Intelligent Robot Using Scale Invariant Feature Transform Detector

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Abstract- **Intelligent robot the concepts arrives from putting some idea into robots mind. Our robot intelligence is for recognizing different patterns assigned to different class of objects. This robot is simply a pick and place robot but having intelligence in it. The intelligence is added using image processing techniques. Image processing technique provides a reliable processing for the robot. The signal generated from processing the real time images is used as input to end-effector for doing the assigned work. These real time images are taken by a web-cam mounted on robotic arm. This added intelligence will provide a better regulated pick and place robot which can be used for different types of pick and place operations. Pattern recognizing is easier to implement than a object recognizing techniques and hence it will be suitable for small scale industries and for undeveloped area to start with robotic automation.**

Index Term- **Image Processing Based Robot, Intelligent robot, pick and place robot, SIFT algorithm**

I. INTRODUCTION

Intelligent robot as the name suggest, a robot with some added intelligent. A pick and place robot provided with some intelligence using image processing technique. Intelligence is mainly concern with recognizing some predefine pattern to obtain the class of the object. Based on the class of the object and placing it to predefined place. Since pattern recognizing is easier to implement the object recognizing technique, it will be helpful small scale industries and industries in undeveloped areas to get help of automation to increase the production in less investment. Image will be obtained in real time to match with pre-defined pattern. Once the match is found the object will be picked by the robotic end effectors to place it on its pre-defined place. We can assign the pattern to the object based on their type, class or requirements. Due to this we can increase the productivity of pick and place robot which can now be used to pick and place the object of different kind at different places. Because normally pick and place robots are used to pick the object from a specified place and place it to some different place any type of object coming will picked and placed on same place. So by this technique we can increase the productivity.

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II. PATTERN DETECTION

A. *Pattern Detection*

In this paper some pattern will be detected to detect the type of object or class of object. This pattern detection can be done by two methods one is feature based and other is template based approach. We can use feature base approach since the search image might get transformed in some manner. In this approach the entire template is not considered and features are extracted from the image for matching purpose. This extracted points will matched in real time to find the required object. Once the extracted feature come in area of action the pattern will be detected and further action can be taken. We can use OpenCV library to implement the pattern detection algorithm.

Fig.1

B. *Feature Extracting Algorithm*

We can use SIFT(Scale-Invariant Feature Transform) algorithm for detecting the feature in the image. We will provide the image of the pre-defined patterns at initial phase. SIFT algorithm extracts the feature of image in terms of keypoints. A pattern with contrast, and gradient variation in color to get more no. of keypoints. Because more gradient variation will produce higher number of keypoints resulting better detection image. As per our study the background should be a single color lighter than foreground color. This produces good keypoints for matching. White background is suggested for good results. Now these points are matched by

calculating the distance from the neighboring points. Based on the match it gives the no. of match points found in process. We can set a threshold value after which it can be considered as good match. This will avoid the false triggering. As per our study the working are should not be directly exposed to light i.e. a direct bright light should be avoided in the area for better matching. Light should fall directly but it should be enough for the camera. We should also give as many templates as possible to get the larger feature points. SIFT algorithm is scale invariant hence it provide a good result than some other algorithm in case of scale variation.

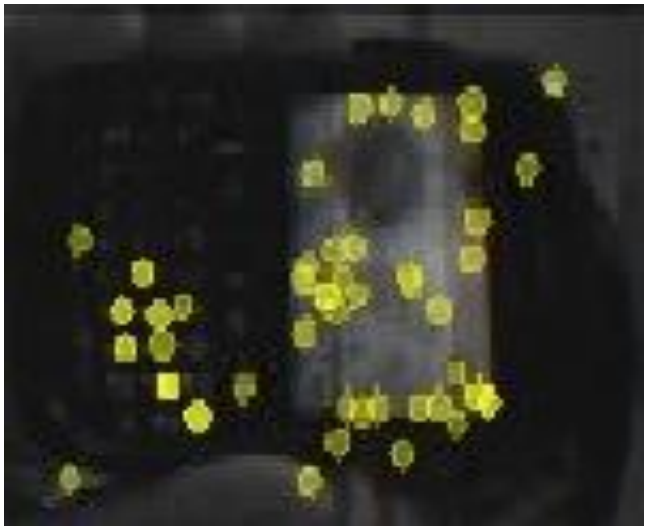

Fig. 2

C. *Image Matching*

Now we have to continuously provide the image as input to match and get the output. This can be done by providing a continuous video feed from a high resolution camera. Now the frame of the video feed can be used by processing it frame by frame. This means we will take a frame from the video process it if match found then action will be taken otherwise next frame will be processed. We can use FLANN technique for this because we will be comparing a set of images. Our study suggests that the camera should be at least 30fps to produces a good result. OpenCV provides the technique to process the frame without saving it, this saves a lot of memory space and gives a fast processing.

D. *SIFT Algorithm*

SIFT algorithm uses feature point detection for matching two images. Feature points are which provides needful information from the image which can be used get the task done. Some points which do not vary even on transforming the scale are called as **keypoints** or **interest point.** Keypoints are the information extracted from different locations of an image. These points consist of corners, junction and the region which have the sharp change from surrounding i.e. blob points. The keypoints have a large set of information about the image. These information doesn't change if we transform the image and hence this is Scale Invariant Feature Transform. The keypoints are also invariant to addition of noise, illumination and viewing angle. Hence this keypoints are stable key point which can be used to do various further processes.

Keypoints information can be variation in intensity or difference between two adjacent pixel etc. According to C. Schmidt[1] keypoint detectors can be of different type based on change in contour, change in intensity and change in parametric factors .

Contour based detectors detect the point on some 2D curve like change in shape, corners, junction of two curves etc. In intensity based detectors the computation of the interest point is done from the gray level image. And Parametric method based on the parametric function of an image.

SIFT algorithm is mainly based on an operator proposed by Lowe[2] known as SIFT operator. This operator being scale invariant also performs large number of feature extraction and identification.

Keypoint descriptors are used for comparing the keypoints of two images. The keypoint descriptors are the information collected from neighborhood of the image. This information can be used to distinguish between two keypoints. For generating keypoint descriptor normalized Gaussian filter is used for smoothening process. After this process the neighborhood is divided small regions. These regions are called as orientation histogram and these have the size of 4*4. By the above process keypoint descriptors are produced which are used for keypoint detection.

So, greater the number of key points more accurate the result will be. Hence by providing a large database of an image we extract more number of key points. Images of the same object taken from different perspective give larger number and different type of keypoints. The initial object detection result may not be accurate but as the number of detected keypoint increases with process the result becomes more accurate.

Due to all this regions SIFT algorithm becomes a useful algorithm for object detection programming. Also this algorithm is time efficient and consumes less memory. Due to its scale invariant approach this is a handy algorithm for pattern detecting intelligent robot. We are OpenCV library to implement our pattern detection program. OpenCV being a dedicated computer vision library provides an efficient solution for implementing image processing programs .

E. *SIFT In OpenCV*

There are different functionality of SIFT which can be availed in OpenCV . These functionalities are used to process an image in OpenCV using SIFT.

Following are some functions which we are using in our program.

sift.detect() this function is used to find keypoints in an image. To only detect some specific part of the image we can use mask for that.

sift.compute() this function is used to get the descriptors from the image. This function is mainly used after **sift.detect()** function.

sift.detectAndcompute() this function detects the keypoints as well as computes for descriptors in one function only.

cv2.drawKeyPoints() this function in OpenCV is used to draw small circle for keypoints.

cv2.DRAW_MATCHES_FLAGS_DRAW_RICH_KEY POINTS() this function is used to draw keypoint size circles and show the orientation.

III. IMPLEMENTATION

A. *Block Diagram*

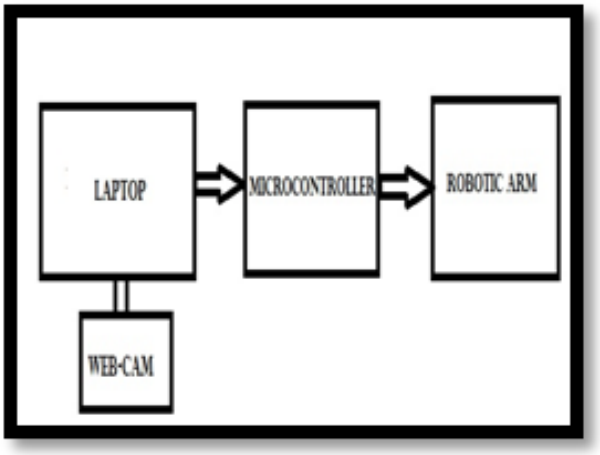

Fig. 3. Block Diagram

Fig. 3 above shows the block diagram of our image processing based intelligent robot. Here webcam will operate as eye of the robot which capture image provide it to the processing unit i.e. a laptop or a desktop system. This system will process the image and accordingly pass the signal to microcontroller which will make the arm to do the predefined task.

B. *Working*

Here the real time image from webcam will be given to processing unit for process. The keypoints from the image will be extracted and then it will be computed for keypoints descriptors. After this part these keypoint descriptors will be compared with the keypoint descriptor of template image. If the threshold amount of keypoint match is found then it will be considered as positive result i.e. image detected. Once the image is detected this signal will be passed to microcontroller. Now work of microcontroller is to make the robotic arm pick the object from its location and place it to the desired location. This task will be performed by microcontroller by controlling the different servomotor of the robotic arm. Servo motor will provide high accuracy to performing the task. In this way automated and selective pick and place robot can be implanted using image processing.

IV. CONCLUSION

Using SIFT image detection algorithm we were able to make a autonomous robot to perform pick and place task.
It gives very accurate result.

V. FUTURE SCOPE

This pattern detector robot can be later use as a cooking robot. Since vessels and method for cooking are repetitive, this robot can be used for the cooking purpose by increasing some intelligent.

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