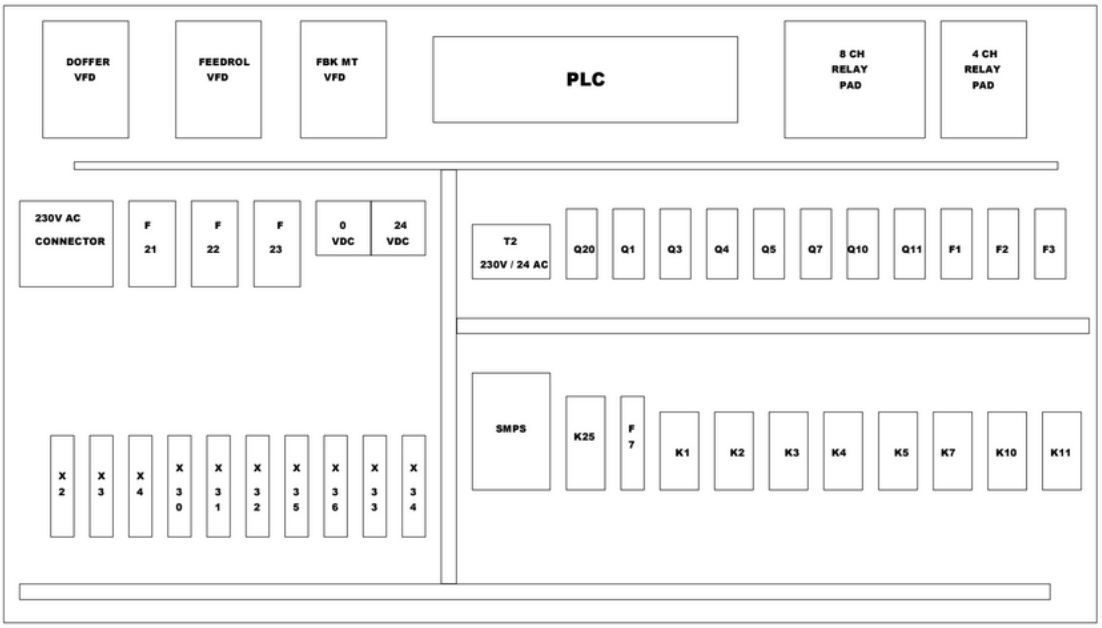

Figure 1 : The Block Diagram of the PLC Controller Implemented in the Textile Industry.

Abstract

Textile consumption is increasing in developed as well as developing countries, The expected percentage increase in the spent on textiles in the developing countries is much higher than the developed countries. As the technology advances the human involvement becomes less and degree of automation will correspondingly get greater. Here we have studied the implementation of PLC automation in the local cotton carding industry. This paper explains various stages of textile manufacturing processes in the textile industry and how we can improve them using automation tools like PLC and SCADA. The paper also highlights various advantages which have been achieved because of this automation.

Keywords: Automation, Textile Industry, Programmable Logic Controller (PLC), Programming Languages, Process Automation.

Introduction

Textile industry is one of the oldest industries existing until date. For most of recorded history humankind has relied on natural fibers, prominent ones being cotton and wool for its textile products. Gradually India has mastered the textile industry and its products gained fame worldwide. It was only after the industrial revolution in England when machines substituted man and production started on a large scale basis. The Indian textile industry got momentum after independence due to open government policies and import of technical expertise and machinery. Today the textile industry applied the scientific parameters to produce the products based on the consumers needs.

So changing fashions and desire for better quality has boosted the textile industry in recent years with the result that new units are being established while the existing ones are going for mass expansion and modernization. Earlier this time all activities were carried out manually, as complexity of the system increased the role of humans became crucial and we need to move towards the use of PLC and SCADA in Industrial Automation. Future scope of industrial automation would be good enough as every technology is involved with automation techniques. It is the use of various control devices such as PLCs to control various operations of an industry without significant intervention from humans and to provide automatic control performance. In industries, there would be a set of technologies that are implemented to get the desired performance or output, making the automation systems most essential for industries.

Textile Manufacturing Process

Textile industry can be divided into two segments based on their output- Yarn & Fibre and Processed Fabric. It can also be divided into two other segments based on the sector, first as Handloom & Handicrafts and the second as Organized Spinning, Weaving & Garmenting. Following sections mentions various textile processes and the automations taken in these areas.

1. Spinning
2. Carding
3. Weaving
4. Dyeing, Printing & Finishing
5. Garment Manufacturing

Spinning

Spinning is a procedure of producing/converting fiber materials in yarns. On an initial stage it goes through the blow room where the size of cotton becomes smaller by the help of machinery followed by carding. After carding, the process is continued by drawing which includes attenuating in spinning mills. The silver produced by drawing is then processed for combining where consistent size of cloth is attained. It is then stepped further for roving for the purpose of preparing the input package. This roving is attenuated by rollers and then spun around the rotating spindle.

Carding

In the spinning sector of textile, the carding process is known as the heart of spinning. Carding is defined as the reduction of entangled mass of fibres into a filmy web which is done by working between two closely spaced and relatively moving surfaces clothed with the sharp wire points. The significance of carding is still higher where new spinning systems are concerned.

Weaving

Weaving is the second level after spinning. Here, the yarn from the spinning section is sent further for doubling and twisting. It is then processed for shifting of yarn in a convenient form of package containing sufficient yarn length. At the stage of creeling the exhausted packages are replaced with the new ones which is followed by wrapping. The wrap yarn is provided with a protective coating to lessen the breakage of yarn which is called sizing. It is considered as an important segment. This yarn is then processed for winding on the weaver's beam supported by the final step of weaving.

Dyeing + Printing + Finishing

Dyeing as well as printing of fabrics are usually carried before the application of other finishes to the product in dyeing mills. It provides colour to fabric and also improves the appearance of it. The

product is then converted from woven to knitted cloth known as finishing. Finishing is specifically carried after dyeing or printing to give a specific look. Dyeing process has multiple stages e.g. Desizing, Scouring, Bleaching, Printing and Finishing.

Garment Manufacturing

Garment manufacturing is the end procedure converting semi-finished cloth into finished cloth. There are various steps completed by garment manufacturing companies for the production of cloth. These processes include- Designing, Sampling, Costing, Maker Making, Cutting, Sewing, Washing, Finishing, Packing, Final Inspection, Dispatch and much more.

Materials and methods

PLCs have been gaining popularity on the factory floor and will probably remain preponderant in coming years. Most of this is because of the advantages they offer, like Cost effectiveness for controlling complex systems. Flexible and can be reapplied to control other systems quickly and easily. Computational abilities allow more sophisticated control. Troubleshooting makes programming easier and reduces downtime. Reliable components make these likely to operate for years before failure.

The programming technique for t he first PLCs were based on relay logic wiring schematics. This eliminated the need to teach the technicians, electricians and engineers how to program a computer but this method has stuck and it is the most common technique for programming PLCs today. According to IEC 61131-3 five programming languages are defined for programmable control systems: LD (Ladder diagram), ST (Structured text), SFC (Sequential function chart), FBD (Function block diagram), and IL (Instruction list, similar to assembly language).

Here, for the automation in the cotton carding industry, we have used **Delta DVP-20EX2** Programmable Logic Controllers (PLCs). Specifications of these PLCs are as below -

Incoming and Outgoing signals of PLC are: -

Relay Output 24V DC
Input Devices rating 24 V DC
Programming capacity 16k steps
20 Digital Input
4 Analog Input
12 Digital Output (6 Relay,6 MOSFET)
1 Analog Output
Password protection - Yes

Problems Faced By the Industry

Due to the occurrence of overheating in DC motors during operation of carding process failure used to occur frequently. Due to intermediate operation caused by these types of failures of the machines , output of the machines decreased exponentially. Due to overheating of dc motors, durability and life span of the motor reduces and also the cost of a dc motor is more than ac motor . This increases the capital cost of the manufacturing process.

Improvements Made

To improve efficiency and reduce power consumption, we converted PCB control to PLC control. Also we converted DC drives to AC drives, which helped to reduce the converter losses and more. AC drives change speed more rapidly than DC motors. It also helps to improve the power factor of overall consumption which helps to reduce tariffs. AC drives increases durability and consistency and costing more over their operational lifespan. Also helped us to reduce the overall cost of manufacturing.

Drives Used in Automation

Main 3 AC Motor

Doffer Motor – 3.7kw/5hp.3ph

Feedroll Motor - 0.33kw/5hp.3ph

FBK MT Motor - 0.33kw/0.5hp.3ph

Other Drives

Cylinder Motor – 4kw/6hp.3ph

Flat Motor – 0.19kw/0.5hp.3ph

Suction Motor – 2.5kw/4hp.3ph

Can Motor – 0.18kw/0.5hp.3ph

FBK Fan Motor – 0.48kw/1hp.3ph

Results and discussion

Automation technologies have helped the textile industry to increase the output multiple times that too at a cheaper cost. Some of the key benefits achieved through automation are mentioned below.

Advantages of PLC Automation

1. Due to automation in the manufacturing process, it is becoming possible to produce more products in less time. Where previously work was done by workers, workers could not work non-stop But as a result of automation, products are now being produced non-stop.
2. Automation leads to reduced error of garments because human intervention is eliminated. This leads to the products with less defects, improved quality, and reduced rejection rates.
3. With less workers than before, but in less time. Therefore, the amount of labor wages in the production of goods in any sector has decreased.
4. Automation made it possible for the same tasks to be performed but with fewer hours of labor for employees
5. Technically skilled personnel are required to operate this equipment with modern technology and high quality. So, the demand for skilled textile workers is increasing with automation.
6. Automation has created automatic machine equipment to handle most of these processes by securing working conditions for all in the textile industry.
7. Improved data flow, reaction time and decision making.

Disadvantages

1. High initial installation cost.
2. Requirement of skilled laborers.
3. System requires a permanent power supply.
4. A higher degree of difficulty when hiring specialized and more expensive labor.
5. Maintenance cost is high.
6. Greater investment of time, money and effort in learning the latest technologies.

Conclusions

The automation of the design of industrial control processes has a history of strong innovations. PLC applications are typically highly customized systems so the cost of a packaged PLC is less compared to the cost of a specific custom-built controller design.Comparisons with earlier structures have increased the flexibility of PLC configurations, PLC computing, scan time, data processing, network communication, graphics display, and other functions. The PLC programming tools are constantly developing, so it can be used more widely in the applications of numerical control technology, control of machining centers which will be more flexible and reliable. Fault tracing in any part of the plant becomes quite easy. Ease of maintenance. The unity pro software uses ladder language

which can be easily understood by any person. PLC may be referred to as a mature technology as it uses different sensors that are connected to record actionable information.

Hence, it gives out an impression that it cannot provide more scope of advancement. Although, with the implementation of AI, cloud computing, big data analytics, PLC is also evolving. As a result, it plays a pivotal function in the future scope of industrial automation. Moreover, there are the latest tools that are used in industrial automation. Various aspects of manufacturing processes for instance are being affected. The aspects include PLCs, PACs (Programmable Automation Controllers), Supervisory Control and Data Acquisition system (SCADA), Human Machine Interface (HMI), and Robotics. Above all, these tools help the automation industry to improve productivity that leads to better profitability. Hence, The future scope of industrial automation lies with the development of these tools. As a result, offering energy efficiency, design advancements, and better safety protocols.

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References

[1] “Automation in the Textile Industry” , 1 Dr. Nitin S. Choubey, 2 Manish Agrawal 1 HoD Computer Science & IT Dept. NMIMS Shirpur, INDIA, 2 PhD Scholar, NMIMS, Shirpur, India

[2] “Application of PLCs for Automation of Processes in Industries ”, Rahul Pawar, Dr. N. R. Bhasme M.E. Student, Department of Electrical Engineering, Government Engineering College, Aurangabad-05, Associate Prof., Department of Electrical Engineering, Government Engineering College, Aurangabad-05

[3] “DESIGN AND IMPLEMENTATION OF LABVIEW BASED SCADA FOR TEXTILE MILLS”, Nirmal Bharat A1, N. D. Thakur 2.1 Electronics Dept., MPSTME, NMIMS, Mumbai, India 2Assistant Professor Electronics and Communication Dept., MPSTME, NMIMS, Mumbai, India

[4] “Automation of a Plain Weaving Machine using PLC ”, Prof. Mr. S. D. Gokhale, Mr. V. B. Kumbhar, Mr. P. P. Zirmite , Mr. S. P. Salgar,Professor, DKTE’s Textile & Engineering Institute , Electronics Department,Ichalkaranji, India.

[5] "Textile Industry in India," India Brand Equity Foundation, September 2015. [Online]. Available: http://www.ibef.org/industry/textiles.aspx. [Accessed 21 December 2015].

[6] A. Thakkar, "Automation in Garment Manufacturing - Its likely impact on advanced and emerging economies," in International Conference on Steering Mature Business - A leading challenge to the Textile Industry, Ahmedabad, 2009..

[7] Suvin Advisors Pvt. Ltd., "Current Scenario of Indian Textile Machinery Market & Future Prospect," Suvin Advisors Pvt. Ltd., Thane, India.

[8] R. Al-Ali, M. M. Negm, and M. Kassas, “A PLC based power factor controller for a 3-phase induction motor,” in Proc. Conf. Rec. IEEE Industry Applications, vol. 2, 2000, pp. 1065–1072.

[9] Rinchen G. Dorjee, “PLC and Fuzzy Logic