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Air Handwriting using AI and Ml

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Abstract - Air-writing recognition has received wide attention due to its potential application in intelligent systems. To date, some of the fundamental problems in isolated writing have not been addressed effectively. This paper presents a simple yet effective air-writing recognition approach based on deep convolutional neural networks (CNNs). Radiational air-writing requires an extra device containing sensor(s), while the wide adoption of smart-bands eliminates the requirement of the extra device. Therefore, air-writing recognition systems are becoming more flexible day by day. However, the variability of signal duration is a key problem in developing an air-writing recognition model. Inconsistent signal duration is obvious due to the nature of the writing and data-recording process.

Key Words: air-writing recognition, interpolation, time-series data, convolutional neural network (CNN), hand tracking.

1.INTRODUCTION

In the last decade, we have grown accustomed to interacting with the digital world in various ways. Touchscreens and other electronic devices are common means for people to connect to the internet. The use of smartphones and other physical devices imposes the additional burden of transporting them and taking them out of one's pocket to interact with them. The primary goal of next-generation technologies is to eliminate the necessity for intermediary physical devices, for instance, smartphones [1]. put for intelligent system control [1]. Air-writing recognition is closely related to motion gestures or sign language recognition. Motion gesture recognition methods can be roughly divided into two categories: device-based and device-free. The device-based method requires the use of either handheld or worn devices to obtain hand (or finger) movement in three dimensions, for example, handheld pointing devices such as Wii [1], inertial sensors attached to a glove [2], [3], or motion sensors on the watch [4]. However, the requirement for handheld or worn devices The associate editor coordinating the review of this manuscript and approving it for publication was Li Zhang . and sensors are troublesome and complicated to use; thus, device-based methods are not commonly used.

By contrast, in the device-free method, users do not need to hold or wear any devices; hence, this method is more convenient than the device-based method. Device-free methods can be further divided into vision-based and radio-based methods. The former utilizes 2D or 3D cameras to capture gesture input images. The latter uses radio sensors such as radar [5]–[7] or WiFi [8]–[11] to obtain gesture signals. In the present circumstances, digital art and traditional art are inclusive of the symbiotic state, so we need to systematically understand the basic knowledge of the form between digital art and traditional art. The traditional way includes pen and paper, chalk and board method of writing. The essential aim of digital art is of building hand gesture recognition system to write digitally. Digital art includes many ways of writing like by using keyboard, touch-screen surface, digital pen, stylus, using electronic hand gloves, etc. But in this system, we are using hand gesture recognition with the use of machine learning algorithm by using python programming, which creates natural interaction between man and machine. With the advancement in technology, the need of development of natural 'human – computer interaction (HCI)' [10] systems to replace traditional systems is increasing rapidly.

2. RELATED WORK

This work presents a vision-based approach; hence, only the vision-based methods that utilize 2D and 3D cameras in the literature are discussed in the

following. Many studies have been carried with 2D technology. Air-writing recognition can also be considered in parallel to hand gesture recognition. The steps involved in vision based 2D hand gesture recognition are hand/finger detection and tracking, feature extraction and classification. An early vision-based work by Oka et al. [16] used a complex device with an infrared and color sensor for fingertip tracking and recognition.

The DTW-based method is a well-studied approach to deal with time-series data and air-writing recognition [4]. Chen et al. determined air-writing to be better than virtual keyboards in typing accuracy [**4**]. The authors also looked into identifying the beginning and end of each letter by the segments of the writing signal in a continuous data stream. A Wii remote was also used by Xu and Xue, where the users were given instructions about the order of movement for each of the air-written letters [5]. Li et al. used mobile-phone-captured motion signals performed by users and an LSTM-based deep neural network architecture to differentiate between twelve different handwritten characters consisting of six uppercase letters and six digits [5]. Moazen et al. attempted to recognize air-writing with a dataset containing 100 sets of samples of all 26 English letters collected from a single subject [6].

Uysal et al. proposed RF-Wri, a device-free machine-learning-based air-writing recognition framework that can differentiate 26 capital letters [6]. Yanay et al. allowed the users to write with their hands in the air naturally while capturing the motion signals by smart-bands [2]. In this experiment, the accelerometer and gyroscope signals were collected from the smart-bands to create a dataset of 15 sets of English alphabet for 55 subjects each. Finally, an average accuracy of 83.20% with the user-independent method and 89.20% with the user-dependent method was obtained in their experiment. To extract air-writing trajectories captured by a single web camera, Hsieh et al. proposed a hand-tracking algorithm [8]. Alam et al. experimented with a trajectory-based air-writing system where a depth camera was used which could track the fingertip to collect three-dimensional (3D) trajectories. They collected 21,000 trajectories and developed LSTM, CNN, and nearest-neighbor-based approaches and managed to obtain 99.17% accuracy. Alam et al. proposed a trajectory-based air-writing character recognition system called CNN-LSTM, which used a combination of convolutional neural networks (CNNs) and long short-term memory (LSTM) to achieve 99.63 percent and 98.74 percent accuracy in the RTD and RTC datasets, respectively. Alam et al. developed a technique for a finger-joint tracking-based character recognition system that uses 3D information to monitor the finger-joint and use the distance between the thumb tip and another finger-joint to identify a numerical digit, alphabet, character, special key, or symbol.

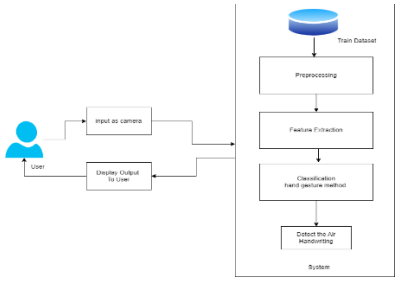

Fig -1: System Architeture

3. LITERATURE REVIEW

A.Robust Hand Recognition with Kinect Sensor

the system proposed used the depth and colour information from the Kinect sensor to detect the hand shape. As for gesture recognition, even with the Kinect sensor. It is still a very challenging problem. The resolution of this Kinect sensor is only 640×480. It works well to track a large object, e.g., the human body. But following a tiny thing like a finger is complex.

B. LED fitted finger movements

suggested a method in which an LED is mounted on the user's finger, and the web camera is used to track the finger. The character drawn is compared with that present in the database. It returns the alphabet that matches the pattern drawn. It requires a red coloured LED pointed light source is attached to the

finger. Also, it is assumed that there is no red-coloured object other than the LED light within the web camera's focus.

4. CHALLENGES IDENTIFIED

A. Fingertip detection

The existing system only works with your fingers, and there are no highlighters, paints, or relatives. Identifying and characterizing an object such as a finger from an RGB image without a depth sensor is a great challenge.

B. Lack of pen up and pen down motion

The system uses a single RGB camera to write from above. Since depth sensing is not possible, up and down pen movements cannot be followed. Therefore, the fingertip's entire trajectory is traced, and the resulting image would be absurd and not recognized by the model

5. METHODOLOGY

One way of human-system interaction is via computer hardware like keyboard, mouse, and other input devices. We can type the characters and letters whatever we wish via the keyboard this system requires speakers, voice recorders, a voice recognizer system, etc. which adds to the cost Our approach Air Writing to Text Conversion comes up with the best-optimized solution to overcome the problem

6. ADVANTAGES

The physical act of air-writing the letters as well as saying and spelling the words creates a big cognitive impression and helps cement the word in the child's memory.

7. APPLICATIONS

The air writing recognition system uses the digital camera of a pc to trace character digits written within the air by the user and then uses a convolutional neural network to classify the character and digits into one of the possible classes. The physical act of air-writing the letters as well as saying and spelling the words creates a big cognitive impression and helps cement the word in the child's memory. The exercise also gives the child some valuable practice in writing that will be useful later on in their education

8. CONCLUSIONS

The system has the potential to challenge traditional writing methods. It eradicates the need to carry a mobile phone in hand to jot down notes, providing a simple another-go way to do the same. providing air handwritten to an public to wright thing correctly and easy way. It will also serve a great purpose in helping especially abled people communicate easily. Even senior citizens or people who find it difficult to use keyboards will able to use system effortlessly

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