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Colour Detection Based Robotic Cart Using Raspberry Pi

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Abstract: *One of the most critical subjects of embedded vision is color tracking in real time. Many computer vision applications begin by detecting and tracking moving objects in video scenes. Customers arriving at hypermarkets may benefit from this concept. A color detection algorithm locates pixels in an image that fit a predetermined color scheme. To differentiate detected pixels from the rest of the image, the color of the detected pixels can be modified. The robot is programmed to track objects by turning left and right to keep the target in view and driving forward and backward to keep the distance between the robot and the object steady. By maintaining a surrounding distance, detection of other objects of the same color pattern is ignored. By keeping a safe distance between the user and the robot, other objects of the same color pattern are not detected. The camera on an ARM11 Raspberry Pi computer attached to the robot is used to capture images. Using inbuilt python files, the acquired image is processed to locate the color using RGB varying pattern methodology. To make the product work smarter, this system also includes automatic billing via RFID reader and tag. The new concept of image processing domain is based on this device theory.*

Keywords: Color Detection, Image Processing, RGB, Computer Vision.

I. INTRODUCTION

In a variety of industries, colour plays a significant role. An object's size and shape, in addition to its colour, may be used to describe it. In a picture, edges have significant local changes in intensity. Edges are usually found at the intersection of two image regions. The shape and size of an object can be determined by measuring its edges. Surveillance, text detection, and form detection are only a fewexamples of edge detection applications. Image processing library focusing on real-time computer vision with applications in a variety of areas including 2D and 3D featuretoolkits, facial & gesture recognition, Human-computer interaction, Mobile robotics, and Object identification and others. The two basic morphological operations are erosion and dilation. Morphological operations, as the name suggests,are a series of operations that process images based on their shapes. Additional pixels are added to an image boundary during dilation; the total number of pixels added depends onthe dimensions of the structuring factor used. We can dilate animage using the Image proc class's dilate process, which takesthree mat objects as input: source, destination, and kernel.

Images define the world; each picture tells a story and provides a wealth of knowledge that can be applied in a variety of ways. The technique known as Image Processing can be used to obtain this information. It is a key component of computer vision that is used in many real-world applicationssuch as robotics, self-driving vehicles, and object detection. Image processing enables us to transform and manipulate thousands of images at once, extracting valuable information from them. It has a wide variety of uses in almost every industry. For this reason, Python is one of the most commonly used programming languages. Its fantastic libraries and software aid in the efficient completion of image processing tasks. A 2D function F(x,y) can be used to represent an image,where x and y are spatial coordinates. The intensity of an image at a particular value of x,y is the amplitude of F at that point. A digital image is one in which the x,y, and amplitudevalues are all finite. It's a set of pixels organized into columnsand rows. Pixels are picture components that store informationabout color and intensity. A picture can also be represented in3D, with the spatial coordinates x, y, and z. Pixels are arrangedin a matrix format.

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II. System Overview

The proposed system's purpose is to make it easier to move items from one location to another without requiring human intervention or the use of multiple sensors. The person will be tracked by the camera, and the video recorded will be processed using open CV python by using the open-source library to detect the colour of clothing from humans, using this as a guide. This data will be processed once more to decide the angle of the object that appears on the frame, and then it will be sent to the Raspberry Pi as a minimum system to convert data from Python code so that both motors attached to the wheels can run and the robot will still follow the object based on the colour.

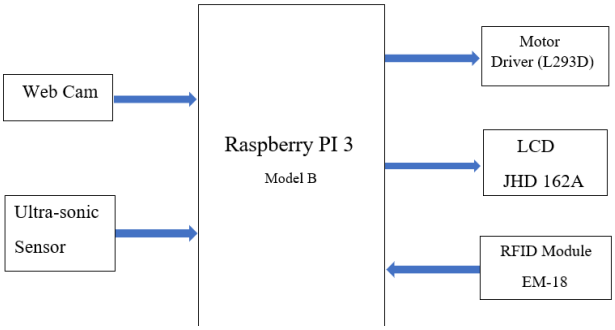

Figure 1: Block Diagram of Proposed System

2.1 Hardware Implementation

A Raspberry Pi motor driver setup is made with 4 GPIO pins. A webcam is connected to get the live video frames. A delay of 0.5 second is made in the program to detect the color programmed to the controller. After capturing the live stream frame by frame, we are converting each frame in BGR colour space (the default one) to HSV colour space.

The mask is basically creating some specific region of the image following certain rules. Here we are creating a mask that comprises of an object in yellow colour. The purchasing details of the customer is stored in Twiliocloud, which we are using to make the storage, and the final payment is made through the wallet reader. These billing and purchasing are done with RFID tag readers in our system. SMS notification will be sent to the consumer mobile number regarding their purchase.

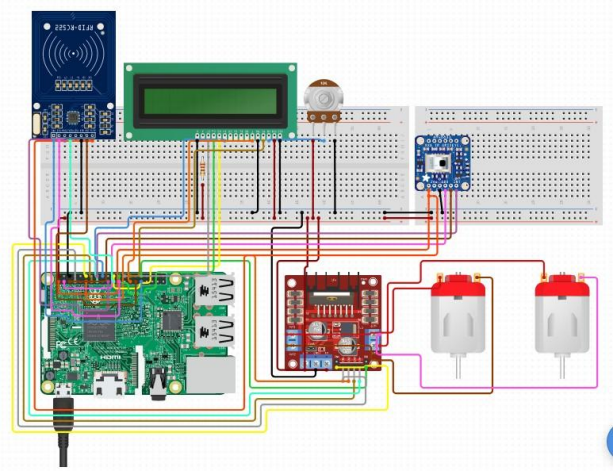

Figure 2: Circuit Diagram of proposed System

III. Process Flow Of Proposed System

In this session the process flow of the proposed system is explained. The flow diagram of the proposed system is shown in Fig.3.

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- Trolley follower motor setup is connected with Raspberry Pi controller.
- The motor rotates and moves based on the movementof the user.
- The user is detected by camera and the processed colour detection value is already programed in the controller.
- RFID reader tag gets the product data to be calculated for billing process of the trolley or the cart.
- The Twilio cloud collects the data of purchased product and bill is paid from the wallet.

The billing is finally displayed in the LCD connectedwith the system.

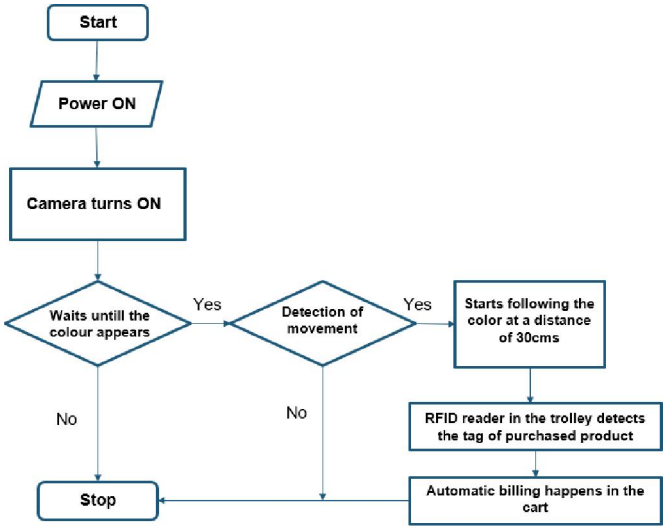

Figure 3: Process Flow Chart of Proposed System

IV. RESULTS

The output displayed with the Raspberry pi window is showed in this results session.

4.1 Unique Color Detection

The frame is made with a center value of a circle detector, when it falls on the right side it moves left and in the left sidethe cart moves right, since the image is considered a mirror frame.

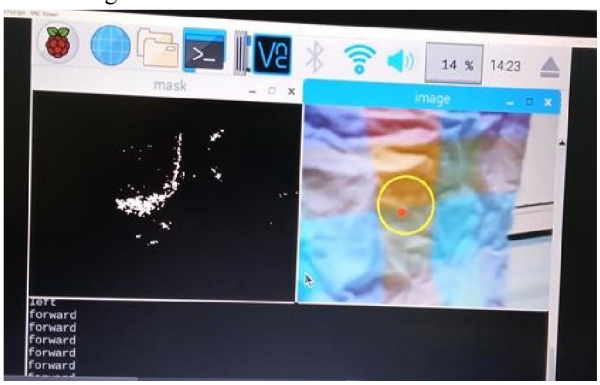

Figure 4: Color to be followed is detected by webcam

4.2 Colour Tracking

The masked frame appears with the detected object's outline. The live comments also appear in the output screen wizard.

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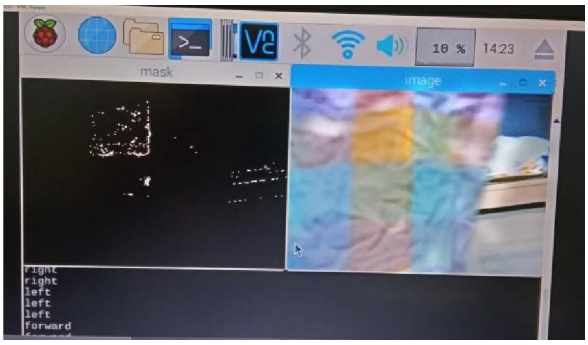

Figure 5: Cart following the detected color

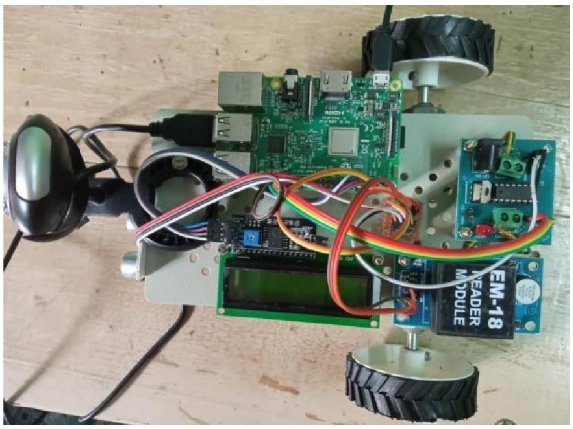

Figure 6: Hardware Setup

4.3 Product purchasing and Billing

For the products to be purchased we had used unique RFID tags with prescribed product value and also a wallet tag for billing. The details will appear on an LCD display in every next step of purchasing.

Figure 7: Addition of first product - Wheat

Figure 8: Addition of second product – Rice

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Figure 9: Addition of third product – Sugar

Figure 10: Billing of all the items purchased

4.4 SMS Notification

An SMS will also be sent to the customer's registeredmobile number referring the purchase details.

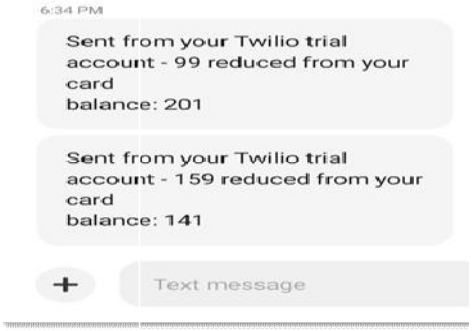

Figure 11: Final message notification of payment

V. Conclusion

Standing in line for a long time is avoided with this automated billing for the user account to pay their bill. The vision-based technique used in the Automatic Trolley can assist humans in a variety of ways, including following them when carrying loads and minimizing human effort. It provides features such as trolley stopping, turning left, and turning right, depending on the color of the trolley. The invention of an automatic trolley has been successfully introduced. Smartand stable systems minimize work load in automated industrial applications. Make shopping more convenient and time-saving

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