



OBJECT SORTING BY ROBOTIC ARM USING IMAGE PROCESSING

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ABSTRACT: Currently, this is the time where the world is moving towards innovation and, considering this every company is trying to develop their production rate to compete with this era of growing technology. In Older days there were many issues for finding an appropriate person for doing a skillful task, who can handle all machinery as well as sort the final product. Due to this, the production rate was very slow as compared to the current situation. Anyway, handling the final product and sorting issues are generally affecting the production rate and revenue of the business because of more sorting time. A huge number of large-scale and small-scale companies follow the old pattern of sorting of an end product. Considering ancient techniques for sorting of final product consist various of issues subsequently "Object Sorting Robotic Arm " is an efficient way to get a solution of this issue.

This technique provides a low-cost methodology for quick and faster sorting and detection of products that continuously take place. The sorting of products with an automated system is an appropriate technique to improve the current technique of sorting end products. The system consists of four interconnected halts which include recognizing an object, handling of product, decision making, and placing the product at the designated place. The System manages a programmed material dealing with end products. It points to grouping similar objects by color and shape, that are drawing close to the transport by choosing an appropriate article and placing it in its pre-customized place. Consequently halting the work done by humans and accomplishing precision and speed inside the work.

Keywords: shape, color, object, robotic arm, categorizing, segregate, conveyor belt.

I.INTRODUCTION

Due to the suggestion of this current time and effectively sorting technique segregation of small and identical products in a continuous stream will now open new sources for industrial sorting processes. Thus with help of different devices an old strategy in upgraded into a new one which identifies objects, with the

help of provided code and sensors which works by sorting object based on its number edges and centroid comprising with geometrical dimensions of every component. Upgrades in devices and circuit boards open a new innovative application in this field. The sorting and arrangement of items with help of a robotic arm are extensively used in many industries. It starts with checking the purpose of work, and then build creation and payments of industry. In the hectic, intolerable, and time-consuming process which can't be done by a human inefficient time, it is a fruitful and efficient technique. Image Processing nowadays has become an inseparable part of growing science and innovates that many tasks would not be completed without it. By mixing Image Processing and different embedded techniques this robotic arm can detect shape and color and segregate objects and place it in their designated place.

Manufacturing companies develop their products with different geometrical and visual aspects which include shape, size, height, color, edges. In the back period, it was an extremely doable task to sort and differentiate products due to lack of demand, the production rate was slow and thus manufacturing companies had sufficient time to complete their task. But considering today's situation the scenario is different, demand for the product is increasing day by day and it's becoming a big task for the manufacturing companies to complete the product in the given slot of time thus there was a need for an automation system to overcome the problems which were faced in ancient days. Also nowadays the cost of raw materials is high so some companies cannot afford labor expenditure for such small and unskilled work of sorting. The sorting work which is done by humans may include some minor errors which the company cannot afford because it will result in the wastage of raw materials and considering today's situation no company can afford any kind of wastage and errors. So for sorting of product, the companies need to adopt a new system format which will help increase production rate and thus remove labor expenditure. However, in this whole mechanism, the system follows an enumeration of the end product, sorting the end product based on its geometrical and visual appearance and place it in its designated place. This is the main reason which promotes every manufacturing company to replace their system into self-sufficient automatic system which provides the new appearance to the company. While adopting a new automated system the most important factor which is to be considered is that the new system should be a low-cost system and this technique should help reduce the overall production cost and labor cost of the company.

Once the system starts, firstly the object is determined, after investigating the object comes near the main station of the conveyor belt where an IR sensor and a camera are situated for further testing of the product. The robotic arm is designed to select the object and place it at its designated place. With help of this advancement in robotics the utilization of the automated robotic arm is done by using a microcontroller, sensors, IR sensors. Thus, a system is implemented for carrying the end product from one spot to a designated location with automated techniques.

II. LITERATURE REVIEW

R. V. Soans et al, They have provided An graphical technique in the current period was initiated to segregate products. The segregating module was developed and trained to sort objects considering the

pictures taken by the camera. Also, the main components required for sorting objects like conveyer belt and actuators square measure were tested with help of Raspberry Pi which uses Python scripting language for generating the code. The determination of the objects was dependent on background light and system performance. Once done the delays between the actuators were not negligible and thus it gave negative results, to improve the quality of the system smart lightweight technique was used [1].

A.K. Singh et al, have suggested that, The updated manufacturing technique of sorting the final product is done by detecting an object. The technique works in such a way that it calculates the percentage of area unit of an object which is going through a conveyor belt. Such a mechatronic system is created for the detection of elements. Once the product was passed through the conveyor belt checkpoint, at the terminal end of the conveyer belt there was a transmitter and infrared receiver located for processing of further algorithm. After the object is passed through the infrared beam the electric counter detects the object and generates the key '0' and was considered as a true count. The detecting product-based automated system firstly detects the presence of a product and counts it. But another side of the technique was that it only detects the object but it does not give any data about the weight of the object [2].

Sushrut Nagesh Kulkarni et al, They have shown that, The main reason behind this study was to allot an integrated system that separates the object considering its color and shape and place it into respective compartments. This is designed purposely for different industries and to fulfill all requirements for pick and place applications. This type of technique is usually implemented by using Raspberry Pi. Hence the reduction of cost is achieved and thus creating an automated, dependable, accurate, cost familiar, and easy to build. An image processing technique was used for the detection of shape and color and the goal of sorting was established [3].

Patil S.M., He has presented that The system retrieves the stored image from the database by comparing it with the query image. The image was retrieved based on their color, texture, shape. The system goes throughout the database to find a similar image to the query image. The further shape of the object was considered using scaling and transitions. Thus the difference between low-level and high-level images was retrieved using different algorithms [4].

R. R. Bilawane et al, They have suggested that, In the first station after finishing the task the workpiece was designed in such a way that it was coming back to the conveyor belt. After this step the color detection part was done concerning its coating, this task was completed by using sensors. The result of the count was displayed through a single LED display. Once this step is completed the robotic arm picks and place the object to its pre-programmed in its respective color container. The functioning of the robotic arm was done through a microcontroller[5].

Rajaa Fadhil Al Hinai et al, They have presented A new business for overcoming the demand for products, and for this purpose implementation of an automated system is the only key. A system was purposely designed to develop an efficient kind of mechatronics with a specific conveyer belt system to fulfill the importance of image processing methods that offer an advantage over alternative technology. Additionally, the system ready to incorporate flexibility and separate merchandise of various colors and

at constant time kind objects mechanically to the proper section mistreatment the most controller that is that the Programmable [6].

Vishnu R. Kale et al, They have provided that, A sensible approach for a true time evaluation and choice of objects in uninterrupted flow is depicted in the system. The four integrated stations of identification, processing, choice, and segregation in addition to a brand new image process feature are altogether formed the standard process system. A collection of the inductive, electrical phenomenon, and optical sensors to differentiate object color is used in the existing system. A mechatronics color sorting system resolution with the application of image processing is introduced in the system. A picture captured by a camera is sensed by an image processing technique to identify the color of the object and other data out of it. This information is progressed by image processing for pick-and-place operations [7].

SHEELA.S et al, They have shown that, The system consists of a conveyor belt run with the help of a DC motor and corresponding pulleys at the motor and its opposite ends that continuously run with the help of raspberry pi3. The Objects that are needed to be segregated are placed on the conveyer belt. The objects are passing through the continuous surveillance of the camera to read the colors of the objects and the program is coded in PYTHON for raspberry pi [8].

P. P. Chavan et al, They have suggested that, The current style provided was strong all told senses, creating it attainable for preparation in industries requiring significant process. Faster and reliable computing of data is done to manufacture a true time output. Before the selecting action takes place, Vector calculation was done to know the precise location of the object which is then followed by space & displacement calculation of the object. Most of the color recognition part was entirely based on a software package and it was processed with the help of the java platform[9].

Pratik Roy et al, They have presented that, Color could be an important feature supported that objects are distinguished sorted and varied industrial applications are performed. the color detection work was done by victimization raspberry-pi that acts as an entry module to IBM cloud. The image was fed into the visual recognition model which supplies the small print of the color of the article. IBM cloud sends back the results to the raspberry pi that successively commands the robotic arm to choose and place the article on the actual box-counting on its color [10].

Himanshu Patel et al, They have shown that, The segregation of objects was done in line with their color mistreatment TCS3200 color sensing element, Raspberry UNO, and servo motors. The frequency scaling of color detection was done to identify the colors of the objects. A color recognizing element was made to detect the things returning in its sight and code for the same was coded in such an easiest way that only the specified object's color unit is detected and picked up within the jaws at the top of servo motors[11].

Amit Kumar Singh et al, They have provided that, An application with a robotic arm was created to find objects of a specific color. The segregating of objects was finished with the help of a robotic arm that was developed using the three degrees of freedom that depicts the cotyloid joint, hinge joint, and wrist of somebody's arm and works in a very similar way. The digital camera that was interfaced to the OpenCV

was provided to make possible the pick and place operations. Therefore a satisfactory application came into existence for sorting purposes [12].

Riky Tri Yunardi et al, They have presented that, The exactness of volume and size of the parcel boxes area unit is all involved in the automatic sorting system. Contour-based object detection is an algorithmic rule of form illustration-supported contour. Size measurement plays an important role in determining the area. Dimensions measurement is sometimes associated with object long, dimension, and height of the object. The boxes of 15 cm long and 25 cm tall are determined with the assistance of this effective system. The system was made to actively check the accuracy of volume between measured and calculated parcel boxes [13].

Lekha Bhausahab Kachare et al, They have implemented that, For sorting objects of different colors and sizes Image processing approach was used. For three basic colored objects as Red, Green, and Blue the designed robotic system was giving accurate results. Using image processing more efficiently in MATLAB for color recognition results in less manual efforts and more accuracy as well as saves time and money [14].

Aashik Chandramohan et al, They have provided, An application was created to assimilate computer vision to a robotic arm. The soundness of the was application was proved by sorting objects like pencils chocolates based on their colors. By using any material that suits the working conditions a robotic arm was built. The developed robotic arm can be used for commercial purposes as it is giving efficient and effective results. The Systems-on-Chip solution is suitable for a system of this nature and any similar Computer-on-chip architecture can be used to carry out the system [15].

Tracking objects as they move through video sequences is one of the most basic and most important tasks in computer vision [16].

III. IMPLEMENTATION

The 5V DC Motor may be a machine that transforms electrical energy into kinetic energy in style of rotation. In our system we tend to use a 5V DC motor, the main operation of this motor is to rotate the belt slowly within the forward direction. The IR detector is placed on top of the belt, because the object placed on the belt comes underneath the detector it senses the article and stops the movement of belt in order that the robotic arm will pick the article. A servomotor may be an actuator that permits for precise management of position. In our system three servo motors are used to manage the movement of robotic arm. The servo motor utilized in our system is G36.

In our system Raspberry-pi is employed for image process. Image is captured by camera then transferred to raspberry pi, at that time by mistreatment open cv library we will discover image and method in addition. Dc motor of conveyer belt is connected with IR detector. Once any object comes ahead of IR detector DC motor stops. Camera is connected with Raspberry pi, the sole job of camera is to discover form and color of the article. The GPIO four pin is connected to a different IR detector that triggers the camera and robotic arm to capture the article and to select up that object robotic arm is connected to GPIO pins 17,27&22 severally that controls the three motors of robotic arm that is grip, base and joint. The

camera utilized in this case are going to be USB internet camera, it'll take the exposure of the article for color sensing purpose. The image captured by the camera are going to be processed by image process mistreatment open CV. The camera utilized in this case is Logitech PN 960-000748 whose technical specifications are Photos Up to 1.3 megapixels (software enhanced) Universal clip fits laptops, liquid crystal display or cathode-ray tube monitors

Shape Detection: Shape is an important aspect to be considered while sorting an object. The shape detection part is done through image processing using an openCV platform. Shape detection is done by calculating total edges of object.

Algorithm:

1. Object Image is captured by webcam
2. Detected Image is passed to microcontroller
3. Microcontroller reads the image in RGB form.
4. $G(x, y)$ is form of object where x & y are dimensions of image.
5. Computing of edges of object through dimensions.
6. Shape is calculated using above formula

$$\text{Edges} = \frac{4\pi * \text{Area}}{\text{perimeter}^2}$$

$$\text{Circularity} = \frac{\text{perimeter}^2}{4\pi * \text{Area}}$$

Where, Area = area of a region, Perimeter = Perimeter of a region

7. Depending on above result the shape of the object is decided whether it is rectangle, circle or square.
8. The accuracy of the detected shape is calculated as:

$$\text{Accuracy} = \sum_{i=1}^n \frac{\sum TD * 100}{\sum FD + \sum TD}$$

Where $i = 1$ to n .

TD = True detection of object FD = False detection of object N = Total number of object

Color Detection: The images clicked from the web cam are firstly in RGB form. Thus for smooth process the images are converted in HSV (Hue, Saturation, and Value) form for better processing.

Algorithm:

1. Captured RGB image is converted into HSV format.
2. Lower and Upper HSV values are calculated using numpy library from python.
3. Color mask are obtained for each color.
4. Binary Values for each color mask is obtained.
5. The obtained color mask in white and black format
6. The black format will be background and white form will show desired color.

RGB Color Segmentation The RGB (Red, Green, Blue) model produces a color which is defined by the value associated with each color. RGB values range from 0 to 255. So, for example, the RGB value (255,0,0) produces the color red, the RGB value (0,255,0) produces the color green, and so on.

OpenCV handles RGB values differently, instead using it in reverse order, in the form of a RGB format. **HSV (Hue, Saturation, Value) Color Segmentation** “Usually, one can think that RGB color space is more suitable for color based segmentation. But HSV color space is the most suitable color space for color based image segmentation”.

Open CV handles HSV values differently than standard HSV values. For example, some applications use Hue = 0-360, Saturation = 0-100 and Value = 0-100 for the HSV range. But OpenCV uses Hue = 0 - 180, Saturation = 0 - 255, Value = 0 - 255.

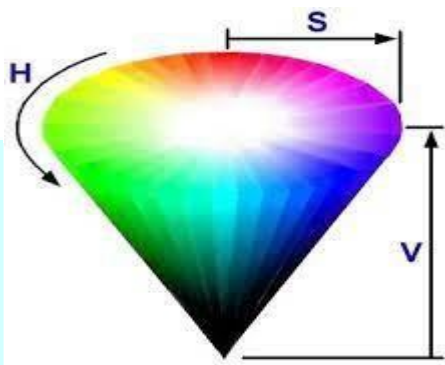


Figure 1: HSV Color Model

Architecture of the proposed system:

The 1.3mp USB camera is connected to raspberry-pi. All the servo motors have external power supply and the signal pin is connected to raspberry-pi GPIO pins which are 2,5,8 and DC motor is connected in such a way that IR Sensor and DC motor are connected to 5V supply which is again connected to external port and their pins are connected to GPIO pins 6&7.

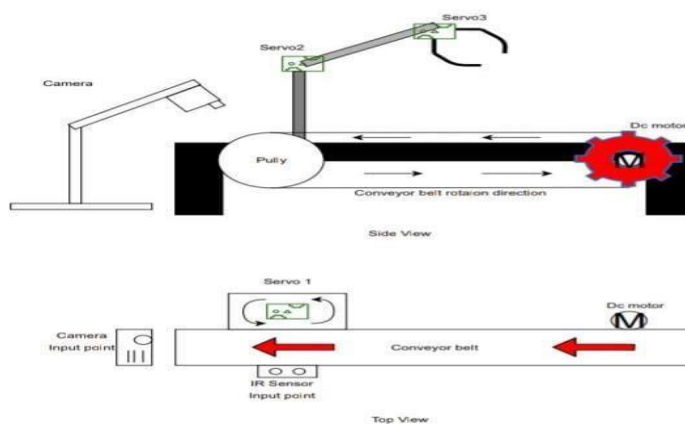


Figure 2. System Architecture

Algorithm:

1. Object moves towards the arm via conveyor belt .
2. IR sensor detects object and conveyor belt stop moving.

3. Mounted camera collects data and detects the object using microcontroller.
4. After verification Robotic Arm starts moving
5. The object is placed to respective place.
6. The process starts once again

IV. RESULT

Conveyor Belt: The main role of conveyor belt is to transfer the product in straight line. It makes sure that continue flow of products are reached to robotic arm. 5v dc motor used to control rotation of belt. A belt conveyor system consists of two or more pulley (sometimes

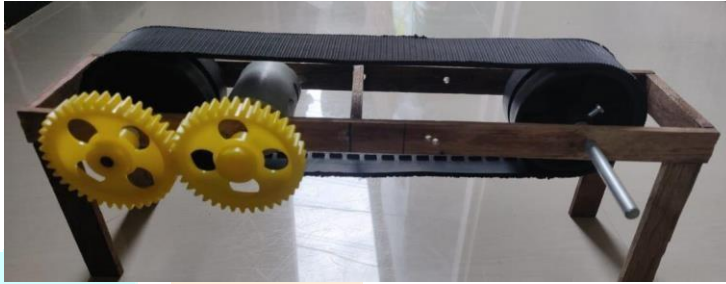


Figure 3: Conveyor Belt

referred to as drums), with a closed loop of carrying medium the conveyor belt that rotates about them.

Robotic Arm: Three Axis Robotic Arm is meant for little mobile robots. It will grip objects with the dimensions up to 60mm with the force up to 250gms. Arm has reach of 23cm. It will elevate the payload up to 400gms. Robotic Arm comes totally assembled and prepared to use Robotic arm will do Left-Right, Up-Down whereas keeping gripper parallel to surface, Twist motions and absorbing action. The 3 Axes of Robotic Arm square measure base axes, arm axes, jaw axes.

The robotic arm has following specifications.

- | | |
|-----------------------------|-----------------------------|
| 1.Number of Axis: 3 axis | 3.Weight: 541gms |
| 2.Gripping jaw length: 43mm | 4. Gripping jaw width: 60mm |

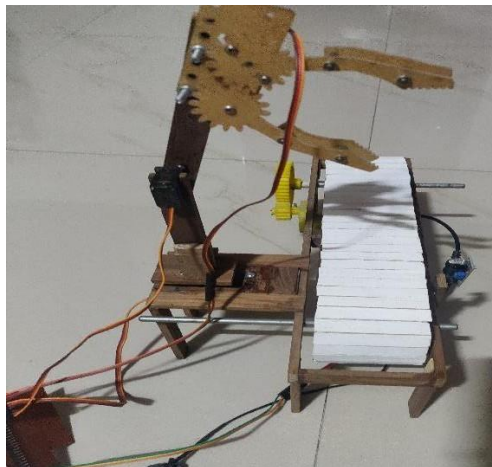





Figure 4: Robotic Arm

Result Table:

Table.no:1

Sr.No	Input Object	Input Object Shape	Input Object Color	Time Required For Sorting (In Secs)	Weight (In grams)	Accuracy (In Percentage)
1.		Square	Green	34s	18	93%
2.		Rectangle	Blue	34s	20	92%
3.		Circle	Red	34s	18	95%

V. CONCLUSION

In this paper, the picture process rule for an object color, from detection, and sorting has been enforced with a success. The system works effectively and separates different objects with help of sensors. The sensing element handling systems that drive the choice and place golem to select up the article and place it into its selected place work is meant. Their area unit two main steps in sensing part first is object detection and second is recognition. The developed robotic arm created promising results and so it will help when commercialized. The system results are economical observation and management of commercial automation i.e. observation and dominant of the transporter. Thus handling of the fabric doesn't need initial effort additionally as reduction is achieved in time as compared to the ancient system. The system performance includes handling station tasks, specifically choose and place mechanism with facilitate of sensing element.so a value-effective Mechatronics system is designed and implemented successfully.

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