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A Survey Paper on Gesture Replication on Robotic Hand

Sukant Agarwal[1], Priyanka Borse[1], Prasad Dhumne[1], Shweta Thakare[1], Babita Sonare[2]
[1]UG Students, [2]Assistant Professor
[1,2]Department of Informaion Technology,
Pimpri Chinchwad Colllege of Engineering, Pune, Maharashtra, India
Email: *prasadhumane@gmail.com*
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Abstract

In many industries, gesture replication on robotic hand has a wide scope. It is also found that it is widely used in the educational fields. If you are looking for a more regular method that will provide an interactive form easily happens to be gesture control. Using physical devices has always been a method widely used. Replica of human hand can made using different modes, operating schemas and different number of degrees of freedom. Few of the most significant models are studied and analyzed in order to provide more know about its working. To provide more ease of operation image input can be used. This input needs to be captured and processed in order to hand the system. Some of the gesture recognition method studied along with these robotics hands for future use.

Keywords: *Gesture, gesture replication, robotic hand*

INTRODUCTION

Many modes of communication with robots are available. Some involve wired as well as wireless devices to communicate. Gesture communication is one way which has provided more natural way of controlling and provides a rich and intuitive form of interaction with the robotic system. Thus, communicating with gestures has been proved a powerful method.

In the robotic industry efficiency, accessibility and accuracy of the system are must. These robots perform jobs that are harmful, repetitive, boring as well as stressful. Though robots can be a replacement to humans but they still need to be controlled by human itself.

Human hand produces hand gesture which helps on providing commands to the robot. Robotic hand which is an electromechanical system can replicate these gestures easily. This gesture replication on robotic hand has a wide scope in industrial as well as educational fields.

As far extracting gestures and reproducing the same is concerned, you should find a number of such systems. They not only capture the image, but also identify the specific gesture before generating the signals.

LITEREATURE SURVEY

Existing Systems

Robotic hand being electromechanical system is one of the most complex design to generate, lot of enhancement has been done to generate and replicate human hand. Thus, in order to increase the functionality and resemblance to human hand, design of robotic hand is becoming complex from decades. Efforts have been put on to produce more functional &cost-efficient robotic hand.

Following is a brief detailed study about few of the robotic hand system:

- As far as the iHY robot hand is concerned, it has a shape of two fingers with a thumb hand with five fingers. As we are aiming for both durability as well as flexibility with heavy duty using the elastic joints is

- possible too. The iHY hands are capable of handling as huge as drilling machines. So looking after something like ball bearings isn't any issue.
- A mimic's human hand in the form of hand gestures controlled robotic arm is also present in the market. It is composed of sensors and actuators which are connected by XBEE module through Arduino uno board, for manipulation operations like analyzing the sensor inputs and producing the motor driving outputs are done in Arduino IDE with the programs in C/C++language.
- A physical device which is a robotic glove is used as a controller with sensory controller mechanism that has sensors to track the movements of human hand. These servo motors receive the driving angle from the Arduino uno connected to it. The main modification in this method is the use of XBEE modules for communicating between the two Arduino uno boards.
- Another model which uses an electro goniometer to track the hand movements also exists. The electro goniometer is made of one potentiometer and two rods; one of them is fixed on the longitudinal axis of ulna bone, while the other axis is mobile, executing the flexion–extension movement in the same time with the hand. The forearm as well as the hand with elastic straps is where they fix the rods. Post that the values are shifted to the computer that are already documented from the potentiometer. For this the Arduino Mega2560 is put to use before being processed in C/CPP. The Bluetooth module comes into play here that helps in transferring the manipulated values to the artificial hand. This hand has flexion extension actuators. These are brought in use for fingers and thumb instead of the motors. This helps avoiding skeletal disorders.
- The Handroid prototype is a movable robot hand that the user can operate remotely. It's designed to have five fingers and a thumb. It helps in 5 Degrees of Freedom (DOF) for every finger. This totals to 15 Degrees of Freedom as a whole. As a result, it can copy the precise movements of a human hand. One of the key improvements here is having fluid motion. It assists in offering advanced controls for you. Improved and better metal working tech is put to use, so the hand is made to be more durable when in actual use for longer period of time. For controlling the robotic hand, the sensory gloves make the job done for remotely controlling the robotic hand.
- A model that provides real time image capturing and processing of the actual hand movement that can control the robotic hand has been proved very useful. It uses MATLAb for image manipulation.

Many operations on image like capturing the image, normalising, and noise reduction is done in MATLAB.A systematic approach is followed which includes image acquisition, hand gesture extraction, determining hand pattern using Principal Component Analysis (PCA) algorithm and converting them. There's a gesture database that's built with a bunch of binary images. These images are of 60x80 pixels. Having stored these images in the database, it becomes a time-saving and space-saving measure when it comes to pattern recognition. When two identical gestures match, especially from the database matches, it's identified and sent over to the robot to execute.

Table 1: *Comparision of Existing Robotic Hand Systems.*

	Designed by or for	**Grasp used**	**Help's in**	**Used sensor**
ihy Robot hand	By Harvard and Yale students	Pinch Grasp	Picking cards, tiny balls.	Fiber optic
I-limb ultra	For prothesis	Auto Grasp	Choice to complete daily chores.	Touch
Analysis of hand by electro goniometer	For prothesis	Extension type gasp	Executing the extension movement.	Pressure
Kinetic humanoid hand	For medical purpose	Thumb and finger grasp	In areas such as manufacturing, space exploration.	Tactile
The Handroid	By Japan students	Auto Grasp	In engineering environments which are inaccessible & Dangerous to human hand.	Magnetic field
Shadow EDC Hand	By Shadow Robot Company	Precision Grasp	Industry standard interfaces and can be used as a tele-operation tool	Pressure, tactical, bio

VISUAL SENSING OF ROBOTIC HAND

Though you can find a number of body motions to start a gesture, the most common of them are the hand and face orientation. You can define gesture recognition as a process of tracking gesture for the sake of representation and then to convert them to an understandable command.

The operation of robotic hand is done by capturing and calculating the pose of the user.

- Be it the hand, palm, or even the fingertips, all can be distinguished separately. The position of the hand and the fingers is calculated. It is done through Euclidean distances as well as angles of the body parts. This helps in finalizing the movement of the serial frame quite easily.

Later, these movements of the fingertips are mapped to the fingers of the robotic hand.

Steps for Image Recognition

Filtering and Sampling

This process helps to bring down density points for processing in the ensuing stages. That's not all it helps to keep a reasonable resolution. This goes on to help to make out the difference between the palm and the finger clearly without any conundrum.

Skin Detection

Then a transformation of color image from skin-color regions into a grayscale image is done such as the value at each point indicates how much the point belonging to the skin tone. Though different ways are present to compute these thresholds to handle uncontrolled imaging conditions, use of a classification technique for thresholding, which is a dynamic or adaptive, is done. This will help to establish some initial thresholds from the average intensity of the high gradient.

Hand Descriptor and Tracker

The region of human hand can be only detected only after obtaining the skin color region. The input frame may also contain some unexpected objects such as the doors,

furniture, etc and these objects are surely not near to human skin. So to overcome this and to improve the accuracy of detecting and tracking the human hand the frames must be flirted and information to be trimmed.

Algorithm

1. You will need to extract the image of a hand from your video streaming.
2. Present skin color based detection technique is used for hand detection which uses images of YCbCr color space. Images of the type are obtained by transferring the extracted frame from RGB color space.
3. To remove some noise and to enhance the image quality some preprocessing techniques, this may include morphological erosion using 15×15 structuring elements, image filling, etc. But before that convergence of pixels is done. The complete image which contains the detected hand is converted into black and white image where the skin pixels are converted to white and non-skin pixels which can be background pixels are converted into black.
4. The process of feature extraction is done with the help of a centroid and this centroid is drawn with the help of perimeter and orientation of detected objects, its area and equivalent diameter which can be brought into being from the frame. This centroid helps to draw a circle similar as the background color pixels and the radius calculation is done using the given formula. Thus, until non-conflicting output is obtained, we continue to use all the features.
   R f = (EquivDiameter/2) + σ (1)
   σ is some threshold value.
5. You can recognize the gestures after you count the white objects and image orientation. Thereafter, you pass a command to the computer's application so you make out the actual gesture.

CONCLUSION

From observation that has been made, it clearly shows that this movement is precise accurate, and is easy to control and user friendly to use.

Thus, the study for the development of robotic hand has been carried out successfully.

Its development should provide us with the solution to general problems like picking or placing things or objects that are away from the user also picking and placing hazardous objects in very fast and easy manner.

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