



INDUSTRY 4.0: AUTOMATIC POOR QUALITY OBJECT SEGRATION SYSTEM FOR CONVEYERS.

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ABSTRACT

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. So the goal of this project is to propose an automatic system to assert the dimensional (length) accuracy of a product and the rejection of the defective products. An IR sensor is used to detect the presence of the object. When a product is arrived then the motor starts running and so as the conveyor belt also starts running. Infrared Sensor detects the dimensions of the product. If the product has correct dimensions it will be further transferred to the acceptor bin, and if not then the product is rejected by pneumatic actuator into the rejecter bin.

Keywords: *Segration System, Production Efficiency, Low cost, Belt Tension*

NOMENCLATURE:

Tb = belt tension

f = Coefficient of friction

L = Conveyor length

g = Acceleration due to gravity

Pp = Power at drive pulley

V = Belt Speed

Kd = Drive efficiency

Pm = Power Required By Pneumatic Cylinder To Drive

1. INTRODUCTION

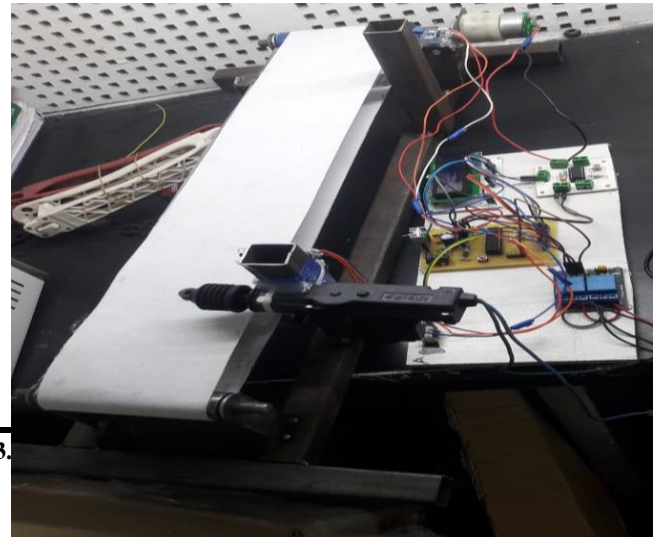
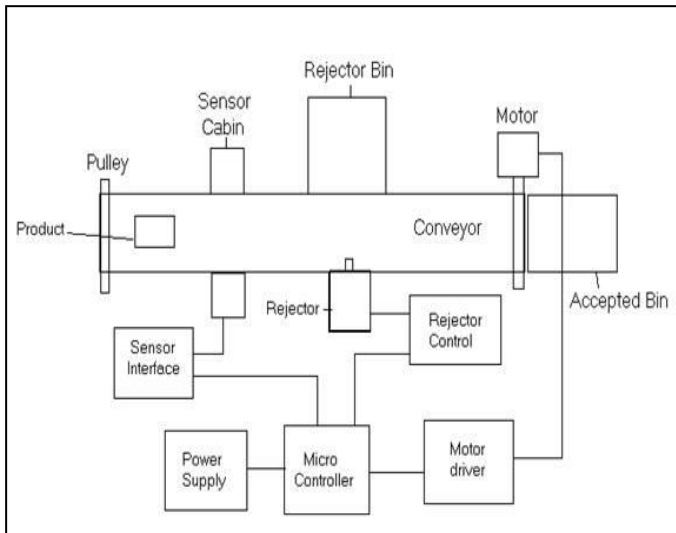
Conveyor system is one part of material handling equipment that transports material from one place to another. Further the conveyor system can also be used for the acceptance and rejection of material or product. Conveyors are used in almost all industries where materials are to be moved. Automated conveyor systems are proved to be very useful as cost labor wages and customer demand is increasing at a great rate. This paper is based on the project which uses fully automated material handling system. Reasons to select automated conveyor systems are: -

- 1) Saving in manpower.
- 2) Improvement in quality and efficiency.
- 3) Increment in consistency and Flexibility.

Manual handling of material could lead to the damage of product; also the worker who is to handle the material cannot determine the fault in the product immediately by observing through naked eyes. This process is very time consuming. Also there is the requirement of skilled labors. So taking these problems into considerations, a fully automated material handling system is developed. The material handling system uses conveyor belt for the

movement of product [1]. The design parameters such as belt speed, length of the belt, design of pulley, motor selection is done [2]. IR Sensor is used to detect the presence of the product, which then allows starting the conveyor belt [3]. The system uses IR Sensors coupled to the base frame which detects the size and movement of the product and sends the information to Microcontroller unit [3]. A microcontroller is used to receive the signal from the IR Sensor and to give the signal to Pneumatic actuator [4]. This is done by using infrared sensors coupled with micro controller unit. There is synchronization between the speed of belt and actuator. Further the micro controller gives the signal to the actuator whether to plunge the product towards rejecter bin or to allow it to pass towards accepter bin. This automation reduces time and improves the material handling speed as compared to manual handling and inspection. .

2. PROTOTYPE SETUP



The goal of this model is to assert the dimensional (length) accuracy of a product and the rejection of the defective products. For this, first of all an IR sensor is being used which will ensure the presence of the object. When a product is arrived then the motor starts running and so as the conveyor belt. As the product is on the conveyor belt, due to the motion of the belt it moves forward. The LASER cut the product. As a result, the counter is ON and starts counting. After a while, the LASER cuts the LDR (light depending resistor). So the counter is OFF and stops counting. This time is calculated and is compared with the time which was set earlier knowing that how much time the product will be in contact with the laser. From this a decision comes whether the length of the product is right or wrong.

If the length of the product is correct then it is allowed to pass through. At the end of the system there is a sensor which will ensure whether the product is passed or not. If the product passes then the motor stops running and will wait for the arrival of the new product on the other hand if the product is defective (wrong length) then another sensor will ensure the arrival of the defective product in the rejection zone. Then the rejection motor will start and will reject the defective product from the conveyor belt. 3.1 Block Diagram of the Working Principle A block diagram of the working principle has been shown in Figure 1. From this diagram it is clear that when a product is reached to the detection zone its length is measured with the help of IR sensor. If the length of the product is accurate it is shown in the LCD display and the product is passed to the product box by the movement of conveyor belt and if the length is wrong then it is dumped to the waste box by means of a punching motor.

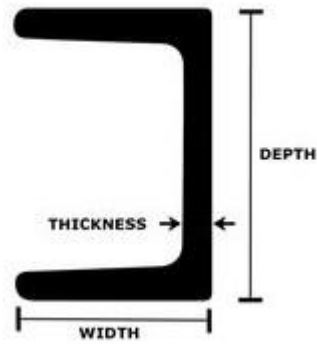
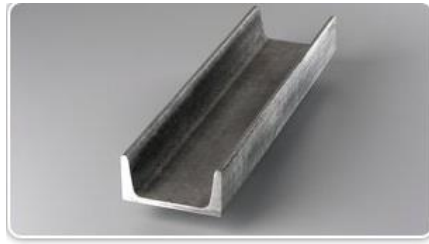
4. DESIGN AND CALCULATION

Base Frame Design

We design a basic frame for a prototype vehicle by steel channel (U beam),

Alloy: Hot Dipped Galvanized

Characteristics: Semi-rough, grey finish. Tapered legs.



Power Calculation

Belt Tension: The Belt Of The Conveyor Always Experiences A Tensile Load Due To The Rotation Of The Electric Drive, Weight Of The Conveyed Materials, And Due To The Idlers. The Belt Tension At Steady State Can Be Calculated As:

$$T_b = 1.37 * F * L * G * \dots \dots \dots \text{Eqn.1.1}$$

Where,

T_b is in Newton.

f = Coefficient of friction usually 0.35

L = Conveyor length in meters. Conveyor length is approximately half of the total belt length.

g = Acceleration due to gravity = 9.81 m/sec²

Power at drive pulley

The power required at the drive pulley can be calculated from the belt tension value as below:

$$P_p = (T_b * V) / 1000 \dots \dots \dots \text{eqn.1.2}$$

5. APPLICATION

1) BEVERAGE PRODUCTS » X-RAY ASSISTED EMPTY BOTTLE INSPECTION

- optical and radiometric base inspection for the detection of foreign objects, chips and cracks
- optical inspection for the detection of finish and thread faults
- optical sidewall inspection for the identification of contamination, damage and glass faults
- optical inspection especially for the detection of transparent foil in a bottle
- mineral ring detection
- scuffing detection
- two residual liquid detections (for lye and water as well as varnish and oil)
- rust ring detection

2) BEVERAGE PRODUCTS » EMPTY CAN INSPECTION

- Detecting deformed cans
- Identifying deformation and damage at the flanged edge
- Detecting dents, bumps, contaminants and foreign objects inside the can
- Optional – detecting scratches, damage, contaminants as well as faulty logos, lettering and coding on the outer wall of the empty can
- Rejecting faulty empty cans early enough
- Automatically adjusting the inspection modules during brand changes

ADVANTAGES

- It is used to avoid human errors.
- By using automation it reduces the testing lifecycle with respect to time.
- We get more reliable test result.
- It reduces man power.
- Low-noise system the Eco push operates without compressed air, making it very quiet.
- Low operating costs the pusher is economical in its energy consumption, making it economical to run.
- Very low maintenance the reliable electric pusher is a very low maintenance solution for everyday operations.
- Service rejection The Eco push can also be used to eject containers for analysis.

6. FUTURE SCOPE AND RECOMMENDATION

The developed dimensional accuracy assertion system can measure only the length of the product. If more sensors are used then it will be possible to measure more dimensions such as height and width. → In order to manufacture defect less products rapidly, there is no alternative of a dimensional accuracy assertion system in the production line. For this purpose if a large scale production of dimensional accuracy assertion system is possible then the price of this product will be cheaper than present manufacturing cost. Due to its simple mechanical design and use of available sensors in the market it will be cheaper. → For more precise and accurate assertion of dimensional accuracy a more accurate structure could be designed. → Steps can be taken to mesh the teeth of the pinion and the timing belt perfectly to avoid the slipping of conveyor belt and get more precise performance. → For actual industrial application Limit switches can be used in replace of sensors and pressure coil or pneumatic system can be used to remove the rejected product from the conveyor belt. → The response time of electromechanical system is relatively fast. But it can be made faster by using industrial grade motor. The microcontroller and motor used in presently developed dimensional accuracy assertion system are properly synchronized. When the industrial grade motor will be used, then the system should be synchronized to perform smoothly and in a faster way.

7. CONCLUSION

In today's highly competitive global world, the management of the integrity of the supply of a product from raw material to delivered finished product, through quality manufacturing is of paramount importance. For the declaration of a product bearing high quality, dimensional accuracy assertion is a must. So our developed model of automatic length sorting is an excellent one because of its working principle and wide implementation. By applying the idea of this model an industry can easily sort the required product according to its demand. Though it has some limitations, but by having done some modification this concept can be implemented in a wide range of application.

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