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An Encompassing Review on Hand Gesture Techniques

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ABSTRACT: The wireless communication enables the users to interact with the robot in a more friendly way. Hand gesture technique is used enormously in recent years for human-computer interaction. It's an efficient way of interaction with machines makes it more popular and applicable for many purposes. The hands, arms, body, and face used for gesture technique perceive critical demeanours of movement by a human. Gesture technique is mainly applicable for video conferencing, sign language recognition, distances learning and in some forensic identification, land rover. This paper gives a complete survey of different gesture techniques. The benefits and limitation of all methods for hand gesture covered efficiently.

KEYWORDS: Gesture, Type of gesture, Hand gesture technologies like vision based approach, Detection, Tracking and Recognition, HMM, DTW, FSM, TDNN, Edge detection and Skin detection algorithm.

I. INTRODUCTION

"Gesture technique the term collectively refers to the whole process of tracking human gesture to their representation and conversion to meaningful commands"
For the past decade, highly skilled interpreters were used to make communication easy between deaf and hearing people. The main objective is to make this device simple as well cheap and used for a number of purposes. To bridge this gap a machine translator (MT) system [1]. which translate to sign languages from spoken languages and vice versa. This system used as a numerous application like telephony accessibility for deaf communities, sign languages education and disabled person who was driving his wheel chair by hand. Through this deaf can easily access a verity of public and information services. Ahuja and Singh [2] explained the basic module of Hand Gesture Recognition. The basic module of Gesture Recognition classification consists of three steps: detection, tracking and recognition. Microsoft Kinect [3] is used to capture every motion and turns it into a feature by using the built-in 3D sensory camera [4]. Microsoft Kinect is widely used in hand gesture recognition [5].

Gesture
A gesture is an action that has to be seen by someone else and has to convey some piece of information. Gesture is usually considered as a movement of part of the body, esp. a hand or the head to express the idea or meaning.
-Distance learning/ teleteching assistance
-Continuously watching stress level of medical patients
-Lie detection
-video conference interaction
-Observing vehicle drivers readiness/ languor levels, and so on.

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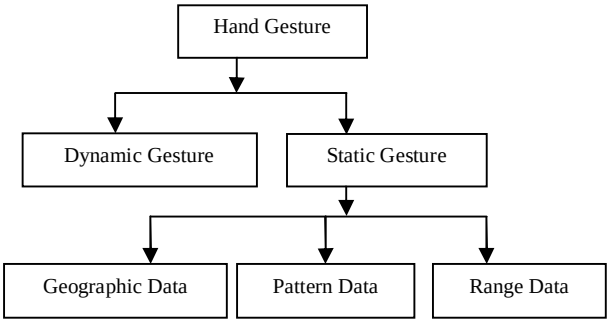

Fig 1: Distinguish of hand gesture

Dynamic gesture and Static gesture are two ways that the gesture can be distinguished as shown in Fig1. Predefining stances are called as static gesture. Dynamic gestures can be represented by various stages such as pre-stroke, stroke and post stroke [6]. Also, determine the stages of static gesture shown in fig1.
Geographic Data: From which point the gesture is originating
Pattern Data: What kind of design/ pattern/ sign the gesture is having
Range data: How much range gesture occupies on space to occur and finish [7].
According to a user's comfort, cost, accuracy, resolution. Latency and range of motion, the sensing technologies may differ.

Types of Gesture
Frequently, gestures can be dialect particular or culture specific, more specifically gestures can be categorized as mentioned below [7].
1.Hand and Arm Gestures: utilizing hand and arm signals individuals can associates with virtual condition. These sorts of signals are required close by postures acknowledgement in communications via gestures and stimulation application [7].
2.Face and Head Gestures: some of the illustrations are provided here I)Head rotation, II)Head moving up and down III) Eye rotation IV)Eyebrows raising V)Winking the eye VI)To talk by opening the mouth VII)Flaring the nostrils; and VIII)Humans emotions like Amazement, illness, fear, outrage, misery and so on[7].
3.Body Gestures: Full body movement is involved in it, as in[7]
-Tracking interaction between people
-Dancer movement analysis and
-Human gaits recognition for medical treatment and athletic training

Sign language

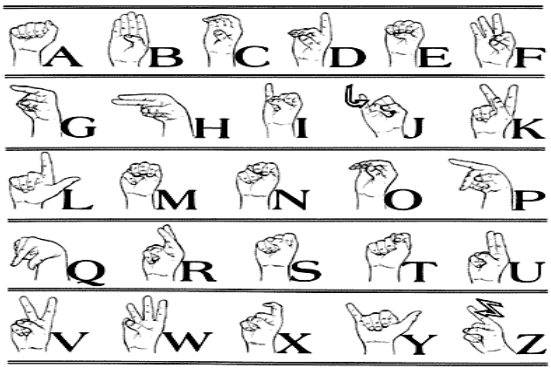

Fig 2: Hand gesture sign alphabets [1]

Sign languages are languages that use the visual standard modality to convey meaning. Language is expressed via the standard sign stream in combination with non-manual elements. Signed communication is a type of natural languages

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sign languages have emerged naturally in deaf communities. Sign language sometimes provided for television programmes [1].
Sign languages are being used widely in international sign use of the deaf and mentally handicapped communities. Using gestures and with the help of sign languages, they able to manage and communicate using gesture and sign language. Around the world. Gestures are mainly using to communicate in number of jobs. The directions to the pilots regarding the take-off on an airport runway, and sports refer uses gestures to tell his decision. fig2 shows A to Z alphabets used for Indian and American Sign Language [1]. Deaf people use these alphabets. Huang, Zhou, Li and Li[8]et al. implemented 3D Convolutional Neural Network to address these problems. There are many studies that experimented on various classification methods in SLR system.

II. RELATED WORK

Hand gesture technologies

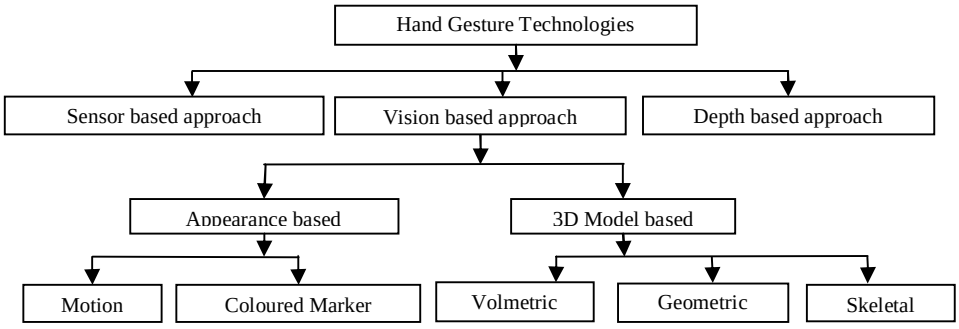

Fig 3: General classification of hand gesture recognition

Hand gesture technologies are followed by three approaches shown in above fig3 like sensor based, vision based and depth based approaches. Most important is vision based approaches there are two main stages first is appearance based and another is 3D model based.

Sensor based approaches
In this paper [9]-[10], fig3 shows Hand gesture recognition sensor based on accelerometer and gyroscope is a sensor for capturing underwater remotely operated vehicle equipped with an arm. In this system sensor uses accelerometers and gyroscope installed in elbow, forearm and wrist. Each sensor is connected by ardunio nano having compact circuit and embedded it into sensor's casing. The sensors are connected to Ardunio Uno acting as master connected to sensor part. Also, used flex sensor. The accuracy of the sensor has been tested under laboratory condition; it has 98% of accuracy.In another paper [11], the sensor used the 3-axis accelerometer work as a sensor and achieves an overall recognition accuracy of 95.6%. The various type of sensors are used like flex sensor, IR sensors used in hand gesture technique.

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Vision based approaches

Fig 4: Vision Based Recognition

In research paper I studied pictures are taken to interface between human and PCs as per the Fig 4. In that vision based approach main tool or component or part is camera which is used to capture the image. To take an image, computerized cameras are used. Acquired pictures are additionally prepared and broken down by utilizing the vision based procedures. Cameras such as fish eye, infrared, monocular and time of flight are various dives sort ones [12]. In that vision based technique recognition of the represented alphabets and numbers are becoming easier.
In this paper [13], there is a direct connection and interaction to human and computer devices. Conversely, numerous challenges for gestures need to be considered. Varieties of lights, different objects which are of skin colour, brightening changes, and complex foundation are such difficulties in this technique.
Image acquisition is the process of capturing images for vision-based approach. Leap Motion Controller, Microsoft Kinect, Data Glove, and Vision-based are some other methods of sign acquisition [14]. Leap Motion Controller (LMC) is a device that can detect hand movement up to 200 frames per second and assign ID to each detection. LMC converts signals into computer commands [15].

Appearance based recognition
In this Appearance based recognition highlights are separated from visual appearance of information hand pictures. The primary advantage is its compelling execution of continuous and effective examination using 3D displays. This approach can additionally recognize distinctive skin hues. The issue of impediment is overwhelmed by this approach [16]. Fundamentally there are two classes first is 2D static based model and second is a movement based model.

Motion based recognition
Motion based models are used for recognition of an object or its motion based on the motion of object in an image sequence. Local motion histogram was introduced which uses an ad boost framework for learning action models [16].

Coloured marker recognition

Fig 5: Coloured marker recognition

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Colour based recognition shows in Fig.5 uses body markers to track the motion of body or body part. As Bretzer et al. (2002) proposed hand gesture recognition employing multistage colour features, hierarchal model and particle filtering. The colour glove shape has small regions with different colour. A wool groove is used when three different colours are to indicate the finger and palms [17]. Still HCI is not that much natural in this technology [18].

3D model based recognition

Hand poses and its motion are key technologies in much HCI system [19]. 3D hand modelling and estimation of its tracking is also involved. This technology is mainly used in virtual keyboard, or recognition of sign language and robot surgery etc. 3D model based recognition technique are categories in three classifications.

Discriminative 3D Hand Modelling

Discriminative 3D Hand approach is use for hand pose estimation. 3D hand modelling with explicit depth of field (DOF) could not be constrained by discriminative approach. These mapping is labelling of different parts, parameters related with pose and appearance specific hand pixel feature [9].

Fig 6: 3D Skeletal Based Models

Part based modelling is human pose recognition technique is proposed by shotlon in which kinect sensor is utilized to skeletal body parts shows in a fig6 [11]. The part labelling is the features of area include into random forest (RF) classifier like surface features, position features and shape feature [20].

Generative 3D Hand Modelling

3D DOF model is explicitly trying to fit in observed hand data [21]. To appraise the 3D hand demonstration 2D hand modelling or 3D Hand Modelling Can Be Utilized. Single 3D hand modelling as indicated by oilkonomidis offered to recap 3D HAND POSTURE CO-ORDINATING OF 26 DOF hand display is done with different views of multiple cameras [21]. 3D interactive hand modelling is detecting interactive hands is very much difficult to handle in 3D hand modelling. To track full articulation of powerfully interacting hands new parametric model is used.

Hybrid 3D Modelling

Combination of discrimination and generative approaches is called hybrid 3D hand modelling. Discriminative depths features are dominated parts here for estimation of initial hand pose [21]. This step is related with generative approach for better accuracy and high efficiency is achieved here.

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III. GESTURE RECOGNITION CLASSIFICATION

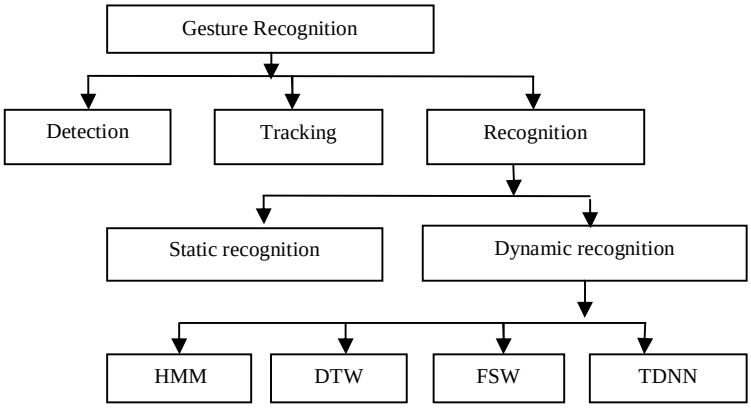

Fig 7: Classification of gesture recognition

Most of the complete hand interactive mechanisms that acts as a building block for hand recognition are of three fundamental phases as shown in above Fig 7.

Detection
The first step in hand gesture recognition. A system is the detection of hands and the segmentation of the corresponding image regions. This segmentation is crucial because it isolates the task-relevant data from the image background, before passing them to the subsequent tracking and recognition stages.

Tracking
If the detection method is fast enough to operate at image acquisition frame rate, it can be used for tracking as well, however, tracking hands is notoriously difficult since they can move very fast and their appearance can change vastly within a few frames. Tracking can be known as the frame-to-frame correspondence of the segmented hand regions or features towards understanding the observed hand movements [22].

Recognition
The overall goal of hand gesture recognition is the interpretation of the semantics that the hand(s) location, posture, or gesture conveys. Hand gesture recognition techniques can be further classified under static and dynamic gestures. To detect static gestures (i.e. postures), a general classifier or a template-matcher can be used.
A dynamic hand gesture is then considered as a path between an initial state and a final state. The main limitation of the approaches based on automata is that the gesture model must be modified when a new gesture needs to be recognized. Moreover, the computational complexity of such approaches is generally huge Vision based hand gesture recognition for human computer interaction since it is proportional to the number of gestures to be recognized which is not the case for methods based on other techniques.

Hidden Markov Model
HMM is a joint statistical model for an ordered sequence of variables [23]. HMM is the result of stochastically perturbing variables in a Markov chain (the original variables are thus “hidden”). Hidden Markov Model requires a large number of training data and high computational costs [24]. However, none the classification methods reviewed in their paper is about deep learning approach

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Dynamic Time Warping
DTW has long been used to find the optimal alignment of two signals. The DTW algorithm calculates the distance between each possible pair of points out of two signals according to their feature values. DTW uses such distances to calculate a cumulative distance matrix and finds the least expensive path through this matrix [25].

Finite State Machine
FSM is a machine with a limited or finite number of possible states (an infinite state machine can be conceived but is impracticable). An FSM can be used both as a development tool for approaching and solving problems and as a formal way of describing solutions for later developers and system maintainers.

Time Delay Neural Network
TDNNs are special artificial neural networks (ANNs) that work with continuous data to adapt the architecture to online networks and are thus advantageous to real-time applications. Theoretically, TDNNs are an extension of multi-layer perceptions. TDNNs are based on time delays that enable individual neurons to store the history of their input signals.

IV. ALGORITHM OF HAND GESTURE RECOGNITION

In that paper [26], joining of calculation, perception and writing computer programs is effectively done. MATLAB is very productive and highly efficient language. There are two algorithms are implemented in MATLAB for gesture recognition. First is edge detection algorithm and another is skin detection algorithm.

Edge Detection Algorithm
Edge detection algorithm perform following step as shown in Fig 8
-Capturing picture utilizing a webcam. Here front camera of the cell phone is likewise to utilize.
-This captured image is converted into frames.
-Histogram equalization is used for image pre-processing
-Edge is detected from hand through several algorithms here canny edge detector is used for that.
-Dilation is performed on twofold picture to amplify the edges of locales of frontal area pixels. This is done to acquire a constant edge.

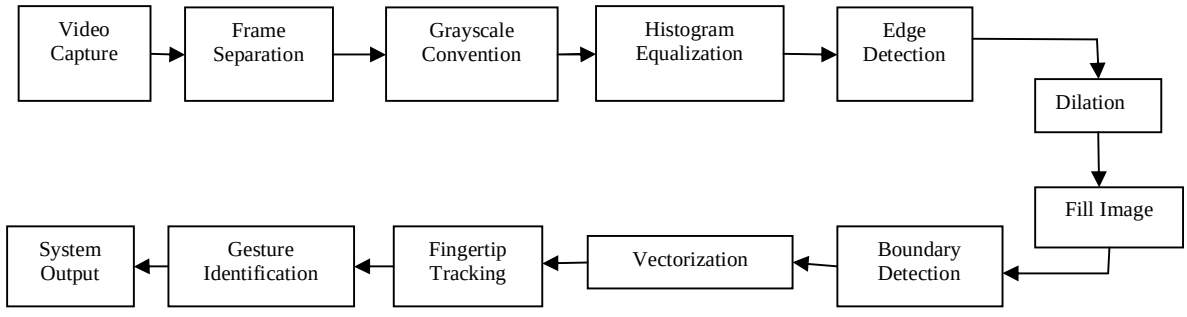

Fig 8: Edge detection algorithm

-The object which is encased by the edges is then filled.
-linear array is used to store the boundary of object which we got from above process.
-Operation related to vectorization is performed on each of the pixel which locates at the boundary
-Then fingertips are detected.
-To determine the motion, tracing of the fingertips is performed on successive casings
-Based on that motion gestures are identify
-Input stream is embedded in the ordinary incoming way of the processing gadget.

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Skin Detection Algorithm

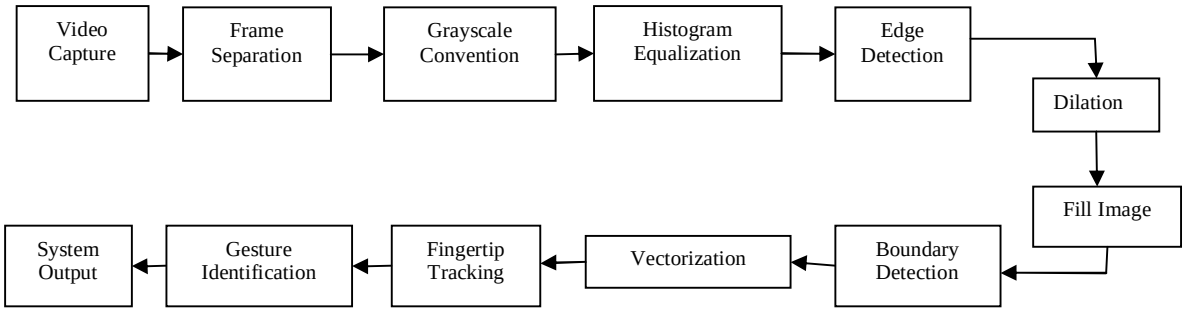

Fig 9: Skin detection algorithm

Skin detection algorithm following step is performed as shown in Fig 9 [26]
-capturing picture utilizing a webcam here front camera of the cell phone is likewise permitted to utilize
-This captured image converted into frame.
-RGB image is converted into HIS colour space.
-Hue and immersion estimation of different conceivable skin tones are utilized for skin detection.
-Linear array is used to store the boundary of object which we got from above process.
-Operation related to vectorization is performed on each of the pixel which located at the boundary.
-Then fingertips are detected
-To decide the movement, tracing of the fingertips is performed on back to back edges.
-Based on that motion gestures are identify
-Input stream is embedded into the ordinary incoming way of the processing gadget.

V. CONCLUSION

Human machine interaction process works very smoothly just because of gesture recognition. Main challenge of this recognition process is to collect input raw data. For that different technique are used and approaches have their own advantages and limitation. The hand gestures recognition models also discussed and distinguish the accuracy.

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