

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC,

Petitioner,

v.

138 EAST LCD ADVANCEMENTS LIMITED,

Patent Owner.

Case No. IPR2024-00961

U.S. Patent No. 7,945,109

**EXPERT DECLARATION OF KENNETH PARULSKI IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW**

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I. INTRODUCTION AND SUMMARY OF OPINIONS

1. I, Kenneth Parulski, have been retained as an independent expert by Google LLC (“Petitioner” or “Google”) in connection with an *inter partes* review of U.S. Patent No. 7,945,109 (the “’109 patent”) (Ex. 1001). I have prepared this declaration in connection with Petitioner’s Petition for *Inter Partes* Review. I believe the statements contained in this declaration to be true and correct to the best of my knowledge.

2. I have been asked by Petitioner to provide my opinion on the technology claimed in claims 1-3 of the ’109 patent (the “Challenged Claims”) and whether the Challenged Claims would have been obvious to a person of ordinary skill in the art (“POSITA”) at the time of the earliest claimed priority date of the ’109 patent, which I have been asked to assume is September 11, 2001. This declaration sets forth the opinions I have formed, the conclusions I have reached, and the bases for these opinions and conclusions. Based on my experience, and knowledge of the art at the time of the earliest claimed priority date, it is my opinion that claims 1-3 of the ’109 patent would have been obvious based on the asserted grounds discussed below. A POSITA would have found it obvious to combine the prior art references I cite and would have been motivated to do so before the priority date. I was not asked to provide any opinions that are not expressed herein.

II. BACKGROUND AND QUALIFICATIONS

3. I believe that I am well qualified to serve as a technical expert in this matter based upon my educational background, career history, publications, and other relevant qualifications, which I summarize below. I understand that my curriculum vitae, which includes a more detailed summary of my background, experience, patents, and publications, is attached as Exhibit 1004.

4. I am currently the Chief Scientist and Managing Member at aKAP Innovation, LLC.

5. I received a Master of Science degree in Electrical Engineering and a Bachelor of Science degree in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology in 1980. I completed my master's thesis research while working at Motorola Corporate Research Labs from 1978 through 1980, where I developed a system for wirelessly transmitting a series of digital images from a moving vehicle over an FM radio communications link to a base station.

6. I joined the Kodak Research Labs division of Eastman Kodak Company in 1980, where I began developing and implementing image processing algorithms. This work included developing and testing algorithms which increased the sharpness in certain areas of an image and decreased the sharpness in other areas of an image.

7. Beginning in 1984, I led a project to develop the world's first color megapixel digital camera system prototype. This included implementing color image processing algorithms, which compensated for the color filter array pattern and the color responses of the red, green, and blue pixels of the Kodak M1 megapixel CCD image sensor. Prints made using this system were exhibited at the Photokina trade show in Cologne, Germany in 1986, in Kodak's first public demonstration of its digital photography technology. Photokina was the world's largest trade show for the imaging industry.

8. Beginning in 1987, I led a team which developed a digital image processing VLSI chipset for digital still and video cameras, which processed the output signal from various Kodak color CCD image sensors. This VLSI chipset performed extensive real-time digital image processing, including color correction processing to improve the color balance and color saturation of the images, as well as digital image processing to increase the sharpness of the images. These digital image processing integrated circuits were sold by Kodak for nearly a decade.

9. From approximately 1986 through 1992, I served as Kodak's technical representative to the Advanced Television Research Program (ATRP) at MIT, which developed the "source adaptive" video compression technologies now used in most HDTV transmission systems. During this period, I met regularly with leading video technologists from major television networks (*e.g.*, ABC, PBS) and

video equipment suppliers (*e.g.*, Ampex, General Instruments) who co-sponsored ATRP, along with the MIT professors and graduate students conducting the ATRP research. This provided me with an in-depth understanding of video production, post-production (*e.g.*, editing), and distribution processes and technologies. As part of this project, I became a named inventor on a television decoding patent which was licensed by MIT to many HDTV manufacturers.

10. From approximately 1990 until my retirement from Kodak in 2012, I was involved in the research and development of Kodak's consumer digital cameras. Beginning in 1992, I served as architect of Kodak's first generation of consumer-oriented digital still cameras, which included the Kodak DC40 camera as well as the Apple QuickTake 100 camera, the first digital camera marketed by Apple. In my role as digital camera architect at Kodak and through my participation in various projects, I acquired experience in all aspects of digital camera design, including the selection of hardware and software components such as lenses, image sensors, digital image processors, and image processing algorithms.

11. Beginning in 1992, I worked with other digital photography experts at Kodak, as well as other companies such as Fujifilm, Canon, and Sony, to develop and standardize the image file formats used in digital cameras and digital photography systems. These image file formats include the Exif image format,

which has been widely used by digital cameras and smartphones to store digital images for more than 25 years. Each Exif image file contains the image data which represents the photograph along with numerous types of image metadata, which provide information from the digital camera which captured the photograph. Examples of image metadata include the camera make and model, capture date and time, camera settings, scene type, subject location, and GPS location.

12. From 2001 to 2009, I served as Kodak Research Fellow and Director, IP & Standards in the Consumer Digital Group. In that position, I was the technical leader of Kodak's digital camera patent licensing program, where I analyzed and provided advice on a very large number of patents involving digital cameras and digital photography systems.

13. From 2010 to 2012, I held the position of Kodak Research Fellow and Chief Scientist in the Digital Cameras and Devices Division. In that role, I invented and prototyped new digital photography systems, including imaging systems using wireless imaging devices and cloud storage and image processing technologies. This included imaging systems that processed, combined, and displayed images captured using a camera phone along with custom content (*e.g.*, graphics and templates) provided from a custom content database by a web server, based on the geographic location of the camera phone.

14. I was employed by Kodak for a total of more than thirty years, during which time I followed the literature closely, attended numerous industry conferences where I discussed the state of the art with engineers working in the field, and supervised the work of numerous engineers performing research and development in the field of digital photography.

15. In 2012, following my retirement from Kodak, I founded aKAP Innovation, LLC. As Chief Scientist and Managing Member, I provide innovation and digital photography related consulting services and participate in the development of ISO (“International Organization for Standardization”) standards for digital photography. I am also Co-founder of Tourblend Innovations, LLC, which has developed a mobile platform that utilizes location based content to provide guided tours of natural, cultural, and historic attractions using a GPS enabled smartphone application.

16. I am a named inventor on more than 225 issued United States patents. Most of these inventions relate to digital cameras, wireless imaging devices, and digital photography systems and have been licensed by Kodak to more than 40 companies for use in digital cameras, smartphones, and photo sharing services.

17. I am the author or co-author of numerous publications, including chapters in leading treatises in the field of digital imaging technology. Among these, I authored the “Digital Photography” chapter in the *Digital Consumer*

Electronics Handbook published by McGraw-Hill in 1997; the “Color Image Processing for Digital Cameras” chapter in the *Digital Color Imaging Handbook* published by CRC Press in 2003; and the “Digital Camera Image Storage Formats” chapter in *Single-Sensor Imaging: Methods and Applications for Digital Cameras*, published by CRC Press in 2008. I have also presented at numerous industry conferences around the world on the subject of digital cameras and digital image processing, including plenary talks at the 2003 PICS Digital Photography Conference and the 2021 Electronic Imaging Symposium.

18. I have received a number of awards in recognition of my achievements in the field of digital imaging technology. For example, in 2001, I received the Eastman Award, Kodak’s top technical honor, for the development of digital cameras. In 2002, I received the Technical Achievement Award from the Photo-Imaging Manufacturing and Distributors Association for “pioneering work in the development of digital imaging technology.” I was the first person to be honored by this photographic association for their contributions to digital photography. In 2008, I received the Achievement Award from the International Imaging Industries Association (I3A) for “significant contributions to the advancement and growth of the imaging industry.”

19. I have served as Chair of the IT10 standards committee for digital photography since 1994. This group provides the officially recognized United

States input for many international standards used by digital cameras, including smartphone cameras. In addition, from March 2007 through February 2013, I was chair of ISO technical committee 42 (ISO/TC42), which is responsible for all international photography standards. In 2013, I was elected chair of the US technical advisory group to ISO/TC42, and was re-elected in 2016, 2019, and 2022. From June 3-7, 2013, I served as head of the US delegation to the 23rd plenary meeting of ISO/TC42, held at the National Museum in Copenhagen, Denmark. From June 2-5, 2015, I served as head of the US delegation to the 24th plenary meeting of ISO/TC42, held in Sapporo, Japan. From June 5-9, 2017, I served as head of the US delegation to the 25th plenary meeting of ISO/TC42, held in Santa Clara, California. From May 13-16, 2019, I served as head of the US delegation to the 26th plenary meeting of ISO/TC42, held in Lisbon, Portugal. From June 4-15, 2021, I served as head of the US delegation to the 27th plenary meeting of ISO/TC42, which was held virtually. From June 19-22, 2023, I served as head of the US delegation to the 28th plenary meeting of ISO/TC42, held in Okayama, Japan.

20. I currently serve as the project leader for ISO standards on digital camera resolution measurements (ISO 12233) and digital camera ISO speed and sensitivity measurements (ISO 12232), as well as the co-project leader for ISO standards on image formats for digital photography (ISO 12234 series), which

includes the standardized Exif and XMP image metadata used in digital image files. This metadata, which is included along with image data in an image file, includes information which identifies, for example, the type of scene captured and the location of the main subject in the scene.

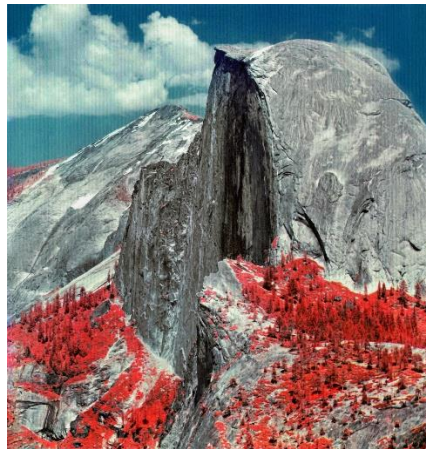
21. I am a Fellow of the Society of Motion Picture and Television Engineers (SMPTE), the global society of media professionals, technologists and engineers. In 2001, Kodak received a Technical Emmy Award for contributions I made to the development of the SMPTE 24P HDTV production standard, which has been used by Hollywood studios for over twenty years to produce movies and television programs.

III. TECHNOLOGY BACKGROUND

A. Early Digital Image Processing and Image Sensors

22. Digital image processing was an active research topic by the late 1960s. To perform digital image processing, each image was sampled and quantized into an array of picture elements, or “pixels”, which were processed by digital computers. This digital image processing research included developing various types of picture coding, to reduce the amount of data needed to transmit each image. For example, a digital linear filter can be applied at the transmitter and an inverse filter can be applied at the receiver. *See* W.F. Schreiber, “Picture coding”, Proceedings of the IEEE, Vol 55, No. 3, March 1967 pp. 320-330.

23. Beginning in 1968, Virginia Norwood conceived and developed the Landsat 1's multispectral scanner (MSS), the first wireless digital camera. The MSS captured and transmitted image data from green, red, and two infrared bands with 6 bits per channel, using a mechanical rocking mirror and an array of 24 detectors. Norwood insisted that the MSS produce and transmit digital data, since she knew that using digital technology made it possible to use computers to analyze the images. Two months before the MSS was launched into space on July 23, 1972, it was tested by taking digital photographs of Yosemite, as shown in the photo below. See <https://www.technologyreview.com/2021/06/29/1025732/the-woman-who-brought-us-the-world/>.



Multispectral scanner false-color image of Half Dome in 1972.

24. In 1969, Bell Labs invented the charge-coupled device (CCD) shift register, providing a very low noise structure for storing and reading the signal charge in an image sensor. See W. S. Boyle and G. E. Smith, *Charge Coupled*

Semiconductor Devices, Bell Sys. Tech. J. 49 (4), 587–593 (April 1970). In 1973, Fairchild introduced the CCD201ADC image sensor, the first commercially available interline CCD. This solid-state image sensor included an array of light sensitive photodiodes, arranged in a grid having 100 x 100 pixels, as depicted in the diagram below. See *Preliminary data sheet CCD201 Solid state self-scanning image sensor 100 x 100-element charge coupled device*, Fairchild Integrated Circuits, Jan. 1974, at 1.

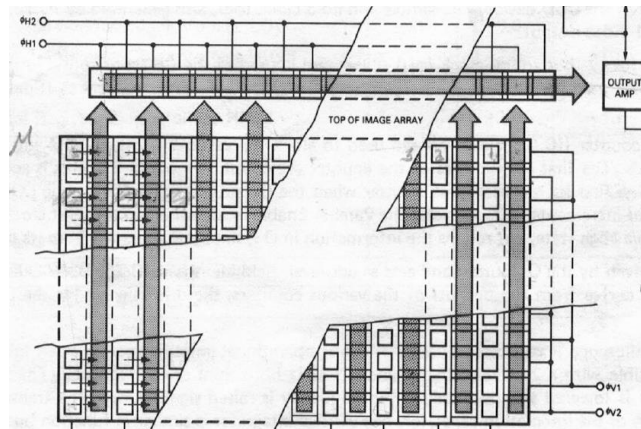


Diagram of Fairchild CCD201ADC image sensor

25. To capture color images using a single image sensor, Peter Dillon and his colleagues at Kodak Research Labs developed integral color filter arrays (CFAs). This was accomplished using a grid of color filters, having the same number of rows and columns as the array of light sensitive pixels on the sensor. Each pixel is covered with a filter that transmits only a specific color. See P. Dillon et al., *Fabrication and performance of color filter arrays for solid-state imagers*, IEEE Trans Electron Devices, vol. ED-25, pp. 97-101 (1978). One such pattern,

invented by Bryce Bayer of Kodak in 1974 and described in U.S. Patent No.

3,971,065, titled “Color imaging array,” has been used in almost all digital cameras since the late 1990s. The pattern includes 50% green pixels arranged in a checkerboard, between alternate rows of red and blue pixels, as shown below in an excerpt from Bryce’s Kodak Research Laboratory notebook dated May 24, 1974.



Excerpt from Bryce’s Bayer’s Kodak notebook depicting color pattern

B. Portable Electronic Cameras

26. The first known portable prototype digital camera was designed by Steve Sasson of Kodak between 1974 and 1976. This work led to U.S. Patent No. 4,131,919, titled “Electronic still camera,” and issued to Lloyd and Sasson.

Sasson’s prototype digital camera was publicly revealed for the first time in the digital camera history portion of an invited paper which I personally presented in May 2000 in Geneva, Switzerland. See Parulski and Rabbani, “*The Continuing Evolution of Digital Cameras and Digital Photography Systems*,” IEEE

International Symposium on Circuits and Systems, Geneva, Switzerland, 2000.

This prototype digital camera used the lens and optical viewfinder from a Kodak XL55 Super 8mm film movie camera and the Fairchild CCD201ADC image

sensor described earlier. The sensor's analog output signal was digitized using a 4-bit A/D converter. The prototype camera, shown in the photo below, captured and stored 10,000 pixel (0.01 Megapixel) black and white still images using a standard Phillips digital cassette tape. The tape recorded 2275 bits/sec, moving at 5-1/4 inches/sec. It took 23 seconds to capture and store each image, and each tape could store up to 30 images.



Steve Sasson holding Kodak portable prototype digital camera

27. On Aug 24, 1981, Sony chairman Akio Morita demonstrated the Sony MAVICA electronic still camera, pictured below, and described the Sony MAVICA system. I personally attended the IEEE Conference on Consumer Electronics in June 1982, where Sony presented their first technical papers describing their MAVICA camera, printer, and transmission system. The MAVICA camera stored up to 50 images on an approximately 2" MAVIPAK floppy disk. See Kihara, et al, "*The electronic still camera – a new concept in photography*," IEEE Trans Consumer Electronics, Vol. CE-28, No. 3, Aug 1982. The MAVICA system also included a video picture printer and a video picture

transmitter for sending and receiving images over a telephone line. A slightly modified version of the “MAVIPAK” was later standardized as the “still video floppy” (SVF).



Sony Mavica electronic still camera, lenses, and still video floppy discs

28. Canon was the first company to sell electronic still cameras in the US, when they introduced the Canon RC-701 electronic camera in 1986. The Canon RC-701 system components included the camera, a player/recorder, a printer, and a unit for transmitting images captured by the camera over a telephone line, as shown in the photo below. See Kriss, et al. “*Critical technologies for electronic still imaging systems*,” SPIE vol. 1082, pp. 157-184 at p. 159 and <http://global.canon/en/c-museum/history/story06.html>.



Canon electronic still camera, printer, transmitter, and player

C. Image Processing in Digital Cameras

29. By the early 1990s, it was widely known that digital cameras could process digital images using custom hardware circuitry or using programmable processors which execute software algorithms that were uploaded from digital storage media. For example, the first publication describing an experimental digital camera was made by NHK in 1983. See “*Fully Digitalized Electronic Still Camera*”, Ohnishi, et. al., J. Inst. TV Engrs of Japan, Vol. 37, No. 10 (1983) pp. 863-868. In this camera, images were captured by a color image sensor and stored using a detachable static RAM memory. An Intel 8086 microprocessor, located in a playback device, was used to perform digital image processing, including color separation, white balance, and gamma correction.

30. By the mid-1980s, custom digital image processing integrated circuits were being developed for use in digital still and video cameras. See “*A Basic Approach to a Digital Color Camera System*”, O’Keefe, et al., IEEE Trans. on

Consumer Electronics, Vol. CE-30, No. 3, Aug. 1984, pp 409-415. These hardwired integrated circuits performed specific digital image processing functions, such as sharpening and color correction, to rapidly produce processed color images from a single-chip color image sensor. For example, the circuitry depicted below provides edge enhancement, using the high-frequency edge “details” to enhance the sharpness of the images. The vertical and horizontal details are extracted using simple high-pass filters, summed, and non-linearly processed by a “detail processing” lookup table (LUT) to provide an edge enhancement signal. See “A High-Performance Digital Color Video Camera”, Parulski et al., SPIE Vol. 1448 Camera and Input Scanner Systems, 1991 (Ex. 1012; “Parulski 1991”), pp 45-58.

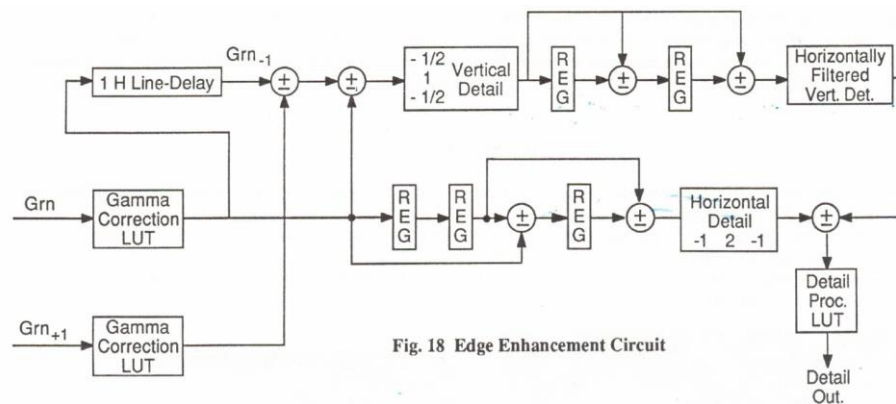


Fig. 18 Edge Enhancement Circuit

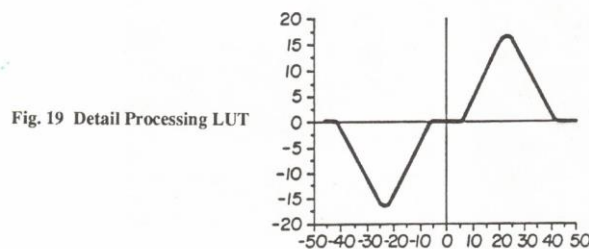


Fig. 19 Detail Processing LUT

Digital edge enhancement circuitry for modifying image sharpness

31. In 1991, Kodak introduced the Kodak Professional Digital Camera System, later known as the DCS-100, which consisted of a camera back fitted to a Nikon F3 camera and a separate digital storage unit (DSU) connected to the camera back using a digital interconnect cable, which are pictured below. This was the world's first commercially available D-SLR camera. The DCS-100 camera used a color image sensor, manufactured by Kodak, having approximately 1.3 Megapixels. The DSU included a magnetic hard drive which stored the captured images, and an LCD display which displayed the captured images. The DSU also enabled the user to enter image metadata, such as image titles, captions, and keywords, which were stored in the image file along with the image data. and to download the captured images to a computer. See Kodak Professional Digital Camera Reference Manual, copyright 1991-1992, pp. 4.2-4.10.



Kodak DCS-100 camera back and digital storage unit (DSU)

32. To process the captured images, the Kodak DCS-100 DSU was connected to a computer, such as an Apple MacIntosh computer. The computer used Adobe Photoshop software, along with the Kodak Driver for Adobe Photoshop software, to download the raw images captured by the Kodak DCS-100 camera and to perform digital image processing. This image processing included color balancing, which permitted the user to select between daylight, tungsten, and fluorescent settings. It also permitted the user to “provide color balancing data by clicking on a white area of a thumbnail or a preview of an image.” See Kodak Professional Digital Camera Reference Manual, copyright 1991-1992, pp. 6-31 – 6.34.

33. The Adobe Photoshop software permitted the user to perform many additional digital image processing operations on the images captured by the Kodak DCS-100 camera. For example, a user could selectively sharpen one portion of the image and selectively blur the rest of the image, as described in the excerpt of the Photoshop 5.0 manual below. See Adobe Photoshop version 5.0 User Guide, 1998 (Ex. 1013; “Photoshop 5.0”), p. 191.

- The focus tools consist of the blur tool and the sharpen tool. The blur tool softens hard edges or areas in an image to reduce detail. The sharpen tool focuses soft edges to increase clarity or focus. For other ways to adjust image sharpness, see “Step 6: Sharpen the image” on page 128, or “Choosing a filter effect” on page 306.



Blurring an image, and sharpening an image

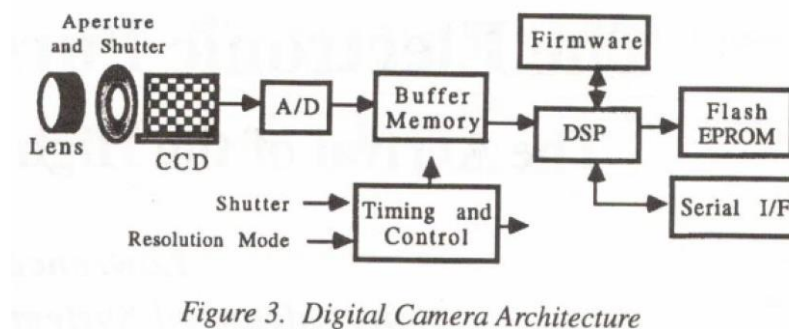
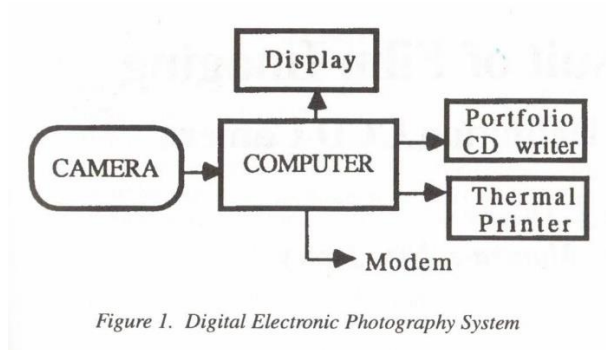
34. The Apple QuickTake 100, pictured below, was introduced in February 1994. I was the architect of the Apple QuickTake 100 and 150 cameras, which were designed by Kodak and marketed by Apple. The QuickTake 100 used a 1 MB internal Flash EPROM memory to store a maximum of 8 “high resolution” images having 640 x 480 pixels, or 32 “standard resolution” images having 320 x 240 pixels. See “*Apple QuickTake 100*” brochure, Apple Computer, Inc. 1994. The digital images were compressed prior to storage in the camera using a software compression algorithm stored in the camera’s firmware memory. The stored images were then transferred to an Apple MacIntosh computer, which performed digital image processing.



Apple QuickTake 100 camera

35. In 1994, I co-authored a paper at the Imaging Science and Technology (IS&T) Conference that detailed the architecture and components of the QuickTake 100 camera. The camera was part of a digital photography system, shown in Figure 1 below, with a computer which performed digital image processing, a display which displayed the processed images, a CD writer which stored and transferred digital images, and a hardcopy printer. The digital camera, shown in Figure 2 below, used a Kodak CCD image sensor with the Bayer color filter to capture “raw” digital images, which were compressed using ADPCM (adaptive differential pulse code modulation) image compression implemented using a DSP (digital signal processor) in the camera. The compressed images were stored in Flash EPROM memory, and later downloaded to the computer. An image processing software module in the computer performed the digital image processing functions shown in Figure 5. These functions included ADPCM

decompression and CFA interpolation, which creates red, green, and blue (RGB) values for all of the pixels in the image array. Edge sharpening was implemented using adaptive FIR (finite impulse response) filters to extract a high frequency “detail” signal, which was added to the color-matrixed and tone corrected RGB signals in a “edge enhancement” block. See Parulski, et al., “*Digital, Still-Optimized Architecture for Electronic Photography*,” IS&T’s 47th Annual Conference, 1994 (Ex. 1014; “Parulski 1994”), pp. 665-667.



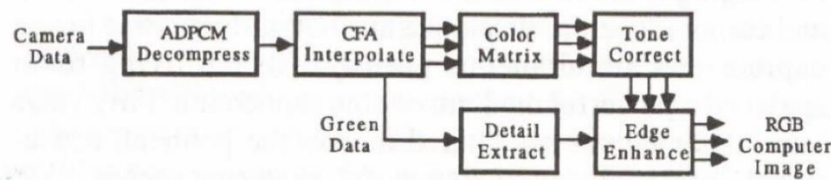


Figure 5. Imaging Processing Module Functions

36. The Casio QV-10 digital camera, pictured below, was released in 1995 in Japan. It included an LCD panel for composing and reviewing digital still images, which allowed captured images to be immediately viewed by the photographer and those being photographed. This feature made the camera very popular, and within two years most newly introduced digital cameras included similar LCD flat panel displays. The Casio QV-10 used a 32-bit RISC microcontroller to perform JPEG compression, by executing the compression algorithm instructions which were stored in a ROM memory. See Parulski, “*Chapter 21 Digital Photography*” in Jurgen, “*Digital Consumer Electronics Handbook*,” 1997, McGraw-Hill, p. 21.5.



Casio QV-10 digital camera

D. Image compression, image files, and image metadata

37. By the late 1990s, essentially all digital cameras used image compression to reduce the amount of memory used to store an image. The JPEG standard (ISO/IEC 10918-1:1994, “*Information technology - Digital compression and coding of continuous-tone still images: Requirements and guidelines*”, available online at <http://www.iso.org>) specifies a baseline compression algorithm for still images using the adaptive discrete cosine transform (ADCT). It was published as an approved international standard in 1994. The baseline JPEG compression uses the DCT (Discrete Cosine Transform) to transform 8 x 8 pixel blocks of the source image into the spatial frequency domain, as shown in FIG. 1 below. The resulting 64 DCT coefficients are quantized and entropy coded, to reduce the amount of data which encodes the still image. The DCT-based decoder, shown below in FIG. 2, reverses these processing steps, and is used, for example, in a computer to decompress JPEG images prior to display. See Wallace, “*The JPEG still picture compression standard*”, submitted in Dec. 1991 for publication in the IEEE Transactions on Consumer Electronics.

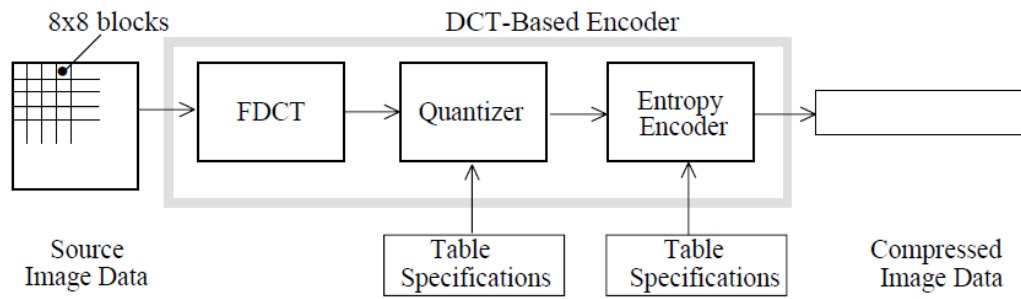


Figure 1. DCT-Based Encoder Processing Steps

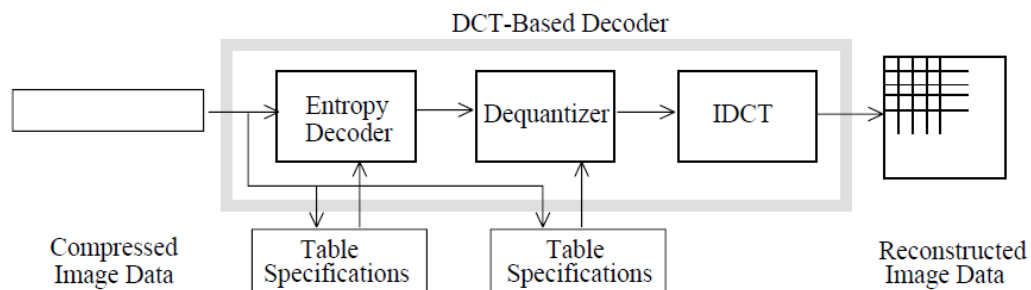


Figure 2. DCT-Based Decoder Processing Steps

38. Almost all digital cameras sold after 1996 used JPEG image compression. Most of these cameras also used the “Exif” format to store JPEG compressed still images. Each Exif/JPEG image file includes JPEG compressed image data along with extensive image metadata, recorded using TIFF tags, which provides information about the image. Exif was initially standardized by the Japan Electronic Industry Development Association (JEIDA), later known as JEITA (Japan Electronic Industry Technology Association). Exif version 1.0 was published in October 1995, Exif version 1.1 was published in May 1997, Exif version 2.0 was published in November 1997, and Exif version 2.1 was published by December 1998. I personally contributed to the image metadata tag definitions

in Exif. This included tags which indicate *e.g.*, the exposure time, lens f/number, scene capture type (e.g., portrait), and subject location, and additional “Exif Print” tags developed for improving the quality of prints made from Exif image files.

39. All versions of Exif, including Exif version 2.1 (Exhibit 1008, referred to in the rest of this Declaration as Exif-V2.1), utilize many image metadata tags that were defined in the TIFF 6.0 specification, which are listed in table 3 of the Exif-V2.1 specification, shown below. These tags provide information such as the make and model of the digital camera which captured the image, the date and time the image was captured, and the size and orientation of the image.

Table 3 TIFF Rev. 6.0 Attribute Information Used in Exif

Tag Name	Field Name	Tag ID		Type	Count
		Dec	Hex		
A. Tags relating to image data structure					
Image width	ImageWidth	256	100	SHORT or LONG	1
Image height	ImageLength	257	101	SHORT or LONG	1
Number of bits per component	BitsPerSample	258	102	SHORT	3
Compression scheme	Compression	259	103	SHORT	1
Pixel composition	PhotometricInterpretation	262	106	SHORT	1
Orientation of image	Orientation	274	112	SHORT	1
Number of components	SamplesPerPixel	277	115	SHORT	1
Image data arrangement	PlanarConfiguration	284	11C	SHORT	1
Subsampling ratio of Y to C	YCbCrSubSampling	530	212	SHORT	2
Y and C positioning	YCbCrPositioning	531	213	SHORT	1
Image resolution in width direction	XResolution	282	11A	RATIONAL	1
Image resolution in height direction	YResolution	283	11B	RATIONAL	1
Unit of X and Y resolution	ResolutionUnit	296	128	SHORT	1
B. Tags relating to recording offset					
Image data location	StripOffsets	273	111	SHORT or LONG	*S
Number of rows per strip	RowsPerStrip	278	116	SHORT or LONG	1
Bytes per compressed strip	StripByteCounts	279	117	SHORT or LONG	*S
Offset to JPEG SOI	JPEGInterchangeFormat	513	201	LONG	1
Bytes of JPEG data	JPEGInterchangeFormatLength	514	202	LONG	1
C. Tags relating to image data characteristics					
Transfer function	TransferFunction	301	12D	SHORT	3 * 256
White point chromaticity	WhitePoint	318	13E	RATIONAL	2
Chromaticities of primaries	PrimaryChromaticities	319	13F	RATIONAL	6
Color space transformation matrix coefficients	YCbCrCoefficients	529	211	RATIONAL	3
Pair of black and white reference values	ReferenceBlackWhite	532	214	RATIONAL	6
D. Other tags					
File change date and time	DateTime	306	132	ASCII	20
Image title	ImageDescription	270	10E	ASCII	Any
Image input equipment manufacturer	Make	271	10F	ASCII	Any
Image input equipment model	Model	272	110	ASCII	Any
Software used	Software	305	131	ASCII	Any
Person who created the image	Artist	315	13B	ASCII	Any
Copyright holder	Copyright	3432	8298	ASCII	Any

Exif-V2.1, 27.¹

40. Exif-V2.1 also includes many image metadata tags that provide information related to the digital camera settings and picture-taking conditions used when the image was captured, which are listed in table 5 of the Exif-V2.1 specification, shown below. These image metadata tags include, for example, the

¹ Citations to Exif-V2.1 use the PDF page numbers.

image exposure time and the lens focal length and f-number. Exif-V2.1, 41. The metadata tags also include the exposure program (e.g., portrait or landscape mode), the subject distance (e.g., the distance at which the camera is focused) and the subject location in the image frame (e.g., whether the main subject is in the center of the frame, or in a different location). *Id.*, 41, 53, 55, 59. The metadata tags also include information about the digital camera's image processing settings, such as the brightness setting. *Id.*, 52.

Table 5 Exif IFD Attribute Information (2)

G. Tags Relating to Picture-Taking Conditions					
Exposure time	ExposureTime	33434	829A	RATIONAL	1
F number	FNumber	33437	829D	RATIONAL	1
Exposure program	ExposureProgram	34850	8822	SHORT	1
Spectral sensitivity	SpectralSensitivity	34852	8824	ASCII	Any
ISO speed rating	ISOSpeedRatings	34855	8827	SHORT	Any
Optoelectric conversion factor	OEFC	34856	8828	UNDEFINED	Any
Shutter speed	ShutterSpeedValue	37377	9201	SRATIONAL	1
Aperture	ApertureValue	37378	9202	RATIONAL	1
Brightness	BrightnessValue	37379	9203	SRATIONAL	1
Exposure bias	ExposureBiasValue	37380	9204	SRATIONAL	1
Maximum lens aperture	MaxApertureValue	37381	9205	RATIONAL	1
Subject distance	SubjectDistance	37382	9206	RATIONAL	1
Metering mode	MeteringMode	37383	9207	SHORT	1
Light source	LightSource	37384	9208	SHORT	1
Flash	Flash	37385	9209	SHORT	1
Lens focal length	FocalLength	37386	920A	RATIONAL	1
Flash energy	FlashEnergy	41483	A20B	RATIONAL	1
Spatial frequency response	SpatialFrequencyResponse	41484	A20C	UNDEFINED	Any
Focal plane X resolution	FocalPlaneXResolution	41486	A20E	RATIONAL	1
Focal plane Y resolution	FocalPlaneYResolution	41487	A20F	RATIONAL	1
Focal plane resolution unit	FocalPlaneResolutionUnit	41488	A210	SHORT	1
Subject location	SubjectLocation	41492	A214	SHORT	2
Exposure index	ExposureIndex	41493	A215	RATIONAL	1
Sensing method	SensingMethod	41495	A217	SHORT	1
File source	FileSource	41728	A300	UNDEFINED	1
Scene type	SceneType	41729	A301	UNDEFINED	1
CFA pattern	CFAPattern	41730	A302	UNDEFINED	Any

Id., 41.

41. The exposure program tag indicates “[t]he class of the program used by the camera to set exposure when the picture is taken” and includes values for

“Portrait mode (for closeup photos with the background out of focus)” and
“Landscape mode (for landscape photos with the background in focus),” as
described in the excerpt from the Exif-V2.1 specification shown below. *Id.*, 55. For
example, the tag value “7” identifies “Portrait mode,” and the tag value “8”
identifies “Landscape mode.” *Id.*

ExposureProgram

The class of the program used by the camera to set exposure when the picture is taken. The tag values are as follows.

Tag	= 34850 (8822.H)
Type	= SHORT
Count	= 1
Default	= 0
0	= Not defined
1	= Manual
2	= Normal program
3	= Aperture priority
4	= Shutter priority
5	= Creative program (biased toward depth of field)
6	= Action program (biased toward fast shutter speed)
7	= Portrait mode (for closeup photos with the background out of focus)
8	= Landscape mode (for landscape photos with the background in focus)
9 to 255	= reserved

Id.

42. The subject location tag specified in Exif-V2.1 is used to indicate “the
location of the main subject in the scene” using an X and Y coordinate location
that “represents the pixel at the center of the main subject,” as described in the
excerpt from the Exif-V2.1 specification shown below. *Id.*, 59.

SubjectLocation

Indicates the location of the main subject in the scene. The value of this tag represents the pixel at the center of the main subject relative to the left edge, prior to rotation processing as per the *Rotation* tag. The first value indicates the X column number and second indicates the Y row number.

Tag = 41492 (A214.H)
Type = SHORT
Count = 2
Default = none

Id.

43. In many digital cameras, the tag values for the Exif tags described above were automatically determined when the photograph was captured by the digital camera. For example, the date and time were determined using a real-time clock in the camera, and the exposure program and subject location were determined either by user selection of the capture mode and focus location, or by automatic algorithms that selected the most appropriate exposure program and recognized the location of the main subject in the captured image.

E. Subject determination and face recognition

44. By the early 2000s, various image processing systems and devices had been developed to analyze and detect objects in a scene being photographed by a digital camera, in order to classify the scene type. One example is described in U.S. Patent No. 6,301,440 to Bolle et al. (Ex. 1010; “Bolle”), titled “System and method for automatically setting image acquisition controls,” which was filed on April 13, 2000, and issued on October 9, 2001. As shown in Figure 2 of Bolle, depicted below, a scene analysis unit uses input attributes, such as the image

intensities 201, colors 230, and depth map 203, to extract raw features in the image. These raw features include geometric features 208, texture analysis 209, and scale determination 210. The raw features form the basis for finding and identifying scene components, such as face detection 211, person detection 212, building recognition 213, vegetation detection 214, and vehicle recognition 215. These scene components are used to determine the final scene classifications, such as portrait 216, close-up portrait 217, group shot 218, action photo 219, natural landscape 220, still-life 221, macro 222, crowd scene 223, back-lit object 224, and night sky 225.

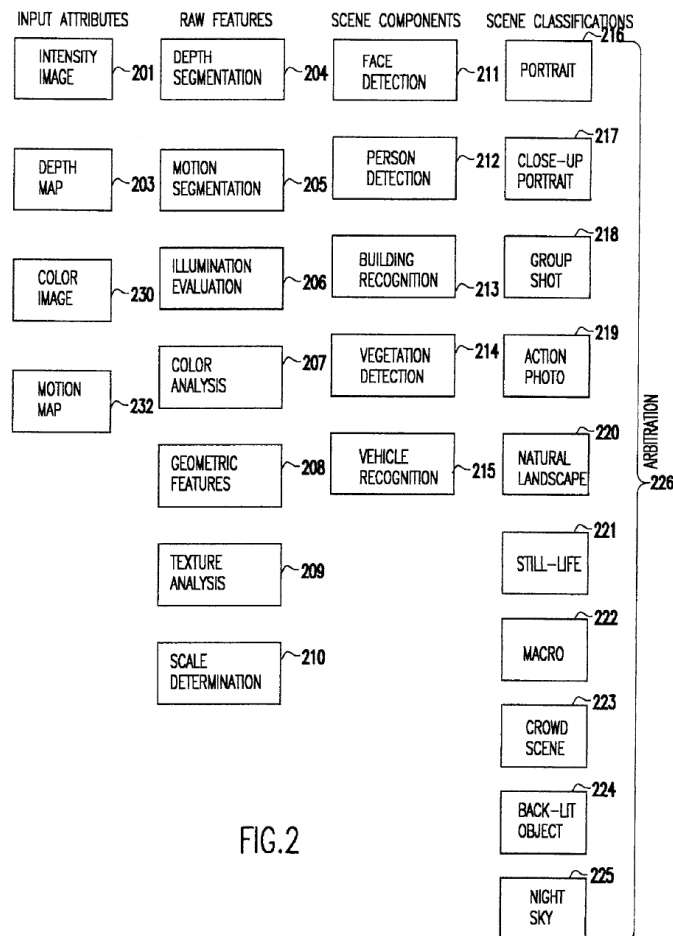


FIG.2

45. Bolle further discloses that “person detector 212 determines whether there are people in the scene. This step may be performed in accordance with any number of conventional techniques. Similarly, face detection 211 could be implemented by facial profile detection, skin-tone detection, etc. These classifications may also be parameterized with additional information such as location, average illumination, velocity, etc. such as “Face at position (x, y) with width W”, or “Landscape with horizon at height y.” Such a scene component module using one or more of these techniques could determine the sizes and locations of all the people in the scene. A subsidiary part of the scene analyzer could process the output of the person detector 212 to determine the type of “person” scene that is being imaged. In one embodiment, simple rules would give the classification; e.g., one large face implies “close-up portrait” 217 one small face and entire body implies “portrait” 217 (labeled 216 in drawing, mistake in spec); many small faces nearly filling the image implies “crowd scene” 223; several medium to large faces in the central portion of image implies “group shot” 218; a few small figures implies some other mode —although people are present, they are not the subject of the photography.” Bolle, 4:16-38.

46. Bolle further discloses that “all of the extracted information can be recorded and used to control a subsequent rendering or reproduction phase. For instance, color information of the original scene can be used to limit the distortions

of automatic color balancing on reproduction. Higher level information can also be stored and later used to index the images (e.g., scene classifications such as people, cars, foliage, landscape, night sky, etc.)” Bolle, 8:1-8. In other words, information such as a “portrait” having a “face at position (x, y) with width W” can be stored as image metadata in an image file, such as by using the exposure program and subject location metadata tags specified in Exif-V2.1, as described above.

F. Image quality adjustments

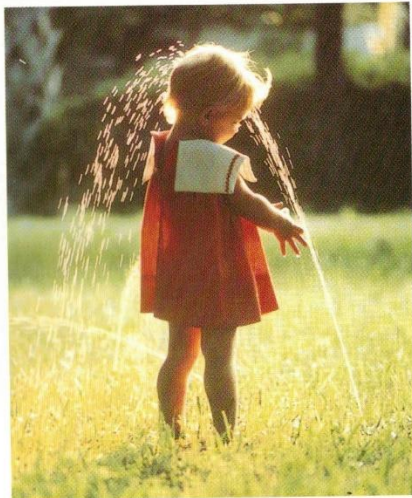
47. The image quality of photographs captured by digital cameras depends on numerous image quality attributes, including the tone reproduction, color reproduction, sharpness, and noise. The tone reproduction is determined by factors such as the image brightness and contrast in the shadows, mid-tones, and highlights of the image. The color reproduction is determined by factors such as the color balance and color saturation, and by how faithfully the image reproduces memory colors such as flesh tones and sky. The sharpness depends on factors such as the lens quality, the focus setting, and the sensor pixel size and pixel count (*i.e.*, number of pixels on the image sensor). The noise depends on factors such as the sensor pixel size and the ambient light level. By the late 1990s, all of these image quality attributes could be adjusted by digital image processing algorithms to improve the quality of images captured by digital cameras.

48. Sharpness is an important image quality attribute. The perceived sharpness of photos captured by a digital camera is determined by several factors, including the pixel size and number of pixels on the image sensor (*i.e.* sensor resolution), the quality of the camera lens (*e.g.* the “Modulation Transfer Function” or MTF), the focus setting and depth of field of the lens as the images are captured, as well as digital image processing which can increase the sharpness (*e.g.* “edge enhancement,” as described earlier) or decrease the sharpness (*e.g.* “noise cleaning” or “blurring”) of the captured digital images. Since 1992, I have served as project leader for the development and revisions of the international standard, ISO 12233, which is widely used to measure the spatial resolution, or “sharpness,” of digital cameras. *See ISO 12233:2000 Photography - Electronic still picture imaging - Resolution and spatial frequency responses* (Ex. 1015; “ISO 12233:2000”).

49. Long before the development of digital cameras, it was well-known to selectively focus a film camera to “emphasize the subject by contrasting it against a background that is distinctly out of focus,” as described on page 35 of the booklet “How to take winning pictures,” which was written for Kodak by Jeff Wignall, copyright 1985, 1988, 1989 (Ex. 1016; “Wignall”), and is reproduced below. By adjusting the lens aperture and focal length, the resulting shallow depth of field can be used “in separating an individual subject from confusing or distracting

surroundings – isolating one face from a crowd, for example.” *Ibid* p. 35. In other words, the area in which the person being photographed is located will be in sharp focus, while the sharpness of the area in which this person is not located will be greatly decreased. This technique of using a shallow depth of field to keep the main subject of an image in sharp focus while blurring other areas of the photograph is also applicable to digital cameras.

SELECTIVE FOCUS



Selective focus is most easily achieved by focusing on a nearby subject with a medium telephoto lens set at a large aperture, such as $f/2.8$.

With an SLR camera you can use a large f-stop, such as $f/2.8$, with a normal or telephoto lens to emphasize the subject by contrasting it against a background that is distinctly out of focus. This technique is called selective focus. By restricting the zone of sharp focus, the viewer's eye is drawn instantly to the heart of the composition.

You can apply selective focus to your work in

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several different ways. Its most useful application is in separating an individual subject from confusing or distracting surroundings—isolating one face from a crowd, for example. But it can also be used in a more subtle manner, to accentuate a telling detail of a larger subject. You might, for instance, photograph a potter at work by selectively focusing on his hands working the clay, while allowing his figure to fall out of focus. You can also use limited depth to turn out of focus foregrounds into natural frames—as with a single rose bud surrounded by a blur of green foliage.

Because only a small part of your picture will be in focus in most cases, it's imperative that you choose your point of focus with extreme care. Areas that are not meant to be sharp should be unquestionably out of focus.

Limiting Depth of Field

The two main considerations in limiting depth of field are focal length and aperture. The longer the focal length of the lens and the wider the aperture, the shallower the region of sharp focus will be. You can achieve some degree of selective focus with almost any lens (with the notable exception of super wide-angles, which have near-infinite depth of field), but generally those in the medium telephoto range (80 mm to 150 mm) will do the job best. Lenses shorter than this tend to produce a lot of inherent depth, and those much

longer frequently have only a few inches of depth, even at very small apertures.

Another factor that must be taken into account is the distance from lens to subject. The closer you are to your main subject, the less depth of field there will be with any given lens at any given f-stop. In other words, a 100 mm lens focused on a subject that's only 10 feet away will have considerably less depth than the same lens (at the same f-stop) focused on a subject that's 20 or 30 feet away. Moving closer aids selective focus.

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Wignall, “How to take winning pictures,” pp. 34-35.

50. As described below, long before the development of digital cameras, it was also well known to attach a diffusion filter to the front of a film camera to

“soften” (*i.e.*, blur) portions of an image, a technique that was used by photographers “more than a century ago.” *Ibid* pp. 32-33. In addition to using “a doughnut shape (center kept clear) of Vaseline” on a filter, “[t]here are also “clear spot” diffusers that leave the center of the image sharp.” *Ibid* p. 33. This technique of using a Vaseline coating or diffuser with a center “clear spot” to keep the main subject of an image in sharp focus while blurring other areas of the photograph is also applicable to digital cameras.

SOFT FOCUS

Lenses and other camera equipment can be manipulated to show scenes in a way new to the eye. For example, soft-focus and diffusion attachments bring to still photography what background violins bring to the cinema: an atmosphere of romance. And the same way that background strings can lull us into a particular frame of mind, so too can a simple technique like diffusion color a viewer's interpretation of a scene. By drawing the viewer's attention away from the specific details of a composition, you can concentrate their attention on mood.

Homemade Diffusers:



Lens misted by breath.

The simplest and most unpredictable method of diffusion is to mist the lens with your breath. After misting the lens, quickly put your eye to the viewfinder, and as the mist lifts, snap the shutter when the desired effect appears.

The most popular method of making homemade diffusion devices is to smear petroleum jelly on a clear glass filter

(such as a skylight filter). The advantage of this type of homemade diffusion is that you can adjust the effect while viewing through the lens, simply by resmearing the jelly. The disadvantage is that it's messy and you risk getting the glop on your lens. A safer, but more permanent alternative, is to use clear nail polish on an old filter. In either case, it's best to build up the density gradually until you get the desired effect.

For occasional use, you can try stretching a piece of nylon stocking over the front of a lens and securing it with an elastic band. As a variation on this method, try using colored stockings—particularly pastel hues.



A doughnut shape (center kept clear) of vaseline applied to an old haze filter was used to make this picture. Be careful to keep the lens free of vaseline.

Landscape and still life photographers first began using the technique more than a century ago in an attempt to capture the soft, dreamy quality of impressionistic paintings. Since then portrait photographers have also come to cherish the technique for its ability to discreetly soften facial lines and wrinkles, without the falseness that retouching often adds. Whatever the subject, soft-focus is at its best in sidelighted and backlit situations, where luminous highlights spill into shadow regions to soften contrast and create a delicate high-key airiness.

Diffusion filters are available in varying degrees of effect, ranging from a gentle softening to an overall mistiness. There are also “clear spot” diffusers that leave the center of the image sharp. And diffusion lenses are specially made to create the romantic look.

Wignall, “How to take winning pictures,” pp. 32-33.

51. Long before the development of digital image processing, it was known to use “unsharp masking” to increase the sharpness of printed photographs which had been captured using photographic film. *See* J.A. Eden, “The unsharp mask technique of printing aerial negatives,” *The Photogrammetric Record*, April 1955, pp. 5-26. The “unsharp mask” was a blurred negative image of the original film, which was then layered with the original film when it was optically printed to create a sharper image. By the 1970s, electronic versions of unsharp masking were being applied to sharpen electronic images. *See* W.F. Schreiber, “Wirephoto quality improvement by unsharp masking,” *Pattern Recognition*, Vol. 2, Issue 2, May 1970. pp. 117-120.

52. Various digital image processing techniques to sharpen or blur digital images were so widely known by the 1970s that they were described in college textbooks. For example, “Digital Picture Processing” by A. Rosenfeld and A.C. Kak, Academic Press, New York, 1976 (Ex. 1017; “Rosenfeld”), includes subchapter “6.4 Sharpening.” This subchapter describes “some simple methods for counteracting blur by “crispening” or “sharpening” the picture. Since blurring “weakens high spatial frequencies more than low ones ... pictures can be sharpened by emphasizing their high spatial frequencies.” *Ibid* p. 179. It then describes how “isotropic derivative operators,” such as the Laplacian, which “strengthens high spatial frequencies more than it does low ones,” can be

constructed. *Ibid* pp. 181-191. In addition, in subchapter 6.5, it describes methods for smoothing an image using averaging, which “blurs the picture.” *Ibid* p. 197-199.

53. Another well-known college textbook, “Digital image processing” by W. K. Pratt, John Wiley & Sons, 1978 (Ex. 1018; “Pratt”), includes subchapter 12.4 “edge crispening.” This subchapter states that “experiments indicate that a photograph ... with accentuated edges is often more subjectively pleasing” and that “edge enhancement or crispening can be accomplished in a variety of ways.” It gives examples of three “typical high-pass masks,” reproduced below, which can be used for “edge crispening”.

Mask 1

$$\mathbf{H} = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix} \quad (12.4-2)$$

Mask 2

$$\mathbf{H} = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 9 & -1 \\ -1 & -1 & -1 \end{bmatrix} \quad (12.4-3)$$

Mask 3

$$\mathbf{H} = \begin{bmatrix} 1 & -2 & 1 \\ -2 & 5 & -2 \\ 1 & -2 & 1 \end{bmatrix} \quad (12.4-4)$$

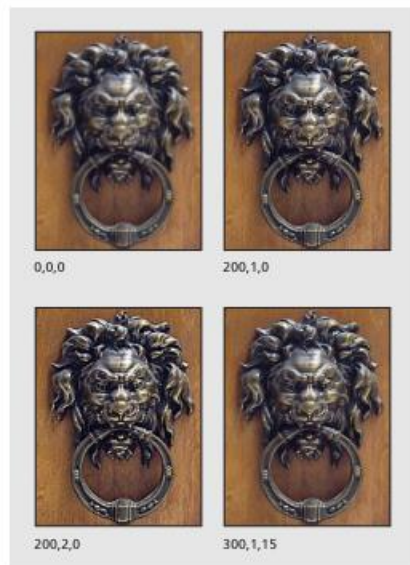
“Digital image processing” by W. K. Pratt, p. 323.

54. Sharpening and blurring were very well-known digital image processing techniques that were widely implemented in image processing software

by the late 1990s. For example, Photoshop 5.0 describes how to use unsharp masking to sharpen edges in an image, as reproduced below.

Step 6: Sharpen the image

Unsharp masking, or *USM*, is a traditional film compositing technique used to sharpen edges in an image. The Unsharp Mask filter corrects blurring introduced during photographing, scanning, resampling, or printing. It is useful for images intended both for print and online.



Numbers represent Unsharp Mask amount, Radius, and Threshold.

The Unsharp Mask filter locates pixels that differ from surrounding pixels by the threshold you specify and increases the pixels' contrast by the amount you specify. In addition, you specify the radius of the region to which each pixel is compared.

The effects of the Unsharp Mask filter are far more pronounced on-screen than in high-resolution output. If your final destination is print, experiment to determine what dialog box settings work best for your image.

To sharpen an image using the Unsharp Mask filter:

- 1 Choose Filter > Sharpen > Unsharp Mask.
 - 2 Sharpen the image:
 - For Amount, drag the slider or enter a value to determine how much to increase the contrast of pixels. For high-resolution printed images, an amount between 150% and 200% is recommended.
 - For Radius, drag the slider or enter a value to determine the number of pixels surrounding the edge pixels that affects the sharpening. For high-resolution images, a Radius between 1 and 2 is recommended.
- A lower value sharpens only the edge pixels, whereas a higher value sharpens a wider band of pixels. This effect is much less noticeable in print than on-screen, because a 2-pixel radius represents a smaller area in a high-resolution printed image.
- For Threshold, drag the slider or enter a value to determine how different the sharpened pixels must be from the surrounding area before they are considered edge pixels and sharpened by the filter. To avoid introducing noise (in images with flesh-tones, for example), experiment with Threshold values between 2 and 20. The default Threshold value (0) sharpens all pixels in the image.

Photoshop 5.0, p. 128.

55. In addition, as depicted below, the user could (1) use an elliptical marquee selection tool to select a person's face in a portrait photo, and then (2) use a "sharpen" filter, such as the "unsharp mask" filter described above, to sharpen

only the selected elliptical face portion of the image. The user could then (3) select the “inverse” portion of the image, and then (4) select a blur filter to blur the remainder of the image.

Using the marquee tools

The marquee tools let you select rectangular or elliptical areas. By default, the selection border is dragged from its corner.



Rectangular and elliptical selections

Sharpen filters Focus blurry images by increasing the contrast of adjacent pixels. They include the Sharpen Edges and Unsharp Mask filters, which find and sharpen areas where significant color changes occur (such as at the edges). The Unsharp Mask filter is commonly used for high-end color correction (see “Step 6: Sharpen the image” on page 128).

To select the unselected parts of an image:

Choose Select > Inverse.

You might use this option to select an object placed against a solid-colored background. For example, you could first select the background using the magic wand tool and then invert the selection.

Blur filters Soften a selection or an image. Blur filters are useful for retouching. They smooth transitions by averaging the pixels next to the hard edges of defined lines and shaded areas in an image.

Adobe Photoshop version 5.0 User Guide, pp. 137, 145, 307.

IV. MATERIALS CONSIDERED

56. In forming my opinions, I have analyzed the following exhibits, including the '109 patent, its file history, and the prior art cited in my analysis of the Petition Grounds, as well as the other materials cited in this declaration.

Exhibit	Description
Ex. 1001	U.S. Patent No. 7,945,109 to Nakami (“the ’109 patent”)
Ex. 1002	File History of U.S. Patent No. 7,945,109

Exhibit	Description
Ex. 1005	U.S. Patent No. 6,556,784 to Onuki (“Onuki”)
Ex. 1006	U.S. Patent No. 7,212,668 to Luo et al. (“Luo-668”)
Ex. 1007	James R. Milch and Kenneth A. Parulski, <i>Using Metadata to Simplify Digital Photography</i> , IS&T’s 1999 PICS Conference, pp. 26-30 (1999) (“Milch”)
Ex. 1008	Digital Still Camera Image File Format Standard (Exchangeable image file format for Digital Still Cameras: Exif), Version 2.1, Japan Elec. Indus. Dev. Ass’n (June 12, 1998) (“Exif-V2.1”), <i>available at</i> http://web.archive.org/web/20010627233957/http://www.pima.net/standards/it10/PIMA15740/Exif_2-1.PDF (archived June 27, 2001)
Ex. 1009	U.S. Patent No. 6,373,992 to Nagao (“Nagao”)
Ex. 1010	U.S. Patent No. 6,301,440 to Bolle et al. (“Bolle”)
Ex. 1011	U.S. Patent No. 5,696,850 to Parulski et al. (“Parulski ’850”)
Ex. 1012	Kenneth A. Parulski et al., <i>A High-Performance Digital Color Video Camera</i> , SPIE Vol. 1448 Camera and Input Scanner Systems, pp. 45-57 (1991) (“Parulski 1991”)
Ex. 1013	Adobe Photoshop version 5.0 User Guide (1998) (“Photoshop 5.0”)
Ex. 1014	Ken Parulski and David Lewis, <i>Digital, Still-Optimized Architecture for Electronic Photography</i> , IS&T’s 47th Annual Conference, pp. 665-67 (1994) (“Parulski 1994”)
Ex. 1015	International Standard ISO 12233:2000(E), Photography — Electronic still picture cameras — Resolution measurements (1st ed. 2000) (“ISO 12233:2000”)
Ex. 1016	Jeff Wignall, <i>How to Take Winning Pictures</i> , pp. 32-35 (Eastman Kodak Company 1989) (“Wignall”)
Ex. 1017	Azreil Rosenfeld and Avinash C. Kak, <i>Digital Picture Processing</i> , pp. 178-203 (Academic Press, New York 1976) (“Rosenfeld”)

Exhibit	Description
Ex. 1018	William K. Pratt, <i>Digital Image Processing</i> , pp. 318-27 (John Wiley & Sons, Inc. 1978) (“Pratt”)

57. Exhibit 1007 (“Milch”) is a true and accurate copy of a paper published in April 1999 and presented at IS&T’s 1999 PICS Digital Photography Conference. PICS stands for Image **P**rocessing, Image **Q**uality, Image **C**apture, **S**ystems Conference and was widely attended by individuals interested and skilled in image processing, including by individuals that would have qualified as persons of ordinary skill in the art. I am one of the authors of this paper and have personal knowledge that this paper was publicly disseminated without restriction at the PICS conference in 1999 in the Final Program and Proceedings.

58. Exhibit 1008 is a true and accurate copy of Exif-V2.1, which was publicly disseminated by December 1998 without restriction to interested and skilled members of the public, including myself and many others that I worked with at Kodak that would have met the definition of a person of ordinary skill in the art. Additionally, any member of the public had access to Exif-V2.1 at least by December 1998 by accessing the public website for JEIDA in order to purchase a hardcopy of this JEIDA standard. I helped develop portions of Exif and have personal knowledge of Exhibit 1008’s public availability before the priority date of the ’109 patent. Indeed, in my paper included as Exhibit 1007, I cited Exif-V2.1 as

Reference number 6, noting its publication date of 1998. This shows that my co-author and I had access to Exif-V2.1, and anyone that had access to our paper would have been able to locate Exif-V2.1 based on the citation.

59. Exhibit 1012 is a true and accurate copy of a paper published in 1991 by SPIE, the Society of Photo-Optical Instrumentation Engineers, in their Conference Proceedings, titled “Camera and Input Scanner Systems, Volume 1448”, which I personally presented during the February 1991 Electronic Imaging Symposium in San Jose, California. This conference was widely attended by individuals interested and skilled in digital cameras and image processing, including by individuals that would have qualified as persons of ordinary skill in the art. I am one of the authors of this paper and have personal knowledge that this paper was publicly disseminated by SPIE without restriction in their Camera and Input Scanner Systems (Vol. 1448) Conference Proceedings.

60. Exhibit 1013 is a true and accurate copy of the Adobe Photoshop version 5.0 User Guide which was available by 1998. I personally used Adobe Photoshop version 5.0 in my work at Kodak. In 1998, I completed a course developed by Adobe which taught me to use the image processing and editing features provided by Photoshop version 5.0. I have personal knowledge that this user guide was publicly disseminated without restriction by Adobe to individuals

interested and skilled in image processing, including by individuals that would have qualified as persons of ordinary skill in the art.

61. Exhibit 1014 is a true and accurate copy of a paper published in May 1994 and presented at IS&T's 47th Annual Conference. IS&T stands for the Society for Imaging Science and Technology, and this conference was widely attended by individuals interested and skilled in image processing, including by individuals that would have qualified as persons of ordinary skill in the art. I am one of the authors of this paper and have personal knowledge that this paper was publicly disseminated without restriction at IS&T's 47th Annual Conference in the Final Program and Advance Printing of Papers.

62. Exhibit 1015 is a true and accurate copy of ISO 12233:2000, which was published by the International Organization for Standardization in Geneva, Switzerland on September 1, 2000 and available without restriction to interested and skilled members of the public, including myself and many others that I worked with at Kodak that would have met the definition of a person of ordinary skill in the art. Additionally, any member of the public had access to ISO 12233:2000 by September 2000 by accessing the public website for ISO (www.iso.ch) in order to purchase a hardcopy of this ISO standard.

63. Exhibit 1016 is a true and accurate copy of pages 32-36 of the book "How to take winning pictures" which was written for Kodak by Jeff Wignall and

was available for purchase without restriction from the Consumer Imaging Division of Eastman Kodak Company to interested members of the public starting in 1989 for the list price of \$6.95, including by individuals that would have qualified as persons of ordinary skill in the art.

64. Exhibit 1017 is a true and accurate copy of pages 179-202 of the textbook “Digital Picture Processing” by Azreil Rosenfeld and Avinash C Kak which was published by Academic Press in 1976 and was available for purchase without restriction to interested and skilled members of the public, including myself and many others that I worked with at Kodak that would have met the definition of a person of ordinary skill in the art.

65. Exhibit 1018 is a true and accurate copy of pages 318-327 of the textbook “Digital Image Processing” by William K. Pratt which was published by John Wiley & Sons in 1978 and was available for purchase without restriction to interested and skilled members of the public. I personally used this textbook as part of an imaging processing course taught by Professor William Schreiber at MIT in 1978.

66. My opinions are based on my experience, knowledge of the relevant art, the documents identified above, and the documents discussed in this declaration.

V. LEGAL STANDARDS

67. I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel for Petitioner, my experience applying similar standards in other patent-related matters, and my reading of the documents submitted in this proceeding. In preparing this declaration, I sought to faithfully apply these legal standards to the Challenged Claims.

A. Claim Construction

68. I have been instructed that the terms appearing in the '109 patent should be interpreted in view of the claim language itself, the specification, the prosecution history of the patent, and any relevant extrinsic evidence. The words of a claim are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art at the time of the invention, which I am assuming here is September 11, 2001. While claim limitations cannot be read in from the specification, the specification is the single best guide to the meaning of a disputed term. I have followed these principles in reviewing the claims of the '109 patent and forming the opinions set forth in this declaration.

B. Level of Ordinary Skill

69. I understand a person of ordinary skill in the art is determined by looking at (i) the type of problems encountered in the art; (ii) the prior art solutions

to those problems; (iii) the rapidity with which innovations are made; (iv) the sophistication of the technology; and (v) the educational level of active workers in the field.

70. In my opinion, based on these factors, a person of ordinary skill in the art (“POSITA”) would have had a bachelor’s degree or equivalent in electrical engineering, computer science, or a related field, in addition to three years in research, design, or development in digital image processing. This is based, for example, on the language and level of detail included in the patent specification and claims. Each of the claims requires increasing sharpness in one area of an image and decreasing sharpness in another area of an image. But the specification does not provide any examples of how to increase sharpness and discloses “using a Gaussian distribution method” as one example of how to “blur away the backgrounds of the image in a suitable way.” Ex. 1001, 13:7-12. A POSITA as defined above would have been aware of various techniques for increasing and decreasing sharpness. Moreover, workers in this field commonly had a bachelor’s degree or equivalent in electrical engineering, computer science, or a related field.

71. I was at least a POSITA as of September 11, 2001, and supervised others who were at least a POSITA.

C. Obviousness

72. I have been told that under 35 U.S.C. § 103, a patent claim may be obvious if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

73. I have been told that a proper obviousness analysis requires the following:

- a. Determining the scope and content of the prior art;
- b. Ascertaining the differences between the prior art and the claims at issue;
- c. Resolving the level of ordinary skill in the pertinent art; and
- d. Considering evidence of secondary indicia of non-obviousness (if available).

74. I have been told that the relevant time for considering whether a claim would have been obvious to a person of ordinary skill in the art is the time of invention. For purposes of my analysis, I assumed that the date of invention for the Challenged Claims is September 11, 2001.

75. I have been told that a reference may be modified or combined with other references or with the person of ordinary skill's own knowledge, if the

person would have found the modification or combination obvious. I have also been told that a person of ordinary skill in the art is presumed to know all the relevant prior art, and the obviousness analysis may take into account the inferences and creative steps that a person of ordinary skill in the art would employ.

76. I have been told that whether a prior art reference renders a patent claim obvious is determined from the perspective of a person of ordinary skill in the art. I have also been told that, while there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, and while a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually and may consider the inferences and creative steps a person of ordinary skill in the art would employ, as filtered through the knowledge of one skilled in the art, obviousness grounds cannot be sustained by mere conclusory statements and must include some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.

77. I have been told that there is no rigid rule that a reference or combination of references must contain a “teaching, suggestion, or motivation” to combine references. But I also have been told that the “teaching, suggestion, or motivation” test can be used in establishing a rationale for combining elements of

the prior art. I have also been told to be aware of distortions caused by hindsight bias, and that reading into the prior art the teachings of the invention at issue is improper.

78. I am aware that a claim may be obvious where the claim represents nothing more than a combination of prior art elements according to understood methods that yields predictable results. I am further aware that a claim may be obvious where it merely involves the simple substitution of one known element for another to achieve predictable results. I am additionally aware that it may be obvious to try a particular combination of claim features if selecting them requires merely choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success.

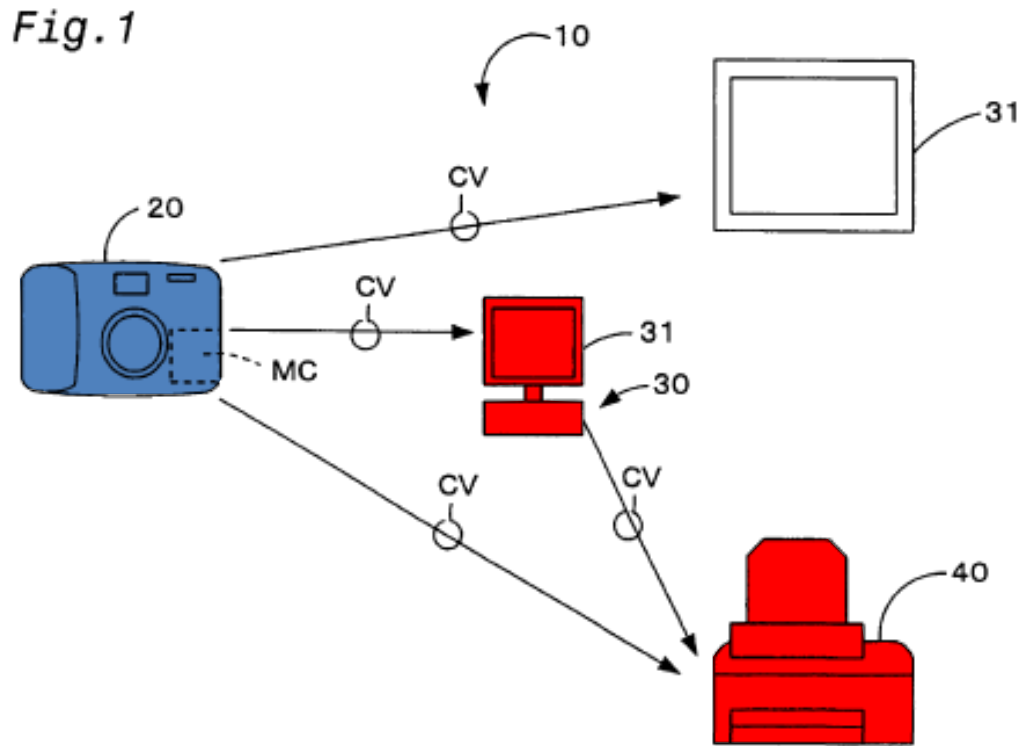
79. I have been informed that, in an obviousness analysis, prior art must be analogous art to the patent being considered. I have been informed that a prior art reference is considered to be analogous, or in the same field of art, if the reference is either (1) in the same field of endeavor as the challenged patent, regardless of the problems the challenged patent and the prior art address, or (2) reasonably pertinent to the particular problem being solved by the challenged patent.

VI. THE '109 PATENT

A. Specification

80. The '109 patent “relates to an image processing technique that uses major object information of images.” Ex. 1001, 1:14-15. According to the specification, the “major object is not always located in the central region of an image,” so “conventional techniques that identify the central region of an image as an emphasis region had difficulties in achieving an image correction of the major object with high accuracy.” *Id.*, 1:19-36. The '109 patent attempts to solve this purported problem “by setting and using an appropriate emphasis region for every image data.” *Id.*, 1:40-43.

81. The '109 patent discloses an image processing system, depicted below, that includes “a digital still camera 20 as a shooting device that generates an image file including image data and image processing control information, which specifies image processing conditions in an image processing device.” *Id.*, 6:6-13.



Id., FIG. 1 (annotated).

82. To generate the image file, the camera “obtains preset image processing control information, i.e. setting information of a shot scene that was set by a photographer.” *Id.*, 8:16-21. “The shot scene may be in modes such as ... a portrait mode that is appropriate for shots that include primarily person(s).” *Id.*, 8:25-29. The camera also “obtains the focus location information at the time of the push-down of the shutter button,” which “indicates the location to which the focus is on within a shooting frame at the time of shooting.” *Id.*, 8:30-40. The camera then stores the preset image processing control information, the focus location information, and the rest of the image processing control information in one

portion of an image file (e.g., Exif image file), and image data generated by the camera in another portion of the image file. *Id.*, 8:48-53.

83. The **image processing device** then processes the image “using the image file that was generated in the **digital still camera 20**.” *Id.*, 6:6-13. The image processing device may be, for example, a personal computer having a CPU “that executes an image processing program.” *Id.*, 7:35-47. When the CPU “**detects the attachment of a memory card**,” it “**reads an image file**” from the memory card, checks for “**image processing control information CI**” in the image file, “**obtains the image processing control information CI including focus location information**,” and “**then executes image processing based on the obtained image processing control information CI**.” *Id.*, 9:8-11, 9:17-29. This process is depicted in Figure 7, below.

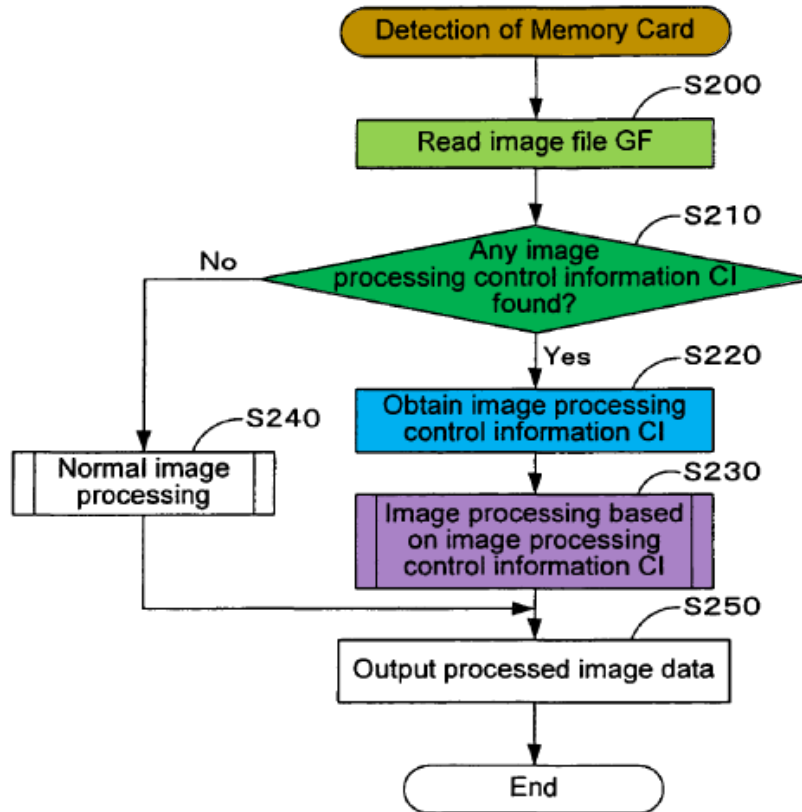


Fig. 7

Id., FIG. 7 (annotated).

84. As one embodiment, the '109 patent discloses using the focus location information for “a sharpness adjustment.” *Id.*, 13:3-7. In this embodiment, the '109 patent discloses determining whether “a portrait mode was selected ... by analyzing the image processing control information CI.” *Id.*, 13:17-20. If so, the '109 patent discloses adjusting the sharpness “without requiring any ad hoc selection processing.” *Id.*, 13:14-17. This can be done by “strengthen[ing] the sharpness of an image at a focus location or in an emphasis region, or weaken[ing]

the sharpness of an image in the other regions by using a Gaussian distribution method, so as to blur away the backgrounds of the image in a suitable way.” *Id.*, 13:7-12. To determine the emphasis region, the ’109 patent discloses dividing the image into plural regions, using the focus location information to determine “a focus location on the image,” and “set[ting] a region at the determined location as an emphasis region.” *Id.*, 10:34-50.

B. Prosecution History

85. The ’109 patent was filed as U.S. Patent Application No. 12/456,491 (the “’491 Application”). Following rejections of the originally filed claims under 35 U.S.C. §§ 101, 102, and 112 and obviousness-type double patenting, Applicant canceled them and added three new independent claims. Ex. 1002, 176-181, 188-192. Regarding the § 102 rejection, Applicant argued that JP-11-136568 (“Hyodo”) discloses “a technique that stores an image and location information into a storage medium at the digital camera side” but does not disclose “a specific image processing application implemented at the image processing apparatus side using the location information as specified in the claimed subject matter.” *Id.*, 191-192. The Examiner then issued a notice of allowance, stating that the prior art of record did not teach or suggest “increasing the sharpness of image area where a person is located and decreasing the sharpness of other image areas, when the

shooting scene information associated with an image indicates a portrait scene, as claimed.” *Id.*, 202-206.

C. Claim Construction

86. I am told that claim construction is not necessary where there is no controversy as to the meaning of the terms with respect to the prior art. In my opinion, the prior art asserted in the petition ground discloses an embodiment within the indisputable scope of the ordinary and customary meaning of the claims. Therefore, it is my opinion that no explicit claim constructions are needed to apply the prior art to the Challenged Claims.

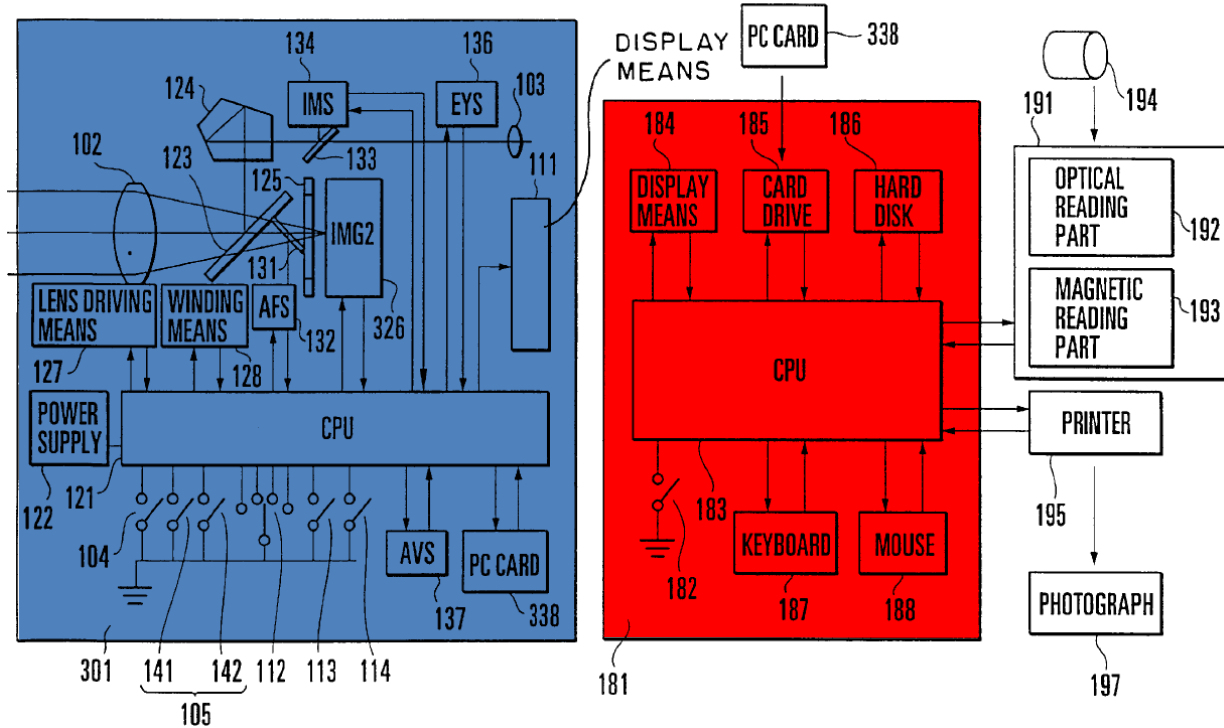
VII. ANALYSIS OF PETITION GROUNDS

A. Overview of the Asserted References

1. Overview of Onuki (Ex. 1005)

87. Onuki, similar to the '109 patent, discloses “an image recording/reproducing system including an **image recording apparatus** for acquiring an image in a particular fashion intended by the photographer” and “an **image reproducing apparatus** for reproducing the image acquired by the image recording apparatus after processing the image in a desired fashion.” Onuki, 1:9-15. One embodiment of this system is depicted in Figure 30, below.

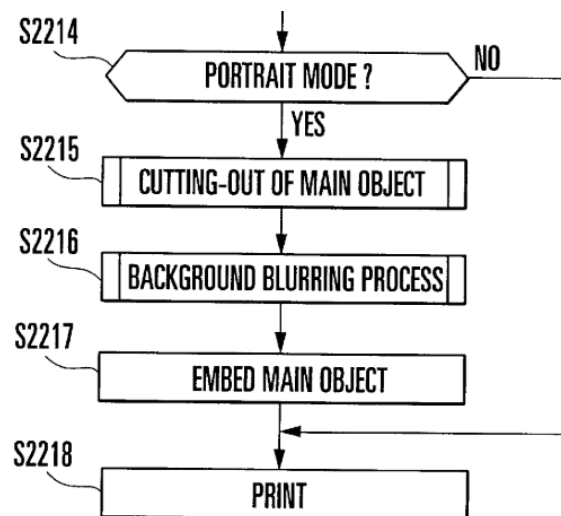
FIG. 30



Id., FIG. 30 (annotated).

88. The **image recording apparatus** is a digital camera “capable of recording an image of an object together with photo-taking information,” such as “information indicating that the picture was taken in the portrait mode” and “information representing the main object location on the image plane determined on the basis of the detection of the visual line of the photographer.” *Id.*, 4:43-46, 21:20-28, 22:20-25, 22:40-56. The “photo-taking information is recorded together with an image signal” representing a photographed image “in the PC card 338 serving as the image recording medium.” *Id.*, 22:40-52.

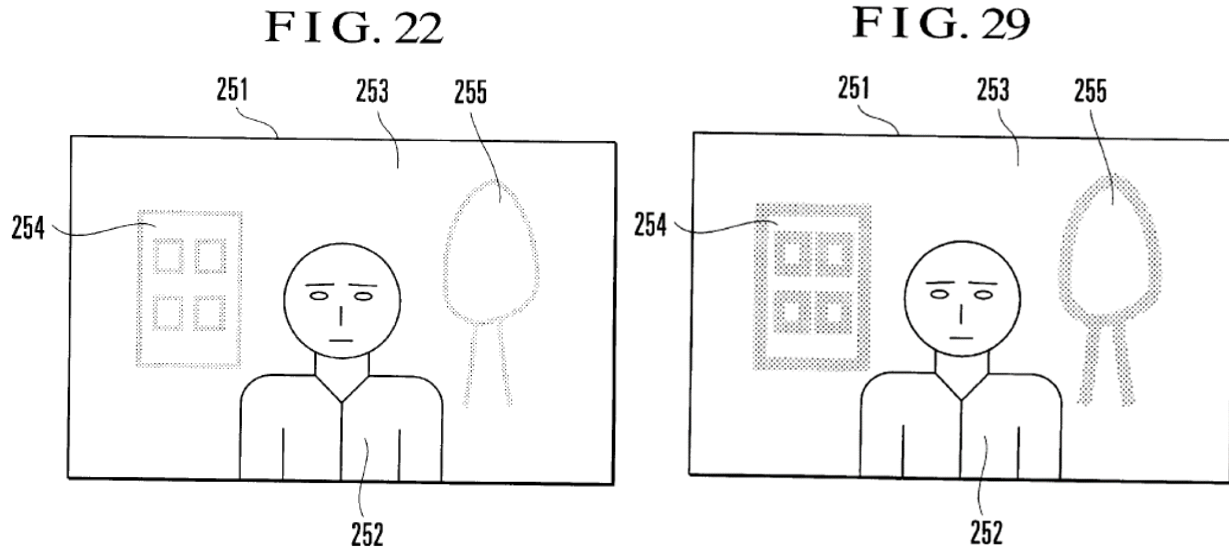
89. The **image reproducing apparatus** “includes a PC card drive 185 for reading” the “image signal and photo-taking information stored in the PC card 338” and subjecting the image data to image processing based on the photo-taking information. *Id.*, 6:59-7:3, 10:61-67, 22:5-11, 22:18-25, 22:40-65. For example, when the photo-taking mode indicates a portrait mode, the **image reproducing apparatus** separates the main object from the background, blurs the background, and embeds the main object into the blurred background image to obtain a final image. *Id.*, 18:60-19:6, FIG. 23.



Id., FIG. 23 (lower portion)

90. Moreover, “because photo-taking mode information employed when a picture is taken is recorded together with an image and is supplied to an image reproducing apparatus, the photographer can obtain a picture which has been subjected to desired image processing without having to perform a special operation or give a special order.” *Id.*, 21:66-22:4. Figures 22 and 29, below, depict

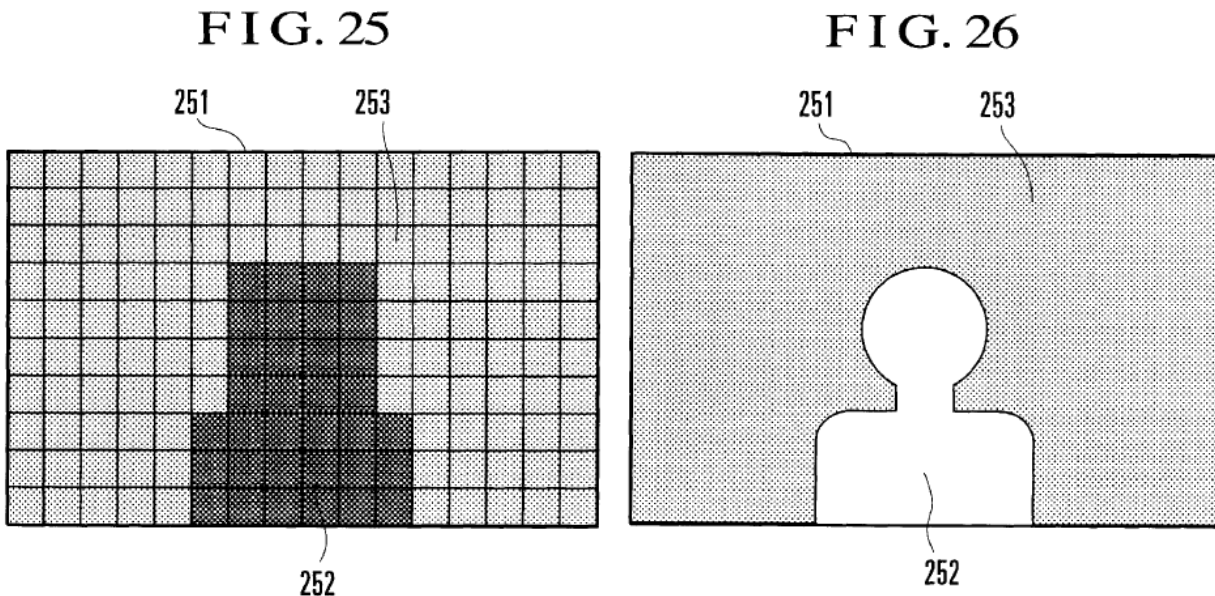
the image before and after image processing, respectively. *Id.*, 3:65-67, 4:23-25, 18:17-22, 21:49-54.



Id., FIGS. 22, 29.

91. To separate the main object from the background, Onuki discloses dividing the image into blocks, extracting “blocks which are more likely to belong to the main object image ... in accordance with the information of the main object location” recorded with the image information, and extracting a boundary line between the main object image and the background image in each of the boundary blocks of the extracted blocks. *Id.*, 19:9-20:20, FIGS. 24-25. “[B]ecause information indicating the main object location on the image plane ... is recorded together with an image and is supplied to an image reproducing apparatus, a main object can be precisely separated from a background, and thus it is possible to eliminate an error in a blurring enhancing process on the background image.” *Id.*,

22:5-11. Below, Figure 25 depicts the extracted boundary blocks 252 of an image, and Figure 26 depicts the image after extracting the main object image. *Id.*, 19:65-67, 20:20-23.



Id., FIGS. 25-26.

92. Onuki is analogous art to the '109 patent because it is in the same field of endeavor, namely, an image processing technique that uses major object information of images. Ex. 1001, 1:14-15; Onuki, 19:45-64, 22:5-11. Onuki is also reasonably pertinent to at least one problem that the '109 patent sought to solve, including processing images where the major object is not necessarily “located in the central region,” because it discloses using “information indicating the main object location on the image plane” when processing the image. Ex. 1001, 1:27-43; Onuki, 19:45-64, 22:5-11

2. Overview of Luo-668 (Ex. 1006)

93. Like Onuki, Luo-668 relates to “processing image pixels to emphasize the main subject of the image.” Luo-668, 1:7-9. Luo-668 discloses emphasizing the main subject by both “altering pixel values in the main subject” and “altering pixel values in the background.” *Id.*, 1:50-56. For example, Luo-668 discloses varying “region sharpness” to emphasize the main subject of an image. *Id.*, 11:55-59. To perform this process, Luo-668 discloses “modifying the blur values of pixels in the digital image” based on belief values that categorize each pixel as part of the main subject or background “in such a way that the sharpness of main subject pixels is retained or increased, while the sharpness of the background is reduced, thereby blurring the background.” *Id.*, 11:64-12:4.

94. Luo-668 is analogous art to the ’109 patent because it is in the same field of endeavor, namely, an image processing technique that uses major object information of images. Ex. 1001, 1:14-15; Luo-668, 2:4-13, 11:55-12:4. Luo-668 is also reasonably pertinent to at least one problem that the ’109 patent sought to solve, including processing images where the major object is not necessarily “located in the central region,” because it discloses generating “a main subject belief map containing values indicating the location of a plurality of regions in the image, ... the belief values are related to the probability that the associated region is a main subject of the image.” Ex. 1001, 1:27-43; Luo-668, 2:4-13. It is also

reasonably pertinent to strengthening “the sharpness of an image at a focus location or in an emphasis region” and weakening “the sharpness of an image in the other regions,” as Luo-668 discloses increasing the sharpness of a main subject and reducing the sharpness of the background. Ex. 1001, 13:3-12; Luo-668, 11:64-12:4.

3. Overview of Exif-V2.1 (Ex. 1008)

95. Exif-V2.1 was issued by JEIDA (Japan Electronic Industries Development Association) “as a standard for the image file format (Exif: Exchangeable image file format) used in digital still cameras and related systems” in 1998. Exif-V2.1,² 1, 3. It “specifies a standard file format for the image data recorded by digital still cameras (DSC) and related systems, which use a PC Card or other removable memory medium” and sought to provide “a framework in which these products can be used readily by ordinary consumers.” Exif-V2.1, 7. Exif version 1.0 was published in October 1996, Exif version 1.1 was published in May 1997, and Exif version 2.0 was published in November 1997. Exif-V2.1, 3, 166. In 2000, JEIDA and EIAJ (Electronic Industries Association of Japan) merged to form JEITA (Japan Electronics and Information Technology Industries Association.)

² Citations to Exif-V2.1 use the PDF page numbers.

96. The '109 patent discloses that the “image file that was generated in the digital still camera 20 typically has a file structure that conforms to the image file format standard (Exif) for digital still cameras. Specifications for Exif files are laid down by the Japan Electronics and Information Technology Industries Association (JEITA).” Ex. 1001, 6:44-48. The '109 patent also acknowledges that it was “well-known to persons skilled in the art” that “files in Exif format use tags to specify each data item.” *Id.*, 7:16-18. However, the applicant never provided any version of the Exif specification to the patent examiner as a prior art publication during the prosecution of the '109 patent.

97. Exif-V2.1 discloses that the image data follows “existing image formats, depending on the image data type,” such as “RGB uncompressed data,” “YCbCr uncompressed data,” and “JPEG compressed data.” Exif-V2.1, 17. For example, the figure below depicts the basic structure of an image file with JPEG compressed image data:

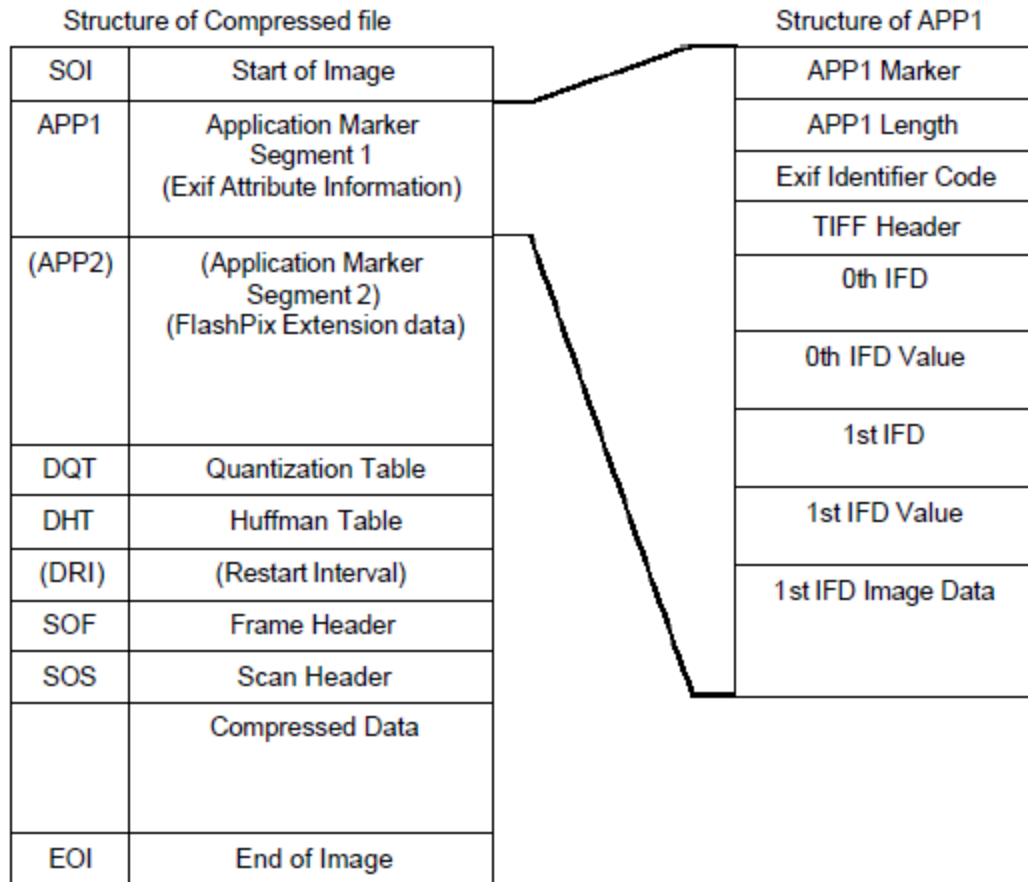


Fig. 6 Basic Structure of Compressed Data Files

Id., 20.

98. Exif-V2.1 also discloses that the file includes various tags that correspond to a value for various types of attribute information. *Id.*, 24, 27-61. For example, Exif-V2.1 discloses “Tags Relating to Picture-Taking Conditions.” *Id.*, 40-41, 52-61. One type of tag relating to picture-taking conditions is Exif’s *ExposureProgram* tag, which is “[t]he class of the program used by the camera to set exposure when the picture is taken.” *Id.*, 55. A tag value of “7,” for example, indicates “Portrait mode (for closeup photos with the background out of focus).”

Id. Another type of tag relating to picture-taking conditions is the Exif-V2.1

SubjectLocation tag, which “[i]ndicates the location of the main subject in the scene” in terms of a row and column within the image. *Id.*, 59. Exif-V2.1 discloses that “[t]he use of a common method of storing attribute information for both compressed and uncompressed data results in a simpler format.” *Id.*, 17.

99. Because Exif-V2.1 image files are compatible “with standard formats in wide use,” they can “be used on personal computers and other information systems.” Exif-V2.1, 8. “The DSC or other system writes data to files in the format specified in this standard,” and personal computers include “dedicated software” that can “read all the images, audio and attribute information recorded in conformance with this standard.” *Id.*, 11.

100. Exif-V2.1 is analogous art to the ’109 patent because it is in the same field of endeavor, namely, an image processing technique that uses major object information of images. Ex. 1001, 1:14-15; Exif-V2.1, 11, 59. For example, Exif provides a *SubjectLocation* tag that “[i]ndicates the location of the main subject in the scene,” thus allowing image processing devices to use such information when processing images. Exif-V2.1, 11, 59. Exif-V2.1 is also reasonably pertinent to at least one problem that the ’109 patent sought to solve, including processing images where the major object is not necessarily “located in the central region,” because it discloses a standard image file format that includes attribute data specifying the

“location of the main subject in the scene” and specifying if an image was captured in portrait mode, just like the image file in the ’109 patent. Ex. 1001, 1:14-15, 1:27-28, 13:3-20; Exif-V2.1, 40-41, 55, 59

B. Onuki and Luo-668 (Ground 1) or Onuki, Exif-V2.1, and Luo-668 (Ground 2) Render Obvious Claims 1-3 of the ’109 Patent

1. Independent Claim 1

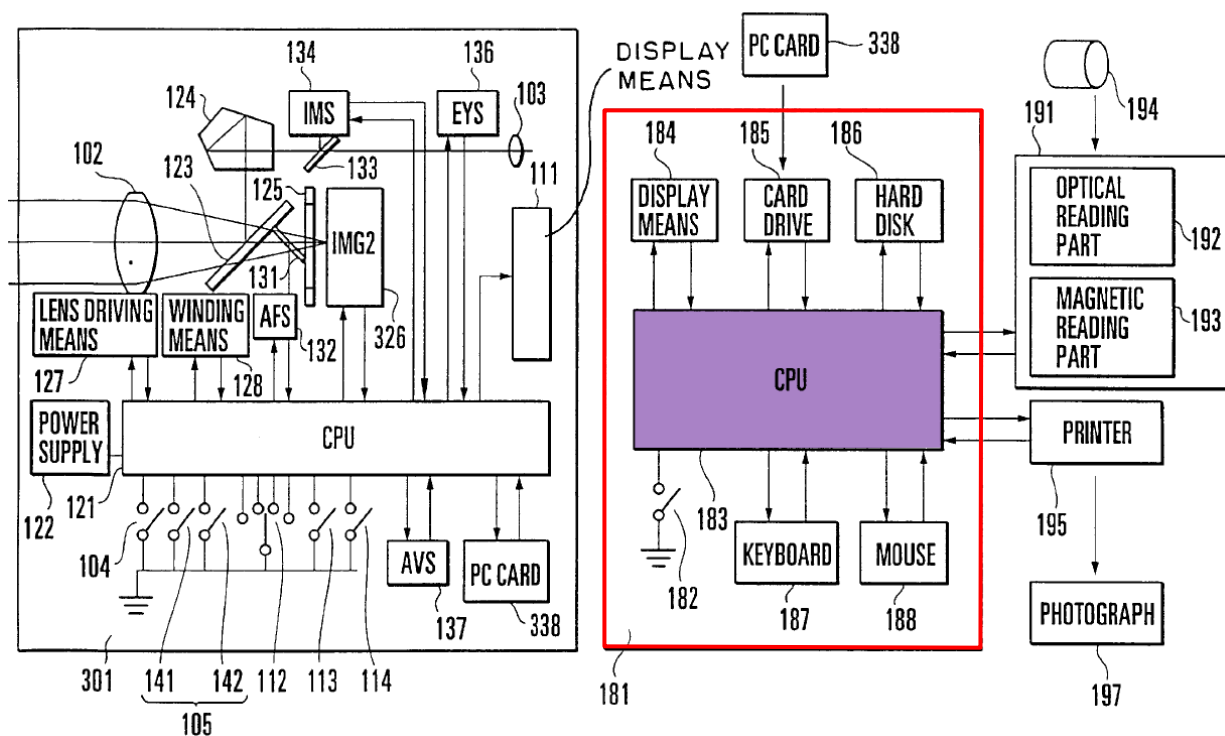
a. [1.pre]: “An image processing apparatus comprising:”

101. To the extent the preamble is limiting, Onuki discloses or suggests “[a]n image processing apparatus.”

102. Onuki discloses an **image reproducing apparatus body 181** (“*image processing apparatus*”), shown in the schematic diagram below, that includes “a PC card drive 185 for reading information from the PC card 338” and a CPU 183. Onuki, 22:57-65, FIG. 30. Figure 1 of Onuki depicts the **image reproducing apparatus** as a personal computer, for example. Onuki, 4:38-42, 4:55-62, FIG. 1. The CPU 183 in the **image reproducing apparatus body 181** “is a control device including a ROM, a RAM, an EEPROM, an A/D converter and a D/A converter”; “is responsible for controlling operations over the entire image reproducing apparatus”; and directs an “image reproducing flow” performed by the **image reproducing apparatus**. Onuki, 6:38-41, 10:40-67, 18:41-51. The CPU 183 uses the PC card drive 185 to read “an image signal and photo-taking information stored in the PC card 338” and transfer the image signal and photo-taking information to the

controlling operations over the entire image reproducing apparatus”; and directs an “image reproducing flow” performed by the **image reproducing apparatus**. Onuki, 6:36-41, 10:40-67, 18:41-51. Accordingly, functions executed by the **image reproducing apparatus** are controlled by the **CPU 183** and, therefore, executed by the **CPU 183**.

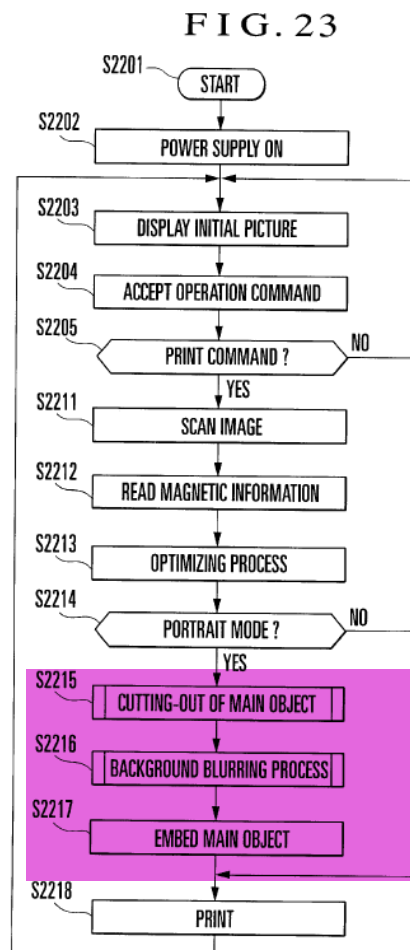
FIG. 30



Onuki, FIG. 30 (annotated).

105. Moreover, Onuki discloses the CPU executing image processing functions. For example, when the CPU reads an image and photo-taking information via a film scanner, rather than via PC card drive 185, Onuki describes “a flow associated with an image processing and outputting operation,” where the

image signal and photo-taking information are “transferred to the CPU 183” in steps S2211 and S2212, respectively. Onuki, 10:61-67, 18:23-26, 18:50-51, 22:57-65, FIG. 23. Onuki then describes executing **image processing functions**, also applicable to the Figure 30 embodiment, like separating the main object from the background image, blurring the background, and embedding the main object image “into the background image subjected to the background blurring process.” Onuki, 18:50-19:6, 22:59-65. These **image processing functions** are highlighted in Figure 23, below. Onuki, 18:50-19:6, FIG. 23.



Onuki, FIG. 23 (annotated).

- c. **[1.b]: “acquiring an image file, the image file including image data, shooting scene information, and location information of a person in the image data, and”**

106. Onuki discloses or suggests “acquiring an image file, the image file including image data, shooting scene information, and location information of a person in the image data.” To the extent Patent Owner contends or the Board finds that this limitation is not disclosed or suggested by Onuki, this limitation is rendered obvious in view of Exif-V2.1.

i. Onuki discloses or suggests this limitation

107. The '109 patent does not restrict the claimed “image file” to a particular format or even a single file. For example, the '109 patent states that “any suitable image file that can contain the image data that is to be output by an output device and the image processing control information CI that specifies image processing conditions of the image data in an image processing device can be used.” Ex. 1001, 14:27-34. The '109 patent also discloses that an “image file” could also include instances where “the image data and the image processing control information CI are stored in separate files” and, “at the point of image processing,” are “unified” such that they function “as if they are stored in one file.” *Id.*, 14:38-57. At least under this understanding of an “image file,” Onuki discloses acquiring an image file.

108. Onuki discloses that a digital camera stores “an image signal” and “photo-taking information” “together” in a removable PC card 338. Onuki, 22:18-25, 22:40-52. Onuki discloses that the image reproducing apparatus reads the “image signal and photo-taking information stored in the PC card 338” via PC card drive 185 and subjects them to image processing. Onuki, 22:57-65, 10:61-67, 18:50-51. The image reproducing apparatus’ CPU 183 “is responsible for controlling operations over the entire image reproducing apparatus,” which includes PC card drive 185, so Onuki discloses the CPU executing the acquiring function. Onuki, 6:38-41, 22:57-59. Moreover, because Onuki discloses that the image signal and photo-taking information are stored “together,” read, and “subjected to image processing,” a POSITA would have understood that Onuki teaches the CPU acquiring an image file including the image signal and photo-taking information. Onuki, 21:66-22:11, 22:47-52, 22:57-65.

109. Onuki’s image signal is “an electric signal representing a photographed image” and discloses the claimed “image data.” Onuki, 22:40-52, 22:59-65.

110. Onuki’s photo-taking information includes a “photo-taking mode,” which discloses the claimed “shooting scene information.” Onuki, 17:57-62. For example, Onuki discloses that the photo-taking mode can indicate that “the image was photographed in the portrait mode.” Onuki, 15:19-23, 18:53-55; see Ex. 1001,

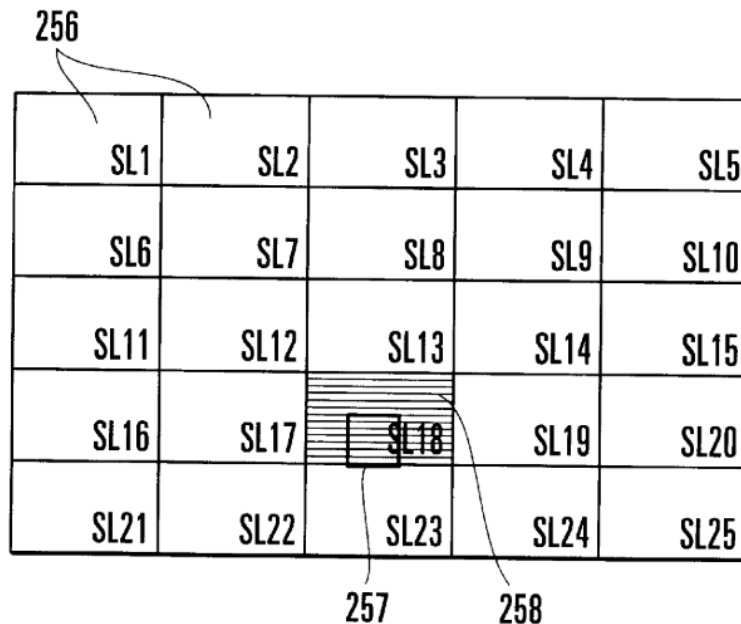
15:4-5 (requiring that “the acquired shooting scene information indicates a portrait scene”). “[B]ecause photo-taking mode information employed when a picture is taken is recorded together with an image and is supplied to an image reproducing apparatus, the photographer can obtain a picture which has been subjected to desired image processing without having to perform a special operation or give a special order.” Onuki, 21:66-22:4.

111. Onuki’s photo-taking information also includes a “main object location,” which discloses the claimed “location information of a person in the image data.” Onuki, 17:57-62. For example, Onuki discloses that, in “a typical example of a portrait scene,” a person 252 is the main object and that the main object location represents an area of the image in which “the representative location of the main object” is located. Onuki, 15:33-37, 17:63-18:10, FIGS. 17, 22. “[B]ecause information indicating the main object location on the image plane, inputted or detected when a picture was taken, is recorded together with an image and is supplied to an image reproducing apparatus, a main object can be precisely separated from a background, and thus it is possible to eliminate an error in a blurring enhancement process on the background image.” Onuki, 22:5-11.

112. Onuki discloses, in Figure 21 below, “a schematic diagram illustrating a manner of defining the location of an object.” Onuki, 3:61-64, FIG. 21. The image plane is divided into 25 blocks, labeled SL1 through SL25. Onuki, 17:63-

18:6, FIG. 21. The “reference number 257 denotes a point directed by a visual line of the photographer” detected by an eye-tracking sensor in the camera. Onuki, 17:63-18:6. Since point 257 is located in block SL18, “a code representing the block number of this area” is recorded by the camera and supplied to the image reproducing device. Onuki, 18:7-10, 22:57-65.

FIG. 21



Onuki, FIG. 21.

ii. Alternatively, Onuki and Exif-V2.1 render the claimed “image file” obvious

113. To the extent Patent Owner contends or the Board finds that Onuki does not disclose an “image file,” Onuki discloses or suggests “acquiring ... image data, shooting scene information, and location information of a person in the image data”; Exif-V2.1 discloses or suggests an “image file including image data,

shooting scene information, and location information of a person in the image data”; and it would have been obvious to combine Onuki and Exif-V2.1 to teach this limitation.

114. As explained in the previous section, Onuki’s image signal discloses image data, and Onuki’s photo-taking mode and main object location that make up the photo-taking information disclose shooting scene information and location information of a person in the image data, respectively. *Supra* Section VII.B.1.c.i. A POSITA would have looked to Exif-V2.1 for details on how to store the image signal, photo-taking mode, and main object location “together,” as Onuki teaches, and provide this information to the image reproducing apparatus for image processing.

115. Exif-V2.1 “specifies a standard file format for the image data recorded by digital still cameras (DSC)” that “use a PC card,” like the digital camera disclosed by Onuki. Exif-V2.1, 7; Onuki, 22:20-25, 22:40-56. Each Exif-V2.1 file includes both image data and attribute information. The attribute information includes numerous picture-taking conditions, which are stored using TIFF tags in the same file as the image data.

116. The standard file format specified by Exif-V2.1 (“*image file*”) includes both “image data,” Exif-V2.1, 14-22, and “attribute information,” *id.*, 23-61. The attribute information includes tags and associated fields for “Picture-

Taking Conditions” like the *ExposureProgram* tag (“*shooting scene information*”) and the *SubjectLocation* tag (“*location information of a person in the image data*”). Exif-V2.1, 40-41, 55, 59. The Exif-V2.1 *ExposureProgram* tag is “[t]he class of the program used by the camera to set exposure when the picture is taken.” Exif-V2.1, 55. A tag value of “7,” for example, indicates “Portrait mode (for closeup photos with the background out of focus).” Exif-V2.1, 55. The Exif-V2.1 *SubjectLocation* tag “[i]ndicates the location of the main subject in the scene” in terms of a row and column within the image. Exif-V2.1, 59.

117. A POSITA would have found it obvious to combine Onuki and Exif-V2.1 such that Onuki’s digital camera uses the Exif-V2.1 image file format to store the image signal and photo-taking information “together,” and its image reproducing apparatus acquires this image file to perform the desired image processing on the associated image signal. Because Exif-V2.1 “specifies a standard file format for the image data recorded by digital still cameras (DSC) and related systems,” a POSITA would have been motivated to use the Exif-V2.1 file format, including its tags for specifying the photo-taking mode and main object location, to ensure compatibility with a wide variety of image reproducing apparatuses that may process the image. The Exif-V2.1 file format was known for its “compatibility with standard formats in wide use,” allowing such files “to be used on personal computers and other information systems.” Exif-V2.1, 8. Indeed, Exif-V2.1 states

that its file is compatible with both “[o]ff-the shelf” and “[d]edicated (system-specific) image processing software running on personal computers.” Exif-V2.1, 11.

118. A POSITA would have been motivated to use a standard image file like the one disclosed in Exif-V2.1 to transfer the image data and necessary information for Onuki’s image processing to the image reproducing apparatus in a single file. A POSITA would have seen such an image file as advantageous because “[w]ith single images or small collections, it is convenient to store the metadata in the same file as the image data, so that a single item on the desktop contains all the information.” Milch, 28. Using a single file conforming to an industry standard to provide such information would have improved the organization of the data and would have simplified the development and implementation of the image reproducing apparatus obtaining the data necessary to perform the requested image processing, since software for reading and utilizing the image data and TIFF tags in an Exif-V2.1 file was well known and widely used.

119. A POSITA would have had a reasonable expectation of success in Onuki’s image reproducing apparatus acquiring an Exif-V2.1 image file including Onuki’s image signal (stored as uncompressed or JPEG compressed image data) and photo-taking information (stored using TIFF tags) “together” for processing

because Exif-V2.1 image files were the standard, well-known way for digital cameras to digitally store image data and associated picture-taking conditions together. Onuki, 22:40-65; Exif-V2.1, 8. Exif-V2.1 describes the applicable digital file format standard at the time and specifies an image file format that includes image data and tags representing picture-taking conditions. Exif-V2.1, 3, 17-22, 40-41, 52-61. The '109 patent even admits that it was “*well-known to persons skilled in the art*” to “use tags to specify each data item” for “files in Exif format.” Ex. 1001, 7:16-18 (emphasis added). Exif-V2.1 also requires personal computers conforming to the standard to include “dedicated software” that can “read all the images, audio and attribute information recorded.” Exif-V2.1, 11. Accordingly, combining Onuki and Exif-V2.1 would have required applying only conventional, well-known techniques for communicating image data and attribute data from a camera to an image reproducing apparatus.

120. A POSITA would have also expected success because Exif-V2.1 specifically provided tags corresponding to Onuki’s photo-taking mode and main object location. Onuki’s photo-taking mode corresponds to the Exif-V2.1 *ExposureProgram* tag, which is “[t]he class of the program used by the camera to set exposure when the picture is taken.” Exif-V2.1, 55. A tag value of “7,” for example, indicates “Portrait mode (for closeup photos with the background out of focus).” Exif-V2.1, 55. Onuki’s main object location corresponds to the Exif-V2.1

SubjectLocation tag, which “[i]ndicates the location of the main subject in the scene” in terms of a row and column within the image. Exif-V2.1, 59.

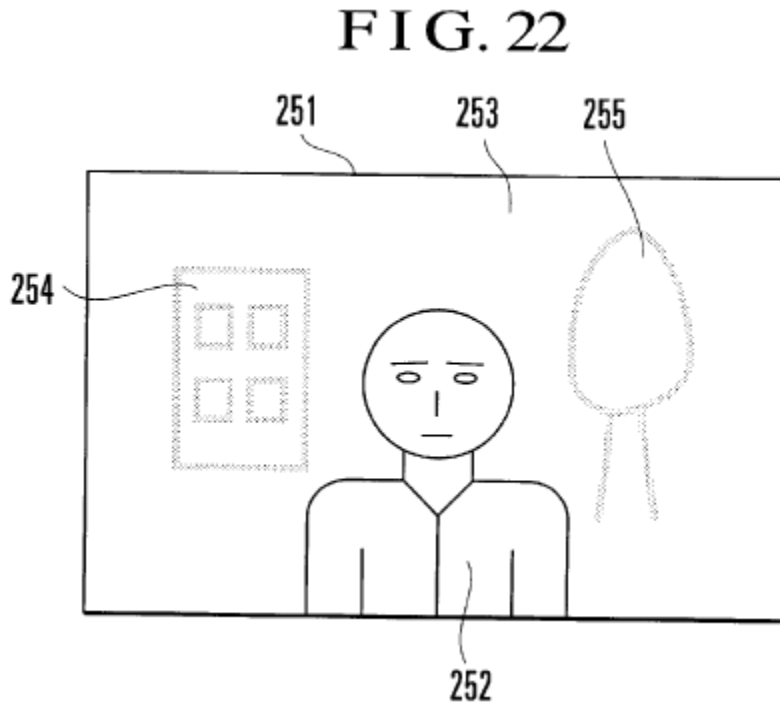
Accordingly, such a design would have been a combination of familiar elements according to known methods to yield predictable results.

- d. **[1.c]: “increasing sharpness of an area in which the person is located and decreasing sharpness of an area in which the person is not located based on the acquired location information when the acquired shooting scene information indicates a portrait scene.”**

121. Onuki in view of Luo-668 renders obvious “increasing sharpness of an area in which the person is located and decreasing sharpness of an area in which the person is not located based on the acquired location information when the acquired shooting scene information indicates a portrait scene.”

122. Onuki discloses an image processing routine that decreases the sharpness of an area in which the person is not located based on the acquired main object location (“*location information*”) when the acquired photo-taking mode (“*shooting scene information*”) indicates a portrait mode (“*portrait scene*”). Onuki, 18:23-20:67, FIGS. 21-29. Onuki discloses that a “portrait mode” refers to “a photo-taking mode in which only a main object is focused.” Onuki, 15:19-23. Figure 22, below, depicts “an example of an image photographed in the portrait mode” before the image reproducing apparatus performs image processing. Onuki,

18:17-19, FIG. 22. As shown, the main object 252 in this image is a person. Onuki,
15:33-37, FIG. 22.



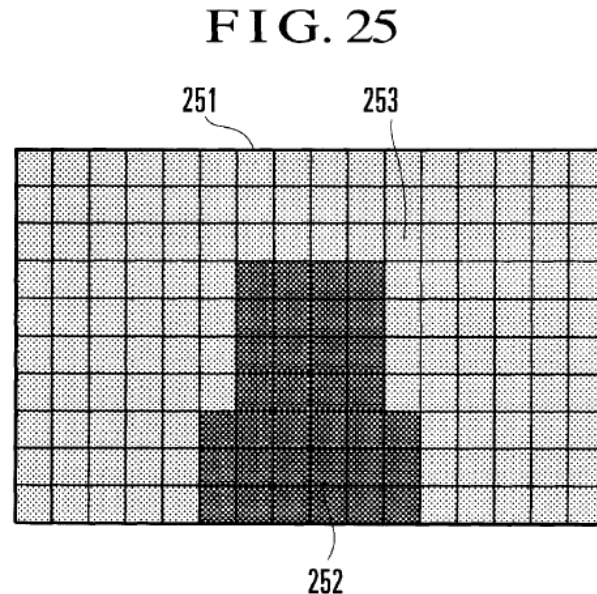
Onuki, FIG. 22.

123. When the CPU of the image reproducing apparatus determines that the photo-taking mode indicates that “the image was photographed in the portrait mode,” “the main object is separated from the background image” based on the main object location. Onuki, 6:39-42, 18:60-65, 19:45-64, 21:40-48, 22:5-11, 22:59-65. Onuki discloses first determining “whether the image was photographed in the portrait mode” based on the previously read photo-taking mode. Onuki, 18:53-55, 21:66-22:4. If so, the image reproducing apparatus divides the image “into small blocks,” performs a spatial frequency analysis on each block, and

preliminarily identifies whether each block “belongs to the main object image”

based on this spatial frequency analysis. Onuki, 19:15-39. This is shown below in

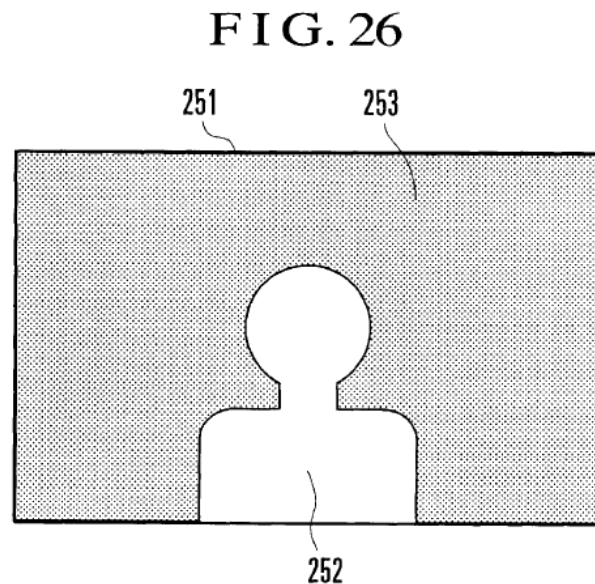
Figure 25. Onuki, 19:40-44.



Onuki, FIG. 25.

124. The main object separation uses the “main object location represented by a location number assigned to a particular small area in the photo-taking image plane” (“*location information of a person in the image data,*” acquired in “*an image file*”), along with a spatial frequency analysis of the image data, to “produce a single closed boundary line surrounding the main object image.” Onuki, 19:18-20:19. The image reproducing apparatus determines which blocks correspond to the main object location and extracts “blocks which are more likely to belong to the main object image ... in accordance with the information of the main object

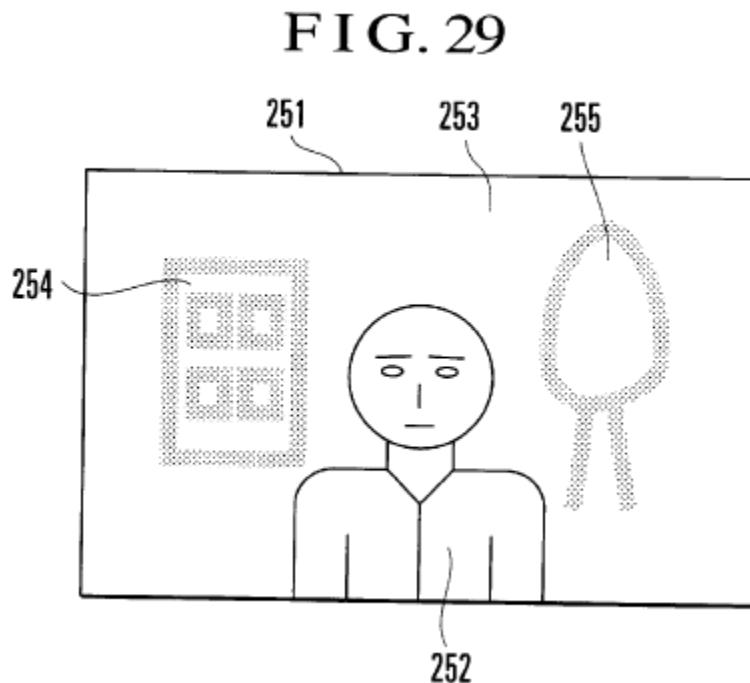
location which was recorded when the image was photographed and which has been detected.” Onuki, 19:45-64. The image reproducing apparatus then extracts “a boundary line between the main object image and the background image” for each of the blocks on the boundary between the two, produces “a single closed boundary line surrounding the main object image,” and cuts out the main object image from the photographed image. Onuki, 19:65-20:19. Figure 26, below, depicts the resultant image with the main object (“*an area in which the person is located*”) separated from the background (“*an area in which the person is not located*”). Onuki, 20:20-23.



Onuki, FIG. 26.

125. Onuki then discloses that “the background image remaining after the cutting-out of the main object image ... is subjected to a process for blurring the background image.” Onuki, 18:66-19:2. A POSITA would have understood that

this blurring process decreases sharpness of an area in which the person 252 is not located. See Ex. 1001, 13:7-12 (disclosing that “blur[ring] away the backgrounds of the image in a suitable way” “weaken[s] the sharpness of an image” in a region other than “an emphasis region”). The main object image is then “embedded into the background image subjected to the background blurring process,” producing the final image of Figure 29, below, which shows the sharpness of the background decreased. Onuki, 19:3-8, 20:60-65, 21:49-53, FIG. 29.



Onuki, FIG. 29.

126. Because the background is separated from the main object image based on the main object location, this decrease in the sharpness of the background (“an area in which the person is not located”) is based on the main object location. “[B]ecause information indicating the main object location on the image plane ...

is recorded together with an image and is supplied to an image reproducing apparatus, a main object can be precisely separated from a background, and thus it is possible to eliminate an error in a blurring enhancing process on the background image.” Onuki, 22:5-11.

127. While Onuki does not explicitly disclose also increasing the sharpness of an area in which the person is located, this would have been obvious in view of Luo-668. Like Onuki, Luo-668 discloses “processing image pixels to emphasize the main subject of the image,” including by “blurring the background regions out of focus.” Luo-668, 1:7-9, 11:59-63. But unlike Onuki, Luo-668 explicitly discloses that further emphasis can be created by both “altering pixel values in the main subject” and “altering pixel values in the background.” Luo-668, 1:50-56, 11:64-12:4. Luo-668 discloses one form of emphasis by varying “region sharpness.” 11:55-59. To perform this process, Luo-668 discloses “modifying the blur values of pixels in the digital image” so that “the sharpness of main subject pixels is ... increased, while the sharpness of the background is reduced, thereby blurring the background.” Luo-668, 11:64-12:4.

128. A POSITA would have been motivated to combine Onuki and Luo-668 to further emphasize the person that constitutes the main object in a photo taken in portrait mode by increasing the sharpness of the main object, including the area corresponding to the main object location. Onuki discloses that, in portrait

mode, a main object should be “focused.” Onuki, 15:21-23. Even if the photographer properly captured the main object in focus, the main object’s sharpness is limited by various factors, including the type of lens, the resolution of the image sensor, and the amount of image compression used in the camera. Increasing the sharpness was a well-known process used in digital image processing to make up for these shortcomings, and a POSITA would have been motivated to apply it when the portion of the image corresponding to the main object lacked the desired sharpness. Doing so would have enhanced the appearance of the main object.

129. Additionally, it was known that some or all of the main object may initially be out of focus for a variety of reasons. For example, the main object may be out of focus due to errors in the focus adjustment step or if the main subject moves after setting the focus. Onuki, 6:20-25, 8:49-59, 16:53-65. Additionally, if the camera does not properly set the aperture, the main object may include areas that are out of focus. Onuki, 17:12-38 (disclosing that setting the aperture “to a too large value” means that “good focus is obtained only for a particular part of an object”). A POSITA would have been motivated to increase the sharpness of the main object, as taught by Luo-668, to improve the clarity of the features of the main object and further emphasize the main object against the background.

130. Furthermore, Onuki discloses a system that includes a printer 195 “for producing a photograph 197 by printing a hard copy” of the processed images from the image reproducing apparatus 181. Onuki, 4:55-62, 4:66-5:2. A POSITA would have understood that hardcopy printers also generally reduced the sharpness of images, due to the digital printing process, and that “[t]he image quality of digital prints [could] be improved by using an appropriate sharpening or ‘edge enhancement’ filter.” U.S. Patent No. 5,696,850 (Ex. 1011; “Parulski ‘850”), 1:29-31. Furthermore, “[t]he appropriate filter depend[ed] on the characteristics of the image input source (digital camera or film plus scanner), the output printer, and the print size.” Parulski ‘850, 1:31-33. A POSITA would have been motivated to use the image reproducing apparatus in Onuki to increase the sharpness of the main object, as taught by Luo-668, so that the photograph 197 produced by printer 195 in Onuki provided high quality images, which properly depict the fine details of the main object in the print.

131. A POSITA would have had a reasonable expectation of success of such a combination, as Onuki already discloses that the main object image is “cut out” from the background and “saved,” allowing the image reproducing apparatus to easily increase the sharpness of the pixels constituting the main object image. Onuki, 20:62-65. Adding Luo-668’s feature of increasing the sharpness of the main object would have been a combination of familiar elements according to known

methods to yield predictable results, requiring a POSITA to apply only conventional image-sharpening techniques to the main object image cut out from the background to increase the sharpness of the main object. Indeed, several techniques for sharpening an image, including by applying “Gaussian unsharp masking,” were well known, and a POSITA would have reasonably expected success in applying such techniques to the main object image to increase the sharpness of an area of the image in which the person is located. U.S. Patent No. 6,373,992 (Ex. 1009; “Nagao”), 2:1-7, 5:1-12; *supra* Section III.F (discussing well-known techniques for increasing sharpness).

2. Independent Claim 2

a. [2.pre]: “A method of image processing comprising:”

132. Onuki discloses or suggests “[a] method of image processing” for the reasons explained for [1.pre]. *Supra* Section VII.B.1.a.

b. [2.a]: “acquiring an image file, the image file including image data, shooting scene information, and location information of a person in the image data; and”

133. Onuki discloses or suggests or in view of Exif-V2.1 renders obvious “acquiring an image file, the image file including image data, shooting scene information, and location information of a person in the image data” for the reasons explained for [1.b]. *Supra* Section VII.B.1.c.

- c. **[2.b]: “increasing sharpness of an area in which the person is located and decreasing sharpness of an area in which the person is not located based on the acquired location information when the acquired shooting scene information indicates a portrait scene,”**

134. Onuki in view of Luo-668 renders obvious “increasing sharpness of an area in which the person is located and decreasing sharpness of an area in which the person is not located based on the acquired location information when the acquired shooting scene information indicates a portrait scene” for the reasons explained for [1.c]. *Supra* Section VII.B.1.d.

- d. **[2.c]: “wherein each of the operations of the method of image processing is executed by a CPU.”**

135. Onuki discloses or suggests “wherein each of the operations of the method of image processing is executed by a CPU” for the reasons explained for [1.a]. *Supra* Section VII.B.1.b.

3. Independent Claim 3

- a. **[3.pre]: “A computer program product comprising:”**

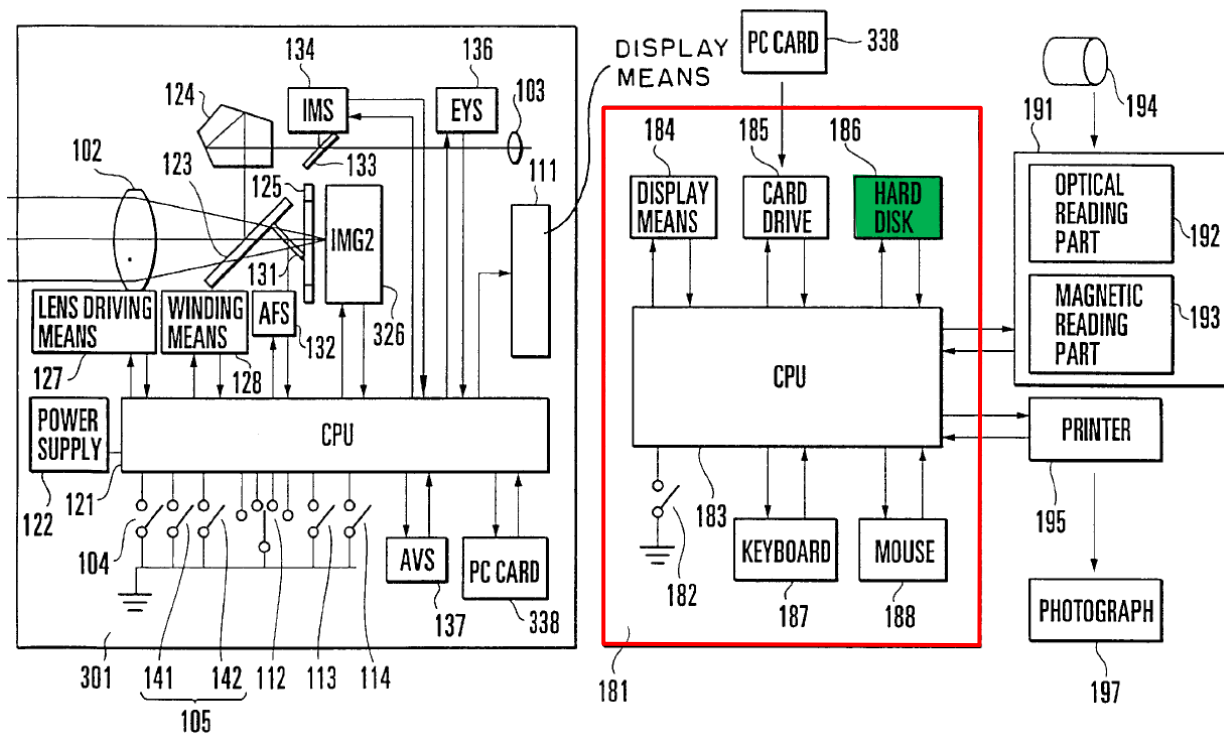
136. Onuki discloses or suggests “[a] computer program product.” Onuki discloses that an image reproducing apparatus body 181 includes a hard disk 186 that “serves to store an image processing program.” Onuki, 6:36-37, 6:49-51, FIG. 30. When “the power supply switch 182 of the image reproducing apparatus 281 is turned on, the CPU 183 is activated,” and “execution of various control programs is started.” Onuki, 18:41-47, 6:52-54. Such an image processing program

executed by the CPU discloses a computer program product. *See supra* Section VII.B.1.a ([1.pre]).

- b. [3.a]: “a non-transitory computer-readable storage medium on which an image processing program is stored, wherein the image processing program includes”

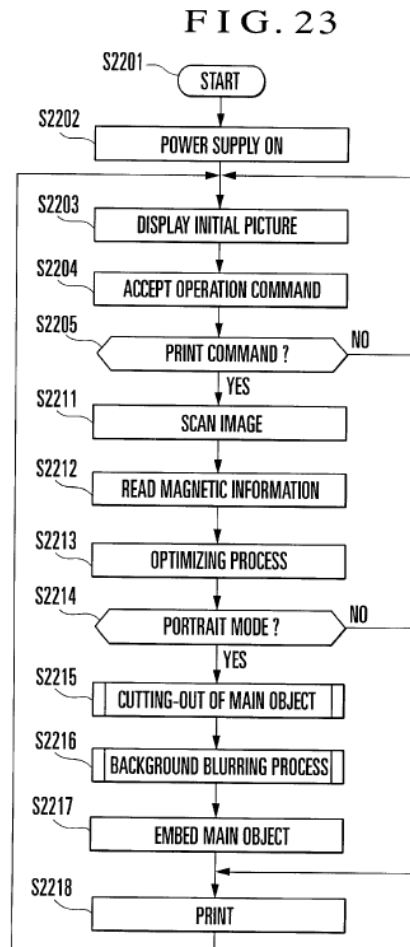
137. Onuki discloses or suggests “a non-transitory computer-readable storage medium on which an image processing program is stored.” Onuki discloses a hard disk 186 (“non-transitory computer-readable storage medium”) that “serves to store an image processing program” (“on which an image processing program is stored”). Onuki, 6:49-51, FIG. 30.

FIG. 30



Onuki, FIG. 30 (annotated).

138. One image processing program stored in hard disk 186 is represented in the flow chart of Figure 23, reproduced below. Onuki, 6:49-51, 18:23-26, FIG. 23.



Onuki, FIG. 23. While Onuki presents this flow chart in connection with its second embodiment, which reads the image and related data from film, Onuki discloses that the image processing proceeds “in a similar manner” in Onuki’s Figure 30 embodiment, which reads the image and related data from a PC card 338. Onuki, 22:57-65, FIG. 23. As described in the following sections regarding [3.b]-[3.c], this

image processing program discloses or suggests or, in view of Exif-V2.1 and Luo-668, renders obvious including the claimed features of claim 3.

- c. **[3.b]: “a computer program code for acquiring an image file, the image file including image data, shooting scene information, and location information of a person in the image data, and”**

139. Onuki discloses or suggests or in combination with Exif-V2.1 renders obvious “a computer program code for acquiring an image file, the image file including image data, shooting scene information, and location information of a person in the image data.” Onuki discloses or suggests or in combination with Exif-V2.1 renders obvious “acquiring an image file, the image file including image data, shooting scene information, and location information of a person in the image data” for the reasons explained for [1.b]. *Supra* Section VII.B.1.c. As explained for [1.b], this acquiring occurs when a CPU reads an image file from PC card drive 185. *Supra* Section VII.B.1.c. A POSITA would have understood that this step would be embodied in computer program code because the computer program that allows Onuki’s image reproducing apparatus to perform image processing is stored in hard disk 186, which is comprised of computer program code. Onuki, 6:49-51, FIG. 30; *supra* Section VII.B.3.b.

- d. **[3.c]: “a computer program code for increasing sharpness of an area in which the person is located and decreasing sharpness of an area in which the person is not located based on the acquired location information when the acquired shooting scene information indicates a portrait scene.”**

140. Onuki in view of Luo-668 renders obvious “a computer program code for increasing sharpness of an area in which the person is located and decreasing sharpness of an area in which the person is not located based on the acquired location information when the acquired shooting scene information indicates a portrait scene.” Onuki in view of Luo-668 renders obvious “increasing sharpness of an area in which the person is located and decreasing sharpness of an area in which the person is not located based on the acquired location information when the acquired shooting scene information indicates a portrait scene” for the reasons explained for [1.c]. *Supra* Section VII.B.1.d. A POSITA would have understood that this step would be embodied in computer program code because the computer program that allows Onuki’s image reproducing apparatus to perform image processing is stored in hard disk 186, which is comprised of computer program code. Onuki, 6:49-51, FIG. 30; *supra* Section VII.B.3.b.

141. For example, as explained for [1.c], Onuki discloses a CPU configured to determine whether the shooting scene information indicates that a portrait mode is selected, Onuki, 6:36-42, 18:53-55, FIG. 23, to divide the image into plural regions, *id.*, 6:36-42, 19:15-17, FIG. 25, to determine which region

corresponds to the region indicated by the location information, *id.*, 6:36-42, 19:45-58, FIG. 21, and to blur a region in which the person is not located, *id.*, 6:36-42, 20:25-59, FIGS. 27-28, and Onuki in combination with Luo-668 renders obvious a CPU configured to increase the sharpness of the region in which the person is located, based on the acquired location information, Onuki, 6:36-42; Luo-668, 11:64-12:4. *Supra* Section VII.B.1.d.

* * *

142. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

143. I declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

144. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on this 21st day of June 2024.

By: 
Kenneth Parulski