

PLC Based Object Sorting System Using Image Processing

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ABSTRACT–Object sorting is needed in manufacturing industries. Objects can be of various shapes and colours, or they can be the same shape and colour. As a result, various objects and parameters need different types of processing. The aim of this project is to identify objects using various image processing algorithms based on colour and shape parameters. An image will be used as the system's input, which will be processed to detect colour or shape, and the object will then be sorted accordingly.

Keywords-Digital image processing, OpenCV Python, Raspberry Pi, Programmable Logic Controller (PLC), Object sorting.

I. INTRODUCTION

The food processing and handling industry is one of the fastest growing sectors, with applications such as cutting, baking, packaging, grading, and sorting of different food products. In the food industry, automated sorting systems are commonly used. In this system, object would be sorted according to colour and shape. It uses integration of RASPBERRY PI and PLC for sorting. Effectively it reduces the labour and working time. Reduced manual handling allows for effective and hygienic object sorting.

Many years ago, when the need for object sorting arose, it was done manually. To address the drawbacks of the traditional sorting system, an automated object sorting system is needed.

Image processing technique is used to sort objects in an automated object sorting system. Objects are sorted without harm and in less working hours thanks to this automated method. As a result, it is used to sort objects in the food industry. It has a wide range of other applications,

such as sorting tablets in the medical industry. In the mechanical industry, it can also be used to sort nuts and bolts. Since it needs less manpower and is more reliable, this system is more common. The objectives of this project are as follows:

1. Manufacturing and assembly of sorting system.
2. Image processing of object using camera and results are obtained for sorting the object.
3. Interfacing of image processing software i.e. Raspberry pi with PLC.

II. BLOCK DIAGRAM

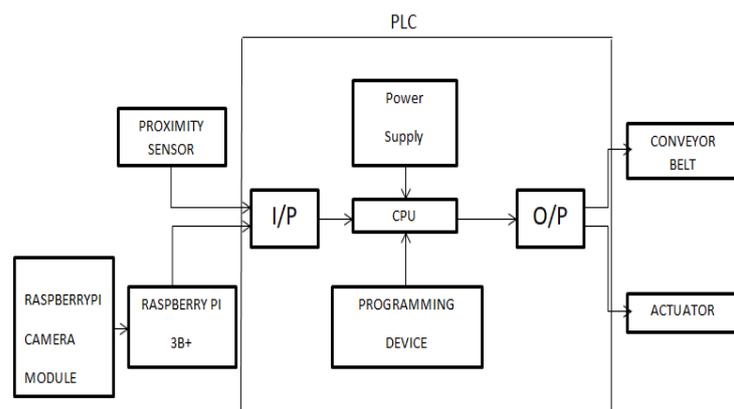
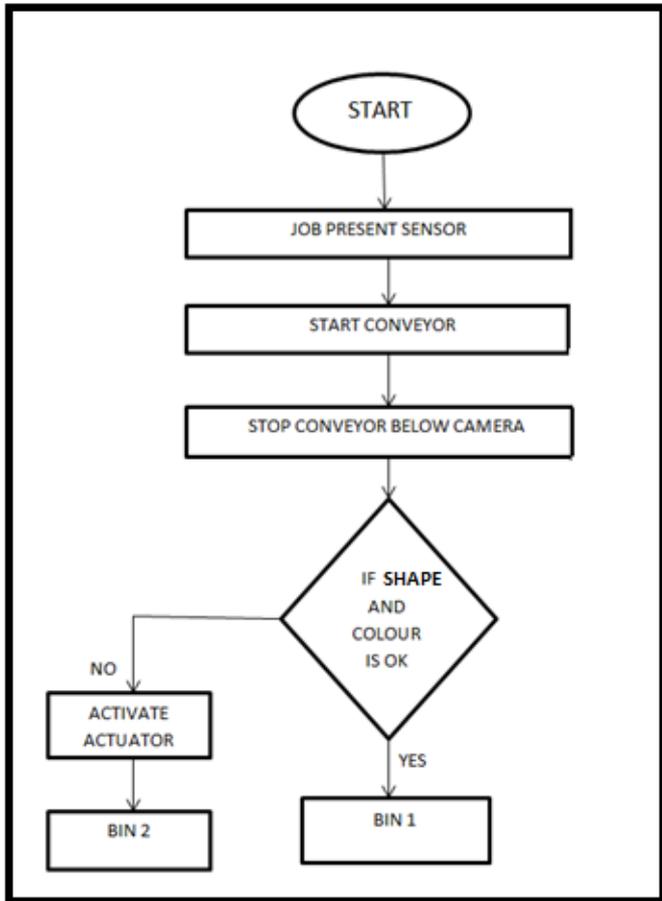


Fig. 1 Block Diagram

Block Diagram consist of Raspberry Pi Camera Module, Raspberry Pi 3B+, PLC, Conveyor Belt, Actuator and Proximity Sensors. In this Proximity Sensors are connected to the Input Module of PLC. Raspberry Pi Camera Module is connected to the USB ports of Raspberry Pi. Raspberry Pi is connected to PLC via MODBUS. We have used PLC as

Primary controller to control Conveyor Belt and Actuator. Conveyor Belt and Actuators are connected to the Output Module of PLC.

III. WORKING



Here, when start button is pressed then conveyor motor will be started. By using proximity sensor, the conveyor motor stopped when object will come below the camera. Then the image of the object will be taken by camera for image processing. After that if the shape and colour of the object is OK then it will proceed to the end of the conveyor and then it will go into the bin 1. If shape and colour of the object is not OK then actuator will separate that object into bin 2.

IV. HARDWARE AND SOFTWARE

HARDWARE:

1. PLC:

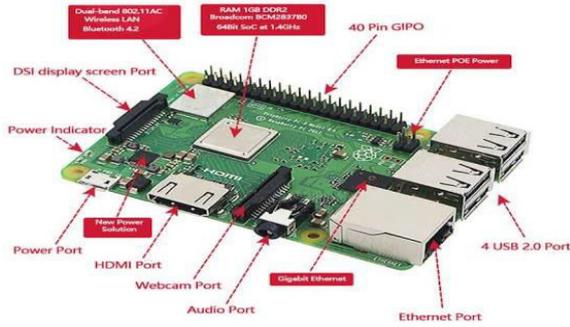


PLC is used for controlling the motion of conveyor. Interfacing of PLC with Raspberry Pi is done through MODBUS.

Specification:

PARAMETERS	SPECIFICATION
Company	DELTA
Model No.	DVP SA2
Software	ISP SOFT
Inputs	8 DI
Outputs	4 DO
Scan Time	0.1 msec
COM Port	Built in RS232 and Two RS485 Ports compatible with MODBUS ASCII/RTU Protocol
Program Capacity	16 K Steps

2. RASPBERRY Pi 3B+:



Raspberry Pi 3B+ module has 40 GPIO pins. It has 4 USB ports to connect keyboard, mouse, web camera and Dexter Er2 Robotics. HDMI cable used to connect the monitor. USB port is used to give supply to Raspberry Pi 3B+.

3. Raspberry Pi Camera Module:



This Raspberry Pi Camera Module Board is a high-resolution 5 MP camera that can take high quality pictures. It does not only take pictures but also shoot videos, making it suitable for drones, CCTV, and other Raspberry Pi projects. A fixed lens with a resolution of 5 MP is built into the camera board. This camera board has a resolution of 2592*1944 pixels and can capture photographs.

4. Proximity Sensors:



For sensing object, three capacitive proximity sensors with a range of 5 to 7 cm are provided. These will be used to detect the object on the conveyor and, if necessary, to stop it.

5. Gear Motor:



A gear motor is used to keep the conveyor belt moving at a slow speed. It aids in slowing down the conveyor speed. It should be driven at a speed of 30-60 RPM.

6. Single Acting Pneumatic Actuator:



The piston or diaphragm of a single acting pneumatic actuator is driven by compressed air, which compresses a spring in one direction and then exhausts the air displaced on the opposite side, allowing the piston or diaphragm to move. To keep the springs from releasing, the compressed air is retained. When the piston or diaphragm is forced to move upward, the compressed air is released and the energy contained in the springs is used to propel the piston or diaphragm to its maximum travel.

7. Solenoid Valve:



A solenoid valve is a valve that is operated by electrochemically. An electric current is used to control the valve through a solenoid. The solenoid and valve are the two main components of a solenoid valve. The solenoid convert electrical energy into mechanical energy, which is then used to open or close the valve mechanically.

8. Bins:

The sorted items will be placed in two bins. Objects with the right shape and colour are placed in one container. Objects that are defective are placed in the second bin.

SOFTWARE:

Image Processing:

Image processing is a form of signal processing in which the input is an image such as a picture, video, or other visual representation. This may produce an image or a collection of image characteristics as a result. Optical and analog. Image processing are also possible here. However, the term "digital image processing" is also used. This is closely connected to computer graphics and computer vision techniques.

1.OpenCV Python:

The OpenCV library stands for Open Computer Vision Library. It was first released in 1999 by Intel. It has since been updated with further changes to strive for real-time computer vision. This library was created using C and C+ programming languages. It runs smoothly on both Windows and Linux operating systems. This library works with a variety of programming languages, including Python, MATLAB, Ruby, and others. Image processing i.e. shape and colour detection can be done quickly and easily with Numpy and Python. OpenCV is an open-source computer vision library for image processing, machine learning, and computer vision. Python, C++, JAVA and other programming languages are supported by OpenCV. It can identify objects, faces etc. by processing images and videos.

2.Delta PLC Software:

- ISP Soft V3.12.
- Commgr V1.12 simulator.

3. Modbus:

Modbus is a communication protocol for transmitting operational data in industries (OD). Modbus supports both serial (RTU) and Ethernet (TCP/IP) communications. It is based on a Client-Server architecture, with the 'Master' device acting as the Server and the 'Slave' device acting as the Client. When the Modbus Slave receives a request from the Modbus Master, it transfers data. You need to send request in the Modbus.

V ADVANTAGES

The following are some of the advantages of an automated sorting system:

- High accuracy is maintained.
- Reduction in the number of labourers required.
- System takes very less time for sorting.
- Possibility of getting defective objects is very less.
- Customer satisfaction is more.

VI APPLICATIONS

This sorting system can be used in a wide range of applications. The following are some examples:

- **Medical Field:** This procedure may be used to sort tablets or capsules of various shapes and colours in the medical field.
- **Mechanical Industry:** In the mechanical industry, it can be used to sort nuts and bolts of various shapes and colours.
- **Food Industry:** This can be used to sort fruits and vegetables by colour and shapes.

VII.RESULT

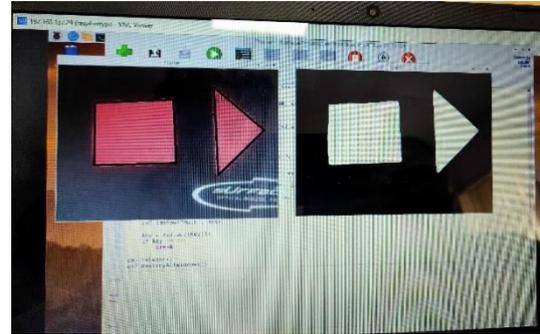


Fig. Masking of objects

Masking is an image processing technique in which a small 'image piece' is defined and used to modify a larger image. Masking is the process which includes many types of image processing, such as edge detection, motion detection, and noise reduction, depend on method of masking.

- The objects are separated into two bins based on their colour and shape.
- Using a pneumatic actuator, objects that aren't the right colour or shape are sorted.

VIII. CONCLUSION

The object sorting method can be effectively implemented in medium and large-scale industries for batch sorting of objects based on different colours and shapes.

In this system, colour and shape information was converted into a series of commands that were sent to the handling device's driving unit. With the help of a computer vision programme, the machine was able to complete an effective sorting process.

IX. REFERENCES

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