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The Space Writer: Review of Research Literature

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Abstract
The Space Writer refers to the software that detects writing in space without any physical contact with the device. It makes a giant contribution to the progress of an automation and may improve the human-machine interface in a variety of programs. It is one of the most active observation topics in computer vision-based analytics and hand gesture evaluation and interpretation. We evaluate the research regarding the hand gesture visual interpretation in the context of its use in HCI. The method for modeling, studying, and identifying gestures is the premise for this topic.
Keywords - *Computer Vision, Vision-based gesture recognition, Object Tracking, character detection, character recognition.*

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I. Introduction

The traditional manner of writing includes pen and paper, chalk, and a board method of writing. The key objective of the Space Writer is to create a hand gesture detection machine that can be used to write digitally using special tools to make the process more efficient. In digital artwork, there are many unique ways to write. Examples include using a keyboard, touch-display surface, digital pen, stylus, electronic hand gloves, etc.However, in this machine, a machine learning algorithm composed of Python, and/or a digital image processing method is used to recognize hand gestures and create verbal interaction between a man and a machine.The development of technology as well as the infectious spread of the pandemic has hastened the need to improve the HCI systems in order to update traditional systems to function without physical contact and to allow a consumer to interact with a laptop or other consumer electronic tool while enjoying their verbal exchanges.

II. Literature review

A. Visual Interpretation of Hand Gestures for HCI:

Two classes of models employed in the paper [6] are the 3D models and the appearance of a human hand in the image. The first model employed in paper [6], 3D hand models,provide elaborate modeling of hand gestures, but [6]also suggests that it leads to computational hurdles which are not overcome due to the real-time requirements of HCI. The second model employed in [6], Appearance-based models,is simpler toimplement and uses real-time gesture recognition but paper [6] implies that it could be a drawback for natural HCI due to inherent limitations.

B. In-Air Continuous Writing Using UWB Impulse Radar Sensors:

The intention of paper [9] is to create a radar-based totally impulseradio ultra-wideband (IR-UWB) device that can come across alphanumeric letters in mid-air without the use of a portable device. the primary goal of [9] became to conquer the troubles caused by artifacts that arise in mid-air writing. [9] has proven that our proposed technique the use of converted snapshots stepped forward the accuracy even for instances with artifacts. The accuracy becomes stepped forward by paper [9] by way of 8.2% for 10 characters.

C. Text Writing in Air:

In paper [3], a fingertip monitoring and a recognizing algorithm is presented. [3] proposed a set of rules with2 important responsibilities: first, it detects the motion of the colored finger and then applies OCR to understand the plotted picture. The proposed technique by [3] is a software program-based solution, which was different from other works of literature which proposed requiring extra hardware like an LED pen or a leap motion controller.

D. Basic Paint Window Application via Webcam Using OpenCV and NumPy in Python:

Paper [4] capitalizes on this void by means of focusing on the development of a motion-to-textual content converter that is probably used as software for intelligent wearable gadgets that allow for writing from the air.

[4] proposes the gadget will use pc imaginative and prescient to trace the finger's route, and in that manner, you'll be able to write from above. The generated textual content via [4] also can be used for various purposes, which include sending messages, e-mails, etc. For the deaf, it'll be a strong manner of conversation. [4] proposes that this is an powerful communication technique that reduces cell smartphone and laptop utilization by way of disposing of the need to jot down.

E.AirScript - Creating Documents in Air

The recognition module of the paper [2] consists of a Convolutional Neural Network (CNN) and 2 Gated Recurrent Unit (GRU) Networks. The output from these recognition modules is merged to getthe ultimate prediction of the characters written. In the evaluation results of the paper [2], the recognition moduleoutperformedother models by achieving an accuracy of 91.6% fromperson-independentcases and a 96.6% accuracy fromperson-dependentcases as found by the author's evaluation results.

F. AirNote–Pen it Down!

Paper [1] is different from the other models by allowing individuals to write in the air by making use of a person's fingertip without having to carry a pen, whereas in the other models, air writing can be done using a stylus or air-pens that have a distinct hue. Deep Learning algorithms were used in paper [1] to identify fingertips in every frame which was usedas a list of coordinates to map. Several 2-secondfilms of a person's hand movements were obtained in various locations using the method proposed in [1]. To train the model for fingertip detection, the dataset was separated into 85 percent training sets and 15 percenttesting sets once it has been prepared and labeled. To train the dataset, paper [1] utilized the Single Shot Detector (SSD) and Faster RCNN pre-trained models.

G. Air-Writing Recognition—Part I: Modeling and Recognition of Characters, Words, and Connecting Motions

Air-writing is addressed on tiers in Paper [7]: motion characters and movement words. remoted air-writing characters are akin to motion gestures in that they will be diagnosed, however with more sophistication and versatility. Paper [7] proposes concatenating clustered ligature models and character letter fashions to generate statistical models for phrases for motion word reputation wherein letters are joined and overlaid inside the identical virtual box in space. Writing movement can be defined as a spatiotemporal pattern, in step with [7]. To keep away from worries with sufficient education records, HMM fashions for movement characters may be easily concatenated to construct a motion phrase with extra linking ligature movements the usage of the generally applied sub-word modeling method. movement man or woman HMMs are educated immediately from the remoted A-to-Z recording, and each man or woman has its very own model. We synthesize the HMM for each phrase in the lexicon in word-based totally reputation and the recognition is carried out at the unit level. phrase-based totally reputation is phrased as a one-out-of-N difficulty with a vocabulary of N words, in keeping with article [7], and becomes increasingly more resilient in opposition to person letter mistakes inside a word. word-based reputation, however, inside the technique proposed by means of article [7], desires the user to finish the entire phrase before reputation and can't deal with phrases that aren't in the consumer's vocabulary (OOV). each writing action and the conditional likelihood of previous letters will have an effect on the decoded letter series[7].

III. Proposed Methodology

Space writer is built to enable a user to put forth their thoughts, ideas, and inspirations with their innovativeness by just flicking your finger in the space around them.Here, the proposed methodology to build the Space Writer is explained which will allow us to write anything by tracing the path of the colored object present at the tip of our finger.

This project will be built using the computer vision techniques and digital image processing of OpenCV. Python, with its extensive libraries and simple syntax, is chosen for the internal program to execute this methodology. However, it can be implemented in any OpenCV-supported language by learning the fundamentals once.

In order to develop this method,Colour Detection and object tracingare used. The colored object present on the fingerwill be detected and its equivalentmask is generated using OpenCV. Further digital image processing is done using morphological operations on the generated mask to make the mask more suitable to detect the gestures with more accuracy. Erosion and Dilation are the main methods used. Erosion removes impurities from the mask, whereas dilation restores the eroded main mask.

ALGORITHM

1.Capture the video from the cameraand the image frames are converted to HSV(Hue-Saturation-Value) color model to facilitate easier detection of the object.

2.Set up the application screen and put all thenecessary buttons to perform tasks to provide various writing toolsthat a traditional system would.
3. Find the mask of thecoloredobject by adjusting the trackbar values.
4. Apply the morphological operations to preprocess the mask using erosion and dilation.
5.Find the center coordinates of the largest hand stroke motion and store them in an array as contour points to redraw the stroke digitally.
6.Finally,redraw the points from the array to display the stroke lines on the canvas.

IV. Conclusion

This paper proposes a device that allows humans to write something within the space around them. The gadget has the ability to project traditional writing strategies on a computer. The visible illustration of interpreting hand gestures might permit the improvement of previous traditional interfaces to more efficient HCI structures that canindicate the potential of the new gesture detection system. It will also help different kinds ofspecially-abled people verbalize without problems. Even hospitalized patients in bed or tired individuals can use the gadget with less effort required. For further work, the development of AI will improve the accuracy and efficiency of writing in the space around us.In future, this gadget can be converted intoa new machine that could allow dyslexicsto write alphabets clearly in the space around them and make their studying experience fun.

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