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ROBOTIC ARM FOR PICK & PLACE OPERATION USING MATLAB BASED ON OFFLINE SURFACE CLUSTERING ALGORITHM

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Abstract: - The industry is moving from current state of automation to Robotization, to increase productivity and to deliver uniform quality. The main objective of this paper is to detect maximum objects within shorter duration for performing robotic arm pick and place task using offline surface clustering algorithm. The pick and place robot is a microcontroller based mechatronic system that detects the object, picks that object from source location and place it at desired location. An implementation of automatic robotic pick & place operation is a long term process as it requires a complex algorithm, sensors and processors for governing the robotic arm movement towards the detected object accurately. In this paper we have developed the prototype of robotic arm movement. In the present situation the detection part is mainly based on the recent template-based linemod approach for object detection. Offline surface clustering algorithm was introduced to overcome the difficulties that occur in present situation and it improves the correct detection rate compared to linemod approach, hence suitable for robotic applications.The foremost idea of this project is to perform Object detection by image processing algorithm using MATLAB software. The detected objects are transmitted to the microcontroller unit through zigbee to perform robotic arm pick & place task and the zigbee technology has been used to control the robotic arm movements.

Keywords*:* Object detection, linemod approach, offline surface clustering algorithm, robotic arm, zigbee.

1. Introduction

Robotic pick and place automation speeds up the process of picking parts up and placing them in new locations, increasing production rates. With many end-of-arm-tooling options available, pick and place robots can be customized to fit specific production requirements. Moving large, small, heavy, or hard-to-handle products can be an easy task to automate in the factory line. Consistency is also a benefit of using a pick and

place system. Many successful approaches that address the problem of general object detection use a representation of the image objects by a collection of local descriptors of the image content. Global features provide better recognition. Color and shape features can also be used. Various object recognition techniques are available. Difficulties may arise during the process of object recognition. The robust and efficient object recognition technique using image processing algorithm can be developed .The image processing algorithm used in this system is offline surface clustering algorithm which can detect an object efficiently and accurately for robotic pick & place operation. Robotic vision continues to be treated including different methods for processing, analysing, and understanding. All these methods produce information that is translated into decisions for robots. From start to capture images and to the final decision of the robot, a wide range of technologies and algorithms are used like a committee of filtering and decisions. A robotic vision system has to make the distinction between objects and in almost all cases has to be made for tracking these objects. Applied in the real world for robotic applications, these machine vision systems are designed to duplicate the abilities of the human vision system using programming code and electronic parts.

2. System Model

This system consists of image acquisition phase, image processing phase and image transmission using communication protocol. The image is acquired by means of a camera and this phase is known as image acquisition phase, this captured image is processed in the Personal Computer by efficient image processing algorithms. Thus, the objects can be detected at this phase and this phase is known as image processing phase, Finally, the detected objects are transmitted towards the microcontroller unit using the communication protocol Zigbee for performing robotic arm pick & place task.

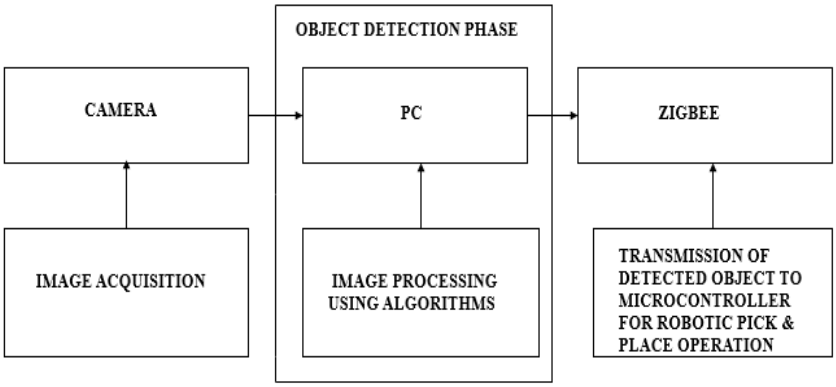

Figure 1: Block diagram for object recognition

2.1 Object Recognition Using Offline Surface Clustering Algorithm

In this process image processing algorithm is used to detect an object. The image processing algorithm used in this paper for object recognition is Offline surface clustering algorithm. Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group called a cluster are more similar in some sense or another to each other than to those in other groups clusters. Cluster analysis itself is not one specific algorithm, but the general task to be solved. It can be achieved by various algorithms that differ significantly in their notion of what constitutes a cluster and how to efficiently find them.

A binary image is a digital image that has only two possible values for each pixel. Typically, the two colors used for a binary image are black and white, though any two colors can be used. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color. **BW = im2bw(I, level)** converts the grayscale image I to a binary image. The output image BW replaces all pixels in the input image with luminance greater than level with the value 1 (white) and replaces all other pixels with the value 0 (black). Specify level in the range [0,1]. This range is relative to the signal levels possible for the image's class. Therefore, a level value of 0.5 is midway between black and white, regardless of class.

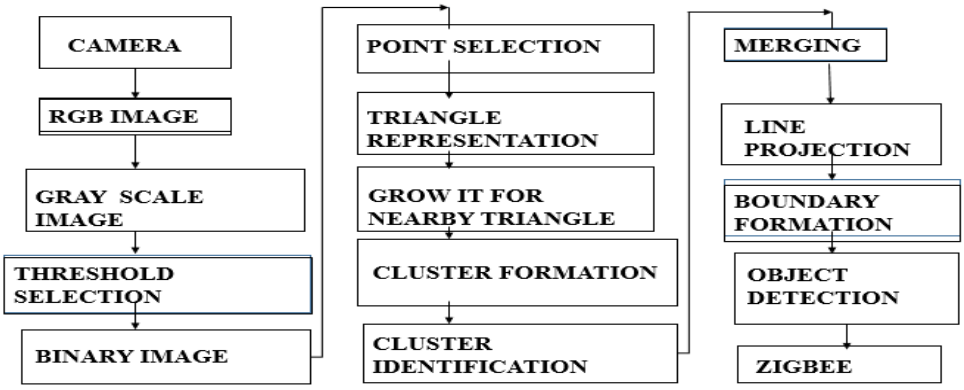

Figure 2: Flow chart for offline surface clustering algorithm

A point is selected for the binary image and the triangular representation is made from that point to boundaries of the image. The triangle is further extended with neighbouring triangles and the cluster is obtained. Now identify the number of individual cluster obtained. Then project the line and merge the similar cluster pixels together to form a boundary. This boundary formation provide efficient object recognition and this makes the robotic wheel to move near the object and the IR sensor is helpful in pick and place operation of the robotic arm by sensing the object placed in the robotic path.

2.2 Block diagram for robotic arm pick & place task

The block diagram for robotic arm pick & place operation is given below:-

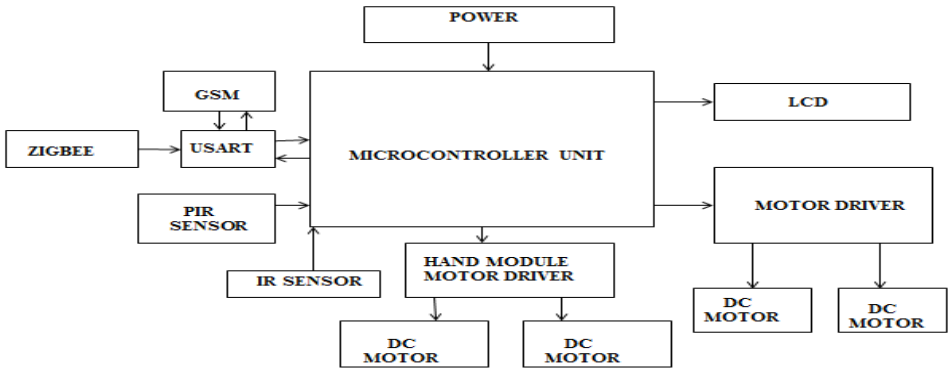

Figure 3: Block diagram for implementing the prototype of robotic pick & place task

The use of Industrial Robots characterizes some of contemporary trends in automation of the manufacturing process. However, present day industrial robots also exhibit a monolithic mechanical structure and closed-system software architecture. They are concentrated on simple repetitive tasks, which tend not to require high precision. The images are captured using a camera and it is transmitted to the computer for performing image processing operations. With the help of image processing algorithm namely offline surface clustering algorithm the objects were detected. The detected objects were transmitted to the microcontroller unit through Zigbee. The microcontroller unit signals the motor drivers to perform pick & place task for the detected objects. The detected objects are represented by means of cluster. Objects with similar pixel are grouped under one cluster. It is also noted that the clustering approach improves the detection rate. Thus, this approach can be used in the automatic robotic pick & place operation. As the implementation of automatic robotic pick & place operation takes long period, we have developed only the prototype of robotic arm movements in this paper. PIR sensor is provided for motion detection. LCD is used to display the status of operation. Robotic movements are performed with the help of zigbee & GSM technology. Once the objects were detected, the robotic wheel stops

its movement. Four DC motors were provided for robotic movements. L293D motor drivers were provided to drive the DC motors required for performing robotic arm & wheel movements. Atmega 8 is used as the microcontroller in this system, which controls and coordinates the entire operation of the prototype.

3. Results & discussion

The object recognition is done by using image processing algorithm in MATLAB software. The image processing algorithm used in this system for object detection is Offline surface clustering algorithm.

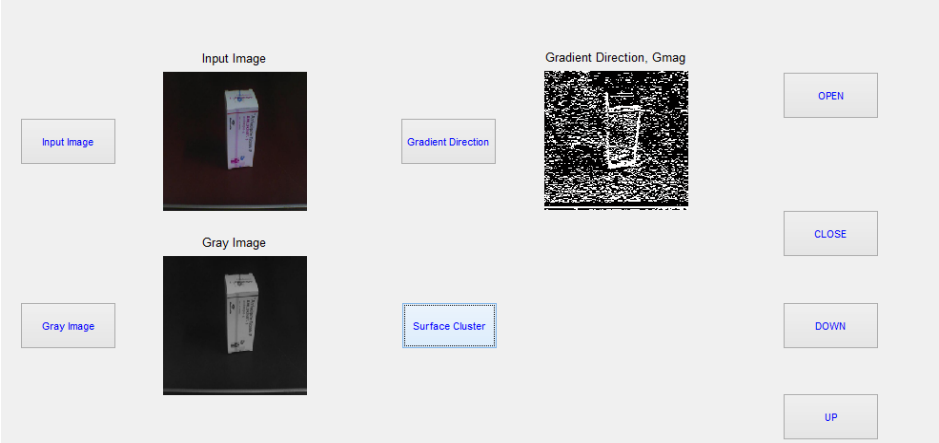

Figure 4: Image captured and converted for object detection

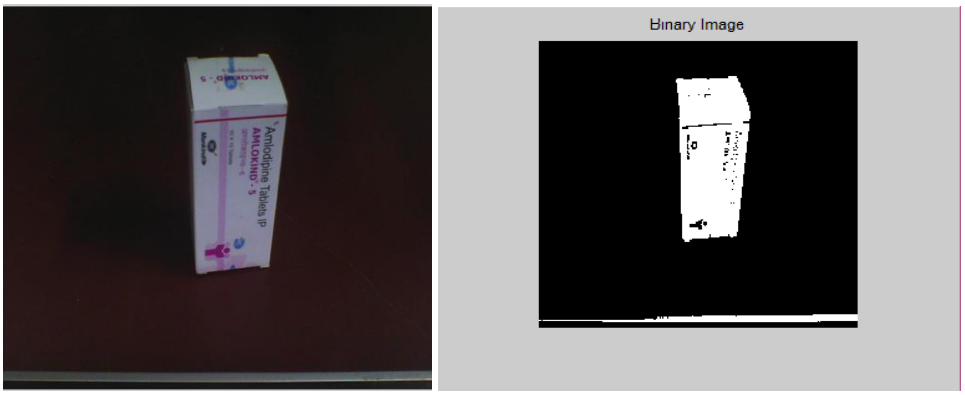

Figure 5: Conversion of input image to binary image

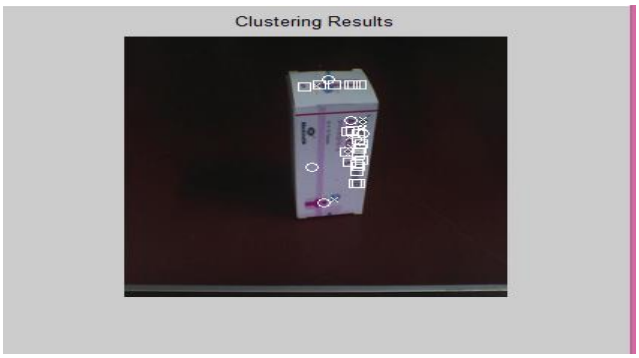

Figure 6: Object detection using clustering approach

The below snapshots deals about the implementation of the prototype of pick & place robot

Figure 7: The prototype of robotic arm

Figure 8: Pick up operation of the robotic arm

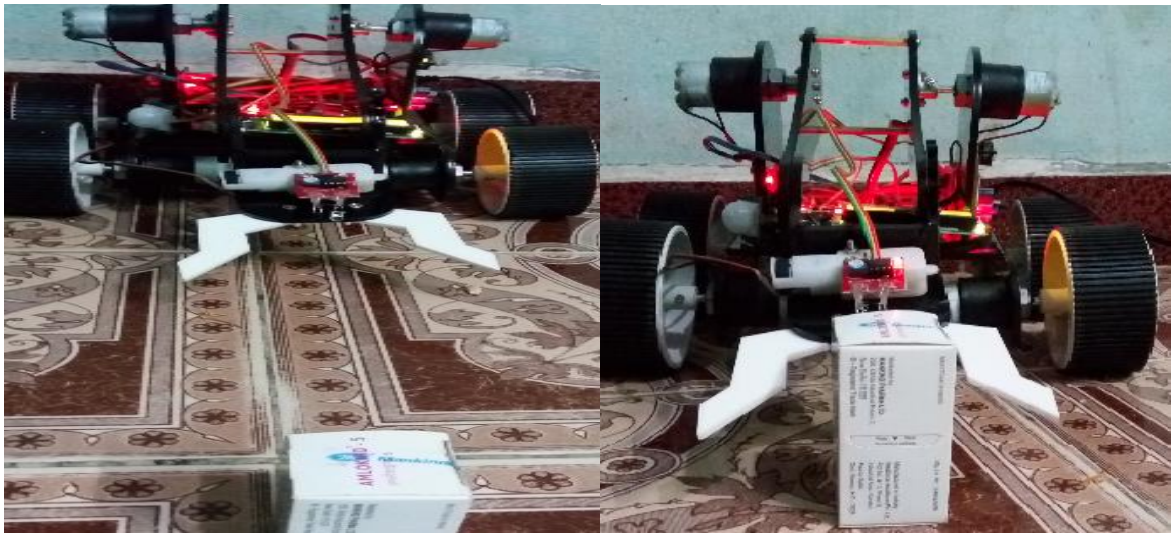

Figure 9: Placing the object by the robotic arm

4. Conclusion & future work

The objects were detected by image processing algorithm using MATLAB software. It is found that the offline surface clustering algorithm can detect more objects within shorter duration. Hence, suitable for robotics application. When the detected objects are transmitted to the microcontroller unit through zigbee , the robotic arm performs pick & place task. Thus, the prototype of robotic arm movements has been developed with the help of zigbee technology.

An implementation of fully automatic robotic arm pick & place operation is a long term process as it requires a complex algorithm, sensors and processors for governing the robotic arm movements towards the

detected object accurately. Hence, in this paper we have developed only the prototype of robotic arm to perform pick & place operation. This system can be extended by developing the fully automatic robotic arm to perform pick & place operation for the detected object without any constraint to distance coverage.

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