

# Gesture Technology: A Survey

Harsh Choudhary, Sandeep Singh Rana

**Abstract**— this paper surveys the use of gesture as mechanism for interaction with computer. It describes both, the various techniques for recognizing gestures and the technology used to recognize the gestures. Initially, the different types of gestures are introduced and ways to make them understandable for the computer with the help of different algorithms are discussed. Further, the various types of technology used in recognizing the gestures are contrasted. The survey concludes with a summary and a discussion of future research directions.

**Index Terms**— Gestures, Gestures Recognition, 3D model based algorithm, skeletal based algorithm, Appearance based algorithm.

## 1 INTRODUCTION

I came across Gesture Recognition while studying Human-Computer Interaction. It involves the use of natural hand gestures to control devices. With the help of mathematical algorithms, a gesture recognition system apprehends human gestures. After gesture recognition, computers can become familiarized with the way humans communicate using gestures. Thus, humans and machines can interact freely with one another. The primary goal of gesture recognition is to create a system which understands human gestures and uses them to control various devices. It is necessary to yield a robust and reliable system [1].

The use of gestures provides an alternative to cumbersome interface devices for human computer interaction. Gestures refer to using specific actions, like scrolling, pinching, and tapping to operate an interface. It also refers to gesture recognition, including tipping, tilting, eye motion, and shaking.

### 1.1 What Are Gestures?

A gesture is a form of nonverbal communication in which visible bodily actions communicate particular messages, either in place of speech or in parallel with it. They are an important aspect of human interaction, both interpersonally and in the context of man-made interfaces. Gestures include movement of the hands, face, or other parts of the body.

## 2 TYPES OF GESTURES

In computer interfaces, two types of gestures are distinguished- Online and Offline gestures. We consider online gestures, which can also be regarded as direct manipulations like scaling and rotating. In contrast, offline gestures are usually processed after the interaction is finished; e. g. a circle is drawn to activate a context menu. [3]

1. **Offline gestures** - Those gestures that are processed after the user interaction with the object are offline gestures. An example is the gesture to activate a menu.
2. **Online gestures** - They are the Direct manipulation gestures. They are used to scale or rotate a tangible object.

## 3 WHAT IS GESTURE RECOGNITION?

Gesture recognition is the phase in which the data analyzed from visual images is recognized as a specific gesture. It is the mathematical interpretation of a body motion by a computing device. Interface with computers using gesture of the human body, typically hand movements. Gesture recognition is an important skill for robots to work closely with humans. It is especially valuable in application involving interaction between human and robot for several reasons. [2]

## 4 ALGORITHMS

Depending on the type of the input data, the approach for interpreting a gesture could be done in different ways. However, most of the techniques rely on key pointers represented in a 3D coordinate system. Based on the relative motion of these, the gesture can be detected with high accuracy, depending on the quality of the input and the algorithm's approach.

### 4.1 3D Model-Based Algorithms

In this, a volumetric and skeletal model of the body part is created in the system and the software uses their relative positions and movements to infer the gestures. The drawback of this method is that it is very computational, intensive and system for real time analysis is still to be developed. [2]

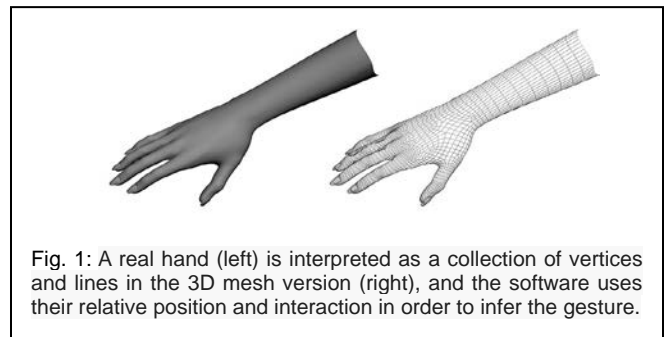


Fig. 1: A real hand (left) is interpreted as a collection of vertices and lines in the 3D mesh version (right), and the software uses their relative position and interaction in order to infer the gesture.

- Harsh Choudhary is currently pursuing bachelor degree program in Computer Science & Engineering from Shivalik College of Engineering, Dehradun (Affiliated to Uttarakhand Technical University), Uttarakhand, India.
- Govind Prasad Arya is currently working as an Assistant Professor in the Department of Computer Science & Engineering of Shivalik College of Engineering, Dehradun, Uttarakhand. E-mail: govind.arya10@gmail.com

## 4.2 Skeletal-Based Algorithm

In this, a skeletal model of the body part is created in the system. This has fewer parameters than the volumetric version and it is easier to compute making it suitable for real time gesture analysis systems. [2]

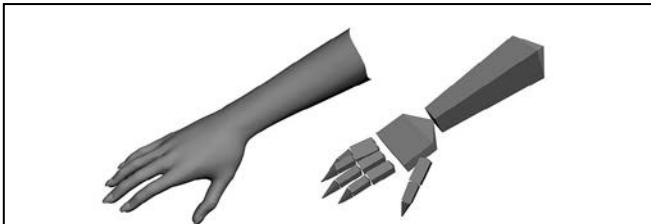


Fig. 2: The skeletal version (right) is effectively modelling the hand (left). This has fewer parameters than the volumetric version and it's easier to compute, making it suitable for real-time gesture analysis systems.

## 4.3 Appearance-Based Algorithms

In this, many images of the hand gestures is registered as templates. They are compared with various hand templates and if they match the corresponding, gesture is inferred. [2][9]

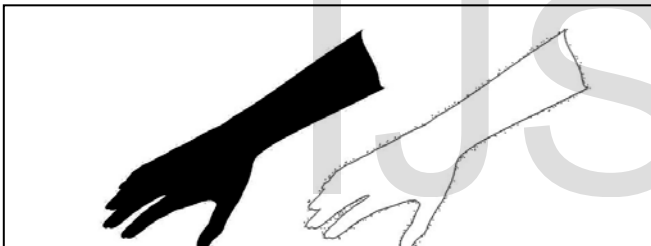


Fig. 3: These binary silhouette (left) or contour (right) images represent typical input for appearance-based algorithms. They are compared with different hand templates and if they match, the correspondent gesture is inferred.

# 5 DEVICES USED TO RECOGNIZE GESTURES

The Commonly used devices are-

## 5.1 Wired Gloves

These can provide input to the computer about the position and rotation of the hands using magnetic or inertial tracking devices. Furthermore, some gloves can detect finger bending with a high degree of accuracy, or even provide haptic feedback to the user, which is a simulation of the sense of touch. This uses fiber optic cables running down the back of the hand. Light pulses are created and when the fingers are bent, light leaks through small cracks and the loss is registered, giving an approximation of the hand pose. [4][8]



Fig. 4: Wired Gloves

## 5.2 Depth-Aware Cameras

Using specialized cameras such as structured light or time-of-flight cameras, one can generate a depth map of what is being seen through the camera at a short range, and use this data to approximate a 3d representation of what is being seen. These can be effective for detection of hand gestures due to their short range capabilities. [5]



Fig. 5: Depth-aware cameras

## 5.3 Stereo Cameras

Using two cameras whose relations to one another are known, a 3d representation can be approximated by the output of the cameras. To get the cameras' relations, one can use a positioning reference such as infrared emitters. In combination with direct motion measurement gestures can directly be detected. [6]



Fig. 6: Stereo cameras

## 5.4 Gesture-Based Controllers

These controllers act as an extension of the body so that when gestures are performed, some of their motion can be conveniently captured by software.

### 5.5 Single Camera

A standard 2D camera can be used for gesture recognition where the resources/environment would not be convenient for other forms of image-based recognition. Earlier it was thought that single camera may not be as effective as stereo or depth aware camera, Software-based gesture recognition technology using a standard 2D camera that can detect robust hand gestures.



Fig. 7: Single cameras

## 6 SIXTH SENSE TECHNOLOGY

When we come across something or someone we use our five senses to recognize or find some information about it or them. These senses do not help us in making the right decisions which are easily accessible online. Sixth Sense as seen in Fig. 4 is a wearable gestural interface that supplements the physical world around us with digital information and lets us use natural hand gestures to interact with that information. It enables us to link with the digital information available using natural hand gestures. It automatically recognizes the objects and retrieves information related to it. For example, for books from amazon it allows users to access it very easily and is very user friendly. Sixth sense has the potential to be one of the best user interfaces that helps in accessing the information available online anywhere and anytime. Sixth sense is comprised of pocket projector mirror and a camera. The projector and the camera are connected to a mobile wearable device [7].

### 6.1 Uses

- Calling Sixth sense prototype projects a keypad onto your hand and uses it to make a call.
- Time details: User can draw a circle on your wrist to get virtual watch that gives them the correct time.
- Access book information System can project amazon ratings on the book as well as reviews and other relevant information.

- Take pictures: On can fashion his index fingers and thumbs into a square (framing gesture), the system will snap a photo.

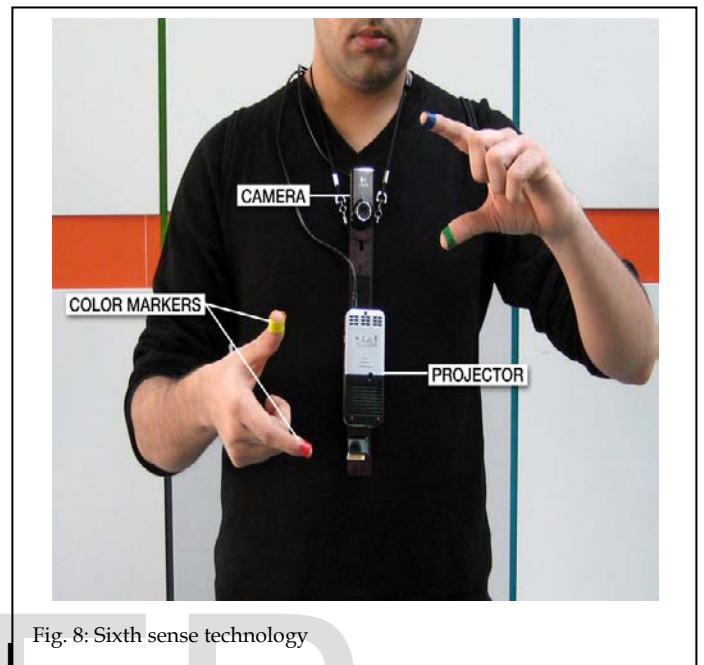


Fig. 8: Sixth sense technology

7

Gesture technology is now part of everyday life for a huge number of people. As this technology continues to evolve, the future possibilities are also incredibly exciting. Whatever that secret may be, is what the future is going to be. Perhaps there will come a day we will be able to speak things and they will just happen all in part to devices being able to completely understand our meanings.

## 8 CONCLUSION

Gestures are an interesting interaction paradigm in a variety of computer applications. It provides us a way to interact with computers without actually touching them. There are many ways in which one can interact with computers and perform various tasks. There are primarily three algorithms through which computer can understand the gestures and infer them. Most widely used algorithm is the skeletal-based algorithm as it has fewer parameters to deal with. Then, we have the devices through which inputs can be given to the computer.

Modern technology has improved the quality of our life, and gesture technology is one of the aspects of it. Technology is changing day by day and so will gesture technology due to its importance in modern technology.

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