International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

Automation of Object Segregation

Ranjitha S Rai[1], Madan G [2], K.R Prakash [3], G. Ravi Krishna[4]

[1]Mtech CAID, Electrical and Electronics Engineering, NIE Mysore
[2]Manager, Incubation center NIE Mysore
[3]Professor and Head IAR Department, NIE Mysore
[4]Assistant Professor, Electrical and Electronics Engineering, NIE Mysore

---

Abstract - *Automation has led to the growth of industries in recent years. For best performance of industrial process, automated systems are used. Image processing has led to a great role in the applications of robotics and embedded systems. Sorting of objects are usually done by humans which takes a lot of time and effort. Detection of object is achieved using image processing technique and suitable sensor and hence robotic arm can be used to sort various objects. This reduces human effort, and also improves the time to market the product. The proposed model includes the conveyor system, capturing and detecting the objects and placing the objects. Using image processing technique the captured image is compared with the pre-specified object. Based on image processing, the robotic arm will be controlled and place the objects in desired location. Raspberry Pi 3B+ model is used to process the captured image. Captured image is other than pre specified object, it involves the conveyor start to move and object is collected at the end of the conveyor system.*

Key Words: **Tensor flow, Dexter Er2 robotic arm, object detection using camera, IR sensor etc**

1. INTRODUCTION

In today's scenario, the robot with high accuracy and minimum error is in demand. The web camera is commonly used to capture the image of the object and its characteristic feature is used to perform a required task by the robot [1].For the industrial applications, the robotic arm can be used to segregate the objects based on the pre- specified image.

The main aim of the project is to segregate of the objects using a Dexter Er2 robot that can pick a pre-specified object and place it to the specified bin. Raspberry Pi 3B+ has to found many useful and changeable implementations in Dexter Er2 robotic systems. The python code has been formulated to control the Robotic arm based on the image processing output.

1.1 Problem identification:

The Earlier manual sorting method is used to segregate the objects. It is a conventional approach that is preferred by production and packaging industries which involves visual observation performed by humans. This is an approach where human labourers are made to work for maximum time to achieve the task. Consider the large scale industries, segregation of an objects that are bulk in number become a tedious task for labourers to recognizing a particular object and placing it in a required place which consumes a lot of time. This is slow and inconsistent when the human labourers do it manually.

Even though this manual segregation suits some organization but this doesn't suit large manufacturing plants. Due to heavy workload, humans may lack in performing the work with high accuracy of the segregation of an object can affect the company in large scaled production rejection. Sometimes humans are restricted to work in hazardous conditions and it is the place where automation plays a major role [2].

1.2 Objectives of the Project:

- Tensor flow Image processing technique to classify the objects.
- Assemble and control the Dexter Er2 Robotic arm and conveyor belt.
- Integrate the vision system, conveyor system and a Robotic arm to segregate the objects.

- To study and investigate how to program the Raspberry-Pi using python and Open CV libraries.
- To interface the Raspberry Pi 3 B+ with a web camera and be able to capture images.
- Initialize the robotic arm by using Servo motion profile generator GUI.
- Control the Conveyer system and robotic arm using a Raspberry Pi 3B+.

2. Methodology

2.1 Block Diagram Description

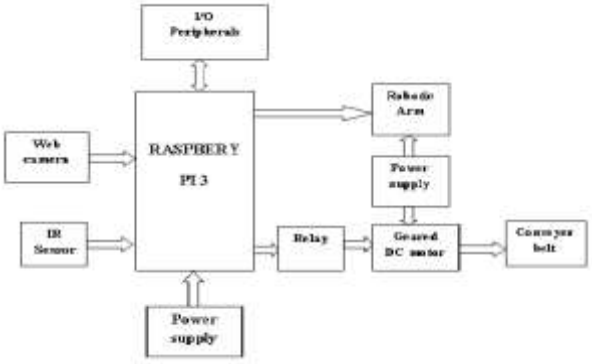

Fig -1: Block diagram of automation of object segregation.

- The model uses Raspberry Pi 3 B+ with Linux operating system, USB Logitech web camera, Dexter Er2 Robotics, Sensor and Relay.
- Switch on the power supply and Raspberry Pi 3B+ initializes all the components.
- The proposed model uses the Tensor flow image processing technique for achieve the goal of the segregation of objects.
- The Conveyor system starts with the help of geared DC motor and relay. Objects are placed on the conveyor system and the conveyor system is to move. When the object approaches to the IR sensor, it detects the objects and sent the signal to Raspberry Pi 3 B+. The Pi is coded in such a way that when the input signal is high, it stops the conveyor system. The camera will capture the images.
- A camera constantly watches the conveyor and if objects are come in its view it capture the image and it send to the Pi. The Pi will compares the captured image is with the pre-specified object or desired object stored in a database through the tensor flow method of the image processing technique.
- When the captured image is of the desired image, the Dexter Er2 robotic arm will be actuated and it picks the desired object and placed the object to the bin at pre-specified a location. The location can be change using the base axis coordinates. The Dexter Er2 robotic and Raspberry Pi 3B+ are connected through FT232 USB to Serial Converter cable. GUI motion profile software can be used to set all the individual coordinates of all the axis of the servo motor. The Dexter Er2 robotic arm has five degrees of freedom namely base rotation, shoulder revolution, elbow pivot, wrist pitch and roll plus servo gripper.
- If the captured image is of an undesired object, the conveyor again start to move, it allowed to pass the object through the belt and collects the object through the bin at the end of the conveyor. Hence deselecting the object. Therefore selecting and deselecting the process of objects can be made easier with the use of Raspberry Pi 3 B+ and Dexter Er2 Robotics.

2.1 Flow Chart:

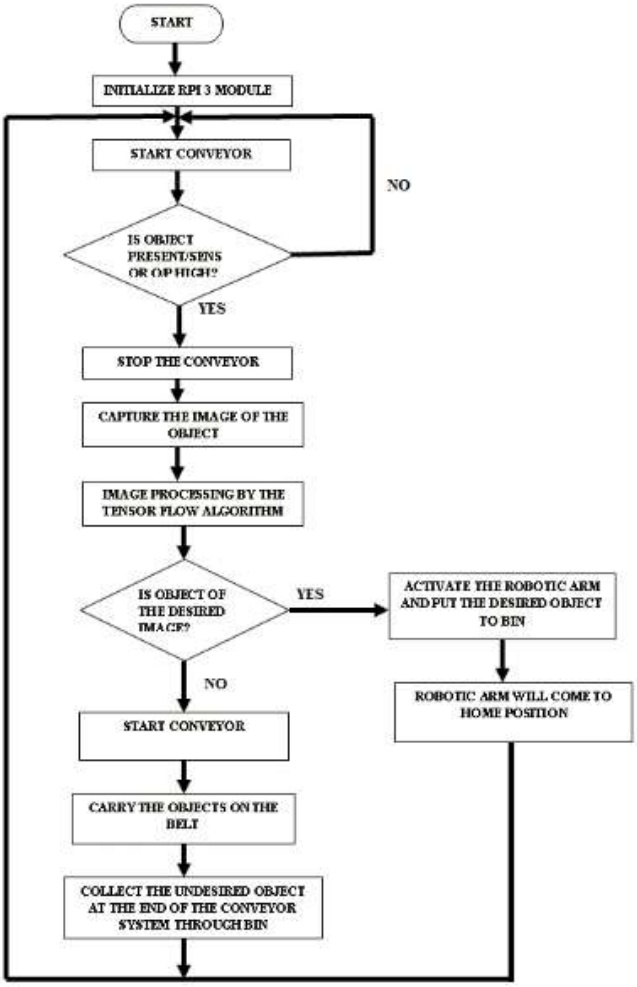

Fig -2: Flow chart of automation of object segregation.

Fig-2 shows the flowchart of the procedure followed for the sorting of objects based on the pre-specified image of the object through Tensor flow image processing technology.

- Initializes the Raspberry Pi module.
- Then the DC motor is initialized to rotate the conveyor system and then the objects are placed on the moving belt.
- When the sensor senses the object, the o/p signal goes high and sent the signal to Raspberry Pi 3 B+ module and it connected to relay and it stops conveyor belt.
- The camera will activate to capture the image of objects as soon as the conveyor stops.
- Any captured image is detected, Raspberry Pi 3B+ has been compared to the pre-assigned image stored in the database, through tensor flow technique and if they are the same, the electrically operated robotic

arm will be activated and that will picks the desired object and placed into the bin which is placed in desired location.

- If the captured image is of an undesired object, the conveyor again start to move, it allowed to pass through the belt and collects the object through the bin at the end of the conveyor.
- The process will repeat an infinite number of times until the power is turned off.

2.2 Component Description:

2.2.1 Raspberry Pi 3 B+:

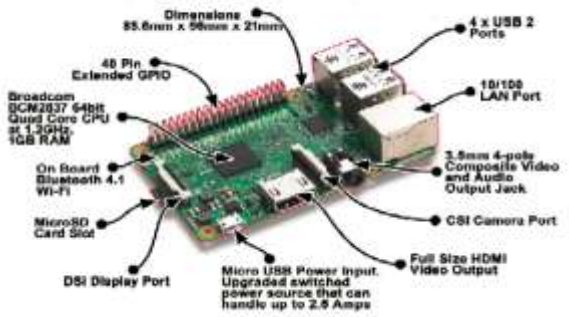

Fig -3: Raspberry Pi 3B+.

Fig 3.3.1 shows Raspberry Pi 3 B+ module, it has 40 GPIO pins that are used to connect the sensor and relay. Four USB ports use to connect the keyboard, mouse, web camera and Dexter Er2 Robotics. HDMI cable used to connect the monitor and 5v micro USB port it uses to give the supply to Raspberry Pi 3 B+ module. The four built-in USB ports can provide output up to 1.2A enabling you to connect more power hungry USB devices.

2.2.2 Dexter ER2 Robotic Arm:

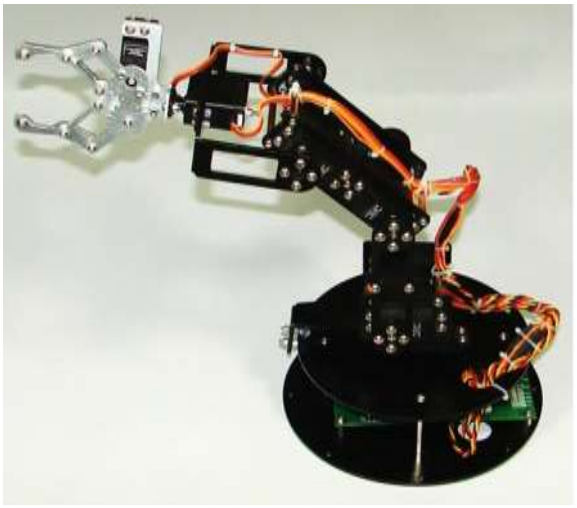

Fig -4: Dexter Er2 Robotic Arm.

The project is used Dexter ER-2 Heavy Duty Robotic Arm. Dexter ER-2 Heavy Duty Robotic Arm with Controller and Accessories is fully assembled and ready to use Robotic Arm. Robotic arm comes preassembled along with the Servo control card, Servo motion profile generator GUI, and Flex sheets with polar and rectangular coordinate systems for the robotic arm. Dexter ER-2 Heavy Duty Robotic Arm is a 5 Axis robotic Arm + Servo Gripper.. Robot Arm has 5 degrees of freedom which includes Base rotation, Shoulder rotation, Elbow rotation, Wrist pitch and roll

2.2.3 USB webcam:

Fig -5: USB webcam.

In this project, Logitech webcam is used to monitor the real-time object image on the Raspberry Pi 3. It's able to deliver a clear 3-megapixel resolution image or 720p HD video recording at 30frames/sec. Fig-5 shows the Logitech USB webcam. The quality and frames/sec of the image helps to enhance and process the image to detect the colour of the object with maximum accuracy [1]

2.2.4 Conveyor system :

Fig -6: Conveyor system.

Fig-6 shows the mechanical structure of the Conveyer system. A conveyor system is a typical bit of mechanical dealing with gear that moves materials starting with one area then onto the next. Conveyors are particularly valuable in applications including the transportation of substantial materials.

2.2.4 IR Sensor:

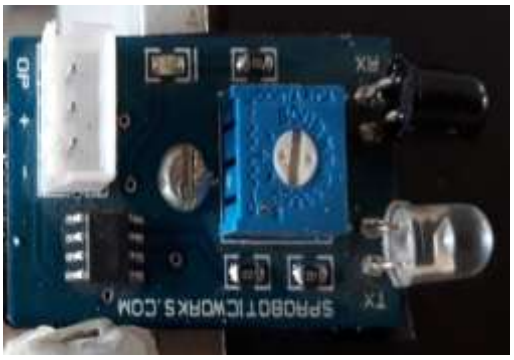

Fig -7: IR Sensor.

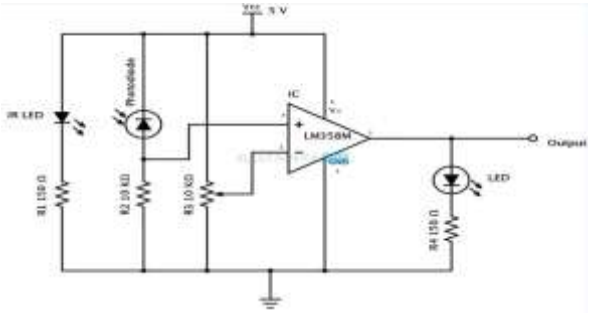

Fig -8: IR Sensor Circuit.

Fig-7 shows the IR sensor used in the proposed model for object detection. It consists of an IR LED, a photodiode, a potentiometer, and an IC op-amp. IC op-amp is used as a voltage comparator. The potentiometer is used to calibrate the output of the sensor according to the requirement. When the IR LED emits the infrared signal if the object is present the photo diode detects the infrared signal.

Fig-8 shows the IR sensor circuit it explain the working principle of IR sensor. The photodiode is very high resistance in the absence of light. When the light emitted by the IR LED is incident on the photodiode after hitting an object, the resistance of the photodiode falls down from high value. One input of the op-amp is connected to the threshold value set by the potentiometer. The other input is from the photodiode series resistor. When the incident radiation falls on the photodiode, the voltage drop across the series resistor will be high. The op-amp IC compares the both threshold voltage and the voltage across the series resistor. If the voltage across the series resistor is greater than the threshold voltage, then the output of the op-amp is high. As the output of IC connected to an LED, it lightens up. The threshold voltage can be adjusted using a potentiometer depending on the environmental condition.

2.2.6 5V Relay circuit module:

Fig -9: 5V Relay circuit module.

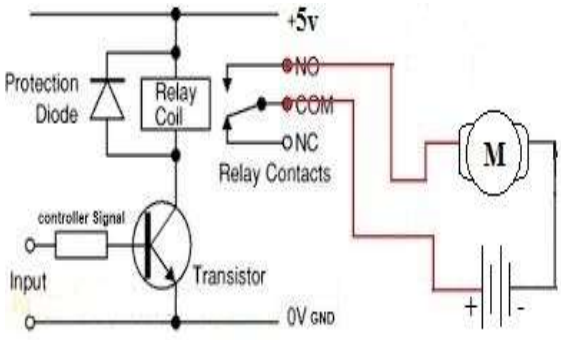

Fig -10: 5V Relay circuit working principle.

Fig -9 shows the SRD-05VDC-SL-C Relay circuit module, the relay is an electromagnetic switch that is used to turn on and turn off a circuit.

It works on the principle of electromagnetic attraction. When there is no input voltage applied to the coil, COM (common) is connected to NC (normally closed contact) and start the DC motor. When there is some voltage applied to the coil, the electromagnetic field produced, which attracts the Armature (lever connected to spring), COM and NO (normally open contact) gets connected and it opens the circuit.

The relay is always configured by using a small Driver circuit as shown Fig-10 which consists of Transistor, Diode and a resistor. Transistor is used to amplify the current so that full current can flow through a coil to fully energies it. The resistor is used to provide biasing to the transistor. And Diode is used to prevent reverse current flow when the transistor is switched OFF. Every Inductor coil produces equal and opposite EMF when switched OFF suddenly, this may cause permanent damage to components, so Diode must be used to prevent reverse current.

2.2.7 12V Geared DC motor:

Fig -11: 12V Geared DC motor.

A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure.

The gear having smaller radius will cover more RPM than the one with larger radius. However, the larger gear will give more torque to the smaller gear than vice versa. The comparison of angular velocity between input gear (the one that transfers energy) to output gear gives the gear ratio. When multiple gears are connected together, conservation of energy is also followed. The direction in which the other gear rotates is always the opposite of the gear adjacent to it.

In any DC motor, RPM and torque are inversely proportional. Hence the gear having more torque will provide a lesser RPM and converse.

3. IMAGE PROCESSING TECHNIQUE, IN ORDER TO CLASSIFY THE OBJECT:

The Image processing techniques are very much popular in the current decade due to the usage of Artificial Intelligence and Machine Learning. Object detection and classification is the most popular application in the field of computer vision which made our life very simple. To achieve this detection and classification has to be addressed separately. Tensor Flow enables designers to make dataflow graphs—structures that shows how information travels through a graph, or a progression of preparing nodes. Every node in the graph speaks to a numerical task, and every connection or edge between nodes is a multidimensional data array or tensor.

Tensor Flow gives the majority of this to the software engineer by method for the Python language. Python is easy to learn and work with and gives helpful approaches to express how abnormal state reflections can be coupled together. Nodes and tensors in Tensor Flow are Python objects, and Tensor Flow applications are themselves Python applications.

4. EXPERIMENTAL RESULTS:

4.1 Image Processing Technique: Tensor flow method

A trial of experiments has been conducted to control the Dexter Er2 robotic arm using Raspberry Pi 3B+. The captured image was processed using tensor flow algorithm to identify the desired object and hence robotic arm is actuated to pick and place the desired object to the bin, which is at desired location. In the automatic operation it fully depends on the raspberry pi and code.

In the proposed model, the Battery and switch are the pre-defined objects. The objects are captured using Web camera, after that it is processed using of Image processing technique in the Tensor flow method. The result of Image processing as shown below.

Fig -12: Detection of battery **Fig -13:** Detection of switch.

Fig-12 shows the Image processing result of the battery, it shows the captured image of the battery and after the processing through tensor flow method it creates the boundary box and percentage of matches and in the terminal screen it shows the detected object name. Fig-13 shows the Image processing result Switch.

2.2.7 Segregation of Objects:

IR sensor senses the object, and sent the signal to Raspberry Pi 3B+. Conveyor will stop and camera will be activated .On receiving the input from the captured image based on image processing using Tensor flow method, the Raspberry Pi 3B+ sent a signal to the Dexter Er2 robotic arm and the robotic arm gets actuated. The arm moves to the desired object and pick that object then place the object to the specified location of the bin


Fig -13: Picking the battery Fig **-14:** placing the battery


Fig -15: Picking the switch. **Fig -16:** placing the switch.

5. CONCLUSION

Automation of segregation of object is successfully implemented through image processing algorithm, Raspberry Pi 3B+ and Dexter Er2 Robotic arm. GUI motion profile generator software helps to set all the coordinates of Dexter Er2 robotics to pick and place the object. Generally detection object is big challenge because of high uncertainty due to external lighting condition. While collecting the objects from conveyor system by a Robotic arm, there are variation in weight and its characteristics.

REFERENCES

[1] Brintha Therese "Robotic arm with real-time image processing using raspberry pi, Both automated and manually", International Journal of Advanced Research March 2018

[2] 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 & Technology, ISSN (Online): 2319-8753, May2016

[3] 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

[4] Sumaiya Sultana RA, Soundarya P, Soumya RK, Niveditha, Prof. Santhosh S" Robotic Arm for Trash Collecting and Separating Robot" International Journal of Research and Scientific Innovation (IJRSI) | Volume V, Issue IV, April 2018