



Object Sorting Robot using Image Processing

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Abstract:

In many Industrial application systems object sorting based on different criteria. The colour can be one of the criteria. The real challenge is to improve existing sorting system in the modular processing system which consists of four integrated stations of identification, processing, selection and sorting with a new image processing feature. Object Sorting Robot using image processing is operating with ARM 7 and MATLAB software. For the detection of colour, it uses image processing technique. This robot has robotic arm which is used for the function of pick and place, and its arm can move in a vertical direction. This paper presents a object sorting system which is based upon the colour with the advantage of image processing. Image is captured in real-time by a webcam and then image processing is used for identification of colour and information out of it. This information is used for picking process of the particular object on the basis of colour and place at desired position. The Proposed system deals with an automated material handling system. The aim of the project is classify the objects based on its colour, with advantage of low cost and highly accurate results.

Keywords: ARM7, image processing, robotic arm, stepper motor, servo motor, camera.

I. INTRODUCTION

Robot is a mechanical device that is designed and programmed to carry out instruction and perform particular duties automatically, with speed and precision. Robots are reprogrammable devices and best suited in sensing, gripping, and moving objects or in performing repetitive tasks such as pick and place, welding, handling radioactive elements and exploration tasks. The goal of the object sorting robot using image processing is to develop a typical model used to pick and place the desired colour objects from one location to another. This robot is used in sorting the objects in a mixture of different colour objects. MATLAB software is used to achieve the goal of this project. MATLAB software consist a lot of image processing library which is use for object detection based on colour. Coding of this project is done in MATLAB software and it shall be efficient to achieve our goal. An algorithm was developed in MATLAB system is to recognize the colour and send command to the microcontroller with the help of serial communication. This project involves with a main tasks, which are coloured object search detection, and navigation. Some industrial work can be dangerous to human, so this robot is can be used for reduce the risk for human also it can help to consume less time and used to avoid labors.

II. LITERATURE SURVEY

Traditionally, sorting of different types of objects was done by the operator manually. However, this method has some disadvantages such as increase in the cost of the product, slow, and inaccuracy due to the human mistake. Previously quality inspection, sorting, assembly, painting, packaging etc. were done manually. But after many involvements in the field of robotics system, the automation industry has undergone a complete makeover and the technology of object recognition is used for such work. In many packaging industries, object counting and sorting is the major and important task that needs to be done. Traditionally, the object sorting process was

done by the manually. However, this method has some disadvantages such as increase in the cost of the product, slow, and inaccuracy due to the human mistake. Existing sorting methods are used to set of inductive, capacitive and optical sensors do differentiate colour. Photodiode based color sensor are used for detection of colour. In this type of sorting method different colour sensors are attached with the robot for detecting the object of particular color. They measure color based on an RGB color model. A large percentage of the visible spectrum can be created using these three colors[1] but the disadvantages of this kind of system is sensor sensitivity range or affection of environmental conditions. In some kind of existing systems of sorting, objects are placed on conveyor belt and according to movement of that conveyor belt objects are get sorted[3][4], but the disadvantage of this system is that object which are not placed on conveyor belt are not considered in sorting process.

III. BLOCK DIAGRAM

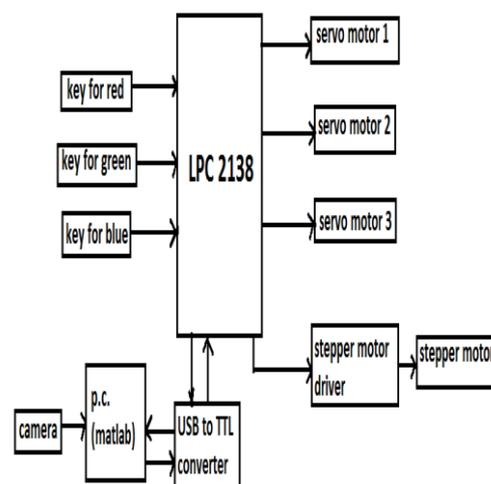


Figure.1. Block Diagram

IV. PROPOSED SYSTEM

In a proposed system, three different keys are used for detection of three primary colour which are red, green and blue. Three servo motor are used in construction of robotic arm. Two servo motor are used to move robotic arm in up and down direction and one servo motor is used for gripper to pick particular colour object. One stepper motor is used for moving robotic arm in circular direction for placing the picked object in a particular color box. Camera is used to sense particular colour for picking and placing process. Image sensing using MATLAB is used in system for detecting the colour of the object. ARM(LPC2138) is the central processing unit, used to control all the functions of other blocks in this robot system. When any key is get pressed, MATLAB using camera is start detecting that particular colour object. Microcontroller takes or read data from colour from MATLAB software and controls all the other functions of the system by manipulating these data. Microcontroller control the motor on the robotic arm to pick a particular colour object, as per the signal from image processing ARM(LPC2138) can understand the colour of the object, it control the arm motor to move towards the specified location, again control the gripper motor to release the object into that particular location. Servo motor is directly controlled by ARM by PWM signal. PWM(pulse width modulation) is great method of controlling the amount of power delivered to load without dissipating any wasted power. Stepper motor is used for angular movement of robotic arm. Stepper motor is a machine to convert pulse to angle displacement. So if we give stepper driver a certain pulse signal, it will drive motor to a certain angle.

System components

1. ARM 7(LPC 2138)-

The LPC2138 is heart of this system. It is an ARM7TDMI-S based upon high-performance, 32-bit RISC Microcontroller which has 512KB on-chip Flash ROM and In-System Programming (ISP), In-Application Programming (IAP). Every other system components are connected to each other by using LPC2138.

2. Camera

Web camera Intex IT 306WC is used to captured images of coloured objects. These images are used by MATLAB for detection of colour and according to basis of that colour objects are get sorted. With a simple clip on mechanism we can connect it to laptop. It has 8MP camera, it delivered sharp, crisp image quality with image resolution 3280*2460.

3. MATLAB

The robot system describes a visual sensor system used in the field of robotics for identification and tracking of objects. The program designed to detect and capture a object through PC based camera using MATLAB software. It describes image capturing processing technique, followed by an introduction to actual robotic application to track the object using serial COM port of the computer. The whole system of making a robot to follow object can divided into four blocks: image acquisition, processing image, decision making, motion control.

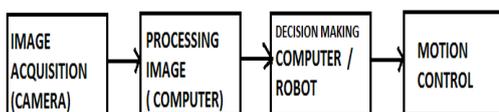


Figure.2. Block Diagram Of Robotic Vision And Control System

Acquisition can be achieve with a computer based camera or digital video camera. This device will capture the image and send it to the processor for further processing in the computer. Image processing involves conversion of RGB coloured image into gray scale images, setting threshold levels and setting of cut off values to remove noise from the binary image. Decision making is done with help of software program.

4. Servo motor

A servomotor is nothing but an actuator that allows to control of both angular and linear position, velocity as well as acceleration. It consists of a motor which is coupled to a sensor for position feedback. Servo motor also requires a relatively sophisticated microcontroller, often a dedicated module designed specifically for use with servomotors. A servomotor is a closed loop mechanism that uses position feedback to control its motion and final position. The input to its control is a signal which is representing the position commanded for output shaft.

5. Stepper motor

A stepper motor is an electrical motor that divides a complete rotation into equal no. of steps. The motor's position can then commanded to move and hold at one of particular step for number of equal steps as long as the motor is carefully sized to the application in respect to torque as well as speed. Step motor is to a machine which is used to convert pulse to angle displacement. So if we give stepper driver a certain pulse signal, it will drive step motor to a particular angle. We can control the angle the stepper moved by the number of the pulse. And we also can control the speed of the stepper rotate by adjusting the frequency of the pulse. The ULN2003 is a mini Stepper Driver with advantage of small size and easy to use.

Flowchart

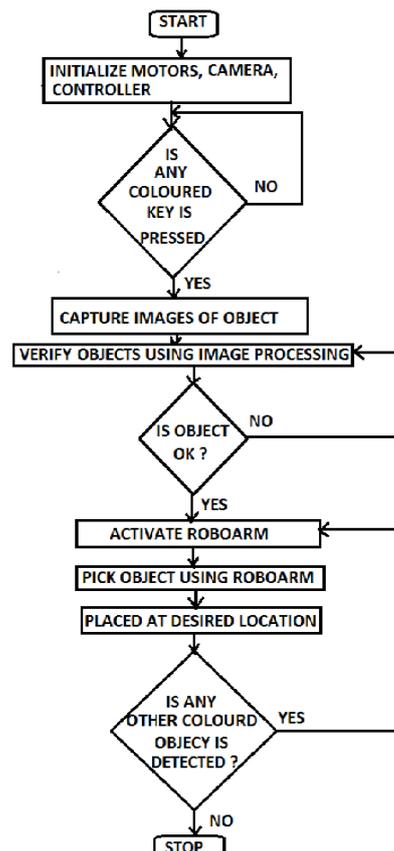


Figure. 3. Flowchart

V. RESULTS

This paper presents design, development and construction of the robotic arm using image processing technique, which can be pick and sort out objects on the basis of different colour. The aim of this project is to design fully functional robotic arms which sorts different coloured objects and this target is achieved successfully.

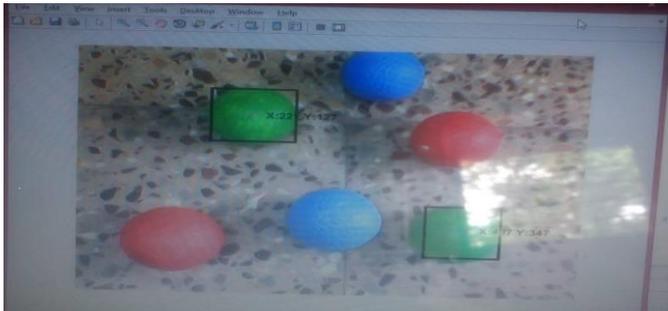


Figure 4. Green Colour Detection

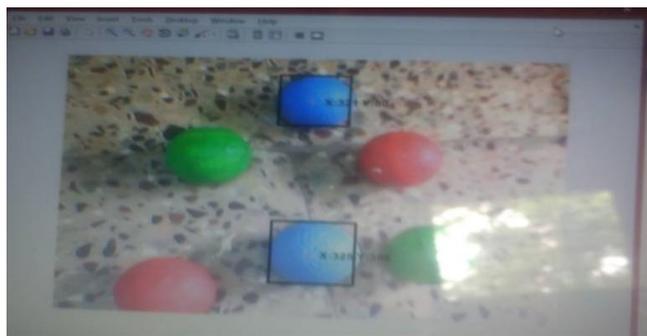


Figure 5. Blue Colour Detection

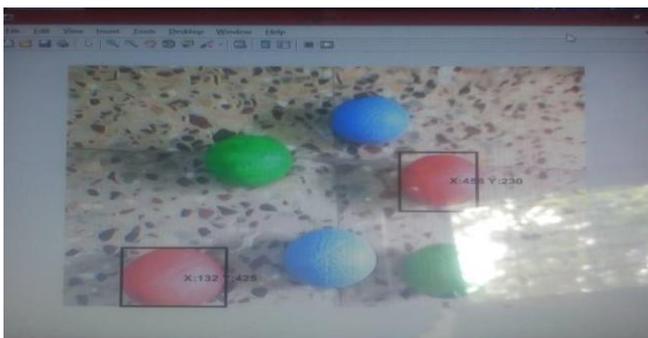


Figure 6. Red Colour Detection

Applications

- In small scale or large scale industries to sort out products based on the colour.
- In any type of departmental store.
- In malls and small shops.
- In various industries to sort the bottles or boxes or bags of various sizes such as medicine and wine industry.
- In food industries to identify the rotten or damaged fruits.
- Artificial robotic intelligence.
- It is used in garbage classifier to separate bio-degradable, non-degradable, metal pieces, and plastics based on color.

Advantages

- High precision: the margin of error can be reduced to great extent.

- This type of sorting robot can be used for various objects or vegetables of different color. Also suit to select pears, apple and other fruits of this kind.
- It gives high degree of intelligence if used with PLC control. The machine with a high degree of intelligent can control it.
- Good quality level.
- Low failure rate with long life.
- Reliable operation and maintenance.
- High accuracy.

VI. CONCLUSION

The conclusions drawn from results given by object sorting robot using image processing are as follows,

1. An image processing approach for object colour detection and object sorting has been successfully implemented.
2. Implemented robot system gives accurate result for three basic coloured objects as Red, Green and Blue.
3. With the help of few software changes this robot can be used for sorting different colour combination of basic specified colour.
4. Due to use of image processing in MATLAB for colour determination, manual efforts are reduced which produces result in improving accuracy as well as saves money and time.

VII. REFERENCES

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