Embedded Based Object Matching And Robot Arm Control

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Abstract- *The humans are more time consuming for the object detection & separation purpose than robots. A project is proposed for fast detection & separation of objects passing over the conveyor belt. It is depend on the Raspberry pi 3 model B with camera (USB webcam) module & it is programmed with python programming language. It is supported by Open Source Computer Vision (Open CV) library.The four objects are detected using camera module & separated by using Robotic Arm. For Circle & Triangle the motor will move in anticlockwise direction & for Rectangle & Pentagon it will move in clockwise direction.*

Keywords- Raspberry pi, USB webcam, servo motor, Memory card, Python, Open CV.

I. INTRODUCTION

Basically it is labor-saving technology by which a process is performed with minimal human assistance. The separation of objects passing over the conveyor belt is done using Camera & the objects are Circle, Triangle, Rectangle & Pentagon. These all objects are of Red colour. When the Circle is passed over the conveyor belt the camera detect that it is a Circle by image processing & the motor will move In anticlockwise direction. After that when the camera detects the object passing over the conveyor belt is Triangle it will move in anticlockwise direction. For Rectangle the motor will move in clockwise direction & for Pentagon it will again move in clockwise direction.

Open CV is a computer vision library used in the industry & use Python programming language, it is easy to use and it has good speed for our work. Raspberry Pi 3 is a low cost single board computer. which is powerful enough to do computer vision at real time. A simple USB webcam is used to capture the real time video. The video frames analyze the real time Colour, Size & Shape of the object.

II. LITERATURE SURVEY

This object detection & separation system is required more mathematics and kinematics for their operation and made the system complex.In this paper only three objects are used & are they separated[1].

Robots were developed to sort the objects in bulk which required more mathematics and kinematics for their operation and made the system complex and also less economical. Robotic arms should be designed as to match to the size of the objects to be sorted which made it object specific design and hence less flexible [2].

The maturity levels of the mangoes were predicted by using the video signals of the CCD (Charge Coupled device) camera which was placed on top of the conveyor belt. The use of CCD cameras in the above method consumed lot of power, dissipated more heat and required additional ICs for operation. This also had a drawback that the maturity levels of mangoes with scratches and black spots on their skin could not be detected with the signals obtained from the CCD camera [3].
Most of the Robots use Matlab software for Image Processing that has less processing speed and they are controlled by Micro controllers which is application specific [4]

Hence we tried to establish a system that overcomes some of the above drawbacks by using Raspberry pi 3.

III. HARDWARE DESIGN

A. List of hardware

The hardware components are:

- Raspberry pi 3 Model B Board
- Servo Motor
- Memory Card
- 1 Amp. power supply adapter
- Web camera

B. Hardware & Software Description

1. Raspberry Pi

The Raspberry Pi is a low cost, credit card-sized single-board computer. It has five models in market i.e. the Model B+, the Model A+, the Model A , the Model B, and the Compute Module. These all models use the same SoC (System on Chip - combined CPU&GPU), but hardware features differ.

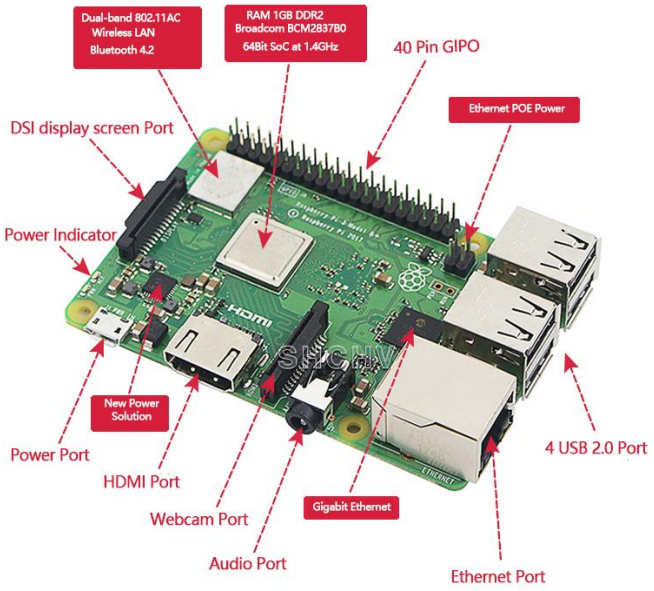

Fig.1 Raspberry pi 3 Module B+

2. Web Camera

A webcam is a video camera. It feeds or streams an image or video in real time to or through a computer to a computer network, such as the internet. These are typically small cameras that sit on a desk, attach to a user's monitor, or are built into the hardware.

3. Servo Motor

A servomotor is a linear actuator or rotary actuator that allows for exact control of a linear or angular position, acceleration & velocity.

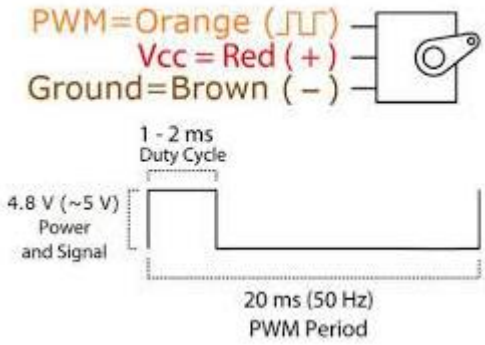

Fig.2 servo motor

4. Raspbian OS

It is available for Raspberry Pi, Raspbian is the most user-friendly, best looking, has the best range of default software's and optimized for the Raspberry Pi hardware. Raspbian is a free operating system based on Debian (LINUX), which is available for free from the Raspberry Pi website.

5. Python

Python is a mostly used for general-purpose, high-level programming language. As compared with other languages like C, C++ or java the python allows the programmers to express concepts in fewer lines of code

6. RPi .GPIO Python Library

It allows you to freely configure and read-write the I/o pins on the Pi's GPIO header within a Python script. This package is not shipped along with the Raspbian.

7. Open CV

It stands for Open Source Computer Vision.It is a library of programming functions mainly aimed at real-time computer vision.

8. Thonny

It is an integrated development environment for Python.

IV. ARCHITECTURE

System consist of the following components:

-Raspberry pi 3 model B board.
-Servo motor
-USB Webcam

Raspberry pi is small single board computer. The servo motor is connected to raspberry pi. The +ve terminal of servo motor is connected to pin no.4 of raspberry pi of GPIO port. The -ve terminal is connected to pin no.9 & the output pin is connected to pin no.21 of raspberry pi of GPIO port. The separate port is available in raspberry pi for camera interfacing.

In working at the initial condition there is no object the motor will remain stable. After that the object passing over the conveyor belt are detected. When circle is detected by the camera the motor will move in anticlockwise direction, similarly when Triangle is detected motor will move in anticlockwise direction, for Rectangle motor will move in clockwise direction & for Pentagon it will move in clockwise direction.

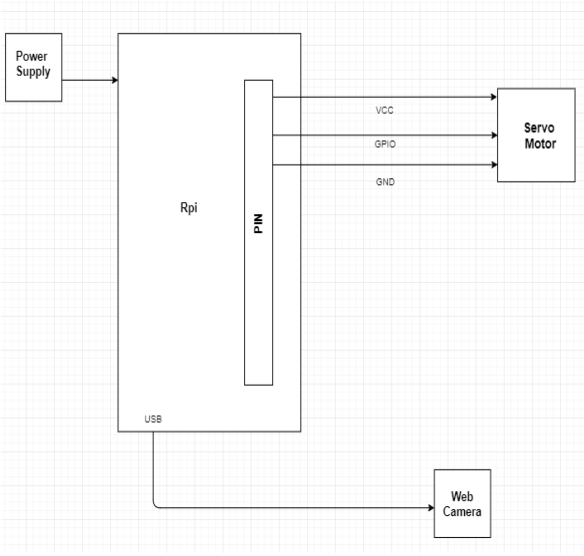

Fig.3 Architecture diagram

V. SIMULATION

In my project "Embedded based object matching & robot Arm control" the thonny simulation software is used. for the camera & real time detection of object the programming is done in python. For camera open, the libraries are below.
Camera.py

```
# import the opencv library
import cv2


# define a video capture object
vid = cv2.VideoCapture(0)

while(True):

        # Capture the video frame
        # by frame
        ret, frame = vid.read()

        # Display the resulting frame
        cv2.imshow('frame', frame)

        # the 'q' button is set as the
        # quitting button you may use any
        # desired button of your choice
        if cv2.waitKey(1) & 0xFF == ord('q'):
                break

# After the loop release the cap object
vid.release()
# Destroy all the windows
cv2.destroyAllWindows()
```

The four objects are used are of shape Circle, Triangle, Rectangle & Pentagon. The given colour is Red.

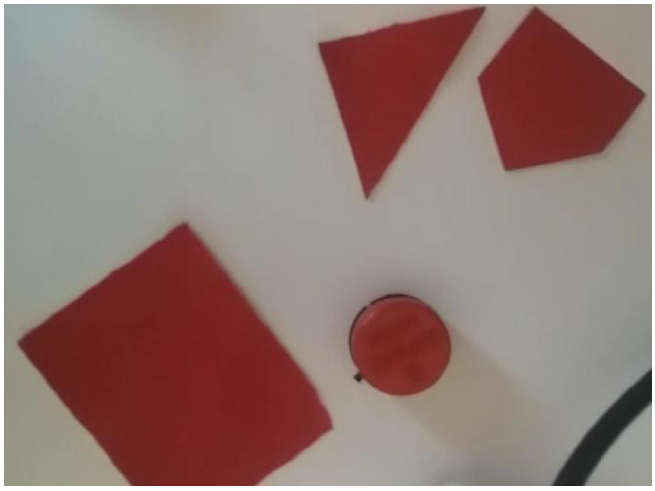

Fig.4 Shapes of input objects

After detecting these all inputs one by one, firstly the brightness check . The particular brightness is set for working this project in both day time as well as in night time. After that the frame is open & then the mask is open.1

Then the result for circle is shown in fig.5 .

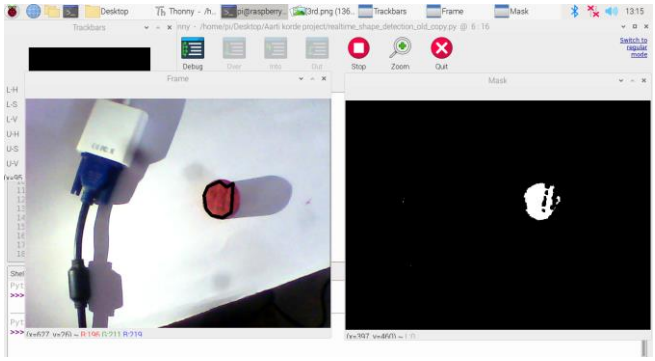

Fig.5 circle detected

The result for Triangle is shown in fig.6

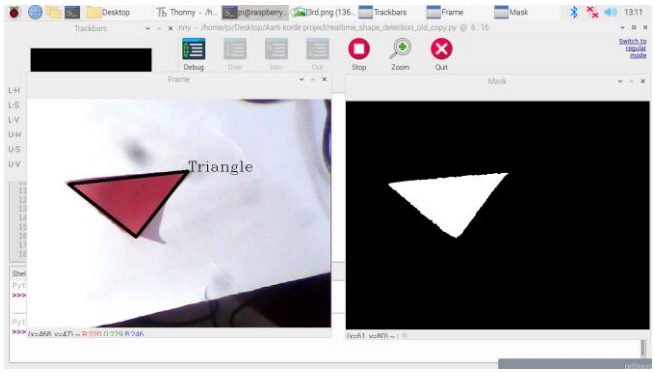

Fig.6 Triangle detected

The result for Rectangle is shown in fig.7

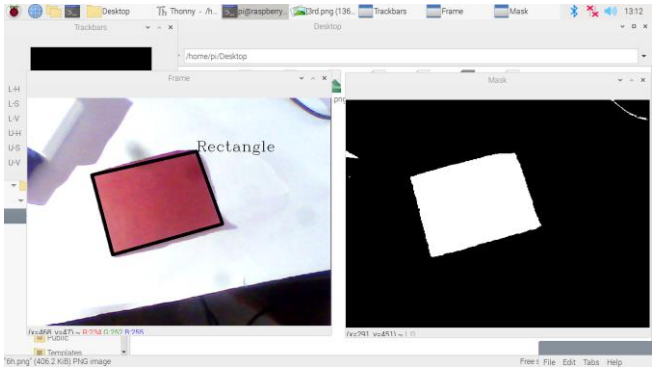

Fig.7 Rectangle detected

The result for Pentagon is shown in fig.8

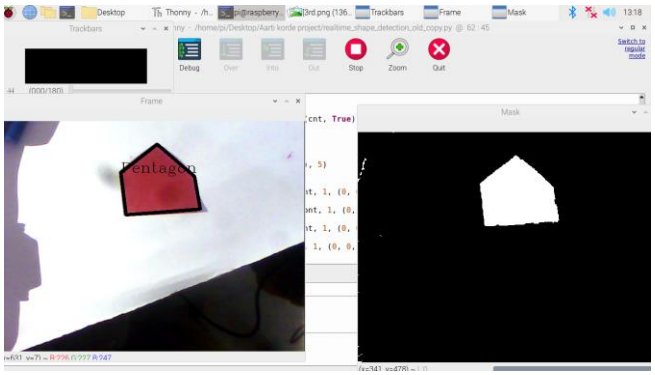

Fig.8 Pentagon detected

VI. CONCLUSION

This project describes the "Embedded based object matching & robot Arm control" . The object sorting robot is a useful, cost less & fast system in industrial application. It is used to reduce the manual working time & provide less human mistakes when manual system is undertaken. The Raspberry pi 3 which makes the system easy to use & more efficient. Generally, sensing the color of the object is a very challenging as there is a chance of high uncertainty due to the external lighting & other noise. Here I have proposed a system which sorts the objects based on their shape which can further be enhanced to sort them based on their size and shape with the help of IR sensors.

VII. EXPERIMENTAL RESULTS

Fig.9 Interfacing Raspberry pi 3 to external devices

In Fig.9 the keyboard, mouse, and Monitor are connected through USB and HDMI cable to Raspberry pi 3 in order to make it functional. And the connection of Ethernet cable to RPI to obtain LAN connection. Fig.10 shows the hardware model of project. It consist of Monitor, Raspberry pi, servo motor, USB Webcam & objects. Firstly Raspberry pi module will initialize. Then the motor will initialize to rotate the belt and then the objects are placed which move along the belt. Camera is activated to capture the real time image of objects as soon as the process is started. If any object is detected, the camera takes the picture of that object and detects the shape of object. According to the shape the objects are separated in clockwise & in anticlockwise direction. Alike the separation is done.

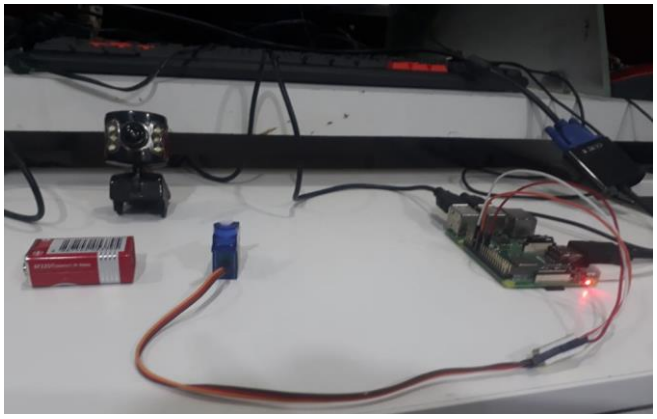

Fig.10 Hardware setup

Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is "Heading 5". Use "figure caption" for your Figure captions, and "table head" for your table title. Run-in heads, such as "Abstract", will require you to apply a style (in this case, italic) in addition to the style

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REFERENCES

[1] Minh-Tri Le, Chih-hung G, Li*, Shi-mei Guo*, & jenn-jier james Lien*, * members, IEEE,"Embedded-Based Object Matching & Robot Arm Control",2019 IEEE 15th international conference on Automation Science And Engineering(CASE)

[2] Aji Joy, "Object sorting robotic arm based on colour sensing", International Jornal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.3, Issue 3, March 2014.

[3] Chandra Sekhar Nandi, Bipan Tudu, and Chiranjib Koley, *Member, IEEE, "*A Machine Vision-Based Maturity Prediction System for Sorting of Harvested Mangoes", IEEE transactions on instrumentation and measurement, vol. 63, no. 7, July 2014.

[4] J. Lastra, J. and I. Delamerm, "Semantic web services in factory automation: Fundamental insights and research roadmap", *IEEE Transaction on Industrial Informatics*, 2,

[5] Datasheets of Raspberry pi 3 model B & Servo motor. Ali A.Abed, sarsh A. Rahman,"Python-based Raspberry Pi for Hand Gesture Recognition"*International Journal of Computer Applications (0975 – 8887) Volume 173 – No.4, September 2017* Sweatha suresh B.,Sneha B.R, Susmitha R.,"Object tracking robot on Raspberry pi using Open CV",*International Journal of Engineering Trends and Technology (IJETT) – Volume 35 Number 4- May 2016.*

[6] Sheela. S , Shivaram. K. R, Meghashree. S , Monica. L, Prathima. A, Shriya.M.Kumar,"Low Cost Automation for Sorting of Objects on Conveyor Belt "International Journal of Innovative Research in Science, Engineering and Technology *(An ISO 3297: 2007 Certified Organization)*
Vol. 5, Special Issue 10, May 2016.

[7] Mayank Dharaskar, Vatan Gupta, Priyanka Kale, Reeta Chopade4, Aayush Jaiswal, Prof. Sharadkumar Ghadale,"IOT Based Surveillance Robotic Car Using Raspberry PI "International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 03 Mar-2018.

[8] Dr. A. Brintha Therese and Prashant Gupta,"ROBOTIC ARM WITH REAL-TIME IMAGE PROCESSING USING RASPBERRY PI, BOTH AUTOMATED AND MANUALLY", International Journal Of Advanced Research(IJAR),March 2018.

[9] Priya Vinayak Garad ,"Object Sorting Robot Based On the Shape",*International Journal of Advance Research, Ideas and Innovations in Technology, 2017.*

[10] Rahul Vijay Soans, Pradyumna G.R.,Yohei Fukumizu,"Object Sorting using Image Processing",2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT-2018), MAY 18th & 19th 2018.