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DESIGN AND FABRICATION OF AUTOMATED SORTING SYSTEM

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ABSTRACT
A type of machine used to transfer material constantly is a belt conveyor. The belt functions as a result of frictional force. The mining, metallurgical, and coal industries employ the belt conveyor extensively due to its straightforward construction, ease of maintenance, high transfer capacity, and long transfer distance. The major goal of this project is to develop a special form of algorithm to attain a novel level of approachability in the area of industrial automation. Without a human, these machines can perform various tasks at various locations. In our project, we created a system for automatically rejecting defective objects as they pass through the conveyor system.

KEYWORDS: *smart object sort, conveyer belt , color sensor , industrial use etc.*

1. INTRODUCTION

Moving, storing, controlling, and safeguarding materials during their production, distribution, use, and disposal constitutes materials handling. In industrial facilities that utilise conveyor systems, there are many material handling devices and systems. Due to its capacity to maintain consistency in the operation speed and consistency of things in motion, it moves objects from the source to the terminal rather than moving objects with people. From straightforward pallet rack and shelving solutions to intricate overhead conveyor systems, automated storage, and retrieval systems, material handling systems come in all shapes and sizes. Sorting and picking are additional aspects of material handling. Different sorting systems have been created recently. Sorting can be used for a variety of things, including literature, consumer goods, and agricultural products. The form of the criteria aggregation model generated for sorting purposes and the methodology used to define the sorting model's parameters, according to Constantine and Michael's report from 2002, can be used to categorise all sorting methodologies.

This study suggested using automatic sorting techniques as the basis for the model. Designing a model and simulating the functionalities of an automatic sorting machine utilising a capacitive proximity sensor is the goal of this project. The photographs of the things (such as plastics, wood, and steel) were captured using the proximity sensor in order to achieve these created automatic sorting methods, and the conveyer belt moves the material from one location to another. The conveyor system sorts items automatically in a way that promotes product manufacture, quality control, and profitable businesses.

It is crucial to be aware that these suggested sorting techniques do, however, have a number of issues. For instance, ineffective sorting, energy consumption, multitasking, and machine adaptability.

2. PROBLEM IDENTIFICATION

The main job that needs to be done in many sorting enterprises is object sorting. Industries that require visual inspection conducted by human operators prefer the old method of manual sorting. This conventional method is cumbersome, time-consuming, and expensive for industries. It is now challenging to find employees who are qualified and eager to embark on the laborious process of inspection. As a result, the suggested system makes an effort to create and implement an automatic method for classifying and identifying products based on their colour utilising embedded vision.

The project's issue statement is to develop an electronic material handling system that may be used to lessen worker effort and the amount of time required for component inspection during production Additionally, it makes moving the created component to another workstation easier. The obvious factor that contributes to the installation of automation systems in businesses is;

1. Saving man power

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2. Improved quality and efficiency

3. OBJECTIVES

- To make the process of sorting the material, this color based sorting machine is being designed.
- In some of industries use man power to transfer the material from one place to other by repeating this for a period of time it will cause injuries to an operator.
- The use of this machine make the work simple for the operator, and no longer to bend and lifts up the materials.

This reduce the cause of injuries to the operator and increasing the work efficiency.

4. BLOCK DIAGRAM

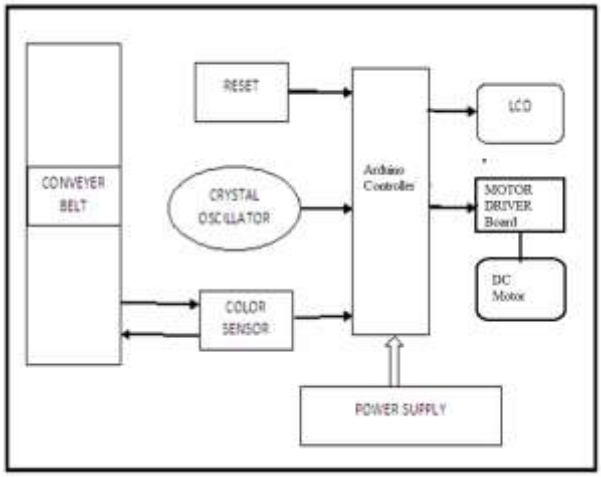

Figure 2. Project Block Diagram

5. WORKING

This device is a prototype for an industrial robot that sorts objects according to their colour. After using a geared motor mechanism to determine the colour of the sorting object, a photodiode-based colour sensor is linked to the conveyer.

Through IC hybrid bridge circuits, the MCU controls the entire movements of each of these motors in both directions. The system picks something off the conveyor belt and sorts it according to colour; it can be utilised in industries and for other things.

The product will be put on the conveyor belt.

- Once the switch is turned ON, the conveyor belt will begin to move the product to the opposite end.
- The sensor will determine the product's colour during its journey.
- The microcontroller will then receive the signal.
- As a result, the motor driver unit will deliver the appropriate signal to the sorting mechanism in accordance with the signal.
- This technique will mostly sort products that are black and white.
- The conveyer belt carried the black product regularly, but the white product was sorted from it and placed in a different container.
- In accordance with the component data provided, the sensor and microcontroller will each provide input to the sorting mechanism utilising a DC motor to activate.

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6. DESIGN OF SYSTEM

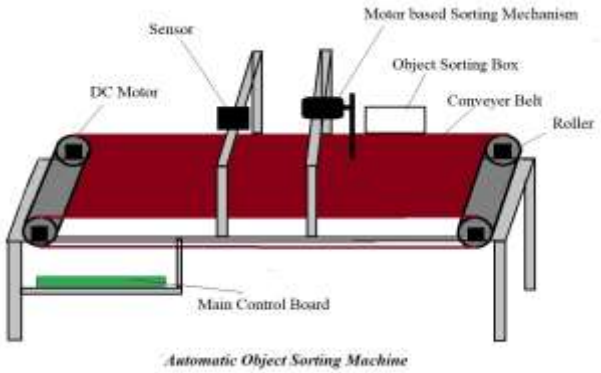

Figure.3. Design of System

7. CALCULATION

Assumptions
Design Considerations:
Open flat belt drive system
Power rating for this belt is 0.023kw
Length of belt=60 cm
Diameter=9 cm
Width of belt= 2---4 cm
Load correction factor (Fa)=1 (Normal load)
Arc of contact factor (Fd)=1 (Because theta=180)
Coefficient of friction=Negligible (Because coefficient of friction between belt and pulley is very low and hence can be neglected)
Numerical Calculations for the Selection of Motor
Required V of belt:
V=130/14=9.28cm/s
or 0.0928m/s ……..1
No. of revolution:
N =V*60/2πr
=9.28*60/2pi*4.5 …….. ….. from 1
=19.7027rpm=20rpm ……...2
The requirement of our project is such that conveyor belt must be able to bear travelling an approximate weight of 100 g in 10-20 seconds.
Now,
Torque(T):
T = F*r
= m*(V/t) *r
=0.1*(0.0928/14)*0.045 …….from 1 T =2.98 Nm . ……3
Power Rating:
Pd=0.0147*V/5.08
=0.02680kw ……..4
Design Power:
Pr = Pd*Fa*Fd
=0.0268*1*1 ……..…from 4
=0.0268kw ……...5
Since the values of both power rating and design power are same , this signifies that the material selection for this project is right.
0.0268=(T1-T2) *0.0928 …….from 1
0.28879=T1-T2 ……6
Angle of loop for open belt drive:
θ=180-2α

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α=Sin-1(D1-D2/2x)
θ=180 or 180*π/180= π radians
T1/T2 = e θ
T1/T2 =e3.1415
T1=23.138T2 ……7
0.288793=23.138T2-T2
T2=0.013045KN
or 13.045N ……from 6&7
AND
T1=0.301835KN or 30.1835N

Numerical Calculations for the Selection of High torque dc motor
Minimum Force required to move materials:
=0.5*9.80665
F=4.903325N ……1
Bore diameter =15 mm
Thrust exerted in forward:
F1= (π *D2*p)/4 (D=0.015 and d=0.005)
= (3.14/4) *(1.5/10)2*(4*105)
F1=70.65N ……2
Thrust exerted in reverse:
F2=(π*(D2-d2) *p)/4
=3.14*0.0002*4*105
F2=62.8N ……..…3
Remarks: It is found that value of F is lesser than F1&F2,Hence for given bore diameter the High torque dc motor would able to accomplish the task.

8. RESULTS AND DISCUSSION

We have developed a sorting machine using Arduino for automatic color sorting, taking in to consideration 2 colors namely white and Black. You may note that the white object and the black object lying in different sections of the container placed on the conveyor belt.

- **Dimensional Analysis**

The prototype is designed for sorting objects of any shape but having fixed sizes of 1cm. We can of course change this parameter by adjusting the aluminum frame of the color sensor. But one may note that it usually results in a change in the light ambience forcing us to do further frequency analysis of the sensor output for test colors. The prototype will get more complicated as we increase the number of colors that have to be detected. The placement of the object on the conveyor belt is very crucial. It must be so placed that the centre of the object and that of the sensor should be aligned with the same vertical plane, so that perfect detection takes place.

- **Time Cost**

The object once placed on the first conveyor belt takes less than half a second to reach the sensor. It takes another 200ms for the sensor to detect the color. An additional 0.6secs is required if the color of the object is not black so s to position the correct compartment in the sorting container, which implies that an additional 0.6secs will be consumed to reposition the container back the normal position on the second conveyor belt. Of course, these time values are dependent on the speed of the DC motors used.

- **Trails**

As mentioned before we have used objects of standard size and having any of the 2 colors for testing our prototype. We conducted a continuous trail with 20 objects and we got 90% correct detection. As long as the colors of the objects do not deviate from the preset values and as long as the placement on the belt is perfect, the detection process seldom fails.

The final result was quite satisfactory. The color detecting sensors worked well and it was able to detect white and black object quite nicely and change the direction of dc motor on right and left side to sort the object in proper place. Geared DC motor was used to get increased torque for the movement of the shaft as well as the conveyor belt. The belt moved from starting point to the end point through the roller without conflicting with the walls. The system performed well as programmed and detects the object according to their color.

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Project Image

Figure 4. Project Image

9. ADVANTAGES

• High productivity: The pace of sorting can be quite fast.
• High precision: The margin of error is greatly decreased.Various items or veggies of various colours can be sorted using this type of machine. Pears, oranges, and other fruits of this kind are suitable choices as well.
• If utilised with PLC control, high level of intelligence. It can be controlled by a very intelligent machine.
• Long life, high quality, and low failure rate.
• Dependable operation and upkeep.

10. APPLICATIONS

Main applications can be for:

- Sorting the goods in accordance with colour.
- Making sure that mass production has quality control.
- With a few tweaks, it may be used to find any coloured object.
- It can be modified such that it can be used to determine a product's dimensions.
- It can be employed in airports by enhancing its sensing capacity.
- Additionally, it is highly helpful in labs and seminars.
- Used in the packaging sector.
- To handle bags containing biomedical waste.
- At airports and subway terminals.

11. CONCLUSION

The management of the integrity of supply of a product from raw material to completed product through quality manufacturing is of the utmost importance in today's fiercely competitive industrial industry.

It is necessary to declare a product as having excellent quality and precise dimensions. As a result, this project for automatic colour sorting is a great one due to its design and widespread application.

An industry can quickly sort the desired product according to its colour by implementing the project's notion. Although it has significant restrictions, this concept can be used in a variety of applications after minimal tweaking.

12. FUTURE SCOPE

It is very useful in wide varieties of industries along with the help of PLC and SCADA, especially in the packaging section. Automatic sorting machine enhances efficiency, practicality, and safety of operators. It ensures remarkable processing capacity as well as peerless performance including color detection. Of course we need to add high speed DC motors and sensors with appreciable response to speed up the system for industrial application.

The model can be improved by making some changes in the program and components. Some suggestions are given below.

- We can add a load cell for measurement and control of weight of the product.
- We can also add a counter for counting the number of products.
- Speed of the system can be increased accounting to the speed of production.

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- The system can be used as a quality controller by adding more sensors.
- The sensor can be changed according to the type of product.

13. REFERENCES

1. *AdityaDeshpande, RuchaKulkarni, RuchaMoghe "PLC Based Object Sorting Automation" International Research Journal of Engineering and Technology, Vol 03, no.07 July-2016, PP.103-108.*
2. *S. V. Rautu, A. P. Shinde, N. R. Darda, A. V.Vaghule, C. B.Meshram, S.S.Sarawade "Sorting of Objects Based on Colour, Weight and Type on A Conveyor Line Using PLC" IOSR,vol.04, no 06, March 2017,PP.4-7.*
3. *Sanjay PrakashDabadea, RohanPrakashChumble "Automatic Sorting Machine Using Conveyor Belt" International Journal of Innovative and Emerging Research in Engineering.Vol 2, no 5, Sept-2015, PP.66-71.*
4. *Alessandro Golfarelli, RossanoCodeluppi and Marco Tartagni, — A SelfLearning Multi-Sensing Selection Process: Measuring Objects One by One by‖, ARCES – LYRAS LAB University of Bologna, Campus of Forlì, 1-4244-12625/07/$25.00 ©2007 IEEE, IEEE SENSORS 2007 Conference.*
5. *Sahu, S., Lenka, P.; Kumari, S.; Sahu, K.B.; Mallick, B.; —Design a colour sensor: Application to robot handling radiation work‖, Vol. 56, No.*
6. *Hiwa Golpira, Hêmin Golpîra, "Improvement of an Apple Sorting Machine Using PSNR Criterion," Advanced Mechatronics System Japan, Sept. 2012, pp. 729-732.*
7. *Mohammad Moghaddam Vahed, Sattom Halder, Mahmood Sabria Chowdhury and S. C. Banik, "Study of Automatic Sorting System for Date Fruits," International Conference on Mechanical Engineering and Renewable Energy, May 2014, pp. 219-224.*
8. *P.B.Vijayalaxmi, Rohan Putta, Gayatri Shinde, Punit Lohani, "Object Detection Using Image Processing for an Industrial Robot," International Journal of Advanced Computational Engineering and Networking, Sept-2013, pp. 21-26.*
9. *Smita Shelke, A.P Patale, "An Automatic Grading System based on A Machine Vision," International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, July-2013, pp.154-160.*
10. *Vishnu R. Kale, V. A. Kulkarni, "Automation of Object Sorting System Using Pick & Place Robotic Arm & Image Processing," Proceedings of 3rd IRAJ International Conference, January 2014, pp. 56-60.*
11. *S. Tsalidis, Dentsoras, "Application of Design Parameters Space Search for Belt Conveyor Design" Journal of Plant Science, Vol. 10, No. 6, pp. 617-629, 2010.*
12. *Huang, Wang, Mei, Zhao, "Time Minimum Trajectory Planning of a 2-DOF Translational Parallel Robot for Pick-and-place Operations" IEEE Computer Magazine, Vol. 56, No. 10, pp. 365-368, 2007.*