Survey On Air Writing Recognition

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Abstract : Human Computer Interaction (HCI) enhances communication with the computer and reduces the barrier between the human expressions and the understanding of computers. The applications include gesture recognition, sign languages, finger painting, virtual mouse and keyboards, etc. Color tracking and detection are other interactions provided by the vision-based HCI systems. The system presents an effective way of communication for deaf or dump peoples are helps user to convey many messages with little efforts. In this paper we reviewed several algorithms and techniques used for finger tip detection and tracking:

Keywords: 6- DOF, Artificial Neural Network (ANN), Hidden Markov Models(HMM), Kinect sensor, OCR, OpenCV, Wireless Inertial Measurement Unit (WIMU).

I. INTRODUCTION

Touch screen panels(TSPs), as human machine interfaces have been ubiquitously adopted in our daily life. These advanced technologies make our life easy and comfortable. Touch Screen Panels uses hardware components which are also complex. The lack of sensing force information is also a drawback of touch screen panels. Air writing recognition is used to write characters or words in free space by hand or finger movements. Air-writing can also contribute to the progression of an automation process and can improve the interface between man and machine. Methods to reduce the processing time while providing higher recognition accuracy is a challenge it can face. Recent advances of tracking technology make it possible for users to track hand and finger motions

II. AIR WRITING RECOGNITION

Air-writing provides a practical alternative interface for text input, especially when conventional input devices, such as a keyboard or a mouse, are not available or suitable. Compared with other non-traditional input methods such as with a virtual keyboard or similar schemes, air writing offers a "eye-free" execution, execution benefit focusing attention.

A. Handwriting Gesture Recognition

Estimation of various handwriting gesture[1] recognition methods, includes pixel-matching method, rule based method and discriminant -function based method. In pixel-matching based method the system's input calculates the correspondence between the handwriting pixels of the pixel template directly. Generate a featured pixel template based on stroke that is normally restarted on a particular gesture. Pixel-templates of all gestures have same dimension. Then a normalized correlation between input pixels and pixel-templates is calculated as the similarity. Rule based method do not need to update the database of handwriting recognition engine. It takes the geometry features of the input and is based on the prior rules to distinguish gestures. This method is fast and very effective for simple-shaped gestures. But for the complex gestures its accuracy is not good enough. Discriminant function based method achieves higher accuracy for gestures. Especially, they can recognize gestures with complex-shape. But they need update database of handwriting recognition, and spend more computation consumption.

B. Phonepiont pen

Numerous sensors in modern mobile phones that enable a range of people-centric applications. PhonePoint Pen is the major idea behind this system[2] to recognize human writing that uses the in-built accelerometer in mobile phones. By holding the phone like a pen, a user can write short messages or draw simple diagrams in the air. The geometric strokes are obtained by translating the acceleration due to hand gestures, and recognized as characters. Take a prototype the *PhonePoint Pen* on the Nokia N95 platform, and evaluate it through real users. Results show that, with an average accuracy of 91:9% English characters can be identified , if the users conform to a few reasonable constraints. Here an attempt to utilize the accelerometer in mobile phones to make a new input technology. Keyboards and touch-screens are mostly used in our daily life, we propose to mimic a pen. The phone identifies the hand gestures as one of multiple strokes, compares the sequence of strokes against a grammar, and recognizes the air-written alphabets. There is negligible practice required in the entire process, and knowing to its algorithmic simplicity, can run entirely on the phone's

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processor. The written message is displayed on the phone-screen, and may also be emailed to the user if they required. Moreover, the pen may offer an intuitive user-experience, adding to the menu of current input methods.

The main drawback is that difficulty in tracking the phone movement while it is being repositioned in 3D space and the prototype begin to have the user must be stationary while writing.

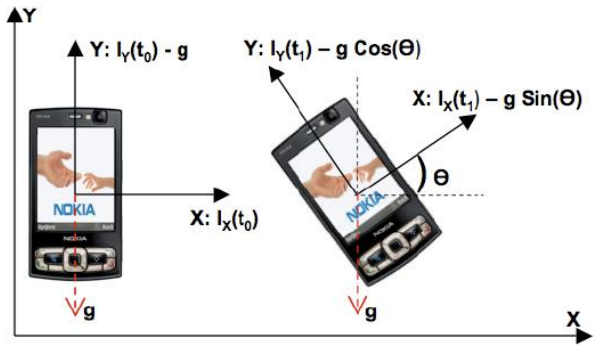

Figure 1 :Earth's gravity projected on the XY axes; the axes are a function of the phone's orientation.

C. Computer vision device based tracking

In [5] Sharad Vikram, Lei Li and Stuart Russell , they have given information about a new way to interact with computers by finger movement in the air. A computer vision device, Leap motion controller efficiently track the finger position. The stream of 3D points from and online recognition of characters they have introduced. The process of segmentation of data coordinates is difficult to determine so data driven approaches and unsupervised learning algorithm are introduced. Dynamic time warping algorithm (DTW) used to recognize the characters in online fashion . This approach use similarity search technique on multidimensional time series. Characters are identified in a time series require test and train of data and a new data set is needed for it. The creation of data set require computer vision device called leap motion controller, which records the data's and a commercial technology that accurately capturing data about the hands. Leap motion device is plug in to the computers via USB and send any type of information. Then the location of fingers is determined. The important is that when the user is writing, there is no proper

"start" and "end" of input. The system will enable us to use more complex types of the input, such as American sign language will help disabled people more easy to communicate with computers.

D. Text writing in the air using OCR

In [6] OCR based character recognition do not need sensors or any other hardware components other than a camera and a red rope . The system is color sensitive so that if there is any red back ground, characters writing may lead to wrong effects. There are two main tasks that are specific. First, it tracks finger movement and applies optical character recognition (OCR) to detect Planned image. Tracking of colored figure movement is done by finding its coordinates and plots such coordinates. After the coordinates are made, OCR applied on the plotted image, output is compared with OCRs trained data sets ,suitable one is selected and displays it. The specific OCR applies for character recognition, which can be significantly reduces the calculation time. This approach shows average accuracy about 92.083% and overall delay is 50ms.

E. Finger writing in air using kinect.

In [7] all the characters in English and Hindi language is written in free space are identified by Kinect sensor. It must be able to provide accurate character output when introduced to various text cases, which wake up from various hand writing and variation in the size of characters drawing different people in air. Characters written on free space are detected by using Microsoft Kinect sensor. Which contain advanced technology hardware cameras, sensors, and four microphone filters. Depth sensor consist of an IR projector and IR camera that provide full body 3D motion capture. RGB(RED, BLUE AND GREEN) camera capable to detect body movements has a pixel resolution about 640x480 and operates at 30 FPS. There are two approaches by which a character can be recognized, hand segmentation and finger tip detection. Hand detection can be performed by using various technologies .One such model is skin color model. It helps to distinguish skin and skin attributes from an image. The depth model can approximately identify the hand location, but not the shape . In background model, it separate background and foreground part of captured image. For efficient calculation artificial neural network (ANN) is used. ANN trained with robust back propagation algorithm (RPROP) and helps to categories variety of hand postures. Finger tip detection and separation is done by using a dual-mode switching algorithm. all kind of hand posture is identified in [7]

F. Tracking with the leap

In Air-writing there is no physical plane to write on and provides no haptic feedback or visualized writing trajectory, Writing a single stroke word written in the same column in each letter virtual board. Use a box-writing style. Compared to the ordinary left-to right writing, the box-writing style reduces the range of the hand motion makes less fatigue on the part of the user.

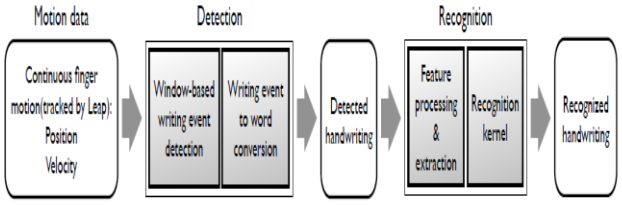

Fig 2: The system diagram of controller-free air-writing detection and recognition

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Suggest a method[4] to detects writing events and segments automatically to the writing part for recognition. The proposed window-based detector classifies whether a writing event occurs in the sliding window, and the consecutive writing windows are constructed to form a writing segment. Delivering segments to recognizer for the final result of recognition or rejection. The proposed strategy is found to be effective in extracting writing trajectories from a continuous stream of motion data mixed with stray and spurious movements.

G. Hand writing recognition based on WIMU device.

In [8] Shashidhar Patil, Dubeom Kim and Seongsill Park, their approach means to find best human computer interaction technique and a low cost sensor technology, which quickly expanded with inertial sensing systems. They had proposed a wireless inertial measurement unit (WIMU) based hand motion analysis technique for hand writing recognition in free space, without a limited environment or writing area. WIMU device includes magnetic, angular rate and gravity sensors (MARG) and also programmed with a sensor fusion algorithm to track users hand movement in 3D space precisely and accurately. Filters and calibration techniques are required to delete the errors and noise From internal signals because inertial sensors is commonly effected by noise and also the influence of gravitation produces Inaccurate output. Hand writing recognition is done by multidimensional hand writing recognition algorithm using DTW, which is efficient in real time.

This approach is suitable for interactive gesture-based applications such as computer games and real time user activity recognition applications.

H. A Wearable Handwriting Recognition System Using Hidden Markov Model(HMM)

Gestures facilitate new forms of user interfaces. Hand gestures enable the hands-free to focus on other tasks independently. This [9] describes a wearable handwriting recognition method based on inertial sensors that allows for spotting and continuously recognizing whole sentences, written in the air. Which is special type of gesticulation. The two phases of approach for spotting and recognition task, which is illustrated in Figure 3. In the spotting stage, using a Support Vector Machine to discriminate motion that contains handwriting from gesture. In the recognition stage, which uses Hidden Markov Models in combination with a statistical language model to identify the written words.

[9]system is focused on the recognition of text from continuous gestural handwriting, it provides a proof-of-concept system for any sort of gesture recognition system that needs to continuously recognize gestures which are composed of an alphabet of primitive gestures. Spotting algorithm works with high recall and low precision but additional filtering based on the results acquired from the recognition stage. This architecture and methods allow the implementation of a system operating in realtime on continuous data [10].

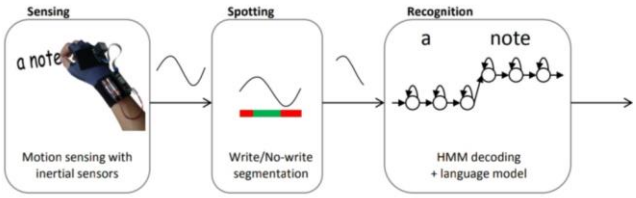

Figure3: Over view of the data processing pipeline with the individual stages of the system.

I. Air writing uses a hidden markov model

Air writing recognizes with 6DOF motion tracking systems. The writing movement is tracked with the position and orientation in the global frame, and the acceleration and angular speed in the device-wise coordinates. Measurement data with dimensions beyond 2-D trajectory will be useful for air writing recognition. Air writing process takes a long time. To make the recording process feasible, and restrict limitations on limited text in stroke orders and uppercase letters, without losing too much data in writing. From these motion data, five basic features are derived for observations of HMMs and from the combination of pure optical, pure inertial, and complete 6-DOF features[11]. Although the handwriting is defined by the planar shape. Air-writing is unistroke without pen-up/pen-down information. The writing style and motor control are typically different from ordinary pen-based writing due to lack of haptic and vision feedback. Air writing divides into two levels: motion characters and motion words. Motion characters are similar to motion gestures, and each character is modeled with an HMM. A motion word is modeled by concatenating character and ligature models. Two approaches to model ligates are presented: hard clustering and decision tree. The latter provides the better capacity of ligature modeling, which improves the performance of the character-based word recognition and stringent requirement for the accuracy. On the other hand, letter- The word-based word recognition achieves relatively low WER but is not able to recognize OOV words. The word-based recognizer is suitable for applications that have a limited vocabulary based word recognition has around 10% WER but can handle arbitrary letter sequences and progressive decoding.

J. Keyword detection by OCR method

In [12] is Provide draw the exact motion of the air writing and also method used for the keyword detection and the output in the format of audio as well as video. While there are many methods and algorithms contained within OpenCV, the most important benefit of this library for the purposes are its basic data structures like Mat, it can be used to store pixel values of an image in an n-dimension array, Scalar and Point, which include pixel values and up to 3 dimensions coordinates.

The functions provided by this library are also necessary in the development process of the object tracking application. There are many options, but considering this thesis, the focus is set on grabbing frames from a live

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camera feed, image threshold using HSV color space ranges, The reason for using the HSV pixel format instead of RGB is that because the HSV color space separates color information (saturation) from light intensity (value) ,which is much easier to threshold. pixel array of the captured image containing HSV values and setting the values of those pixels to 0 when their values are below a lower boundary or 255 when the values are above a provided higher boundary, result in the creating a binary image. After getting our expected results in color detection and tracking optical character recognition should be focused on the recognition. The OCR method Algorithm is an efficient way to find characters from the image . After character Image is detected, the characters must be compared with database images then the characters should be recognized. Since then, the keywords need to be displayed on the basis of the user's choice.

K. Air writing is recognize basis of 6 degrees of freedom hand motion

Air writing is different from traditional handwriting. The characters or words recognize the basis of 6 degrees of freedom hand motion data. Written motion is observed with location and orientation in the global frame, and the acceleration and angular speed in the device-reordered coordinates. The air-recording recording process takes a long time. To make the recording process possible, the limited words in the stroke orders and upper-case letters makes limitations on the possibility of air-writing data acquisition without losing too much of them. From this motion data, get basic features for observations of HMM, and combination of complete optical, clean incentive, and complete 6- DOF features. Though the handwriting is in full-planar shape, the motion information beyond the spatial orbital is a diagnostic description.

Air-writing without a pen-up / pen-down information is one-stroke. Writing style and motor control are typically different from Pen-based texts. They are divided air-writing into two levels , movement characters and movement motions. Motion characters are similar to motion gestures, each character is designed with an HMM. The complex nature and ligature models can be used to describe a motion. They present two approaches to model ligates : Hard clustering and decision tree. Before the recognition of the words based on words is evident. The ligature provides better performance for modeling, which improves the performance of a character-based word recognition. Word-based word recognition can only be done by a relatively low word error rates (WER), but can not recognize obsolete terms. Word-based recognizer is ideal for accurate textual and strict applications that provide accurate information. On the other hand, the alphabetical word recognition is 10% WER but can handle unilateral letter sequences and progressive decoding. In order to enhance the accuracy of letter-based recognition, the user can choose the right to makes suggestions using the n-best decoding system In an analysis on the information speed, motion footprint, physical strain, and an evaluation of text input methods based on two movements, a study says: Air-writing and virtual keyboard. Air-writing may not be enough for general-purpose text input, but is suitable for informative and short text input in the motion-based network user interface, where traditional text or input is not available[13]

III. CONCLUSION

In this paper we described the main approaches used in air writing recognition. We describe an air-writing character recognition, users can input characters virtually in the air, without any additional device such as keyboard, touch screen, or digital pen. Each of the methods have their own merits and drawbacks. Many of the modeling is done by using artificial neural network, hidden markov model,OCR etc .Air writing is uni-stroke without pen up/ pen down information. Various techniques have been described in this paper for character recognition in air writing recognition system.

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