Application of Drives and Automation in Pulp and Paper Mill

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ABSTRACT

The application of latest digital drives and state-of-the-art automation system to a Pulp & Paper Mill are described. The Drive and automation systems used are based on several independent processing units with dedicated functions. The data processing units are interconnected with LIN and LINK buses which communicates through gateway. Operator Station are based on colour, visual display units enables the operator to control display and analyse complete plant parameters. The paper delves on the importance and integration of the various drive system and the process control system on the common platform incorporating an integrated automation approach. This provides information accessibility and control from the board room where the requirement is more for integration with the main plant ERP systems to the shop floor where individual sections can be controlled. The systems are also designed with a redundant approach wherein a failure of communication from the shop floor to the board room will not effect the process controls.

INTRODUCTION

The use of distributed drives and control systems for process and power applications are growing rapidly during the recent years. The main motivation for distributing the functions of automation systems to several independent control unit or sub-stations is that data could be processed and used at the same place where it is generated. The distribution of functions will also increase the availability of automation system. The integrated approach visualized in this paper provides for the integration of the following sections in the pulp and paper mill. Stock preparation, paper machine, and paper impregnation.

The distributed system where high-speed buses are used will also have considerable decrease in the amount of cabling required because the same transmission lines are used for several signals in a mulplexed mode.

The digital realization of drive and automation system have several advantage as compared to a conventional isolated analogue system. The digital system is programmable which means that very advanced functions could be included in the system. The programmability is also the functions that can easily be changed even after the installation of the system. A digital system is also inherently more reliable than analog system because larger noise margins would be obtained.

A digital system could also accommodate advanced algorithms for fault detection and diagnosis. The use of colour visual display unit make it possible to decrease size of control room makes them better manageable. The flexibility of colour videos also allows very efficient man machine dialogues to be incorporated in the system. The use of the serial high-speed buses or communication means that it is ready to connect several operating consoles and have all the information available at each control console.

In APPM the following instrumentation and automation projects were executed:

- Digester
- Boiler and Steam Water Control
- ClO_2 Stock preparation and Bleaching

In ITC the following areas are revamped and executed:

- AC Drives for pulp sheeter for line shaft application.
- Digital DC Drives for paper sheeter and for super calendar application.

Process control and drive system

The system is very modular where the control is divided into two layers. The systems could functionally be divided into following groups:

- Management Information System Station- ERP
- Engineering System- Designing of Control strategy
- Control Room Station- CPU subsystem
- Plant Room Station- I/O subsystem

The engineering room station is responsible for designing the control strategies, development of the screens, and access control.

The control room is responsible for day-to-day operation of the various section of the plant by viewing, controlling and reporting.

The CPU subsystem is responsible for overall control.

The plant room station is responsible for collection of different signals like digital and analogue from various sub-sections like for ex. Temperature, pressure, flow etc.

Control on a higher hierarchy level would be arranged on a digital communication bus which enable integration of the plant data with the enterprises automation solution. This enables automatic transfer of data through relational databases and sharing of data with manufacturing and planning systems for seamless system integration from control to board room.

Hardware of the system

The typical system architectures and some of the screens for various operations of the paper plant are now illustrated.

Data transmission systems

Profibus

Designed for fast cyclic transfer of time critical data from intelligent devices such as temperature controllers, I/O units, drive etc. to a PLC or PC based controller. This is an easy to apply understand.

Lin

It is masterless taken passing peer-to-peer network conforming to IEEE802.4

Devicenet

A cost effective communication link designed to replace hardwired I/O interconnection between industrial devices which offers following advantages over other industrial networking protocols in view of its simplicity, device interchangeability open standard and reliable communication.

Link system

Link fibre optic distributed control system to provide a highly flexible control strategy. Link includes configurable analogue, digital and serial I/O modules that can be distributed on machinery to minimize signal and control wiring. There are no expensive I/O adapters or racks to worry about, and each module has its own application memory and processor to execute application software locally. Each Link component utilises high speed peer to peer communications over a real-time fibre optic network, eliminating the signal and control wiring between drives, operator stations and system I/O. The ability of the link modules to handle all the necessary machine control and sequencing eliminates the requirement for PLCs, reducing the complexity of the Drive Control System. At the same time, with one fibre optic cable replacing hundreds of

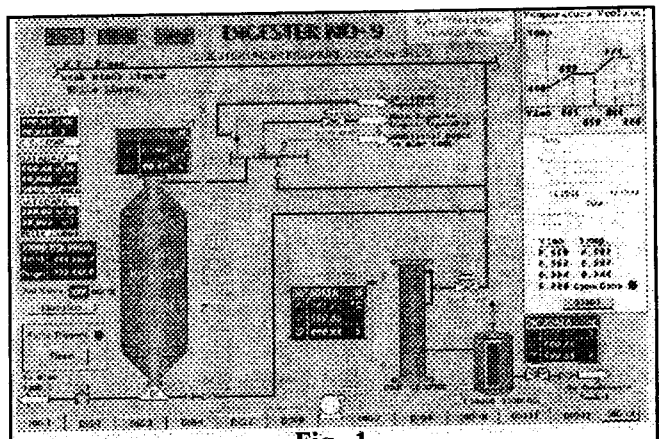

Fig. 1

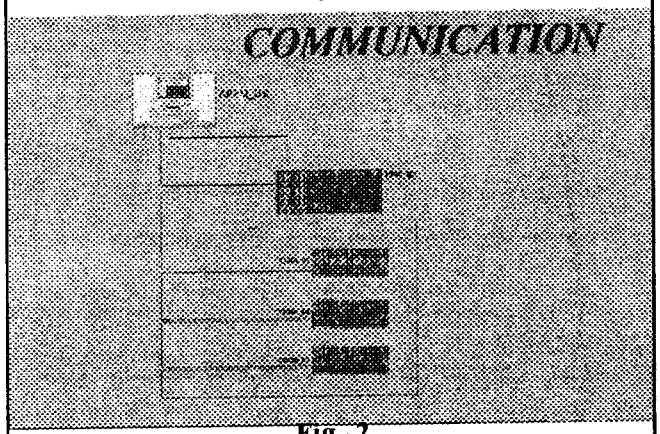

Fig. 2

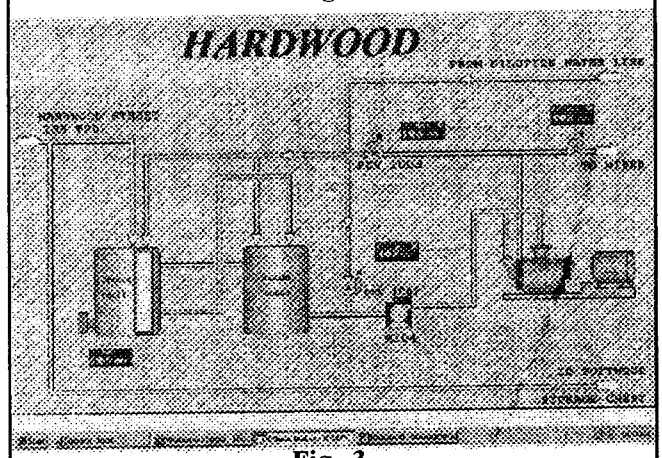

Fig. 3

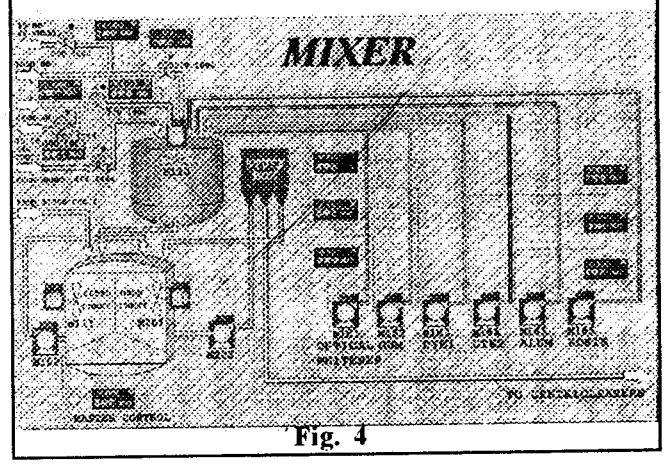

Fig. 4

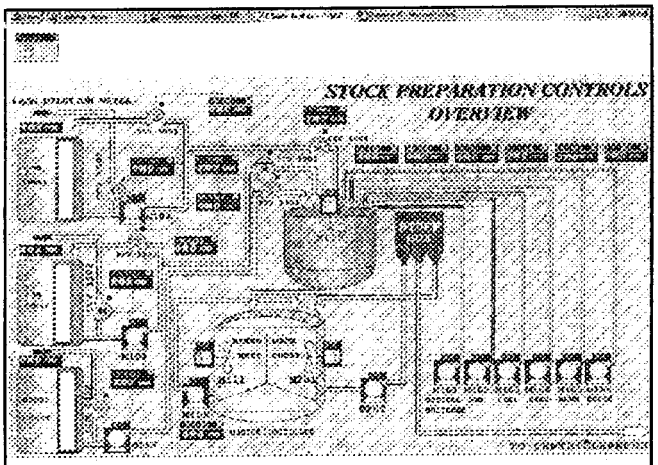

Fig. 5

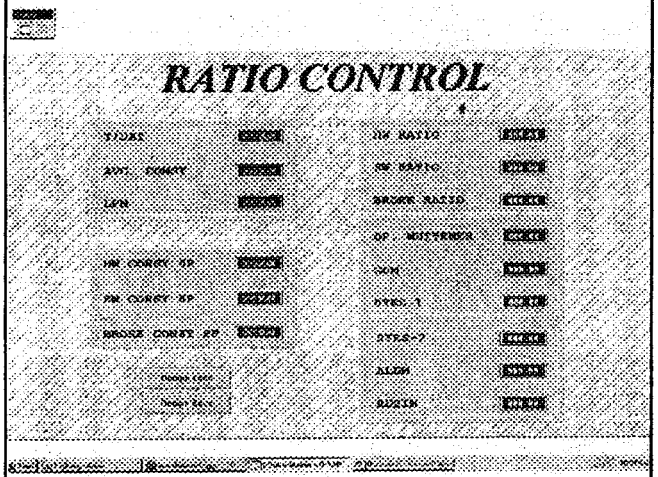

Fig. 6

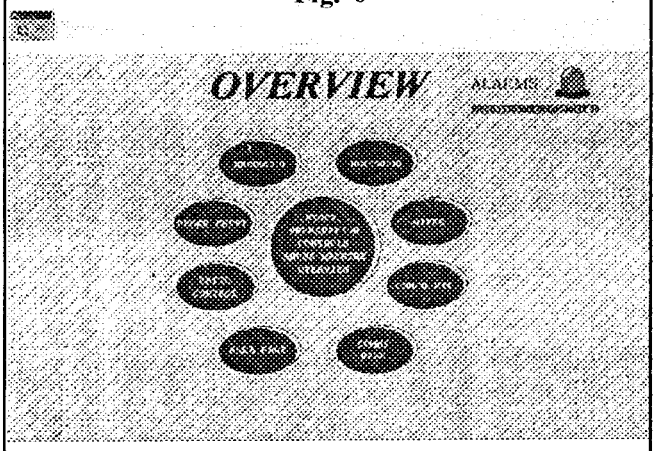

Fig. 7

wires, installation time and costs is dramatically reduced. A further advantage of the fibre optic network was its inherent immunity to noise, providing highly robust communications between all the required drives, operator stations and other control equipment.

The system implementation

Pulp Mill

(a) Digestor: An overview of this is has been given

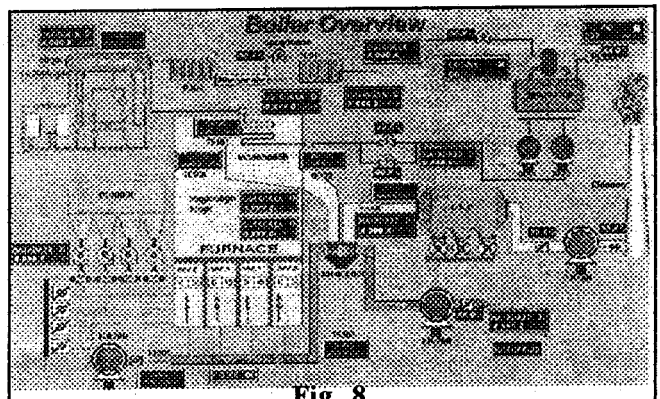

Fig. 8

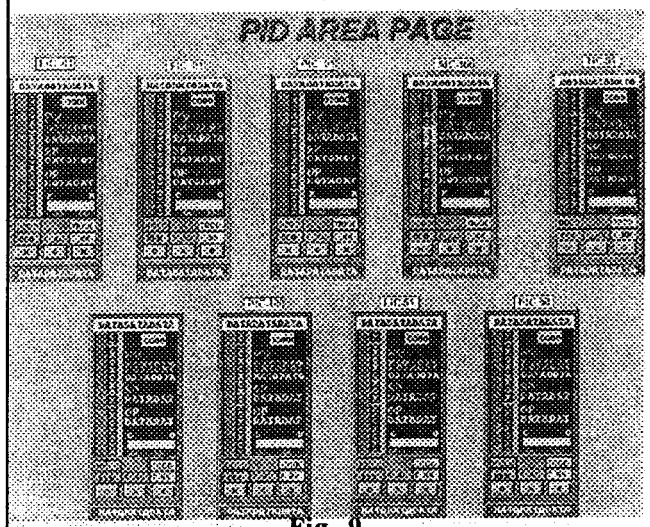

Fig. 9

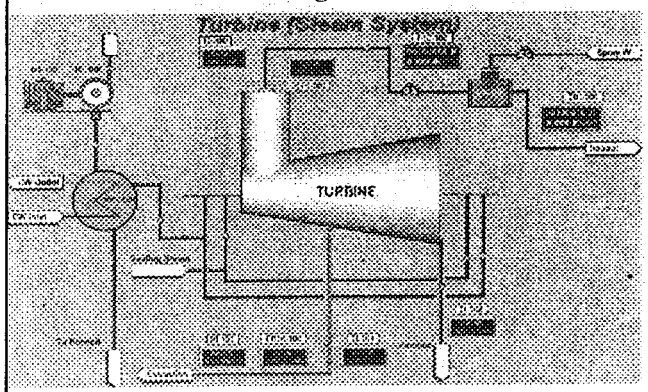

Fig. 10

in Fig. 1. This consists of 9 digesters where temperature profiles are set. The total system has around 40 closed loops for temperature, pressure and level and around 20 digital inputs and outputs for interlocks.

(b) Stock preparation: An overview of this is has been given in Fig. 2. The stock preparation hardware system consists of

- 3 Nos. racks of Eurotherm T2500 data acquisition and control system.
- 2 Nos. of Eurotherm T940 Process Supervisors.
- 1 No. Development station which permits

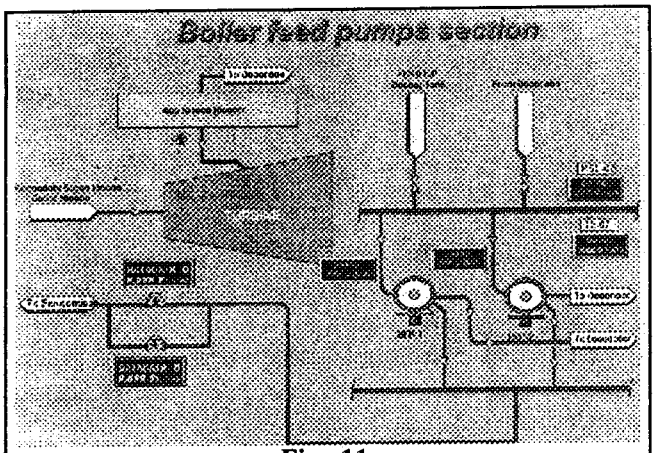

Fig. 11

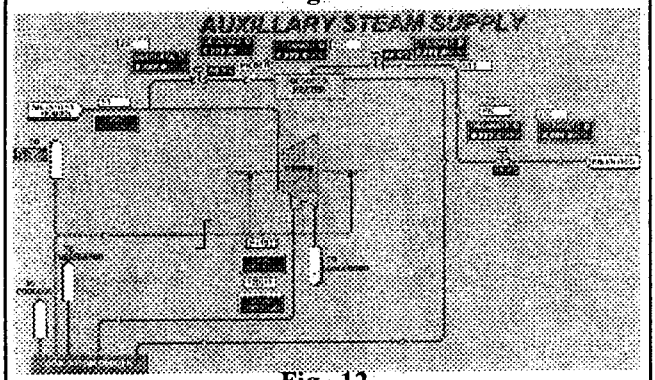

Fig. 12

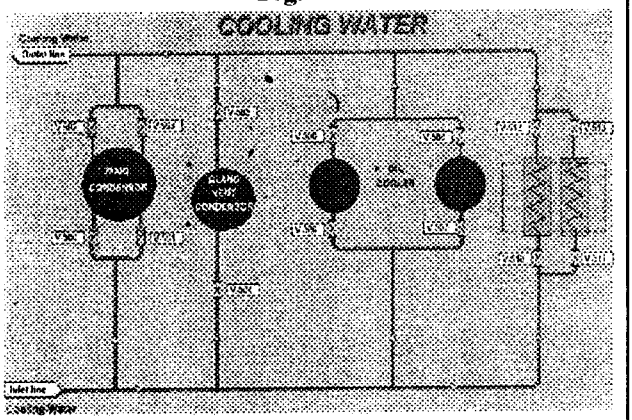

Fig. 13

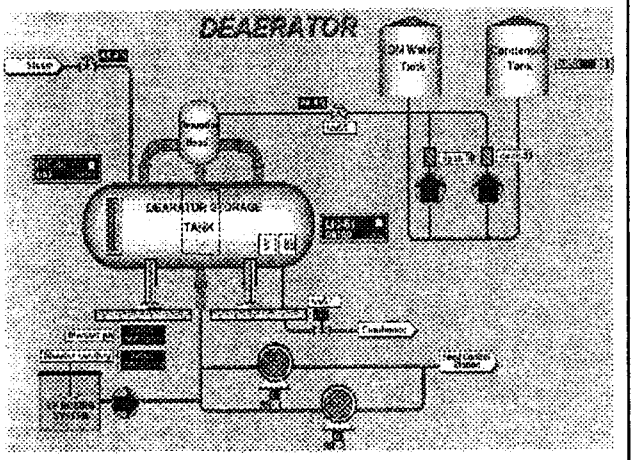

Fig. 14

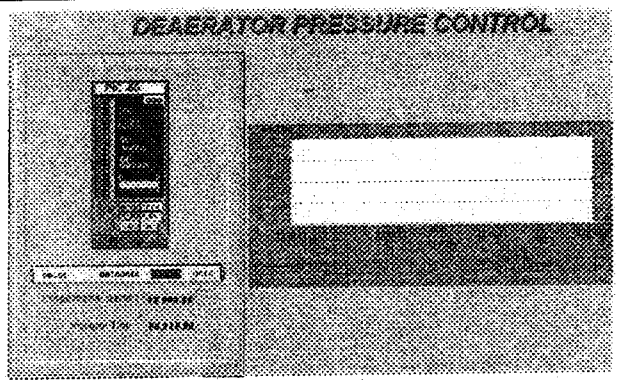

Fig. 15

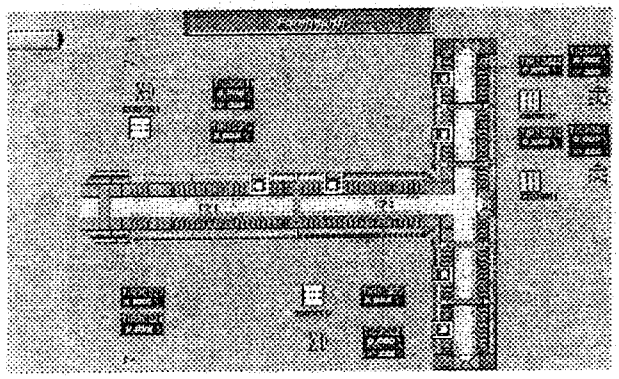

Fig. 16

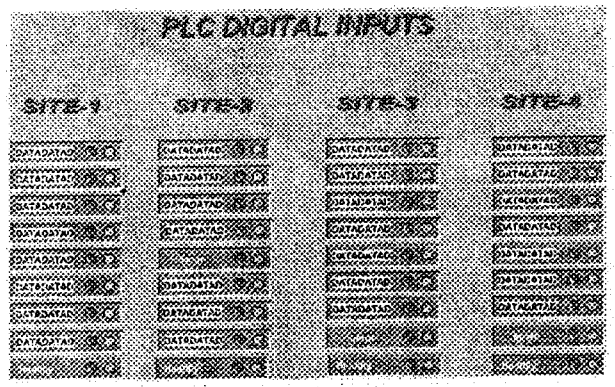

Fig. 17

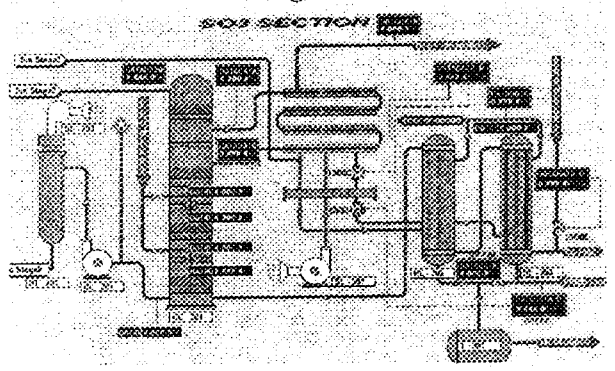

Fig. 18

development of control strategies viewing of plant mimics and report generation.

Paper Mill

(a) **Pulp Sheeter Drive:** 250 KW Line Shaft digital

AC Drives

(b) Paper Machine Drive: Digital DC Drives. Overview of these given in Fig. 3.

Power Plant

The power plant automation consists of 32 Analog Inputs out of which 8 are in closed loop control and 40 digital inputs and outputs for interlock. The controls are on the following:

a) Single and three element drum level control.
b) ID, FD control damper in furnace pressure control loop.
c) Combustion control loop for damper control and cold feeders and stockers as per process requirements.
d) Interlocks to the ID, FD and secondary Air fans, Coal feeder and stoker and Ash Conveyor System.

Typical screens are indicated in appendix 4. Type of boiler Stocker type - coal fired boiler.

CONCLUSION

The new process control and Drive control system which got installed in the above mills have offered the following advantage as compared the conventional system.

- Cabling cost drastically reduced.
- It is easy to realize complicated control algorithms
- The control room is considerably smaller than the conventional design.
- The process control and motion control systems can directly interfaced to the centralized control system.
- The steam, air, water were optimized and improvement in quality of the output, reducing the cycle time, better operator and diagnosis procedures and failures.
- Energy conservation.
- System improvement.
- The advantage of digital control systems means that the decision-making capability is greatly improved by seamless integration of the all the information available rather than having isolated islands.
- The information gathered also provides invaluable process knowledge.

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