ABSTRACT

On-Air painting is one of the many attractive and demanding research field in domain of pattern identification and image rectification. It contributes immensely to a new human-machine interaction application. The traditional art of writing in the age of digital era is being replaced by digital art. For creating, rectifying, and visualizing paint in air, 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 and allows the user to draw in the air in a natural way. Paint software have been in our life since 1985 with the first release of windows 1.0. Artists use paint to create beautiful canvas. With the profound growth in technology, new methods and devices have come up but requirement of another input device like mouse or a pencil are still there. We propose unified CNN-RNN approach for shade detection and segmentation strategies to accomplish this goal. Color detection is a shade handling strategy where we can identify any tone in each scope of HSV shading space which coordinates the advantages of both CNNs (Convolutional Neural Networks) and RNNs (Recurrent Neural Networks).

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INTRODUCTION

1.1 OUTLINE

The traditional art of writing in the age of digital era is being replaced by digital art. Digital art refers to the forms of speech and the transmission of art in digital form. Tracking an object is viewed as a significant importance inside the field of Computer Vision. The innovation of fast computers, the accessibility of affordable and excellent video cameras and the requirements of computerized video examination have given rise to importance in tracking methods. Free-to-air collaboration is a hotly debated topic in development of communication and release of consumer-level computer platforms such as Microsoft Kinect and other movement tracking advancements. In spite of recent advances in object detection and tracking, accurate and robust detection and tracking of the fingertip remains a challenging task, primarily due to small dimension of the fingertip. Moreover, the initialization and termination of mid-air finger writing is also challenging due to the absence of any standard delimiting criterion. To solve these problems, we propose a new writing hand pose detection algorithm for initialization of air-writing using the Faster R-CNN framework for accurate hand detection followed by hand segmentation and finally counting the number of raised fingers based on geometrical properties of the hand. Further, we propose a robust fingertip detection and tracking approach using a new signature function called distance-weighted curvature entropy. Finally, a fingertip velocity-based termination criterion is used as a delimiter to mark the completion of the air-writing gesture. Experiments show the superiority of the proposed fingertip detection and tracking algorithm over state-of-the-art approaches giving a mean precision of 73.1% while achieving real-time performance at 18.5 fps, a condition which is of vital importance to air-writing.

1.2 WHY USE PYTHON, NUMPY, PANDAS

Python is open source, interpreted, high level language and provides great approach

for object-oriented programming. It is one of the best languages used by data scientist for various data science projects/application. It provides great functionality to deal with mathematics, statistics and scientific function. It provides great libraries to deals with data science application. It uses the elegant syntax; hence the programs are easier to read. The interactive mode of Python makes its simple to test codes. It allows developer to run the code anywhere, including Windows, Mac OS X, UNIX, and Linux. It is free software in a couple of categories. It does not cost anything to use or download Pythons or to add it to the application.

Numpy is Python library that provides mathematical function to handle large dimension array. It provides various method/function for Array, Metrics, and linear algebra. NumPy stands for Numerical Python. It provides lots of useful features for operations on n-arrays and matrices in Python. The library provides vectorization of mathematical operations on the NumPy array type, which enhance performance and speeds up the execution. It's very easy to work with large multidimensional arrays and matrices using NumPy. Nearly every scientist working in Python draws on the power of NumPy. NumPy brings the computational power of languages like C and Fortran to Python, a language much easier to learn and use. With this power comes simplicity: a solution in NumPy is often clear and elegant. The core functionality of NumPy is its "ndarray", for *n*-dimensional array, data structure. These arrays are strided views on memory.

Pandas is a fast, powerful, flexible and easy to use open source data analysis and manipulation tool, built on top of the Python programming language. Pandas is one of the most popular Python library for data manipulation and analysis. Pandas provide useful functions to manipulate large amount of structured data. Pandas provide easiest method to perform analysis. It provides large data structures and manipulating numerical tables and time series data. Pandas is a perfect tool for data wrangling. Pandas is designed for quick and easy data manipulation, aggregation, and visualization. There two data structures in Pandas: Series handle and store data in one-dimensional data whereas DataFrame handle and store Two-dimensional data. It is a multi-paradigm programming language. Object-oriented programming and structured programming are fully supported, and many of its features support

functional programming and aspect-oriented programming (including by meta programming and metaobjects (magic methods)). Many other paradigms are supported via extensions, including design by contract and logic programming.
It is a group by engine allowing split-apply-combine operations on data sets.

Data science is an interdisciplinary field focused on extracting knowledge from data sets, which are typically large (see big data). The field encompasses analysis, preparing data for analysis, and presenting findings to inform high-level decisions in an organization. As such, it incorporates skills from computer science, mathematics, statistics, information visualization, graphic design, complex systems, communication and business. Data science is a "concept to unify statistics, data analysis, machine learning, domain knowledge and their related methods" in order to "understand and analyze actual phenomena" with data. NumPy targets the CPython reference implementation of Python, which is a non-optimizing bytecode interpreter. Mathematical algorithms written for this version of Python often run much slower than compiled equivalents. NumPy addresses the slowness problem partly by providing multidimensional arrays and functions and operators that operate efficiently on arrays; using these requires rewriting some code, mostly inner loops, using NumPy. The core functionality of NumPy is its "ndarray", for n-dimensional array, data structure. These arrays are strided views on memory.

Inserting or appending entries to an array is not as trivially possible as it is with Python's lists. The np.pad(...) routine to extend arrays actually creates new arrays of the desired shape and padding values, copies the given array into the new one and returns it. NumPy's np.concatenate([a1,a2]) operation does not actually link the two arrays but returns a new one, filled with the entries from both given arrays in sequence. Reshaping the dimensionality of an array with np.reshape(...) is only possible as long as the number of elements in the array does not change. These circumstances originate from the fact that NumPy's arrays must be views on contiguous memory buffers. A replacement package called Blaze attempts to overcome this limitation. Algorithms that are not expressible as a vectorized operation will typically run slowly because they must be implemented in "pure Python", while vectorization may increase memory complexity of some operations from constant to

linear, because temporary arrays must be created that are as large as the inputs. Runtime compilation of numerical code has been implemented by several groups to avoid these problems; open source solutions that interoperate with NumPy include scipy.weave, numexpr. Many modern large-scale scientific computing applications have requirements that exceed the capabilities of the NumPy arrays. For example, NumPy arrays are usually loaded into a computer's memory, which might have insufficient capacity for the analysis of large datasets. Further, NumPy operations are executed on a single CPU. However, many linear algebra operations can be accelerated by executing them on clusters of CPUs or of specialized hardware, such as GPUs and TPUs, which many deep learning applications rely on. As a result, several alternative array implementations have arisen in the scientific python ecosystem over the recent years, such as Dask for distributed arrays and TensorFlow or JAX for computations on GPUs. Because of its popularity, these often implement a subset of Numpy's API or mimic it, so that users can change their array implementation with minimal changes to their code required.[6] A recently introduced library named CUPy. accelerated by Nvidia's CUDA framework, has also shown potential for faster computing, being a 'drop-in replacement' of NumPy.

1.3 WHY USE OPEN CV, TKINTER

OpenCV is the huge open-source library for the computer vision, machine learning, and image processing and now it plays a major role in real-time operation which is very important in today’s systems. By using it, one can process images and videos to identify objects, faces, or even handwriting of a human. When it integrated with various libraries, such as NumPy, python can process the OpenCV array structure for analysis. To Identify image pattern and its various features we use vector space and perform mathematical operations on these features.

The first OpenCV version was 1.0. OpenCV is released under a BSD license and hence it’s free for both academic and commercial use. It has C++, C, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android. When OpenCV was designed the main focus was real-time applications for computational efficiency. All things are written in optimized C/C++ to take advantage of multi-core

processing.

Tkinter provides Python users with a simple way to create GUI elements using the widgets found in the Tk toolkit. Tk widgets can be used to construct buttons, menus, data fields, etc. in a Python application. Once created, these graphical elements can be associated with or interact with features, functionality, methods, data or even other widgets.

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 18 million. The library is used extensively in companies, research groups and by governmental bodies.

Along with well-established companies like Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, Toyota that employ the library, there are many startups such as Applied Minds, VideoSurf, and Zeitera, that make extensive use of OpenCV. OpenCV’s deployed uses span the range from stitching streetview images together, detecting intrusions in surveillance video in Israel, monitoring mine equipment in China, helping robots navigate and pick up objects at Willow Garage, detection of swimming pool drowning accidents in Europe, running interactive art in Spain and

New York, checking runways for debris in Turkey, inspecting labels on products in factories around the world on to rapid face detection in Japan.

It has C++, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. OpenCV leans mostly towards real-time vision applications and takes advantage of MMX and SSE instructions when available. A full-featured CUDAand OpenCL interfaces are being actively developed right now. There are over 500 algorithms and about 10 times as many functions that compose or support those algorithms. OpenCV is written natively in C++ and has a templated interface that works seamlessly with STL containers.

The tkinter package (“Tk interface”) is the standard Python interface to the Tcl/Tk GUI toolkit. Both Tk and tkinter are available on most Unix platforms, including macOS, as well as on Windows systems.

Running python -m tkinter from the command line should open a window demonstrating a simple Tk interface, letting you know that tkinter is properly installed on your system, and also showing what version of Tcl/Tk is installed, so you can read the Tcl/Tk documentation specific to that version.

Tkinter supports a range of Tcl/Tk versions, built either with or without thread support. The official Python binary release bundles Tcl/Tk 8.6 threaded. See the source code for the _tkinter module for more information about supported versions.

Tkinter is not a thin wrapper, but adds a fair amount of its own logic to make the experience more pythonic.

For example, a button widget can accept mouse clicks, and can also be programmed to perform some kind of action, such as exiting the application.

generator expressions. The standard library has two modules (itertools and functools) that implement functional tools borrowed from Haskell and Standard ML and Data Science.

In 1962, John Tukey described a field he called “data analysis,” which resembles modern data science. Later, attendees at a 1992 statistics symposium at the University of Montpellier II acknowledged the emergence of a new discipline focused on data of various origins and forms, combining established concepts and principles of statistics and data analysis with computing.

A facial recognition system is a technology capable of matching a human face from a digital image or a video frame against a database of faces, typically employed to authenticate users through ID verification services, works by pinpointing and measuring facial features from a given image.

Development began on similar systems in the 1960s, beginning as a form of computer application. Since their inception, facial recognition systems have seen wider uses in recent times on smartphones and in other forms of technology, such as robotics. Because computerized facial recognition involves the measurement of a human's physiological characteristics, facial recognition systems are categorized as biometrics. Although the accuracy of facial recognition systems as a biometric technology is lower than iris recognition and fingerprint recognition, it is widely adopted due to its contactless process. Facial recognition systems have been deployed in advanced human-computer interaction, video surveillance and automatic indexing of images.

Facial recognition systems are employed throughout the world today by governments and private companies. Their effectiveness varies, and some systems have previously been scrapped because of their ineffectiveness. The use of facial recognition systems has also raised controversy, with claims that the systems violate citizens' privacy, commonly make incorrect identifications, encourage gender norms and racial profiling, and do not protect important biometric data. These claims have led to the ban of facial recognition systems in several cities in the United States.