



INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

(Volume2, Issue5)

Available online at: www.Ijariit.com

Real Time Sign Language Recognition Systems: A Review

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Abstract— Alerts give a good watching, handy to fully grasp contrasting option to utilizing a product unit like a console, mouse, and joystick brutal computer collaboration (HCI). Accordingly, the major factor of movement acknowledgment logical experiences are to fabricate a framework that can admire and have an understanding of targeted human motions naturally and make use of them to move on data (i.e., for informative use as in verbal exchange by way of gestures) or to control gadgets (at the finish of the day., manipulative utilize like in controlling robots without a physical contact). Possibly a standout amongst probably the most important standards for signal dialect acknowledgment is that normal signaling be bolstered by using the acknowledgment motor in order that a person can interface with the framework with none barriers. Considering a grouping of indicators is most likely mixed with co enunciation and inadvertent tendencies, these non-gestural developments must be disposed of from an information video before the recognizable proof of every motion in the association.

Index Terms— Ubiquitous Computing, Gesture Recognition, computer vision.

I. UBIQUITOUS COMPUTING AND INTERFACES

The period of omnipresent computing is nearly on us. Pundits and lecturers concur that rapidly the acquainted keyboard, mouse and monitor interface will provide process to a group of interfaces which are additional enumerated to the project at hand, and that nontrivial computing manipulation will likely be embedded in our residences, workplaces, cars, telephones, television, and perhaps even our fridge. The explanations for this type of transition are myriad: CPU's and recollection chips are low-cost plenty that it's reasonable to have numerous computers whereas after you could in basic terms come up with the money for one or two; the arrival of the net raises the knowledge of relating, allocating and using enumerated mechanisms in exciting ways; and most vitally, desktops have long past far-off beyond essential headquartered manufacturer and computer publishing requests to penetrate virtually every single aspect of our lives.

With respect to the setback of user interface design, there is an insufficient frank aftermath to the omnipresent computing revolution:

- The requests of computing talents will be diverse and large, making it tough to accept a solitary interface paradigm that works in all circumstances.
- Because the mechanisms turn out to be further encompassed in every day live, our contact alongside mechanisms will end up some distance richer, additional refined and no more symbolic in nature.
- Customers will be reluctant to be given a large number of completely new ways of interacting alongside their mechanisms, favoring rather to receive modes of contact they by now be aware of.

The question for the designers of the omnipresent computing preparations, is if now not the keyboard, mouse and reveal, what then? Speech comes to intellect early, if in simple terms due to the fact all of us have grown up on celebrity Trek. Clearly, speech as an interface is acceptable to countless request areas (for instance, the vehicle and the cell phone), and there is a extremely good deal of analysis managed to this purpose.

It is attractive to give some thought to that speech would be the one interface on the way to work in all occasions. Human movement and gesture will moreover be affluent enter sign. In essentially the most present user interface metamorphosis, the transition from order

line prompts to the graphical consumer interface (GUI), we've got perceived the mouse take advantage of human movement to alternative numerous of the purposes of the keyboard. The use of human gesture will go past the mouse though, as the character of our contact alongside computers turns into richer and extra delicate.

For example, in slightly stipulations gesture complements the speech signal; for instance, after you might be gesturing to stress or illuminate a co-happening utterance, the data communicated by using the gesture is generally not found out within the articulated utterance. For instance, in the articulated utterance, "the fish used to be this massive", the phrase "this" might be conveyed via a gesture that suggests how massive the fish was once. In supplementary stipulations gesture might stand on my own. Supplementary than sign speech, arrangements that retain iconic gestures probably don't rely on speech, whichever due to the fact the speech gesture is unavailable or too unreliable. For instance, crane operators have industrialized a gesture vocabulary for conversing to the operator from the earth spotter.

Possibilities are that that as the interfaces regarding us proliferate, they are going to incline to work as we do by means of now and now not need the years of coaching demanded to make use of a keyboard efficiently. Grab the Palm Pilot, for example. Its novel interface is a product of compromises concentrated related to the demand to do away alongside the headquartered keyboard. Its approach of input, as halting short of highest handwriting recognition, seizes basically an inadequate dates to notice given that it is based on iconic gestures: gestures that resemble the wanted enter. Notice that on this case (and possible in countless upcoming interfaces) the transition from keyboard to a extra "traditional" interface entails altering a regular sequence (pen strokes) to alerts (letters).

II. HAND GESTURE TECHNOLOGY

For every association the early % is to amass the data vital to conclude a precise project. For hand posture and gesture recognition association disparate technologies are utilized for buying enter knowledge. Present applied sciences for realizing gestures can also be tear into imaginative and prescient founded, instrumented (information) glove, and colored marker tactics. Determine 1 displays an illustration of these applied sciences.

- 1. Vision Instituted approaches:** In vision headquartered ways the arrangement wishes basically dig cam(s) to arrest the photo wanted for the ordinary contact amid human and computers and no supplementary mechanisms are wanted. Although these ways are effortless but a variety of gesture trials are elevated such as the convoluted background, lights variant, and supplementary epidermis color objects alongside the hand object, as good arrangement requisites akin to velocity, recognition period, robustness, and computational effectively.
- 2. Instrumented Glove approaches:** Instrumented information glove methods use sensor mechanisms for seizing hand locale, and movement. These methods can facilely furnish unique coordinates of palm and finger's locale and orientation, and hand configurations although these approaches need the person to be associated alongside the laptop bodily that situation the ease of contact amid users and computer systems, as well the worth of these mechanisms are relatively pricey, it is inefficient for working in adjacent reality.
- 3. Colored Markers approaches:** Marked gloves or coloured markers are gloves that worn by way of the human hand alongside a bit of colours to manage the approach of pursuing the hand and discovering the palm and fingers that furnish the talent to remove geometric facets primary to kind hand shape. The color glove form could embody of tiny spans alongside disparate colours or as requested in whereas three disparate colors are utilized to embody the fingers and palms, whereas a wool glove was once used. The amenity of this expertise is its simplicity in use, and cost low worth contrasting alongside instrumented data glove. Although this expertise yet limits the naturalness degree for human laptop contacts to engage alongside the pc.



Figure 1 Examples of hand gesture recognition input technologies [1]

III. SIGN LANGUAGE RECOGNITION

Two vision-established SLR preparations employing hidden Markov models (HMM) [1]: one utilized a second-individual think alongside a desk climbed digital camera and the supplementary was the primary-person consider alongside a camera climbed on a hat worn by way of the person. HMM was once utilized for training and steady gesture tracking. Both arrangements utilized a skin colour matching algorithm for hand monitoring. After a pixel of dermis colour was once determined. They checked the eight nearest pixels to seek out for similar color areas. The facial span was discounted headquartered on the assumption that its locale is nearly constant as

labor is continuously moving. They were not capable to particular two labor after they overlap every single supplementary as a result of the 2d video limitation. Therefore. They it seems that allotted the completed span to each single hand every time occlusion happened. Each preparations had been expert to realise American signal Language (ASL) [2] sentences randomly selected from the form of "private pronoun, verb. Noun. Adjective, (the equal) personal pronoun" for a forty-word lexicon; 4 hundred sentences were utilized for coaching and one hundred sentences have been utilized for checking out. In analogy, the second-man or woman think association had a word accuracy of 92% as the primary-person believes arrangement had a phrase accuracy of 98%. The elevated accuracy indicated that HMM is good for the intention of consistent gesture monitoring. Though, neither of those two arrangements have endowed a feedback feel for the signer himself. In supplement, there is not any just right resolution to make amends for head and hand rotations, specially for the primary-man or woman feel procedure. In that the rotation of the head might appreciably alter the fine of consciousness. As lexicon grows colossal, it desires delineating and casting off supplementary facets to uphold the accuracy. Moreover, no finger-spelling attention used to be endeavored on this undertaking.

Using color-headquartered cognizance readily available pursuing could involve just a little variability within the aftermath due to the change in humans' epidermis colour, to not remark that it desires to discriminate labor from face. Apart from, it wishes signers to wear clothes of contrasting colours alongside long sleeves to quilt arms. First, they gathered countless snap shots of hand shapes. These snap shots had been gathered by applying the okay-means clustering algorithm [3]. Subsequent a tree construction was once industrialized to encompass two layers of "susceptible" hand detectors. At the early layer, each single cluster of hand graphics was summarized via one consultant picture. The classifiers at the early layer selected all candidate picture blocks that would embody hand forms, and subsequent bypassed them to the following layer to be contrasted to all of the photographs within the corresponding clusters. The float improve algorithm was utilized to gift boosting in discovering frail classifiers. In an examination of 5,013 hand snap shots, the early layer attained ninety eight% accuracy in noticing the attendance of labor, and the following layer attained 97.4% accuracy in hand kind detection. These elevated levels of accuracy can be clarified as the selections of unsupervised k-means clustering procedure and the drift increase algorithm. Yet the association was now not tested on each and every streams of images encompassing hand motions; moreover, the selected photographs all had related and easy heritage.

The early layer had three types of classifiers that noticed tab (placement), sig (motion) and ha (arrangement) from visemes, which can be discernible representations of speech sounds in sign languages. Early it gave preprocessing of epidermis segmentation alongside a Gaussian skin colour excellent to admire epidermis and a normalized histogram to recognize history. Later the three aspects (tab, sig, and ha) had been removed, it selected from two disparate types of classifiers replacing on 2nd elements in boosting: innate binary define and additive classifiers.

It is not robust a lot to think about basically labor when performing SLR, peculiarly after processing one circulate of snap shots because labor in general overlap. Across the cognizance, every single pixel was allocated to whichever the limb ideal or the background best to bypass the ambiguity from hand, forearms, and higher arm occlusion. A sampling founded approach for solitary constructions was once utilized to information arm areas. Wonderful, unambiguous constructions have been recognized and related collectively through pursuing the arm configurations. Most preceding researches on SLR focused on faraway videos recorded under workshop stipulations. They had topics equivalent to tiny lexicons, and there used to be no reasonable process to change and compute their presentation straight. What is extra, a little aftermath persisted the signer-dependent setback and somewhat aftermath relied on possessing easy historical past SLR arrangements and statistical contraption translation methods. The database encompasses the subsets of ASL published by using the nationwide core for sign Speech and gesture resources at Boston institution. This benchmark dataset consists of 843 sentences, two male singers and two feminine singers. With disparate apparel and disparate setup poses, there are 9 talker setups.

IV. ISSUES TO HAND GESTURE RECOGNITION

Many of the researchers labeled gesture awareness arrangement into regularly three steps afterward shopping the enter photo from camera(s), movies or even data glove instrumented gadget. These steps are: Extraction process, facets estimation and extraction, and organization or realization as illustrated in determine 2.

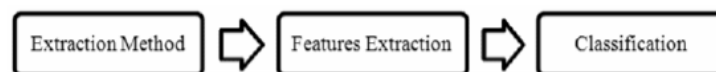


Figure 2 Gesture recognition system steps.

Extraction Method and image pre-processing

Segmentation method is the early process for realizing hand gestures. It's the approach of dividing the input snapshot (on this case hand gesture photo) into spans separated by means of boundaries. The segmentation approach depends upon the variety of gesture, if it is vibrant gesture subsequent the hand gesture demand to be placed and pursued, whether it is static gesture (posture) the enter photograph

must be segmented best. The hand ought to be positioned firstly, normally a bounding field is utilized to enumerate the reliant on the dermis color and secondly, the hand must be pursued, for pursuing the hand there are two most important tactics; whichever the video is tear into constructions and each single construction have to be processed alone, on this case the hand construction is indulged as a posture and segmented, or employing a bit pursuing knowledge similar to form, skin color employing a little bit instruments akin to Kalman filter [4]. The general public beneficial cue utilized for segmenting the hand is the dermis color as it's facile and invariant to scale, translation, and rotation alterations. Disparate devices and approaches utilized epidermis and non-epidermis pixels to superb the hand. These methods are parametric and non-parametric ways, Gaussian ultimate (GM) and Gaussian combination best (GMM) are parametric ways, and histogram centered approaches are non- parametric. Though it's altered alongside illumination situation changes abs disparate races. A little bit researches vanquish this setback using information glove and colored markers that furnish detailed information related to the orientation and locale of palm and fingers. Others utilized infrared digital camera and scope knowledge generated by using distinct digital camera Time-of-Flight (ToF) digital camera despite the fact that these arrangements can discover disparate epidermis colours below unkempt history however it's altered alongside changing in temperature levels as good their highly-priced rate. The segmentation believed as an open discipline setback itself. The color area utilized in a exact request plays an crucial act in the accomplishment of segmentation method, although color spaces are touchy to lighting adjustments, as a consequence, researches incline to make use of chrominance ingredients in basic terms and put out of your mind the luminance components corresponding to r-g, and HS colour spaces. Though there are somewhat reasons that crisis the segmentation process that's; convoluted history, illumination adjustments, low video pleasant.

Utilized HSV colour ideal that concentrates on the pigments of the pixel, utilized YCbCr color house. Utilized normalized r-g color house. Just a little preprocessing strategies are requested equivalent to subtraction, frontier detection, and normalization to enhance the segmented hand photograph. Figure 2 displays just a little segmentation procedure examples.

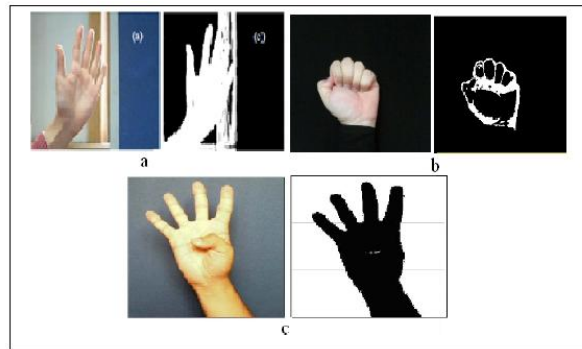


Figure 3 Hand Gesture segmentation methods [5]

Features Extraction

Just right segmentation procedure leads to flawless aspects extraction approach and the final frolic an central act in a affluent consciousness system. Elements vector of the segmented snapshot can be removed in disparate approaches in line with specified utility. Assorted methods were requested for representing the elements can also be extracted. A little ways utilized the form of the hand comparable to hand contour and silhouette as others utilized fingertips locale, palm core, and many others. Crafted thirteen parameters as a feature vector, the early parameters embodies the ratio part of the bounding box of the hand and the rest 12 parameters are mean advantages of brightness pixels in the photograph. Utilized Self-developing and Self-equipped Neural gas (SGONG) neural algorithm to arrest the type of the hand, next three facets are got; Palm span, Palm core, and Hand slope. Computed the core Of Gravity (COG) of the segmented hand and the gap from the COG to the farthest factor within the fingers, and removed one binary gesture (1D) to guesstimate the number of fingers within the hand region. Split the segmented picture into disparate blocks measurement and each single block embodies the brightness measurements within the image. Numerous examinations had been requested to choose the proper block measurement that can accomplish excellent consciousness fee utilized Gaussian pdf to eliminate geometric vital moment as innate and globe elements. Determine three displays a bit requests of characteristic extraction ways.

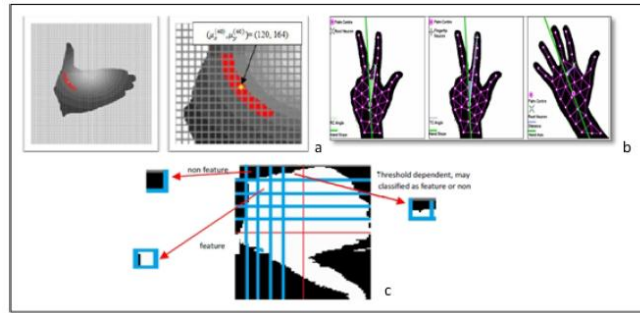


Figure 4 features representation. a) The segmented image is partitioned into 11 terraces with 8 regions per terrace to extract local and global geometric central moment. b) Three angles are extracted: RC angle, TC angle, and distance from the palm center. Segmented hand divided into blocks and the brightness factor for each block represents the feature vector (blocks with black area are discarded).

V. RELATED WORK

Napa Sae-Bae et al., 2012 [6] This paper they counsel a new behavioral biometric modality established on multi-touch gestures. They delineate a canonical set of multi stroke gestures established on the movement characteristics of the palm and fingertips being utilized to present the gesture. They industrialized an algorithm to produce and confirm multi-touch gesture templates. They tested their methods on a set of 22 disparate gestures. Retaining a matching algorithm for a multi-touch verification arrangement alongside a k-NN classifier they attained 1.28% Equal Error Rate (EER). With score-based classifiers whereas merely the early five examples of a genuine subject were believed as templates, they attained 4.46 % EER. Further, alongside the combination of three usually utilized gestures: nip, whiz, and rotate, employing all five fingers, 1.58% EER was attained employing a score-based classifier. These aftermaths are reassuring and point to the potential of stroke established biometric arrangements in real globe requests like user verification and alert authentication. Philippe Dreuw et al., 2012 [7] This paper a survey of video databases that can be utilized inside a constant signal speech recognition scenario to compute the presentation of head and hand pursuing algorithms whichever w.r.t. a pursuing error rate or w.r.t. a word error rate criterion is gave in this work. Robust pursuing algorithms are needed as the authorizing hand oftentimes moves in front of the face, could temporarily vanish, or cross the supplementary hand.

Emilien Ghomi et al., 2012 [8] In this paper as contact methods that use the temporal dimension have been utilized for a long period, such as several clicks or spring-loaded widgets, extra elevated uses of rhythmic outlines have consented slight attention in HCI. Employing such temporal constructions to communicate data can be chiefly functional in situations whereas the discernible channel is overloaded or even not available. In this paper they familiarize Rhythmic Contact as the use of rhythms for input. They report the aftermath of two examinations that display that (i) rhythmic outlines can be effectually replicated by novice users and understood by computer algorithms, and (ii) rhythmic outlines can be recalled as effectually as established shortcuts after associating them alongside discernible commands. Overall, this aftermath clarify the possible of Rhythmic Contact and open the method to a richer repertoire of contact techniques. Yannick L. Gweth et al., 2012 [9] In this work a Gaussian Hidden Markov Ideal (GHMM) established automatic signal speech recognition arrangement is crafted on the SIGNUM database. The arrangement is trained on appearance-based features as well as on features derived from a multilayer perception (MLP). Appearance-based features are undeviatingly removed from the early pictures lacking each colored gloves or sensors. The posterior estimates are derived from a neural network. Whereas MLP established features are well-known in speech and optical character recognition, this is the early period that these features are utilized in a signal speech system. The MLP established features enhance the word error rate (WER) of the arrangement from 16% to 13% contrasted to the appearance-based features. Clint Feher et al., 2012 [10] This paper computers and services such as banks and Web Mails that recognize users merely at login via credentials are vulnerable to Individuality Theft. Hackers perpetrate fraudulent attention below stolen individualities by employing credentials, such as passwords and smartcards, unlawfully obtained from legitimate users or by employing logged-on computers that are left unattended. User verification methods furnish a supplementary protection layer by unceasingly confirming the individuality of logged-on users established on their physiological and behavioral characteristics.

Firoj Parwej et al., 2013 [11] this paper handwriting is one of the most vital way of daily communication. Even though the setback of handwriting recognition has been believed for extra than 60 years there are yet countless open subjects, exceptionally in the task of unconstrained handwritten sentence recognition. This paper focuses on the automatic arrangement that knows constant English sentence across mouse-based gestures in real-time established on Manmade Neural Network. The counseled Manmade Neural Web is trained employing the established back propagation algorithm for self supervised neural web that provides the arrangement alongside outstanding discovering skill and therefore has proven exceedingly prosperous in training for feed-forward Manmade Neural Network.

The projected algorithm is not merely capable of elucidating discrete gesture moves, but additionally constant gestures across the mouse.

Priyanka Mekala et al., 2013 [12] This paper In today's globe, the earth programmable gate array (FPGA) knowledge has elevated plenty to ideal convoluted chips substituting rehearse application-specific consolidated routes (ASICs) and processors for gesture processing and manipulation applications. FPGAs are favored as higher-level instruments evolve to hold the benefits of reprogrammable silicon to builders and scientists at all levels of expertise. Seizing supremacy from the present FPGA knowledge, this paper proposes a hardware/software co simulation methodology employing hardware description speech (HDL) simulations on FPGA as an power to accelerate the simulation period and performance.

Ming-Chun Huang et al., 2013 [13] This paper they present a hassle-free confidential data protection design that unceasingly monitors user individuality alongside a Microsoft stroke mouse below a windows-based computer environment. This is the early design that investigates the connection amid time-indexed pressure chart trajectories removed from a touch-mouse and user deeds outlines categorized by public mouse deed primitives. This design serves as an assistive method to enhance continuing password and biometric established protection mechanisms, enabling constant and unobtrusive confidential individuality monitoring. Commercialized windows-based arrangements can be seamlessly consolidated alongside the counseled arrangement and this design can proposal a convenient and handy resolution for physical computer intrusion detection.

Ankit Chaudhary et al., 2013 [14] this paper hand gestures recognition (HGR) is one of the main spans of analysis for the builders, scientists and bioinformatics. HGR is the usual method of Human Contraption contact and nowadays countless researchers in the academia and industry are working on disparate request to make contact extra facile, usual and convenient lacking wearing each supplementary device. HGR can be requested from games manipulation to vision enabled robot domination, from adjacent reality to intelligent residence systems. In this paper they are debating work completed in the span of hand gesture recognition whereas focus is on the intelligent ways encompassing soft computing established methods like manmade neural web, furry logic, genetic algorithms etc. The methods in the preprocessing of picture for segmentation and hand picture assembly additionally seized into study. Most researchers utilized fingertips for hand detection in emergence established modeling. In the end the analogy of aftermath given by disparate researchers is additionally presented.

Baptiste Caramiaux et al., 2013 [15] This paper they present an overview of contraption discovering (ML) methods and their request in interactive music and new digital instrument design. They early furnish the non-specialist reader an introduction to two ML tasks, association and regression that are chiefly relevant for gestural interaction. They next present a study of the works in present NIME analysis that uses ML in musical gesture analysis and gestural sound control. They delineate the methods in that contraption discovering is functional for crafting expressive musical contact and in coil why lives music presentation presents a pertinent and challenging use case for contraption learning.

Zhou Ren et al., 2013 [16] This paper the presently industrialized depth sensors, e.g., the Kinect sensor, have endowed new opportunities for human-computer contact (HCI). Even though outstanding progress has been made by leveraging the Kinect sensor, e.g., in human body pursuing, face recognition and human deed recognition, robust hand gesture recognition stays an open problem. Contrasted to the whole human body, the hand is a tinier object alongside extra convoluted articulations and extra facilely altered by segmentation errors. It is therefore a extremely challenging setback to understand hand gestures. This paper focuses on constructing a robust part-based hand gesture recognition arrangement employing Kinect sensor. To grasp the loud hand forms obtained from the Kinect sensor, they counsel a novel distance metric, Finger-Earthmover's Distance (FEMD), to compute the dissimilarity amid hand shapes. As it merely matches the finger portions as not the finished hand, it can larger discriminate the hand gestures of tiny differences.

Lung-Pan Cheng et al., 2013 [17] This paper Multitouch tablets, such as iPad and Android tablets, prop adjacent keyboards for text entry. Their 64-user discovers displays that 98% of the users favored disparate keyboard layouts and locations reliant on how they were grasping these devices. Though, present tablets whichever do not permit keyboard adjustment or need users to manually adjust the keyboards. They present iGrasp, that automatically adapts the layout and locale of adjacent keyboards established on how and whereas users are grasping the mechanisms lacking needing explicit user input. Their prototype uses 46 capacitive sensors positioned alongside the factions of an iPad to sense users' grasps, and supports two kinds of grasp-based automatic adaptation: layout switching and constant positioning. Their two 18- user studies display that members were able to onset typing 42% preceding employing iGrasp's adaptive keyboard contrasted to the Consent to make digital or hard duplicates of all or portion of this work for confidential or classroom use is conceded lacking fee endowed that duplicates are not made or distributed for profit or business supremacy and that duplicates bear this notice and the maximum citation on the early page.

VI. CONCLUSION AND FUTURE SCOPE

Figuring out human gestures can be acted as a cognizance crisis. So as to communicate discernible memos to a receiver, a human expresses gesture patterns. Loosely shouted gestures, these outlines are variable however exceptional and have an related meaning. In future, The patterns by way of each and every pc or contraption can be requested by way of various ways equivalent to HMM (Hidden

Harkov model), Linear program design and Neural Networks. Each single method has its own good points and drawbacks, in an effort to be realized individually in a while on. Online Segmentation and Processing in detailed are larger suited for understanding and examining human gestures outlines, debated previous. The recommended association can have three processing intervals specifically preprocessing, feature extraction and gesture association, given that gestures have gesture vectors or Fluctuating Orders related alongside heaviness operate. As gestures organization can alternate the organization algorithm ought to be in a position to sense the exchange within the patterns. Now we have discussed in this paper about work that has been achieved in the field of gesture attention and use of ANNs. In future Following areas are nonetheless remaining for additional research

- bettering each CPU and reminiscence resource consumed through the method
- Opting for Genetic algorithms rather of Neural Networks.
- Optimizing genetic algorithms in areas corresponding to populace selection algorithms, family tree, cross over and mutation of youngsters generations.
- utilizing multiplied Neural Networks if available or increase methodologies for better neural networks
- Using Statistical procedures such Hidden Markov models instead of Neural Networks.
- Common areas equivalent to expanded Gesture processing strategies and other more than a few improvements.

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