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Automated System for Rejection of Poor Quality Material

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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 paper 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 **-**IR Sensor (Infrared Sensor), Pneumatic Actuator

I. 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. .

II. Working

The main objective of this paper is to check the dimensional accuracy of the product. So the working of the system is fully based on the size of product. For this, first of all an IR sensor is used to detect the presence of the object. When the product is kept on the conveyor, the motor starts running. Motor is connected to the driving pulley which drives the conveyor belt. As the product is on the conveyor belt, due to the motion of the belt it moves forward. The IR sensor as shown in fig.1.1 is placed between the paths of the conveyor belt near to the driving pulley. When product comes in contact with the IR sensor, it measures the dimension of the product. The dimension here refers to the vertical height of the product. It gives signal to the microcontroller. Microcontroller then compares the measured dimension of product with the specified dimension. If the dimensions are matched then the product allowed passing to the acceptor bin which is present at the end of the conveyor belt. If the product is not matched with the specified dimension, then the microcontroller gives signal to the pneumatic actuator. Pneumatic actuator plunges off that product in the rejecterbin.

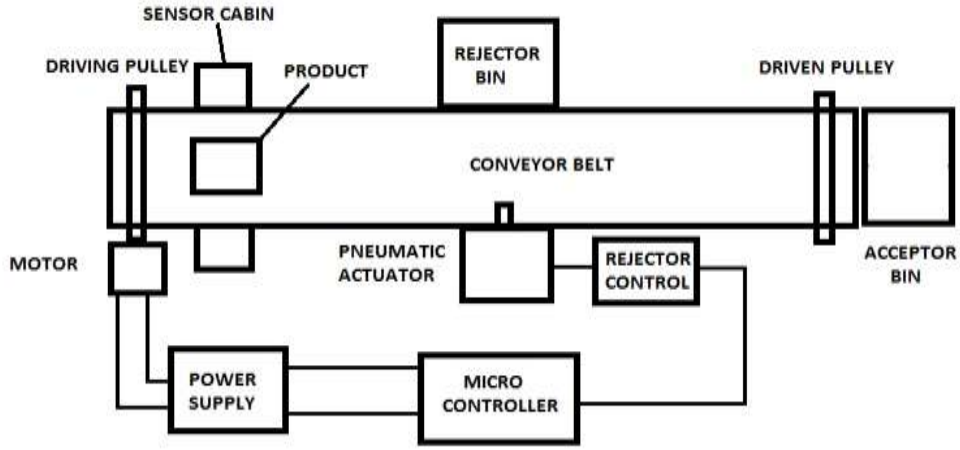

Fig.1.1 Architecture Diagram Of Whole Project

Objectives

Our objective of this research paper as,

1] Increment in the quality and manufacturing capacity for industries

2] Elimination of manual based tasks and operations

3] Reduce cost factor and handling time of products

III. Description of System Components

4.1 IR Sensor

An infrared sensor is an electronic instrument which is used to senses certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. An IR sensor consists of a transmitter and a receiver. The transmitter transmits the infrared rays while the receiver receives the transmitted rays.

The IR sensor detects the material if present on the conveyor and then only sends the signal to start the conveyor system. The second use of IR sensor is to measure the vertical dimension of the object. The IR sensor is placed at a desired height of the material. Below which material can pass without reflecting the IR rays. If the material size is above the pre-defined size then the rays will be reflected back to the receiver and the receiver will send the signal to the microcontroller for further rejection of material by actuation.

4.2 Microcontroller

The function of microcontroller is to receive the signals given from the IR sensor and further gives the signal to the actuator. There is the synchronization between the object speed and the actuator and this synchronization is made using belt speed. Microcontroller has a very important role in the actuation of pneumatic actuator. The microcontroller is allowed do function in such a way with the help of UVision KEIL4 software. The microcontroller used in this paper is 8051.

4.3 DC Motor

For transmission to belt we use DC Mabuchi motor JC-578VA

The motor specification is as follows:

Brand Name: MABUCHI

Model Number: JC-578VA

Type: Servo Motor

Speed(RPM):100rpm

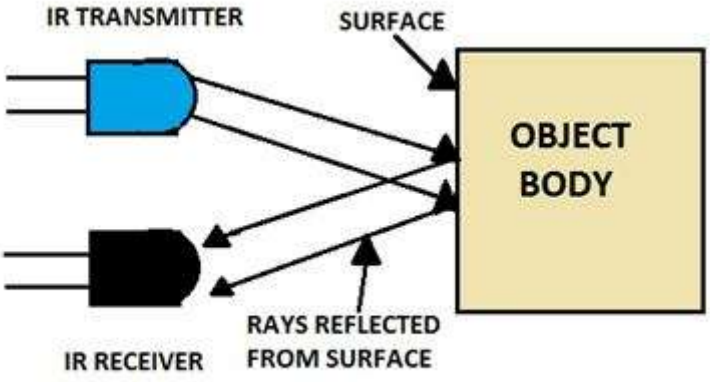

Fig.4.1 IR Sensor

4. 4 Conveyor Belt

The conveyor belt used here consists of two pulleys with continuous chain of product one of the wheels is powered by a 14 rpm converted speed, moving the belt and the material on the belt goes forward.

The length of the belt is given by:

$$L = 2C + \frac{\pi}{2}(D + d) + \frac{(D - d)2}{4} \times C$$

Where:

D→ Diameter of the larger pulley

d→ Diameter of the small pulley

C→ Central distance between two pulleys

The central distance between two pulleys is 520mm.

$$L = 2C + \frac{\pi}{2}(D + d) + \frac{(D - d)2}{4} \times C$$

L=2*520+1.57*(45+45)+0

L=1182mm =1.182 meters

Specifications of belt are:

Type of belt = Flat Belt

Material used = Nylon

Length = 1.182 m

Width = 0.125 m

4.5Pneumatic Actuator

Pneumatic actuator used here is Pneumax ISO-6432MIR Cylinders, Double acting, Magnetic, With stainless piston rod.

Specifications of Pneumatic actuator are:

Type = Double acting pneumatic cylinder.

Bore Size = 8 MM

Stroke = 15 MM.

ISO Profile = ISO 6432.

Operating Temperature Range = 10-40^{o}C.

Working Medium = Compressed air upto 4 bar pressure.

Force of piston required to push the rejected object=

$$F = P * \tfrac{\pi}{4} * (D_1{}^2\text{-}D_2{}^2)$$

Where:

F= Force required by piston(N)

P= Pressure
D_1= Bore diameter of Piston in (m)
D_2 = Piston rod diameter (m)

$$= (10)^5 * \frac{\pi}{4} * [(0.015)^2 - (0.008)^2]$$

=12.66N
=0.012KN

IV. Conclusion

The developed model of automatic material sorting is excellent 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. Thus the manual based tasks and operations are reduced as it does not involve labor work for sorting of product, the object sorting process gets faster as compared to manual sorting, thereby reducing the handling and inspection time to minimal, hence reducing the manpower cost and time. There are some limitations, but due to flexibility of the system certain modifications can be done and these limitations can be eliminated and this concept can be implemented in the various material handling applications. This model can be used in packaging industry, quality check for industrial use, in production lines to check the dimensions of product etc. As the construction is flexible in nature, various sensors to detect various faults can be used in future.

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