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Research Article

Development of Automated Material Handling System for Small Scale Industries

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A B S T R A C T

To study and analyze the Robots with Conveyor belt which performs the operation of picking and placing the object from one place to another place. The production is increasing day by day as the time is passing and it has become a priority of every company to speed up their production rate along with profit. When production occurs on a large scale then problem arrives in the material handling system because of so many factors like counting of products, removing the defective piece etc., Due to these reasons manufacturing units are found to be more interested towards automation via robots for their work. The main objective is to transfer materials among the automatic robots on industrial layout from machining department to storage department in an efficient manner and designed coveyor belt that was made automated and controlled with sensors to perform the task.

Keywords: Conveyor Belt, Pick and Place Operation, Sensors, Robots, Microcontrollers

Introduction

Many industrialists and academic professionals have done a research about this particular topic and it has always been an interesting topic to ponder upon i.e., the material handling system. Many experts have shared their views and regarded material handling management system as the backbone of any production industry and worked on automated pick and throw Conveyer Belt which performs the operation of picking and placing the object from one place to another place. As we know, the production is increasing day by day as the time is passing and it has become a priority of every company to speed up their production rate along with profit. When production occurs on a large scale then problem arrives in the material handling system because of so many factors like counting of products, removing the defective piece etc. due to these reasons manufacturing units are found to be more interested towards automation via robots for their work.[1-6]

With the recent advancements in industrial technologies, performed experiments on pick and place robotic arm using MATLAB software as offline surface clustering algorithm. Their study was focused on identifying maximum number of objects picked and placed by robotic arm within shorter period of time.[7-16] They do so by image processing algorithm using MATLAB software.[17-23] Material handling is a very tedious and time consuming work especially when it is performed by human, also it is very risky work as it can lead to the loss of item in case of human's fatigue and tiredness etc. These types of work where repeatability of task is required are efficiently done with the help of robots by programming them to do the specified task with precautions. Therefore after analyzing above researches we found that and efficient system must be designed which automatically controls the transmission of material handling using Arduino Uno (microcontroller) and Ultra sonic sensor and making it fully automated is the future demand. In the

era of advancement of technology, manufacturing such machines will reduce the efforts of humans beings and proves to be a boon of technology thus an effective method is required for pick and place and transmission of objects from one place to another. It is easily being done now a days with use of one such system but also it make us curious to discover the possibilities how far we can go in this topic therefore we concluded to fabricate a model which could not only handle the material but handle it automatically and efficiently also it should count and sort the material as our source researchers have made in their project. So the machine learning could of effectively used in practical rather than just reading it in syllabus and forgetting.

Design Methodology

We decided to purchase other micro controllers and pulleys and other components after making a list of components required and followed the methodology of understanding and evaluating the already existing material handling systems Then we collected the data required such as Phase AC induction motor, Conveyor belt, different type of sensors, Micro controllers etc. Then we calculated design standards such as conveyor belt length, width required motor rpm etc. based on which selection of parameters were done. CATIA is the cornerstone of the Dassault Systems product life cycle management software suite. The CAD model has been created in the workbench of the CATIA v5 software according to the dimension. Our research is based on handling of bulk material and its packaging process. It is a combination of mechanical and electrical logics including conveyor as shown in Figure 1 and the packaging process is controlled automatically by using sensors. At first we thought about the design of this machine. Though we build a prototype we had to be careful about the design and dimension. After surveying on various industries we cleared our concept and designed our machine with proper dimension.

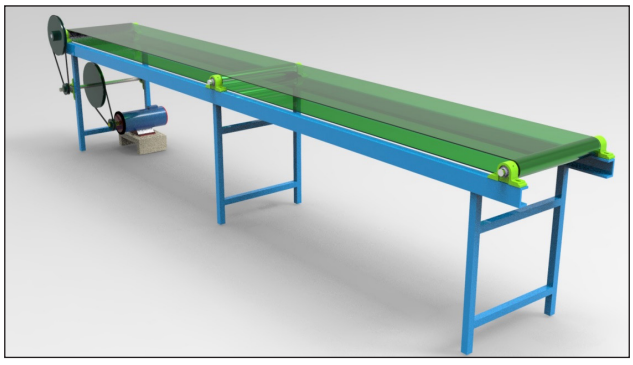

Figure 1.Conveyor Design

A conveyor belt (or belt conveyor) consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler. There are two main industrial classes of belt conveyors; those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport industrial and agricultural materials, such as grain, coal, ores, fines and lumps material. Conveyors are durable and reliable components used in automated distribution and warehousing. In combination with computer controlled pallet handling equipment this allows for more efficient retail, wholesale and manufacturing distribution. It is considered a labor saving system that allows large volumes to move rapidly through a process, allowing companies to ship or receive higher volumes with smaller storage space and with less labor expense. Some sequential steps are adopted while building up this machine. Some machining process (such as metal cutting, soldering, welding, facing, turning, grinding, boring and drilling) were identified and incorporated to construct the parts. The main purpose of our working procedure was to build up a functional prototype. The main components of our machine are given below Table 1.

Table 1.Main Components

Conveyor	Electronic Components
Conveyor Belt	0.5Hp 1440rpm AC Motor
Conveyor frame	Ultra-Sonic sensor
Roller	Arduino Uno
Bearings	9V DC battery
Pulleys	Relay
Drive Unit	Bread Board
V Belts	Jump wires and !0C wires

The various machining processes those were used in making the Conveyor. The Belt Conveyor are Metal cutting, Drilling, Boring, Threading, Welding and Grinding. We use metal cutting to cut the thick metal bar into required length for making frame. And also to cut the shaft into desired length. Drilling process was also used here for different purposes such as to drill holes in the Frame at different positions to screw the bearings; in this research project 4 pulleys were used. These pulleys were drilled along its central axis to make a path of shaft and top portion of the Wood was drilled in different points to make hole to screw the Motor to a wooden board. The pulleys were bought from the market. As the hole of the pulleys was smaller than the outer diameter of the shaft, these holes were enlarged by boring method with the help of lathe machine. The pulleys were bored two 3 inch pulley, 10 inch pulley and 12 inch pulley. In this process welding was widely used. As the project was to make a prototype and there was small budget for it, welding was used here for most of the joining process.

It has been already mentioned that the welding process was widely used here. So, grinding process was also used here to grind the various parts after cutting to get a plane surface for welding. The welded parts were also grinded for fine surface. Speed reduction is done by using multiple pulleys (12 inch, 10 inch, 3 inch 2). Initial speed of motor is 1440 rpm and reduced by 4 times up to 360 rpm, next level of pulleys are 3 inch and 10 inch one of the pulleys attached to the turning shaft and another one is fitted to the conveyor roller those are attached by V belts reduced by 3.33 times. Final speed obtained is 108 rpm.

Arduino Code

```
int trigPin=7;
int echoPin=8;
int trigPin1=9;
int echoPin1=10;
long duration;
int distance;
long duration1;
int distance1;
void setup() {
pinMode(trigPin,OUTPUT);
pinMode(echoPin,INPUT);
pinMode(trigPin1,OUTPUT);
pinMode(echoPin1,INPUT);
pinMode(2,OUTPUT);
pinMode(4,OUTPUT);
pinMode(12,OUTPUT);
digitalWrite(12,HIGH);
digitalWrite(2,HIGH);
Serial.begin(9600);// put your setup code here, to run once:
}
void loop() {
digitalWrite(trigPin,LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration=pulseIn(echoPin,HIGH);
distance= duration*0.034/2;
digitalWrite(trigPin1,LOW);
delayMicroseconds(2);
digitalWrite(trigPin1, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin1, LOW);
duration1=pulseIn(echoPin1,HIGH);
distance1= duration1*0.034/2;
Serial.print("Distance 1:");
Serial.println(distance);
Serial.print("Distance 2:");
Serial.println(distance1);
delay(500);
if(distance1<30){
delay(2000);
digitalWrite(4,LOW);
delay(2500);
digitalWrite(4,HIGH);
delay(5000);
digitalWrite(4,LOW);
delay(2500);
digitalWrite(4,HIGH);
delay(5000);
digitalWrite(4,LOW);
delay(2000);
}
digitalWrite(4,HIGH);
}
```

Result and Discussion

Speed reduction
Diameter of roller = 60 mm
Center to center distance C = 3460 mm
Length of Conveyor Belt L = (D+d/ 3.1415) + 2C
= (60+60)/2×3.1415)+3460
= 7110 mm
Speed of Motor N = 1440 rpm
Pulley ratio = 12/3 × 10/3 = 13.33
Output Speed n = 1440/13.33 = 108 rpm
Velocity = πDN/60 = (3.1415×60×108)/60 = 339.282 mm/s
Time taken for object moving from starting position to end position
Time = Velocity/Distance = 3460/339.282 = 10.19 sec

After object is placed at in front of the ultrasonic sensor it will detect and a signal to the relay module it may start the conveyor automatically and the object moving along conveyor belt stopped at various stations after passing all stations object stopped at the end of the conveyor belt automatically. When the objectstop moving the Magnetic robot come and pick the object placed at storage station, loop will continued.

Conclusion

This research project deals with the Aspects of Material handling used in Industries. It covers all the program of design as key schedule enunciated earlier in this paper, which broadly consists of designing, fabrication, assembly etc. In present work an effort has been made to reduce human labour and increase productivity of industry. It will increase the probability of successful operation and the working life of the Robotic Arm. So this can be concluded that this project helps industries grow by reducing their time consumption in transmission of material, makes material handling easy task and save labor cost in turn increasing their productivity which ultimately lead to profit.

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