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DESIGN & FABRICATION OF AN AUTOMATIC LIQUID FILLING MACHINE

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Abstract*- This project is to design and fabrication of automatic liquid filling machine using microcontroller and pneumatic actuator. This project combined the knowledge of mechanical, electrical, pneumatic and electronics. When the container comes 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. Water solenoid valve supply water when needed. If the container is filled up by the water then it passes on the conveyor belt and the next container will come and microcontroller will repeat the loop. In this project, IR (Infrared Ray) sensors, IR LED (Light Emitting Diode) is used as it is a pilot device that detects the presence of a container without physical contact.*

Keywords: Conveyor System, Flow Process, Control System

1. INTRODUCTION

In this modern era, 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. The field of automation has had a notable impact in a wide range of industries beyond manufacturing [8]. 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 [1]. 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. Now a day Microcontroller is using widely in the industries to make their process fully automated. It also gives the facilities to monitor the process and find out the problems if necessary [3].

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 [2]. 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.

2. WORKING PRINCIPLE

The goal of the project is to fill up the container to a fixed level. When the motor starts functioning the shafts with bearing start rotating. So the conveyer belt over the shafts also rotates. The belt rotates continuously until the motor is stopped. When the container is on the conveyer belt due to the motion of the belt it moves forward. The IR transmittance and receiver sensors are used to measure the presence of the container. Sensors as the input devices will send signal to microcontroller where microcontroller as the controller will give command to the actuator to do action [7]. 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. If the container is filled up by water then it passes on the conveyor belt and next container will come. In this project, IR (Infrared Ray) sensors, IR LED (Light Emitting Diode) is used as it is a pilot device that detects the presence of an object without physical contact.

3. METHODOLOGY

The block diagram, process flow diagram and 3D view of the construction of liquid filling machine are described below:

3.1 Block Diagram

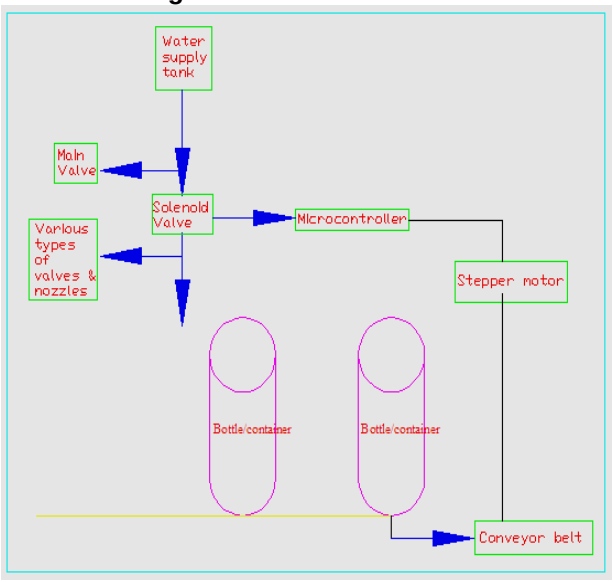

Fig. 1: Flow diagram of an automatic liquid filling machine.

3.2 Process Flow Chart

The process flow chart of a food packaging process is given bellow:

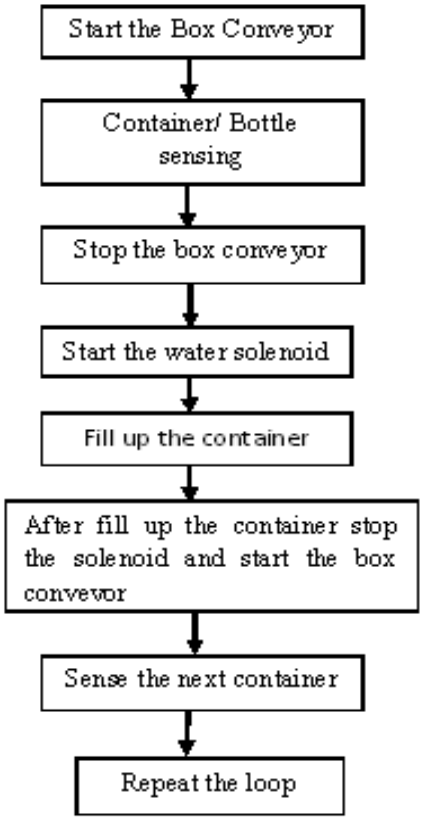

Fig. 2: Process flow chart.

3.3 3D Layout of the Project

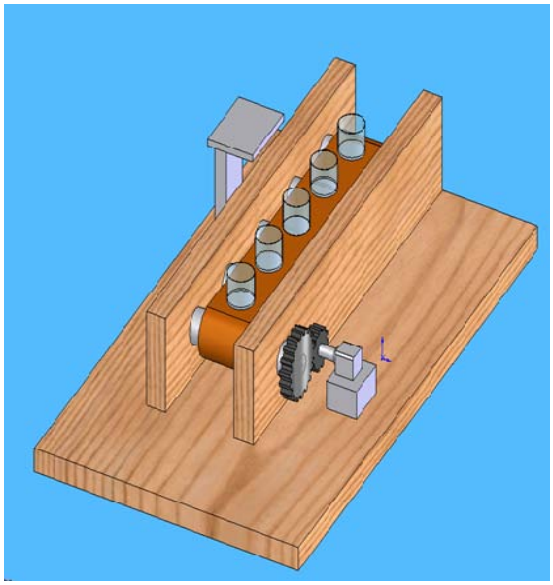

Fig. 3: 3D layout of the project

4. DESIGN AND CONSTRUCTION

4.1 Basic System Blocks

System is a black box. This system is made up with some building blocks. This system blocks are given bellow:

a) Mechanical system blocks: In my design mechanical parts are power roller, ideal roller, bearing, belt and pulley. To join the mechanical structure with each other I have use different size of screw.

b) Electrical system blocks: The electrical parts that I have used are AC motor, relay, voltage regulator, LDR, LED and connecting wire [6].

c) Pneumatic system blocks: The pneumatic part that I have used is water solenoid and plastic pipe.

d) Computer system blocks: The computer system is covered with software and hardware. Here I have use serial port to communicate with the microcontroller and to download the program to the microcontroller [5].

e) Information system blocks: To make a mechanical manual system automatic a flow of information is required. In this project work I need to make two senses from two different light sensor LDR and this senses or pulses goes to the microcontroller. With this pulse or information microcontroller will work according to the program.

f) Communication system blocks: The communication system explains who the different parts of a system are interrelated and communicating with each other. Here the communication system is sensor microcontroller actuator.

g) Control system blocks: It is the most important block while designing a mechatronics product. At first the sequence of the system should be considered. Then a sequential control is required. This sequential control is done with the help of microcontroller program [4].

4.2 Device Dimension

Dimension of different parts are given below:

Base dimension: Length 75 cm, Width 50 cm, Height 8 cm

Box roller dimension: Roller length 10 cm, Roller diameter 2.5 cm, Number of roller 5 (3 ideal roller)

Pulley dimension: Roller pulley diameter 3.2 cm

Bearing: Name HCH-6002z, inside diameter 1.5 cm, outside diameter 3.2 cm.

Fig. 4: Box conveyor arrangement

Fig. 5: Box conveyor setting

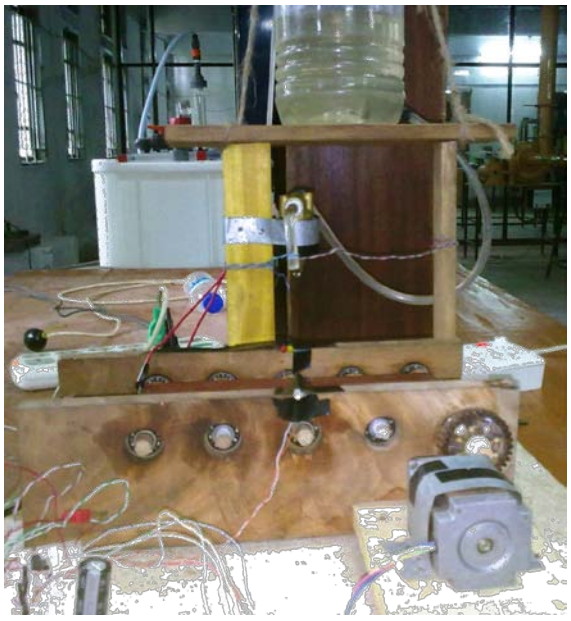

Fig. 6: Total Arrangement (front view)

Fig. 7: Total arrangement (top view)

Circuit Diagram:

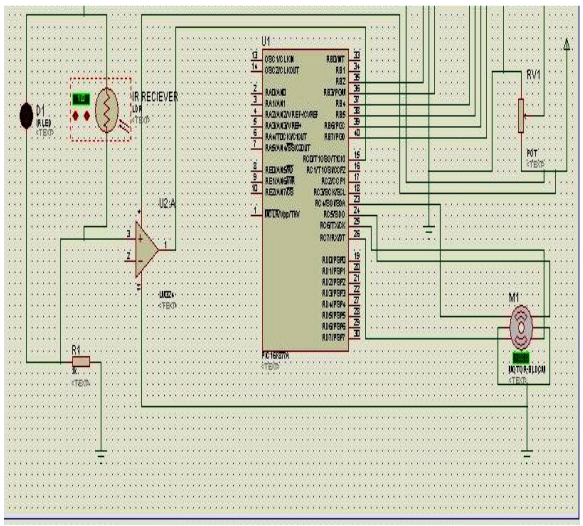

Fig. 8: Circuit diagram

5. RESULTS

Type: Mineral water bottle filling machine
Application: Beverage and Mineral water bottle filling machine
Automatic Grade: Automatic
Driven Type: Electric
Voltage: 220v
Power: 0.5kw
Place of Origin: CUET
Machine Dimension (L*W*H): 45cm*40cm*65cm
Weight: 2.5kg
Bottle Dimension: 250ml
Capacity: 156 bottle per hour
Control: Microcontroller
Material: Wood and Plastic
Filling type: Gravity pressure filling

6. DISCUSSION

Specially, in beverage industries this type of prototype is suitable. But for industrial purpose we need high production rate. A large production rate can be obtained by modifying the prototype. Although this prototype worked for mineral water filling but there are some substances which cannot be filled by gravity pressure

such as toothpaste, honey, edible oil etc. We need moderate pressure for those types of filling. We can use a pump and a nozzle instead of solenoid valve for those types of filling.

7. CONCLUSION

The main purpose of the project was to build up an automated process of liquid filling machine. Friction, vibration, mechanical alignment, current ratings were the main problems to run the project properly. IC, transistor, voltage regulator had to be changed for several times. To fill 200 ml it took about 20-25 seconds. This project can be developed in future time for better performance.

8. REFERENCES

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