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Object Sorting Robot Based On the Shape

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Abstract: In present days, all industrial systems are fully automated. Object sorting is one of the popular systems for industrial applications. In past days humans are used for the object sorting but it was the time-consuming process for a large number of objects in industries. Replacement of human operators with the robotic arm will reduce human efforts and also provides high accuracy & efficiency. Robotic arm operating using ARM7. Detection of shape is using image processing in MATLAB. The robotic arm is controlled by the microcontroller with DC motor. This paper presents an object sorting base on the shape of an object using image processing. The image is captured by using the camera, then image processing is performed for shape identification. This project deals with the fully automatic industrial material handling system. The aim of this project is the separate out objects according to its shape.

Keywords: ARM7, Robotic Arm, Image Processing, MATLAB, Servomotor.

INTRODUCTION

A **process automation** or **automation system** (PAS) is used to automatically control a process such as chemical, oil refineries, paper and other factories. Today's world is the world of technology as well as science. Due to automation, life has become fast and luxurious. As the technology is growing most people are adopting the new technologies rather than using the old.

The progress in technology is making people more demanding towards the things they use and consume, this is the reason why everything is automated. The use of Image processing techniques for separation of grain. It is inexpensive and is less time-consuming.

Object sorting Robot is one of the useful, costless and fastest systems in Industrial applications to reduce the manual working time and provides less human mistake when the manual system is undertaken. The objective of this project is to design an efficient, microcontroller based system that picks up right shaped objects and put it down at the right place to optimize the productivity, minimizing the cost of the products and decreasing human mistakes.

Shape based sorting is extensively used in many industries for sorting purposes to ensure the quality of the object is up to the mark e.g. Food processing industries, pharmaceutical industries, automotive industries, agriculture industries. Such sorting reduces the human effort, labour cost and also time of operation. Most of the errors caused by humans due to their limited potential are eliminated due to use of automated system supported by shape-based sorting using image processing.

IMAGE PROCESSING SURVEY

Image processing captures a two-dimensional image as the input of a system and producing a modified image. Present image processing tends to refer to the digital domain where the colour of each pixel is specified by binary digits. But many techniques are common to analog signals and even optical images. Image processing is a type of signal dispensation, which outputs as an image or gives characteristics associated with that image. Image processing basically includes 3 steps (a) Importing the image with an optical scanner or by digital photography, (b) Observing and manipulating the image which includes data compression and image enhancement and at last, (c) Output can be image or report that is based on image analysis. The purpose of image processing can be divided into 5 distinct groups' viz. (1) Visualization - Observe the objects that are not visible. (2) Image reshaping and restoration - To create a better image. (3) Image retrieval (4) Measurement of image pattern - Measures various objects in an image. (5) Image Recognition - Distinguish the objects in an image

II. BLOCK DIAGRAM

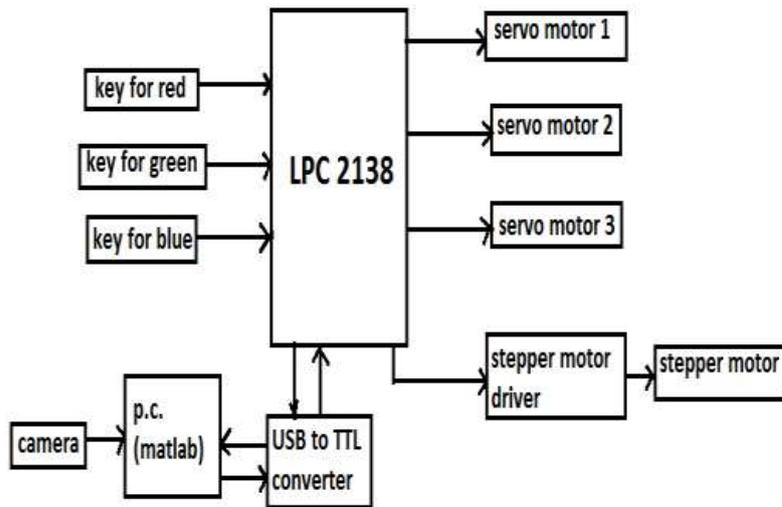


Fig1. Block Diagram of system

III. PROPOSED SYSTEM

In a proposed system, three different keys are used for detection of three primary colour which is red, green and blue. Three servo motors is used in the construction of robotic arm. Two servo motor is used to move robotic arm in up and down direction and one servo motor is used for the gripper to pick a particular colour object. One stepper motor is used for moving robotic arm in a circular direction for placing the picked object in a particular color box. The camera is used to sense particular colour for picking and placing process. Image sensing using MATLAB is used in a 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. The 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 controls 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 the ARM by PWM signal. PWM (Pulse width modulation) is a great method of controlling the amount of power delivered to load without dissipating any wasted power. Stepper motor is used for angular movement of the 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 the 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 capture images of coloured objects. These images are used by MATLAB for detection of colour and according to the basis of that colour objects are getting sorted. With a simple clip-on mechanism, we can connect it to the laptop. It has an 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 an 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 divide into four blocks: image acquisition, processing image, decision-making, and motion control. Acquisition can be achieved 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 the conversion of RGB coloured image into grayscale 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 controlling 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 the 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 a number of equal steps as long as the motor is carefully sized to the application in respect to torque as well as speed. A step motor is a machine which is used to convert pulse to angular 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 the advantage of small size and easy to use.

IV.FLOW OF SYSTEM

1. Initialize Microcontroller, camera, motors.
2. The camera continuously detecting the object.
3. If an object is detected then the image is captured & image processing is performed in MATLAB.
4. It gives the information about its shape & distance from roboarm.
5. According to this information position of roboarm is adjusted.
6. This roboarm grips that object and place it at a particular position.
7. If there is another shape object then goes to step number 5, otherwise, stop.

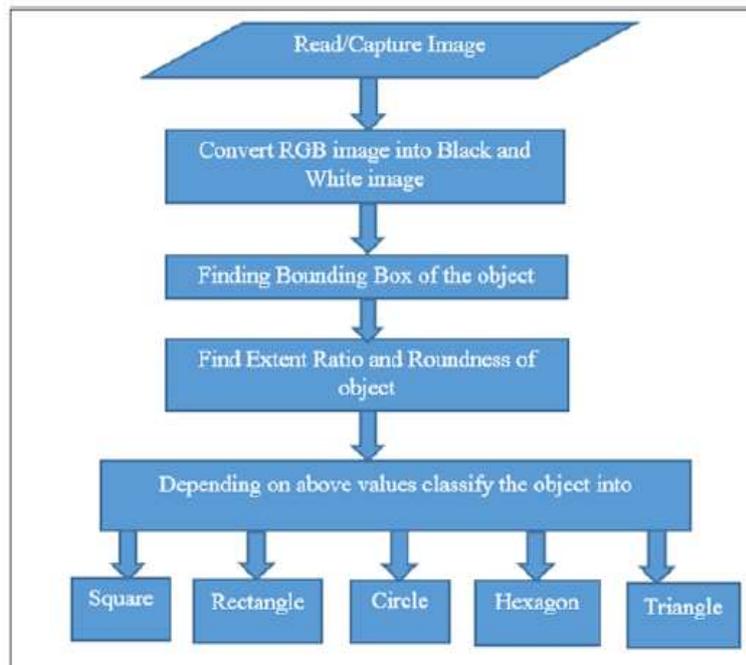


Fig2: Flow of System

V.RESULTS

Input Image

Input objects are placed as circles, Triangals, Squares. Image of this input objects is taken by MATLAB through the camera as below.

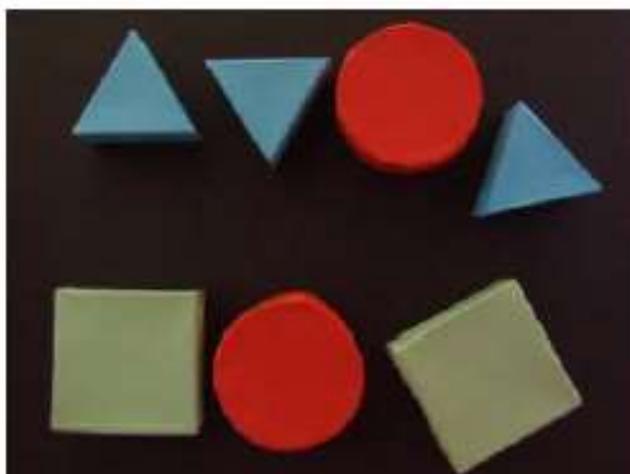


Fig3.Input Image

Output For circle shape

As the circle key is pressed all circle objects are selected & placed at circle basket.

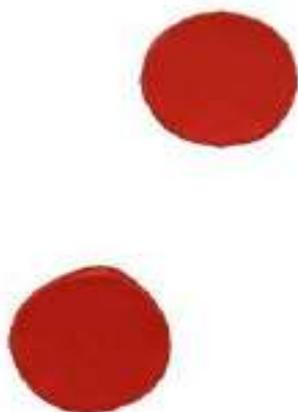


Fig4. Circle shape Detection

Output for Square shape

As the square key is pressed all square objects are selected & placed at the square basket.



Fig5. Square Detection

Output for Triangle shape

As the triangle key is pressed all Triangle objects are selected & placed at Triangle basket.



Fig 6. Triangles Shape Detection

In this way, according to shape, all objects are sorted.

VI.ADVANTAGES

1. High precision.
2. High accuracy.
3. Time-saving than the manual method.
4. It gives a high degree of intelligence if used with PLC control.
5. Good quality level.
6. The low failure rate with long life.

VII.APPLICATIONS

1. In small scale or large scale industries to sort out products based on the shape.
2. In any type of store.
3. In malls and small shops.
4. In various industries to sort the bottles or boxes or bags of various sizes such as medicine and wine industry.

CONCLUSIONS

According to this review paper, I have concluded that by using image processing application we can easily sort out different shape objects from each other like a square, triangle, circle. By using this system time required for sorting objects from the each other decreases than conventional separation system. It is also helpful to minimize labour cost, time and power. It is very useful for large-scale industries. It improves the accuracy.

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