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PLC Based Product Sorting Conveyor Machine

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ABSTRACT

The primary reason for the framework is to separate the item as for their shading code a naturally circulate the item as per their hues. In this anticipate we will distinguish the shade of the item which is put on transport line you need and that question is dispatch to separate box. This can be accomplished effectively by utilizing headway as a part of innovation particularly in the field of inserted frameworks. Presently a day's such a large number of helpful innovations are turning out to make our way of life more solace, extravagant and secure. In this anticipate we are utilizing Arduino (controller) and shading sensor. This shading sensor distinguishes shading and gives serial yield of RBG worth. It can distinguish 16.7 million shading shades giving RGB esteem for the recognized shading. The distinguished shading is recognized as measure of three essential shading values to be specific Red, Green and Blue with 8-bit exactness for every essential shading. Any shading can be isolated or consolidated into three essential hues Red, Green and Blue utilizing the RBG values.

Keywords: Arduino, PLC, RBG, Shading sensor, Shorting, 8-Bit.

I. INTRODUCTION

Machines can perform highly repetitive tasks better than humans. Worker fatigue on assembly lines can result in reduced performance, and cause challenges in maintaining product quality. An employee who has been performing an inspection task over and over again may eventually fail to recognize the color of product. Automating many of the tasks in the industries may help to improve the efficiency of manufacturing system. The purpose of this model is to design and implement a system which automatically separates products based on their color. This machine consists of three parts: conveyor belt, color sensor, and dc motor. The output and input of these parts was interfaced using PIC microcontroller. To reduce human efforts on mechanical maneuvering different types of sorting machines are being developed. These machines are too costly due to the complexity in the fabrication process. A common requirement in the field of color sorting is that of color sensing and identification.

II. DIFFERENT SORTING CONSTRUCTIONS

- **LARGE SYSTEMS :** Conveyors are commonly implemented to assist in the transportation of products throughout its manufacturing and assembly process. Seen below (Figure 3) is the Denver, Colorado airport baggage sorting system. This is an example of a large complex automated system with manual input for loading and unloading baggage, luggage, and other parcels.
- **SMALL SYSTEMS :** Smaller scale sorting systems are commonly used in the food storage industry. Other applications include pharmaceuticals, libraries, and sports, such as bowling. The postal sorting system is another example however; it is not done with automation but by manual labor. It is done by cross checking a database and then manually placing the object in its defined position. The figure below describes a simple sorting system with almost no automation besides the conveyor belt.
- **CONVEYOR SYSTEMS :** In general conveyor systems are used in many different industries because of all of the advantages they provide. Conveyors can transport items from place to another easily and quickly. They can move all different sizes shapes and of products. Conveyor systems can be installed almost anywhere with many different layouts and operation modes available. Some examples include mechanical, hydraulic, and fully automated systems. When compared to manual labor that would be stressful and strenuous conveyor belts are an obvious advantage.

III. BASIC TYPES OF CONVEYOR BELTS

The basic types of conveyor systems are

- Roller bed conveyor belts
- Flat belt conveyors
- Modular belt conveyors
- 4 cleated belt conveyors
- Curved belt conveyors
- Incline/decline belt conveyors
- Sanitary and wash down conveyors
- Specialty conveyor belts

IV. COMPONENT DESCRIPTION

AVR MICROCONTROLLER

Figure 1 AVR microcontroller

AVR is a family of microcontrollers developed since 1996 by Atmel, acquired by Microchip Technology in 2016. These are modified Harvard architecture 8-bit RISC single-chip microcontrollers. AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

AVR microcontrollers come in different packages, some designed for through-hole mounting and some surface mount. AVRs are available with 8-pins to 100-pins, although anything 64-pin or over is surface mount only. Most people start with a DIL (Dual In Line) 28-pin chip like the ATmega328 or the 40-pin ATmega16 or ATmega32.

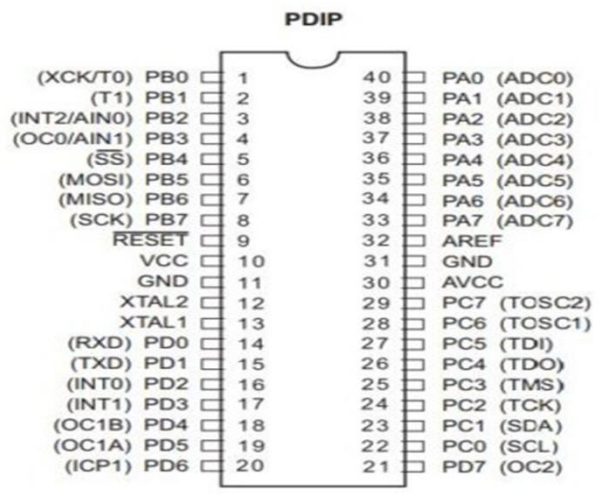

Figure 2 AVR ATmega16 Microcontroller pin diagram

TCS230 COLOR SENSOR

Figure 3 colour sensor

The TCS230 is a programmable color sensing module equipped with GY-31 light-to frequency converter that combines configurable 8x8 silicon photodiode array as single monolithic CMOS integrated circuit. The output is a square wave (50 percentage duty cycles) with frequency directly proportional to light intensity (irradiance). The full scale output frequency can be scaled by one of three preset values via two control input pins. Digital inputs and digital output allow direct interface to a microcontroller or other logic circuitry. Output enable (OE) places the output in the high impedance state for multiple units sharing of a microcontroller input line. The light-to-frequency converter reads an 8 x 8 array of photodiodes. Sixteen photodiodes have blue filters, 16 photodiodes have green filters, 16 photodiodes have red filters, and 16 photodiodes are clear with no filters. The four types (colors) of photodiodes are inter-digitized to minimize the effect of non-uniformity of incident irradiance. All 16 photodiodes of the same color are connected in parallel and which type of photodiode the device uses during operation is pin-selectable. Photodiodes are 120 mm x 120 mm in size and are on 144-mm center.

DC MOTOR

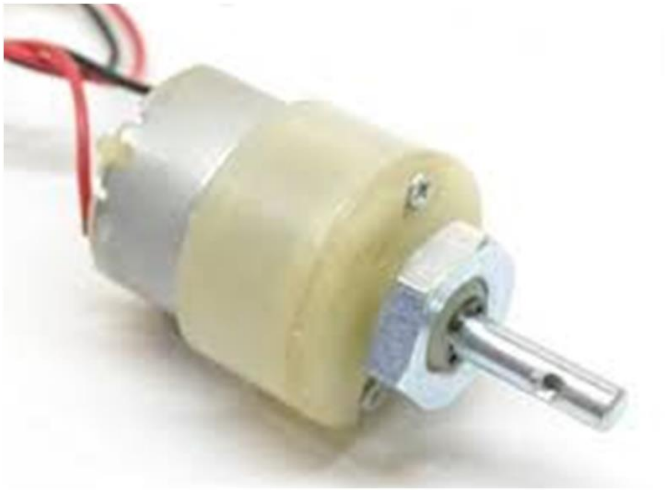

Figure 4 DC Motor

DC motors are electric motors that are powered by direct current (DC), such as from a battery or DC power supply. Their commutation can be brushed or brushless. The speed of a brushed DC motor can be controlled by changing the voltage alone. By contrast, an AC motor is powered by alternating current (AC) which is defined by both a voltage and a frequency. Consequently, motors that are powered by AC require a change in frequency to change speed, involving more complex and costly speed control. This makes DC motors better suited for equipment ranging from 12VDC systems in automobiles to conveyor motors, both which require fine speed control for a range of speeds above and below the rated speeds.

SOFTWARE

The Arduino coordinated advancement environment(IDE) is a cross-stage application written in Java and gets from the IDE for the handling programming dialect and the wiring ventures. It is intended to acquaint programming with craftsmen and other new commers new to programming advancement. It incorporates a code editorial manager with elements, for example, punctuation high lighting, prop coordinating and programmed space and is likewise equipped for accumulating and transferring projects to the board with a solitary snap. A system or code composed for Arduino is known as a portrayal. Arduino projects are composed in C or C++. The Arduino IDE accompanies a product library called "wiring" from the first wiring venture, which makes numerous basic info/yield operations much less demanding.

V. PROPOSED SYSTEM

The proposed system is designed for automatic sorting of Red or Green or Black colored products. The prototype consists of two DC motors, two conveyor belts, a AVR and a color sensing circuit using TCS230 (Fig. 3). DC motors are used to control the conveyor belts. After integrating the programmed PIC and the TCS230 circuitry with the structure of the model, we measure the frequency of signals corresponding to each color by observing them on a CRO. Based on this study the timer delay value is adjusted by reprogramming the PIC. The time required for the product to reach the corresponding container in the separator placed on second conveyor belt is also considered. L293D Hybrid IC is used to drive the second motor both in clock wise and anti-clock wise direction, which provides the to and fro movement of the container. Separators were used to create compartments of equal sizes meant for collecting objects of same color. The end section consists of a DC motor (12V, 30rpm), which is used to control the movement of the second conveyor belt in order to position the separator according to the sensor output.

CONVEYOR DESIGN

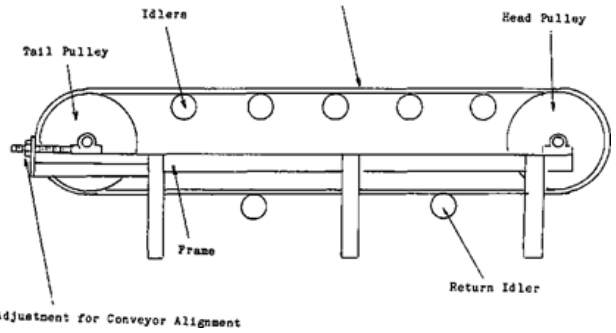

Figure 5 conveyor belt design

MATHEMATICAL MODEL EQUATIONS

The mathematical model is used to describe the system to be designed. According to Newton's second law, the dynamic state of the system is described. The mathematical model is used to facilitate control of each part of the system. Then the system is controlled as a whole. Knowing that each piece of the system is connected to another piece, for example, part of the conveyor is wrapped around the two pulleys, the first pulley is connected to the motor shaft. When the motor spins, this pulley rotates, then conveyor moves and the second pulley rotates, producing controlling of the system as a whole.

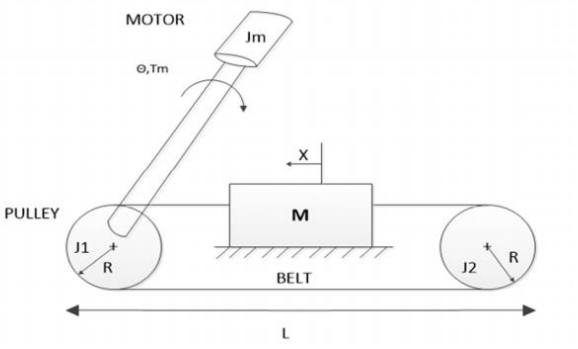

Figure 6 Description of the selected system

The assumption to analysis system:

1- There is no relative motion between objects and conveyor belt.
2- The motor produces torque in a short time
3- Motor shaft for rotation only.
4- The rotation angle of the motor is equal to the rotation angle of the pulley there is no gears.

The hypotheses that were considered in the mathematical model

- The conveyor belt is assumed to be spring
- The mass is distributed along the conveyor belt is considered to be in the middle.
- Since the mass is taken in the middle, for this k1=k2.See Figure below

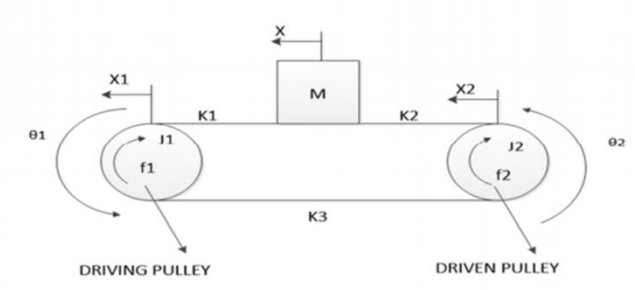

Figure 7 Hypotheses mathematical model

IMPLEMENTAION

CONTROL UNIT: This is the main unit in the device it is capable of controlling the all other units.it will accept the signal from the input units such as sensor unit and capable of analysing the signals from the input unit and delivers the signals to the output's units such as the conveyor unit and robotic arm unit. All other units are works depending upon the direction given by the control unit.

CONVEYOR UNIT: The main job of this unit is to move the object form other place to sensor unit, when the object comes to the sensor unit the conveyor has to stop with the help of sensor unit.

SENSOR UNIT: The purpose this unit is to informs the arriving of the object on the conveyor with the help of IR sensor and determines the colour of the object with the help of the color sensor and send these signals to the control unit for further operation.

VI. WORKING PRINCIPLE

Photodiode based shading sensor is joined with this framework for recognizing the shade of the article. They measure shading in light of a RGB shading model. An extensive rate of the obvious range (380 nm to 750 nm wavelength) can be made utilizing these three hues. Limit switches are utilized here as a part of request to keep accurate base position. MCU (MICROCONTROLLER UNIT) is the focal handling unit, which controls all the elements of different pieces in this framework. MCU takes or read information from shading sensor and controls all the elements of the entire framework by controlling this information.

Our Controller (Arduino) will perceive the shade of item and as per article shading one automated arm shaft will move that question the same shading compartment. MCU can't drive an engine specifically, so an engine interface is utilized here. The engine drive area acknowledges the low-level consistent sign from the controller and to give important voltage and current excitation to the engine. Engine driver circuit is required to give an interface between the 5V rationale signal from the microcontroller and the high ebb and flow and high voltage power side to drive the engine, since engine is an electromechanical gadget, which changes over electrical vitality to pivot/mechanical vitality. For this vitality change huge current excitation is required. These much vitality can't be given by the coherent sign pins from the microcontroller. So, an engine interface is utilized here. The engine drive segment ought to have the ability for tolerating the low-level sensible sign from the controller and to give essential voltage and current excitation to the engine. Generally high current transistor switches or transfers or ICs with engine drive bundles are utilized for this reason. Here bidirectional engine drive is required so a H-span based hardware is utilized to control the arm engines and wheel engines..

VII. APPLICATION

- Color Detection & Sorting operations like brick sorting, tablets separation, etc.
- Process control to printed materials.
- Ambience light detection.
- Robotics color detection.

- Packet sorting
- Toy's sorting
- Bottle sorting

VIII. CONCLUSION

The shading sensor IC TCS3200 demonstrate verging on stable reaction in different daylight conditions. The framework is working with open circle.

A superior determination can be accomplished if shut circle control is fused. The framework reactions are a tad bit slower than anticipated.

It can be enhanced by utilizing a more propelled shading sensor and microcontroller. Client interfaces additionally can be given as an alteration which will empower the on-interest reconfiguration of the development bitterly.

In this way we can accomplish framework utilizing headway as a part of innovation in the field of Embedded framework.

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