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A REVIEW ON AUTOMATIC DOOR OPENING TECHNIQUES AND METHODS FOR PRODUCT TESTING

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***Abstract*—This paper is reviewing the different techniques and methods used for a Refrigerator door opening for product testing. This System will be used for the replicating customer uses pattern of refrigerator at test lab, to evaluate refrigerators actual field performance, during development stage of the product. Due to resource optimization, safety, reduced operating cost and lead time, accuracy in repeated task, the automation is highly recommended in the industries. Comparison for suitable techniques for this system are described in this paper, also to evaluate further, proposed system is described in brief.**

***Index Terms*—PLC, Relay based electric motor, pneumatic cylinder, solenoid valve, hydraulic cylinder, moving arms.**

I. INTRODUCTION

In this paper different methods for refrigerator door opening are compared with other relevant techniques. As manual method requires attentive man power and is prone to errors, automatic methods will be used. The alternative method is relay logic based electric motor using embedded system. Though it is abundantly used in industries, but it is more complex, bulky and have high maintenance requirements for continuous operations at required ambient conditions. Hence PLC controlled pneumatic cylinder comes in the picture. PLC based automatic door opening system using pneumatic cylinder is easy to integrate, clean, economical, user friendly and will have all the advantages of automation.

II. TECHNOLOGIES AND METHODS USED

A. Manual Method

In this method a operator is doing the door opening and closing operation by using stop watch. Here human errors are possible. In this method a operator requires to keep continuous watch on test parameters, also he needs to be on field continuously to complete activity, keep it's record and documentation for analysis and future help. As the operator might changes with shifts their may be chances of errors in activity. Also it will cause operator fatigue in harsh ambient environment.

B. Relay Logic Based Electric Motor Operating Technique

In this method, relay logic controlled electric motor, based on embedded system is used. Here operator is required to start and stop the activity. As it is not fully automatic, a supervisor has to keep watch on operation if its going as per plan.This system is somewhat complex and bulky, due to requirement of hardware and size of electric motor. Few parameters record can be kept with the help of computerised systems[6][10].

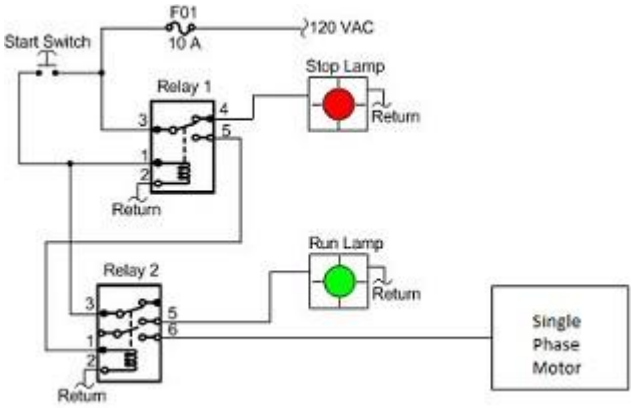

Fig. 1. Block Diagram of Relay Based Motor [10].

C. PLC Based Pneumatic System

A PLC is a solid state user programmable control system with functions to control logic, sequencing, timing, arithmetic data manipulation and counting capabilities [1][2][7]. It is operated as industrial computer which contains a central processor unit- CPU, input-output interface, RAM-ROM Memory and a programming device. CPU of Programmable Logic Controller provides Intelligence to the system [1][4][8]. It accepts data, status information from various sensing devices like proximity switches, limit switches [1][4][7], executes the user application program store in the memory and gives suitable output commands to devices like solenoid valves, actuators, switches etc [1][2][8].

Programmable Logic Controller (PLC) is used for industrial control systems and is a special computer devices [3]. They are used in many industries such as manufacturing lines [1],oil refineries, conveyor systems and so on [1][8]. For the Task of device controlling the PLC provides a flexible way to link the components together[7]. Basic Block Diagram of PLC have a computer processor i.e. CPU which is assigned to run one program that monitors a series of different inputs and logically

manipulates the outputs for the desired control[1]. They are meant to be very flexible in how they will be programmed while providing the benefits of high reliability (no program crashes or mechanical failures) [8], compact and economical over traditional systems[6]. Here the block diagram of PLC is Shown[1][8].

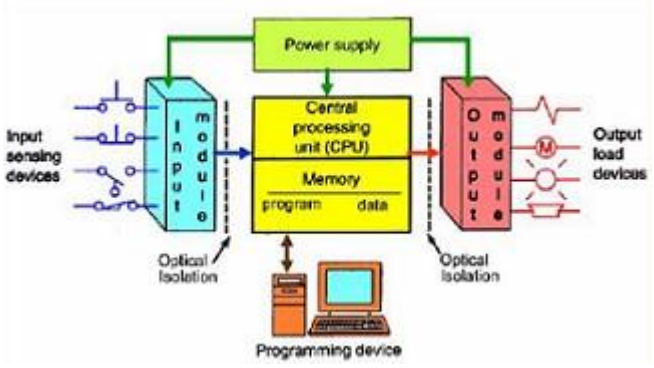

Fig. 2. Block Diagram of PLC.

III. ACTUATORS

A. Motorized Valve

Motorised valves generally consist of a synchronous electric motor, gears to reduce the speed and increase the torque output of the motor. They are electrically actuated valves and have comparatively slow operating speed [3][5].

B. Solenoid Valve

A solenoid valve is controlled by electric power. The valve comprises a solenoid, which is having an electric coil with a movable ferro-magnetic core (plunger) in its center. In the rest position, the plunger closes off a small orifice. A magnetic field will be generated due to current through the an electric coil. Operating Speed of Solenoid valve is high[1][3][4][5].

IV. COMPARISON

TABLE I
COMPARISON

Parameters	Systems and Methods	
	Relay Based	***PLC based***
Installation	Time consuming	Less time consuming
Operation	Complex	Easy to operate and neat
Speed	Less	Faster
Hardware required	Much	Less
Reliability	Less	More
Upgradation	Difficult	Easy and economical
Compatibility	Rigid	Flexible
Size	Bulky	Small

V. PROPOSED SYSTEM

A. Diagram of Proposed System

In proposed automated system for door opening, pneumatic double acting cylinder with position control sensors will be used. Compressed Air will be supplied by air compressor. System control will be done by PLC's- Programmable Logic Controller. Choosing PLC control will give greater flexibility to use different testing logic, evaluation of test to learn will require less set up time. Ladder diagram programming will be used with inbuilt PLC Timer , which can be choose based upon test criteria.

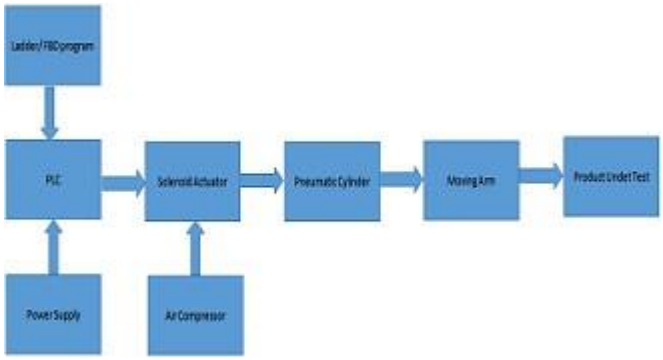

Fig. 3. Proposed System.

B. Double-Acting Pneumatic Cylinder

Here , we will prefer double acting pneumatic cylinder as we need to open and close the door in same sequence [9]. It uses air pressure, which acts alternately on both sides of the piston, will leads to reciprocating motion[4]. Sliding reed switch will be used to control the stroke length of the cylinder, through which door opening and closing angle can be maintained as per requirement [4][9].

In a double-acting cylinder, the extending volume and retracting volume differ by the displacement of the rod[4][9].

The Air consumption of the single-acting cylinder will be derived by using formula is as follows:

- A = Piston Area in square Inches.
- S = Stroke in Inches.
- C = Cycles / Minute.
- Cubic Feet per Minute (CFM) = (A x S x C) / 1728.

Keep in mind that cylinder sequence and dwell times can affect the results while using this formula [9].

In some applications, the double-acting cylinder need to extend and retract at a different rate. Hence, this will changes the calculation of air consumption [9].

In this situation, formula for calculating the air consumption of each stroke is as follows [9]:

- EC = Extend cycles/ minute (ignoring dwell time).
- RC = Retract cycles/ minute (ignoring dwell time).
- Cubic Feet per Minute (CFM) = (A x EC x S) / 1728 + [(A – R) x RC x S] / 1728.

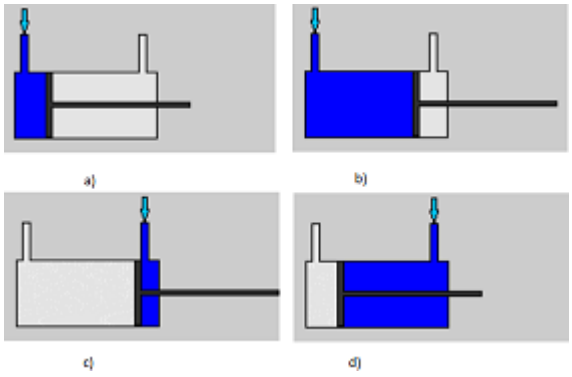

Fig. 4. Double-Acting Cylinder [9].

VI. ADVANTAGES

- It reduces the requirement of man power.
- The efficiency can be increases by reducing the manual errors with this set up.
- The accurate parameters can be measured periodically.
- The system flexibility can be improved.

VII. DISADVANTAGES

- The initial cost for set up will be higher.

VIII. CONCLUSION AND FUTURE ENHANCEMENT

By implementing the said set up for Automatic door opening system the purpose of testing is achieved with accurate parameters.
In future the implementation SCADA and HMI will definitely improve the testing with number of multiple stations along with quick response.

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