

Intralogistics in the Pulp and Paper Industry

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INTRODUCTION

Abstract

This paper explores the development and integration of automation in the pulp & paper industry to enhance operational efficiency, productivity, and safety. More specifically, the automation will focus on six-axis anthropomorphic industrial robots and autonomous mobile robots (AMRs). The paper discusses the challenges faced by the industry, the benefits of automation, and the application of material handling bales of cellulose and removing the wire to hold the bales together during transportation (de-wiring) prior to placing the de-wired bales into the pulper. Additionally, the paper addresses implementation considerations, including technical requirements, and human interface, to foster successful adoption in the industry.

Introduction

The pulp and paper industry plays a vital role in global economies, producing a wide range of essential products. However, it faces challenges to efficiency, safety, and environmental impact. The emergence of automation offers potential solutions to address these challenges and revolutionize various aspects of the industry. This paper provides an overview of six-axis industrial robots and AMRs and their applicability in the pulp and paper sector.

Challenges

The pulp and paper industry confronts several challenges, including labor shortages, rising operational costs, stringent safety regulations, and the need for increased sustainability. These issues necessitate innovative technologies to optimize processes, improve productivity, increase personnel safety, and reduce environmental impact.

Six-Axis Industrial Robots: An Overview

A robot has become an ambiguous term and can encompass a variety of categories. Our focus is on six-axis anthropomorphic industrial robots, sometimes called robot arms (see Figure 1). These robots are the most ubiquitous robots used throughout the manufacturing industry. They are accurate, fast, and dexterous.

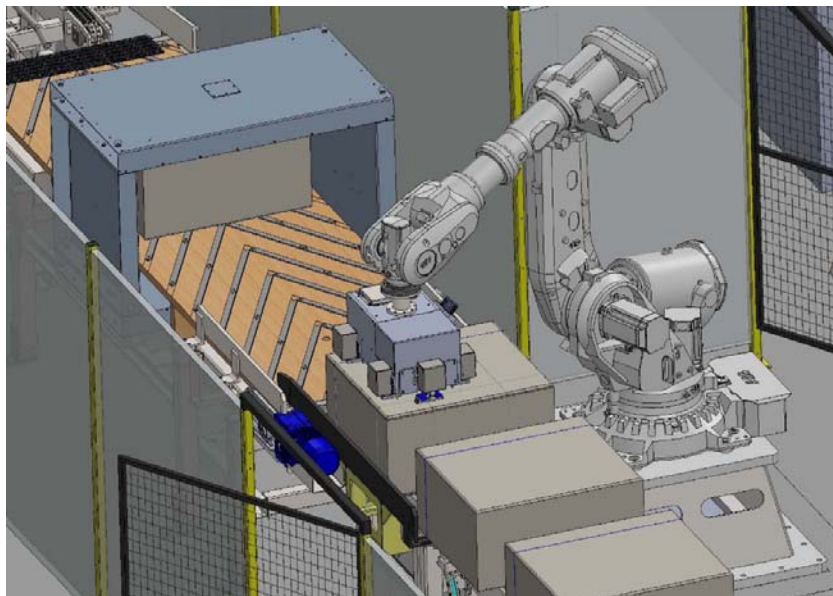


Figure 1

Autonomous Mobile Robots: An Overview

An AMR is more of a vehicle than a robot, however, it has been called a “robot” and therefore, for the purposes of this paper, will be continued to be referred to as a robot. AMRs work in fleets or multiple AMRs controlled by one fleet manager. This manager maintains the status of each AMR and gives it its mission based on priorities programmed in the fleet manager software. Polytec has been developing and installing AMR’s, mostly for material handling.

Polytec’s propriety navigation software enables each AMR to navigate and interact with the given environment safely and effectively. Its sensors scan the area in real time to ensure the accuracy of its location, but the sensors are also a safety system that checks for obstacles or obstructions in the path of the AMR including human personnel to avoid collisions. The brains of the system is the fleet manager, which maintains constant communication with each AMR, plans its missions, prioritizes the missions while allowing for manual override of the mission priorities. An additional feature is the ability to monitor the system remotely for production management or remote troubleshooting should there be a problem that requires service.

Polytec offers a variety of AMRs. The smaller AMRs are shown in Figure 2. These AMRs can handle loads of up to 500 kg, and are narrow enough to fit through tight corridors. The Voyager S50 (a in Figure 2) has lifting capabilities which allow for the AMR to move underneath structure assemblies with a load and lift them off the ground so that they can be transported to a programmed location. The Voyager N50 (b in Figure 2) has a small section of a belt conveyor to move bins from the AMR to a fixed conveyor at either the beginning or end of the manufacturing process.



Figure 2

Polytec’s standard AMR, the Voyager 200, has a lifting payload of 2 metric tons (c in Figure 3). This load can be moved anywhere in the facility that has been mapped and in a preprogrammed path. Similar to the Voyager N50, the Voyager 200XL (e in Figure 3) has a section of motorized roller conveyor placed on top of the AMR. This allows it to receive bins or pallets, transport them, and roll the payload onto another fixed conveyor. Finally, there is the Rolls Royce of AMRs. The Voyager 200R (d in Figure 3) has a combination of AMR and industrial robot on top. This combination allows for maximum flexibility and increasing the capabilities of the platform. The sensors that are used for the AMR’s navigation are also used as safety sensors for the robot while it is in motion. In addition to these standard solutions, Polytec also customizes AMRs for specific requirements.



C VOYAGER 200

PAYLOAD	2000 kg
LENGHT	1300 mm
WIDTH	950 mm
HEIGHT	490 mm



d VOYAGER 200 R

INTEGRATED ROBOTIC ARM BRACCIO ROBOTICO INTEGRATO

PAYLOAD	30 kg (arm) - 2000 kg
LENGHT	1300 mm
WIDTH	954 mm
HEIGHT	1902 mm



e VOYAGER 200 XL

SURFACE WITH INTEGRATED AUTOMATIC ROLLERS SUPERFICIE CON RULLI MOTORIZZATI INTEGRATI

PAYLOAD	2000 Kg
LENGHT	2006 mm
WIDTH	1868 mm
HEIGHT	555 mm

Figure 3

Applications of Automation in the Pulp and Paper Industry

Automation is more than just robots and AMRs. There is a great deal of effort in implementing a system that is robust and improves production. The entire plant can be a large data gathering system that is fed into a controller that uses that data to make decisions and run various programs. The robots and AMRs, for example, are the tip of the spear, but there is a controller that tells the robot what to do and when to do it. This solution in its entirety is the essence of automation.

The most appropriate application for AMRs is in material handling. They can be utilized to transport cellulose bale at the start of the process or at the end of the process for handling the finished product (see Figure 4) reducing manual labor and minimizing the risk of accidents. The information from the AMR can be sent to the fleet manager for maintaining real time inventory status.

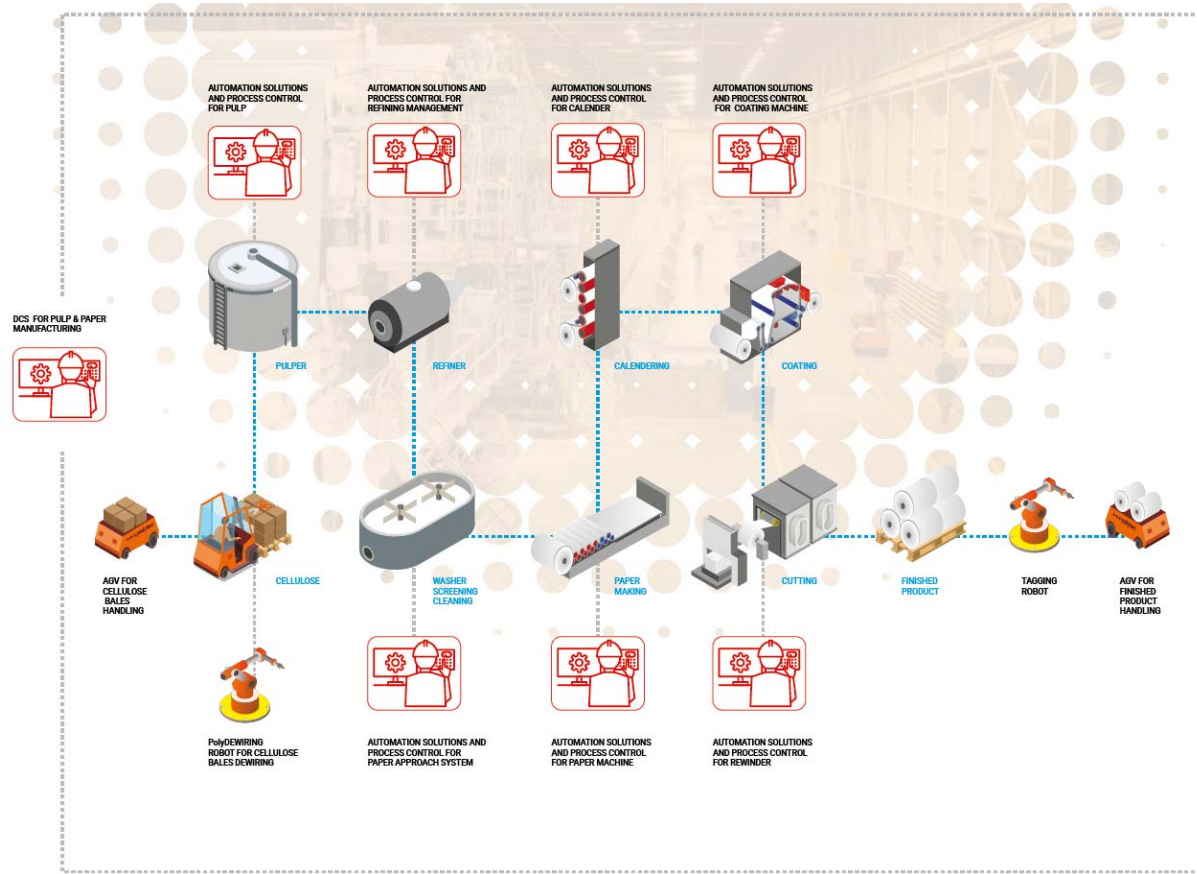


Figure 4

Polytec has vast experience with industrial robot integration. These projects include the pulp & paper industry where the robot is used to remove the wire strap for the cellulose bales prior to its entry into the pulper (see Figure 5). The bales come down a conveyor towards the robot. Once it reaches the work area of the robot, the robot uses 3D vision sensors to locate the wire. The robot uses a specialized end of arm tool that has the vision sensor as well as the cutting tool to cut the wire after the vision system has relayed the location of the wire to the robot.



Figure 5

Benefits of Automation

The main benefit of automation is enhanced safety. AMRs and robots can handle repetitive tasks, protecting human workers from exposure to harmful environments and reducing workplace accidents. AMRs and robots can also work tirelessly and consistently, leading to improved throughput and reduced processing times. Although initial costs may be high, as with most capital investments, the long-term benefits of reduced labor costs, minimized downtime, and optimized resource utilization make AMRs and robots cost effective in the long run. Automation systems collect vast amounts of data, providing valuable insights into production processes, enabling data-driven decision-making to optimize operations further.

Implementation Considerations

Prior to installation, certain technical requirements must be evaluated first of which are the spatial constraints. The AMR can navigate through narrow corridors, but the path must also be considered. Even though the AMR has safety features that will stop the vehicle if a person is in the direct path of the AMR, the payload which it carries might cause an accident and potentially harm someone. People can be in areas where AMRs operate, but it should be a low traffic area for people and equipment such as forklifts. The floor of the facility must also be kept to a somewhat clean area with minimal debris. The AMR can operate in an open indoor environment, but not in an outdoor environment. The work area of the robot must be isolated from human personnel. Safety features with redundancy must be implemented. The final consideration is the return on investment. As with any capital investment, a company must conduct a comprehensive cost-benefit analysis to determine the viability of deploying AMRs.

Conclusion

The integration of robots and AMRs into the pulp and paper industry represents a promising opportunity to overcome various challenges while enhancing safety, productivity, and environmental sustainability. By considering the technical, economic, and social aspects, industries can adopt and leverage robot and AMR technology effectively. Through continuous innovation and collaboration, the pulp and paper sector can embark on a transformative journey toward a more efficient and sustainable future.