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Automatic color object sorting system

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Abstract— This paper presents development and design of automatic color object sorting system. The proposed system is low cost, low power. In this paper object sorting using robotic arm based on color detection is designed and implemented. Furthermore, the robotic arm is used to place the sorted object on conveyor belt. Existing sorting method uses a set of different capacitive, inductive, and optical sensors to differentiate object color. In the proposed system a mechatronics color sorting system is developed with the image processing technique. Image processing technique senses the objects captured in real-time by a webcam and then identifies color and information out of it. This information is processed by image processing technique for pick-and-place mechanism. The arduino microcontroller sends signal to circuit which drives the various motors of the robotic arm to grip the object and place it at the specified location. Based upon the detection, the robotic arm moves to the specified location, releases the object and comes back to the original position. So, the proposed system will eliminate the monotonous work done by human and provides greater accuracy and speed in the work.

Keywords- Robotic arm, Micro-controller, Camera, Conveyor belt system, Servomotor, Image Processing.

I. INTRODUCTION

In the world of science and technology, more seems never be enough. In today's industrial environment, a robot or rather a robotic arm to be precise is not something hard to find. These robots and robotic arms provide mechanical assistance for human workers in many factories. Mainly the colour sorters are used in agricultural machineries like rice sorter, beans sorter, peanut sorter etc. Colour sorters are used in other industrial applications also like quartz sand sorter, plastic granule sorting of coloured nuts and bolts etc. [3]. It reduces the human effort, labour and cost. Computer vision methods, especially those referring to object classification and pose determination are extensively used in robot manipulation of rigid objects [1]. Existing sorting method uses a set of different capacitive, inductive, and optical sensors to differentiate object color [2]. Image processing in today's world grabs massive attentions as it leads to possibilities of broaden application in many fields of high technology. The real challenge is how to improve existing sorting system.

The present paper relates to an apparatus and method for classify in and sorting small-sized objects, using electronic systems and advanced sensors operating on the basis of a physical and geometric characterization of each element. The project can work successfully and separates different objects using sensors. The sensor handling systems which will drive the pick and place robot to pick up the object and place it into its designated place can. There are two main steps in sensing part, objects detection and recognition. The system may successfully perform handling station task, namely pick and place mechanism with help of sensor.

Thus a cost effective Mechatronics system can be designed using the simplest concepts. The most common technology used in this project is image processing. Due to the advent of powerful cameras, computers, controllers for controlling the machines and sophisticated tools image processing has

become the most powerful emerging technology. The techniques developed for object recognition, MATLAB has the most powerful tool box for image improving, enhancing and categorizing different images using different features such as color, dimensions and texture of the object. Generally signal processing is used in the analysis of the color of an object. In this paper the detection of different colors is done through image processing technique using MATLAB [4].The arduino microcontroller sends signal to circuit which drives the various motors of the robotic arm to grip the object and place it in the specified location. Based upon the detection, the robotic arm moves to the specified location, releases the object and comes back to the original position

II. SYSTEM DESCRIPTION

The project of pick and place robotic system for sorting mainly consists of following parts. It is presenting that the automatic sorting based on color is processed in advanced material handling system which is controlled by microcontroller assembly. The other main part of this technique is sensor which is camera in this case for high resolution and color identification. The sensor perform the well job of identifying objects as well as it helps for turning of robotic arm to next object sorting. The basic design is shown in figure 1.

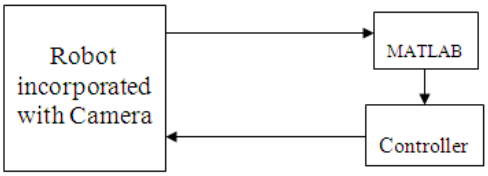

Figure 1. Basic Design

So microcontroller process so much of data at a time. MATLAB software processing the images given by camera. Thus, the processing of the image will be done by the processor inside the PC. A GUI is developed in MATLAB to communicate with the microcontroller. The hardware consists of a machine with two motors one attached to the base to provide 90 degrees rotation and other is attached to the gripper for picking and dropping the objects detected. USB to Serial cable is used in Between MAX 232 and the PC for the flow of data. To drive the two DC motors the motor driver IC L293D is used. The block diagram of system is shown in figure 2.

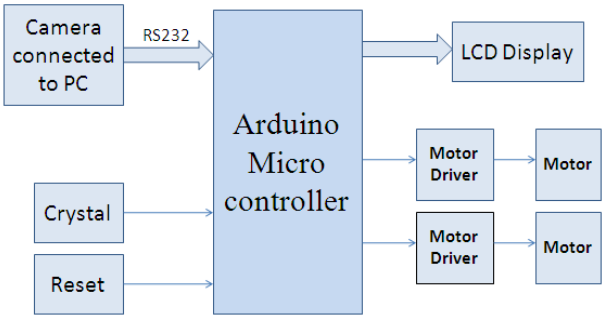

Figure 2. Block Diagram of System

The camera will take a snap and it will feed to PC for color processing. In PC, MATLAB is used for processing on color, depending on this signal will be given to microcontroller Atmega 328. The microcontroller in turn will control the servomotors by PWM signals. These servomotors will control the movement of robotic arm, by controlling their angular movement. Thus the robotic arm will be fully controlled by servomotors. The gripper of Robotic arm will pick the object place it depending on its size.

This is full automatic process no manual support is needed. The Arduino microcontroller is good platform for robotics application. The microcontroller used here is with the support of Arduino kit. It is the software and hardware also, using both the above system is developed. Thus the real time, continuous object sorting can be done.

The camera used in this case will be overhead camera, it will take the snapshot of the object for color sensing purpose. The image captured by the camera will be processed by image processing using MATLAB.

The camera used in this case is Logitech PN 960-000748 whose technical specifications are:

• Video capture: Up to 1024 x 768 pixels
• Fluid Crystal Technology
• Photos: Up to 1.3 megapixels (software enhanced)
• Hi-Speed USB 2.0 certified (recommended)

2.1 Robotic Arm and Servomotors

The robotic arm with three servo-motors are mounted as one servo for the basis rotation of 360 degrees, one servo for the elbow and, finally, one servo for opening and closing the gripper at the wrist. The servos assure accurate and repetitive movements, the links are very light and the bearings minimize the friction. The servos are driven by the controller and the driving code is on-purpose implemented [5].

The robot used in this project is 4 Axis Robotic Arm. 4 Axis Robotic Arm is designed for small mobile robots. It can grip objects with the size up to 60mm with the force up to 250gms. Arm has reached of 23cm. It can lift the payload up to 400gms. Robotic Arm comes fully assembled and ready to use. First two axis of the arm are made up of NRS-995 dual bearing heavy duty metal gear motors and remaining 2 axis and gripper uses NRS-585 dual bearing plastic gear servo motors. Axis 2 and 3 enables gripper to maintain its angle constant with the surface while moving up and down. Robotic arm can do Left-Right, up-Down while keeping gripper parallel to surface, Twist motions and Gripping action. Robotic Arm will require current up to 5Amps. Make sure that your robot can supply that much amount of current for proper operation of the arm. The robotic arm has following specifications [6].The axis capabilities is shown in table 1.

- Number of Axis: 4 + Gripper
- Gripping force: 250gms (Maximum)
- Gripping jaw length: 43mm
- Gripping jaw width: 60mm
- Weight: 541gms (Including 2 NRS-995 and 3 NRS-585 servo motors)
- Operating voltage: 5V to 6V

Table 1. Axis Capability

Axis Capabilities: Mechanical Assembly	**Maximum Angle (^{0})**	**Speed (Degree/sec)**
Waist	180°	0-27°
First Arm	180°	0-27°
Second Arm	180°	0-27°
Third Arm	180°	0-27°
Fourth Arm	180°	0-27°

Servos are DC motors with built in gearing and feedback control loop circuitry. and no motor drivers required. A servomotor is a rotary actuator that allows for precise control of angular position. The

four axis robot arm is shown in figure 3.They consist of a motor coupled to a sensor for position feedback, through a reduction gearbox. They also require a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing. The servo motor has some control circuits and a potentiometer (a variable resistor) that is connected to the output shaft. This pot allows the control circuitry to monitor the current angle of the servo motor. If the shaft is at the correct angle, then the motor shuts off. If the circuit finds that the angle is not correct, it will turn the motor the correct direction until the angle is correct. The output shaft of the servo is capable of traveling somewhere around 180 degrees. Usually, its somewhere in the 210 degree range, but it varies by manufacturer. A normal servo is used to control an angular motion of between 0 and 180 degrees.

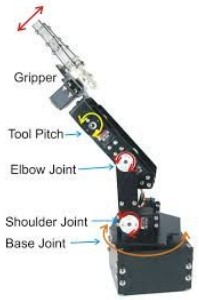

Figure 3. Four Axis Robot Arm

If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops. Servomotors measure both the position and also the speed of the output shaft. They may also control the speed of their motor, rather than always running at full speed. Both of these enhancements, usually in combination with a PID control algorithm, allow the servomotor to be brought to its commanded position more quickly and more precisely, with less overshooting. The servo turn rate, or transit time, is used for determining servo rotational velocity. This is the amount of time it takes for the servo to move a set amount, usually 60 degrees. The servomotor rotation is shown in figure 4.For example, suppose you have a servo with a transit time of 0.17sec/60 degrees at no load, this means it would take nearly half a second to rotate an entire 180 degrees.

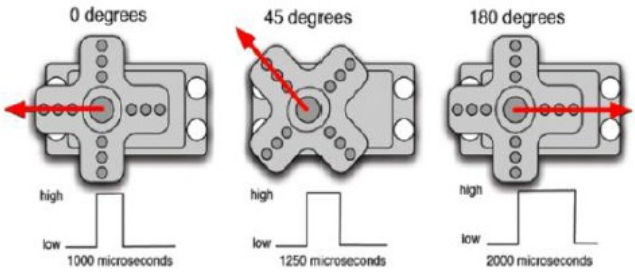

Figure 4. Servomotor Rotation

2.2 Color image processing using MATLAB

A simple approach for developing object reorganization system is shown below:

- Decide the ideal position of the object with respect to the camera
- The distinguishing feature of the object to be picked is to be figured out.
- Deciding the robots movement as planned

The ideal position of the object will be when the centre of the frame coincides with the center of the object. The color of the object will serve as the distinction on the basis of which we will identify it. In order to have accurate color detection a few live images of the object must be captured and the pixel values for different colors should be noted. Taking a mean of the pixel values obtained through various images would be fair and justifiable. This threshold range will then be used to mark all pixels containing the object as '1' and all other pixels as '0'. In the algorithm' s initial settings are set. The settings include starting the MATLAB, starting image acquisition tool box, setting up the settings. For trigger and frames per second in image acquisition tool box, starting the video. After starting the video the serial port must be opened and image processing toolbox must calculate the total number of pixels captured. Initially the DC motor of the robot is off and the infinite while loop is started for continuously capturing the video through camera. After starting the infinite loop the image of the object is captured and is displayed to the operator. The image is converted into Ycbcr format. This format separates the intensities in each color then size of the image is calculated. The image is then captured and all the pixel values for different colors are noted. The mean of the pixel values available are noted. A binary matrix is created in which pixel values of the object will be 1 having the color (of the desired color) and all other pixels which do not belong to the object (no color detected) are marked 0. Then centre of the object is initialized and the colored pixels are determined. After determining the red pixels, centre of the object is calculated. MATLAB sends commands to the development board in terms of characters using serial communication. As soon as the microcontroller receives the commands it energizes the motors for the desired operation. After the command is executed the camera waits for the next object to pass on for the repeated operation.

III. RESULT

We considered different colored objects in circular, rectangular shape. The result obtained is shown in Table 2.

Table 2. Result of Sorting of Various Colors

Sr. No.	color	No. of object	Result	
			Sorted	Not Sorted
1	Red	15	15	13
2	Blue	8	8	6
3	Green	5	5	4
4	Orange	5	5	3
5	Navy Blue	3	3	2

IV. CONCLUSION

This paper demonstrates implementation of automatic color object sorting system. In this paper color sorting scheme is implemented using algorithm. The algorithm used gives good results, see Table 2 for greater details. The proposed system is cost effective and efficient.

REFERENCES

[1] Gian Luca Foresti, Felice Andrea Pellegrino, "Automatic Visual Recognition of Deformable Objects for Grasping and Manipulation" IE

[2] EE Transactions On Systems, Man, And Cybernetics—Part C: Applications And Reviews, Vol. 34, No. 3, August 2004

[3] Alessandro Golfarelli, Rossano Codeluppi and Marco Tartagni, " A Self-Learning Multi-Sensing Selection Process: Measuring Objects One by One by", ARCES – LYRAS LAB University of Bologna, Campus of Forlì, 1-4244-1262-5/07/$25.00 ©2007 IEEE, IEEE SENSORS 2007 Conference.

[4] Aji Joy," Object Sorting Robotic Arm Based on Colour Sensing" International Journal of Advanced Research in Electrical,Electronics and Instrumentation Engineering, Vol. 3, Issue 3, March 2014 ISSN (Online): 2278 – 8875

[5] MathWorks India - Image Acquisition and Processing Using MATLAB - MATLAB Webinar

[6] AmitAgrawal, Yu Sun, John Barnwell, Ramesh Raskar, Vision Guided Robot System for Picking Objects By Casting Shadows, International Journal of Robotics Research, vol. 29 no. 2-3, pp.155-173, February 2010

[7] Szabo, R.; Lie, I., Automated colored object sorting application for robotic arms, Electronics and Telecommunications (ISETC), 2012 10th International Symposium , pp.95,98, 15-16 Nov. 2012

