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Survey of Computer Vision Based Hand Gesture Recognition System and Methods

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Abstract— Gestures furnish a nice-looking, user-friendly alternative to employing a multimedia constituent like a keyboard, mouse, and joystick inhuman computer contact (HCI).Accordingly, the frank target of gesture credit logical studies are to craft a arrangement that can recognize and comprehend precise human gestures automatically and retain them to communicate data (i.e., for communicative use as in sign-language) or to manipulation produce (in supplementary words., manipulative use like in manipulating robots lacking each physical contact). Plausibly one of the most vital needs for indication speech credit is that usual gesturing be upheld by the credit engine so that a person can link alongside the arrangement alongside no constraints. As a sequence of gestures is usually blended alongside co articulation and unintentional movements, these non-gestural movements ought to truly be eliminated from an input video beforehand the identification of every single gesture in the sequence.

Keywords— Gesture Recognition, Sign Language Recognition, Human computer interaction

I. INTRODUCTION

A gesture is a form of non-verbal contact in that visible bodily deeds converse particular memos, whichever in locale of speech or jointly and in parallel alongside words. Gestures contain movement of the labor, face, or supplementary portions of the body.

Gestures permit people to converse a collection of feelings and thoughts, from contempt and hostility to approval and affection, frequently jointly alongside body speech in supplement to words after they speak.

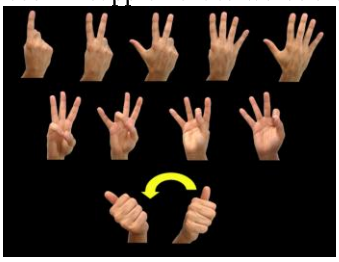

Figure 1 Hand Gesture and American Sign Language for Numbers

Understanding human gestures can be acted as a outline credit problem. In order to con vey discernible memos to a receiver, a human expresses gesture patterns. Loosely shouted gestures, these outlines are variable but different and have an associated meaning. The wave gesture is variable because even the alike person's hand locale could be countless inches away from the locale in a preceding wave. It is different because it can be effortlessly discriminated from a disparate gesture, such as a beckoning or a shrug. Finally, it has the concurred meaning of "hello."

Computer credit of hand gestures could furnish a extra usual human computer interface, permitting people to point, or rotate a CAD ideal by rotating their hands. Interactive computer games should be enhanced if the computer might comprehend players' hand gestures. Gesture credit could even be functional to manipulation household appliances. We discriminate two groups of gestures: static and dynamic.

A static gesture is a particular hand configuration and pose, embodied by a solitary image. A vibrant gesture is a advancing gesture, rep resented by a sequence of images. We focus on the credit of static gestures, even though our method generalizes in a usual method to vibrant gestures. For the broadest probable request, a gesture credit algorithm ought to be fast to compute. Here, we apply a easy outline credit method to hand gesture credit, emerging in a fast, use able hand gesture credit system.

The trackball, the joystick, and the mouse are tremendously prosperous mechanisms for hand established computer input. Yet all need that the user grasp a little hard ware, that can be awkward. Furthermore, none accommodates the richness of expression of a hand gesture

Research on gesture credit has countless motivations, all of that are connected to enhancing the interface amid humans and computers. If a computer can notice and understand a set of gestures, it can infer the sender's memo and answer appropriately. For example, a conductor can manipulation a "virtual orchestra" by gesturing commands to a video camera.

The arrangement replies by appropriately fluctuating the volume and tempo of the prerecorded music being played. As one more example, a arrangement can annotate video clips of athletic events alongside meaningful descriptions. After demanded for an example of a triple salchow, one more arrangement replies by swiftly discovering the figure skating hop amid an annotated database of video sequences. As a final example, a karate education arrangement can visually assess the presentation of a student's kick.

II. GENERAL DESCRIPION OF SIGN LANGUAGE

Sign tongues are the most raw and usual form of tongues might be dated back to as main as the advent of the human society, after the early theories of signal tongues materialized in history. It has commenced even beforehand the rise of articulated languages. As next the signal speech has evolved and been adopted as an integral portion of our date to date contact process. Now, signal tongues are being utilized extensively in global signal use of deafened and dumb, in the globe of sports, for spirtual habits and additionally at work locations [7]. Gestures are one of the early forms of contact after a youngster learns to express its demand for food, warmth and comfort. It enhances the emphasis of articulated speech and helps in expressing thoughts and feelings effectively. A easy gesture alongside one hand has the alike meaning all above the globe and way whichever 'hi' or 'goodbye'. Countless people excursion to external states lacking knowing the authorized speech of the visited state and yet grasp to present contact employing gestures and signal language. These examples display that gestures can be believed global and utilized nearly all above the world. In a number of jobs concerning the globe gestures are way of communication. In airports, a predefined set of gestures makes people on the earth able to converse alongside the pilots and thereby give orders to the pilots of how to become off and on the run-way and the referee in nearly each sport uses gestures to converse his decisions. In the globe of sports gestures are common. The pitcher in baseball receives a sequence of gestures from the coach to aid him in selecting the kind of throw he is concerning to give. Hearing impaired people have above the years industrialized a gestural speech whereas all described gestures have an allocated meaning. The speech permits them to converse alongside every single supplementary and the globe they live in.

The credit of gestures representing words and sentences as they do in American and Danish signal speech undoubtedly embodies the most tough credit setback of those requests remarked before. A working signal speech credit arrangement might furnish an opportunity for the deafened to converse alongside non-signing people lacking the demand for an interpreter. It might be utilized to produce speech or text making the deafened extra independent. Unfortunately there has not been each arrangement alongside these skills so far. In this undertaking our target is to develop a arrangement that can categorize signal speech accurately.

Advantages and Disadvantage

The various advantages and disadvantages of Gesture Recognition are given below:

ADVANTAGES

- Speed and adequate reliable for credit system. Good presentation arrangement alongside convoluted background.
- The radial form separation and frontier histogram for every single removed span, vanquish the shackle advancing setback and variant rotation problem.
- Exact form of the hand attain managed to good feature extraction. Fast and influential aftermath from the counseled algorithm.
- Simple and alert, and prosperous can understand a word and alphabet. Automatic sampling and increased filtering data enhanced the arrangement performance.
- The arrangement prosperously knows static and vibrant gestures. Might be requested on the mobile robot control.
- Simple, fast and facile to implement.can be requested on real arrangement and frolic games.
- No training is required.

DISADVANTAGES

- Irrelevant object might overlap with the hand. Wrong object extraction appeared if the objects larger than the hand. Performance recognition algorithm decreases when the distance is greater than 1.5m between the user and the camera.
- System limitations restrict the applications such as; the arm must be vertical, the palm is facing the camera and the finger color must be basic color such as red or green or blue.

Ambient light affects the color detection threshold.

III. LITERATURE SURVEY

Mingyu Chen et al, in "Feature Processing and Modeling for 6D Motion Gesture Recognition" 2013 [7], the authors describe A 6D motion gesture is represented by a 3D spatial trajectory and augmented by another three dimensions of orientation. Using different tracking technologies, the motion can be tracked explicitly with the position and orientation or implicitly with the acceleration and angular speed. In this work, they address the problem of motion gesture recognition for command-and-control applications. Our main contribution is to investigate the relative effectiveness of various feature dimensions for motion gesture recognition in both user-dependent and user-independent cases. They introduce a statistical feature-based classifier as the baseline and propose an HMM-based recognizer, which offers more flexibility in feature selection and achieves better performance in recognition accuracy than the baseline system. Our motion gesture database which contains both explicit and implicit motion information allows them to compare the recognition performance of different tracking signals on a common ground. This study also gives an insight into the attainable recognition rate with different tracking devices, which is valuable for the system designer to choose the proper tracking technology.

Gritzman, A. et al, in "Improvements in feature vector selection and parameter optimisation for continuous gesture recognition" 2013 [8] the authors describe Gesture recognition has attracted significant interest due to diverse potential applications, including: hand writing recognition, robot control and human-computer interfaces. This paper identifies and addresses three shortcomings in current approaches to feature vector selection and parameter optimisation for continuous gesture recognition. First, in selecting the final feature vector, researchers typically analyse only a small subset of possible feature combinations; however, the limited subset is likely to omit the optimum feature vector. Second, selection of the final feature vector is based on performance in isolated recognition; however, the final feature vector may not perform adequately in continuous recognition. No protocol currently exists to evaluate and select the final feature vector in continuous recognition mode, thus a novel scoring system is developed. Finally, optimization of the number of states in the Hidden Markov Models (HMMs) and the number of clusters (k-means clustering) is performed independently, ignoring any possible interdependency. To investigate and address these shortcomings, a gesture recognition system geared towards sign language interpretation is designed. The system is tested on a 9-word gesture vocabulary, and subsequent analysis confirms the above conjectures: first, the optimum feature vector cannot be intuitively predicted and must be determined through rigorous analysis; second, selecting the final feature vector in continuous mode improved the accuracy score by 5.85 % and the perfect sentence recognition by 47.2 %; finally, optimising the number of states and number of clusters simultaneously improved the accuracy score by 3.0 % and the perfect sentence recognition by 11.1%.

Frolova, D. et al, in "Most Probable Longest Common Subsequence for Recognition of Gesture Character Input" 2013 [9], the authors describe This paper presents a technique for trajectory classification with applications to dynamic free-air hand gesture recognition. Such gestures are unencumbered and drawn in free air. Our approach is an extension to the longest common subsequence (LCS) classification algorithm. A learning preprocessing stage is performed to create a probabilistic 2-D template for each gesture, which allows taking into account different trajectory distortions with different probabilities. The modified LCS, termed the most probable LCS (MPLCS), is developed to measure the similarity between the probabilistic template and the hand gesture sample. The final decision is based on the length and probability of the extracted subsequence. Validation tests using a cohort of gesture digits from video-based capture show that the approach is promising with a recognition rate of more than 98 % for video stream preisolated digits. The MPLCS algorithm can be integrated into a gesture recognition interface to facilitate gesture character input. This can greatly enhance the usability of such interfaces.

Nyirarugira, C. et al, in "Modified levenshtein distance for real-time gesture recognition" 2013 [10], the authors describe In this paper, a real time dynamic gesture recognition method based on a modified Levenshtein distance is proposed. The method addresses the issues faced in dynamic gesture recognition methods that are due to gesture variability within the class due to differences in the gesture speed. Since the gesture speed and duration will vary from one gesture to another, or from one person to the next, without taking this variability into account there will be an increase in the number of recognition errors. Here, they use a modified Levenshtein distance to represent each gesture class by one gesture exemplar and no restrictions on the gesture speed is necessary. Experiments demonstrate real-time gesture recognition rates of 93.9% for gestures of variable speed.

Jun Haeng Lee et al, in "Real-Time Gesture Interface Based on Event-Driven Processing From Stereo Silicon Retinas" 2014 [11], the authors describe They propose a real-time hand gesture interface based on combining a stereo pair of biologically inspired event-based dynamic vision sensor (DVS) silicon retinas with neuromorphic event-driven postprocessing. Compared with conventional vision or 3-D sensors, the use of DVSs, which output asynchronous and sparse events in response to motion, eliminates the need to extract movements from sequences of video frames, and allows significantly faster and more energy-efficient processing. In addition, the rate of input events depends on the observed movements, and thus provides an additional cue for solving the gesture spotting problem, i.e., finding the onsets and offsets of gestures. They propose a postprocessing framework based on spiking neural networks that can process the events received from the DVSs in real time, and provides an architecture for future implementation in neuromorphic hardware devices. The motion trajectories of moving hands are detected by spatiotemporally correlating the stereoscopically verged asynchronous events from the DVSs by using leaky integrate-and-fire (LIF) neurons. Adaptive thresholds of the LIF neurons achieve the segmentation of trajectories, which are then translated into discrete and finite feature vectors. The feature vectors are classified with hidden Markov models, using a separate Gaussian mixture model for spotting irrelevant transition gestures. The disparity information from stereovision is used to adapt LIF neuron parameters to achieve recognition invariant of the distance of the user to the sensor, and also helps to filter out movements in the background of the user. Exploiting the high dynamic range of DVSs, furthermore, allows gesture recognition over a 60-dB range of scene illuminance. The system achieves recognition rates well over 90% under a variety of variable conditions with static and dynamic backgrounds with naive users.

Atan, O. et al, in "Bandit Framework for Systematic Learning in Wireless Video-Based Face Recognition" 2015 [12], the authors describe Video-based object or face recognition services on mobile devices have recently garnered significant attention, given that video cameras are now ubiquitous in all mobile communication devices. In one of the most typical scenarios for such services, each mobile device captures and transmits video frames over wireless to a remote computing cluster (a.k.a. solution that assumes a-priori knowledge of the system performance under every possible setting. Unlike well-known reinforcement learning techniques that exhibit very slow convergence when operating in highly-dynamic environments, the proposed bandit-based systematic learning quickly approaches the optimal transmission and cloud resource allocation policies based on feedback on the experienced dynamics (contention and congestion levels). To validate their approach, time-constrained simulation results are presented via: (i) contention-based H.264/AVC video streaming over IEEE 802.11 WLANs and (ii) principal-component based face recognition algorithms running under varying congestion levels of a cloud-computing infrastructure. Against stat- -of-the-art reinforcement learning methods, their framework is shown to provide 17.8% ~ 44.5% reduction of the number of video frames that must be processed by the cloud for recognition and 11.5% ~ 36.5% reduction in the video traffic over the WLAN.

Zhou Ren et al, in "Robust Part-Based Hand Gesture Recognition Using Kinect Sensor" 2013 [13], the authors describe The recently developed depth sensors, e.g., the Kinect sensor, have provided new opportunities for human-computer interaction (HCI). Although great progress has been made by leveraging the Kinect sensor, e.g., in human body tracking, face recognition and human action recognition, robust hand gesture recognition remains an open problem. Compared to the entire human body, the hand is a smaller object with more complex articulations and more easily affected by segmentation errors. It is thus a very challenging problem to recognize hand gestures. This paper focuses on building a robust part-based hand gesture recognition system using Kinect sensor. To handle the noisy hand shapes obtained from the Kinect sensor, they propose a novel distance metric, Finger-Earth Mover's Distance (FEMD), to measure the dissimilarity between hand shapes. As it only matches the finger parts while not the whole hand, it can better distinguish the hand gestures of slight differences. The extensive experiments demonstrate that their hand gesture recognition system is accurate (a 93.2% mean accuracy on a challenging 10-gesture dataset), efficient (average 0.0750 s per frame), robust to hand articulations, distortions and orientation or scale changes, and can work in uncontrolled environments (cluttered backgrounds and lighting conditions). The superiority of their system is further demonstrated in two real-life HCI applications.

Sichao Song et al, in "An ant learning algorithm for gesture recognition with one-instance training" 2013 [14], the authors describe In this paper, they introduce a novel gesture recognition algorithm named the ant learning algorithm (ALA), which aims at eliminating some of the limitations with the current leading algorithms, especially Hidden Markov Models. It requires minimal training instances and greatly reduces the computational overhead required by both training and classification. ALA takes advantage of the pheromone mechanism from ant colony optimization. It uses pheromone tables to represent gestures, which scales well with gesture complexity. Our experimental results show that ALA can achieve a high recognition accuracy of 91.3% with only one training instance, and exhibits good generalization.

Napa Sae-Bae et al, in "Multi touch Gesture-Based Authentication" 2014 [15], the authors describe This paper investigates multi touch gestures for user authentication on touch sensitive devices. A canonical set of 22 multi touch gestures was defined using characteristics of hand and finger movement. Then, a multi touch gesture matching algorithm robust to orientation and translation was developed. Two different studies were performed to evaluate the concept. First, a single session experiment was performed in order to explore feasibility of multi touch gestures for user authentication. Testing on the canonical set showed that the system could achieve good performance in terms of distinguishing between gestures performed by different users. In addition, the tests demonstrated a desirable alignment of usability and security as gestures that were more secure from a biometric point of view were rated as more desirable in terms of ease, pleasure, and excitement. Second, a study involving a three-session experiment was performed. Results indicate that biometric information gleaned from a short user-device interaction remains consistent across gaps of several days, though there is noticeable degradation of performance when the authentication is performed over multiple sessions. In addition, the study showed that user-defined gestures yield the highest recognition rate among all other gestures, whereas the use of multiple gestures in a sequence aids in boosting verification accuracy. In terms of memorability, the study showed that it is feasible for a user to recall user-defined gestural passwords and it is observed that the recall rate increases over time. It is also noticed that performing a user-defined gesture over a customized background image does result in higher verification performance. In terms of usability, the study shows that users did not have difficulty in performing multi touch gestures as they all rated each gesture as easy to perform.

Neto, P. et al, in "Real-time and continuous hand gesture spotting: An approach based on artificial neural networks" 2013 [16], the authors describe New and more natural human-robot interfaces are of crucial interest to the evolution of robotics. This paper addresses continuous and real-time hand gesture spotting, i.e., gesture segmentation plus gesture recognition. Gesture patterns are recognized by using artificial neural networks (ANNs) specifically adapted to the process of controlling an industrial robot. Since in continuous gesture recognition the communicative gestures appear intermittently with the non-communicative, they are proposing a new architecture with two ANNs in series to recognize both kinds of gesture. A data glove is used as interface technology. Experimental results demonstrated that the proposed solution presents high recognition rates (over 99% for a library of ten gestures and over 96% for a library of thirty gestures), low training and learning time and a good capacity to generalize from particular situations.

Taheri, S. et al, in "Component-Based Recognition of Facesand Facial Expressions" 2013 [17], the authors describe Most of the existing methods for the recognition of faces and expressions consider either the expression-invariant face recognition problem or the identity-independent facial expression recognition problem. In this paper, they propose joint face and facial expression recognition using a dictionary-based component separation algorithm (DCS). In this approach, the given expressive face is viewed as a superposition of a neutral face component with a facial expression component which is sparse with respect to the whole image. This assumption leads to a dictionary-based component separation algorithm which benefits from the idea of sparsity and morphological diversity. This entails building data-driven dictionaries for neutral and expressive components. The DCS algorithm then uses these dictionaries to decompose an expressive test face into its constituent components. The sparse codes they obtain as a result of this decomposition are then used for joint face and expression recognition. Experiments on publicly available expression and face data sets show the effectiveness of their method.

Shiguo Lian et al, in "Automatic user state recognition for hand gesture based low-cost television control system" 2014 [18], the authors describe Hand gesture based television (TV) control is attracting more and more researchers. Most of existing works focus on the hand gesture recognition algorithm and the corresponding user interface, while the power consumption or computational cost is not considered carefully. In practice, keeping the camera device and the gesture recognition module running all the time often costs much energy. Till now, few methods have been reported to solve this problem. This paper proposes an automatic user state recognition scheme to recognize the TV user's state and activate the camera-based gesture recognition module only when the user is trying to control the TV. Specifically, the user's behavior active or not is detected by low cost sensors, the user's gaze watching TV or not is tracked by the face-based view detection, and the user's state is then decided according to a finite-state machine composed of four states: Absent, Other Action, Controlling, and Watching. The prototypes based on an ultrasonic distance sensor array, a red-green-blue (RGB) camera, and a depth camera are implemented and tested. The results show that the proposed scheme can effectively reduce the power consumption or computational cost of the original hand gesture based control schemes.

Yanmin Zhu et al, in "Vision Based Hand Gesture Recognition" 2013 [19], the authors describe Hand gesture recognition has attracted much attention from academia and industry in recent years due to its apparent superiority over traditional techniques in human-computer interaction in terms of convenience. This domain has been investigated from different perspectives among which vision based approaches provide the most natural and intuitive interfaces. This paper presents a comprehensive review on vision based hand gesture recognition, with an emphasis on dynamic hand gestures. First, a brief introduction of the basic concepts and the classification of hand gesture recognition techniques are given. Then, a number of popular related technologies and interesting applications are reviewed. Finally, they give some discussion on the current challenges and open questions in this area and point out a list of possible directions for future work.

Aleotti, J. et al, in "Arm gesture recognition and humanoid imitation using functional principal component analysis" 2013 [20], the authors describe A method is proposed for gesture recognition and humanoid imitation based on Functional Principal Component Analysis (FPCA). FPCA is a statistical technique of functional data analysis that has never been applied before for humanoid imitation. In functional data analysis data (e.g. gestures) are functions that can be considered as observations of a random variable on a functional space. FPCA is an extension of multivariate PCA that provides functional principal components which describe the modes of variation in the data. In the proposed approach FPCA is used for both unsupervised clustering of training data and gesture recognition. In this work they focus on arm gesture recognition. Human hand paths in Cartesian space are reconstructed from inertial sensors. Recognized gestures are reproduced by a small humanoid robot. The FPCA algorithm has also been compared to a state of the art algorithm for gesture classification based on Dynamic Time Warping (DTW). Results indicate that, in this domain, the FPCA algorithm achieves a comparable recognition rate while it outperforms DTW in terms of efficiency in execution time.

Yali Wang et al, in "Wheeled robot control based on gesture recognition using the Kinect sensor" 2013 [21], the authors describe Human Machine Interaction (HMI) plays a very important role in intelligent service robot research. Traditional HMI methods such as keyboard and mouse cannot satisfy the high demands in some environments. To solve this problem, many researchers pay attention to vision-based gesture recognition research recently. This paper proposes a simple method to control the movement of a robot based on Kinect which provides skeleton data with low computation, acceptable performance and financial cost. The method can recognize eleven defined gestures by using the coordinates of joints, which are obtained from the skeleton model provided by the Kinect SDK. A Khepera III robot is used as a prototype control object, to verify the effectiveness of the proposed method. The experimental results show that the success rate of gesture recognition is over 96%. The proposed method is robust to work in real-time

IV. CONCLUSION

Load Sign speech is the most oftentimes utilized instrument after the transmission of audio is nearly impossible or prohibited, or after the deed of including and typing is tough, but the potential of vision exists. Moreover, signal speech is the most usual and expressive method for the hearing impaired. The main trial that faces Signal Speech credit nowadays is to develop methods that will scale well alongside rising vocabulary size. Unlike in articulated tongues, phonemes can transpire simultaneously in Signal Speech recognition. The number of probable combinations of phonemes afterward imposing linguistic constraints is concerning 5.5 × 108. Gesture credit, that is less constrained than Signal Speech credit, suffers from the alike problem. Thus, it is not feasible to train standard models for large-scale Signal Speech applications. There are approached that yet need thought of the combinations at training time. We desire way to Signal Speech credit that aspires to being a resolution to the scalability setbacks.

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