AN AUTOMATED MECHANISM FOR SMART PACKAGING LINE MANAGEMENT

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ABSTRACT

Packaging Line Management System (PLMS) is an application which stores, manages all the data needed in analysis of the production details. All the packed shippers’ details are captured and can be retrieved by the user as detailed or as a summary. The paper keeps track of various activities, like batch number of every product which is manufactured in the industry. The exclusive right of authorization is implemented by using the user roles. The data is well secured and authenticated the results of searched queries are very quick and efficient. The development of the application is made in C#, .Net language and for storing data SQL Server 2012 is used for database storage as a backend. This paper explains very clearly about the packaging line management which provides very quick access to the users whoever involved in using this software. The detailed usage of the developed application is explained in the paper along with the comparative performance for clear understanding.

Key words: Automation, Line Management, Password Policy, Packaging, Scanning.

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1. INTRODUCTION

To routinely get to the shelf first with innovative, new products that capture the consumer’s imagination, consumer products companies must unite their creative capacity – their brand value, marketing with their technical strengths in an environment of continuous collaboration [1]. Currently, automation in the industry became the global drift in manufacturing and with the success of the Japanese and European industries in terms of production; more and more companies are switching to automation [8]. Automation is certainly the motto as today’s manufacturers face razor-thin profit margins, Just-In-Time (JIT) manufacturing and the ISO-9002 standards. Companies must automate in order to deliver what today’s customer is expecting when he wants it and at the price he wants to pay. Innovations in packaging the product development and manufacturing process to drive brand value in the market which requires a scalable IT architecture which can protect brand value assets while providing secure and authenticated access to all participants in this crucial process[2].

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Depends upon the product packaging the product will look more effectively which results in displaying attractively in the departmental racks the place where 90 percent of purchase decisions are made. Modifications in consumer preferences, government regulations, product contents and environmental factors are the influence factors over packaging projects [3]. Managing these things effectively will add additional benefit for the profitable brand growth. Varying levels of automation have been adopted within groups such as Palletization and automatic storage and retrieval systems. In order to keep track of performance, most industries have been using new methods and techniques, including lean principles and Six Sigma [7]. There are IT solutions to support steady improvement by increasing visibility on plant performance and to implement easy-to-use technologies.

1.1. The negative consequences which are impacting today are many
Coordination between the cross functional teams is cumbersome and error-prone. Time and expense are wasted on package and branding which are later found to be unfit for this purpose. Brand assets which are stored are not reliable and prone to errors improper alignment of the brand labels may results in market complaints which require more manual interventions and consumption of huge human efficiency and resources.

The main objective of this application is

- To show how packaging can impact the supply chain.
- To reduce the human effort by which organization can get the profitable growth.

The development of the application is made in C# .Net language and for storing Data SQL Server 2012 is used for database storage as a backend [4].

Benefits of the packaging systems include:

- Increase in material flow and revenue
- Reduce product damage
- Reduce maintenance costs and downtime of the machine.
- Reduce labor costs.
- Increase profitability.

In order to occupy the market in this competitive world and to face competition from competitors in the market, consumer product companies must and should gain control of the package and branding management process. Only a PLMS platform-based solution has the ability to create the required alignment of people, processes and branded assets in a sufficient scalable manner.

Upon such a platform suppliers, package designers, graphical arts, outside agencies and production houses collaborate in real time all around the world. Upon such a platform discipline specific applications are an integrated part of the collaboration process, enabling individuals to do their work using systems they know and trust while sharing seamlessly in the global process. This platform delivers unprecedented access to get accurate information regarding the process, whether that information is related to packaging, reports, labels, marketing copy or customer feedback.[6] This paper discusses processes which are fundamental in the packaging and label management which illustrates how the PLMS platform helps consumer products companies compress cycle times, reduce costs and win more consistently in occupying the market.
2. PROPOSED WORK

Fig. 1 describes the process of material packaging system, which will be automated using the Software. This is a step by step process which corresponds to the input and output peripherals that are needed to function effectively [5]. Steps in the automated packaging is placement of box which is filled with material, Scanning in order to accept or reject the boxes at last sealing and Strapping of the final product, or end item. The overall design is implemented using an experimental prototype.

![Diagram of automated packaging system]

**Figure 1** Flow Chart diagram representing the structure of an automated system.

Fig 2: Shows the block diagram used to describe the process of roller conveyor functionality this conveyor is driven by Geared Motor.

In the initial step the Shipper's which are placed in feeding station then the conveyor gets transferred to the next station for scanning in order to validate the acceptance or rejection of the boxes. In this process there are total 6 no. of conveyors.

![Roller conveyor block diagram]

**Figure 2** Roller conveyor block diagram which was used by the researchers in the process of implementing the automated system.

From the manual operation, software is used to convert the packaging system into an automated process. Input components such as scanners and sensors are used to indicate the condition corresponding to the hardware flow of the project design. System is interfaced with PLC and provides the feasible solution for implementation. Packed boxes data will be collected and shown as an output about the product packed. As shown, it consists of three stations namely...
box feeding, checking and sealing and strapping stations. The 2”x2”x2”card-board box is used as the object to be transported.

![Carton Box with small marble as a sample material](image)

**Figure 3** Carton Box with small marble as a sample material

Fig.3 describes about the boxes which are used by the researchers which consists of small marble stone with the some weight to act as a sample material for experimental testing of the prototype.

![Representation of the emergency stop button](image)

**Figure 4** Representation of the emergency stop button.

Fig 4: The Emergency Stop Button is clearly recognizable by its red color and is mounted at a spot that can be easily reached, when the button is pressed, all movements of the machine stop immediately. The button remains mechanically locked and the machine cannot restart.

![Representation of the Barcode scanner](image)

**Figure 5** Representation of the Barcode scanner.

The barcode scanner shown in fig: 5 is used to scan the barcode on the shippers and transfers barcode information to system. Then the shipper gets transferred to roller conveyor if the Shippers Barcode Scanning information is not matched with the existed data then that Shipper gets rejected and is pushed on to the Rejection Conveyor. If the shipper is found Ok, then it will transfer to the next station for strapping and wrapping [9]. The packed shipper then gets transferred to the Exit Conveyor for unloading.
3. WRAPPING AND STRAPPING STATIONS

3.1. Strapping Conveyor
This Conveyor is driven by an Electrical Geared Motor and Rollers are connected by loop to-loop chain linkage. Sensors are fitted which senses the presence of the Boxes on the Conveyor. Powered Roller Conveyor is provided in the system to facilitate Smooth movement from one Station to another Station during Packing. Main frame is anchored on the floor. It is made out of heavy duty steel Structures which are stress-relieved. The Strap Chute Assembly is fitted to this Main Frame the cross strapping (2x0) is done at this Station.

After Cross Strapping the Bundles are get transferred to the turn Cum Conveyor, where Roller Conveyor moves downwards direction and turning Mechanism get rotated by 90° through Turn Mechanism, before Feeding to the Strapping Machine -2. Powered Roller Conveyor is provided in the system to facilitate Smooth Carton movement from one Station to another Station during Packing. Main the Strap Chute Assembly is fitted to this Main Frame. Automated wrapping and strapping will be applied on the pallet as shown in fig: 6

![Figure 6 Showing the Wrapping and Strapping of the pallet.](image)

4. EXPERIENTIAL RESULTS
This application consists of various modules such as user module, product master and reports page.

4.1. Login Screen
![Figure 7 Login screen](image)

By using this screen user will provide the username and password which are provided to the users depends on their roles as shown in fig.7.
4.2. Administration
Three types of user can access management software. Classified access will be provided for user, power user and administrator as shown in fig.8.

- Operator: user can assess limited functions mainly production window and reports.
- Supervisor: User can assess functions like creation of the products etc. in addition to the privileges provided to the User Login.
- Administrator: Administrator has full privilege of the software. They can create, delete and modify user logins.

![Login credentials](image)

**Figure 8** Login credentials.

4.3. Password Security Policy Feature
After 3 consecutive wrong attempts of login by a particular user, then that user would be blocked. Password is encrypted and cannot to be viewed either in frontend or backend.

4.4. Shipper Label Data Verification by Scanning
After label application PLMS application will trigger the online scanner and scans the barcode on the label verifies and confirms the data in case of failure shipper will be rejected and expects operator intervention for error rectification. Upon successful validation shipper will move further.

4.5. Re introduction of the Rejected Shipper’s
Rejection of the shipper will happen due to poor barcode and UN identified shippers.

1. Operator scans the product label on the shipper using handheld scanner while re introduction.
2. PLMS application receives data from the HHT and collects the Product details.
3. Then shipper will move forward to complete further process.
4.6. Reports

Table 1 Requirements and specifications

<table>
<thead>
<tr>
<th>Utility Requirements</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>3Ph., 415 V±10%, 50Hz AC</td>
</tr>
<tr>
<td>UPS</td>
<td>1Ph., 230 V±10%, 50Hz AC</td>
</tr>
<tr>
<td>Air Supply</td>
<td>Dry air, 6 Bar</td>
</tr>
</tbody>
</table>

Figure 9 Analysis report

Manufactured shippers reports can be generated according to the user requirement like day wise, month wise, form to period wise or batch wise and can be exported to pdf or in excel format.

Below given Table: 2 for time calculation in the existing and in proposed methods.

Table 2 Comparative table

<table>
<thead>
<tr>
<th>TASK</th>
<th>Manual Operation</th>
<th>Proposed Automated Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>In feeding Boxes</td>
<td>3 Sec</td>
<td>2 Sec</td>
</tr>
<tr>
<td>Scanning</td>
<td>5 Sec</td>
<td>3 Sec</td>
</tr>
<tr>
<td>Strapping</td>
<td>10 Sec</td>
<td>5 Sec</td>
</tr>
<tr>
<td>Wrapping</td>
<td>20 Sec</td>
<td>10 Sec</td>
</tr>
</tbody>
</table>

By following the current methodology one can save 18 seconds of time by which we can increase the productivity of the organization by which the benefit will increase to organization.

PC:

Application compiles Security Policy in the System as below.

- Minimum password length – from 8 to 20 alpha-numeric characters.
- Password change frequency- 45 days.
- Password re-use frequency – more than 90 days
- Prompt user – 7 days before expire the password
- Auto lockout of unused account for 30 consecutive days
- Auto lockout the user after 3 wrong password login attempt
- Date format shall be in DD-MM-YYYY format to display

Software Specifications: The following support software's are mentioned below in Table 3:
Table 3 Software specifications required

<table>
<thead>
<tr>
<th>S.No</th>
<th>Component</th>
<th>Details</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MS SQL 2012</td>
<td>2012 or above</td>
<td>Database installed in the server</td>
</tr>
<tr>
<td>2</td>
<td>.NET Framework</td>
<td>4.0 or above</td>
<td>Framework used in development of the application</td>
</tr>
</tbody>
</table>

5. CONCLUSION

This entire process is designed for the automation process, by using this application one can monitor, inspect and maintain the data in an efficient and in a proper manner. This paper presented the process of automatic shipper handling mechanism which was happening manually. This application will perform very well since the latest .Net Framework supports much new functionality other components used in this process are assigned with specific IP address by using which we can trouble shoot the problems in a easy manner. Cost reduction is the main motto of this system which focuses mainly on the man-power reduction. Hence for this over all process only one operator is needed for operating and maintaining this automated system. These controllers are used to implement the packaging and material handling, which gives hundred percent fully automated systems with fool proof without any human intervention. Also, another recommendation is that some automation process may also be implemented using other programming language like Java, PLC microcontroller, or an ASIC. At last the proposed design is for conveying and packing of Shippers.

Scope of Future Work

Each and every industry differs on type of product manufactured, nature of machineries available, category of worker involved, methodology adopted and the management principles and policies in force in the industries. Every industry aims to enhance the productivity, empower manufacturing capabilities, to reduce man power by using smart machines. IOT technology is providing the same opportunity for every developer in designing smart mechanisms. Therefore a particular case study carried out at package industry can further be reinvestigated in other process industries like automotive products sector, batch production industries, bottling plants or such industries where products are manufactured in lots.

REFERENCES


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