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Fingertip Detection and Character Recognition Technique by using Leap Motion Controller in Air

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***Abstract*— Leap Motion Controller is a 3D Gesture Recognition tool which track the movement of hand and objects in its scenario . The controller provides position of object in 3D space in the form of informative data . It consist of led bulb and uses infrared radiation to track the objects . Leap Motion Controller can track twenty frames per seconds. This paper starts with brief review of various character recognition techniques which includes the methods of recognising character in human understandable language . Artificial intelligence techniques plays a major role in determining the character it includes various methods which are helpful in recognition of character such as HMM, Supervised Learning , Clustering , etc. Further, in this paper we are supposed to use coordinated path ordering Techniques to recognise character using Leap Motion Controller.**

Keywords—Leap Motion , Natural Human Computer Interaction

I. INTRODUCTION

Natural Human Computer interaction is prevailing research in the field of gaming, education, healthcare. Recently in advancement of Robotics and other bomb diffusion squad. In this techniques people can interact with machine in more simple manner by moving hand gesture in air and providing a user a more interesting and novel way of communication with machines.

Traditional Gesture Recognition based Techniques uses optical camera which are unable to provide depth of the objects [4]. Microsoft Kinect which provide more intuitive way of learning provide Gesturing Information including depth by using infrared light range sensing camera[1]. Now, Leap Motion Controller could detect palm and finger movements on top of it . The Tracking data which contain palm and finger position, direction, velocity could be accessed using its SDK. It Consist of three Infrared light emitters and two camera which receive IR light[1,2,7].

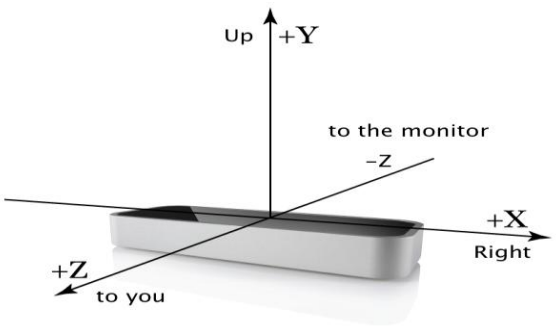

fig 1 . Leap Motion : The axes orientation

Character recognition is process of converting the language written in spatial form into computer understandable form (unicode). Many researchers suggest the way of recognising character such as fuzzy based , artificial neural networks , HMM, etc. There have been significant research in the field of Human computer interaction like finger - painting ,virtual mouse , gesture recognition , sign language , writing system etc. Recent studies present character writing in the air based on leap motion controller which regards fingertip as a virtual tool and its position as written character . critical component in writing in air is fingertip position estimation[5]. Although previous studies proposed tracking the moving fingertip for recognition of character in air. we found that algorithm failed when dealing with the fast writing situation and a more general environment when challenging lighting background[11]

Wang,Su,Lin [1] proposed Recognition System for digits writing in air using coordinated path ordering with normalization coding in which features are recorded as temporal data series in time order map the coordinates onto a 6x8 table according to stroke order and then ensure the path code of a digit in which overlapping part will not be overwritten , providing us a more efficient way to differentiate digits.

In [2] apply palm normal with hand gesture and implement for single hand control and controlling the speed of avatar movement .Whereas [7] evaluation testing of leap motion controller, it appears device is not ready to interpret the full range of sign language.

In [4] and [6] stated gesture in air and Hand Motion trajectories for recognition of Air-Drawn Symbols uses webcam and depth sensing camera like Kinect came as a great rescue in any live condition of varying light and background.

In [10] and [13] uses inertial sensors attached to back of hand continuously recognition of sentences written in air. In trajectory estimation presented a method that does not depend on motion detection , also tested different combination of information with FDA technique to see how they affect the recognition performance.

In this paper we proposed a new tracking detection based fingertip position estimation algorithm for character writing in air .Our algorithm provide robust and accurate fingertip position estimation in various challenging situation and significantly improves the character recognition rate .

Our main contribution lie in two aspects:

First, By using new physical structure guided constraint which detect the fingertip position on the plane. Second, to incorporate a dashboard for position of character which applies to recognise particular character.

II. THE PROPOSED SYSTEM

- The flowchart of the proposed recognition system for character writing in air is illustrated in fig 2 . First, Leap Motion controller is initialized , including turning on the leap motion Listener. Leap Motion SDK V2 desktop is for building with standard tracking, including support for OSX, Linux, and tool tracking. A legacy OSX VR integration is also available.If you're using Windows and don't require tool tracking, its recommend Leap Motion Orion and Orion Unity Assets.
- Leap Motion Controller SDK can detect movement of any object in its interaction area . Then we have to set coordinates of required character for recognition on the dashboard according to their shape and position on the output screen. Then we analyse the start condition for fingertip position detection on the output screen . Then we record the movement of fingertip in the air and match the position with dashboard coordinates . If the coordinates of moving fingertip match with the coordinates of dashboard , then we follow the coordinates request for character recognition. And set the required character on output screen .
- Our proposed method is based on gesture sign language recognition in air by using Leap Motion Controller for the detection of keyboard shortcut keys. A predefined dataset is to be created by Microsoft visual studio SDK in database. Then, captured sequence of patterns in sign language is to be matched with the database selection . Further, we can apply HMMs to improve the performance and analyze to obtain more accurate results

III. COORDINATED PATH CHARACTER RECOGNITION

Many software and devices nowadays are available for typing and performing a keyboard and mouse based task virtually in which no actual involvement of keyboard exist. Unlike virtual view for the physically disabled person such as handicapped, dump, deaf it continues a challenge to solve. To save quality time and improve the performance of common desktop user keyboard shortcut plays a vital role.

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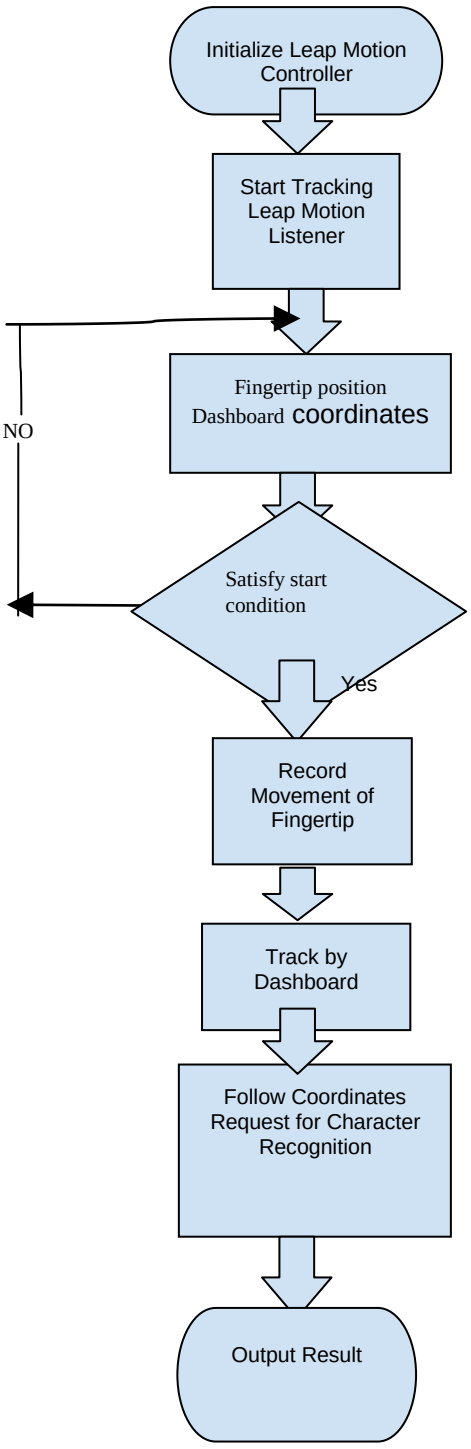


Fig 2. Flowchart of the proposed method

We proposed a way for developing a fingertip position detection and character recognition system to recognize global character in air. The fingertip position trajectory motion is captured with the help of leap motion controller and processed data object should match with dataset stored in database.

A vision-based approach is chosen for recognition of gesture movement in particular frames captured by Leap Motion controller. Gesture Recognition for various sign language of keyboard keys are supported by supervised learning approach.Further,

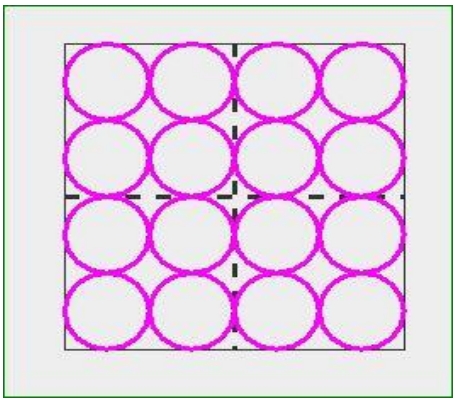


Fig. 3 Proposed Coordinates arrangement on screen

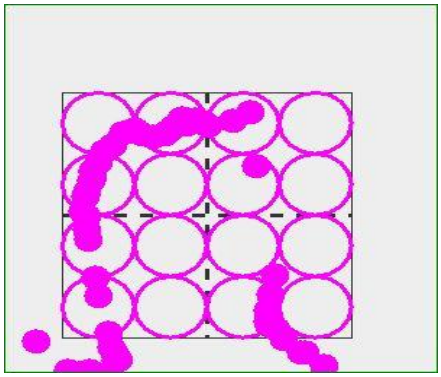
Arrangement of coordinates on dashboard

Fig3. illustrates our proposed coordinates path order dashboard on screen in this method is similar to the pixel representation for the formation of picture or image in digital image processing , here pixel is replaced by fixed sized circle in a plane and its center of each circle represents a coordinates . when the finger tip projection by leap motion listener comes in contact with these centre of circle which leads to occurs required character detection. In this arrangement each circle act as particular key of character to be produced as output on screen .Here , we describe several methods as follows

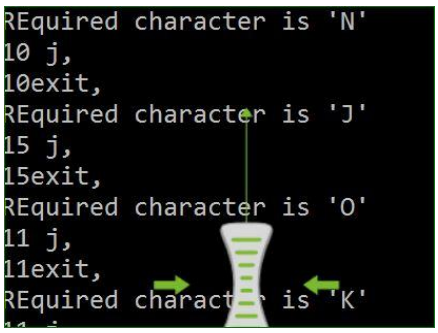
Several Methods for detection

Method 1:

Taking Each centre of circle coordinates acts as required character to be recognized by leap motion controller . Whenever the cursor for recognition comes in contact with the centre of circle . A particular character will be printed on screen .For example a Character ‘A’ is marked in the centre of first circle. Then this centre act as key for producing character ‘ A’ on screen which further utilises as text to speech format.



(a)

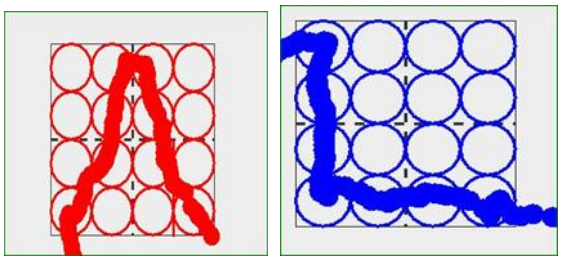


(b)

fig 4 . (a) shows movement of fingertip crossing the each centre of circle and (b) shows the output results recognizing character on screen in command prompt windows.

Method 2:

Taking Each centre of circle acts as various coordinates of character ‘A’ . In Fig 5a shows while trying to draw character A using Leap motion controller on screen . Here we marked all the centre of circle crossed while drawing character ‘A’ on screen . If All the marked centre of circle covered while drawing the character , then it’ll recognise the character A on screen .Similar procedure is being followed for other alphabetic character and digits.



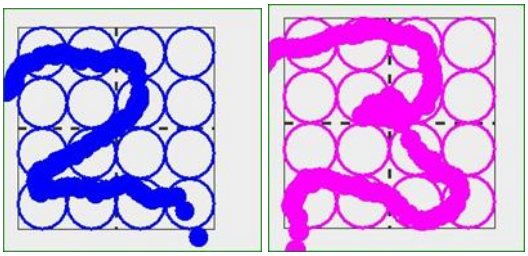


Fig 5. Marked each centre of circle covered for recognition

IV. EXPERIMENTAL RESULTS

Here we present the outlines of various methods used in handwriting and sign language character recognition system. These methods can be used to optimise the performance of our experiment.

A. Partial Matching

While drawing character with free hand finger tip , it is not possible to draw same pattern as marked in previous attempt . There also some situation that points occurs are going near to centre of circle not exact to the centre . In order to overcome this type of ambiguity we have to be prepared with target points which are common for one type of character detection.

B. Oblique Characters

Oblique characters Occurs when the shape and size of character drawn using fingertip does not match with the sample coordinates in the system , here mismatch condition arises which leads to valid character unrecognised . Solution for oblique character is the method in which we can divide the screen in patterns of circle where you don't need to change the directions while drawing on screen and the solution does not affect the result

C. Normalization with speed

As Leap motion controller is fingertip recognition rate is higher than any other devices. In this method difference of speed Leap Motion Controller to detect fingertip and speed to catch the various points on coordinates to detect a symbol is directly proportional to the performance of our system

Let P° , V° denotes 2-D position and velocity on xy plane as feature vector for HMM's respectively. The Normalization process is required to make the recognizer scale and speed invariant [3] . Normalization of P° and V° is accomplished as follows :

$$P = \frac{(P^\circ - \overline{P^\circ})}{\sigma_y}, \quad \sigma_y \text{ is the standard deviation of } p_y \quad (1)$$

$$V = \frac{V^\circ}{max\|V^\circ(i)\|} \quad , \; i = 1,2,.....N \qquad (2)$$

V. CONCLUSION

In this paper we summarize the gesture recognition techniques can be used for detection of keyboard keys by using Leap Motion Controller. We also classify the gesture recognition system on the basis of control and interface of medium between the computer and human hand figure. We also listed various the methods from which one or combination can be used to recognise keyboard characters. Further, this paper provides guidelines to build gesture based input in air and support the sign language recognition as input method to reduce the complexity of keyboard keys.

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