



www.archive.org
415.561.6767
415.840-0391 e-fax

Internet Archive
300 Funston Avenue
San Francisco, CA 94118

AFFIDAVIT OF ELIZABETH ROSENBERG

1. I am a Records Request Processor at the Internet Archive, located in San Francisco, California. I make this declaration of my own personal knowledge.
2. The Internet Archive is a website that provides access to a digital library of Internet sites and other cultural artifacts in digital form. Like a paper library, we provide free access to researchers, historians, scholars, and the general public. The Internet Archive has partnered with and receives support from various institutions, including the Library of Congress.
3. The Internet Archive has created a service known as the Wayback Machine. The Wayback Machine makes it possible to browse more than 450 billion pages stored in the Internet Archive's web archive. Visitors to the Wayback Machine can search archives by URL (i.e., a website address). If archived records for a URL are available, the visitor will be presented with a display of available dates. The visitor may select one of those dates, and begin browsing an archived version of the Web. Links on archived files in the Wayback Machine point to other archived files (whether HTML pages or other file types), if any are found for the URL indicated by a given link. For instance, the Wayback Machine is designed such that when a visitor clicks on a hyperlink on an archived page that points to another URL, the visitor will be served the archived file found for the hyperlink's URL with the closest available date to the initial file containing the hyperlink.
4. The archived data made viewable and browseable by the Wayback Machine is obtained by use of web archiving software that automatically stores copies of files available via the Internet, each file preserved as it existed at a particular point in time.
5. The Internet Archive assigns a URL on its site to the archived files in the format `http://web.archive.org/web/[Year in yyyy][Month in mm][Day in dd][Time code in hh:mm:ss]/[Archived URL]` aka an "extended URL". Thus, the extended URL `http://web.archive.org/web/19970126045828/http://www.archive.org/` would be the URL for the record of the Internet Archive home page HTML file (`http://www.archive.org/`) archived on January 26, 1997 at 4:58 a.m. and 28 seconds (1997/01/26 at 04:58:28). A web browser may be set such that a printout from it will display the URL of a web page in the printout's footer. The date indicated by an extended URL applies to a preserved instance of a file for a given URL, but not necessarily to any other files linked therein. Thus, in the case of a page constituted by a primary HTML file and other separate files (e.g., files with images, audio, multimedia, design elements, or other embedded content) linked within that primary HTML file, the primary HTML file and the other files will each have their own respective extended URLs and may not have been archived on the same dates.
6. Attached hereto as Exhibit A are true and accurate copies of printouts of screenshots of the Internet Archive's records of the archived files for the URLs and the dates specified in the attached coversheet of each printout.



7. I declare under penalty of perjury that the foregoing is true and correct.

DATE: 11/02/2020

Elizabeth Rosenberg
Elizabeth Rosenberg

JURAT

State/Commonwealth of TEXAS)

☐ City ☒ County of Wise)

On 11/02/2020, before me, Shannara Ann Franzel,
Date Notary Name

the foregoing instrument was subscribed and sworn (or affirmed) before me by:

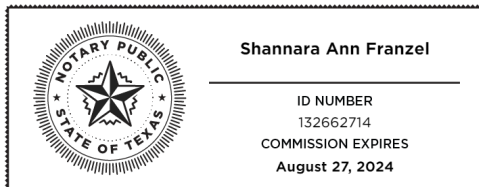
Elizabeth Rosenberg

Name of Affiant(s)

☐ Personally known to me -- OR --

☐ Proved to me on the basis of the oath of _____ -- OR --
Name of Credible Witness

☒ Proved to me on the basis of satisfactory evidence: passport
Type of ID Presented



WITNESS my hand and official seal.

Notary Public Signature: Shannara Ann Franzel

Notary Name: Shannara Ann Franzel

Notary Commission Number: 132662714

Notary Commission Expires: 08/27/2024

Notarized online using audio-video communication

DESCRIPTION OF ATTACHED DOCUMENT

Title or Type of Document: Affidavit of Authenticity

Document Date: 11/02/2020

Number of Pages (including notarial certificate): 3

Exhibit A

<https://web.archive.org/web/20100727192450/https://news.stanford.edu/pr/01/digicam3425.html>



STANFORD

NEWS SERVICE

NEWS RELEASE

4/23/01

Dawn Levy, News Service (650) 725-1944; e-mail: dawnlevy@stanford.edu

Speedy camera-on-a-chip unites image capture and processing

Faster than a speeding bullet. Able to leap photographic obstacles with a single computer chip. It's a camera. It's a chip. It's a camera-on-a-chip.

Thanks to the efforts of electrical engineering Professor Abbas El Gamal, psychology and electrical engineering Professor Brian Wandell and their students, it's getting harder to take a bad picture. Conventional digital cameras capture images with sensors and employ multiple chips to process, compress and store images. But the Stanford researchers have developed an innovative camera that uses a single chip and pixel-level processing to accomplish those feats. Their experimental camera-on-a-chip may spawn commercial still and video cameras with superpowers including perfect lighting in every pixel, blur-free imaging of moving objects, and improved stabilization and compression of video.

"The vision is to be able to ultimately combine the sensing, readout, digitization, memory and processing all on the same chip," says El Gamal. "All of a sudden, you'd have a single-chip digital camera which you can stick in buttons, watches, cell phones, personal digital assistants and so on."

Most of today's digital cameras use charge-coupled device (CCD) sensors rather than the far less expensive complementary metal-oxide semiconductor (CMOS) chips used in most computing technologies. Light arriving at the CCD sensor is converted into a pixel charge array. The charge array is serially shifted out of the sensor and converted to a digital image using an analog-to-digital converter. The digital data are processed and compressed for storage and subsequent display.

Reading the data from a CCD is destructive. "At that point the charge within the pixel is gone," Wandell says. "It's been used in the conversion process, and there's no way to continue making measurements at that pixel. If you read the charge at the wrong moment, either too soon or too late, the picture will be underexposed or overexposed."

Another limitation of CCD sensors, El Gamal says, is designers cannot integrate the sensor with other devices on the same chip. Creating CMOS chips with special circuitry can solve both of these problems.

In 1993, El Gamal began working on image sensors that led to the establishment of Stanford's Programmable Digital Camera Project to develop architecture and algorithms capable of capturing and processing images on one CMOS chip. In 1998, he, Wandell and James Gibbons, the Reid Weaver Dennis Professor of Electrical Engineering, brought a consortium of companies together to fund their research effort. Agilent, Canon, Hewlett-Packard and Eastman Kodak currently fund the project. Founding sponsors included Interval Research and Intel.

Designers of the Mars Polar Lander at NASA's Jet Propulsion Laboratory were the first to combine sensors and circuits on the same chip. They used CMOS chips, which could tolerate space radiation better than CCDs, and the first-generation camera-on-a-chip was born. It was called the active pixel sensor, or APS, and both its input and output were analog.

The Stanford project generated the second-generation camera-on-a-chip, which put an analog-to-digital converter in every pixel, right next to the photodetector for robust signal conversion. Called the digital pixel sensor, or DPS, it processed pixel input serially one bit at a time.

In 1999, one of El Gamal's former graduate students, Dave Yang, licensed DPS technology from Stanford's Office of Technology Licensing and founded Pixim, a digital imaging company that aims to embed the DPS chip in digital still and video cameras, toys, game consoles, mobile phones and more.

The need for speed

The second-generation camera-on-a-chip was relatively peppy at 60 frames per second. But the third generation left it in the dust, capturing images at 10,000 frames per second and processing one billion pixels per second. The Stanford chip breaks the speed limit of everyday video (about 30 frames per second) and sets a world speed record for continuous imaging.

What makes it so fast? It processes data in parallel, or simultaneously the chip manifestation of the adage "Many hands make light work."

"While you're processing the first image, you're capturing the second," El Gamal explains. "It's pipelining."

Besides being speedy, its processors are small. At a Feb. 5 meeting of the International Solid State Circuits Conference in San Francisco, El Gamal and graduate students Stuart Kleinfelder, Suk Hwan Lim and Xinqiao Liu presented their DPS design employing tiny transistors only 0.18 micron in size. Transistors on the APS chip are twice as big.

"It's the first 0.18-micron CMOS image sensor in the world," El Gamal says. With smaller transistors, chip architects can integrate more circuitry on a chip, increasing memory and complexity. This unprecedented small transistor size enabled the researchers to integrate digital memory into each pixel.

"You are converting an analog memory, which is very slow to read out, into a digital memory, which can be read extremely fast," El Gamal says. "That means that the digital pixel sensor can capture images very quickly."

The DPS can capture a blur-free image of a propeller moving at 2,200 revolutions per minute. High-speed input coupled with normal-speed output gives chips time to measure, re-measure, analyze and process information. Enhanced image analysis opens the door for new or improved research applications including motion tracking, pattern recognition, study of chemical reactions, interpretation of lighting changes, signal averaging and estimation of three-dimensional structures.

Photography is not a new tool in research. In 1872, Leland Stanford hired Eadweard Muybridge to conduct photographic experiments testing his idea that at one point in its gait, a horse has all four feet off the ground. That research led to the development of motion pictures.

But most people don't use cameras to advance the frontiers of science or industry. They just want to take a decent picture, and high-speed capture solves a huge problem: getting exposures throughout an

a decent picture, and high-speed capture solves a huge problem: getting proper exposure throughout an image with a big range of shades between the darkest and brightest portions of the picture.

"It's very difficult to combine low-light parts of an image with high-light parts of an image in one image," El Gamal says. "That's one of the biggest challenges in photography. Film does a very good job of that. Digital cameras and video cameras don't do as well."

Images taken in bright environments need short film or pixel exposure times, and those taken in dim environments need long exposure times. With a single click, the camera-on-a-chip captures and measures the charges in the pixels repeatedly, at high speed. Its algorithm waits until the right moment for each individual pixel to assemble a final picture with perfect exposure throughout the image.

"What I consider the real breakthrough of this [DPS] chip is that it can do many very fast reads without destroying the data in the sensor," Wandell says.

Wandell, an expert in human vision and color perception, says working with cameras gives him ideas for hypotheses about how the brain processes images. He and students including Jeffrey DiCarlo and Peter Catrysse in electrical engineering and Feng Xiao in psychology have used ideas from human vision to create image-processing algorithms to optimize the image quality for printing or display on a computer monitor.

While current cameras can focus on objects and judge illumination levels, historically they have not been used for image analysis, Wandell says. Their forte image capture is a "fundamentally different job," he says. The human brain's forte, however, is image analysis, and Wandell says future camera designs may borrow from biology to build more intelligence into cameras.

-30-

By Dawn Levy

© Stanford University. All Rights Reserved. Stanford, CA 94305. (650) 723-2300. [Terms of Use](#) | [Copyright Complaints](#)