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DESIGN AND DEVELOPMENT OF AUTOMATIC BOTTLE FILLING MACHINE

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ABSTRACT—This Project objective is to design and Implement a Programmable Logic Controller based automatic bottle filling using a DELTA PLC (DVP 14 SS) which acts as a field controller that runs the designed prototype by sensing the presence of bottle in a conveyor belt and then filling it accordingly up to a fixed level. PLC acts as the heart of the system. The system sequence of operation is designed by ladder diagram and the programming of this project by using programming software. Sensor used as a input signal transmitter for the PLC in this system. In this project sensor has been used to detect the position of bottle that move along the conveyor belt at the low speed of motor or conveyor. The input signal that has been sent from then sensor to the PLC has being made as a reference. The input signal is taken by PLC and accordingly output is obtained. Output of a PLC is the movement of the conveyor, motor rotation, solenoid valve, submersible pump etc.

I. INTRODUCTION

Now a day's the automation becomes most important part in manufacturing industries. In an automation the control system and information technologies are used to reduce the human work in the production of goods and services. In the traditional or conventional machining the worker is required to observe and perform the operations on a machine manually to make particular product or job. These tasks become tedious for worker. Automation is used to reduce the need of worker or operator during the machining process because the operation can be automatically controllable by the particular sensors and control devices and achieve a good accuracy with less time and reducing the worker involvement.

II. PROBLEM STATEMENT

Traditional methods involve manual handling of bottle by human and placing below the solenoid valve and then filling liquid in it.
Traditional method not achieves accuracy because no proper adjustment by human below the solenoid valve.
The amount of liquid fill is varies because the human error is presents.

III. METHODOLOGY

In this project the conveyor system is used for transfer of bottle from one place to another and it is driven by the motor.
The sensors are used to determine the exact position of bottle means it detect the present of bottle from that the conveyer is stop then the solenoid valve is used to fill the predetermined amount of liquid in the bottle then the conveyer starts running. This whole process is controlled by programmable logic controller (PLC). There is one tank which is supply the liquid to the solenoid valve and this tank is filling by submersible pump which is also controlled by PLC.

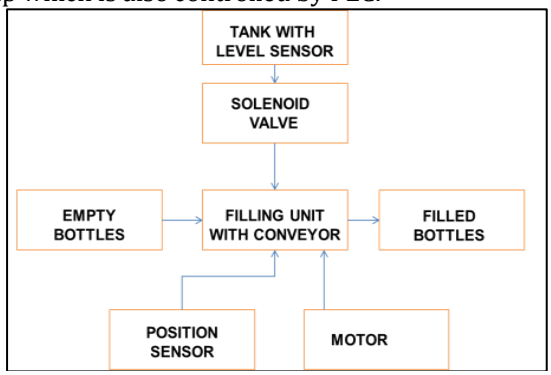

Fig.no.1 block diagram of methodology

IV. LITERATURE REVIEW

1.Md. Abdulla Al Nakib, Md. RanaAhmmad, Shahruk Osman (2018),is studied on, ―Design And Implementation Of PLC Based Automatic Bottle Filling. In this paper presents PLC is immensely useful device in automation system to increase production of goods. Automation increases the production of goods. Consequently, it can develop economic growth. The main objective of this paper is to design PLC based automatic bottle filling system. The cost of machine installation is more. But it can run for a long period of time. This machine has been implemented successfully. In this, PLC has been used to control the overall system by using ladder logic. The overall process is more reliable. It also saving time and operating system of this machine is so easy.

2.Ameer L. Saleh, Lawahed F. Naeem , Mohammed J. Mohammed (2017) is studied on, ―PLC Based Automatic Liquid Filling System For Different capacity Bottles. In this paper they find out An automatic water filling machine system for different sized bottles by using PLC has been developed and implemented. The PLC is used in this system to achieve more productivity with less time high reliability for and flexible in work. The system is designed to working with different capacity bottles by simply change the program.

V. DESIGN

Belt speed

$$V = \frac{\pi \times d \times N}{60} \text{.....(1)}$$

Where,
V = Belt speed;
d = diameters of rollers; and
π= pi
N=Motor Rpm
We have diameter of roller
d=100mm=0.1m and N=60 Rpm

$$\therefore V = 0.1 \times \pi$$

V= 0.314 m/s=314 mm/s

Belt capacity (B.C.)

$$B.C = 3.6 \times A \times \rho \times V \text{ .....(2)}$$

Where
A = belt sectional area (m^2);
ρ = material density (kg/m^3)= 1522 kg/m^3
V = belt speed (m/s)= 0.314 m/s

$$A = L \times H$$
$$A = 0.150 \times 0.005$$
$$A = 7.5 \times 10^{-4}\ m^2$$
$$BC = 3.6 \times 7.5 \times 10^{-4} \times 1522 \times 0.314$$
$$BC = 1.29035\ Kg/sec$$

The mass of material Mm (live load) per meter (kg/m) loaded on a belt conveyor is given as:

$$MM = \frac{BC}{(3.6 \times V)} \text{.....(3)}$$

Where,
BC = Conveyor capacity (1.29035 Kg/sec); and
V = belt speed (0.314 m/s).

$$MM = 1.29035/(3.6 \times 0.314)$$
$$MM = 1.1414\ kg$$

Length of belt

$$L = (\pi d) + (2 \times \text{centre distance}) \text{.....(4)}$$
$$L = (\pi \times 0.1) + (2 \times 0.8)$$
$$L = 1.9141\ m$$

Velocity of fluid through solenoid valve (V_1)

$$Q = A \times V_1 \text{.....(5)}$$

Where,
Q=discharge through solenoid valve in m^3/sec
Assume Q=2 lit/min=$3.33 \times 10^{-5}\ m^3/s$
d= diameter of solenoid valve

$$\text{Area} = \frac{\pi}{4} \times d^2 = \frac{\pi}{4} 12.5 \times 10^{-3}$$
$$A = 1.22 \times 10^{-4}\ m^2$$
$$3.33 \times 10^{-5} = 1.22 \times 10^{-4} \times V_1$$
$$V_1 = 0.2713\ m/s = 271\ mm/s$$

Time required to fill the bottle
Assume 0.5 litre bottle
In 1 sec discharge is 0.03333 lit/sec
For 0.5 lit bottle time required =bottle capacity (in litre)/discharge in 1 sec (in litre)

$$T = 0.5/0.0333$$
$$T = 15\ sec$$

For 0.25 litre bottle
In 1 sec discharge is 0.03333 lit/sec
For 0.25 lit bottle time required =bottle capacity (in litre)/discharge in 1 sec (in litre)

$$T = 0.25/0.0333$$
$$T = 7.5\ sec$$

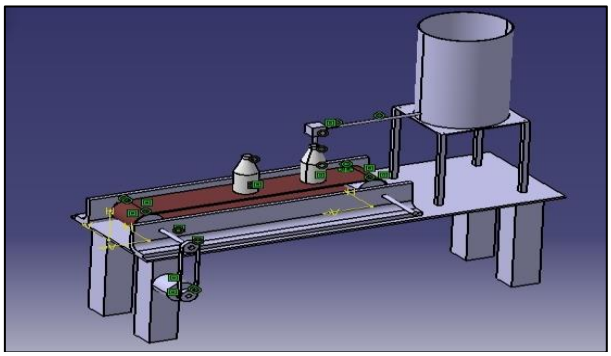

Fig.2 3d model of bottle filling machine

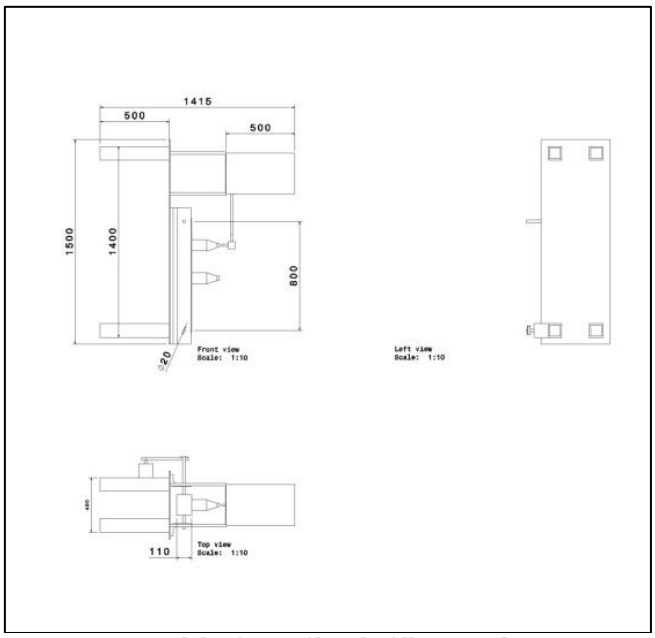

Fig.3 2d drafting of bottle filling machine

CONCLUSION

The system offers advantages like portability, low power consumption, flexibility. The careful selection of sensors and their mounting reduces the costof system. The moderate liquid filling speed found its use in many cottages
Industries. The designed system with certain modifications can be made usefulin the beverage industries, dairy plant, chemical industries and paint industriesDue to less human intervention and automation it is possible to maintain
Hygienic environment during liquid filling

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