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Computerization in Material Management for Mattress Industry

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Abstract: Most of the medium-scale mattress manufacture industries carried out their processes manually and they do not have proper storage management systems and software applications for handling all the processes automatically, where most of the processes are repeated continuously and are carried out manually with labor-intensive work. Which consumes more time and Space and is more prone to errors and damaging of products. So, the focus of this paper is to give a solution of software application for Automation in material handling and systematic storage with a machine interface. This Automation material handling software solution is designed for the mattress industry where cut foams are transferred from one place to another place through conveyors based on their destination, like cut foam transferred to direct dispatch or to other cutting machines for further processing or the storage location This whole process carried out with help of PLC (Programmable Logic Control) and ASRS (Automatic Storage and Retrieval System).

Keywords: PLC (Programmable Logic Unit), ASRS, Machine interface.

I. Introduction

This research paper focuses on material handling automation in the foam cutting sector, where foam is cut into various shapes and sizes for its intended application. In the current system, cranes are used to transport foam blocks from one process to another on the manufacture line. Cranes are designed to transfer processed foam blocks from the outlet of vertical cutting machines to other processes. This movement is entirely reliant on human labor. Also due to varying process timings, there is an inadvertent accumulation of WIP material, necessitating the storage of a large number of foam blocks in free space and occasionally in aisles. Various technologies have been employed to address current issues as well as to identify items in the system. This study depicts the use of barcode technology and an automated storage and retrieval system [2].

The software application 'Automation in Material Handling' for the mattress industry is designed to automate the whole process in the mattress manufacture industry and automate and control the flow of the materials in the conveyors. And also controls the effective storage of foams in ASRS, all transactions will be stored in the database. Admin can view the current status of all the transactions. There is no application that interfaces with machines and controls all the activities Hence the software 'Automation of Material Handling' is designed. Handling ASRS for effective storage and retrieval process of the foam and also it is used for tractability of the materials for this process time and space management and also the quality of the material can be maintained.

With the increase in competition and consumer expectations worldwide, the need for smarter, faster and more powerful technologies has been on the rise. Conventional industrial tasks were majorly controlled manually, which induced the risk of errors and proved to be more time-consuming and expensive. Automation resolves these issues by incorporating a variety of systems (process, machinery, software) that work together to achieve flexibility, a better quality of products and lesser manufacture times in a cost-efficient manner. Automation reduces the probability of an error occurrence and provides energy and resource conservation. Therefore, the recent trend in industries is the shift towards faster and more reliable automated systems over inefficient manual operation. Industrial automation has been the target of many studies that aim at increasing the performance level of the processes along with reducing their complexity. Among the various automation techniques, PLC has been replacing the traditional relay controls due to its reliability, stability, flexibility and ease of programming. The importance of industrial control and monitoring has been increasing, due to its reliability, consistency and higher efficiency compared to manual inspections. Manual inspections may be carried out irregularly and are prone to errors.

Our proposed system is planned to avoid the present problems. Our focus would be to streamline the material flow and information flow and to have complete accountability and traceability using the User Interface.

Every cut of Foam is assigned with a QR code which consists of basic information like foam name, description, dimension, destination etc... QR code is scanned at the beginning of the transfer of foam to get the foam information and destination of the foam like CCMs or Direct dispatch. An automated storage and retrieval system (AS/RS) is a storage system under which a defined degree of automation is to be implemented to ensure

precision, accuracy and speed in performing storage and retrieval operations.

II. Literature Review:

Many studies have been made on monitoring and industrial automation using many technologies, but few of them have been discussed in this paper. A considerable amount of research had been made on the storage and retrieval of items [2].

In the Existing system, the whole process was carried through manually. In the Existing system for transfer of the foams from one location to another location, trolleys were used. The existing System has no Traceability of foams. They are storing all the foams in the same place and this process is time-consuming for locating the specific foams when they are needed. The existing system was Labor intensive work for the completion of the whole process and also Existing system was facing labor problems. For the unorganized storage of foam, there will be heavy chances of damaging foams so the quality of the foam was reduced so it was a problem to maintain the quality of foam. So, in this paper, we are focusing on giving solutions for these problems.

Implementation of the storing process of cut foams for this ASRS has been proved useful, and ASRS for storage management has been implemented using plc. In ASRS stackers have been implemented for placing the items in the correct location, the location for storing the cut foam is stored in a QR code which is scanned at the beginning of the conveyor.

II.1 Existing System

Many studies on monitoring and industrial automation have been undertaken to utilize various technologies, but just a few of them have been mentioned in this study. The storage and retrieval of materials have been the subject of extensive investigation.

The entire process was carried out manually in the previous system. Trolleys were employed in the previous system for transporting foam from one site to another. There is no traceability of foams in the existing system. They keep all of the foams in the same location, which makes it difficult to find certain foams when they are needed. The existing system required a lot of labor to complete the entire process, and it was also plagued by labor shortages. Because of the significant risk of harming foam when it is stored in an unorganized manner, the quality of the foam will be lowered, making it difficult to preserve foam quality. As a result, the focus of this work is on providing solutions to these issues.

The storing of cut foams for this ASRS has shown to be beneficial, and ASRS for storage management has been implemented utilizing plc. Stackers have been included in ASRS to ensure that objects are placed in the correct area. The location of where the cut foam will be kept is saved in a QR code that is scanned at the start of the conveyor.

II.2 Proposed System

The use of PLC to recreate the real-time environment of the foam cutting industry is the emphasis of this article. The primary components that were employed in the proposed system are listed below.

2.2.1 QR code: QR code is present on every foam which is scanned at the beginning of the conveyor. QR code is scanned to get the details of the foam like foam name, Foam Density, Foam length and width, Foam destination, foam weight etc and there is a unique identification block number for every foam block. Based on the QR code, the destination of the foam will be decided. All the details of the foam will come from the client's existing ERP software. There will be the hardware part for scanning the QR code of the foam blocks which is connected to our system serially to get the data from the scanner.

2.2.2 Conveyors: Conveyors have a conveyor belt to carry foam blocks from one location to another location like to the destination or the ASRS storage. Every Conveyor has a motor that will be operated through the PLC ladder logic. And also conveyors have proximity sensors at every distinct distance for sensing the foam present on the conveyors. PLC will work with all the input and output tags of PLC. Our software is integrated with the PLC with serial connection with hardware UART cable. So that we can write and read commands to the PLC with our software.

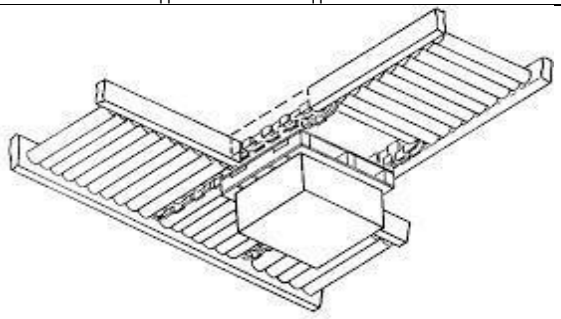

Fig 1: Conveyor

2.2.3 ASRS: Automatic Storage and Retrieval System which has a specific number of rows and columns based on the storage capacity of different sizes of blocks with front and back positions for the storage and retrieval of the foams. Each cell block of ASRS has a unique address for the efficient and systematic storage and traceability of the foams.

	Cranes			**Conveyors**
1	Transfer	of	heavy	Transfer of heavy,
	items			medium and light
				item
2	Used in	small	scale	Used in manufacture
	industry			industry
3	Human operator			Operated
				automatically
4	Random	transfer of		Systematically
	items			transfer of items

Table 1 Comparisons between cranes and Conveyors

Stacker:

Fig. 2: ASRS

These automated storage and mechanized systems eliminate the need for human intervention in performing basic operations such as automatically removing an item from a storage location, transferring the above item to a specific location or interface point, and automatically receiving an item from a processing or interface point and storing it at a predetermined location. The Stacker Crane is equipped with a Stacker is the hardware component to handle the foam blocks, stacker moves on the x-axis, y-axis and z-axis to carry foam blocks, Stacker can carry only one foam block at a time. Stacker is used to carrying foam blocks from the pickup location and place the foam block in further processing units or to the ASRS.

III. Flow chart

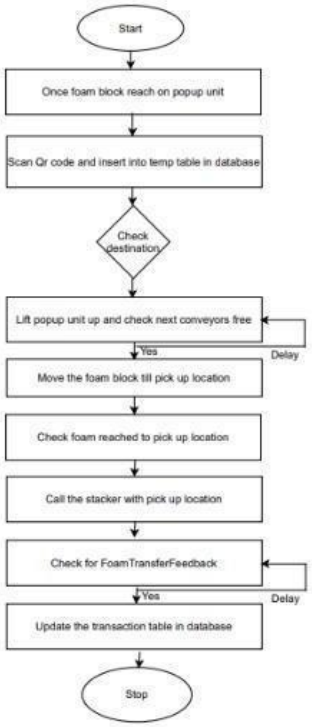

Fig. 3: Flowchart of the proposed system

An automated storage/retrieval system (AS/RS) is a storage system that employs a certain level of automation to ensure precision, accuracy, and speed in storing and retrieval processes. Telescopic grabber in this idea, allowing it to stack and retrieve items from the rack as well as take up loads directly from the loading and unloading station. This is mostly used for storing foam blocks after the process is completed and for subsequent processes, leading to process optimization, vertical space usage, and other resource utilization. It has features like complete accountability and traceability, complete vertical space utilization, software integration, and FIFO maintained at the Long Block level.

Automated Dispatch Section: An automated dispatch section is an integrated system that uses a set level of automation to ensure that Short Foam Block is transferred safely, easily, and accurately from the cutting machines to the dispatch area. This automated dispatch section, which includes a roller conveyor, pop-up units, and an EOT Crane with grabbing attachments, removes human interference in executing basic activities in the dispatch of Short Foam Blocks. It is designed to transfer Short Foam Blocks once the cutting process is completed and for future procedures, making Short Foam Block loading in vehicles easier, faster, and more efficient. It facilitates the operation of the Short Form Block and ensures its complete safety.

CCM Feeding Section: An automated CCM Feeding section is an integrated system that uses a set level of automation to ensure that Short Foam Block is transferred safely, easily, and accurately from the cutting machines or storage section to the appropriate CCM. This automated CCM Feeding section is made up of a Roller Conveyor and a Telescopic portion with a foam block transferring attachment that eliminates the need for human intervention in conducting basic CCM Feeding operations. It is used to make feeding Short Foam Blocks to the CCM easier, faster, and more efficient once the cutting process is completed or from an ASRS storage site. It guarantees ease of use, complete safety of the Short Foam Block, precise placement of the Short Foam Block on the CCM table, and complete traceability of the Short Foam Block that is fed.

Conclusion

This study shows how PLC simulations can be used to monitor and regulate the foam cutting sector and also this technique is used in various sectors where Automation of Material Handling is needed. It explains how the proposed system eliminates all of the old system's flaws, such as time- consuming processes and reliance on humans. The proposed system incorporates software integration with PLC through the use of components such as scanning the foam QR code to obtain information, using conveyors for foam transfer, and an Automated Storage and Retrieval System (ASRS) for storage, as well as a User Interface for a user, to interact with the machine. Successfully given the solution for real-time industrial problems.

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