PROCESS AUTOMATION FOR A FOOD PROCESSING PLANT

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Abstract - The proposed project work carried out in ID Fresh Food (India) Pvt. Ltd.Even there is a large demand in the market the company not able to meet the demand by the manual production process. In this project the cooking process of the parota production is aim to automate. By this project aim to reduce the manpower and increase the profit by increasing the production and quality. And also reduce the material wastage of manual handling. The parita is one of the famous food in India, here the company manufacturing the product in large scale and distribute in all major cities. So for large scale production automation is the best solution and add many advantages by this.

Keywords– Cooking Process, Production, Automate.

1. Introduction

The automation of manufacturing plants has been actively pursued for more than 50 years. And it will continue to be so, even more aggressively, during the next 50 years. The increased zeal in industrial automation is mainly due to the explosive growth in computer hardware and software technology. As computer invade a high level of automation in every facet of the manufacturing processes. The automation always gives fruitful results in industry. Parota is the one of the most famous south Indian food. In this paper a cooking system for the parota explained. The parota can't go for any oven cooking or oil based cooking, it need conventional thava cooking since it add an extra taste for the product.

Why Automation?

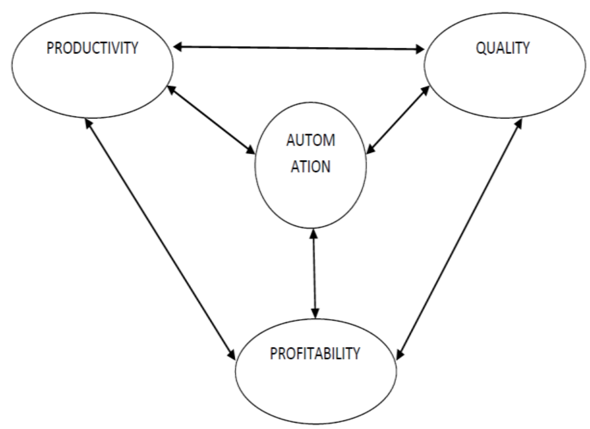

Figure 1.Reasons for automation.

A. Improved Productivity.

Plant productivity may be defined as the quality of the end products manufactured per unit of operating parameters – plant size, number of workers, time of operation, etc. Therefore, productivity is directly related to how efficiently the input resources are utilized in translating them into marketable end products. This is possible because automation allow for efficient schedule of work flow and labor use. The ability to maintain good record and information used past process can clearly highlight areas that can be targeted for more efficient allocation of resources.

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B. Improved Quality.

[1]Quality assurance is one of the most important goals of any industry. The ability to manufacture high quality products consistently is the basis for success in the highly competitive food industry. High quality products encourage customer loyalty and result in expanding market share. Quality assurance methods used in the food industry have traditionally involved human visual inspection. Such methods are tedious, tolerance tightened; it became necessary for the food industry to employ automatic methods for quality assurance and quality control. In fact, this aspect of food manufacture is one of the areas that have received the most attention in terms of automation.

C. Improved Profitability.

Increased profit is perhaps most important from the perspective of management. Improved profitability not only adds to shareholder value but also allows management to invest strategically in expanding plant operations, increasing product lines, further improving product quality and productivity. Both of these contribute directly to improve profitability.

2. Objective.

This is a paper for automating the cooking process of the parota production. The major reasons behind making this project are listed below:

To reduce the quality related issues by automating the cooking and cooling process of the parota production process. The parota has to undergo variety of many complicated processes. Each process is requiring separate machinery or separate skilled peoples to carry out the process. Parota is the one of the most famous food item of Indians and which is available in two varieties of taste, taste of wheat and taste of maitha. The process of each is same. The specular character of the parota is its layers on it. This layer is created by very careful processes calla rolling and pressing. If the pressing is not proper thelayer will disappear from the product. The next quality issue is in cooking stage. The company provides half cooked product. It will give a even golden color for the product. If the cooking more than half cooked it will get rejected due to quality issues. And also shape and size of the product fully determined by the pressing phase. By the manual operation is very difficult to obtain uniform shape, size and even cooking. By implementing automation it is required to rectify the above quality issues.

Increase Productivity by automating the plant. The company has a factory of 2600 square feet and it's much capable for the production of 5000 kg per day in a single shift. But due to the problem of handling labor and quality related issues the only 2500 kg is being processing per day. In total production process the pressing, cooking and cooling is the complicated process and space consuming and costly process. The pressing and cooking has to carry out in an extremely high temperature. So the workers feel tiredness due to continue working in such atmosphere. Reduce labors. By automating the company aim to reduce labors. Because managing the labors is the main headache for the company to maintain quality and standards. The manual handling increases the level of contamination on the product. The product will get expire suddenly if the contamination level is high. Also the company focuses on reducing the manufacturing cost by reducing the labor cost in long term concern.

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3. Methodology.

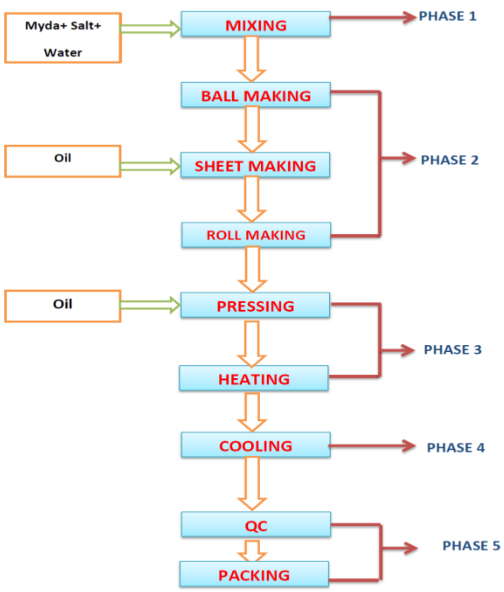

Figure 2. Production Flow Chart

The figure.2 shows the total production flow chart for the parota cooking.

In the given flow chart second process of the phase 3 is aim to automate in this paper. The daily production is 42000 pieces per day for this 2500 kg of ray material and 1200 L water is required as raw material. Conventional thava cooking is the best method of cooking for parota, but when we come to automate the process we need to reduce the manual workers and increase the production rate.

Figure 3.Conventional ThavaCooking.

In conventional thava cooking one operator is require to cook the parota such six thava is required to replace with the automated system. So the entire thava need to replace by a single automated cooking system. But for achieving 84000 pieces of parotas per day such a two machines can utilize.

In this mechanism main thing need to concentrate is two side cooking of the parota. For that a conveyor based cooking can utilize to get two side cooking of the parota. The cooking conveyor has two phases, top phase and the bottom phase. The top phase is used for cooking one side and the bottom phase is used for cooking other side of the parota. Each conveyor is actuated with an AC motor.The two major controls over this conveyors are speed control and temperature control.

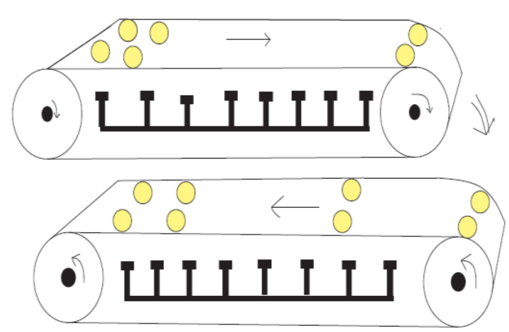

Figure 4.Automated Cooking Conveyors.

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A. Speed Control.

[5]The speed is needs to control with a VFD (variable frequency drive). The VFD is a type of motor controller that drives an electric motor by varying the frequency and voltage supplied to the electric motor. Other names for a VFD are variable speed drive,adjustable speed drive, adjustable frequency drive, AC drive, Microdrive, and inverter.Frequency (or hertz) is directly related to the motor's speed (RPMs). In other words, the faster the frequency, the faster the RPMs go. If an application does not require an electric motor to run at full speed, the VFD can be used to ramp down the frequency and voltage to meet the requirements of the electric motor's load. As the application's motor speed requirements change, the VFD can simply turn up or down the motor speed to meet the speed requirement.

Figure 5.Variable Frequency Drive.

B. Temperature Control.

[5]To control and monitor the temperature a device called resistance temperature detector (RTD) is fixed on the conveyor belt. It will have a LED display which will show the present temperature in a digital format. The Temperature sensors tend to measure heat to ensure that a process is either; staying within a certain range, providing safe use of that application, or meeting a mandatory condition when dealing with extreme heat, hazards, or inaccessible measuring points. Resistance temperature detectors (RTDs) are temperature sensors with a resistor that changes resistive value simultaneously with temperature changes. Accurate and known for repeatability and stability, RTDs can be used with a wide temperature range from -50°C to 500°C for thin film and -200°C to 850°C for the wire-wound variety.

C. Conveyor Specifications.

The material used to fabricate the conveyor is SS 304 since it is food industry we can go for only food grade materials. SS 304 is a food grade material for fabricating all kind of machinery of the food industry.

The total load on the conveyor belt is 5.4 kg (maximum) at a time. So the drive system needs a 0.5 HP AC motor to drive the belt. Each phase need separate motor and both motors can connect to a single VFD for the speed control.

The Top length of the Belt is 40000 mm and the top width is 600 mm. Since each parota have a diameter of 200 mm we can place 3 piece of parota on a single raw. Theoretically we can place maximum 60 piece of parota at a time over a single conveyor. Practically 50 piece of parota is capable to place over a single conveyor.

The heat source for the conveyor to cook the parota is LPG. The four gas long burners are placed in equal distance and they will continuously provide flames. The depth of the flame is controlled with a valve. Depending on the temperature displaying on the sensor display the operator adjust the flame depth accordingly.

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Once the parota placed over the starting edge of the conveyor, the parota moves over the hot belt. The temperature of the belt will in the rage of 180 to 190 degree Celsius. Once the parota reach at the end of the top conveyor it will fall to the second conveyor. During the fall time the parota will flip and the other side of the parota will come in contact with the hot belt of the conveyor. The total time for cooking a parota is 91.76 seconds. Soon each conveyor the parota need to spend around 45.88 seconds. In this way at the end of the second conveyor we will get a cooked parota ready to cool and pack.

4. Experimental Verification.

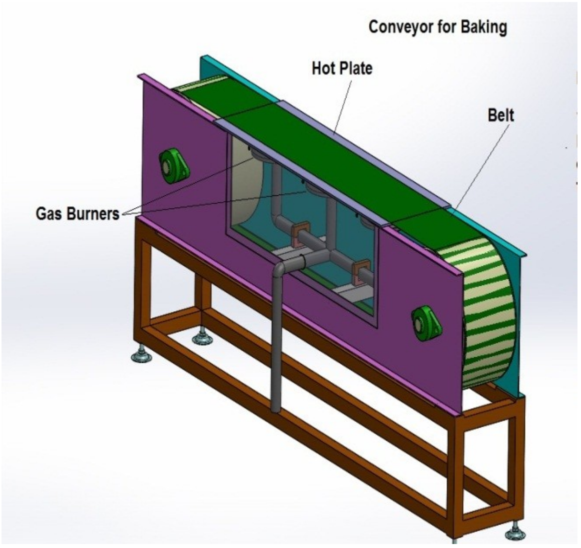

Figure 6.Prototype Model.

As shown in the figure.6 the prototype is developed to test the concept experimentally. The following observations are found.

a. The cooking conveyor velocity is exactly 0.8183 m/s.
b. The conveyor belt temperature is 184 degree Celsius.
c. The double side cooked parota got a perfect golden color over that.
d. The cooking was even and the rate of over cooked or less cooked parota as an average of 10 sample is two out of ten.
e. The labor requirement is reduced to 4 from 21

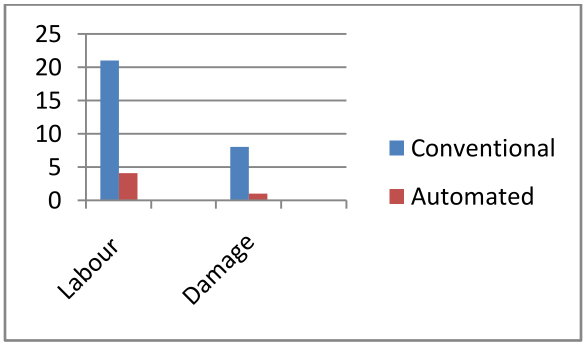

Figure 7.Experimental Observations.

5. Analysis and result.

As per the experimental verification done above the following result is obtained.

a. Labor cost reducible to52.5 %
b. Damage rate is reducing to an average of two out of ten in a ten sample test.
c. Since the labor cost and material wastage reduced profit increased accordingly.

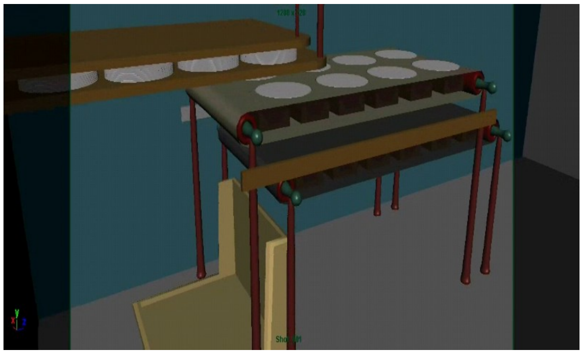

Fig.8 Parota Moving On top Conveyor

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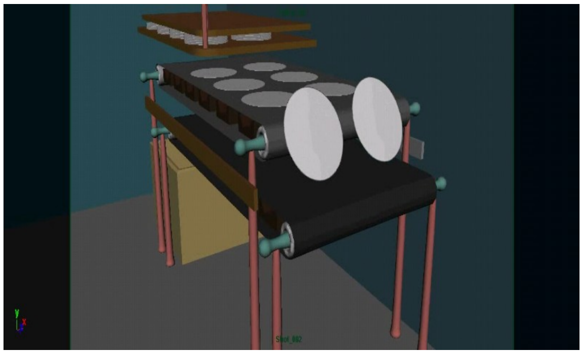

Figure.9 Parota Falling to second Conveyor

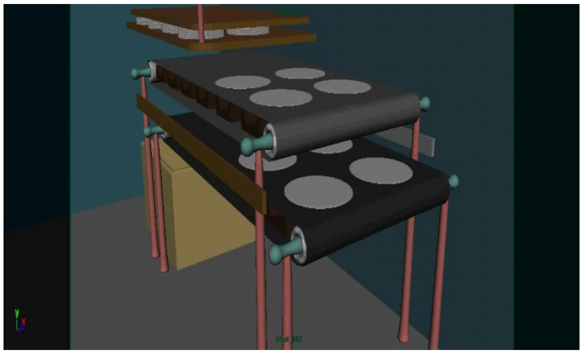

Figure.10 Parota moving on second Conveyor.

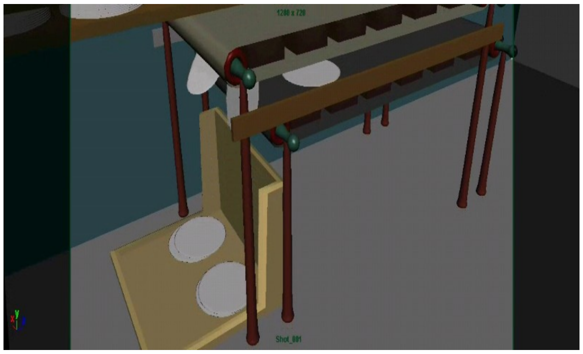

Figure.11 Parota Collecting at the end.

6. Conclusion.

As we know the industrial automation bring fruitful results in this cooking conveyor also given outstanding performance. Not only the specified results above apart from that, there are other advantages. Those are by using an automated system the plant can keep hygienically all time and since it is a food industry the manual labor should be less as much as possible not only for the cost consideration but if manual labor is more the microbiological growth will be more on the product and in the plant. It will make serious quality issues. By this automation all the advantages are achieved.

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