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A Innovative Approch for Robotic Hand for Object Tracking and Grasping Methods

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Abstract -From the last two decades making robotic hand with enhanced capabilities is the main object and lots of work has been done in this field. This paper focuses on different methods which are used for robotic hand systems. Diversification is stated in areas of the grasping techniques, fingers, the degrees of freedom and quality of hand. The Degrees Of Freedom (DOF) terms describes the flexibility of grasp. The controlling mechanism is either sensor based or gesture controlled or simulation based or pre-programmed states. From the evolution with clamp type industrial hand, now the five finger and with more functionality and flexible artificial hand are available. They different in the manner of their design and techniques to operation and interaction with the object, day by day the research in this field is trying hard to make more functional and advancement in the artificial hand, here we are trying to find out the previous methods to track and grasp the object by different type of robotic hand.

Keywords- Robotic hand, Robotic arm, DOF, Gesture Control.

I. INTRODUCTION

Form the evaluation of robots, (the word rabu meaning slave) human are trying to make more useful so that the work has been done in more comfort and efficient manner. So that they have developed the replica of most important body parts of human being is Hand as robotic hand. The whole body of any human being is supported in terms of input or sensing and output as physical work on hand, it is complex and load bearing part of body. Thus the best mechanism to make multipurpose robot is to develop a mimic of human hand as robotic hand, they are much useful in defense, hazardous area, natural accidents, limb persons, defense etc. that's why it is the growing field of research in this area.

However we are getting more & more flexibility in the robotic hand, but it's also increase the complexity in parallel. Now in this section we discuss about previous techniques and work on robotic hands.

II. REVIEW OF ROBOTIC HANDS

2.1 Industrial ROBOT STAUBLI TX 90, the Mechanical Hand SAH with Collision Detection

The Schunk Anthropomorphic Hand (SAH) used with the Industrial Robot Staubli TX 90developed by Jan Rosell Raul Suarez Carlos Rosales and Alexander Perez [1] was controlled by hand and robot simulator which captured the hand positions and movements with sensitized gloves. The SAH which is based on the DLR hand has three fingers with four joints and the thumb with five joints, thus there are a total of 17 joints with 13 independent DOF (see Figure 1) .The industrial robots Staubli TX 90 has six DOF.

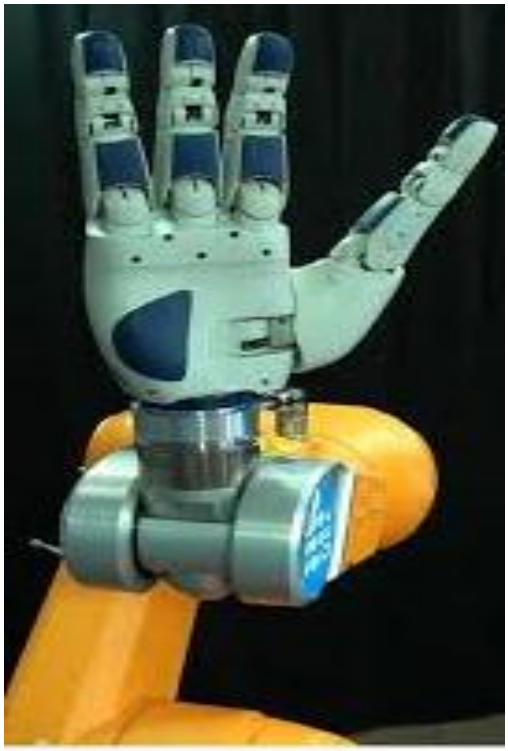

Fig. 1 Anthromorphic SAH Hand attached with

2.2 Real Time Robotic Hand Control Using Hand Gestures:
This paper proposes a model of robotic hand which is controlled by image processing using mat lab tools for real time image processing , it's also normalize and for noise reduction. the [process are followed which includes image acquisition hand gesture recognition determination of hand patterns using PCA algorithm [2] and then conversion into control instruction the control the artificial hand.

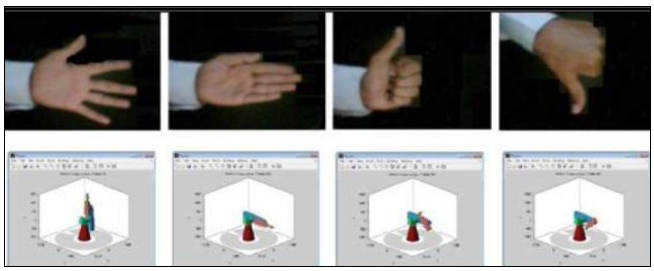

Fig. 2 Gesture database

They have used PUMA robotic hand (fig 2) to implement the motion trace by the human hand, there is a data base of different gesture consisting of binary image of size 60 x 80 pixels which are pre stored. So that it uses less memory in pattern recognition, and whenever a patter is matched with the pre stored patterns the set of instruction related to that gesture is identified and then instructions are passes for the execution the commands are written in specific language as functions which according to the robot, by this manner robotic system is control using camera with live streaming.

Fig. 2.1 PUMA Robotic Hand

2.3 Multi Fingered Robotic Hand Controlled using Bluetooth Wireless Module:

This model is based on master slave control concept where the sensitized glove acts as master and the multi fingered hand acts as slave. The master controls the slave using KC-21 Bluetooth wireless module. The slave has 5 fingers with a total of 15 DOFs by 3 DOF for each finger. The multi fingered hand was developed using 5 volt dc motors which are controlled by L293D motor drivers. The end effectors, the robotic hand also has flex sensors to act as a feedback mechanism for tracking the movement of the dexterous hand. To control the robotic hand PIC18F4520 18's family mid range microcontroller is used as controller.[3] The master (sensitized glove) has flex sensors, the bend sensing resistance which is worn on the human hand and senses the actual position and tracks the movement of fingers.

2.4 The Handroid:
The Handroid prototype (see Figure 3) was which is a remotely operated five finger movable robot hand was developed by ITK Japan. It can be used in environments which are dangerous to human hands [4].

It has a thumb and four fingers with 15 DOFs on the whole which include 5 Degrees Of Freedom in each finger, can replicate the exact movements of human hand. [4]. It is controlled by using 6 motors connected to the wrist, in which 4 are used to control the fingers and 2 for the thumb. The intervention in this model is the inclusion of fluid motion to provide better control. The artificial hand is constructed with light weight aircraft part using advance metal working techniques. It is controlled by a correspondence between master human hand and slave robotic hand.

Fig.3 the Handroid

The gloves which having sensors are worn by human hand acts as the master which remotely controlled the robotic hand when the master hand perform any motion the sensors are e to slave robotic hand.

2.5 iHY Robot Hand:
iRobot has design iHY robot hand (see Figure 4) designed by Harvard and Yale students is a design three finger mechanism in which one is opposite to other two. To increase flexibility and durability they have induce high quality polymer material... Heavy drilling machines can be held by these hands. The griping mechanism is controlled n by the five motors in which four are to operated the finger and one motor is for moving the hand from one

orientation to another.. An added part called the finger nail enables the pinch grasp feature for picking cards; tiny balls etc. (see Figure 5). [5] Motor allows that wrap the object clutching it firmly.

In iHY robot they have use fiber optic sensor [5] to track the object depending on the variation in joint angles. So that the receptor of the light identifies the amount bending that the Finger has been taken. Each finger has a separate microcontroller embedded in it which collects data from the sensors an process it f grasp, or the manipulation and actuation for the finger to perform the grip, the pressure sensors are to embedded to indicate how strong and powerful the grasp.

Fig. 4 iHY Hand

Fig. 5 finger of iHY Hand picking object

The figure 5 show the how accurate the hand to pick the object, we can see the sensors inside the body of fingers.

2.6 I-Limb Ultra

The I-limb ultra is a hand that is designed for people who need more functionality and prosthesis. With i-limb ultra looks like a natural hand [6]. Fig(6).

It is controlled by the software called biosm,that provides hand post uses that are needed for daily lives. It has 14 Predefined grips we used to complete daily life's work like pinching mode index finger mode, thumb push etc.

It also has the fingertip feature, that allows us to have an extra power grip used like when bottle cap, tying shoeless, etc. [6]. This robotic hand has four fingers with thumb which be manually rotated to the desire grasping position.

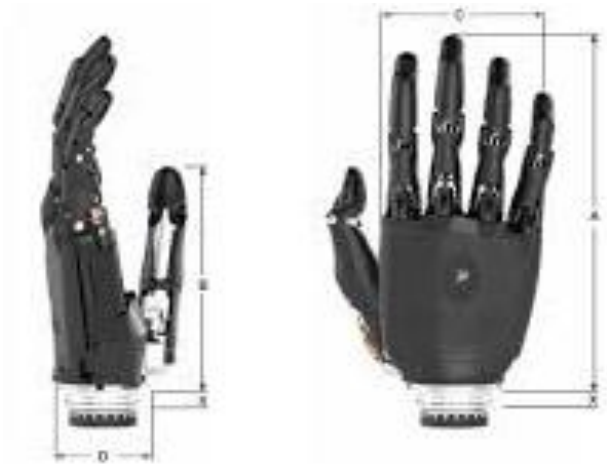

Fig. 6. I-Limb Ultra

Fig.7. I-Limb Ultra hand holding ball

It also has a Mobile app that can be used to switch between the pre defined 14 configurations. [6] And the auto-grasp in which hand automatically moves to the natural position after period of inactivity. That prevents the objects from slipping from grip.

2.7 Hand Gestures Controlled Robotic Arm:

This robotic hand deals with designing a robotic hand that copies the gesture human hand. It's having sensors and actuators connected by xbee module on UNO arduino board. [7]

The Ardino IDE is used for the operation like manipulation and analyzing of input taken by the sensor and producing the outputs for driving the motor. it has the glove specially design for controlling the robotic hand , the glove itself contain the sensors that track human hand movements and parallel transfer the signal to robotic hand , the whole program is coded in c/c++.I the glove there is a sensor for each finger, the variation in bending cause to change in resistance , thus the variation in resistance is read as input in the form of analog signal I taken by arduino Uno and then further processed and manipulated for the desire output and send the signal to the actuators.[7] in this model thee arm posses servo motors to control the finger movement and three motors are there to control tilt and pan movement .the angular movement s are controlled by arduino uno itslf for the accuracy. The difference in this model is the use of two arduino Uno board communicated trough XBEE module, which is connected in gloves with transmitter and receiver and in robotic hand as well and the communication is integrated with radio frequency.

2.8 Shadow EDC Hand

The shadow robot company has developed the most advanced dexterous hand The Shadow EDC (Ether CAT Dual Can) hand, which can be mounted on a range of robot arms as part of it, and used as a tele operation.[7] (see Figure 8) its initial features are the High Bandwidth sensing, Human Kinetics, and Biotic Tactile sensors, etc.

It has 20 actuated DOF (degree o freedom) and 4 actuated movements for it joints. These joints are responsible for the exact human motion and palm and thumb motion. it has total of 129 sensors which enable to manipulate the control system and understand the environment conditions, it also sense the position and force sensors along it the tactile sensing data which transferred using 100Hz to1 KHz bandwidth through Ether CAT interface.

Fig: 8 Shadow hand holding Egg.

The most important achievement in this model was the algorithm which is used to Grasp Stabilization And Control (GSC), [7] with the use of Based cloud values and parameters and 3d value, segmentation algorithms applied which find the pre computed grasp and its implementation if the grasped of object is not known and it's not yet computed then the collection of all possible grasp are collected and the mesh is reconstructed over it.

2.9 Analysis of Hand Arm System using Electro Goniometer:

This model of robotic hand is actuated by a equipment which is command control an uses an electro goniometer to sense the hand movement, the electro geniometrer is having one potentiometer and two rods,one is with ulna bone on longitudinal axis and the other axis is free the rods are fixed with forearms and hand with elastic straps to executing the flexion extension movement in the same time similar to the hand.see fig(9). The computation has been done through Arduino Mega2560 and processed in C/C++ coding languages. Then evaluated values are transferred using Bluetooth module to the artificial hand using. This robotic hand having flexion extension actuators o movements in fingers and the thumb rather than motors to prevent skeletal disorders.

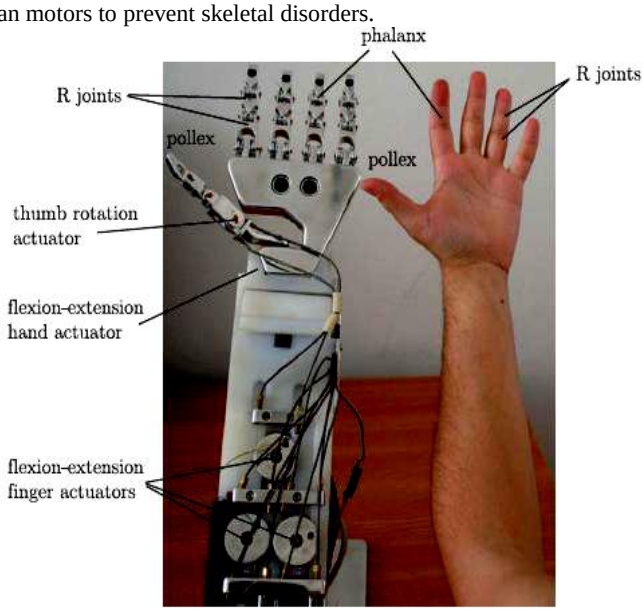

Fig. 9 Artificial hand

The main study was related to wrist joint movement and its normal and abnormality from a series of test results, then the Largest Layout Exponent (LLE) was calculated .It was found that the mean LLE of the wrist movement was approximately from 0.020 to 0.032. Based on these results [9] the exact movement of human wrist was replicated to the artificial robotic hands.

III. EXPERIMENTAL SETUP FOR OUR CASE STUDY

Following the design philosophy proposed in section,

We will try to develop the robotic hand and arm system which is specially design in such a manner so that it would be efficient in the terms of mobility and trying to put as much function as possible to increase the usability of robotic hand, but the main focus is to implement the image processing technique by which we can easily control the robot hand, whether it is not visible for the master hand or human being.

IV. CONCLUSION

It is clear that most or all of the research already carried on-To develop a robotic hand, including projects not presented in this paper, involves one common purpose, i.e. the study of control techniques on dexterous manipulation. One of the first arising problems is that the mechanical Configuration by itself penalizes the achievement of a good Final design since it's harder for a non-anthropomorphic Robotic hand to manipulate with dexterity objects which have been designed to be manipulated by a human hand.
The reduction of the controlled DOF in order to reduce the number of actuators and sensors may lead to a complex mechanism as seen in the Belgrade/USC Hand, but is an approach that can be partially reused in a design process depending on the task. Peter K. Allen, Member, IEEE, Aleksandar Timcenko, Student Member, IEEE, Billibon Yoshimi, Student Member, IEEE, and Paul Michelman, Member, IEEE, [10] have developed a robust system for tracking and grasping moving objects. The system relies on real-time stereo triangulation of optic-flow and is able to cope with the inherent noise and inaccuracy of visual sensors by applying parameterized filters that smooth and can predict the moving object's position. Once this tracking is achieved, a grasping strategy is applied that performs an analog of human arm movement schemas[10].

This has been achieved with the robot PUMA which is an industrial robot and useful in special condition. We are trying to developed a mobile robotic human hand, which is easier to handle and useful for robust conditions like natural hazard defense, bomb diffusion, substitute for limb persons, and try to make it more efficiently that when the robotic hand is not in our vision it can find and grasp the object, so that we are trying to implement image processing technique to send the signal to its master hand or remote and thus it would be easily accessible and operatable for master hand.

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