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FEATURE EXTRACTION OF OBJECT FOR A PICK AND PLACE ROBOT

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ABSTRACT

Controlling a Robotic arm for applications such as object sorting with the use of vision sensors would need a robust image processing algorithm to recognize and detect the target object.

This project is directed towards the development of the image processing algorithm which is a pre-requisite for the full operation of a pick and place Robotic arm intended for object sorting task. For this type of task, first the objects are detected, and this is accomplished by feature extraction algorithm. Next, the extracted image (parameters in compliance with the classifier) is sent to the classifier to recognize what object it is and once this is finalized, the output would be the type of the object along with its coordinates to be ready for the Robotic Arm to execute the pick and place task.

The major challenge faced in developing this image processing algorithm was that upon making the test subjects in compliance with the classifier parameters, resizing of the images conceded in the loss of pixel data. Therefore, a centered image approach was taken.

—Keywords – Object Detection, Object Recognition, Feature Extraction, Classifier.

I. INTRODUCTION

Vision based control of the robotic system is the use of the visual sensors as a feedback information to control the operation of the robot. Integration of the vision based algorithms can enhance the performance and the efficiency of the system. Vision based configurations have been implemented to mimic human visual sensors. Orienting towards robotic arms, object recognition is vital for the operation of arms for navigation and grasping tasks. Often it has been the case that image processing (IP) algorithms require huge processing time for the successful implementation of object recognition. The work presented in critically explains the basic algorithms to be addressed before applying image processing techniques. These techniques include image enhancement, noise reduction and a visual loop algorithm (based on trial and error approach) [1]. Moreover, works presents the IP algorithms and approaches to reduce response time and increase in the efficiency for the object recognition tasks. In discussion is based on the reduction of computation time using Train arp algorithm (derived from ANN). It also presents the method to migrate from the statistical approach to Artificial Neural Networks (ANN) [2]. The efficiency is 95% and response time of 94ms. Similarly, migration is obtained by employing parallel programming approach known as object surface reconstruction method. Up on comparison with serial approach, parallel programming method is ten times faster. To reduce cost and improve on

performance, has presented the communication of vision system via USB. The vision system used was a webcam for which via MATLAB, the system is enabled to perceive environment through artificial vision via IP algorithms. Along with the classification part, the concept of Feature Extraction (FE) is also studied. FE mostly acts as a pre- processing algorithm to furnish the dataset for the classifier to make important decisions/classification. The work of elaborated on the usage of multi-stereo vision technique for the detection of 3D Object. Eliminating the background i.e. objects of least interest, using opening and closing morphological techniques, 3D detection of a particular object was achieved. Similarly, conversed about Viola-Jones IP method, which is the one of the Robust Object detection algorithms known as state of the art face detector [4]. The robustness of this algorithm was due to cascaded architecture of the strong classifiers arranged in the order of complexity [5]. This approach was incorporated to reduce the processing time. Lastly, feature extraction via Contour matching is also one of the best methods to detect objects .The trained shape is matched according to a probabilistically Motivated distance measure which enhances the shape comparisons within the framework. The work in this also presented on the noise reduction and other image optimization via segmentation and other IP techniques [6]. The goal of this paper is to develop IP technique which will involve the FE and classification algorithms suitable for object sorting task. Additionally, the system to be developed needs to be robust as it will be tested on a real time basis [7][8]. It is planned to use the developed IP technique on SCORBOT ER-4U (robotic arm platform) [9] which will be refurbished and utilized to sort electronic components such as resistors and capacitors for laboratory technicians. The remainder of this paper covers the algorithms of feature extraction and classification. Further discusses on the determination of object location and also portrays all the results carried out for the development of the algorithms.

II. WORKING

Here we are using a Humanoid Robot which is capable of Detection and Recognition of different objects and can be controlled through voice. The Movement of the humanoid robot is done basing on Arduino Mega and we make mobile robot whose motions can be controlled by the user by giving specific instructions in the computer. In this project we are implementing simple and easy hardware for Object and speech detection and recognition. So, for this purpose we use a Library which is especially developed for image processing technique known as Open CV(Open source Computer Vision) .The system is programmed using Python programming language for object and face recognition and for controlling the mechanism of the robot we write the program in Arduino. All these data is given to the Robot such that when an object is identified, Later, the identified object is picked and placed by a robotic arm. This Robot can be used in real time in automated system

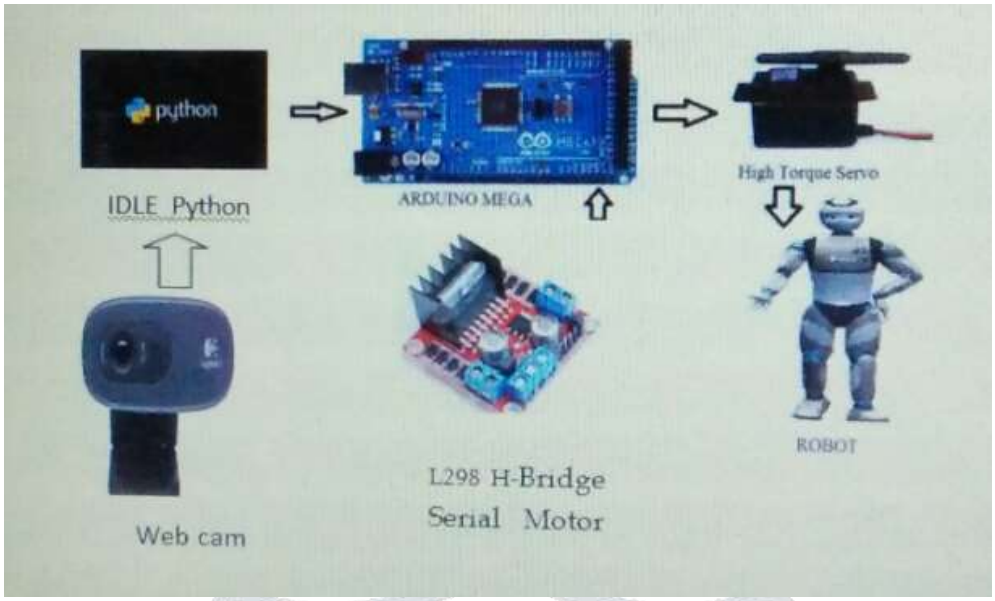

Fig.1 working flow of the design

III. METHODOLOGY

The feature extraction part in the development of this model plays a vital role as it furnishes the raw image and compiles it accordingly with the classifier's specifications.

A. Algorithm

1. The image is read and converted to grayscale. The grayscale conversion is achieved by eliminating hue and saturation information while preserving the luminance. The colored image (RGB image) is 3 dimensional. To convert to a 2 dimensional grayscale image, the following equation represents the correct proportion of RED, GREEN and BLUE pixels to be taken into account:

2. Then the grayscale image is converted into a binary image. The method used to convert to binary image is known as Otsu's method. This method is a non- parametric and an unsupervised method of automatic threshold selection for picture segmentation. The threshold selected by Otsu's method will intend to minimize the intra-class variance of black and white pixels. *Even though the threshold value can be selected independently by the user, it is set to auto-mode as during the tests, images will vary.

3. Edge Detection

Once the images are converted to binary, edge detection criterion is applied to detect edges in a given image. This part is very crucial as this criterion will act as a pre- requisite for BLOB's analysis in the later procedures. The Edge Detection algorithm developed is based on the "Canny method". This method finds edges by looking for the local maxima of the gradient of the image. This gradient is based on the Gaussian Filter.

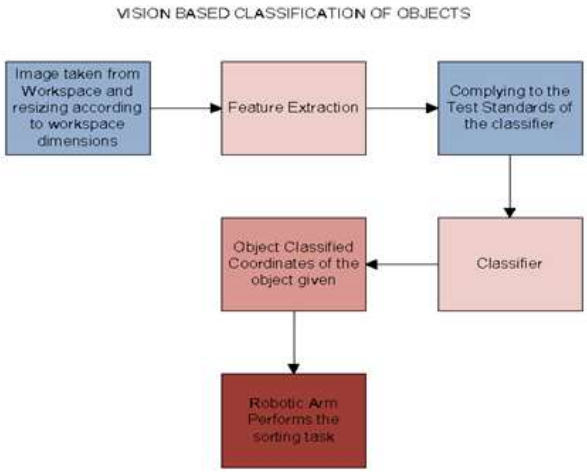

Fig2. Conceptual frame work of the whole system

Overview of the Canny Method

a. Smoothing: the effect of Gaussian smoothing is blurring of an image and this degree of blurring is entirely based on the standard deviation of the Gaussian distribution. The more the standard deviation, the more it will be the blur the image. In this model a value of 1.41 is set as a standard deviation value.

b. Non-Maximum Suppression: at the above step, the edges were blurry, this method converts these blurry edges to sharp edges by preserving all the local-maxima in the gradient image and deleting the rest.

c. Double Thresholding: This is where edge selections are optimized, this step uses double thresholding and is not likely be fooled by the noise/color variations due to rough surfaces. The pixels which are stronger than the high threshold value are preserved; however, the pixels which are weaker than the lower threshold value are suppressed.

d. Edge tracking by Hysteresis: Here, edges which are strong edges (with higher threshold values) and edges (weak ones if any) which are connected to the strong edges are finally preserved. By default, 8 connected pixels in the canny method are divided into BLOB's. The BLOB's containing at least one strong pixel are selected and preserved, while others are suppressed.

4. Image Dilation: This procedure enlarges the edges created by the edge detection algorithm on the basis of a rectangular structuring element.

5. Image Filling: The edges dilated are filled such that, outline of the edges are more clear and visible.

6. BLOB's Analysis: Since the image being analyzed is in the form of a cluttered scene, connected objects as per the strong filled edges will form a BLOB and are identified as an object. Likewise, each BLOB will form an object. Once the objects are detected, a rectangular bounding box will be formed around the detected object and it will be cropped as outlined by the bounding box. Then that cropped image will be resized to 20 by 20 pixels and converted to grayscale to be ready for testing (for classification).

Fig.3 Input image applied to identify he objects

CLASSIFIER

Figure 2: Conceptual Framework for the training phase The above block diagram shows the process by which the training data is manipulated and trained by the classifier. The JPEG formatted images are the training data which consists of the images of some objects .These images are first converted to grayscale and then resized into 20 by 20 pixels sizes. Thereafter, the data file (in .txt format) is trained by the classifier. Once, via Back-Propagation algorithm the weights are optimized, the values of weights are written to a file which will be used to perform tests (to determine the reliability of the classifier).

Fig 4. (a)gray scale image (b) Binary image

1) Here firstly the original image is taken from the work space through as shown in fig3

2) Then the original colour input image is converted into a gray scale image. The gray scale conversion is achieved by eliminating hue and saturation information while preserving the luminance. The coloured image (RGB image) is 3 dimensional. To convert to a 2 dimensional gray scale image as shown in fig.4(a)

3) Then the grayscale image is converted into a binary image. The method used to convert to binary image is known as Otsu's method. This method is a nonparametric and an unsupervised method of automatic threshold selection for picture segmentation.

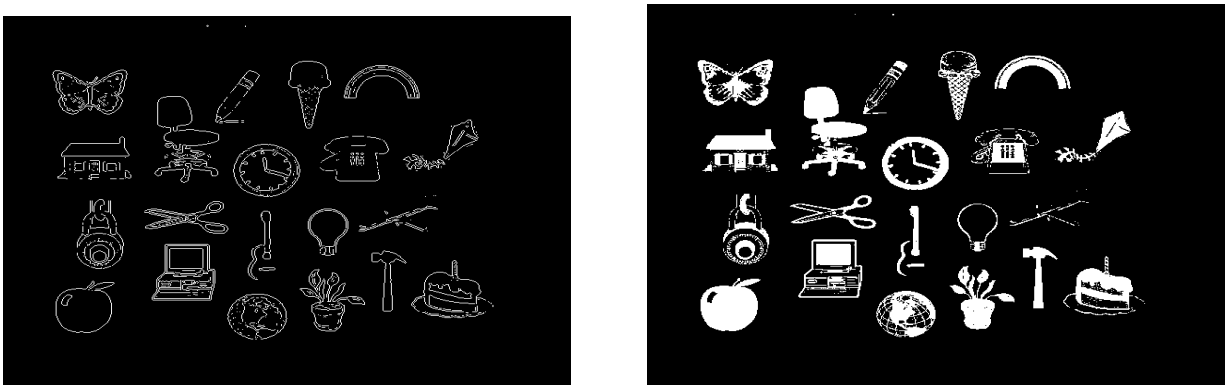

Fig5. (a)edge are detected (b) edge dilation and filling

The threshold selected by Otsu's method will intend to minimize the intra-class variance of black and white pixels as shown in fig.4(b).Even though the threshold value can be selected independently by the user, it is set to auto-mode as during the tests, images will vary.

4) Then edge detection is performed and edges of the objects are obtained as shown in the below fig.5(a)

Fig 6 (a) .BLOB's analysis (b) Classified image

5) Then dilation is performed this procedure enlarges the edges created by the edge detection algorithm on the basis of a rectangular structuring element and then edge filling is performed as shown in below fig.5(b)

6) Then BLOB's analysis is done and all the objects are surrounded by rectangular boxes.

7) Then this image is sent to a classifier and classifies the required object.

8) Then the image is recoginized and pixel value are changed and then it is extracted shown in below fig.7

Fig.7 Recognized object

9) Then this image is picked and placed by using the arm.

Implementation in Python:

In this with the help of the python program and running the program the object will be detected and recognized. This code contains certain packages and libraries. Through with the objects are taken through a webcam objects are captured and they are processed in the python and python is interconnected with Arduino which performs pick and place task.

1) Here firstly video streaming takes place and objects are captured with a camera.
2) After capturing the image we have to given input as a image name it will cheek whether the object according to the name and it will pick and place the object according to the commands given by us.

Fig8. (a) Capturing image (b) Picking and placing the object with a robotic arm

Then at last it will place the object at a particular position .Thus we have recognized the object from the work space in PYTHON, finally here we concluded that we are making a Humanoid robot which can pick and place a desired object from the work space through commands given by us. So, a physically handicapped people can't do their works by them and even a blind person can't recognize the objects, so this robot can be used as an assistant and even to so tasks which humans can't able to do. So this robot is much more useful in these fields and not only in these fields can the robot be used in many other fields as our requirement.

IV. CONCLUSION

In order to achieve the result of the proposed project "FEATURE EXTRACTION OF OBJECT FOR A PICK AND PLACE ROBOT ", has undergone many phases. Coming to the status of our work, we have initially studied in detail about the ANN classifier and FE algorithm, Generic algorithm and other algorithms and about main objective of the object detection and recognition and also about pick and place robotic arm.

In our Project we have used modules such as camera module to capture the objects and store it in the database, Arduino Board for the physical motion of the robot and L298 H-Bridge Serial Motor Driver to move the robot it will control the rover speed and motion and actuator to turn the degree of the arm and a effectors an arm like structure to pick and place the target object. So we studied in detail about each component which are interfaced, thus we have interfaced the components successfully.

Here we have simulated the output by using PYTHON programming and observed the output of the simulation and a object is detected and recognized from a input image. We have completely implemented the work towards our project successfully.

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