MANTECH Publications

International Journal of Robotics and Autonomous Systems
Volume 6, Issue 1, January-June, 2021

Robotic Hand Gesture Replication- A Survey

S. Mallikraj[1], V Gopal[2]
Assistant Professor
Department of Mechanical Engineering
KCG College of Technology, Tamilnadu
Corresponding Author's Email id: *s.mallik_raj@gmail.com*

Abstract

Gesture reproduction on a robotic hand offers a wide range of applications in a variety of sectors. It's also discovered that it's commonly employed in educational settings. If you're searching for a more regular technique to give an interactive form, gesture control is a good option. Physical devices have long been a popular mode of communication. Different modes, operating schemas, and degrees of freedom can be used to create a human hand replica. A few of the most important models are explored and analysed in order to have a better understanding of how they work. Image input can be utilised to make operations easier. In order to hand the system, this input must be captured and processed. Some of the gesture recognition methods were investigated in conjunction with these robotic hands for future applications.

Keyword: *Robotics sector, Gesture communication, Robotic hand,*

INTRODUCTION

There are numerous ways to communicate with robots. To communicate, some use both wired and wireless devices. Gesture communication is one method that has enabled a more natural means of directing and interacting with robotic systems, as well as a rich and intuitive type of engagement. As a result, communicating using gestures has shown to be an effective way. In the robotics sector, system efficiency, accessibility, and accuracy are critical. These robots carry out hazardous, repetitive, dull, and unpleasant tasks. Though robots can take the place of people, they must still be directed by humans.

Hand gestures are produced by the human hand and are used to provide commands to the robot. These gestures can be easily replicated by a robotic hand, which is an electromechanical system. This motion reproduction on a robotic hand has a wide range of applications in both industrial and educational settings.

There should be a number of methods available for extracting gestures and replicating them. Before creating the signals, they not only record the image, but also identify the exact gesture.

SURVEY OF LITERATURE

Existing Methodologies

Because the robotic hand is an electromechanical system, it is one of the most difficult designs to create. A great deal of work has gone into creating and replicating the human hand. As a result, robotic hand design has become increasingly complicated in recent decades in order to improve usefulness and similarity to human hands. Aims have been made to develop a more functional and cost-effective robotic hand.

The following is a brief overview of a few robotic hand systems:

- The iHY robot hand is made up of two fingers and a thumb hand with five fingers. Because we are seeking for both durability and flexibility with heavy duty, we can also use elastic joints. Hands as large as drilling machines can be handled by the iHY. Taking care of something like ball bearings isn't a problem.

- A robotic arm that mimics a human hand using hand movements is also available on the market. It is made up of sensors and actuators that are connected to an Arduino uno board by an XBEE module. Manipulation tasks such as evaluating sensor inputs and producing motor driving outputs are performed in the Arduino IDE using C/C++ programmes.

- A physical device, a robotic glove, is employed as a controller with a sensory controller mechanism that includes sensors to track human hand movements. The driving angle for these servo motors is determined by the Arduino uno that is linked to it. The usage of XBEE modules for communication between the two Arduino uno boards is the most significant change in this method.

- There is also a model that tracks hand movements with an electric goniometer. The electro goniometer is made up of one potentiometer and two rods, one of which is anchored to the longitudinal axis of the ulna bone and the other of which is moveable, allowing the hand to flex and extend at the same time. The rods are held in place by elastic straps on the forearm and hand. The values are then transferred to the computer, which have already been documented from the potentiometer. The Arduino Mega2560 is used for this, and it is then processed in C/CPP. In this case, the Bluetooth module comes into play, assisting in the transfer of altered values to the artificial hand. Actuators for flexion and extension are present on this hand. Instead of using motors, these are used for fingers and thumbs. This aids in the prevention of bone problems.

- The Handroid prototype is a moveable robot hand that can be controlled remotely by the user. It's made with five fingers and a thumb in mind. It aids each finger's 5 degrees of freedom (DOF). This adds up to a total of 15 Degrees of Freedom. As a result, it can accurately mimic human hand movements. Fluid mobility is one of the most important improvements here. It helps you by providing advanced controls. The hand is made to be more robust when in actual usage for a longer amount of time, thanks to improved and better metal working technology. The sensory gloves perform an excellent job of directing the robotic hand remotely.

- A model that captures and processes real-time images of genuine hand movements in order to operate the robotic hand has proven to be quite useful. It manipulates images with MATLAb.

In MATLAB, many operations on images are performed, such as picture capture, normalization, and noise reduction.

	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

Image capture, hand gesture extraction, hand pattern determination using the Principal Component Analysis (PCA) algorithm, and conversion are all part of a systematic approach. A gesture database is made up of a collection of binary images. These photos have a resolution of 60x80 pixels. When it comes to pattern identification, storing these photographs in the database becomes a time- and space-saving solution. It's identified and supplied to the robot to perform when two similar gestures match, especially from the database.

ROBOTIC HAND VISUAL SENSING

Though there are a variety of bodily motions that can be used to begin a gesture, the hand and face orientation are the most prevalent. Gesture recognition can be defined as the process of tracking gestures for the purpose of representation and then converting them into a command that can be understood.

The robotic hand's function is accomplished by capturing and calculating the user's stance; the hand, palm, and even the fingertips can all be identified separately. The hand's and fingers' positions are calculated. It is accomplished using Euclidean distances and angles of body parts. This makes it simple to complete the serial frame's movement. These movements of the fingertips are afterwards translated to the robotic hand's fingers.

Image Recognition Procedures

Sampling and Filtering

This procedure aids in the reduction of density points for subsequent processing.

That's not all; it also aids in the maintenance of a reasonable resolution. This continues to assist in clearly distinguishing between the palm and the finger without any ambiguity.

Skin Detection

After that, a colour image is converted from skin-color regions to a grayscale image, with the value at each point indicating how much of the point belongs to the skin tone. Though there are other methods for computing these thresholds to deal with uncontrolled imaging settings, the usage of a dynamic or adaptive classification strategy for thresholding is used. This will aid in the establishment of some early thresholds based on the high gradient's average intensity.

Tracker and Hand Descriptor

Only after getting the skin colour region can the region of the human hand be recognised. The input frame may also contain some unexpected objects, such as doors, furniture, and other similar items, none of which are likely to come into contact with human skin. To circumvent this, frames must be flirted with and information reduced to increase the accuracy of identifying and tracking the human hand.

Algorithm

1. From your video streaming, you'll need to extract a hand image.

2. For hand detection, the current skin colour based detection technique is employed, which employs images in the YCbCr colour space. The type of image is created by converting the retrieved frame from RGB colour space to CMYK colour space.

3. Some preprocessing techniques, such as morphological erosion with 15 15 structural components, picture filling, and so on, may be used to remove some noise and improve image quality. But first, the pixels must be converged. The entire image, which includes the identified hand, is transformed to black and white, with skin pixels becoming white and non-skin pixels, which could be background pixels, becoming black.

4. The process of feature extraction is carried out with the aid of a centroid, which is drawn using the perimeter and orientation of detected objects, as well as their area and equivalent diameter, which may be derived from the frame. This centroid is used to draw a circle that is comparable to the background colour pixels, and the radius is

calculated using the algorithm provided. As a result, we'll keep using all of the features until we get non-conflicting results.

R f = (EquivDiameter/2) + σ (1)

o is some threshold value.

5. After counting the white objects and orienting the image, you should be able to distinguish the gestures. After that, you give a command to the computer's application, which allows you to see the actual gesture.

CONCLUSION

Based on the observations gathered, it is apparent that this action is exact and accurate, as well as easy to handle and use. As a result, the study for the construction of a robotic hand was completed successfully.

Its advancement should provide us with solutions to common difficulties such as quickly and easily picking and placing things or objects that are far away from the user, as well as picking and placing hazardous materials.

REFERENCES

1. Pablo Gil1,*, Carlos Mateo1, Fernando Torres1, "3D Visual Sensing of the Human Hand for the Remote Operation of a Robotic Hand" International Journal of Advanced Robotic Systems.
2. Saurabh A. Khajone, Prof. Dr. S. W. Mohod, Prof. V. M. Harne (May 2015), "Implementation of a Wireless Gesture Controlled Robotic Arm", International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE), Volume 4, Issue 5.
3. Aditya Purkayastha, Akhil Devi Prasad, Arunav Bora, Akshaykumar Gupta, Pankaj Singh (May 2014), "Hand Gestures Controlled Robotic
4. ITK (2012), "Multi-fingered Robot Hands Handroid" from:http://www.itkpro.com/en/pro/kin dengisyu.htmITK.Japan "Handroid" Hyper Japan.
5. Daniela Tarnita, Dan B. (2013), "Analysis of a hand arm system", Marghitu Robotics and Computer-Integrated Manufacturing, Volume 29, pp. 493–501.
6. Satyam M Achari, Shashwat G Mirji, Chetan P Desai, Mailari S Hulasogi, Sateesh P Awari (May 2018), "Gesture Based Wireless Control Of Robotic Hand Using Image Processing", International

Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056 Volume 05, Issue 05.

7. C.V. Vishal Ramaswamy, S. Angel Deborah (January 2015), "A Survey of Robotic Hand- Arm Systems", International Journal of Computer Applications (0975 – 8887) Volume 109, Issue 8.
8. Arm", Journal of International Academic Research For Multidisciplinary Impact Factor 1.393, Volume 2, Issue 4, ISSN: 2320-5083.
9. Shadow Robot Company (2014), http://www.shadowrobot.com/products/dexterous-hand/ Shadow Robot Company.
10. Anand Kumar Kirori, Rajeshwar Lal Dua (May 2012), "Review of Control Mechanism of Multi-fingered Robotic Arm and Proposal of New Design", IOSR Journal of Engineering, Volume 2, Issue 5, pp. 1251−1254.
11. Ram Pratap Sharma, Gyanendra K. Verma, "Human Computer Interaction using Hand Gesture", Eleventh International Multi-Conference on Information Processing-2015 (IMCIP- 2015).
12. Harish Kumar Kaura1, Vipul Honrao2 Sayali Patil3 , Pravish Shetty (2013), "Gesture Controlled Robot using Image Processing", (IJARAI) International Journal of Advanced Research in Artificial Intelligence, Volume 2, Issue 5.