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Design & Modeling of Unscrambler for Bottle Packaging

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Abstract

Automation is use of control system and information technologies to reduce the need for human work in the production goods and services. In the scope industrialization, automation is a step beyond mechanization. Whereas mechanization provide human operator with machinery to assist them with the muscular requirement of work, automation greatly decreases the need for human sensory and mental requirement as well. Unscrambler is the most common automation device that is used in industrial field for product sorting system. In purposed project unscrambler is used for sorting of bottle system. Packed mineral water is become preferred choice for huge mans of people to cop up the demand of it complete automation is need. There are many automation system is exist for packed mineral water but that all are very costly. Due to more cost of automatic system industry are use the manual process. My proposed work for proper positioning of the bottle is cheap & maintenance free. In our research it is used for bottle sorting system. It is required human resource for put bottle on the turn table. Present work will reduce human resource and make it automatic by using elevator, modification of turn table, flip hooks, proximity sensor, pneumatic actuator and sprocket mechanism. Here author has proposed design of the fully automated unscrambler. Main objectives of this research are reduced human resource and make it automatic. So that it can increase production rate. This all elements are arranged as per requirement so it should be able to make system automatic. After making system automatic calculate production rate and compare it to existing production rate.

Keyword: *Automation, Mechanization, Muscular, Turn table, Unscrambler, Mineral*

I. INTRODUCTION

Turn table (uncrambler) play a very vital role in the automatic bottle packaging industry. It should supply the sufficient flow of bottle to the production line. Turn table is unscrambler which is supply various size and shape bottle to the production line in proper way. Bottle packaging rate is depend upon flow of supply of bottle, if the bottle is not supply proper way and fast it should effect the production rate. During the past decade, global manufacturing competition has increased significantly. Consequently, the manufacturing industry around the world have been undergoing some fundamental changes, including a move to low cost, high quality systems and a shift in a focus from large business customers to diffused commodity market for all size and type of customer. In order to satisfy today’s customer, the industry needs its product to be of extremely high quality and at the same time be affordable. In order to achieve the good quality in products industries are making use of more and more automation system in manufacturing. Manufacturers use various tools to bring about the high quality products and among of them is the turntable that being used for sorting the products. While using this tool, the product will be sorted with specification required thus can ease the production process and the productivity of the production will increase.

II. PROBLEM IDENTIFICATION

Many Small companies today are still use the manual sorting process to sort the part for production process, by using simple unscrambler. Simple unscramble consist turn table, it can be take long time to finish the work because human will usually feel bored and tired to do same task repetitively. This situation will result to inefficient work condition for the worker. The repetition of this work over long period of time can expose the workers to experiencing lower back pain and some cases of mosculesketal disorder.

Fig 1. Existing unscrambler

Expensive automated sorting system that are used in large company do not suit application for the smaller company such as for the small and medium enterprise because of high cost to implement. To install this system, it will require a large space depending on the process required.

III. EXISTING TURN TABLE

Existing turn table feed the bottle to the production line using human resource. Following figure shows the model of the existing turn table.

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Fig 2. Model of turn table

Diameter of unscrambler	600mm,700mm,900mm,1200mm (standard)
Container input	Round, vital, flat, square shape
Container diameter	16mm to 100mm
Container height	Up to 240mm
Height of disc	850mm to 950mm
Disc linear speed	20meter/min
Motor specification	0.50Hp/075 Hp,220v, Ac,3Phase

Table 1. Technical specification of existing unscrambler

IV. DESIGN AND DEVELOPMENT PHASE

Methodology

1. Design of bin for bottle for bottle storage

2. Design of bucket elevator

3. Modification of existing unscramble

4. Design of flip hook

5. Design of sprocket

6. Selection of sensor

7. Selection of pneumatic actuator

1. Design of bin for bottle storage

Bin is used for bottle storage. Which is supply the bottle to the elevator? Bin size is user configurable

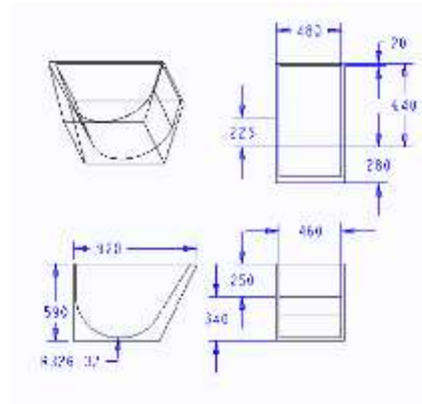

Fig 3. Drawing of bin

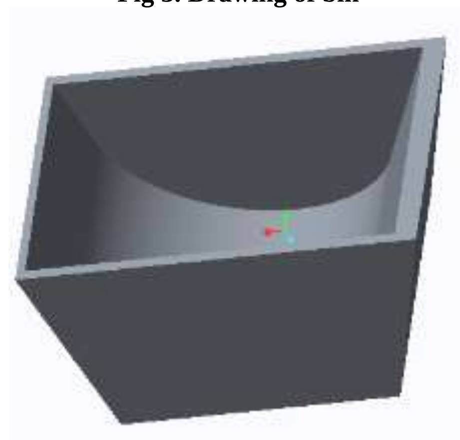

Fig 4. Model of bin

2. Design of bucket elevator

Three component of bucket elevator
i) Bucket
ii) Pulley
iii) Belt

i. Bucket

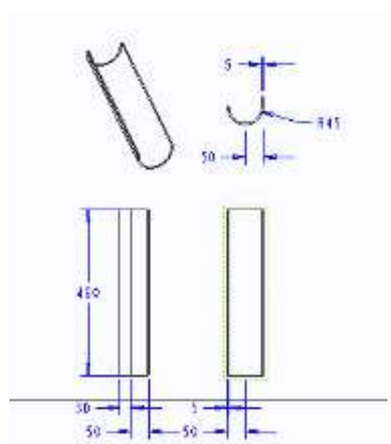

Fig 5. Drawing of bucket

Fig 6. Model of bucket

ii. Pulley

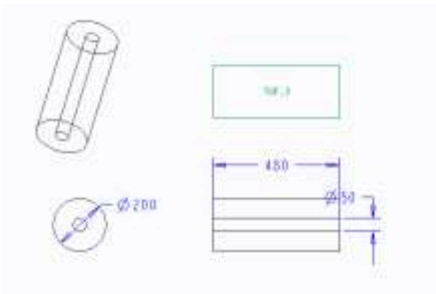

Fig 7. Drawing of pulley

Fig 8. Model of pulley

iii. Elevator belt

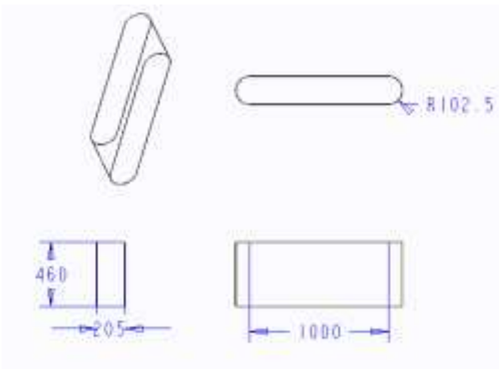

Fig 9. Drawing of elevator belt

Fig 10. Model of elevator belt

3. Modification of existing turn table

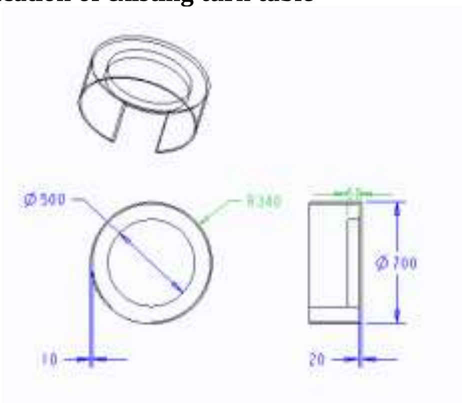

Fig 11. Drawing of modified turn table

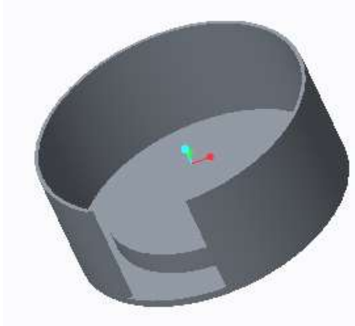

Fig 12. Model of modified turn table

4. Design of flip hook

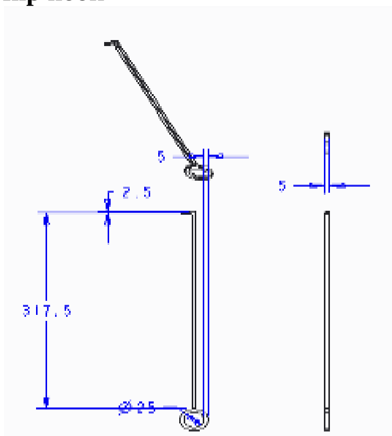

Fig 13. Drawing of flip hook

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Fig 14. Model of flip hook

5. Design of sprocket

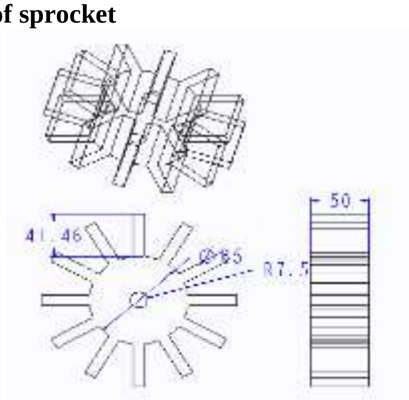

Fig 15. Drawing of sprocket

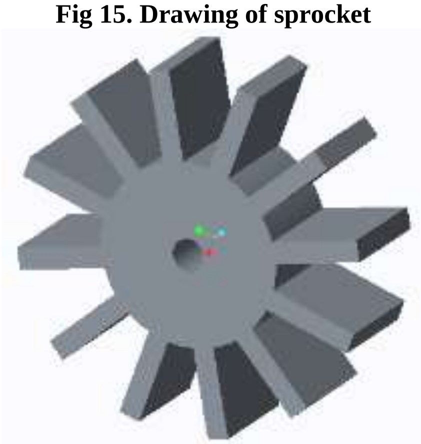

Fig 16. Model of sprocket

6. SELECTION OF SENSOR

Capacitive proximity sensor is similar to inductive proximity sensor. The main different between the two types is that capacitive proximity sensors produce an electrostatic field instead of an electromagnetic field, capacitive proximity switches will sense metal as well as nonmetallic material such metal as paper, plastic, glass, liquid etc.

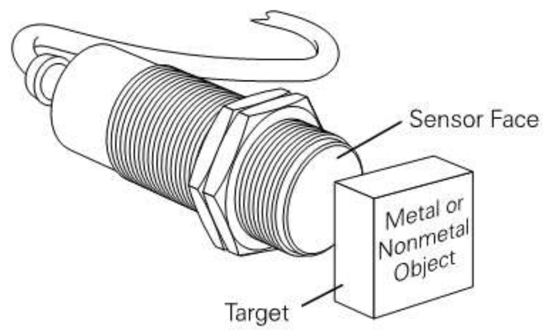

Fig 17. Proximity sensor

The sensing surface of a capacitive sensor is formed by two concentrically shaped metal electrodes of an unwound capacitor. When an object near the sensing surface it enters electrostatic field of the electrodes and changes the capacitance in an oscillator circuit. As a result, the oscillator being oscillating. The trigger circuit reads the oscillators amplitude and when it reaches a specific level the output state of the sensor changes. As the target moves away from the sensor the oscillator's amplitude decreases, switching the sensor output back to its original state.

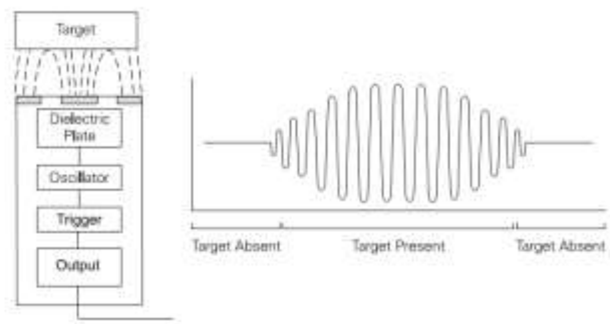

Fig 18. Principle operation of proximity sensor

7. SELECTION OF PNEUMATIC ACTUATOR

In industrial control system, an actuator is a hardware device that converts a controller command signal into a change in the physical Parameter. The change in physical parameter is usually mechanical. Such as position or velocity change. An actuator is a transducer, because it changes one type of physical quantity. Say electric current, into another type of physical quantity, say rotational speed of the electric motor. The controller command signal is usually low level and so an amplifier to strength the signal sufficiently to drive the actuator.

A list common actuator is dc motor, hydraulic piston, induction motor, linear induction motor, pneumatic cylinder, relay switch, solenoid and stepping motor. Depending the type of amplifier used. Most actuator can be classified into one of three categories 1) electrical 2) hydraulic 3) pneumatic. Electrical actuator is most common. They include ac and dc motors of various kinds, stepper motors and solenoids.

Electrical actuators include both linear device and rotational devices. Hydraulic actuator use hydraulic fluid to amplify the controller command signal.

Fig 19. Pneumatic rotary actuator

Hydraulic actuators are often specified when large forces are required. Pneumatic actuator used compressed air as the driving power. Again, both linear and rotational pneumatic actuators are available. Because of the relatively low air pressure involved, actuators are usually limited or relatively low force application compared with hydraulic actuators.

V. ASSEMBLY AND WORKING OF NEW UNSCRAMBLER

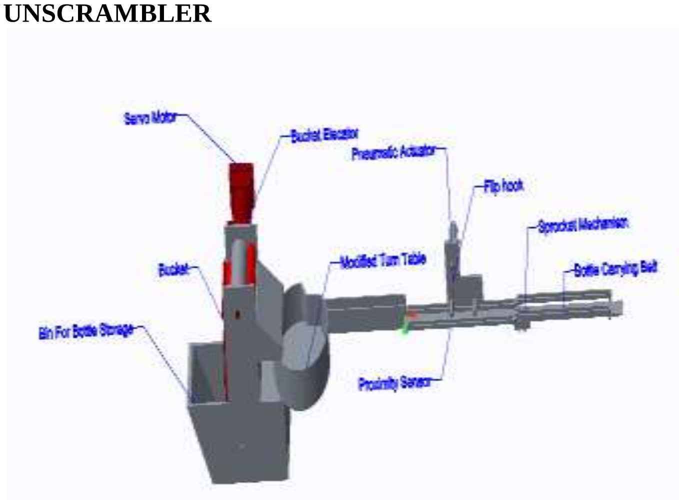

Fig 20. Assembly of new unscrambler

Bottle stacked in a bin or container on the ground will be taken to the rotating table through the bucket elevator. From the elevator it will gently dropped on the rotating table. The shape of table made curve to facilitate flow of bottle towards the periphery of table. The table is fixed on the robust base rotated using gear mechanism. Bottle from rotating table will be drawn on the belt conveyor through the small passage on the periphery of table by providing obstacle in its path.

The bottles moving on the conveyor belt will be arranged to flow in specific condition by using sensor and some mechanical arrangement. A proximity sensor sense the neck of bottle and allow to it move advance by changing its position by 180 degree with the help of flip hook mechanism.

Once the bottle move in specific position, the next task is to put it in vertical position. This will be done by pushing end of bottle in downward direction while bottle moves/slides forward from one conveyor to another. Thus now on second conveyor, the bottle stacked in vertical position from where it will flow in production line where it will flow in production line where feeling and capping furnished.

VI. EXISTING SPEED AND FLOW RATE

Linear speed of turn table= 20 meter/min (given existing data)
Linear speed = rotary speed * radius of disc (v=w*r)
Rotary speed= linear speed/radius of disc
= 20*1000/450
=44.44RPM
Flow rate= number of unit produce / Total time taken to produce unit
Existing flow rate= 22 bottle / per minute (calculated by practically)

VII. CALCULATING NEW FLOW RATE USING MOTION SIMULATION

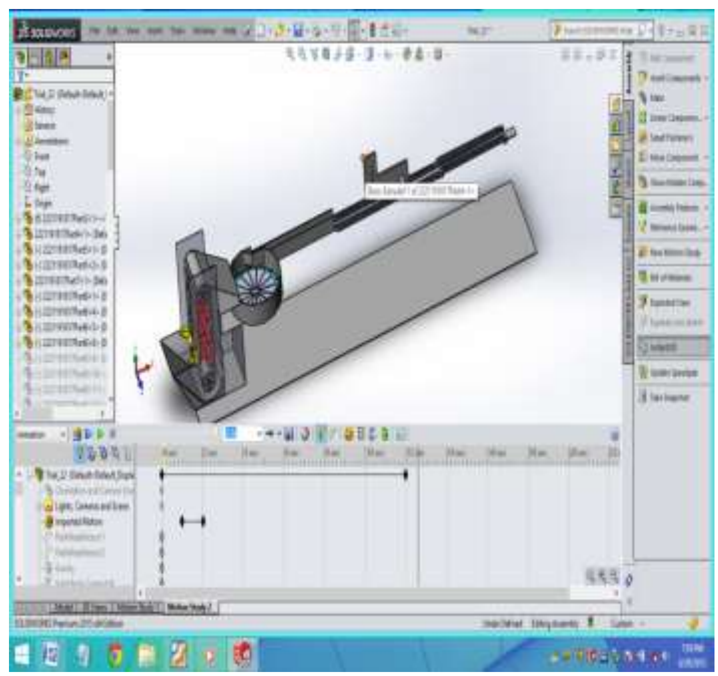

Fig 21. Motion simulation of model

Motion simulation is done using the solid works. Following various motions is given to the various component of model. Speed of all components is constant 100RPM. According to motion simulation one bottle required 15s from bin to exit of unscrambler. Second bottle is also behind the first bottle. Time lag between two bottles is one second. Additional time filling and capping of bottle is 5s.Total time is 20s for one bottle.

Now all bottles are in series so that per minute according to total time and time lag between two bottles we can achieve 40bottle/minute. Where existing flow rate is 22bottle/minute. We can achieve 18 more bottle using unscambler per one minute.

VIII. COMPARISON OF EXISTING AND NEW FLOW RATE

Time	Existing flow rate	New flow rate	Different
Per minute	22 bottle	40 bottle	18 bottle
Per hour	1320 bottle	2400 bottle	1080 bottle
Per day	31680 bottle	57600 bottle	25920 bottle
Per month	950400 bottle	1728000 bottle	777600 bottle

Table 2. flow rate comparison

IX. CONCLUSION

The main aim is this research is implementing of automation in bottle packaging plant. Existing plant is not automatic and it is required human resource to supply the bottle to the production line. In existing plant we can achieve 22 bottles per minute which is calculate by practically. After design and implement of new unscrambler we can achieve 40 bottles per minute which is calculate by motion simulation of model in solid works. So that we can achieve 18 more bottle and 30% more flow rate using new unscrambler.

X. FUTURE SCOPE

As a future scope, this concept is use in various industries like water bottle packaging plant, pharmaceutical, beverages, cosmetics, and other industries which is use bottle for the product packaging.

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