Automatic Color Based Object Sorting Using Image Processing

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Abstract -*The process of arranging items systematically is named sorting. Manual sorting of Object is preferred at the wholesale market and industries supported different parameters like size, shape, quality, etc. But it's a time-consuming, less efficient, and inconsistent method. The existing systems in the market can sort single Object with single or multiple parameters. To replace this traditional sorting way, the proposed system presents an automatic Object sorting mechanism with an image processing technique. It recognizes and classifies two different Object with two different Color analysis method.*

Key Words: **Image Processing, Python, Arduino Uno, Color Detection, IR Sensor Web Camera, Conveyor Belt.**

1.INTRODUCTION

At today's date quality of product, color, size, and so on not possible to sort on the same line traditionally.it is in the nature of humans to make mistakes. however, a company or factories may experience significant monetary losses due to human error, due to the variability of products being produced. however, it often fails to produce the desired result, and training is only responsible for about 10% of the human errors that occur. This is because it only takes care of issues related to lack of knowledge, skills, or ability.

Image processing is the process of converting an image to digital form and then performing operations on it to create a better image or extract important information.in this the input is in the form of the image captured from the camera and output is some information extracted from the image. In this project, a low-cost automation system will be developed as a part of an industrial project for sorting the projects according to their colors the project mainly focused on sorting 3 different color objects using image processing. IR sensor and DC motor interfaced with Arduino to sort the products. the system consists of a conveyor belt that takes the object in front of the camera and thus sorting is decided by Arduino.

It is designed such that it will classify and distribute objects through a conveyor belt towards the dispatch section and it will check the object based on the color, if it is found green color then the conveyor belt will move continuously otherwise it will stop and the object will be passed to basket. To do so we are using Arduino, conveyor belt, sensor, and motor. as the signal is applied to the conveyor belt through Arduino it starts moving, then the web camera will detect the object and stop the conveyor belt. The camera clicks the image of the object and checks the color of the object. If the color of the object is red then it will command the conveyor belt to move right otherwise it will move straight forward, and if the color of an object is yellow then it will command the conveyor belt to move left otherwise it moves straight forward.

1.1 OBJECTIVES OF STUDY

To integrate color recognizing, sorting, and motor with a microcontroller. to check the code and troubleshoot with the efficiency of the system. To sort objects consistent with their respective colors and stations accordingly. This project purposed to automate the sorting process of products within the industries that supported their colors. additionally, it aimed to automate the tactic of sorting products to eliminate human errors in sorting products and hence the manual effort, time consumed and avoids danger which happed when humans add dangerous places. Moreover, the project aimed to develop this system with long durability, low cost, less maintenance, and inspect to make this system as user-friendly as possible. Therefore, color object sorting systems are going to be developed by using image processing and Arduino which can serve the factories with the assembly of top quality and accurate products which will raise the reputation of the company and may also provide customers satisfactory products.

1.2 PROBLEM STATEMENT

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 are the decreased time consumption. The quality and capability to repeat precise movements makes it easy to increase the speed of the process

2. DESCRIPTION OF WORK

The proposed system nullifies the human error which is generated within the traditional method and to offer quality result at the output. to try to do so we've used Sensors, a Camera, a 2 DC motor for push mechanism and conveyer belt, a Microcontroller with USB TTL cable, and the OpenCV software. Fig 1.1 shows the diagram of the system.

I. IR Sensor: - during this system we've used 1 IR sensor. Basically, when the power supply is on, the conveyer belt starts moving so when the object is kept on the conveyor belt the IR sensor detects it and stops the conveyor belt near the camera.

II. Camera: - the type of camera utilized during this technique is a USB camera. It captures the image of the object and provides it to the computer.

III. Conveyor belt: - The platform where the object is placed is that the conveyer belt which is controlled by the IR sensor& Microcontroller.

IV. USB TTL Cable: - The USB TTL serial cable connects the serial UART interface to the USB port. It's a two-way data transmission device that converts USB data signals to normal serial data ports.

V. DC motor: -The DC-based conveyor is driven by a 12V DC motor. The AC must be able to supply the DC motor with the required quantity of current. As a result, the DC motor driver L293D is used.

VI. Microcontroller: - The ATMEGA 328 Microcontroller is used during this technique. supported the coding given to the microcontroller by OPENCV it detects object color and moves the object in a tray with the assistance of dc motor.

VII. Software: - the method of extracting the feature from a picture captured with the camera is often done from OPENCV. In OpenCV the Graphics User Interchange (GUI) is wont to sort object supported the mixture of the red, green, blue color on this we get to understand the color of the object, is it red or yellow. the aim of using OPENCV software it's inbuilt libraries and it gives accurate result.
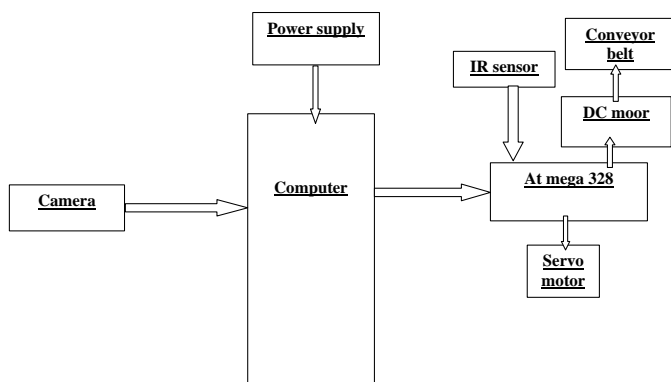
2.1 BLOCK DIAGRAM

Fig -1: Block Diagram of System.

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3. METHODOLOGY

The complete project is divided into three sections that are software design, hardware design, and programming. In the first section, we design the software flow which is related to OpenCV software also create GUI with the help of OpenCV. In the second section, we design the PCB layout and mechanical part (conveyor belt). In the third section, we worked on the programming of microcontrollers and OpenCV software.

3.1 SOFTWARE REQUIREMENT

Python IDE (Programming) : - Python code editors are meant to help programmers easily code and debug their programs. Using these Python IDE (Integrated Development Environment), you'll manage an outsized codebase and achieve quick deployment. These editors can be used to create desktop or web applications by developers. An IDE (Integrated Development Environment) understands your code far better than a text editor. it always provides features like build automation, code linting, testing, and debugging. this will significantly speed up your work. The downside is that IDEs are often complicated to use. Here is a few python IDE code editor.

OpenCV Lib :-(Open-Source Computer Vision Library) is a free and open-source software library for computer vision and machine learning. OpenCV was established to provide standard infrastructure for computer vision applications and to accelerate the use of machine perception in consumer products. OpenCV, as a BSD-licensed software, makes it simple for companies to use and alter the code. There are some predefined packages and libraries that make our life simple and OpenCV is one among them. for instance, for detection of red color, the syntax is,
lower_range = np.array([0,100,100])
upper_range = np.array([5,255,255])
mask = cv2.inRange(hsv, lower_range, upper_range)

Arduino IDE: -The Arduino IDE is a free, open-source program for developing and compiling code for the Arduino Module. It is an official Arduino software, making code compilation too easy that even a typical person with no prior technical knowledge can get their feet wet with the training process. The Arduino IDE has specific code structuring guidelines to support the languages C and C++.

3.2 COLOR DETECTION

Step 1: - Capture Image
Firstly, the camera captures the image. The image captured is in RGB format. In OpenCV, each pixel is 3dimensional and is represented in the form of a matrix whose size is equal to the size of the image.

Step 2: - The colored image converting to a Black and white image. The RGB colorful image is converted to the greyscale image before being transformed to black and white. The grayscale image may be a matrix that holds the luminance value of the image. The luminance coefficients are calculated based on the sensitivity.

$$Y= 0.3*R+0.59*G+0.11*B$$

The image is then transformed from grayscale to black and white. The function in OPENCV that provides the conversion between grayscale to B/W image is BW= im2bw (I, threshold).

Step 3: - Recognizing the color, in this centroid pixel of the object is to detected and extracted firstly, to get the value of the pixel there is an OpenCV function P=impixel(I,x,y) returns the value of a pixel in a provided image, where x and y are the centroid values. In the 3D matrix of RGB color space, if the worth of specified centroid pixel has more If the object was red and yellow in color, it would be sorted. As a result, the object is classified as red or yellow-based on the proportion of RGB within the selected centroid pixel.

3.3 HARDWARE DESIGN

The hardware configuration of computer-based Computer vision systems is comparatively standard. Typically, a computer vision system consists of:
• An illumination device that shines a light on the sample being tested.
• A solid-state Charged Coupled Device array camera, to accumulate a picture
• The A/D (analog-to-digital) conversion of scan lines into picture elements or pixels digitized during an N row by M column image is performed by a frame-grabber.
• a private computer or microprocessor system, to supply disk storage of images and computational capability with software and specific application programs
• A high-resolution color monitor, which aids in visualizing the pictures and therefore the effects of varied image analysis routines, on the pictures.
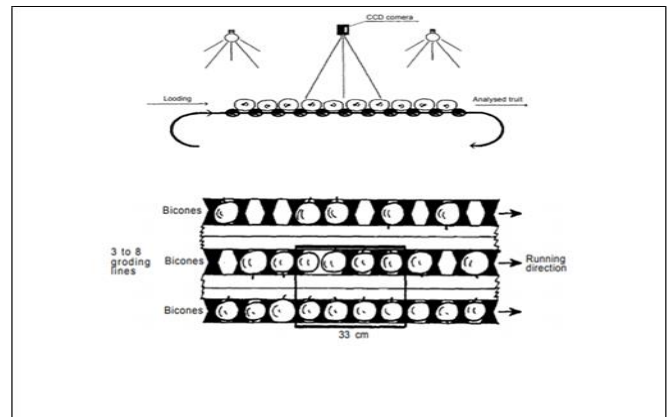

Fig -2: - A side and front view of the conveyor

4. ARDUINO UNO

The Arduino Uno is an open-source microcontroller board based on the Arduino-designed Microchip ATmega328P microprocessor. the board is equipped with analog input/output(I/O) pin sets that can be interfaced with different expansion(display)and other circuits. The board features 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino (Integrated Development Environment) IDE. Arduino Uno. "Uno" means an Italian language and was chosen to mark the discharge of Arduino Software (IDE) 1.0. Uno board and version 1.0 of Arduino software. were the reference versions of Arduino, now enhanced to newer versions. The Uno board is the first of many Arduino USB boards and the reference design of the Arduino platform.
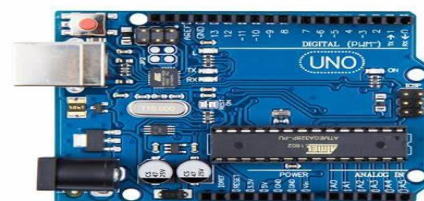

Fig- 3: - Arduino Uno

The ATMEGA 328 microcontroller serves as the Arduino board's processor. Nearly it consists of 28 pins. From these 28 pins, the inputs are often controlled by transmitting and receiving the inputs to the external device. It also consists of pulse width modulation (PWM). These PWM are wont to transmit the whole signal during a modulation. An input power supply like Vcc and Gnd are used. These integrated circuits mostly have analog and digital inputs. These analog and digital inputs are used for the method of certain applications

5. WEB CAMERA

A webcam may be a video camera that feeds or streams a picture or video in real-time to or through a computer to a network, like a web. Small cameras that sit on a desk, attach to a user's monitor, or are incorporated into the hardware are known as webcams. During a video chat conversation with two or more individuals, webcams are frequently used. with conversations that include live audio and video. For example, Apple's iSight camera, which is made into Apple laptops, iMacs, and a variety of iPhones, is often used for video chat sessions, using the iChat instant messaging program (now called Messages). Webcam software allows users to record or stream video over the internet. As video streaming over the web requires tons of bandwidth, such streams usually use compressed formats. The maximum resolution of a webcam is additionally less than most handheld video cameras, as higher resolutions would be reduced during transmission. Webcams are less expensive than most video cameras due to their lesser resolution, yet the impact is sufficient for video chat conversations.

Fig- 4: - Web Camera

6. CONVEYOR BELT

The carrying medium of a belt conveyor system is a conveyer belt (often shortened to a belt conveyor). A belt conveyor system is one among many sorts of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes mentioned as drums), with an endless loop of carrying medium the conveyer belt that rotates about them. The belt, and hence the material on the belt, is moved forward by one or both of the pulleys being powered. The drive pulley is the powered pulley, whereas the idle pulley is the unpowered pulley. Belt conveyors are divided into two categories in the industrial world: material handling and transportation. such as moving boxes throughout a plant, and bulk material handling, such as transporting vast volumes of resources and agricultural goods such as grain, salt, coal, ore, sand, overburden, and more.
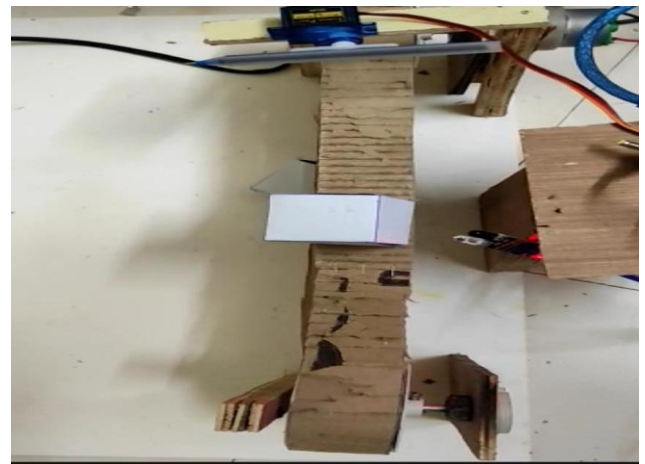

Fig- 5: - Conveyor Belt

7. FUTURE SCOPE

The Proposed Project is often improved in certain areas. The sorting system is often made to work faster by employing a more powerful microcontroller. More complex image processing is often done to spot objects of multiple colors and multiple shapes.

8. ADVANTAGES

- Improves productivity
- Less human interference.
- Increases in production capacity and quality.
- Easily developed.
- Time saving and efficient
- The accuracy of sorting of product increases

9. CONCLUSIONS

Finally, sorting systems are used to classify objects based on a variety of characteristics so that they can be packaged appropriately. So, manual sorting may be a time and energy-intensive process. it has been reported to be a complex and global problem. Therefore, automatic sorting systems leave fast and efficient sorting of products. According to that, this project was designed and developed to sort products in a specific conveyor belt design which has been chosen with taken into consideration the requirements of the process.

10. RESULT

Image processing is done in OpenCV which is an interface with a USB web cam on a PC/ laptop that captures the image of the object. According to the command given by OPENCV to the microcontroller sorting of object is done. We are using the RGB color model for image processing so it will sort on the basis of three-color RED, GREEN, and BLUE combination.

The whole sorting process takes approx. 30 seconds to sort one object.

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