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Creating A Python Algorithm for A Robot to Identify RGB Colours of A 2D Captured Image

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Abstract Robots face many problems in identifying RGB colours in captured images, which affects their performance in many applications. These challenges include different lighting, colour matching, constraints, and environment. The same object will appear in assorted colours in different light, making it difficult for robots to identify and distinguish colours. differences, especially in complex scenes. For example, under certain conditions blue and green hues will be remarkably similar to each other, resulting in misclassification. Cheap or poorly calibrated sensors do not detect colour accurately, resulting in inaccurate identification. Additionally, reflections and shadows can alter colour perception, adding another layer of difficulty to accurate colour identification. Calibration, normalization, and machine learning techniques. A simple Python algorithm for colour correction and analysis is here.

Keyword: RGB, Robot, Colours, Python, 2-D Image, Google Colab.

1. Introduction:

In the rapid development of robotics, the ability to understand and interpret visual information forms the basis of advanced robotic systems. A key part of this vision is colour recognition, which allows the robot to better interact with its environment. Among the various colour models, the RGB (red, green, blue) colour model is widely used in digital images due to its simplicity and performance. Check the colours and do it. Each colour in the RGB model is

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defined using the values of three primary colours, which together can represent a variety of colours. This capability allows robots to perform tasks such as

sorting products, identifying products, moving around, and even helping maintain quality during production. Image capture: Use a camera or other image sensor to capture visual information. These systems can be trained to recognize subtle changes in colour and adapt to different lighting conditions; This makes them powerful and versatile in a variety of applications. This cannot be emphasized enough. It plays a key role in enabling robots to understand and interact with their environment, paving the way for artificial intelligence and robotic control. As technology continues to advance, the integration of complex colour recognition capabilities will strengthen the functionality and usefulness of robots in many areas from job automation for everyday users.

2. Literature Review:

Masoud Shaloo, et al. in 2023, Performed a study “Real-Time Colour Detection for Automated Production Lines Using CNN-Based Machine Learning”. In this work, two algorithms are proposed to use YOLOv8; one of them is to process low-light images, the second is to use YOLOv8 to process high-light images and is based on light intensity, illumination angle and training data[1].

Md. Abdullah Al-Noman, et al. in 2022, performed a study “Computer Vision-based Robotic Arm for Object Colour, Shape, and Size Detection”. This study evaluates the performance of colour detection algorithms using various colour, light, and information sources. The algorithms have been tested on production lines with light intensity from 7 to 800 lx, at a distance of almost 100 lx and at an angle from 0° to 45° to the camera. The study found that the algorithm's accuracy is affected by the colour of the object, light intensity, angle of light, and shape of the image. At illumination intensities of 700 lx and above, white, red, and grey components cannot be identified correctly, and chrome colour can be detected with 100% accuracy using fewer images[2].

R. Narmadha, et al. in 2022, Conducted a study “Computer Vision-based Robotic Arm for Object Colour, Shape, and Size Detection”. According to them, In the field of robotics and automation, all sectors are moving towards automation to achieve rapid growth and development. Specifically, in this workplan, a robotic arm manipulator is used to select small

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items and place them on shelves based on colour recognition with a machine learning algorithm. The arm and wrist can be rotated to a predetermined angle, just like the human hand. Colour detection is done with colour sensors. Robotic arms are widely used and are the first choice for electronic devices in many applications due to their similar functions to human arms. The functionality of the robotic arm is based on the output received from the sensors so that the robotic arm picks up and places specific objects. In addition, here all data is updated via Bluetooth technology and a special model is created for this, which allows the robot arm to select small objects and then collect them and put them in different boxes. Real-time updates received from the Bluetooth module are randomly adjusted. The robotic arm is controlled by a microcontroller-based system, which in turn controls the servo motors used in the base, elbow, wrist, and grip[3].

Mathias Unbernath, et al. in 2021, gave an article “The Impact of Machine Learning on 2D/3D Registration for Image-Guided Interventions: A Systematic Review and Perspective”. The recently released machine learning- based approach to configuring the image anticipates this by using a custom training model that holds the promise of solving some of the wicked problems in 2D/3D recording, rather than specifying the required operation on the map. In this article, they examine the impact of machine learning on 2D/3D recording and follow the latest work conducted to introduce this modern technology. Based on these insights, they offer their thoughts on the most important needs, important unanswered questions, and next steps[4].

Gaddala Neil Amartya Singh, et al. in 2021, performed research “Implementation of The System for Colour Detection and Identification Using Robotic Arm: A Review”. This study shows how to recognize the colours of objects and classify them according to their intensity with the help of a robotic arm and different sensors. The aim of the project is to create a system that will reduce human error, time in the relevant field, and increase the efficiency of the product. Controllers used for programming purposes, Arduino Uno (ATMEGA328P) and PIC, Raspberry Pie (ARM processor) are some of the controllers used in MATLAB. The article also explains how the TCS230 (colour sensor) detects the colour of the object and processes the data to use the Arduino's classification system. The robot arm is controlled by a DC servo motor in the L293D motor driver[5].

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Cui Yang, et al. in 2021 gave an article "Automatic 3-D Imaging and Measurement of Human Spines with a Robotic Ultrasound System". This paper describes a novel, radiation-free robotic ultrasound system for 3D imaging and a 3D imaging-based spine method. A fully convolutional network (FCN) fuse-Unet based on RGB, and depth images captured by the RGB depth (RGB D) sensor Kinect is proposed to achieve automatic recognition of the human spine and scan the plan first. The 6-degree-of-freedom robotic arm then assumes the role of a therapist and completes an automated assessment based on a pre-planned approach using a vector-based approach and two force sensors to ensure the probe fits the patient well. Northern region. Finally, the 3D ultrasound reconstruction and visualization of the spine is completed, and based on this, the Cobb angle is calculated to evaluate the morphological structure of the spine. Model and in vivo experiments were performed to evaluate the effectiveness of the proposal. Experimental results confirmed the efficiency and accuracy of the system and demonstrated its potential for clinical use[6].

Shantani Sinha, et al. in 2020, gave an article "Colour Sensor-Based Object Sorting Robotic Arm". In this article, he proposed a mechatronic application that does not recognize colour automatically, but where the classification process is done by a robotic arm. Colour grading is the result of classifying and analysing products of assorted colours to store them and place them at the desired location, thereby increasing efficiency and reducing human effort making mistakes in certain tasks. The current project discusses the design and development of a three-degree-of-freedom (3-DOF) robotic arm. The system consists of two DC gear motors and four servo motors. Two DC gear motors are used to move the robot to any desired position. It has three joints, an end effector, two connecting rods and a rectangular platform. The type of controller used is an Arduino Uno microcontroller that connects to a PIR sensor, a TCS3200 colour sensor, and four servo motors to control the orientation of the robot arm. Robotic arms are widely used in business, but most are programmed to follow pre-learned trajectories. Very few robots can make quick decisions, so they cannot be considered intelligent machines[7]. H. Golnabi and A. Asadpour in 2007, researched on "Design and application of industrial machine vision systems". This article explains the role and importance of machine vision in technology. First of all, the understanding of vision from a global perspective is explained. The design process is discussed, and an overview of the model is presented. These systems include systems

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and subsystems that, of course, depend on the application and the type of work that needed to be done. In general, the purpose of machine vision was to use a limited environment of space and make, capture the image, analyse the captured image, identify some objects and features in each piece image, and start the next process to accept or reject the image. corresponding item. . When you see that the system had completed all these stages, the job is actually finished. The sequence and correct operation of each system and subsystem for image quality was described here[8].

3. Methodology:

3.1. Selecting an image:

First of all, we selected a colourful image that will be used for colour recognition by the robot. For testing, we have taken the image shown in Fig 1.

Fig 1: Testing Image

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3.2. Creating google colab notebook:

After that, we created a new google colab notebook and uploaded our image in the content folder. Also, copied the path of the image.

3.3. Creating python program for Robot Colour Recognition on Google Colab notebook:

After that, we started creating Python program for robot colour recognition. Firstly, we started with import numpy as np function. Then, we used import matplotlib. image as mping function for reading images. After that, we used import cv2 function to use computer vision library.

Then, we used image = mping.iread(path of the downloaded image) function for reading our imported image. After that, we applied image.shape function to get the dimensions of image and also used gray_image = cv2.cvtColor(image, cv2.COLOR_RGB2GRAY) function to convert image into grey colour. And we got our output as shown in Fig 2. Then, we used print(gray_image) function to get pixel values of the image at different point as output shown in Fig 3. After that, we applied tiny_image = np.array([[0, 20, 30, 150, 120],

[200, 200, 250, 70, 3],

[50, 180, 85, 40, 90],

[240, 100, 50, 255, 10],

[30, 0, 75, 190, 220]])

function to create a five by-five image using just grayscale and numeric values. Also, we used plt.matshow(tiny_image, cmap='gray') function to show the pixel grids and got the output as shown in Fig 4.

Then, we applied from google.colab.patches import cv2_imshow function to use computer vision library. And finally, we started visualizing RGB colour spaces step by step for each colour using blue_image = image[:0] cv2_imshow(blue_image) function for blue colour as shown in output in Fig 5(a)

green_image = image[:1]

cv2_imshow(green_image) function for green colour as shown in output in Fig 5(b) and red_image = image[:2]

cv2_imshow(red_image) functions for red colour as shown in output in Fig 5(c).

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3. Results and Discussion:

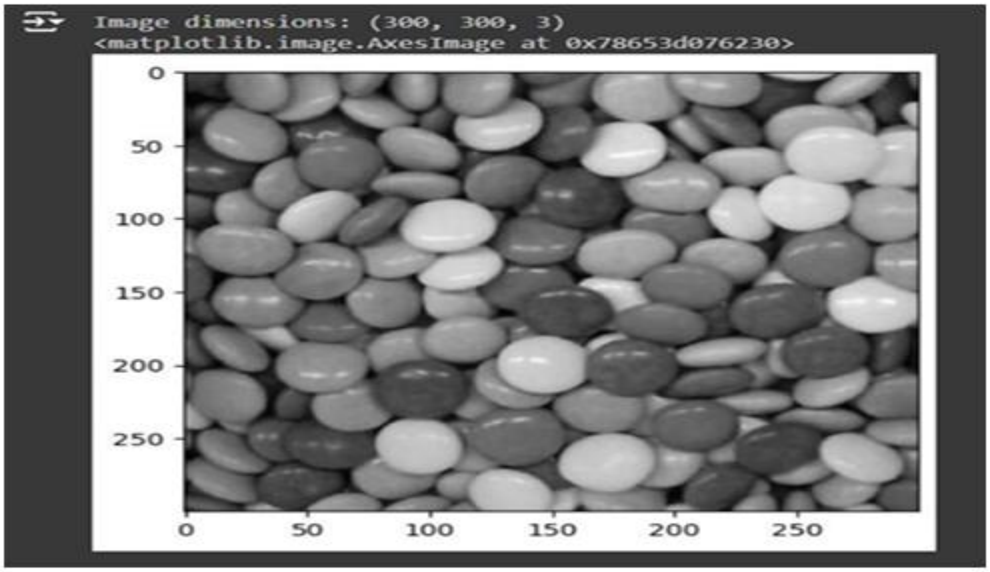

Fig 2: Grey image with scaling output.

```
[[ 69  69  72 ...  91 115 124]
 [ 69  68  69 ...  94 115 122]
 [ 68  66  66 ...  94 111 118]
 ...
 [ 56  62  70 ...  81  82  82]
 [ 42  47  55 ...  80  81  81]
 [ 40  43  49 ...  79  80  80]]
```

Fig 3: Pixel values of image at different points output.

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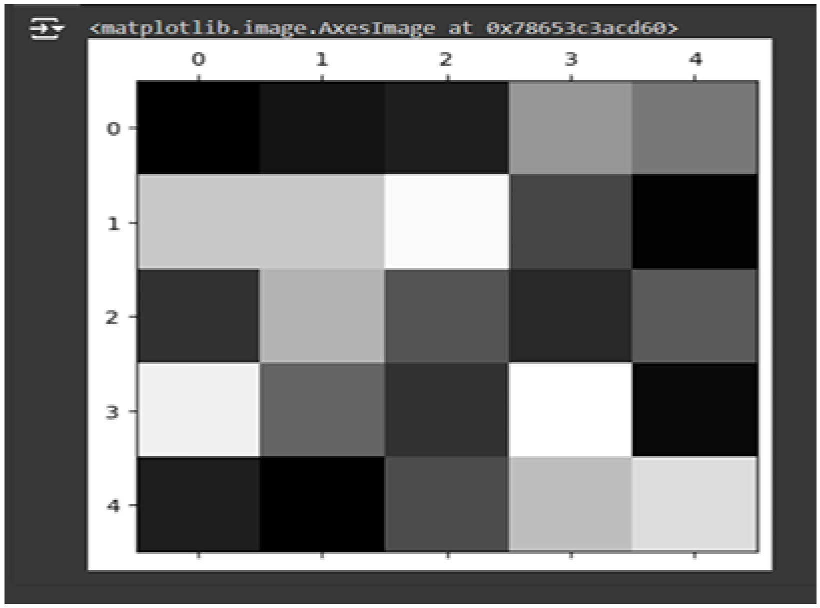

Fig 4: 5x5 image using just grayscale, numerical values

Fig 5(a): Blue Colour output

Fig 5(b): Green Colour Output

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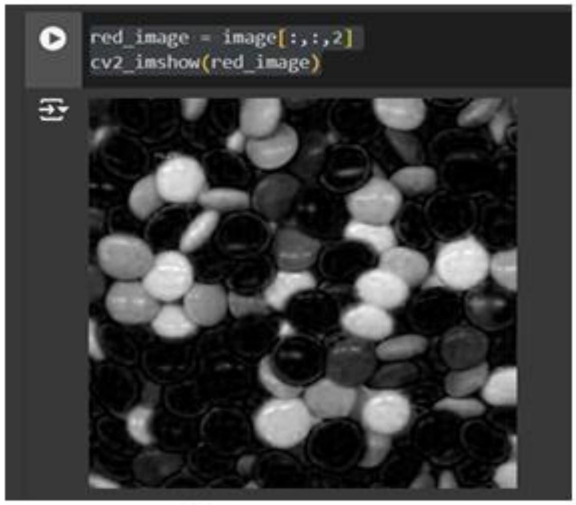

Fig 5(c): Red Colour Output

4. Conclusions:

In this study, we successfully developed and evaluated a Python algorithm that can identify RGB colours from 2D captured images, suitable for robotic applications. The performance of this algorithm is measured through several steps that include image acquisition, preprocessing, colour detection, and classification. By using powerful Python libraries such as OpenCV and NumPy, we obtain high-quality and accurate simulations suitable for real-time robotics. Colours are different thanks to the combination of transitions and changing the colour space. The results show high accuracy, with the algorithm correctly identifying the most common colours in the test image. This success demonstrates the potential of this algorithm to be integrated into robotic systems requiring advanced colour recognition, such as task classification, quality analysis, and self-control. Powerful algorithms learn strategies for better colour classification and expand the colour to see more. Additionally, evaluating the algorithm in a real-world robotics application will provide insight into the algorithm's real-world performance and potential areas for improvement.

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