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Color Based Object Sorting Robot Development: A Review

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Abstract: The designing a robot for sorting objects on the basis of color and shapes are essential needs in current food or similar type industries. The techniques associated with these tasks and implementation feasibilities are the fundamental studies. Variety of techniques are available for these tasks, along with their implementation strategies. The main approach of this paper is to address such techniques to identify performance oriented technique. Few techniques and their implementation strategies are discussed in this paper.
Keywords: Color based sorting, robotic arm, MATLAB, Color identification theory.

I. INTRODUCTION

Situations where humans work repeatedly and contains the same process every cycle have an ability to give uneven results. In the future a wide range of that kind of applications can be improved by using a robot. A robot's work gives the same result each time as opposed to the human. When the robot is programmed it will do the exact same operations every time. Further advantages of using a robot is the decreased time consumption. The quality and capability to repeat precise movements makes it easy to increase the speed of the process. To purchase in a robot is a one-time investment but in the long term the investment will be worth it due to the consistent quality and labour costs. Robots can work both day and night, compared to humans who need breaks and sleep. One kind of task which a robot would be able to perform is sorting objects into categories for instance by color, shape or size. This is, however, not always a simple combination. In this paper a review is done on robot designs.

II. LITERATURE SURVEY

Kunhimohammed C. K [1] in their journal explain about a Visual sorting setup in an industrial setting. Movement on the conveyor of items at random position is stated by them. Orthographical view is set for the camera to observe items view. In many manufacturing plants the separator is used to separate the items near the camera view such that no items will have overlapping regions. The process is optimized by processing only desired regions of items instead of processing entire image by using sensor device thereby reducing the processing times. Also, the items which will not meet the desired levels of classification, for those items human based inspection requirement signal is indicated [2].

The information on Wikipedia [3] presents a smart approach for a real time inspection and selection of objects in continuous flow. Sorting of objects based their color is the basic theme of this project. For sorting objects are selected using sensors while moving on conveyor. Camera is interfaced with microcontroller to trigger the snapshot. PC mounting is done for camera and USB based interface is used. Color processing is done by the image feed by camera. MATLAB based application is developed in PC for processing on color, using this information signal is given to the microcontroller Atmega 328 for further actions. Servo motors are controlled by microcontroller using PWM based signals. Robotic arm movement is controlled by these servo motors by controlling their angular movement. Gripper is used to pick the object and place it in respective bucket on the basis of its color. The process discussed above is fully automatic with no human interference or support. Arduino kit support is used to program the microcontroller used. For the development of robotic applications, Arduino provides a good platform. Both the software and hardware support is available [3].

Trinesh, T. M. and Vijayavithal Bongale [4] propose another way of sorting; the proposed system is an embedded system which increases the speed of color sorting procedure, provides the accurate color sorting process. The system is useful for decreasing the implementation cost for color sorting. To optimize the production rate of industrial product the system is very useful. Color sensor is used to identify the color of an object. Servo motors and microcontroller based robotic arm is developed for operations. The object on the conveyor belt is picked there by achieving synchronization in system. The places are pre-programmed for placing the object by picking them from the conveyor belt. Speed and accuracy is achieved by using this system compared to monotonous work to be performed by humans. The color sensing is done using color sensor which is then sent to the microcontroller to process based on which, the microcontroller sends signals to the driver circuit to drive the various motors of the robotic arm and to grip the object and

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place it in the specified location. Pick the object move to a specified location based on color release the object and come back to original position are the steps followed by robotic arm [4].

N. R. Vange et al [5] introduced a project about sorting with a robotic arm and the idea of sorting colored objects using a sensor and the arm. Wireless camera is used to capture the images for processing. Wheel based chassis is used for mounting the robotic arm, to allow a robot to move from place to place. RS232 interface is used to control the robotic arm movement via a motor. Only three primary color based sorting is done which shows little ambiguity in the detection of other colors. To make user friendly development platform for microcontroller based system and a sorting programming language which was simple, efficient and familiar as the entire control mechanism has to be user friendly. Intel 8051 microcontroller could easily be used, but the problem was the slowness of the code execution which increased the output time. [5]

Color sorting robotic arm implemented by U Amin et al [6] have a capability to select the specified color object and place it at a desired location. At the beginning, when the object is determined by the robot, the gripper of the robot picks the object and places it in the respective color based positioned places. Light Dependent Resistor (LDR) is used at the locations as a color sensor. It senses the light reflected by the body. RGB color sensor, TCS 3200, is consist of an array of photodiodes to identify the color of surface of the body from which reflected light is captured by the sensor. The chip is CMOS type with integrated color sensing capability. The array consists of a matrix arrangement of 8x8 sensors which gives in total 64 filter sensors are used in it. For the processing of color, an oscillator which is integrated in the chip, the data collected from the sensor is converted into a 50% duty cycle square wave generated. Microcontroller can be programmed to process these waves or wave can be sent directly to the motor drivers. To pick and place the object at a specific location controller can be programmed. The arm rotation is controlled by specifying an angle of rotation [6].

Dharmannagari, Vinay Kumar Reddy have developed material handling fully automated. A pair of IR sensors is used by interfacing with 89S52 microcontroller for automation. Microcontroller receives the signal from a color sensor which changes in accordance with the object color. Eight channel relay circuit used to drive the various motors based on the signal received from the color sensor and processed by microcontroller. At the specified location, programmatically robotic arm picks and places the object. [7]

An apparatus method is used by S. Wanve et al [8]. The method is suitable for sorting small-sized objects. Advanced sensors operating based on physical and geometric characteristics of the objects are used along with microcontrollers. Object detection and recognition are two main steps involved in sensing process of an object. Using this simplest concept cost effective mechatronics system can be developed. Image processing is also used in this system. Image processing toolbox in MATLAB is used for object recognition. Various processes such as image improving, enhancing, feature extraction based on texture, color and dimensions of an object, and finally classification. For detecting different colors image processing is done in MATLAB. The further motor driving system is developed using Arduino [8].

To pick and place object with specified angular rotation mechanism with 10, 70 and 170 degree values is developed [9]. Color detection using color sensor along with Arduino is done. The stations are bifurcated as RED, Green and Blue based on color of objects and these locations are set at respective angular rotations. The arm used for pick and place goes back to initial position automatically after every object placement [9].

K. Prusa et al [10], have development of fruit and vegetable sorting system. Color based sorting is done using video camera based object color detection system. Variety of combinations of colors are processed, in case if object is rejected by means of different color category then such objects are removed from the stack and are marked as unacceptable.

For the sake of sorting object are placed on conveyor belt. Camera used along with flash to condition the environment in terms of lighting to achieve accuracy in color detection. The centralized processor which processes the color information sends signal to microcontroller to accept or reject the object. Also the timing control is done to achieve location based accuracy based on busy flags in processor so that no object is missed on conveyor belt. To achieve the speedy process to be done, processor used required to be high speed which assures speed and accuracy in entire system. The video camera with specific three color output facility is used for color information retrieval. Based on intensity of color if sorting is to be done the system is well suitable. For the sake of welding applications, a robot is the excellent choice [11]. The processes in which humans are combustive and explosive to unwanted temperature and other factors, robots are the best solutions [12]. In terms of initial investments, robotic system is costlier, but with effective output processing requirements the investment cost is negligible in terms of accuracy and efficiency for longer terms perspective.

To bring autonomy in processing and manufacturing long with efficiency and accuracy for long term production environments where speed of manufacturing is also and effective parameter to be considered, robotic system is the best choice [13].

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Wide spread requirements for automation in industries have shown significant improvements in technology which satisfy accuracy and efficiency requirements. The technological advancements such as computer aided design (CAD) and computer aided manufacturing (CAM) are leading towards enormous growth of industrial automation [14].

For the sake more advancements in the robotic arm and their applications, following are the types of processes required to be accommodated in the system while considering development [15]. Vision system

1) Sensors
2) Control system
3) Drive system
4) Manipulator system
5) End effectors
6) Computer software and hardware

D.A. Forsyth, have shown ways of making 3dimensional work strategy for robotic arms. For color based analysis requirements in automation system, Hue, saturation, luminance (HSL) is one such color coordinate system, or color space. For getting precise color information of an object, hue, saturation, and lightness are the main channels to be considered. Hue is defined as the attribute of a color according to its similarity with one of the primary colors red, green, or blue, or a combination of adjacent pairs of these colors considered in a closed ring, as shown in figure 1. [16].

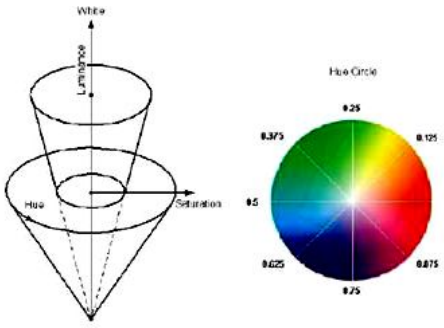

Figure 1: HSL diagram with Hue circle

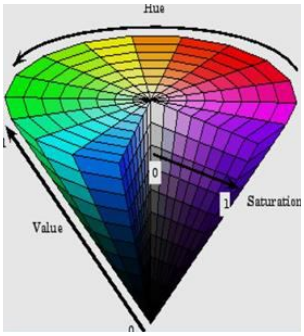

Figure 2: HSV color model single hex cone

Defined color theory which defines color in a space. This is done in accordance with hue, saturation and intensity (HSI) information of the target location in space. Object surface reflected wavelength of white light is varied and its average value is Hue. The degree of whiteness or grayscale is measured as Intensity. Based on vividness of hue, saturation is a measured [17]

III.CONCLUSIONS

This paper provides survey on various techniques involved in color sorting robots. Variety of literature is available for the study of color based sorting techniques. A few are addressed in this paper which are selected on the basis of implementation strategies and technologies used. This paper supports for understanding the essential needs for designing color sorting robot and planning its implementation strategies.

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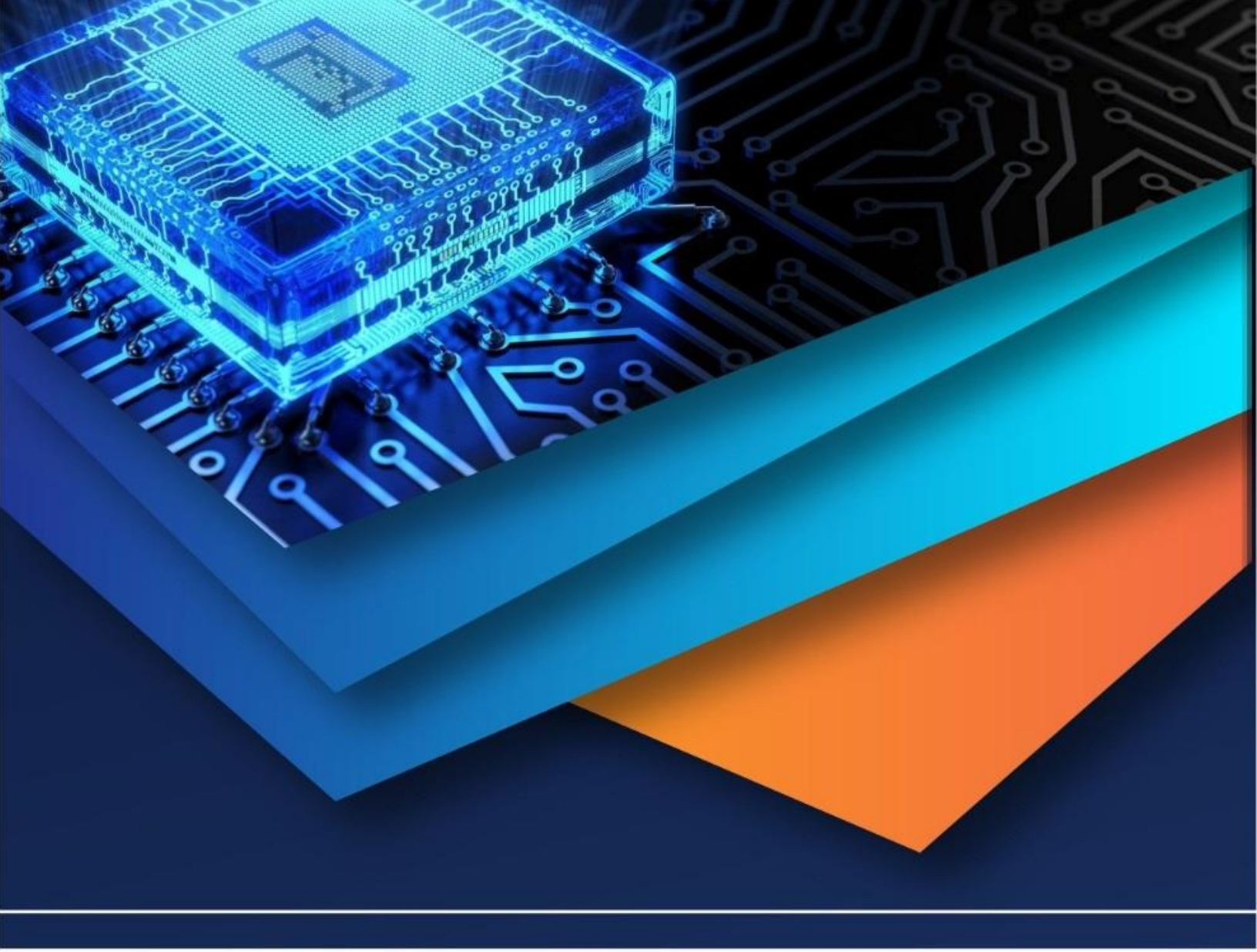

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