International Journal of Advanced Mechanical Engineering.
ISSN 2250-3234 Volume 4, Number 7 (2014), pp. 803-811

http://www.ripublication.com

PLC Controlled Low Cost Automatic Packing Machine

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Abstract

Rapid development of modern mechanization and automation of packaging technology with each passing day, the quantitative packaging of various items should be accurate and this has a direct impact on the survival and economic benefits. Most manufacturers have adopted a highly automated production line. Low Cost Automation (popularly known as LCA), is the introduction of simple pneumatic, hydraulic, mechanical and electrical devices into the existing production machinery, with a view to improving their productivity. This would also enable the operation of this equipment by even semi-skilled and unskilled labor, with a little training. This will involve the use of standardized parts and devices to mechanize or automate machines, processes and systems.

Keywords— Low Cost Automation, PLC.

I.INTRODUCTION

The emphasis of the early research into packing tended to concentrate on the well constrained problem of packing regular shapes. The main objective of the proposed work is to present the advantages of using automated packing machine which can automatically pack various sized products and to check its performance. Development of fully automated packing machines keep cost factors such as space and personnel at a low level. This helps in reducing the total cost of the project.

II. SENSORS

A sensor is a device that measures a particular characteristic of an object or system. Some sensors are purely mechanical, but most sensors are electronic, returning a voltage signal that can be converted into a useful engineering unit. Sensors take

advantage of the mechanical or electrical response of its components to relate the response to a relevant quantity. In the field of engineering, sensors are used in test and monitoring applications.

Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors which include cars, machines, aerospace, medicine, manufacturing and robotics.

Inductive Sensors

Inductive sensors use currents induced by magnetic fields to detect nearby metal objects as shown in Figure 1. The inductive sensor uses a coil (an inductor) to generate a high frequency magnetic field. If there is a metal object near the changing magnetic field, current will flow in the object. This resulting current flow sets up a new magnetic field that opposes the original magnetic field. The net effect is that it changes the inductance of the coil in the inductive sensor. By measuring the inductance the sensor can determine when a metal have been brought nearby. These sensors will detect any metals.

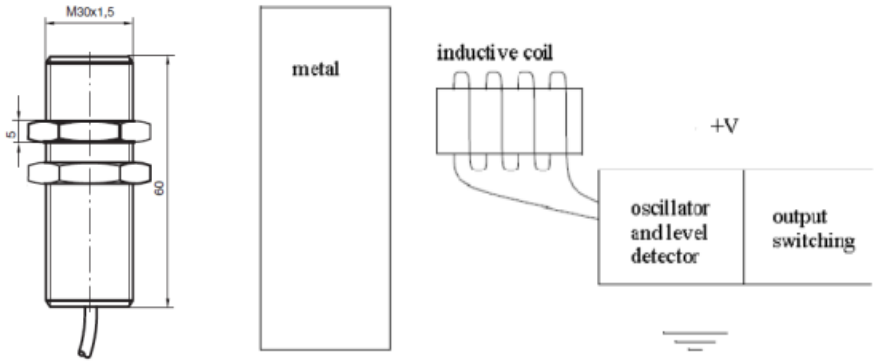

Figure 1: Inductive sensor

Capacitive Sensor

Capacitive sensors can directly sense a variety of things such as motion, electric field and indirectly sense many other variables which can be converted into motion or dielectric constant, such as pressure, acceleration, fluid level, and fluid composition. They are built with conductive sensing electrodes in a dielectric, with excitation voltages on the order of five volts and detection circuits which turn a capacitance variation into a voltage, frequency, or pulse width variation. The range of application of capacitive sensors is extraordinary.

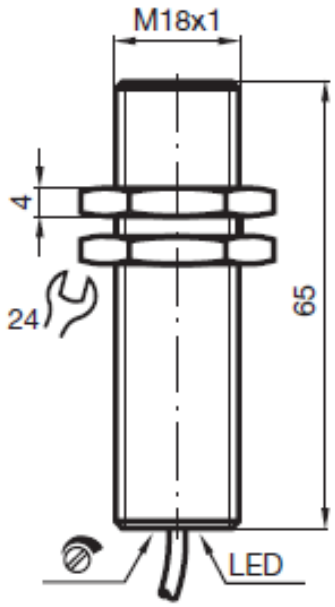

Figure 2: Capacitive sensor

Photoelectric Sensors

A photoelectric sensor is another type of position sensing device. Photoelectric sensors are similar to the ones with a modulated light beam that is either broken or reflected by the target. The control consists of an emitter (light source), a receiver to detect the emitted light, and associated electronics that evaluate and amplify the detected signal causing the photoelectric output switch to change state.

Figure 3: Photoelectric sensor

Working of photoelectric sensor:
Photoelectric sensor (Thru-beam) is suitable for detection of opaque or reflective objects. It cannot be used to detect transparent objects. In addition, vibration can cause alignment problems. The emitter and receiver are in one unit. Light from the emitter strikes the target and the reflected light is diffused from the surface at all angles. If the receiver receives enough reflected light the output will switch states. When no light is reflected back to the receiver the output returns to its original state. In diffuse scanning the emitter is placed perpendicular to the target. The receiver will be at some angle in order to receive some of the scattered (diffuse) reflection. Below Figure 5.5 shows the arrangement and working of photoelectric sensor.

III. Related work

This chapter is about detailed history of Automatic Packing machines which used different technologies. Here we present only a brief history of the subject with special mention of the pioneers in the field and some important events. Automatic Packing Machine is based on detecting products of different sizes coming in a single line. Product will be sensed and based on the PLC program, packing takes place

Wu Wen Jun's [1] book Packaging Engineering which gives information on PLC Control of Feed Weight measurement and Automatic Packaging was helpful in knowing the various parameters to be considered while packing.

Liu Ching [2] also has published a book "Packaging Engineering", which shows various applications of PLC in packaging. This helped in gaining information regarding about how and where PLC can be used to control the packing operations.

Kelvin Erickson's [3] paper on "Programmable Logic Controllers" gives necessary knowledge about the PLCs, their architecture and functioning.

Jiing Lai and Chia Hsiang Menq [4] have given a technical manual which outlines the controlling of pneumatic actuators. This gives knowledge about how a pneumatic systems can be controlled for accurate positioning.

Hugh Jack [5] has published a book which was referred to know about the automated manufacturing systems which uses PLCs for their operations. This book gave a interesting information about the automated manufacturing systems.

John Hackworth and Frederick Hackworth's [6] book "Programmable Logic Controllers: Programming and Application" was referred to know how a PLC can be programmed and to collect information regarding the applications of a PLC.

Whelan and Bruce [7] have published the work on Automated Packing Systems-A Systems Engineering Approach. It is not the aim of this review to try and cover all the various elements discussed in the literature relevant to packing as this has been done extensively elsewhere. The aim of this review is to concentrate on the elements in the literature that are relevant to industrial packing.

From the above literature survey we conclude that PLCs are widely used in Automatic Packing Machines as they are highly versatile and are available in required specifications.

Programmable logic controller (PLC)

A Programmable Logic Controller, PLC or Programmable Controller is a digital computer used for automation of electromechanical processes, such a control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory.

Advantages of PLC:

- PLC is armored for severe conditions like dust, moisture, heat, cold, etc.
- Programming a PLC is easier than wiring the relay control panel..
- PLC can be reprogrammed. Conventional controls must be rewired and are often scrapped instead.
- PLC takes less floor space then relay control panels.
- A PLC has facility for extending input/output arrangements.
- Maintenance of the PLC is easier, and reliability is greater.
- Special functions such as time-delay actions and counters can be easily implemented using PLC.

IndraControl L20:

The IndraControl L20 is a modular and scalable control. It combines the benefits of a compact small control with a standardized I/O system on the basis of terminal technology. It is a hardware platform that can be used for PLC applications. It provides onboard interfaces, e. g. high-speed inputs and outputs (8 each) and communication interfaces, such as Ethernet, PROFIBUS and RS232. The locally available I/O units can be extended by the Rexroth Inline I/O system, just by simply mounting the components side by side.

Operating elements and interfaces are arranged on the front. The eight-digit display with four operator keys, the Reset button with light-emitting diode, the RS232 interface, and the receptacle for the Compact Flash card are provided to the left of the unit. Further interfaces (Ethernet, PROFIBUS DP) are located in the central section of the unit. The terminals for digital inputs and outputs (eight each) and the voltage supply connectors are arranged to the right of the unit.

Figure 4: PLC kit

WORKING METHODOLOGY

Products are passed on conveyor. They are sensed by the first proximity sensor and the counter is set to '1'. As soon as the product completely passes through through the sensor, SENSOR 1 switches off. When the sensor switches off, timer(previously set to certain delay) starts. After certain delay, cylinder extends and seals the film. The extended cylinder rod is detected by SENSOR 2 and the counter is reset to '0'. This process is repeated for the required duration.

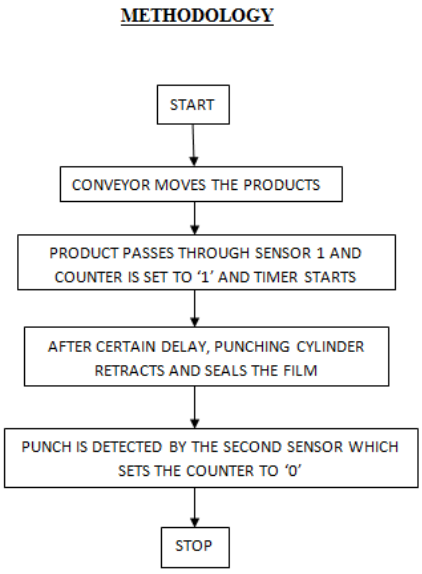

Figure 5: Working Methodology

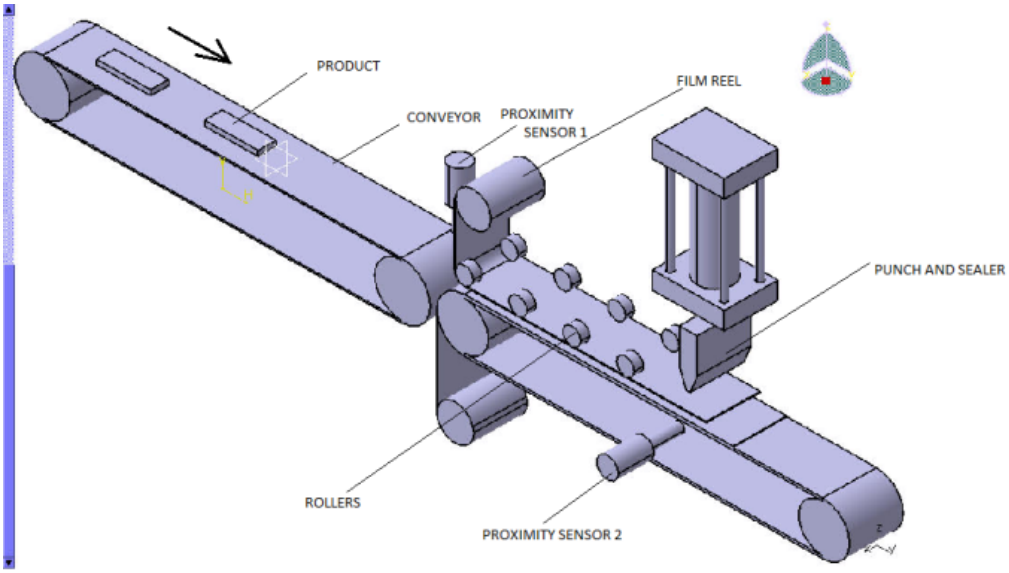

Figure 6: Model of automatic packing machine

Ladder diagram:

PLC programs are typically written in a special application on a personal computer, and then downloaded by a direct-connection cable or over a network to the PLC. The program is stored in the PLC either in battery-backed-up RAM or some other non-volatile flash memory. Often, a single PLC can be programmed to replace thousands of relays.

IEC 61131-3 currently defines five programming languages for programmable control systems: function block diagram (FBD), ladder diagram (LD), structured text (ST; similar to the Pascal programming language), instruction list (IL; similar to assembly language) and sequential function chart (SFC).These techniques emphasize logical organization of operations.

Ladder logic is a programming language that represents a program by a graphical diagram based on the circuit diagrams of relay logic hardware. It was primarily used to develop software for programmable logic controllers (PLCs) used in industrial control applications. The name is based on the observation that programs in this language resemble ladders, with two vertical rails and a series of horizontal rungs between them. Figure 10 shows simple ladder logic.

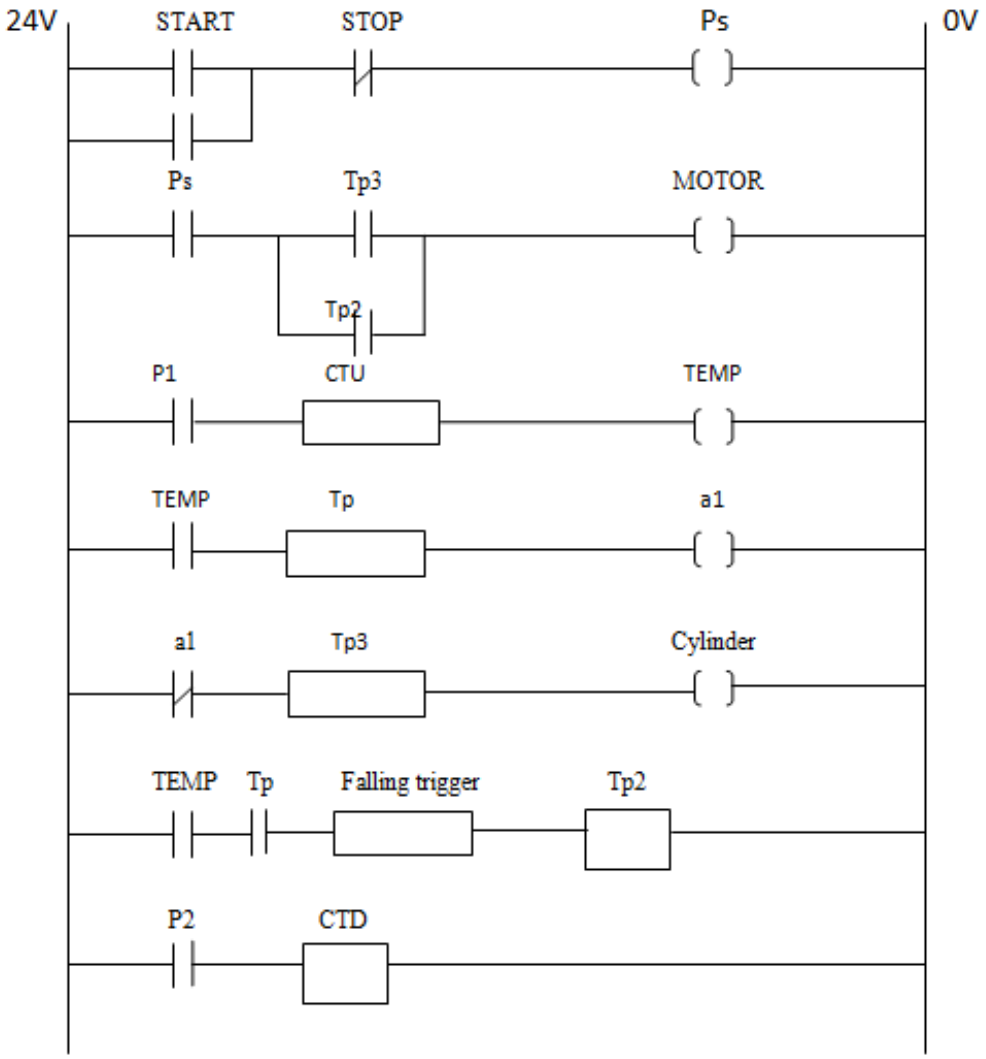

Figure 7: Ladder diagram

IV. Conclusion

This paper discusses the automatic packing of different sized products based on PLC. Photoelectric sensor senses the leading and lagging end of the product, and based upon the calculation in the program; packing of different sized products takes place.

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