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AUTOMATIC MATERIAL HANDLING SYSTEM WITH COLOR AND METAL SENSORS

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ABSTRACT

This paper carries out a detailed review of the various techniques employed in the recent years in Material Handling System. It aims to create an autonomous robot. This paper aims at the problem to create an autonomous robot that can identify objects when placed on the conveyor belt based on color sensing and metal sensing and then sort by relocating them to a specific location. It synchronizes the movement of robotic arm to pick the objects moving on a conveyor belt[1]*. First it will sort the material on the basis of metallic and non-metallic and further the elements are sorted according to their color.*

Keywords: Color Sensors, Conveyor Belt, DC geared Motor, Metal Sensor, Microcontroller, Robotic Arm

I. INTRODUCTION

A robot can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. Robot is an integral part in automating the flexible manufacturing system that one greatly in demand these days. Robots are now more than a machine, as robots have become the solution of the future as cost labor wages and customers demand. Robot and automation is employed in order to replace human to perform those tasks that are routine, dangerous, complex and in hazardous area. This article is based on the research project which is a fully automated material handling system to be used in industry. The most apparent reasons that are associated in installing of robotic systems in industry are:

1) Saving of manpower.
2) Improved quality & efficiency.
3) Increased consistency & flexibility.

Even though the cost of acquiring robotic system is quite expensive but as today's rapid development and a very high demand in quality with International Standard Organization (ISO) standards, human are no longer capable of such demands. Research and development of future robots is moving at a very rapid pace due to the constantly improving and upgrading of the quality standards of products. This paper aims at fully automated material handling system. This can be done by using sensors interfaced with Micro Controller Unit. It synchronizes the movement of robotic arm to pick the objects moving on a conveyor belt. It aims in classifying the colored objects and metallic and non-metallic objects which are coming on the conveyor by picking and placing the objects in its respective pre-programmed place. Thereby eliminating the monotonous work done by

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human, achieving accuracy and speed in the work. This robot involves metal sensors that senses whether the object is metallic or non-metallic and sends the signal to the microcontroller. The robot further senses the color of the object and send the signal to microcontroller unit. The microcontroller sends signal to eight relay circuits which drives the various motors of the robotic arm to grip the object and place it in the specified location. Based upon whether the object is metallic or non-metallic and the color detected, the robotic arm moves to the specified location, releases the object and comes back to the original position.

II. METHODOLOGY

The pick and place robotic arm with conveyor belt is a system that detects the object on the conveyor belt, picks that object from source location and places at desired location based on color identified and metal/nonmetal. For detection of object, firstly infrared sensors are used which detect presence of object as the transmitter to receiver path for infrared sensor is interrupted by placed object. Also the color of the object is detected by the color sensor. Its metallic nature is detected by the metal detector. Now as soon as robotic arm receives the signal from the controller, it picks with end effectors and places it on the respective destination depending on the respective color of the object that is red, green or blue. If another object causes interrupt, it again does the same job. The system uses AT89S52 Micro Controller Unit as its controller for performing different operations by the robot.Also if the object does not meet required condition then it is rejected and put away from the conveyor belt i.e, when a different color is spotted.

III. RESEARCH OBJECTIVES

The main objective for this study was:

a) To increase the manufacturing capacity for industries.

b) To increase the labor productivity by the redistribution of laborers in the industries.

c) Reducing the cost factor and handling time of a product.

d) To eliminate the manual based tasks and operations.

IV. INSTALLATION AND TECHNIQUE

4.1 Microcontroller

A microcontroller is an inexpensive single chip computer. Single chip computer means that the entire computer system lies within the confines of the integrated circuit chip. The micro controller on the encapsulated sliver of silicon has features similar to those of our standard personal computer. Primarily, the micro controller is capable of storing and running a program. The micro controller contains a CPU , RAM, ROM , I/O lines, serial and parallel ports, timers and sometimes other built in peripherals as A/D (analog to digital) and D/A (digital to analog) converters.

4.1.1 Features:-

• Compatible with MCS-52™ Products

• 8K Bytes of In-System Reprogrammable Flash Memo.

• Fully Static Operation: 0 Hz to 24 MHz

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• Three-level Program Memory Lock
• 128 x 8-bit Internal RAM
• 32 Programmable I/O Lines
• Two 16-bit Timer/Counters

4.2 DC Motors

Direct current motor is designed to run on DC electric power. The pure DC designs are Michael Faraday's homo-polar motor (which is uncommon), and the ball bearing motor, which is so far a novelty. The most common DC motor types are;

A. Brushed DC motors B. Brushless DC motors

4.3 Conveyor Belt

The conveyor belt used here consists of two wheels which serve the function of pulleys, with a continuous loop of material. One of the wheels is powered by a 75 rpm DC motor, moving the belt and the material on the belt forward. Here, the conveyor motor receives power and signal from the central supply through rectifier and control circuit [11].

4.4 Robotic Arm

The work space of this arm is a circle in which it rotates to pick and place the job and position itself. The base of the arm is provided with a dc motor to rotate the arm; the motor rotates in both clockwise and anticlockwise directions to place the job. The motor is interfaced with the microcontroller and relay. The robotic arm movements are controlled by the DC motor of 75 rpm [2][3][5][6]. Here micro controller controls the movement of the arm depending on the color of the object (Red, Green or Blue) or metal object placed and relay drives it that is it supplies power to arm. When the job is picked up the arm moves through a particular angle to its left or right, ifthe color of the job is red then the robotic arm moves towards its right with certain angle and releases the job at a particular place, if the color of the job is blue then the robotic arm moves towards its right with an angle more than that of red and releases the job at a specified place, if the color of the job is green then the robotic arm moves towards right by an angle fixed by limited switch, if the job is a metal object then robotic arm moves towards left by angle fixed by limited switch . The same procedure is followed for non-metallic objects. Once it releases the job, the robotic arm automatically comes back into its initial position with the help of interrupter onto the conveyor to pick up another object.

4.5 Gripper

24.5 V, 75 rpm, DC motor is used to control the gripper movement, for opening and closing of the gripper. The DC motor receives its signal from the controller for performing gripping and dropping operations. The gripper has been specially designed in order to grip rectangular or square objects from the running conveyor and dropping them at programmed locations. An industrial robot is defined as automatically controlled, reprogrammable, multipurpose manipulator programmable required axes. The parameters such as Degree of freedom, Work Volume, Payload, accuracy, repeatability, acceleration and robot kinematics are considered before designing the robotic arm [7][8].

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4.6 Transformer

Usually, DC voltages are required to operate various electronic equipment and these voltages are 5 V, 9 V, 12 V or 18 V. But these voltages cannot be obtained directly. Thus the A.C input available at the mains supply, i.e., 230 V is to be brought down to the required voltage level. This is done by a transformer. Thus, a step down transformer is employed to decrease the voltage to a required level.

4.7 Infrared LED Sensors (IR Sensors)

An Infrared sensor is an electronic device that measures infrared (IR) light radiating from objects in its field of view. IR sensors are often used in the construction of IR-based motion detectors apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall. It is the same principle in all Infra-Red proximity sensors. The basic idea is to send infra-red light through IR-LEDs, which is then reflected by any object in front of the sensor. Then all one have to do is to pick-up the reflected IR light. For detecting the reflected IR light that was emitted from another led of the exact same type. This is an electrical property of Light Emitting Diodes (LEDs) which is the fact that a led produces a voltage difference across its leads when it is subjected to light. As the name implies, the sensor is always ON, meaning that the IR led is constantly emitting light. This design of the circuit is suitable for counting objects on the conveyor belt. However this design is more power consuming and is not optimized for high ranges in this design, range can be from 1 to 10 cm, depending on the ambient light Conditions. As one can see the schematic is divided into 2 parts the sender and the receiver.

4.7.1 IR Transmitter

TSAL6200 is a high efficiency infrared emitting diode in GaAlAs on GaAs technology, moulded in clear, blue grey tinted plastic packages. In comparison with the standard GaAs on GaAs technology these emitters achieve more than 100% radiant power improvement at a similar wavelength. The forward voltages at low current and at high pulse current roughly correspond to the low values of the standard technology. Therefore these emitters are ideally suitable as high performance replacements of standard emitters.

Features

a) Extra high radiant power and radiant intensity.

b) High reliability.

c) Low forward voltage.

d) Suitable for high pulse current operation.

e) Peak wavelength = 940 nm.

f) Good spectral matching to Si photo detectors.

4.7.2 IR Receiver

The TSOP17-series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter. The demodulated output signal can directly be decoded by a microprocessor. TSOP17XX is the standard IR remote control receiver series, supporting all major transmission codes.

Features

a) Photo detector and preamplifier in one package.

b) Internal filter for PCM frequency.

c) Improved shielding against electrical field disturbance.

d) TTL and CMOS compatibility.

e) Output active low.

f) Low power consumption.

g) High immunity against ambient light.

h) Continuous data transmission possible (up to 2400 bps).

i) Suitable burst length 0.10 cycles/burst.

4.8 Color Sensors

TCS3200 Color Sensor is a complete color detector, including a TAOS TCS3200 RGB sensor chip and 4 white LEDs. The TCS3200 can detect and measure a nearly limitless range of visible colors [4][9].

Specification:

a)baby size: 3 CM * 2.7 CM (length-width).

b)interface definition: VCC GND power supply.

c) SO - S3 E0 OUT communication interface.

d) Plate load TCS3200 color sensor. Support 3-5V voltage input

e) TCS3200 and to test the best object distance is about 1 cm.

4.9 Metal Sensors

Metal sensor uses a detecting circuit in which EMF is produced if the passing object is a metal and no EMF produced in case of non-metal. The metal detecting circuit used here is of vegakit [10].

4.10 Relays

A relay is an **electrically operated switch**. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. ULN 2003 circuit board is used in this research project.

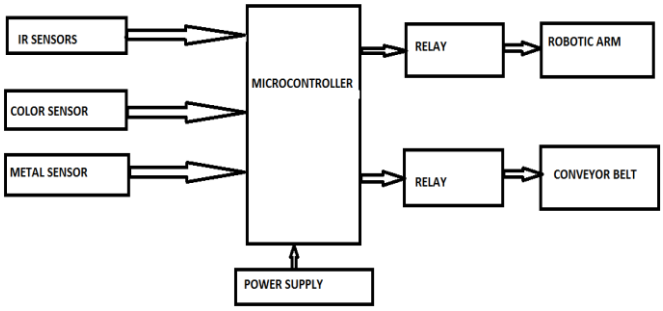

Fig.1 Block Diagram

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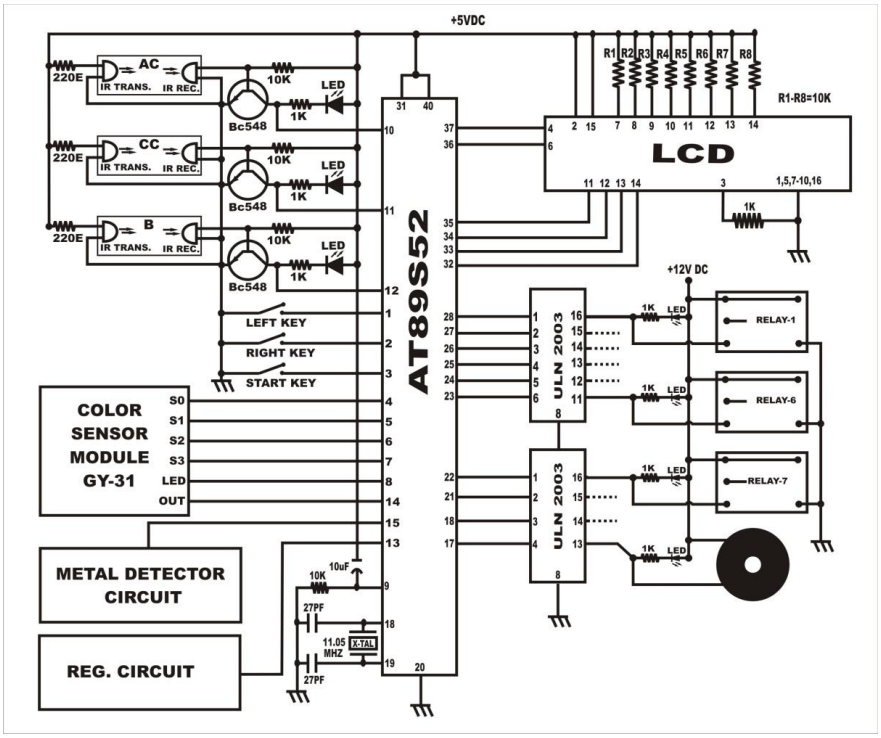

Fig.2 Main Controlling Circuit

V. APPLICATIONS

1. Used in Packaging Industry.
2. for handling of biomedical waste bags.
3. At Airports and metro stations.

VI. FUTURE IMPLEMENTATIONS

This project involves the sorting of objects through color sensors the future cements can be done by increasing the efficiency of the color sensor. Another area of improvement is that it is designed to follow voice commands or gesture control. Other improvement can be done by using camera and Digital Image Processing (DIP). MATLAB is the software environment for research and automation using DIP. This will give an extra edge to by processing in the real time.

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