Paper Machine Automation using PLC, VFD's and HMI

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Abstract- **The focus of this paper is on the automatic working of paper machine at Ruchira Papers Ltd. This project including the upgrading of dryer section to improve the quality and quantity of their production . In traditional system only single motor was used to control the complete line which face difficulty of synchronization, mechanical wear & tear and the motor run at fix speed. A new controller was added with advanced drives system and enhanced display unit i.e. HMI to overcome the problems that are faced in old system. This system work with the combination of hardware and software which help them to extended equipment life through reduced mechanical stress , high efficiency, energy saving and highest possible performance levels along with speed controls.**

INTRODUCTION

In this research paper deals with paper machine automation. In paper industry when raw material, water and chemicals mixed together then the modern paper manufacturing requires and uses high technology tools like PLC, VFD'S and HMI to get a precise quality of paper . The modernisation of the conventional system by replacing the command parts like relays, contactors, timers by a modern tool like Programmable logic controller, to run the motor at various speed VFD is used and Monitoring systems get information from a number of motors and VFD's which help to assure the balanced flow of production, this can be achieved by using HMI or SCADA System. The primary reason for upgrading the system is to overcome the problem of synchronization, immunity to electrical noise, moisture, mechanical wear & tear and the motor run at fix speed. By implementing this project allows simple operation, decreases manpower and precision work.

PLC SCANNING PROCESS

A PLC (Programmable Logic Controller) is a real computer, which is also capable of receiving data via its inputs their sending command by its outputs.
As soon as we launch the execution of the program, the Controller will carry out three phases cyclically:
Phase 1: Snapshot of the status of its inputs
Phase 2: Program execution
Phase 3: Outputs activation or deactivation

At the end of Phase 3, the Controller returns to Phase 1, and so on.

PROBLEM FORMULATION

In today's industrial sector there are various factors like power or energy consumption, raw material & workers which affect the expenses of the industry. To reduce the operating cost and to increase the savings of plant we have to work on the above factors. Energy consumption a important area for cost reductions, since cost of energy is increasing day by day thereby harming both financial and environmental factors. There is need to save the electricity for our future generation, as the flow of energy is unidirectional in nature and is not cyclic. So, it is necessary that energy should be saved and overall efficiency of the system is maintained. In Paper Machine, the major problems are mechanical wear and tear, motors run at fixed speed , load sharing and synchronising the speed of different motor.

PROBLEM SOLUTION

The survey reveals that all the above problems can be achieved by using PLC,VFD and HMI which provide easy access and control of paper making machine .All of this great expansion of automation offers advanced technological methods which will results to reduce the faults, energy consumption, risk factors for serious and fatal accidents in the pulp and paper industry and reduced costs of production to improve their profitability and efficiency. The speed of motors should be adjusted in such a way that the tension of the paper from one roll to another roll remains constant.

AUTOMATION OF PAPER MACHINE

This structure aims at paper machine automation using PLC, VFD and HMI. In this structure PLC interfaced with the VFD through CANOPEN network and the RTU communicate with the HMI through Ethernet switch. The input commands are all given using HMI and the output are also displayed on the same HMI Screen.
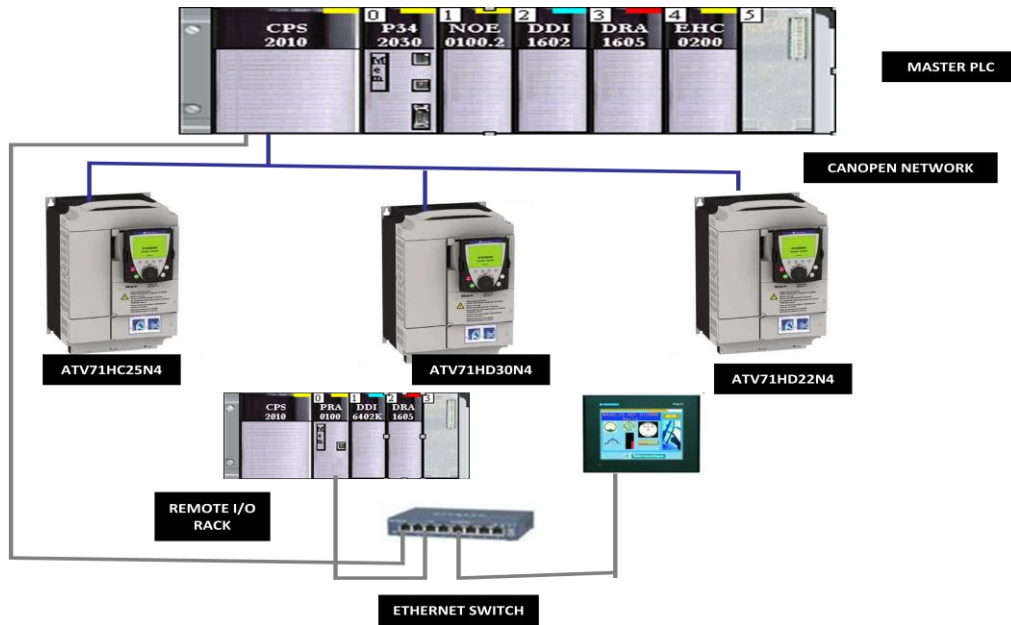
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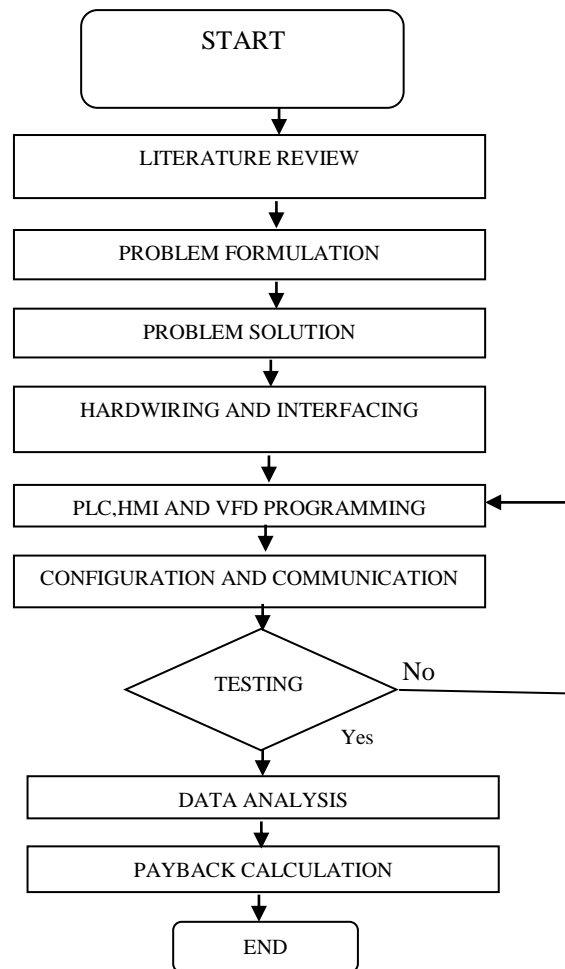
ENERGY SAVING

In a plant continuous load is motoring load, Due to continuous operation motors has to run all the working hours without any break and it is very difficult to run the motors without any fault for 24*7days even when they are loaded or not loaded and due to this lots of energy is also wasted. By using drives in controlling the motor, there is a saving of more than 20% of energy.

ENERGY CONSUMPTION OF 300 KW MOTOR OF OLD SYSTEM

Rated KW	300
RPM	1480
Efficiency	94
Rated Voltage	415 V
Rated Current	463 Amp
Load Current	440 Amp
Actual Power= (√3*V*I*Cos Φ)/1000	284 KW
Energy Consumption (Actual Power*No. Of Working Hours) per day	6831.2 KWH
Energy Consumption (actual power*number of working hours*350) per year	2390949 KWH

ENERGY CONSUMPTION OF MOTORS USING VFD

S no.	HP	KW	Energy consumption / year (KWH)
1.	20	15	138565
2.	30	22	159484
3.	40	30	228767
4.	268	200	1543247

Total energy consumption by 4 motors using VFDs/ year= Sum of all above 4 motors data.

=138565+159484+228767+1543247

= 2070063 KWH

TOTAL ENERGY SAVED & PAYBACK CALCULATIONS

Total energy saved = Energy consumption/year by motor - Energy consumption/year by motors using drive.

= 2390949-2070063 KWH

= 320886 KWH

Energy cost at Rs. 5.74/unit = total energy saved x 5.74 = 320886 x5.74 = 1841885 /-

Cost of drive panels and auxiliary material = 2516325/-

Payback period = (cost of drive / energy cost per year) = 2516325 / 1841885 = 1.36

Thus this capital is recovers within 1 year and 4 months.

RESULTS

This part of the study shows the outcome of the research obtained by calculation done for energy consumption before and after automation is shown in the form of chart figure.
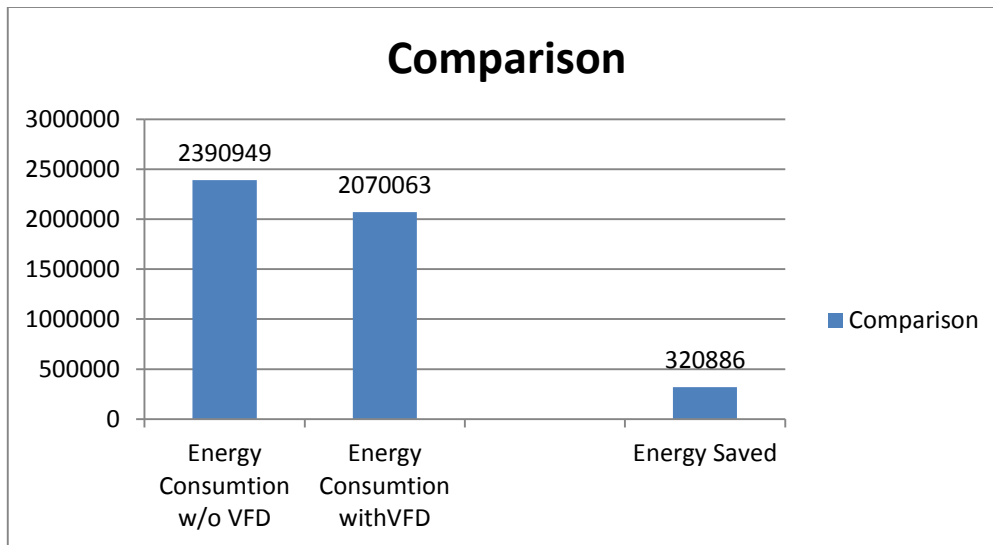
CONCLUSION

The results demonstrate that the modernization of traditional control for the machines can effectively handle by replacing the old components with new ones, made by (Schneider, ABB , Siemens, etc.) to maintaining the synchronisation , speed, load interruption and torque limits. By replacing all the electrical command parts with the PLC and by fetching digital and analogue signal through PLC and VFD and displaying the important parameters on HMI which also shows the current state of the machine. This will help the industry to fetch the maintenance history, enter new parameters and diagnose the fault this will help for future planning of different values in a organised way because stored data can be viewed by teams of experts. As a result, paper web breakage could be minimised while empowering sufficient usage of the machine drive effectiveness. Dryness is increased from 30% to 35% as the numbers of dryer sections are increased The energy consumption of the paper machine is reduced as the speed of induction motor is controlled by VFD can save energy according to affinity law.

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