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DESIGN AND FABRICATION OF AUTOMATIC OBJECT COUNTING AND REJECTING MACHINE USING PNEUMATIC ACTUATOR

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Abstract- *The aim of this project is to design and fabrication of automatic object counting and rejecting machine using microcontroller and pneumatic actuator. This project combined the knowledge of mechanical, electrical, pneumatic and electronics. When object moves from one place to another with the rotation of conveyor belt. Sensors as the input devices will send signal to microcontroller where microcontroller as the controller will give command to the actuator to do action. This action involves turning ON or OFF an output devices such as conveyor motor, valves and switches. The main system to be used in this project is microcontroller with the combination of pneumatic system. Compressor supply compressed air in double acting cylinder through solenoid valve when needed. If the object fulfills the required dimension(length, height) then it passes on the conveyor belt and will be shown in LCD, how many object are passing and if, not fulfill the required dimension than double acting cylinder push the object from conveyor belt. In this project, IR (Infrared Ray) sensors, IR transmittance is used as it is a pilot device that detects the presence of an object without physical contact.*
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Keywords: Pneumatic actuator, Solenoid valve, Compressed air, IR sensor, Microcontroller

1. INTRODUCTION

Now a day, in the present state of intense competition, production efficiency is generally regarded as the key of success. Production efficiency includes the speed at which production equipment and production line can be ,lowering material and labor cost of the product ,improving quality and lowering rejects, minimizing downtime of production equipment and low cost production equipment .The program that needs all above needs is microcontroller or PLC . In today industries, it is important to automate production of multiple varieties of goods, in moderate quantity, as well as achieving higher overall productivity and requiring minimum investment plant and equipment.

In an industrial context, we can define automation as a technology that is concerned with the use of mechanical, electrical, electronic, and computer-based systems in the operation and control of production. In this project, the task to be done is to design and implementation of an automated object counting and rejecting machine using microcontroller and pneumatic actuator.

The main keyword of this design is microcontroller and sensors. Nowadays industries are playing a vital role in the national economy .So it is very important for an industry to maintain the quality of the product they produce. At the same time it is also a disgrace for an industry if their product is not accepted by the customers. Many industries need to produce various types of product at various types of range. Taking this matter under consideration the project is made which is very useful for industries. There is a great advantage of this project. This project gives knowledge about the different branches of science. Two sectors of engineering science are very useful for this project. They are

1. Mechanical Engineering
2. Electrical Engineering

2. PNEUMATIC ACTUATOR

A Pneumatic actuator mainly consists of a piston, a cylinder, and valves or ports. The piston is covered by a diaphragm, or seal, which keeps the air in the upper portion of the cylinder, allowing air pressure to force the diaphragm downward, moving the piston underneath, which in turn moves the valve stem, which is linked to the internal parts of the actuator. Pneumatic actuators may only have one spot for a signal input, top or bottom, depending on action required. Valves require little pressure to operate and usually double or *triple* the input force. The larger the size of the piston, the larger the output pressure can be. Having a larger piston can also be good if air supply is low, allowing the same forces with less input. These pressures are large enough to crush object in the pipe [1]

3. METHOD USE IN THIS PROJECT

There are three methods used in order to complete this design project which explains detailed in next chapter.

They are:

i. Literature Research

This is done through reading appropriate/relevant books, journal and others. Besides that, searching and surfing information from internet.

ii. Development of the hardware

This is done by selecting materials, study the suitable mechanism and approach, and implement the design from schematic diagram to real prototype.

iii. Development of the software

This is done by selecting the suitable software, study the mechanism and approach of microcontroller. Lastly is combined the completed software and hardware to do analysis and see the final outcomes of the design project. [2]

4. ADVANTAGES

The main advantages of automation are:

1. Less time required to detect the product.
2. As the whole system is performed by machine there is less possibility of mistake.
3. Less man power required.
4. If the industry can produce the product within the required range then the demand of the product will be increased. So the company will be benefited.
5. It can reduce the cost of product.
6. The percentage of good product is increased

5. APPLICATIONS

1. Sorting the product according to the length.
2. In different industries where huge amount of production is occurred.
3. Ensuring quality control in mass production.
4. By some modification it can be used to determine any kind of limitation of the product.
5. By some modification it can be used to measure the dimension of a product.
6. By increasing its length sensing capacity it can be used in airport.
7. It is also very useful in laboratories

6. INTRODUCTION TO AUTOMATION

The definition of automation is the process of following a predetermined sequence of operations with little or no human labor, using specialized equipment and devices that perform and control manufacturing processes. It is achieved through the use of variety devices, sensors**,** actuators, techniques and equipment that are capable of observing the manufacturing process, making decisions concerning the changes that need to be made in the operation, controlling all aspect of it. Automation is broadly classified into two which are manufacturing automation and service automation.

Following are the example of manufacturing automation:

- Automatic machine tools to process part
- Automatic assembly machines
- Industrial robots
- Automatic material handling
- Automated storage and retrieval systems
- Automatic inspection systems
- Feedback control systems
- Computer systems for automatically transforming designs into parts
- Computer systems for planning and decision making to support manufacturing

There are three types of automation as explain below:

a) Fixed Automation

The used of custom-engineered equipment to automate a fixed sequence of processes or assembly operations. It is typically associated with high production rates and it is relatively difficult to accommodate changes in the product design. This is also called hard automation.

b) Programmable Automation

The equipment is designed to accommodate a specific class of product changes and the processing or assembly operations can be changed by modifying the control program. It is suited to "batch production", or the manufacture of a product in medium lot sizes.

c) Flexible Automation

This equipment is designed to manufacture a variety of products or parts and very little time is spent on changing from one product to another. So a flexible manufacturing system can be used to manufacture various combinations of products according to any specified schedule.

7. IMPACT OF AUTOMATION

Automation has had a notable impact in a wide range of highly visible industries beyond manufacturing. Once-ubiquitous telephone operators have been replaced largely by automated telephone switchboards and answering machines. Medical processes such as primary screening electrocardiography or radiography and laboratory analysis of human genes, sera, cells and tissues are carried out at much greater speed and accuracy by automated systems. In general automation has been responsible for the shift in the world economy from agrarian to industrial in the 19th century and from industrial to services in the 20th century. At first glance, automation might appear to devalue labor through its replacement with less expensive machines; however, the overall effect of this on the workforce as whole remains unclear. Today automation of the workforce is quite advanced, and continues to advance increasingly more rapidly throughout the world and is encroaching on over more skilled jobs, yet during the same period the general well-being and quality of life of most people in the world have improved dramatically. What role automation has played in these changes has not been well studied.

- Making tasks that are beyond the human capabilities such as handling too heavy loads, too large objects, too hot or too cold substances or the requirement to make things too fast or too slow
- Economy improvement. Sometimes and some kinds of automation implies improves in economy of enterprises, society or most of human kind. For example, when an enterprise that has invested in automation technology

recovers its investment; when a state or country increases its income due to automation like Germany or Japan in the 20th century or when the human kind can use the internet which in turn use satellites and other automated engines.

The main advantage of the automated manufacturing are: higher consistency and quality, reduce the lead times, simplification of production, reduce handling, improve work flow and increase the morale of workers when a good implementation of the automation is made.
Automation plays an increasingly important role in the global economy and in daily experience. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities

8. DOUBLE ACTING CYLINDER

Pneumatic cylinders (sometimes known as air cylinders) are mechanical devices which utilize the power of compressed gas to produce a force in a reciprocating linear motion.
Like hydraulic cylinders, pneumatic cylinders use the stored potential energy of a fluid, in this case compressed air, and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers prefer to use pneumatics sometime because they are quieter, cleaner, and do not require large amounts or space for fluid storage.
Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki Room, pneumatics is used to prevent fluid from dripping onto people below the puppets. [3]

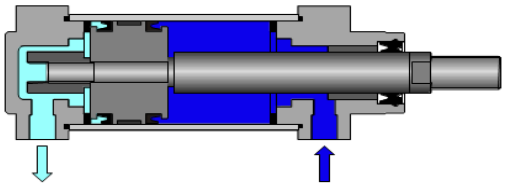


Fig 1: Double Acting Cylinder when piston moves from right to left

In figure 1 here compressed air, enters into the right side of the cylinder and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction that means right to left.

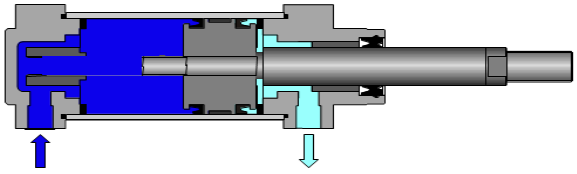


Fig 2: Double Acting Cylinder when piston moves from left to right

In figure 2 here compressed air, enters into the left side of the cylinder and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction that means left to right.
A solenoid valve has two main parts: the solenoid and the valve. The solenoid converts electrical energy into mechanical energy which, in turn, opens or closes the valve mechanically. A direct acting valve has only a small flow circuit, shown within section E of this diagram (this section is mentioned below as a pilot valve). This diaphragm piloted valve multiplies this small flow by using it to control the flow through a much larger orifice.

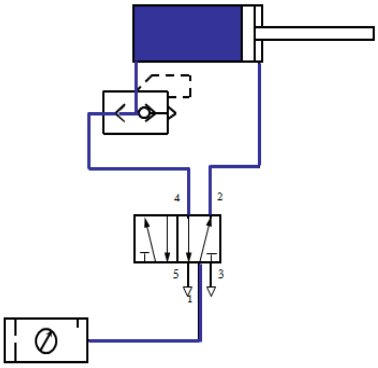


Fig 3: Solenoid valve actuated when piston moves from right to left

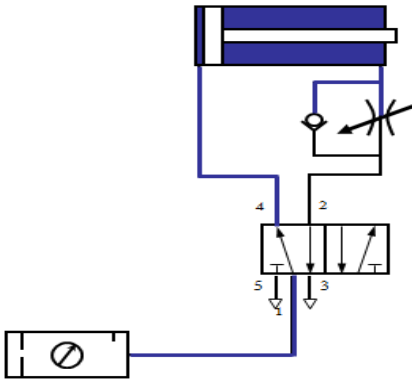


Fig 4: Solenoid valve actuated when piston moves from left to right

Designation	Number
1	Reserved for Pressure Source.
3, 5	Reserved for exhaust ports.
2, 4	Reserved for working ports.

As a general rule Odd numbers are at the bottom and Even numbers on the top.

Solenoid valves may use metal seals or rubber seals, and may also have electrical interfaces to allow for easy control. A spring may be used to hold the valve opened or

closed while the valve is not activated.

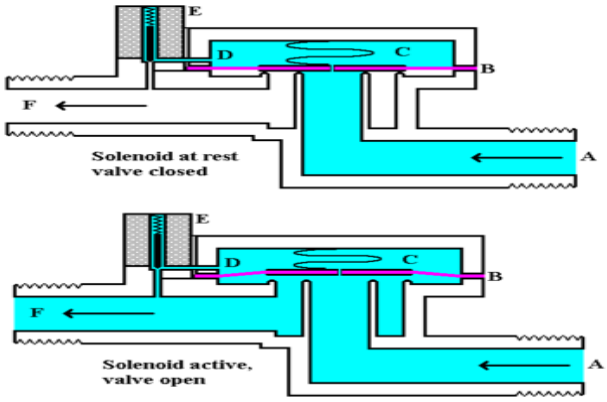


Fig 5: schematic of solenoid valve ON and OFF condition

Valve Designation

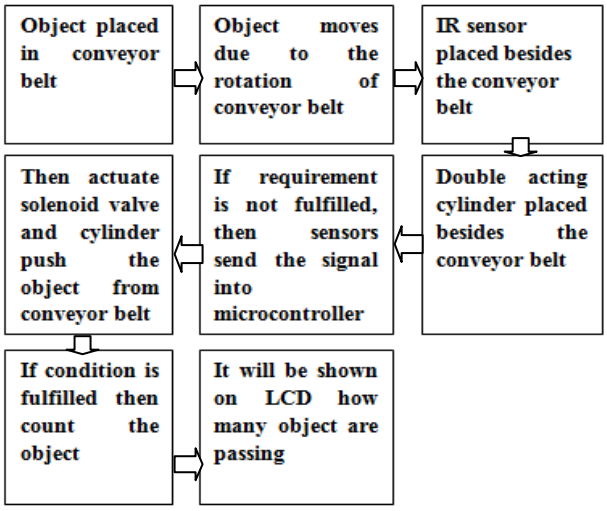
A- Input side
B- Diaphragm
C- Pressure chamber
D- Pressure relief conduit
E- Solenoid
F- Output side

The diagram to the right shows the design of a basic valve. At the top figure is the valve in its closed state. The water under pressure enters at **A**. **B** is an elastic diaphragm and above it is a weak spring pushing it down. The function of this spring is irrelevant for now as the valve would stay closed even without it. The diaphragm has a pinhole through its center which allows a very small amount of water to flow through it. This water fills the cavity **C** on the other side of the diaphragm so that pressure is equal on both sides of the diaphragm. While the pressure is the same on both sides of the diaphragm, the force is greater on the upper side which forces the valve shut against the incoming pressure. In the figure, the surface being acted upon is greater on the upper side which results in greater force. On the upper side the pressure is acting on the entire surface of the diaphragm while on the lower side it is only acting on the incoming pipe. This result in the valve being securely shut to any flow and, the greater the input pressure, the greater the shutting force will be.

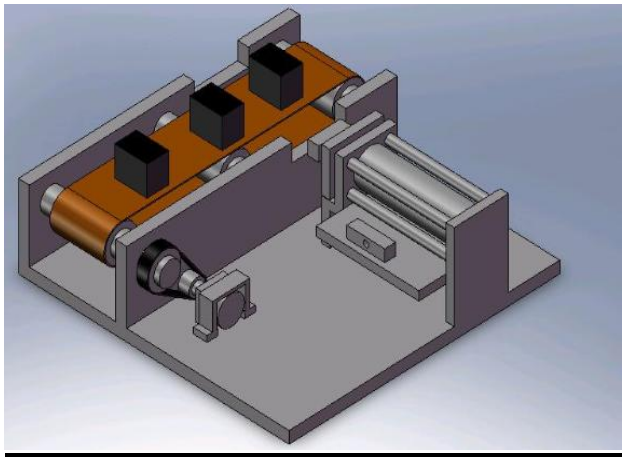
In the previous configuration the small conduit **D** was blocked by a pin which is the armature of the solenoid **E** and which is pushed down by a spring. If the solenoid is activated by drawing the pin upwards via magnetic force from the solenoid current, the water in chamber **C** will flow through this conduit **D** to the output side of the valve. The pressure in chamber **C** will drop and the incoming pressure will lift the diaphragm thus opening the main valve. Water now flows directly from **A** to **F**.

When the solenoid is again deactivated and the conduit **D** is closed again, the spring needs very little force to push the diaphragm down again and the main valve closes. In practice there is often no separate spring, the elastomeric diaphragm is molded so that it functions as its own spring, preferring to be in the closed shape.

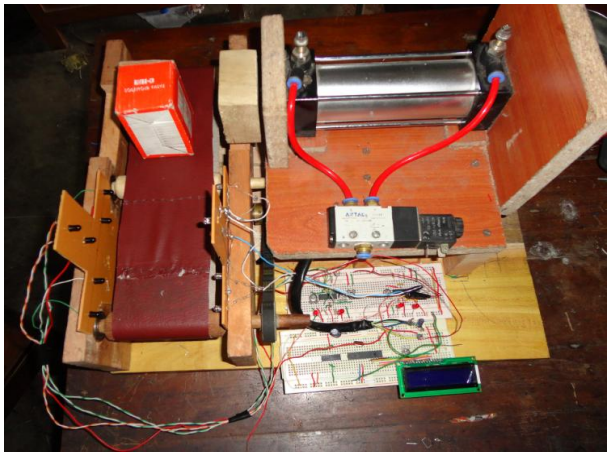
9. BLOCK DIAGRAM OF PROJECT



10. 3D VIEW OF AUTOMATIC OBJECT COUNTING AND REJECTING MACHINE



10. TOTAL ARRANGEMENT OF PROJECT



9. REFERENCES

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[3]http://en.wikipedia.org/wiki/Double-acting_cylinder
[4] Figure 1, 2,3,4,5 from FESTO didactic