# Self-Adaptable Assistive Robotic Arm (CareBot)

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***Abstract- As the proportion of people in the older age groups grows, demand in personal care provider increases. At all times they are in need to find alternatives for doing their daily activities. The ability of robotic technology to meet these demands is high due to technological advancements. Our aim is to design an assistive robotic arm system such that it is capable of moving around and performs the tasks assigned to it intelligently through self-learning such as fetching medicines, mobile phones, switching on/off gas, lights, fans, TV, washing machines, microwave ovens, gas regulators requires an arm with fingers that can do all these tasks. This may help the old age people and disabled reduce the cost of personal care nurse. We have designed a mechanical arm with a self-maneuvering robot which is able to pick an object from a certain place then deliver it to the patient. The developed vision system has advantage of interactive trainability with the help of the proposed graphical user interface (GUI), in which the required features can be easily selected by ordinary users.***

***Indexed Terms: Object tracking, Dimension estimation, 4 DOF Arm, Self-maneuvering, SURF (Speeded-Up Robust Features).***

## I. INTRODUCTION

Mankind is habituated to seek comfort. Over the last few decades, robotics research has expanded. Vision system play a vital role in the robot pick-and-place task and used to detect objects, and to measure their locations or poses. The aim is to design a user-friendly interface that can efficiently lower the level of difficulty of robot. Robot pick-and-place task is common for indoor service robots or automatic assembly lines. To achieve automatic robotic pick-and-place operation, many studies have been performed in the areas of anthropomorphic graspers design, sensor-motor coordination. The vision system detects even a small object placed randomly on a target surface. Based on a camera vision system the robotic gripper can grasp the object in a suitable way. Using a simple camera, we proposed a robot vision system that performed object recognition and 2D pose (rotational angle) estimation for robot pick-and-place operation. However, on the condition that the target objects are unrestricted, it will be difficult to achieve fully autonomous vision-based robot. With the help of the proposed GUI, the potential users do not need to have specialized knowledge. Pick and place robot arms are widely used in industries. The person could get help from this fully automated mobile robot for picking and placing the objects in the desired location. This robot can reach up to a small cupboard for picking the object. Thus, this robot would help the disabled to get their medicines out and their daily activities without much difficulty. The robot arm consisted of 4 DOF which was able to move front and back about 180 degrees. For the side, it was able to reach a maximum of 360 degrees it was the maximum range of the servo motor of the arm. A robotic arm based on haptic which can pick and place objects was designed.

Servo driver (PCA9685) is the main controller and the servo motors with a torque of 5kg for the robot arm are used with the gripper grabs. The project has been implemented, with further plans of making it an autonomous robot that would recognizes objects face and would categorize objects. The robot currently works with the function of picking up and placing the object i.e. pillbox.

## II. RELATED WORK

A robot with height 35.5 and 5 DOF [1] (degree of freedom) is designed to pick and place objects through voice commands. But it is restricted to pick the object with dimensions lesser than that of grabber. [2] Ahn, et al has developed a combination of three robotic systems (ReceptionBot, Carebot, and RoboGen) to upload and download patient’s information. [4] A grabber is proposed with two characteristics (self-adaptive, flexibility) to reduce the internal forces and provide a better force distribution for grasping. The papers [2, 8, 9, and 5] presents a robotic vision system which is capable of recognizing both different target objects by feature extraction method. [6]A PDA (personal digital assistants) based mobile robot system is developed for home monitoring by SLAM (simultaneous Localization And Mapping) and vision processing to avoid the obstacle. [8] Hands-off assistive robot for aiding persons during their rehabilitation by recognizing the patient intention and emotions using speech and gesture [7, 10]. It's the foremost preliminary step for proceeding with any research work writing.

## III. METHODOLOGY

The Self-Adaptable Assistive Robotic Arm (Carebot) is designed to work in the following two modes:

### i) *Two type of mode:*

a) Time triggered mode: In this method, the bot delivers the pill box to the user in time as per instructed to it.

b) Event-triggered mode: in this method, the bot delivers the object which is selected by the user through the GUI.

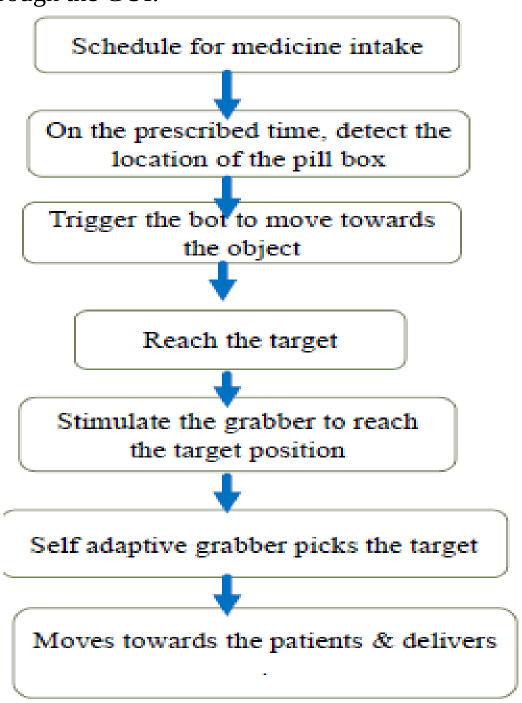


Fig.1. Time Triggered Mode

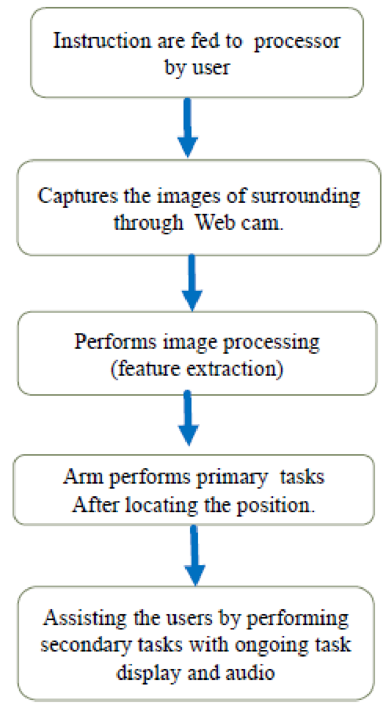


Fig.2. Event Triggered Mode

### ii) *Description*

- The user can select the mode from the GUI and the respective mode is send to the processor through Wi-Fi via mobile.
- In Time triggered mode, the user can modify the to-do-list with respective to the time.
- It periodically checks the list and reminds the user to do the secondary task right in time without any delay.
- The objects are trained for the picking with the help of feature extraction and stored it in the database. The user can easily select the object to be pick in GUI.
- Images are fetched using IP-Webcam/RPi cam and get processed by Open-CV (blurring, thersholding, colour segmentation).
- After locating, object is recognized, and its dimension are identified.
- The grabber is adjusted by calculating the width the jaw so that its adaptable to pick the object rather than causing harm

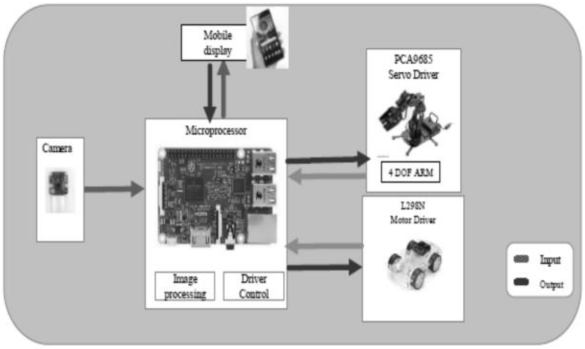


Fig. 3. Block Diagram

## IV. IMPLEMENTATION AND RESULTS

*i) Object tracking:*

The image is taken through Rpi3 cam and resized for easy betterment of processing. The image is blurred using Gaussian blur for noise reduction. The color conversion is done. The color segmentation is done by getting Upper and lower bound (color) of the object. Erosion and dilation is done for morphological transformation which erodes the boundaries of the foreground objects (noise removal).

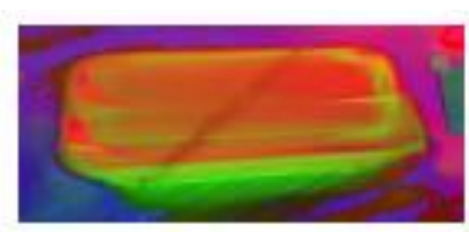

Fig 4. Conversion of image to HSV

Fig. 5. Masking (Thresholding)

ii) *Dimension marking:*

Then the contours is obtained and the moments of the contours is taken for identifying the centroid. The corner points of the contours is consider for calculation of the dimension of the object. Then the corner points are joined together and the distance between mid-points are calculated using Euclidean distance. With the help of pixel per matrix method the dimension of the object is identified.

Centroid (Cx, Cy) is given by the relations, $Cx = M10/M00$ and $Cy = M01/M00$

Euclidean distance:

To identify the pixels between the two points.

If p = ($p_1$, $p_2$) and **q** = ($q_1$, $q_2$) then the distance is given by

$$D\,(p, q) = \sqrt{(q_1 - p_1)^2 + (q_2 + p_2)^2}$$

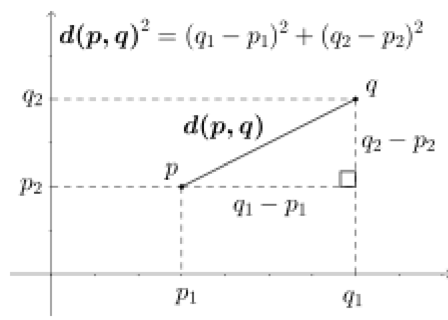


Fig 6. Euclidean distance

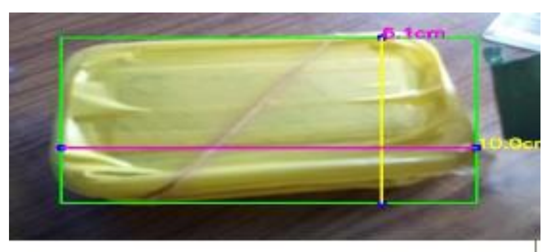


Fig 7. Dimension marking

iii) *Object identification* (Feature Extraction & matching)

The images of various objects are stored in datasets with its respective features (Key points and descriptions) by means of SURF method. The train image and query images are compared with features.

The similar features are joined by flan matcher technique.

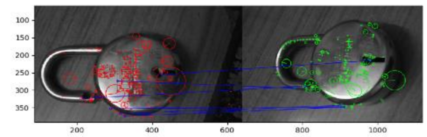

Fig 8. SURF and matching

*iv)CareBot design:*

a) Robotic Arm:

The arm was made using 7 servo motor of MG995 with brackets (U & L). Designing a 4 DOF arm is done by considering the weight handled by the base. In the upper arm, the camera is been installed for capturing. PCA9685 driver is used to controlled the Robotic Arm.

Fig 9. Servo Control using GUI

Fig 10. ARM

Fig 11. 4 DOF ARM motion

b) Chassis:

The chassis consist of two 12v DC motors and L298N driver IC for the movement.


Fig 12. Chassis movement

v) *Reminder GUI*

For time triggered mode a reminder GUI is created


Fig 13. Reminder GUI

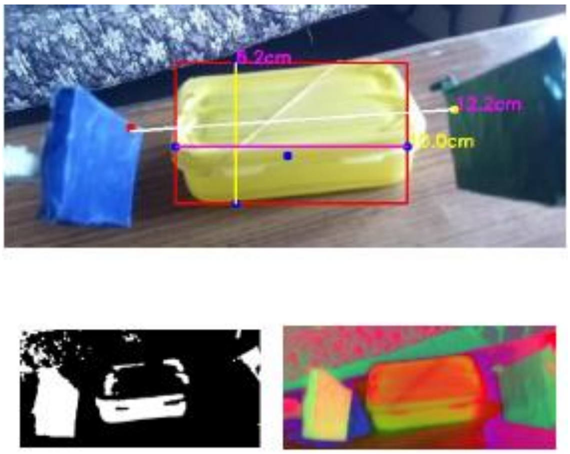

Fig. 14. Locking of Grabber

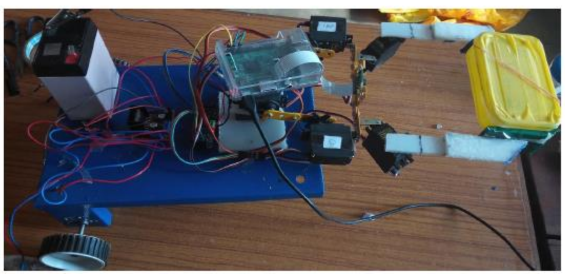

Fig. 15. The CAREBOT

## VI. CONCLUSION

In this paper, we have designed and implemented a 4 DOF (degree of freedom) self-learnable robotic arm system with vision that can recognize different objects and track the objects in order to pick the same and place it where the user wants. This Carebot can be programmable and trainable corresponding to the application and for future extensions. Carebot's function comes under two different modes that are time triggered mode and event triggered mode. By utilizing time trigger mode, the Carebot automatically grabs the object and place it near to the user as per the time schedule. In event trigger mode the user can select the desired object using GUI interface to pick and deliver the required item. The proposed GUI allows the user to control the robot to do the tasks without any technical knowledge. From object recognition experimentation, the accuracy rate is 100% for the 5 target objects indicating that the selected features are good enough to recognize the objects and it is able to grab the trained object successfully. However, for the future use, more other interpretable features can be included in the GUI in order to recognize more number of different objects at the same time. The future applications of this self-adaptable robotic arm can be expanded in various environments such as assistive bots, pick and Place bots, target tracking bots, surveillance bots and dismantling bots.

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