IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X
PP. 04-07
www.iosrjournals.org

Sorting of Objects Based on Colour, Weight and Type on A Conveyor Line Using PLC

S. V. Rautu, A. P. Shinde, N. R. Darda, A. V.Vaghule, C. B.Meshram, S.S.Sarawade
(Department of Mechanical Engineering, M.E.S. College of Engineering, Pune, S.P. Pune University, India)

Abstract:- *Sorting of products in an industry is a tedious industrial process, which is generally carried out manually. Continuous manual sorting creates quality consistency issues. Segregation based on different characteristics like weight, colour, type require different equipment for weighing and then separating. We have proposed an efficient method which uses load cell, inductive sensor and TCS 230 colour sensor for identifying and segregating on the basis of weight, colour and type (metal or non-metal) of object and Siemens 300 Series PLC to control the overall process of sorting two types of objects. The system rejects and discards objects that are not of required characteristics by pushing them out of conveyor line using a flipper mechanism. A circular container, having three partitions is used to collect objects of three different colours. Two conveyor belts were used, each controlled by separate DC motors. The first belt is for placing the product to be analyzed by the load cell and inductive sensor, which also contains a colour sensor at the end for one type of segregated object and the second belt also has a colour sensor for the components separated by the load cell and inductive sensor.*
Keywords *–Colour Sorting, Conveyor Line, DC Motor Siemens 300 series PLC, TCS230 Colour Sensor.*

I. INTRODUCTION

Automation is the use of control systems for handling different processes and machineries to replace human efforts. Automated systems generally use complex algorithms which increase the cost of the design and the power consumed. But this not only reduces manual efforts, time consumed, but gives more time to work on factors like aesthetics. Using automation also prevents danger which might occur when humans are made to work in hazardous environments. Thus, use of automation is effective in manufacturing industry.Sorting based on colour, weight and type is done in many industries to ensure the quality of the object is consistent and up to the mark. Automated sorting also reduces the labour cost and the production time. The error cased due to human negligence are avoided by the use of automated system by colour based sorting using a colour sensor.

1.1 Proposed System

In this project, we have proposed a Low Cost Automation System for sorting coloured objects on the basis of their colour, weight variation and type(metal or non-metal). The project mainly focuses on sorting 2different weighing non-metallic objects which are available in 3 different coloursusing load cell, TCS230 coloursensor, inductive sensor and DC geared motors interfaced with Programmable Logic Controller (PLC). A DC motor is used for the flipper which is used for pushing the object from one conveyor to other conveyor line and also the rejection bin. For collection of objects segregated based on colour, a circular disc having 3 compartments is used, which is operated using the DC motor. The system consists of conveyor belt which takes the objects like bottles, small boxes or packages in front of sensors and thus sorting logic is decided by PLC. PLC is programmed with different logics, each for sorting different weight andcolour product combination. The system consists of total 2colour sensors, an inductive sensor and a load cell, all used to detect the colour, type and weight respectively. There would be two conveyor lines, primary and secondary. The function of primary conveyor belt is to take the boxes in front inductive sensor followed by the load cell and colour sensors. Post the rejection system, the primary line would carry objects of the weight prescribed for segregation for the primary line(say weight 1)while the secondary line would carry the objects of weight 2 and rest all would be discarded in the rejection bin. The colour sensor at the end of both the conveyor lines will segregate the objects based on their colour and send the signal to the PLC, which will initiate the DC motor on which the circular container is mounted, having three compartments, one for each colour, in which the objects would be collected.
Objectives of the project:

1. To sort objects depending upon the colour.
2. To analyse the quality of the object.

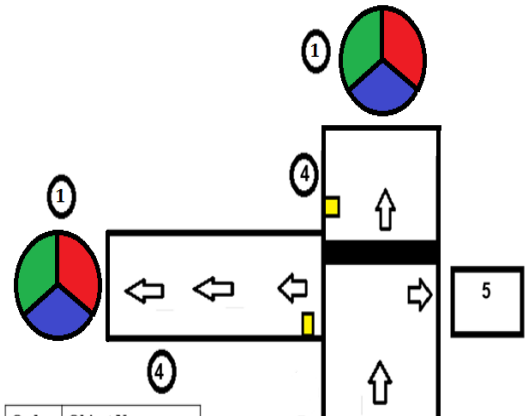
DOI: 10.9790/1684-17010060407

3. To design easy and simplified operational system.
4. To count and display count of the object.

II. COMPONENTS

1. Conveyor Belt
   The system comprises of the main line and a subordinate line on which lighter objects are segregated. The conveyor line is driven by two 60 rpm motors of the DC type. The belt is a flat belt conveyor made up of polyurethane.
2. Inductive Sensor
   Inductive sensor is a non-contact type sensor which is the first sensor in the system to sense the incoming object. This sensor is used to distinguish between metals and non-metals. It utilizes the inductive effect for the detection of metals.
3. Load cell
   It is a contact type device used to measure the weight of the object which passes on the conveyor line. This device is mounted under the conveyor belt on which the object passes. The range of the load cell is from 0 to 3kg. This load cell is of a bending beam type
4. TCS230 Colour Sensor
   This sensor is used to differentiate between three colours i.e. red, green and blue. The model of the sensor is TCS230. The object which is moving on the conveyor line is sensed by this sensor which sends the signal to the PLC according to the wavelength produced by the reflected wave. The object is further sorted on the basis of the colour.
5. DC motors:
   The DC motors work using direct current instead of alternating current. The motors are used to drive the system i.e. the motor is coupled to the rollers on which the conveyor belt moves. Five motors would be used, two motors mounted on rollers for conveyor line, i.e. one for each conveyor line, two motors for the two collection containers and one motor for the flipper mechanism.
6. Rejection Unit
   It comprises of a bridge on which the DC motor is mounted to which the flipper is attached. As soon as the PLC receives a signal from the load cell or the inductive sensor for a particular object, the flipper is initiated and if the object has undesired properties than the required ones, it slides the object into the rejection system; or the flipper slides it on the secondary conveyor line if it has the weighs as the weight set for secondary conveyor belt. If neither of the above conditions hold true and the object weighs as per the weight limit set for the primary line, the flipper leaves the object undisturbed and it continues on the primary conveyor line.

III. BLOCK DIAGRAM



Order No.	Object Name
1	Object Collection
2	Inductive Sensor
3	Load Cell
4	Colour Sensor
5	Rejection Box

Fig 1: Schematic diagram of conveyor system

DOI: 10.9790/1684-17010060407

IV. FLOWCHART

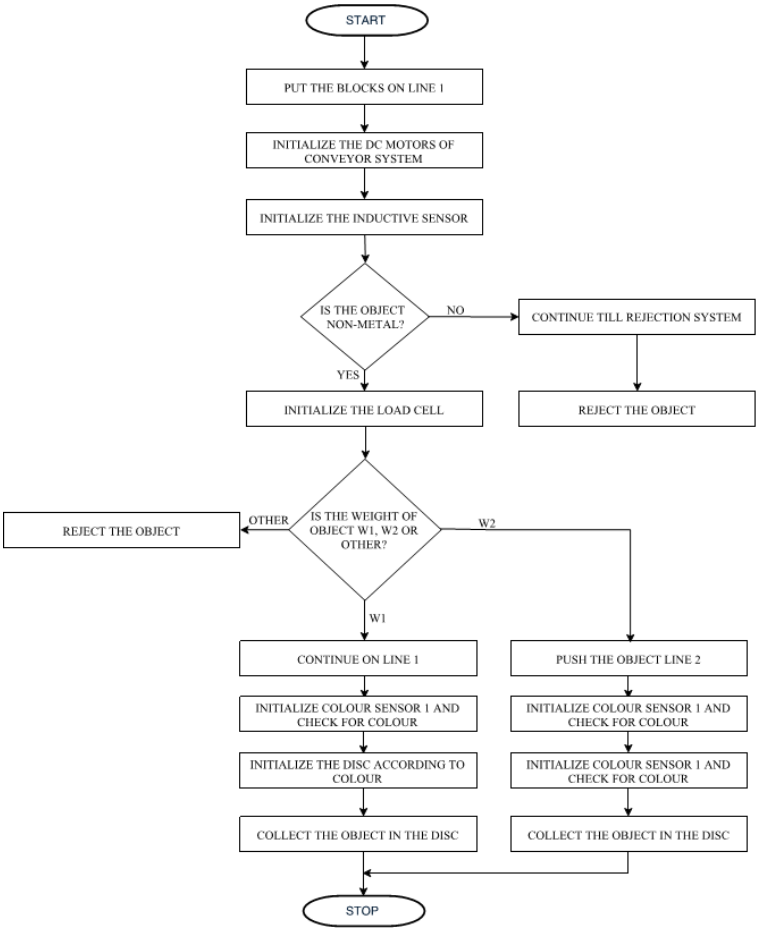


Fig 2: Sequence of operation

Flowchart Description

1. The objects are fed to the main conveyor line with the help of slider crank mechanism feeder at a stipulated time interval.
2. This in turn initializes the DC motor which will move the object along the conveyor line.
3. The object when comes in front of the inductive sensor, it is sensed whether the object is metallic or non-metallic. The response generated is sent to the PLC
4. The object then moves ahead where it reaches to the load cell sensor. Here the weight of the object is measured and it is categorized in two specific values, say W1 and W2.
5. The W2 object is moved to the secondary conveyor line with the help of flipper mechanism while W1 object moves along the same line. The objects having weight others than the specified weights and also the metallic objects are rejected to the rejection system.
6. The object is then sensed by the colour sensor for three colours such as red, green, blue.
7. The sensor senses the colour of the block and gives the feedback signal to the PLC.
8. The PLC sends a signal to the motor of the rotating disc where the object is collected in accordingly to its colour.
9. The same colour sorting steps take place on the secondary line on which W2 blocks are moving.
10. Thus the objects are automatically sorted according to the given conditions successfully.
11.

V. CONCLUSION

We have proposed a system which would increase the production rate and accuracy of material handling systems. The system would segregate objects based on their type i.e. metal or non-metal, weight and colour as required by the user. Use of PLC with the frame of logic gates will make program modification easy and thus, we can modify the system according to the requirement.

DOI: 10.9790/1684-17010060407

VI. APPLICATIONS

Robots can be used in numerous industries and hazardous environment, where it is risky for humans to work. It has application in material handling systems and manufacturing industries like-

i. Food industry
ii. Agricultural products scaling and grading
iii. Mineral Sorting
iv. Pharmaceutical
v. Handling biomedical waste bags
vi. Airport

VII. FUTURE SCOPE

1. Segregation based on size can be done by installation of sieves of various sizes.
2. pH sensors can be installed for food industry application to check the freshness.
3. Replacing DC motors by stepper motors to increase accuracy.
4. Sensors can be replaced by cameras for digital processing which is done using MATLAB
5. Robotic arm can be used instead of flippers and containers to place the object at desired locations, thus making the process of sorting more effective.
6. Modifications can be done to inspect cracks, defects on the surface of the object etc.

REFERENCES

[1] DharmannagariVinay Kumar Reddy, Sorting Of Objects Based On Colour By Pick And Place Robotic Arm And With Conveyor Belt Arrangement, International Journal Of Mechanical And Robotics Research, ISSN 2278 – 0149, January 2014.

[2] Kunhimohammed C. K, MuhammedSaifudeen K. K, Sahna S, Gokul M. S And ShaeezUsman Abdulla, Automatic Color Sorting Machine Using TCS230 Color Sensor And PIC Microcontroller, International Journal Of Research And Innovations In Science & Technology, ISSN (Online): 2394-3858, 2015

[3] Prof. NilimaBargal, AdityaDeshpande, RuchaKulkarni, RuchaMoghe, PLC based Object Sorting Automation, International Research Journal Of Engineering & Technology, ISSN (Online): 2395-0056, July 2016

[4] Sheela S, Shivaram. K. R, Meghashree S, Monica L, Prathima A, Shriya M. Kumar, Low Cost Automation for Sorting of Objects on Conveyor Belt, International Journal Of Innovative Research in Science, Engineering & Technology, ISSN (Online): 2319-8753, May 2016

[5] Ganesh B. Shinde, Vishal P. Ghadage, Akshay A. Gadhave, Dr. D. K. Shedge, PLC Based Auto Weighing Control System, International Journal Of Engineering And Technical Research (IJETR), ISSN: 2321-0869.

DOI: 10.9790/1684-17010060407