International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 04, April 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

DEVELOPMENT OF AUTOMATED MECHANISM FOR FOOD PACKAGING

Devendra S. Kushavaha[1], Prof. Sunil R. Sobhrajani[2]

[1,2] *Mechanical Department, MEFGI -Rajkot, (India)*

ABSTRACT

Manufacturers are adopting automation for time saving and good quality production. Automation helps to improve quantity and quality of product and it also saves production time. Saving of time means reducing the production cost that manufacturers can provide good quality product at low price. Life style of people are getting very busy and fast so, most of people like to use ready to eat or pre-cocked food. Food industries are facing huge market demand for food products. In India, most of food industries are using the automation for the primary food packaging but there is still absence of automation for the secondary food packaging. Most of small food industries or local food industries are doing the secondary packaging manually which is taking much time. Even the main production of the food and primary packaging are completing with automated machines. Adopting automation for secondary packaging is costly because it needs to be imported from other countries like Germany, U.S.A., china who are using full automation for the food industries. Developing and adopting secondary packaging automation will help growth of local food industries.

Keywords – Automation; Secondary food packaging; pneumatic system, PLC; PTC Creo Parametric 2.0

I. INTRODUCTION

Now a day's people's life style getting very busy so, most of people like to use pre cocked food or ready to eat food. So the food that save people time getting very famous. So, Consumer demand for shelf-stable, high-quality food with a maximum degree of safety is increasing very high. That is the main reason for the food industries to focus on processing of liquid and semisolid foodstuffs. Food products should also meet the sensory and nutritional parameters, as specified by the consumer and legislative authorities. Thermal processing is one of the reliable methods to preserve the food. Aseptic processing and packaging is an established technique used for decade to process suitable low-acid food products like milk and milk products, for example, puddings as well as nondairy desserts, fruits and vegetables juices, soups, sauces and particulate foods. Even there are many kind of food available that getting very famous in consumer due to food quality and its time saving cocking procedure.

Food industries are giving most of attention to their food quality. But just better quality is not enough to stand to the market competition. There are certain many other factor that need to be focused like advertising, production, and packaging etc. packaging is much important factor for the industries like the production. Packaging provides the advertising for the product, show the standards of food and reputation of company. Food industries are also creating new kind of food with different flavor for standing in the market against high completion of market. They are trying to provide best quality food product at possible low price. Though Food industries are investing

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

much money to promote their product, they need to concentrate on the production time that effects the final product price.

In new days all the industries are adopting the automation for taking their production to high level. Even food and pharmaceutical companies are also adopting the automation for production. Automation in food industries offer the hygienic and fast environment for the food production. It takes the food production at very high level of technology. Most of food industries are adopting the automation for the production and packaging for boosting their production. Automation takes the industry to the edge of the technology.

2. COMPONENTS

2.1 PLC

PLC is a Programmable Logic Controller. PLC is essentially a user friendly micro-processor based microcomputer. The most important advantage of PLC is that it can be easily programmed and reprogrammed. PLC has tremendous impact on industrial control and instrumentation due to its high reliability and flexibility at the design and implementation stages.

Figure 1. PLC

2.2 SMPS

A switched-mode power supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies. Switching power supplies have high efficiencies and are widely used in a variety of electronic equipment, including computers and other sensitive equipment requiring stable and efficient power supply.

Figure 2. SMPS (Switch mode power supply)

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 04, April 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

2.3 Solenoid Valve

Solenoid valve is an electromechanically operated valve. The valve is controlled by the electric current. Solenoid valves are mostly used for controlling the fluid flow. Their tasks are to shut off, release, distribute the fluid flow. They provide safe and fast switching. Solenoid valve have high reliability, long service life, good medium compatibility of the material used, low control power and compact design.

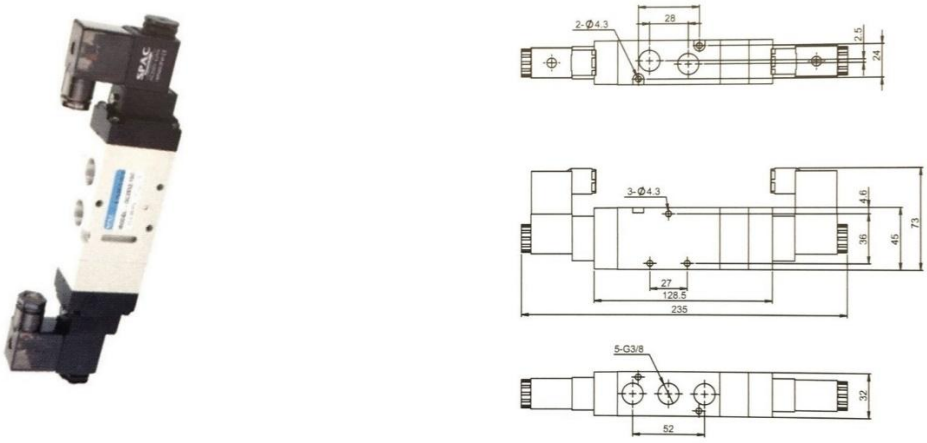


Figure 3. 5/3 Solenoid Valve

Technical Parameters	
Valve Type	5 Ports / 3 Position
Port Size	G 3/8”
Nominal Diameter (mm)	10
Applicable Medium	Compressed air, dry, filtered and Lubricated
Applicable Pressure Range	1.5-9 kgf/cm^2
Design	Spool type with spacer sleeve
Applicable Temperature	5^o – 60^o c

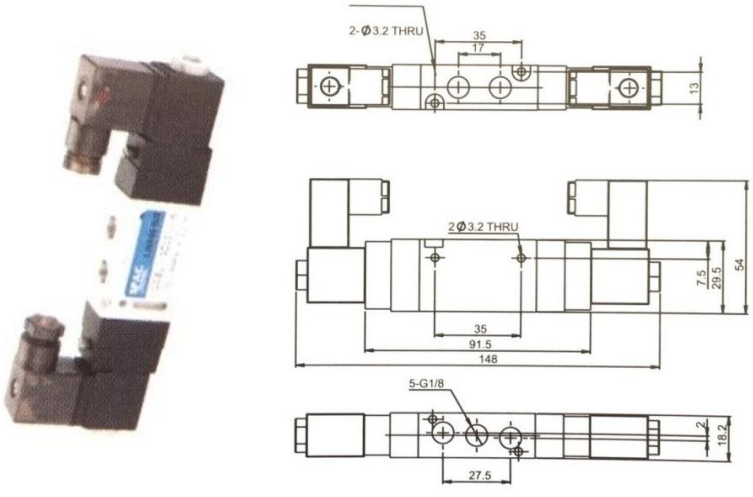


Figure 4. 5/2 Solenoid Valve

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

Technical Parameters	
Valve Type	5 Ports / 2 Position
Port Size	G 1/8”
Nominal Diameter (mm)	6
Applicable Medium	Compressed air, dry, filtered and Lubricated
Applicable Pressure Range	1.5-8 kgf/cm^2
Design	Spool type with spacer sleeve
Applicable Temperature	5^o – 60^o c

2.4 FRL Unit

Filter Regulator Lubricator (FRL) contains air leaving a compressor is hot, dirty, and wet which can damage and shorten the life of downstream equipment, such as valves and cylinders. Before air can be used it needs to be filtered, regulated and lubricated. An air line filter cleans compressed air. It strains the air and traps solid particles (dust, dirt, rust) and separates liquids (water, oil) entrained in the compressed air. Filters are installed in the air line upstream of regulators, lubricators, directional control valves, and air driven devices such as cylinders and air motors. That maintains the pressure of air to entire circuit.

Figure 5. FRL Unit (Filter RegulatorLubricator)

Technical Parameters	
Medium	Compressed Air
Port Size	G 1/4”
Design	Filter, Regulator with pressure Gauge and Lubricator
Pressure Gauge Port Size	G1/8”
Flow Rate (nl/min)	1700
Max. Supply Pressure	10 kgf/cm^2
Regulating Pressure range	0.5 to 8.5 kgf/cm^2
Ambient/medium Temperature	0 to 60^o c
Filtration in microns	5,40 (Standard)

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 04, April 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

2.5 Relay Card

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

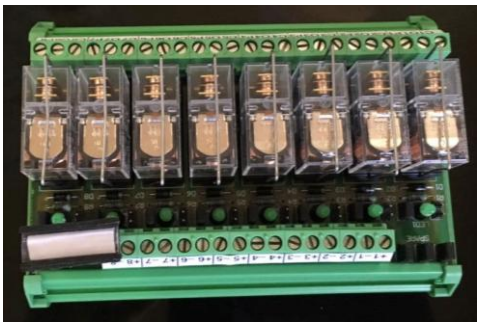


Figure 6. Relay card

2.6 Pneumatic Actuator

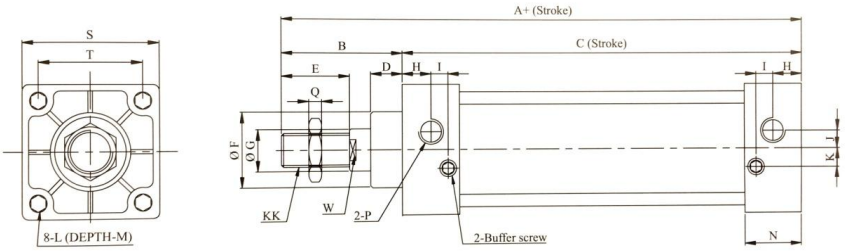


Figure 7. Pneumatic Actuator

Technical Parameters	
Bore (mm)	32
Standard Stroke length (mm)	50, 100, 200
Action	Double Acting Type
Medium	Filtered and Lubricated Compressed air
Operating Pressure range	1-10 kgf/cm^2

International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 04, April 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

Proof Pressure	15 kgf/cm^2
Ambient and medium temperature	-5 to 70^o c
Operating Piston Speed	50 – 800 Mm/s
Cushion Type	Adjusting Cushioning
Cushion Stroke (mm)	24
Port Size	G1/8”

III. CALCULATION FOR FORCE

D = 32mm d = 12mm P= 5 Kgf/m^3

- Thrust $F = \frac{\pi D2}{4} \times \frac{P}{10}$

$$F = \frac{3.14 \times (32)^2}{4} \times \frac{5}{10}$$

F = 401.9 N

Where, D=Bore in mm,

P= Working Pressure in bar,

- Pull $F = \frac{\pi (D2 - d^2)}{4} \times \frac{P}{10}$

$$F = \frac{3.14 \times (32^2 - 12^2)}{4} \times \frac{5}{10}$$

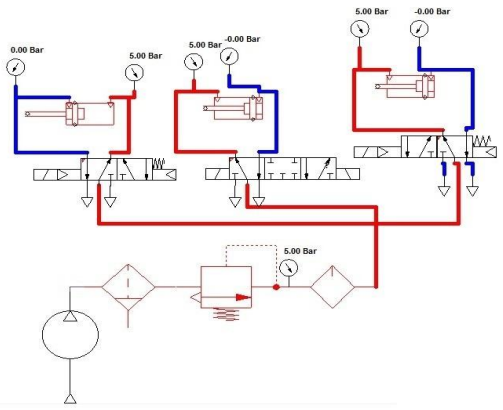
F = 345.4 N

Where, D=Bore in mm,

d=diameter of piston in mm

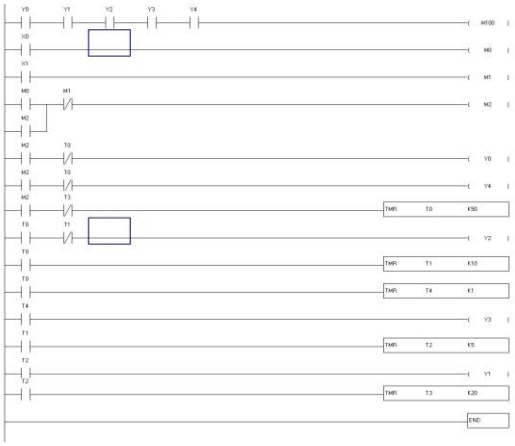
P= Working Pressure in bar

3.1 Pneumatic Circuit



International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 04, April 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

3.2 Ladder Diagram



3.3 Modelling of Mechanism

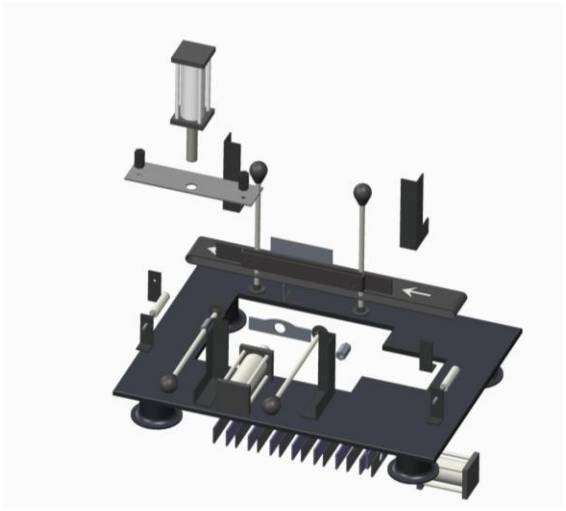


Figure 8. Exploded view of assembly

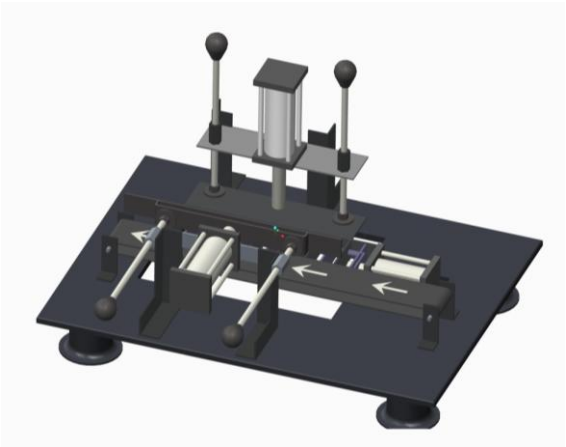


Figure 9. Final Assembly of Mechanism

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

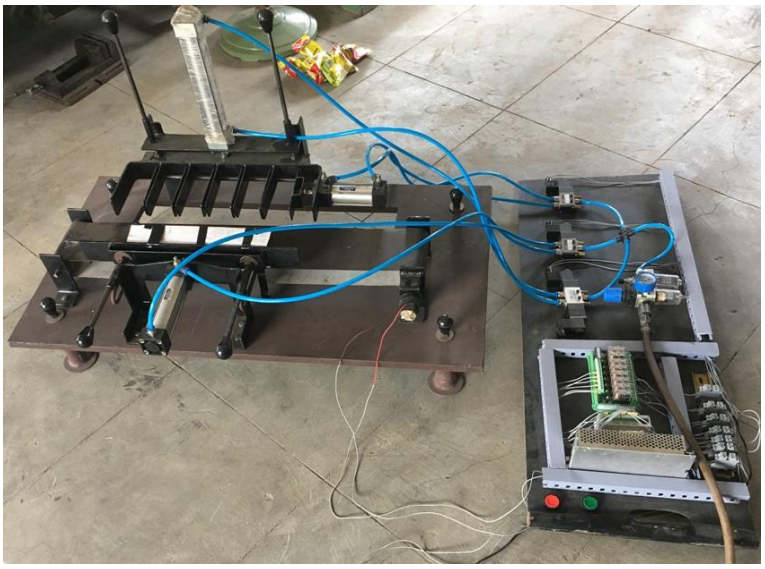


Figure 10. Prepared prototype for Automated Mechanism for Secondary Food Packaging

V. CONCLUSION

With the above developed automated mechanism, primary food packages can be packed automatically for the secondary packaging.

The manpower requirement can be reducing with the use of this automation.

It reduces the total packaging time so production time is reducing.

Pneumatic drive is selected for the above mechanism that provides clean, hygienic and best suited for food industries.

References

[1] Paul Harris, Sean Nolan *"Energy optimization of pneumatic actuator systems in manufacturing",* ELSEVIER Journal of Cleaner Production 72 (2014) 35-45.

[2] J. S. Dai *"Robotics and automation for packaging in the confectionery industry",* Woodhead Publishing Limited, March 2013.

[3] Davide Aloini, Riccardo Dulmin *"A peer IF-TOPSIS based decision support system for packaging machine selection",* ELSEVIER Expert Systems with Applications 2013.

[4] Giorgio Figliolini and Pierluigi Rea *"Design and Test of Pneumatic Systems for Production Automation"* Laboratory of Robotics and Mechatronics 2013.

[5] Darwin G. Caldwell, Gustavo A. Medrano, *"Control of Pneumatic Muscle Actuators",* IEEE Control Systems 1995.

[6] Christopher G. Toomey *"Pneumatic Conveying System Optimization"* IEEE transactions on industry applications, vol. 50, no. 6, November/December 2014.

[7] James E. Bobrow and Brian W. McDonnell *"Modeling, Identification, and Control of a Pneumatically Actuated, Force Controllable Robot"* IEEE transactions on robotics and automation, vol. 14, no. 5, October 1998.

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

[8] Felix Damrath, Anton Strahilov *"Experimental Validation of a Physics-based Simulation Approach for Pneumatic Components for Production Systems in the Automotive Industry"* ELSEVIER Journal of Cleaner Production (2015) 35 – 40.

[9] Rita Ambua, Andrea Manuello Bertetto *"Re-design of a guide bearing for pneumatic actuators and life tests comparison"* ELSEVIER Tribology International 96 (2016) 317–325.

[10] Garrett R. Mullins a, James H. Harrison *"Smartphone monitoring of pneumatic tube system-induced sample hemolysis"* ELSEVIER Clinica Chimica Acta 462 (2016) 1–5

[11] Robert B. Van Varseveld and Gary M. Bone *"Accurate Position Control of a Pneumatic Actuator Using On/Off Solenoid Valves"* IEEE/ASME transactions on mechatronics, vol. 2, no. 3, September 1997.

[12] Canziani, Francesco, *device for collecting and stacking objects delivered by a sorting equipment and sorting equipment comprising these devices*. European Patent EP 0518180 A2, 1992.

[13] Carimando, Angelo *Automation system for filling palletized containers with ready packed food products.* European Patent EP 0915012 A1,1997.

[14] Davi Daniele *Equipment and method for packaging packets of products in bags*. European Patent EP 1759995, A1 2007.