

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. IPR2024-00957
U.S. Patent No. 7,454,056

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

TABLE OF CONTENTS

I.	INTRODUCTION AND SUMMARY OF OPINIONS.....	14
II.	BACKGROUND AND QUALIFICATIONS	15
III.	TECHNOLOGY BACKGROUND.....	22
A.	Early Digital Image Processing and Image Sensors	22
B.	Portable Electronic Cameras	25
C.	Image Processing in Digital Cameras	28
D.	Image compression, image files, and image metadata.....	37
E.	Subject determination and face recognition.....	43
F.	Image quality adjustments.....	47
IV.	MATERIALS CONSIDERED	58
V.	LEGAL STANDARDS	62
A.	Claim Construction.....	62
B.	Level of Ordinary Skill	63
C.	Obviousness.....	64
VI.	BACKGROUND	67
A.	The '056 Patent	67
B.	Prosecution History	70
VII.	CLAIM CONSTRUCTION	71
VIII.	ANALYSIS OF PETITION GROUNDS.....	71
A.	Overview of the Asserted References	71
1.	Overview of Yano (Ex. 1005).....	71

2.	Overview of Schroder (Ex. 1006).....	74
3.	Overview of Steinberg (Ex. 1007).....	75
4.	Overview of Kuwata (Ex. 1008).....	76
5.	Overview of Nakamura (Ex. 1009).....	78
6.	Yano, Schroder, Steinberg, Kuwata, and Nakamura Are Analogous Art.....	80
B.	Ground 1: Yano and Schroder Render Obvious Claims 1, 3-7, and 11	82
1.	Independent Claim 1	82
a.	[1.pre]: “An image processing device for executing color balance correction on image data of a photographed image, said image processing device comprising:”	82
b.	[1.a]: “an image data acquisition module that acquires said image data;”	84
c.	[1.b]: “a specific subject area determination module that determines a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”.....	85
d.	[1.c]: “a specific subject characteristic value calculation module that calculates a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area,”	87
e.	[1.d]: “wherein said specific subject characteristic value calculation is executed using weighted distribution, and wherein said weighted distribution is set so as to be a weight in a center area of said	

	specific subject area larger than a weight in an area outside said center area;”	89
f.	[1.e]: “a correction value calculation module that calculates a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”	94
g.	[1.f]: “a correction execution module that executes said color balance correction on said image data using said calculated correction value.”	100
2.	Dependent Claims	102
a.	Claim 3: “An image processing device according to claim 1, wherein said specific subject characteristic value includes a characteristic value relating to a hue of said specific subject.”	102
b.	Claim 4: “An image processing device according to claim 1, wherein said specific subject characteristic value includes a specific color characteristic value for representing a characteristic of pixel data included within said specific subject area, said pixel data belonging to a specific color range.”	103
c.	Claim 5.....	104
i.	[5.a]: “An image processing device according to claim 4, wherein said specific color characteristic value includes a statistical value of pixel values of said pixel data belonging to said specific color range,”	104
ii.	[5.b]: “wherein said characteristic target value includes a preset pixel target value, and”.....	105
iii.	[5.c]: “wherein said calculated correction value includes a correction value for	

	eliminating or reducing a difference between said statistical value of pixel values and said pixel target value.”	105
d.	Claim 6.....	106
i.	[6.a]: “An image processing device according to claim 4, wherein said specific subject includes a face part of a human subject, and”	106
ii.	[6.b]: “wherein said pixel data belonging to said specific color range includes flesh colored pixel data belonging to a color range corresponding to a flesh color of said human subject.”	107
e.	Claim 7: “An image processing device according to claim 1, wherein said correction execution module executes said color balance correction using said calculated correction value when an area ratio of said specific subject area to a whole area of said photographed image is greater than a reference value.”	108
3.	Independent Claim 11	110
a.	[11.pre]: “An image processing method for executing color balance correction on image data of a photographed image, said image processing method comprising:”	110
b.	[11.a]: “acquiring said image data;”	110
c.	[11.b]: “determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”	110
d.	[11.c]: “calculating a specific subject characteristic value, wherein said specific subject characteristic	

	value represents a characteristic of image data corresponding to said determined specific subject area,”	111
e.	[11.d]: “wherein said calculating said specific subject characteristic value is executed using weighted distribution, and wherein said weighted distribution is set so as to be a weight in a center area of said specific subject area larger than a weight in an area outside said center area;”	111
f.	[11.e]: “calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”	111
g.	[11.f]: “executing said color balance correction on said image data using said calculated correction value.”	111
C.	Ground 2: Yano, Schroder, and Steinberg Render Obvious Claims 2, 8, 12-16, and 18	112
1.	Independent Claim 8	112
a.	[8.pre]: “An image processing device for executing color balance correction on image data of a photographed image, said image processing device comprising:”	112
b.	[8.a]: “an image data acquisition module that acquires said image data;”	112
c.	[8.b]: “a specific subject area determination module that determines a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”	112
d.	[8.c]: “a specific subject characteristic value calculation module that calculates a specific subject	

	characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;”	112
e.	[8.d]: “a correction value calculation module that calculates a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”	113
f.	[8.e]: “a correction execution module that executes said color balance correction on said image data using said calculated correction value,”	113
g.	[8.f]: “wherein when a plurality of said specific subject areas are determined, said specific subject characteristic value calculation is executed using weighted distribution, wherein said weighted distribution is set according to a size of each specific subject area on each specific subject characteristic value of said plurality of specific subject areas.”	113
2.	Independent Claim 12	118
a.	[12.pre]: “An image processing method for executing color balance correction on image data of a photographed image, said image processing method comprising:”	118
b.	[12.a]: “acquiring said image data;”	118
c.	[12.b]: “determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”	118
d.	[12.c]: “calculating a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data	

	corresponding to said determined specific subject area;”	118
e.	[12.d]: “calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”	119
f.	[12.e]: “executing said color balance correction on said image data using said calculated correction value,”	119
g.	[12.f]: “wherein when a plurality of said specific subject areas are determined, said calculating said specific subject characteristic value is executed using weighted distribution, wherein said weighted distribution is set according to a size of each specific subject area on each specific subject characteristic value of said plurality of specific subject areas.”	119
3.	Dependent Claims	120
a.	Claim 13: “An image processing method according to claim 12, wherein said specific subject characteristic value includes a specific color characteristic value for representing a characteristic of pixel data included within said specific subject area, said pixel data belonging to a specific color range.”	120
b.	Claim 14.....	120
i.	[14.a]: “An image processing method according to claim 13, wherein said specific color characteristic value includes a statistical value of pixel values of said pixel data belonging to said specific color range,”	120
ii.	[14.b]: “wherein said characteristic target value includes a preset pixel target value, and”	120

iii.	[14.c]: “wherein said calculated correction value includes a correction value for eliminating or reducing a difference between said statistical value of pixel values and said pixel target value.”	120
c.	Claim 15:	121
i.	[15.a]: “An image processing method according to claim 13, wherein said specific subject includes a face part of a human subject, and”	121
ii.	[15.b]: “wherein said pixel data belonging to said specific color range includes flesh colored pixel data belonging to a color range corresponding to a flesh color of said human subject.”	121
d.	Claim 16: “An image processing method according to claim 12, wherein said executing said color balance correction on said image data using said calculated correction value is carried out when an area ratio of said specific subject area to a whole area of said photographed image is greater than a reference value.”	121
4.	Independent Claim 18	122
a.	[18.pre]: “A computer program product for executing color balance correction on image data of a photographed image, said computer program product comprising:”	122
b.	[18.a]: “a computer readable medium; and”	122
c.	[18.b]: “a computer program stored on said computer readable medium, said computer program comprising:”	123

- d. [18.c]: “a program instruction for acquiring said image data;” 123
- e. [18.d]: “a program instruction for determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;” 124
- f. [18.e]: “a program instruction for calculating a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;” 124
- g. [18.f]: “a program instruction for calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and” 125
- h. [18.g]: “a program instruction for executing said color balance correction on said image data using said calculated correction value,” 125
- i. [18.h]: “wherein when a plurality of said specific subject areas are determined, said specific subject characteristic value calculation is executed using weighted distribution, wherein said weighted distribution is set according to a size of each specific subject area on each specific subject characteristic value of said plurality of specific subject areas.” 126
- 5. Claim 2: “An image processing device according to claim 1 wherein said specific subject characteristic value calculation is executed by obtaining a weighted average value of each specific subject characteristic value of a plurality of specific subject areas.” 126
- D. Grounds 3-4: Yano and Kuwata (Ground 3) or Yano, Schroder, and Kuwata (Ground 4) Render Obvious Claims 9 and 17 126
 - 1. Independent Claim 9 126

- a. [9.pre]: “An image processing device for executing color balance correction on image data of a photographed image, said image processing device comprising:” 126
- b. [9.a]: “an image data acquisition module that acquires said image data;” 127
- c. [9.b]: “a specific subject area determination module that determines a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;” 127
- d. [9.c]: “a specific subject characteristic value calculation module that calculates a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;” 127
- e. [9.d]: “a correction value calculation module that calculates a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value,” 127
- f. [9.e]: “wherein said calculated correction value includes a correction value weighted according to an area ratio of said specific subject area to a whole area of said photographed image; and” 128
- g. [9.f]: “a correction execution module that executes said color balance correction on said image data using said calculated correction value.” 132
- 2. Independent Claim 17 133
 - a. [17.pre]: “An image processing method for executing color balance correction on image data of

	a photographed image, said image processing method comprising:"	133
b.	[17.a]: "acquiring said image data;"	133
c.	[17.b]: "determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;"	133
d.	[17.c]: "calculating a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;"	133
e.	[17.d]: "calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value,"	134
f.	[17.e]: "wherein said calculated correction value includes a correction value weighted according to an area ratio of said specific subject area to a whole area of said photographed image; and"	134
g.	[17.f]: "executing said color balance correction on said image data using said calculated correction value."	134
E.	Grounds 5-6: Yano and Nakamura (Ground 5) or Yano, Schroder, and Nakamura (Ground 6) Render Obvious Claim 10	134
1.	Independent Claim 10	134
a.	[10.pre]: "An image processing device for executing color balance correction on image data of a photographed image, said image processing device comprising:"	134
b.	[10.a]: "an image data acquisition module that acquires said image data[;]"	135

- c. [10.b]: “a specific subject area determination module that determines a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image, and” 135
- d. [10.c]: “wherein said specific subject area determination module determines said specific subject area using pixel values of pixel data included in a target area for determination, and a position of said target area in said photographed image;” 135
- e. [10.d]: “a specific subject characteristic value calculation module that calculates a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;” 140
- f. [10.e]: “a correction value calculation module that calculates a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and” 140
- g. [10.f]: “a correction execution module that executes said color balance correction on said image data using said calculated correction value.” 141

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. 7,454,056 (the “’056 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 1-18 of the ’056 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 ’056 patent, which I have been asked to assume is March 30, 2004. 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 1-18 of the ’056 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.

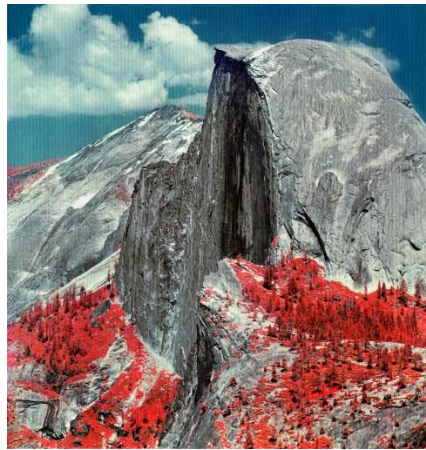
21. I am a Fellow of the Society of Motion Picture and Television Engineers (SMPTE), the global society of media professionals, technologists and engineers. In 2001, Kodak received a Technical Emmy Award for contributions I made to the development of the SMPTE 24P HDTV production standard, which has 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.

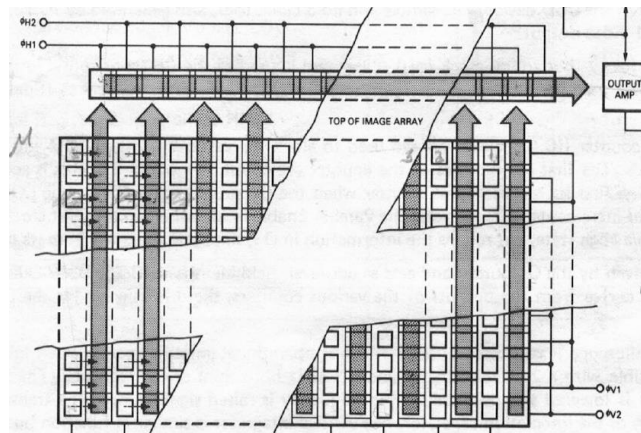


Diagram of Fairchild CCD201ADC image sensor

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. To view the images, the static RAM memory was detached from the camera and inserted into the playback device. 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 (“Parulski 1991”; Ex. 1014), pp 45-58.

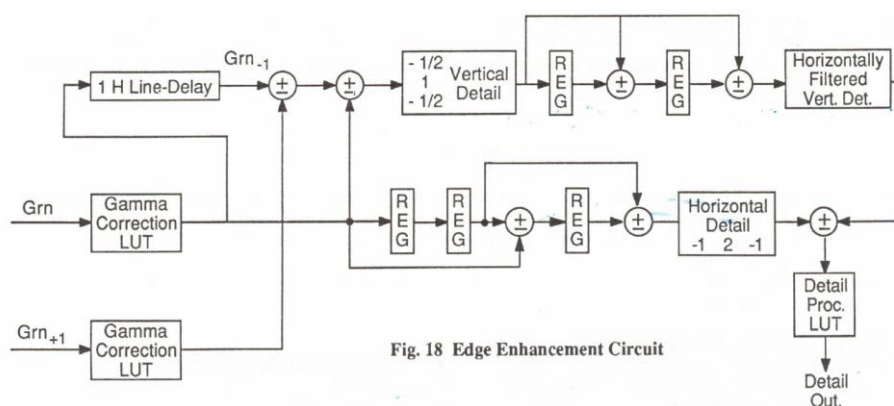
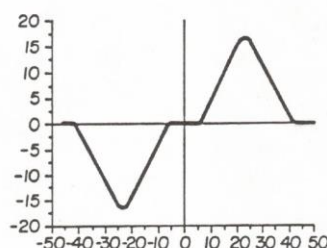


Fig. 18 Edge Enhancement Circuit

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 (“Photoshop 5.0”; Ex. 1015), 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 (“Parulski 1994”; Ex. 1016), pp. 665-667.

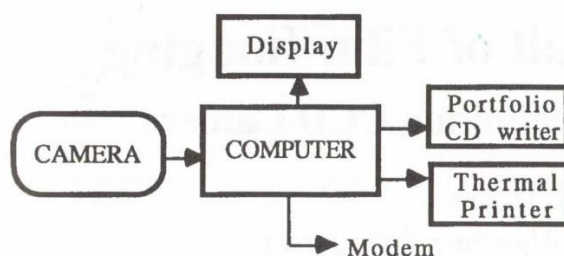


Figure 1. Digital Electronic Photography System

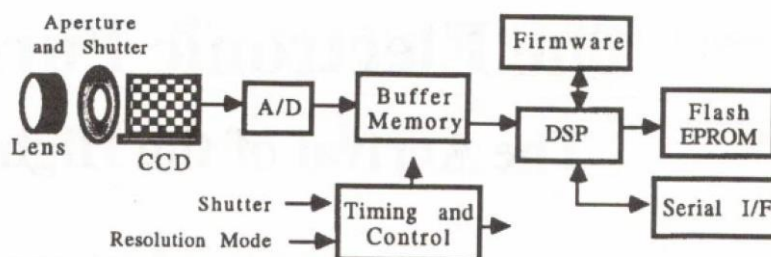


Figure 3. Digital Camera Architecture

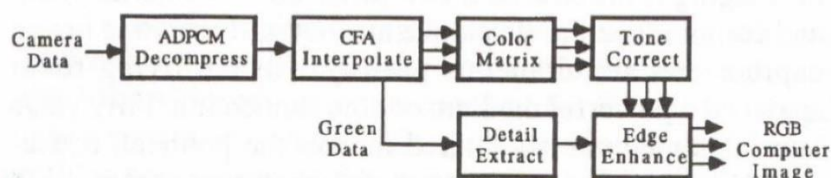


Figure 5. Imaging Processing Module Functions

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

37. In 1997, Kodak released the DC210 Digital Camera, pictured below, which was the first consumer digital camera with an image sensor having at least one million pixels (i.e., 1 Megapixel). The general design of the Kodak DC210 camera became the dominant design for consumer digital cameras. The features that it offered, including a zoom lens, megapixel image sensor, LCD graphical user interface, video output, JPEG image compression, and removable flash memory card storage, soon became standard features of almost all consumer digital cameras. Flash memory cards using the Exif/JPEG image format became a very common way to store images in digital cameras, and then transfer the images to personal computers (PCs).



Kodak DC210 Digital Camera

D. Image compression, image files, and image metadata

38. 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 Figure 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 Figure 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.

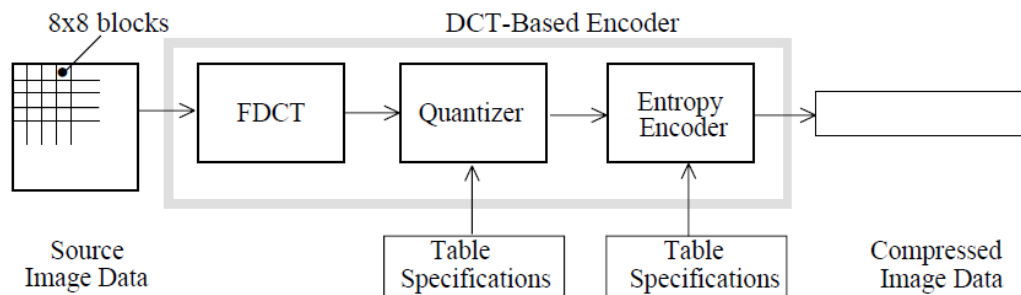


Figure 1. DCT-Based Encoder Processing Steps

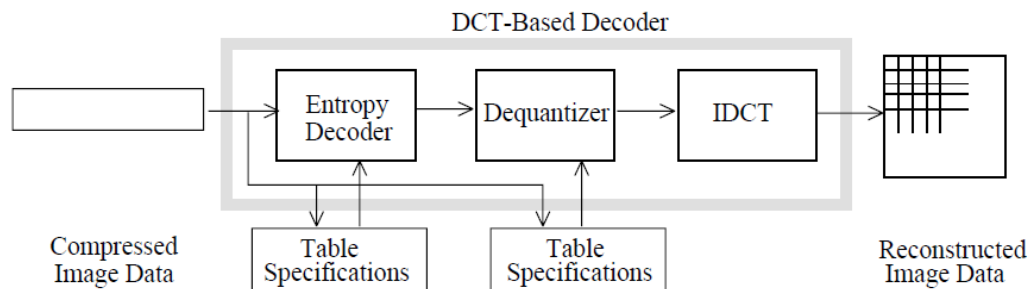


Figure 2. DCT-Based Decoder Processing Steps

39. 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, Exif version 2.1 was published by December 1998, and Exif version 2.2 was published in April 2002. 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.

40. All versions of Exif, including Exif version 2.2, utilize many image metadata tags that were defined in the TIFF 6.0 specification, which are listed in table 3 of the Exif version 2.2 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	33432	8298	ASCII	Any

41. Exif version 2.2 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 version 2.2 specification, shown below. These image metadata tags include, for example, the image exposure time and the lens focal length and f-number. The metadata tags also include the scene capture type (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). The metadata tags also include information about the digital camera's image processing settings, such as the contrast, sharpness, and saturation settings.

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	OECF	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
Subject area	SubjectArea	37396	9214	SHORT	2 or 3 or 4
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
Custom image processing	CustomRendered	41985	A401	SHORT	1
Exposure mode	ExposureMode	41986	A402	SHORT	1
White balance	WhiteBalance	41987	A403	SHORT	1
Digital zoom ratio	DigitalZoomRatio	41988	A404	RATIONAL	1
Focal length in 35 mm film	FocalLengthIn35mmFilm	41989	A405	SHORT	1
Scene capture type	SceneCaptureType	41990	A406	SHORT	1
Gain control	GainControl	41991	A407	RATIONAL	1
Contrast	Contrast	41992	A408	SHORT	1
Saturation	Saturation	41993	A409	SHORT	1
Sharpness	Sharpness	41994	A40A	SHORT	1
Device settings description	DeviceSettingDescription	41995	A40B	UNDEFINED	Any
Subject distance range	SubjectDistanceRange	41996	A40C	SHORT	1

42. The scene capture type “indicates the type of scene that was shot” and “can also be used to record the mode in which the image was shot,” as described in the excerpt from the Exif 2.2 specification shown below. For example, the tag value “2” identifies a “portrait” scene and the tag value “3” identifies a “night scene”.

SceneCaptureType

This tag indicates the type of scene that was shot. It can also be used to record the mode in which the image was shot. Note that this differs from the scene type (SceneType) tag.

Tag = 41990 (A406.H)
Type = SHORT
Count = 1
Default = 0
0 = Standard
1 = Landscape
2 = Portrait
3 = Night scene
Other = reserved

43. The subject location tag specified in Exif version 2.2 is used to identify a circle of a specified diameter which is centered at a specific X and Y coordinate location, or a rectangle, having a specified height and width, centered at a specific X and Y coordinate location, as defined in Figures 12 and 13 of the Exif version 2.2 specification, shown below.

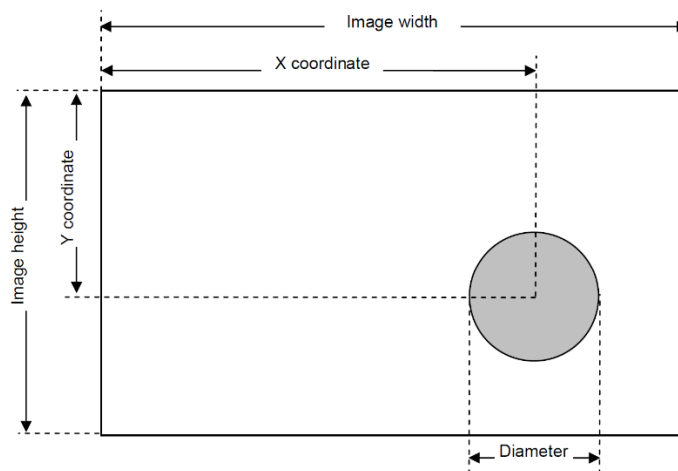


Figure 12 Circular area designation

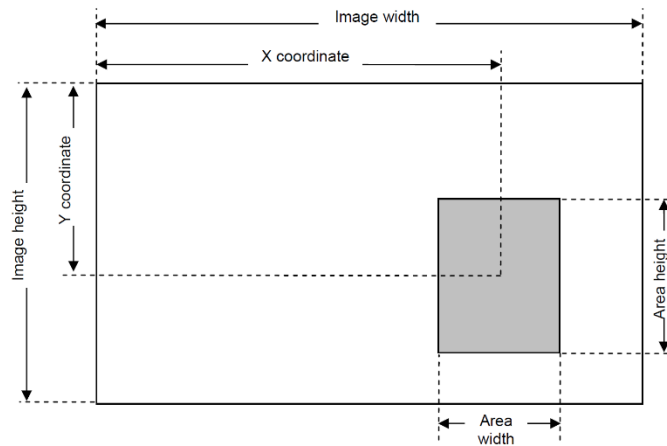


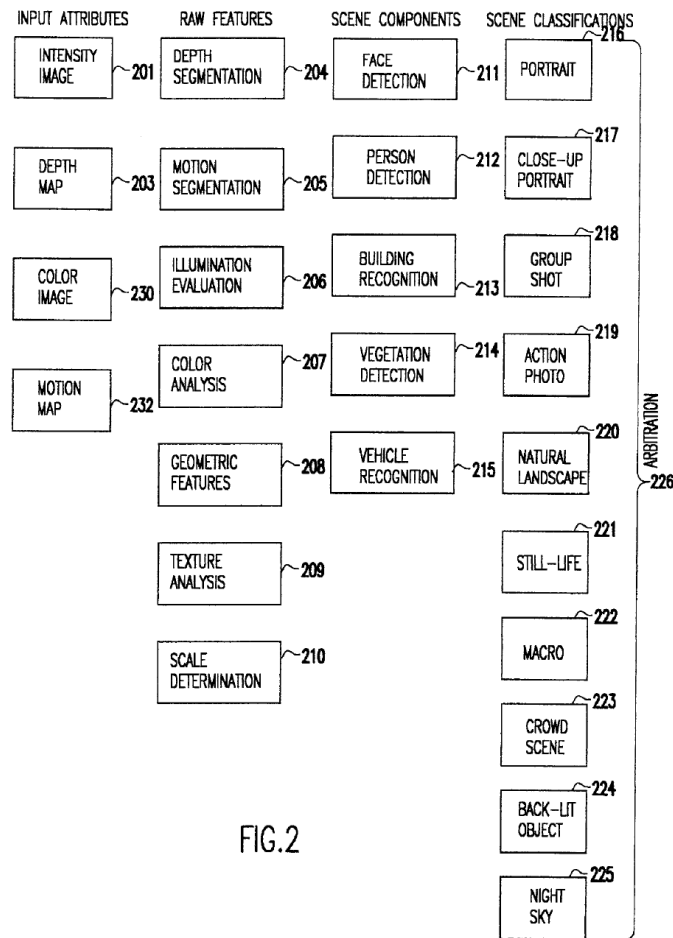
Figure 13 Rectangular area designation

44. 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 scene capture type 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 scene capture type and recognized the location of the main subject in the captured image.

E. Subject determination and face recognition

45. 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. (“Bolle”; Ex. 1010), 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 212, group shot 213, natural landscape 220, crowd scene 223, and night sky 225.



46. 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.

47. 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 scene capture type and subject location metadata tags specified in Exif version 2.2, as described above.

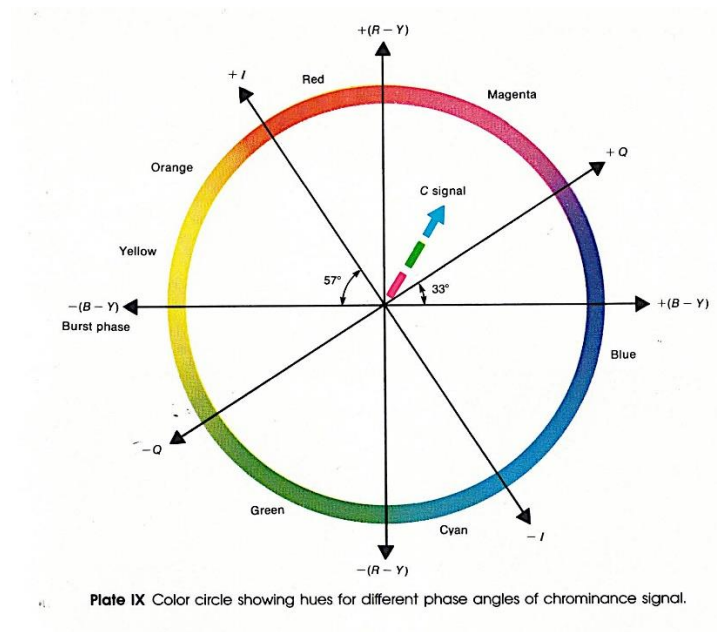
F. Image quality adjustments

48. 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.

49. Color reproduction is an important image quality attribute and relates to how the colors of objects in a scene are depicted in the captured and reproduced images. The colors of objects can be represented using a set of three parameters. In 1905, Albert Munsell published his notation for describing the color of objects. (See “Munsell, A. H., *“A color notation”*, 14th edition, 1981, p. 4). He used the parameters “hue,” “value,” and “chroma” to distinguish colors. Hue is the “name” of the color, such as red, yellow, green, blue, or purple. Value is the “lightness”

(i.e., brightness) of the color, and distinguishes dark colors from light colors, such as a dark red color from a bright red color. Chroma is the “strength” (i.e., saturation or intensity) of the color, and distinguishes vivid colors from those that are nearly grey. (*ibid*, pp. 15-16).

50. Color television systems developed in the 1950s, including NTSC and PAL, used a color subcarrier to transmit the hue and saturation of objects in the image. The high frequency modulated color subcarrier was added to the baseband luminance (i.e., brightness) signal. The color circle, reproduced below, shows the hue versus subcarrier phase for the NTSC color system transmitted in the United States. See Grob, Bernard, “*Basic television and video systems*,” McGraw-Hill, 1984. When the subcarrier level is near zero (i.e., near the center of the circle), the color is muted. As the level increases, the color becomes more saturated (i.e., more vivid).



Grob, plate IX.

51. The color reproduction of both color video systems and photographic systems is influenced by the color balance, which is referred to as the “white balance” in some situations. One important factor which influences the color balance is the type of light which illuminates the scene. Graphs of the relative spectral power distributions for typical tungsten and fluorescent lamps, and for three types of daylight illumination, are depicted in Figures 1.1 and 1.2 below. Giorgianni and Madden, *Digital Color Management*, Addison-Wesley, 1997, p. 562. Note that fluorescent and incandescent lamps were common in the early 2000s, but have been largely replaced by more efficient LEDs. Daylight has relatively equal relative radiant power between 400 and 700 nanometers, while a typical incandescent lamp has much lower power for blue (e.g., 450 nm)

wavelengths than for red (e.g., 600 nm) wavelengths. As a result, a scene photographed using incandescent illumination will have a red tint, unless color balance is performed.

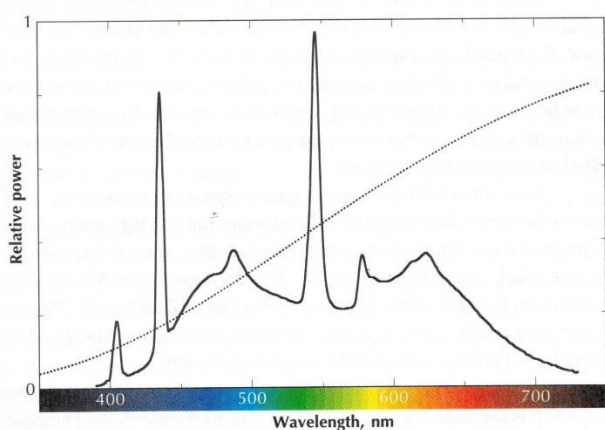


Figure 1.1
Comparison of the relative spectral power distributions for typical tungsten (dotted line) and fluorescent (solid line) light sources. The curves describe the relative power of each source's electromagnetic radiation as a function of wavelength.

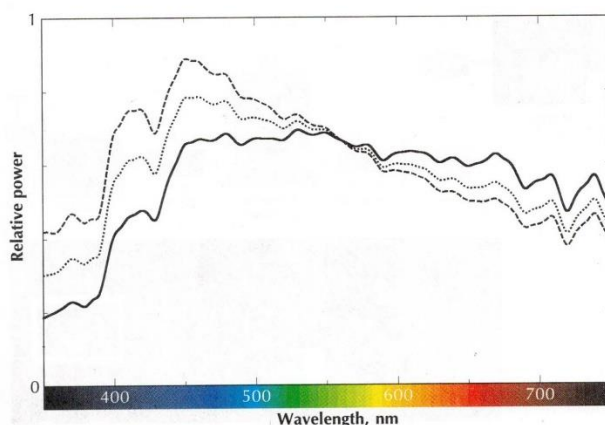


Figure 1.2
Relative spectral power distributions for three of many types of day-light illumination. The spectral characteristics of day-light can vary greatly depending on solar altitude, weather, and atmospheric conditions.

Giorgianni and Madden, p. 562.

52. Historically, the term “color balance” was used in the photographic industry. For example, when daylight balanced film was used under tungsten illumination, the color balance could be corrected by placing a color compensating filter (such as a Kodak Conversion Filter for Color Films) over the lens of the film camera. See “Kodak filters for scientific and technical uses,” 3rd edition, 1980, p.

25. In another example, when producing color prints from color negative film, the color balance could be adjusted by placing the appropriate Kodak Color Printing filters in the enlarger beam to “control the light reaching the three light-sensitive emulsions of the color print material.” *Ibid*, p. 57.

53. By the 1950s, color correction was being used when making prints from color film. For example, U.S. Patent 2,571,697, titled “Method for correcting photographic color prints,” to Evans (“Evans”; Ex. 1017), which issued in 1951, describes “a method for overcoming the defects in images due to incorrect lighting conditions and emulsion sensitivity.” Evans, 1:31-34. The color of the integrated light from the film was measured using red, green, and blue photo-electric cells, and the quantity of the light from these three primary colors needed to make the print substantially gray was calculated. Evans, 2:15-31. The patent also discloses that “it is not always desirable ... to integrate exactly to neutral gray” and that it may be desirable to produce “a hue near gray” rather than “an exact neutral gray.” In other words, rather than performing a “full” color balance correction, it may be desirable to instead perform a “partial” correction.

54. By the 1980s, color video cameras often included an “auto white” balance feature which adjusted the RGB (red, green, and blue) signals of the camera so that equal signals were produced from an illuminated white object. White balance was achieved by momentarily pointing the camera at a white card

illuminated by the light to be used for capturing the scene and pressing an “auto white” button. The red and blue signal amplitudes were then measured and adjusted to match the green signal level from the white card, and the gain factors required for the red and blue channels were stored so that the camera remained color balanced for the particular light source. See Grob, *Basic television and video systems*, 5th edition, 1984, p.61.

55. By the 1990s, various color balance techniques were widely implemented in image processing software. For example, Photoshop 5.0 describes several ways to adjust the color balance of images. (Adobe Photoshop version 5.0 User Guide, 1998. (“Photoshop 5.0), p 131. For example, the “Color Balance” command in Photoshop 5.0 “lets you change the mixture of colors in a color image,” as described below.

To adjust the levels of a particular color in an image:

1 Open the Color Balance dialog box, as described in “Using color adjustment commands” on page 105.

Note: You must be viewing the composite channel to use the Color Balance command. (See “Using the Channels palette” on page 240.)

2 Choose Shadows, Midtones, or Highlights to select the tonal range on which you want to focus the changes.

3 With RGB images, select Preserve Luminosity to prevent changing the luminosity values in the image while changing the color. This option maintains the tonal balance in the image.

4 Drag a triangle toward a color you want to increase in the image; drag a triangle away from a color you want to decrease in the image.

The values above the color bars show the color changes for the red, green, and blue channels. (For Lab images, the values are for the *a* and *b* channels.) Values can range from -100 to +100.

Photoshop 5.0, pp. 131-132.

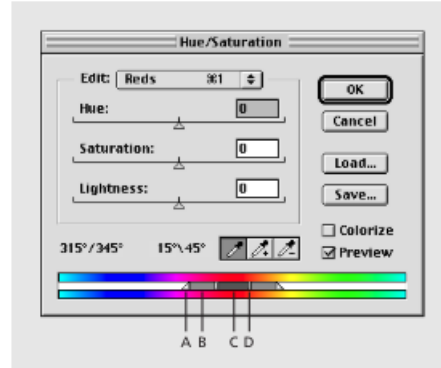
56. In addition, the “Hue/Saturation” tool in Photoshop 5.0 “lets you adjust the hue, saturation, and lightness of individual color components in an image file.” “Adjusting the hue, or color, represents a move around the color wheel. Adjusting the saturation, or purity of the color, represents a move across its radius.” Photoshop 5.0, p. 132. Adjusting the hue changes the color balance of the image, for example by making greenish-looking flesh caused by fluorescent lighting appear more natural.

Expert Declaration of Kenneth Parulski

U.S. Patent No. 7,454,056

To adjust an image using Hue/Saturation:

1 Open the Hue/Saturation dialog box, as described in “Using color adjustment commands” on page 105.



A. Adjusts fall off without affecting range B. Adjusts range without affecting fall off C. Moves entire slider D. Adjusts range of color component

Two color bars are displayed in the dialog box. These bars represent the colors in their order on the color wheel.

The upper color bar shows the color before the adjustment; the lower bar shows how the adjustment affects all of the hues at full saturation.

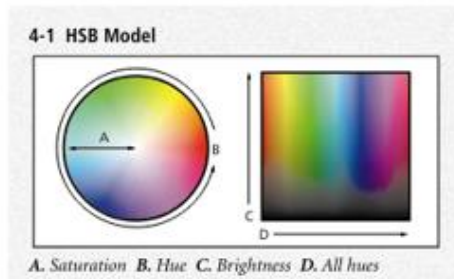
2 Choose which colors to adjust:

- Choose Master from the Edit menu in the dialog box to adjust all colors at once.
- Choose one of the other preset color ranges listed for the color you want to adjust. An adjustment slider appears between the color bars, which you can use to edit any range of hues. (For information on how to modify the slider's range, see the instructions later in this section.)

Using the Hue/Saturation command

The Hue/Saturation command lets you adjust the hue, saturation, and lightness of individual color components in an image. Like the Color Balance command, this command relies on the color wheel. Adjusting the hue, or color, represents a move around the color wheel. Adjusting the saturation, or purity of the color, represents a move across its radius.

 For a color illustration of hue, saturation, and brightness, see figure 4-1 on page 223.



3 For Hue, enter a value or drag the slider until the colors appear as you want.

The values displayed in the text box reflect the number of degrees of rotation around the wheel from the pixel's original color. A positive value indicates clockwise rotation, a negative value counterclockwise rotation. Values can range from -180 to +180.

4 For Saturation, enter a value or drag the slider to the right to increase the saturation, left to decrease it. The color shifts away from or toward the center of the wheel, relative to the beginning color values of the selected pixels. Values can range from -100 to +100.

 For a color illustration of saturation, see figure 6-5 on page 226.

5 For Lightness, enter a value or drag the slider to the right to increase the lightness, left to decrease it. Values can range from -100 to +100.

57. In a digital camera, color balance typically includes adjusting the red, green, and blue signal levels provided by the image sensor in the camera to correct for the color temperature of the light source used to illuminate the scene. This is necessary because the human visual system (*i.e.*, the eye and brain) perceives colors almost the same under a wide range of light sources, due to chromatic adaptation. Therefore, the effective color sensitivity of the image sensor used in the camera must be adjusted to compensate for the light source which illuminates the scene, in order to mimic this chromatic adaptation.

58. The algorithms which perform color balance in a digital camera are often called “white balance” algorithms, since this term had been used for color balance in video cameras, as described earlier. By the early 2000s, many algorithms determined the appropriate color balance settings using image data

from the color sensor which had been averaged into blocks. The number of blocks typically ranged from twenty to several hundred. The average color values for each of the blocks were converted into color difference signals, such as “R-B” and “G-(R+B)/2” as shown in Figure 10 below. The color difference signals were then analyzed to determine which blocks included color values in the same regions of the color difference space as common illuminants, such as daylight, tungsten, and fluorescent illuminants. Once the likely scene illuminant was determined, RGB amplification factors were applied to correct the color balance of the captured images. See Parulski and Spaulding, Chapter 12, “Color image processing for digital cameras” in Digital Color Imaging Handbook, CRC Press, 2003, pp. 743-744.)

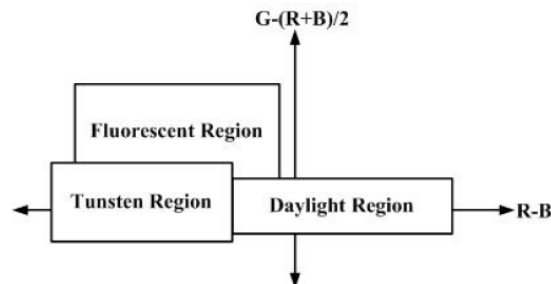
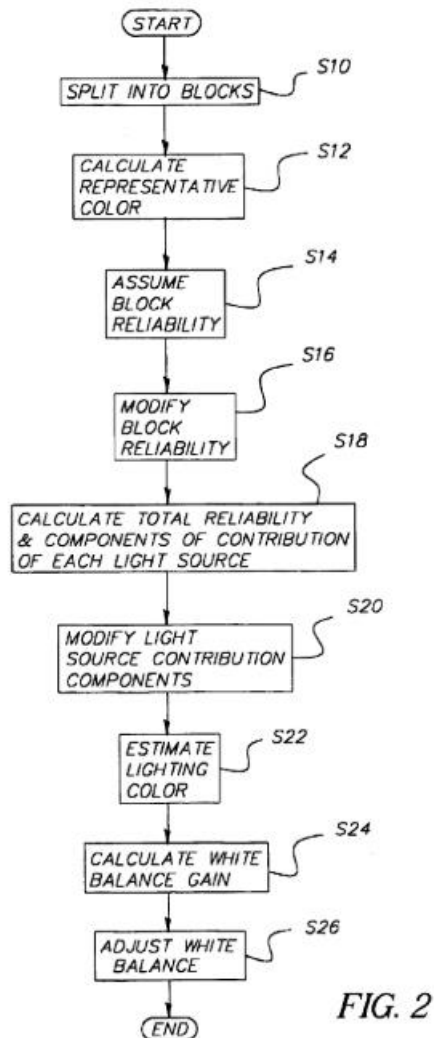


Fig. 10. Color difference space for white balance determination.

59. U.S. Patent 6,791,606, titled “Auto white balancing apparatus and method,” to Miyano (“Miyano”; Ex. 1018), which was filed on May 9, 2000, and issued on September 14, 2004, provides an example of a color balance algorithm used in Kodak digital cameras. As shown in Figure 2 below, the image is split into

blocks in step S10, and each block is averaged in step S12 to calculate a “representative color” value for each block. (Miyano, 3:66-4:33). The “reliability” of each block is determined in steps S14 and S16 by calculating the variance of the pixel values and the number of saturated pixels in each block, as well as the luminance of the block and the distance between the representative color value of the block and the prestored values of four different light sources, which can be daylight, shade-light, tungsten light and fluorescent light. *Ibid*, 4:59-5:33, 6:5-36, 6:61-7: 28. A large variance or many saturated pixels means that the block is less reliable and will have less influence on the color correction. *Ibid*, 8:7-47. A high luminance level means the scene is probably being taken outdoors, while a low level indicates an indoor scene. *Ibid*, 10:12-33. In step S18, the luminance and color difference values of each of the blocks are weighted according to their reliability and averaged. *Ibid*, 9:8-22. In step S20, the “components of contribution of each light source j are weighted and averaged with a standard color ... for each light source j” which was “previously stored in the apparatus.” *Ibid*, 9:28-48. In step 22, white balance gain values are calculated by estimating the “color of a white object under the composite lighting” from the weighted light sources. *Ibid*, 11:33-46. In step 24, white balance gain factors are calculated. Finally, in step S26, a white balance adjusting circuit performs color correction by multiplying the red, green, and blue pixel values of the image by these gain factors. *Ibid*, 11:33-45.



Miyano, FIG. 2

IV. MATERIALS CONSIDERED

60. In forming my opinions, I have analyzed the following exhibits, including the '056 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. 7,454,056 to Hayaishi ("the '056 patent")

Ex. 1002	File History of U.S. Patent No. 7,454,056
Ex. 1005	U.S. Patent Application Publication No. 2004/0021779 to Yano (“Yano”)
Ex. 1006	U.S. Patent No. 6,898,312 to Schröder (“Schroder”)
Ex. 1007	U.S. Patent No. 7,440,593 to Steinberg et al. (“Steinberg”)
Ex. 1008	U.S. Patent Application Publication No. 2003/0043394 to Kuwata et al. (“Kuwata”)
Ex. 1009	U.S. Patent No. 5,557,688 to Nakamura (“Nakamura”)
Ex. 1010	U.S. Patent No. 6,301,440 to Bolle (“Bolle”)
Ex. 1011	U.S. Patent Application Publication No. 2004/0208363 to Berge et al. (“Berge”)
Ex. 1012	Certified English Translation of Japanese Patent Publication No. JP2003-248825 to Hibi et al. (“Hibi”)
Ex. 1013	Japanese Patent Publication No. JP2003-248825 to Hibi et al.
Ex. 1014	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. 1015	Adobe Photoshop version 5.0 User Guide (1998) (“Photoshop 5.0”)
Ex. 1016	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. 1017	U.S. Patent No. 2,571,697 to Evans (“Evans”)
Ex. 1018	U.S. Patent No. 6,791,606 to Miyano (“Miyano”)
Ex. 1019	European Patent Application EP1400923A2 to Hayaishi et al. (“Hayaishi”)

Ex. 1020	William K. Pratt, <i>Digital Image Processing</i> , pp. 318-27 (John Wiley & Sons, Inc. 1978) (“Pratt”)
Ex. 1021	European Patent Application EP0152434B1 to Bayer (“Bayer”)

61. Exhibit 1014 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.

62. Exhibit 1015 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.

63. Exhibit 1016 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.

64. Exhibit 1020 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 image processing course taught by Professor William Schreiber at MIT in 1978.

65. 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

66. 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

67. I have been instructed that the terms appearing in the '056 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 March 30, 2004. 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 '056 patent and forming the opinions set forth in this declaration.

B. Level of Ordinary Skill

68. 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.

69. 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 claim requires the determination of a specific subject area in an acquired image, the calculation of a specific subject characteristic value, the calculation of a correction value for color balance correction using the specific subject characteristic value, and the execution of color balance correction on the acquired image using the calculated correction value. This was the framework for many well-known prior art techniques for executing color balance correction based on the subject matter in an image, and a POSITA as described above would have been familiar with these techniques. Indeed, the specification assumes a level of knowledge that is consistent with someone having the education and experience

described above. For example, when describing a “face area determination,” the specification states that “CPU 200 analyzes the image data corresponding to the image section which is the target of processing, and judges whether preset judging standards are met, and whether the subject within the image section is the face part of a human subject.” Ex. 1001, 6:47-56. The specification does not describe, for example, how the CPU determines that an image section belongs to part of a human face. A POSITA as defined above would have been aware of the various techniques for making that determination, including several that are described in prior art references discussed below. Moreover, workers in this field commonly had a bachelor’s degree or equivalent in electrical engineering, computer science, or a related field.

70. I was at least a POSITA as of March 30, 2004, and supervised others who were at least a POSITA.

C. Obviousness

71. 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.

72. 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).

73. 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 March 30, 2004.

74. 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.

75. 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.

76. 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.

77. 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.

78. 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. BACKGROUND

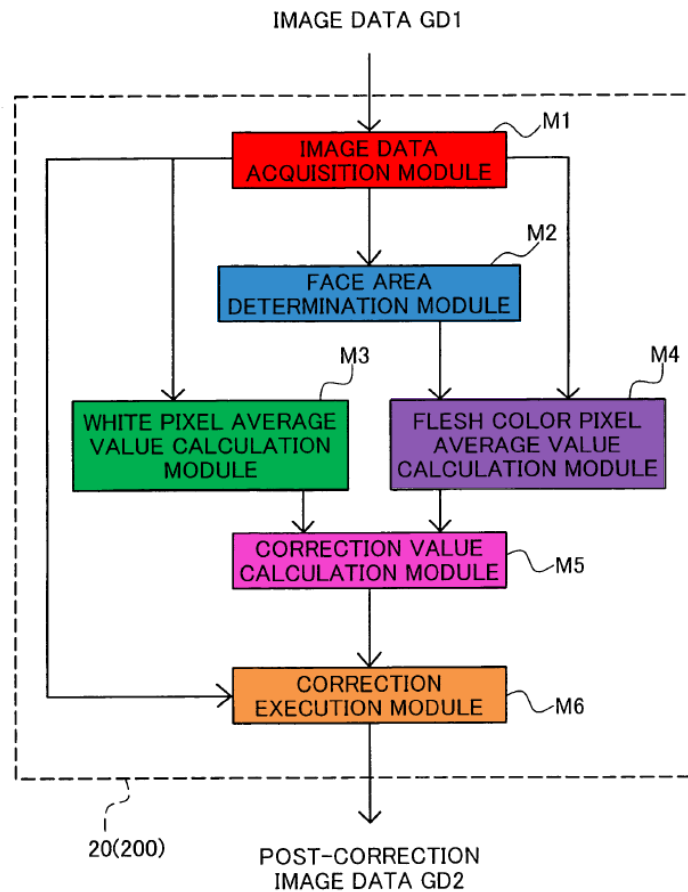
A. The '056 Patent

79. The '056 patent relates to “color balance correction on image data.” Ex. 1001, 1:8-10. The '056 patent states that color balance correction “correct[s] changes in color according to the type of light source during imaging.” Ex. 1001, 1:12-15. One known color balance correction method “correct[s] each color component so that the average color of the overall image becomes colorless (white

or gray).” Ex. 1001, 1:15-19. According to the ’056 patent, performing this known method on a human portrait can risk “making an undesirable change to the color tone of a specific subject.” Ex. 1001, 1:25-33. The ’056 patent aims to “execute color balance correction according to the subject and to improve the appearance of the subject in an image.” Ex. 1001, 1:38-42.

80. Figure 2, reproduced below, discloses a block diagram of an image processing device, such as a personal computer. Ex. 1001, 4:3-7, 5:19-23.

Fig.2



Ex. 1001, FIG. 2 (annotated). As depicted, an image data acquisition module M1 acquires image data GD1 for processing and sends the image data to a face area determination module M2, a white pixel average value calculation module M3, a flesh color pixel average value calculation module M4, and a correction execution module M6. Ex. 1001, 5:24-32.¹ The face area determination module M2 “determines an area containing the face part of a human subject as the subject” and “sends the face area determination results to the flesh color pixel average value calculation module M4.” Ex. 1001, 5:33-38.

81. By analyzing the image data corresponding to the determined face area, the flesh color pixel average value calculation module M4 “calculates the flesh color pixel average value” and sends this average value to a correction value calculation module M5. Ex. 1001, 5:44-52. Similarly, by analyzing the image data GD1, the white pixel average value calculation module M3 “calculates the white pixel average value” and sends this average value to the correction value calculating module M5. Ex. 1001, 5:39-43. Based on either the white pixel average

¹ In the claims, the specific subject area determination module corresponds to the face area determination module M2, and the specific subject characteristic value calculation module corresponds to the flesh color pixel average value calculation module M4. Ex. 1001, 6:4-9.

value and “a preset white pixel target value” or the flesh color pixel average value and “a preset flesh color pixel average value,” the **correction value calculation module M5** calculates “a correction value for color balance correction” and sends this correction value to the **correction execution module M6**. Ex. 1001, 5:53-62.

The **correction value calculation module M5** calculates a flesh correction value if, for example, the proportion of the face area in the image data is greater than a certain threshold, such as 15/256 of the total image area. Ex. 1001, 7:33-46, 7:52-8:3. Using the image data GD1 and this correction value, “the **correction execution module M6** executes color balance correction on the overall image data GD1, and generates post-correction image data GD2.” Ex. 1001, 5:63-6:3.

B. Prosecution History

82. The '056 patent was filed as U.S. Application No. 11/093,941 (“’941 Application”) by Seiko Epson. Ex. 1001, cover (codes (21), (73)). The Examiner initially rejected certain claims as anticipated by U.S. Patent Application Publication No. 2003/0235333 (“Lin”) and/or U.S. Patent Application Publication No. 2004/0208363 (“Berge”; Ex. 1011). Ex. 1002, 203-206. The rest were objected to as being dependent upon a rejected base claim but would be allowable if rewritten in independent form. *Id.*, 206. Applicant then revised the independent claims to include features from one of the objected-to dependent claims. *Id.*, 215-225. The Examiner then issued a notice of allowance. *Id.*, 235.

VII. CLAIM CONSTRUCTION

83. 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.

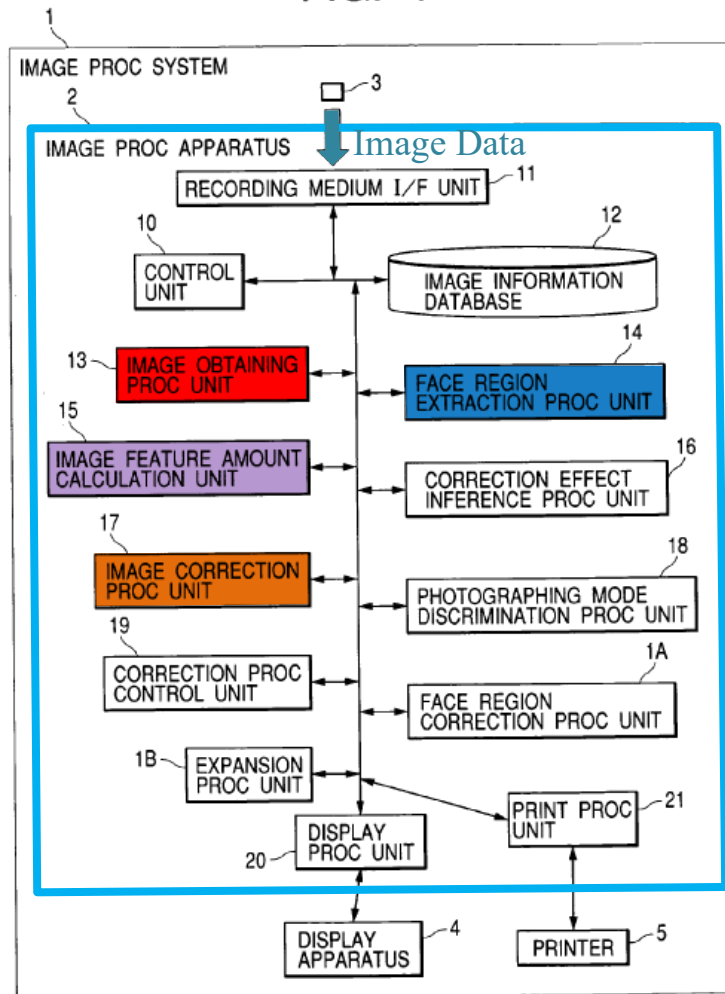
VIII. ANALYSIS OF PETITION GROUNDS

A. Overview of the Asserted References

1. Overview of Yano (Ex. 1005)

84. Yano, like the '056 patent, discloses “using an image processing apparatus which displays and prints a person image photographed (or shot) by a digital camera” to automatically perform “color correction” to correct “the face region of the person to generate the image of an appropriate flesh color that human beings feel desirable.” Yano, [0007], [0054], [0060]-[0063]. Figure 1, below, depicts “a block diagram showing the functional structure” of one embodiment of an [image processing apparatus](#). *Id.*, [0017].

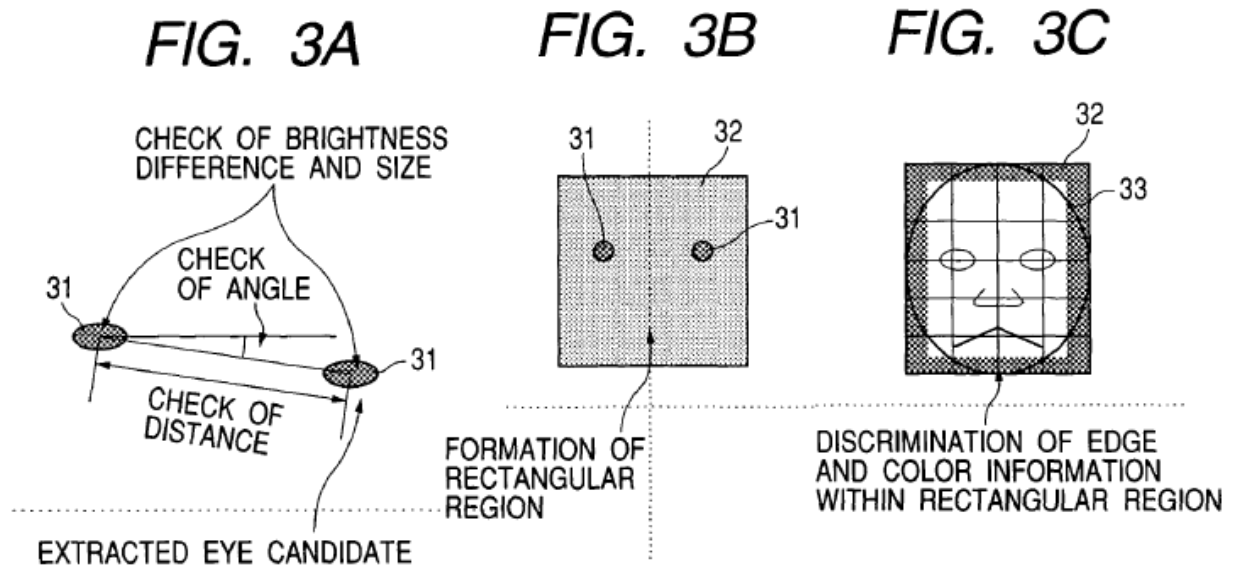
FIG. 1



Id., FIG. 1 (annotated).

85. In the image processing apparatus depicted above, an image obtaining processing unit 13 “obtains through the recording medium I/F unit 11 the image data” and related photographing information “from the recording medium 3.” Yano, [0024]. A face region extraction processing unit 14 “extracts the face region of the person from the image data obtained by the image obtaining processing unit

13.” *Id.* Portions of a process for extracting face region 33 from the image data are shown in Figures 3A-3C, below. *Id.*, [0032]-[0034].



Id., FIGS. 3A-3C.

86. An **image feature amount calculation unit 15** then calculates a “feature amount” of the extracted face region 33. *Id.*, [0025]. This feature amount includes, for example, “the lightness and hue histograms in regard to each pixel, the average value, the distribution value, and the total number of pixels included in the face region 33.” *Id.*, [0057].

87. If the **image processing apparatus** determines that the face region 33 is of a sufficient size and that a correction effect can be obtained, an “**image correction processing unit 17** obtains the parameters for the color correction from the image feature amount of the face region 33, and then actually performs” an image correction process. *Id.*, [0060]. This process includes obtaining the “center

value and distribution value” of “a range of hue of the flesh color that human beings feel desirable” that are “stored in the **image correction processing unit 17**” and using them to obtain corrected pixel values for “each pixel” in the image. *Id.*, [0060]-[0063].

2. Overview of Schroder (Ex. 1006)

88. Schroder, like the '056 patent, discloses a “method for correcting the colors of photographic images represented by image data.” Schroder, Abstract, 1:8-18. Like the '056 patent, Schroder discloses that various factors, including “the spectrum of the illumination light (e.g. tungsten light, flash light, sun light),” can lead to “deviations in color” that “affect the photographic image data such that the image displayed to the user deviates from the optical appearance of the photographic object to a human being at the time the picture has been taken.” *Id.*, 1:34-64. Schroder discloses that “memory colors” like skin color “represent characteristic colors for photographic images and may be used as a reference for color correction.” *Id.*, 1:65-2:22.

89. Schroder discloses that one or more spatial sections of an image are selected as a “reference part.” *Id.*, 3:53-65. This can be done either manually via a user interface or automatically via analysis of “the color values and/or their spatial distribution in the image in order to detect regions related to reference colors.” *Id.*, 6:36-55. A reference color is then assigned to the selected reference part. *Id.*, 4:8-

11. For example, Schroder discloses that “skin regions can be automatically detected using a structural face detector or using other methods and ... a skin color will be assigned to the detected skin regions.” *Id.*, 17:30-33.

90. Schroder discloses manipulating “the image data for correction purposes” such that “the color value or color values present in the one or more selected parts” transform to match a color distribution associated with the reference color. *Id.*, 4:12-23. The transformation is determined using a “color value of the reference part” calculated from “the color values of the pixels in the reference part” and the reference color, “which corresponds to the target color value of the reference part.” *Id.*, 10:40-11:11. Schroder discloses that “not only the selected parts are transformed in order to achieve a corrected image but also the remaining (unselected) parts of the image are corrected in the same or corresponding way as the selected parts are corrected.” *Id.*, 4:36-46.

3. Overview of Steinberg (Ex. 1007)

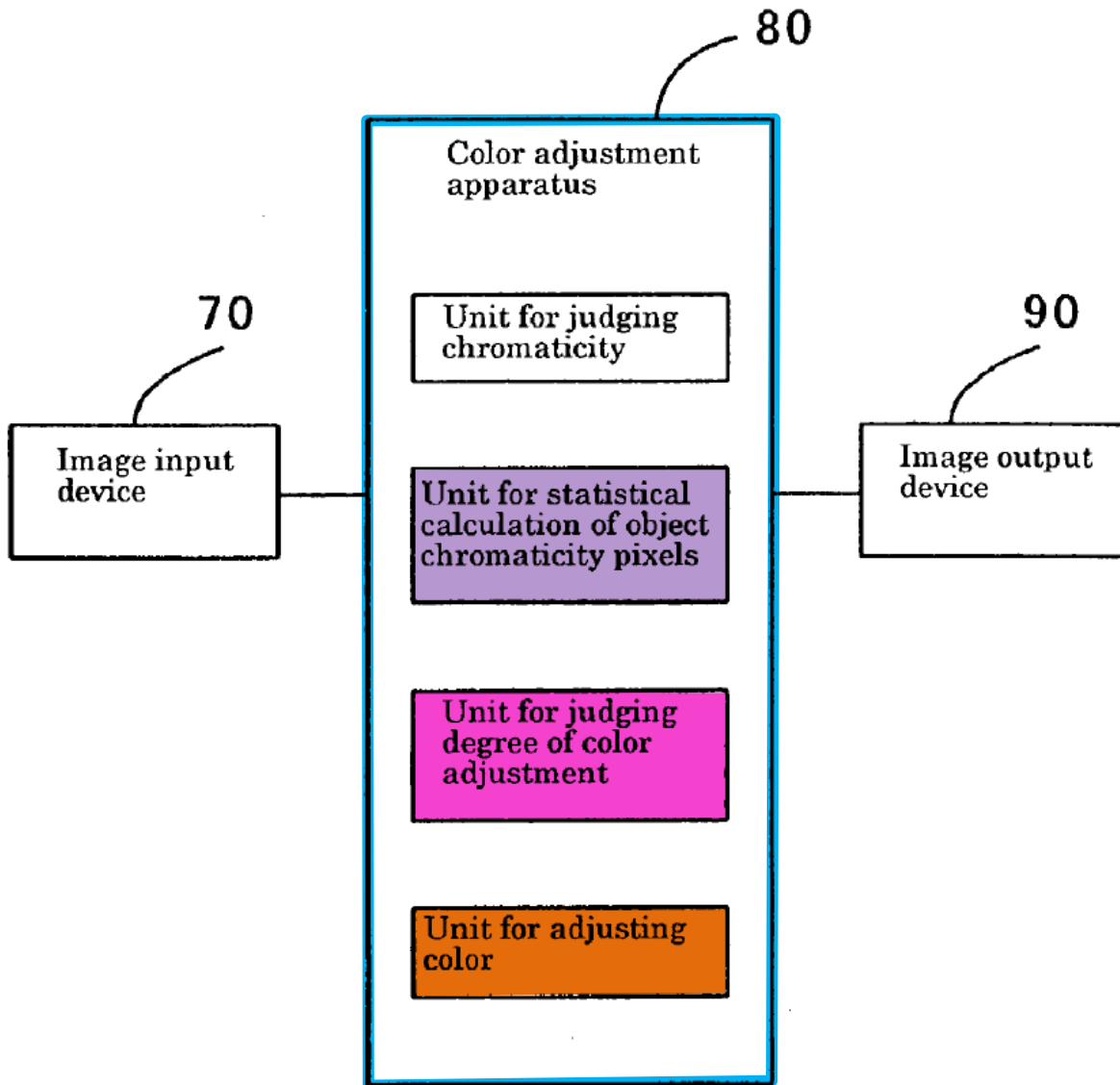
91. Steinberg discloses a “way to color-correct the image based on the skin tones of the faces” that can be “part of an image enhancement software.” Steinberg, 17:1-6. These color corrections “may be global, affecting the entire image.” *Id.*, 17:6-13.

92. Steinberg discloses that a device such as a PC loads a “default set of image attributes” related to “the overall color balance” and downloads an image to

the device. *Id.*, 18:42-46. The device then applies “a face detection process” to the downloaded image “to seek faces in the image.” *Id.*, 18:46-49. “When faces are detected, ... they are marked, and labeled.” *Id.*, 18:56-57. Each of the detected faces “is given a weight based on size of the faces” that “define[s] the importance of the face in relation to other faces detected.” *Id.*, 18:58-63, 12:9-19. “After the faces are correctly isolated,” the device compares their attributes to the default set of image attributes and determines “a potential transformation” that will cause the values to match. *Id.*, 19:8-12.

4. Overview of Kuwata (Ex. 1008)

93. Kuwata, a patent publication originally assigned to Seiko Epson that was not disclosed during the prosecution of the '056 patent by Seiko Epson, discloses a color adjustment device that “is capable of minimizing an adverse side effect in adjustment of an image data.” Kuwata, [0002]. [0006]. Kuwata’s **color adjustment apparatus**, depicted below in Figure 25, automatically sets “a degree of enhancement” according to “a ratio of the number of flesh color pixels to the total number of pixels.” *Id.*, [0221]-[0235].



Id., FIG. 25 (annotated).

94. The unit for statistical calculation of object chromaticity pixels performs “statistical calculation ... on flesh-color-like pixels according to chromaticity of each pixel” to calculate “an average value” of the flesh-color-like pixels. *Id.*, [0223]-[0228]. The apparatus includes “an ideal value” that is “predefined for preferable flesh color” for use in the color adjustment. *Id.*, [0230]-

[0231]. But Kuwata discloses that, if the apparatus applies a difference between the average value and the ideal value without factoring in the ratio of the flesh color pixels to the total number of pixels in the image, “a flesh color part may become satisfactory but colors of pixels on any parts other than the flesh color part may be affected significantly.” *Id.*, [0231]-[0232]. To address this issue, the **unit for judgment degree of color adjustment** determines “a ratio of the number of flesh color pixels to the total number of pixels (flesh color ratio) ... for regulating a degree of color adjustment.” *Id.*, [0233]. It then determines a degree of adjustment by taking the difference between the average value and the ideal value and multiplying the result by the flesh color ratio. *Id.*, [0233]-[0234], [0238]. The **unit for adjusting color** then carries out color adjustment using the degree of adjustment. *Id.*, [0238].

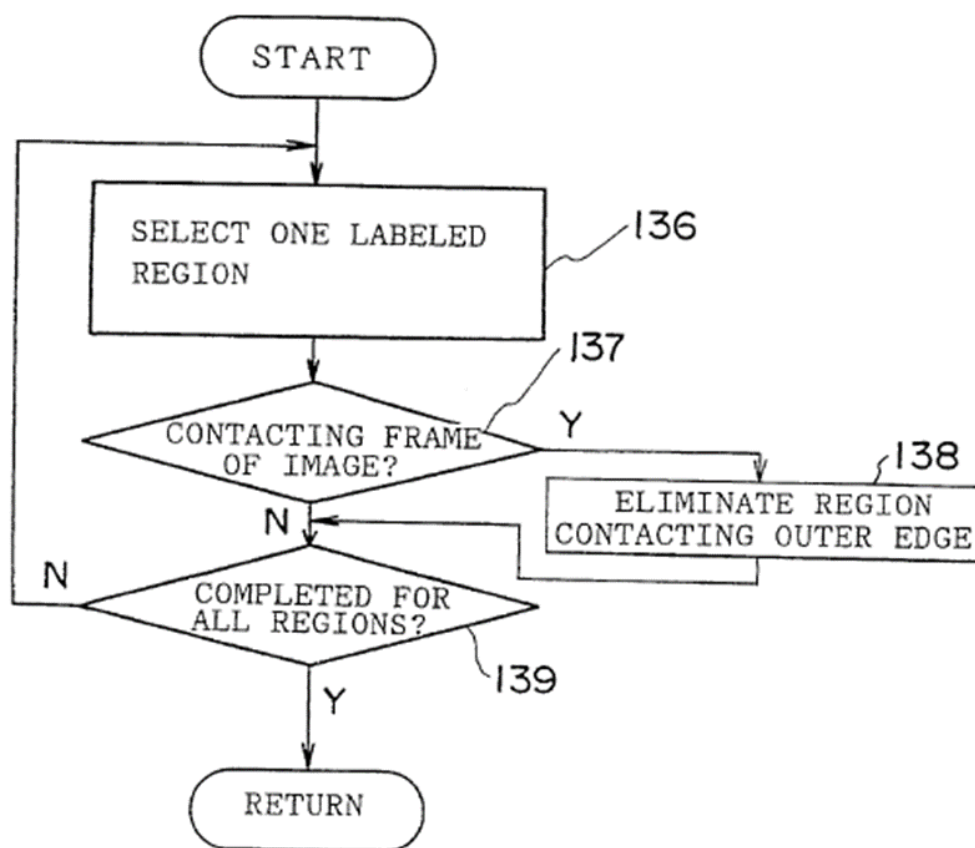
5. Overview of Nakamura (Ex. 1009)

95. Nakamura, similar to Yano’s face-region extraction, discloses a method of “extracting regions likely to be face regions” within an image. Nakamura, Abstract. Nakamura discloses that, “[w]hen a photograph of a person is viewed, the area which is most noticed is the person’s face,” making it “necessary to print the color ... of a human face at an appropriate color.” *Id.*, 1:24-28. Nakamura discloses that determining face regions based on color alone may produce errors because objects like “the ground, tree trunks, clothes, and the like”

may exhibit “a color which is similar to a flesh color.” *Id.*, 1:59-64. Additionally, “the color of the light source which illuminates the subject” can affect “the hue of the photographed image.” *Id.*, 2:2-8.

96. To automatically extract human face data “with high accuracy” from a color image, Nakamura discloses dividing the image into “color regions having the same or similar hue values,” excluding any “color regions which contact an outer edge of the color original image,” determining “whether the divided region is a human face,” and extracting regions determined to be a human face. *Id.*, 3:27-60. Because faces “usually exist[] at a central area of the original image,” any color regions “contacting the outer edge (frame of the image) of the original image are usually not characteristic images and are portions of the background or the like.” *Id.*, 4:2-12, 10:58-64. Nakamura discloses that excluding these color regions allows face regions to be extracted based on the hue value “even from images in which faces, the ground, trees, and the like are included.” *Id.*, 4:2-12, 4:41-58, 9:7-18. Figure 6, below, depicts a flow chart showing Nakamura’s elimination of color regions contacting the outer edge from consideration. *Id.*, 10:54-56, 10:64-11:9, FIG. 6.

FIG. 6



Id., FIG. 6.

6. Yano, Schroder, Steinberg, Kuwata, and Nakamura Are Analogous Art

97. Yano, Schroder, Steinberg, Kuwata, and Nakamura are analogous art to the '056 patent because they are in the same field of endeavor, namely, image processing. Ex. 1001, 1:8-10 ("The present invention relates to image processing."). For example, Yano discloses "an image processing apparatus which corrects gradation and color reproduction characteristics of an image." Yano,

[0002]. Schroder discloses “a photographic image processing device” that performs “a color correction method” on images. Schroder, 1:8-18. Steinberg “relates to digital image processing,” including “processing of enhancements of a digital image using information gained from identifying and analyzing faces appearing within the image.” Steinberg, 1:45-48. Kuwata “relates to an image processing apparatus” and a “color adjustment device ... for carrying out optimum color adjustment.” Kuwata, [0002]. And Nakamura “relates to a method of extracting characteristic image data,” such as extracting a human face from an image. Nakamura, 1:11-16, 3:27-31.

98. Yano, Schroder, Steinberg, Kuwata, and Nakamura are also analogous art to the '056 patent because they are reasonably pertinent to one or more problems that the '056 patent purports to solve. For example, Yano, Schroder, Steinberg, Kuwata, and Nakamura are each reasonably pertinent to the problem the '056 patent identifies regarding the application of “typical color balance correction method[s]” that adjust the image to become “colorless (white or gray)” when a person is “the main subject.” Ex. 1001, 1:12-33. For example, Yano discloses a color balance method that “correct[s] the face region of the person to generate the image of an appropriate flesh color that human beings feel desirable.” Yano, [0054]-[0063]. Schroder similarly discloses using “memory colors” like “skin tone” “as a reference for color correction” that is applied to “all image data.”

Schroder, 1:65-2:22, 4:8-46. Steinberg similarly discloses a “way to color-correct the image based on the skin tones of the faces.” Steinberg, 17:1-2. Kuwata similarly discloses adjusting color image data so that “natural flesh color is given” in “a flesh color image of a person’s face.” Kuwata, [0061], [0221]-[0237].

Nakamura is reasonably pertinent to this problem because it discloses techniques for extracting a face region in an image, which is pertinent to accurately determining face regions for use in the color correction described in references like Yano, Schroder, Steinberg, and Kuwata, and in the ’056 patent. Nakamura, 3:40-60, 4:41-57, 8:40-9:21, 10:54-11:43, FIG. 2.

B. Ground 1: Yano and Schroder Render Obvious Claims 1, 3-7, and 11

1. Independent Claim 1

- a. [1.pre]: “An image processing device for executing color balance correction on image data of a photographed image, said image processing device comprising:”**

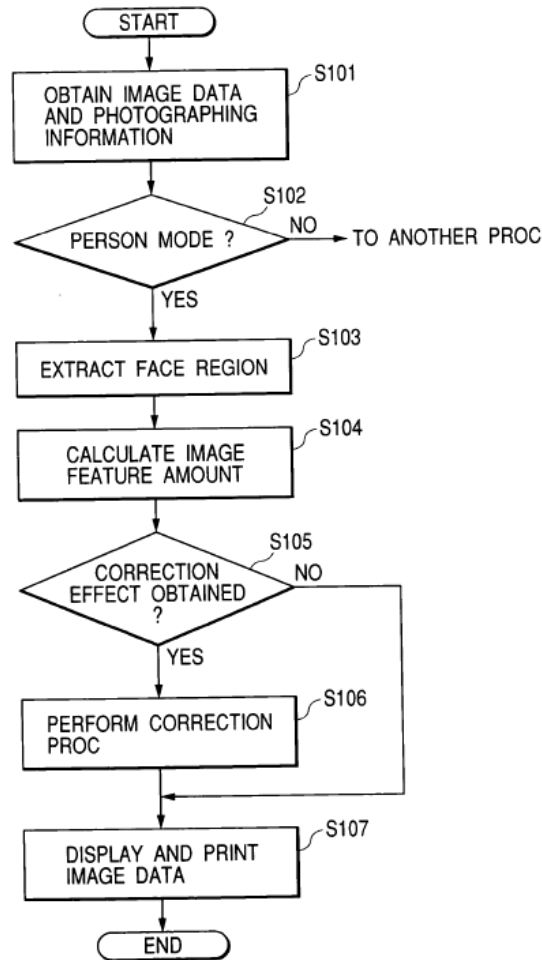
99. If limiting, Yano discloses or suggests [1.pre].

100. Yano discloses “an image processing apparatus such as a PC” (“*image processing device*”) that executes color balance correction by executing “color correction” on “the entire image” so that a “face region” of a person within the image includes “an appropriate flesh color that human beings feel desirable.”

Yano, [0015], [0054]-[0063]. The color balance correction is executed on “image

data photographed (or shot) by a digital camera and recorded on a recording medium” (“*image data of a photographed image*”). Yano, [0015]. Figure 4, below, depicts steps of the color balance correction. Yano, [0013], [0054], FIG. 4.

FIG. 4



Yano, FIG. 4.

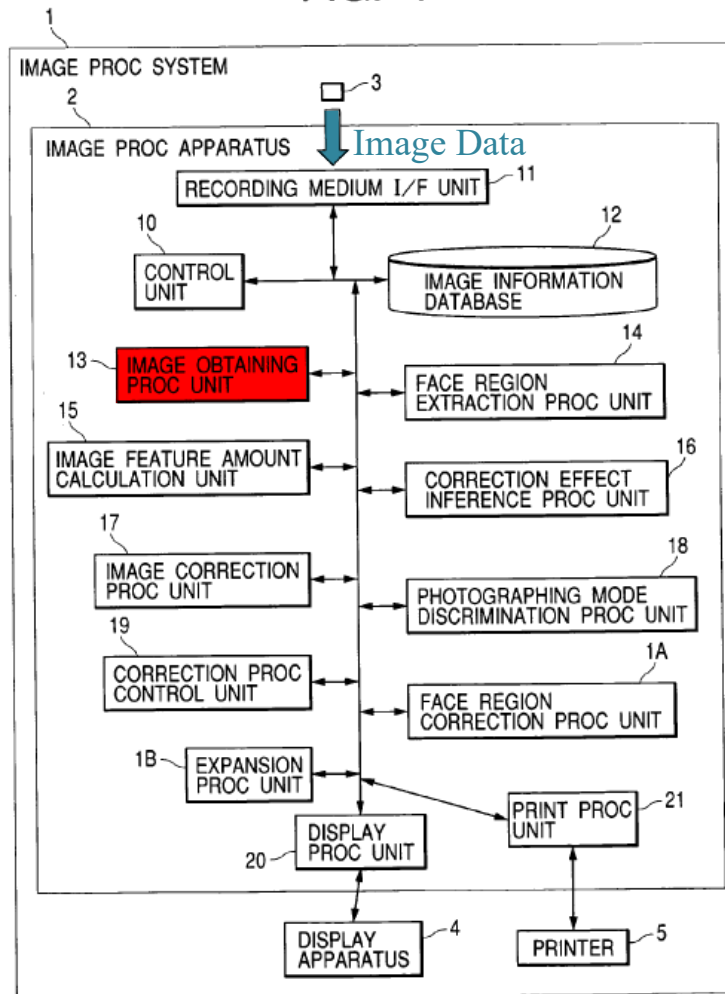
101. Yano’s color balance correction is the same color balance correction disclosed in the ’056 patent, as both disclose executing the correction according to

the hue of the specific subject. Ex. 1001, 2:29-33; Yano, [0054]-[0057], [0060]-[0063].

b. [1.a]: “an image data acquisition module that acquires said image data;”

102. Yano discloses or suggests [1.a] because it discloses that the image processing apparatus “reads image data from a recording medium 3 on which the image data photographed by a digital camera has been recorded.” Yano, [0017]-[0018]. For example, as depicted below, Yano discloses that the image processing apparatus includes an **image obtaining processing unit 13** (“*image data acquisition module*”) that “obtains through the recording medium I/F unit 11 the **image data** ... from the recording medium 3 on which the **image data** indicating the image including the person has been recorded.” Yano, [0021], [0024], [0038]. This **image data** is then stored in image information database 12. Yano, [0024].

FIG. 1



Yano, FIG. 1 (annotated).

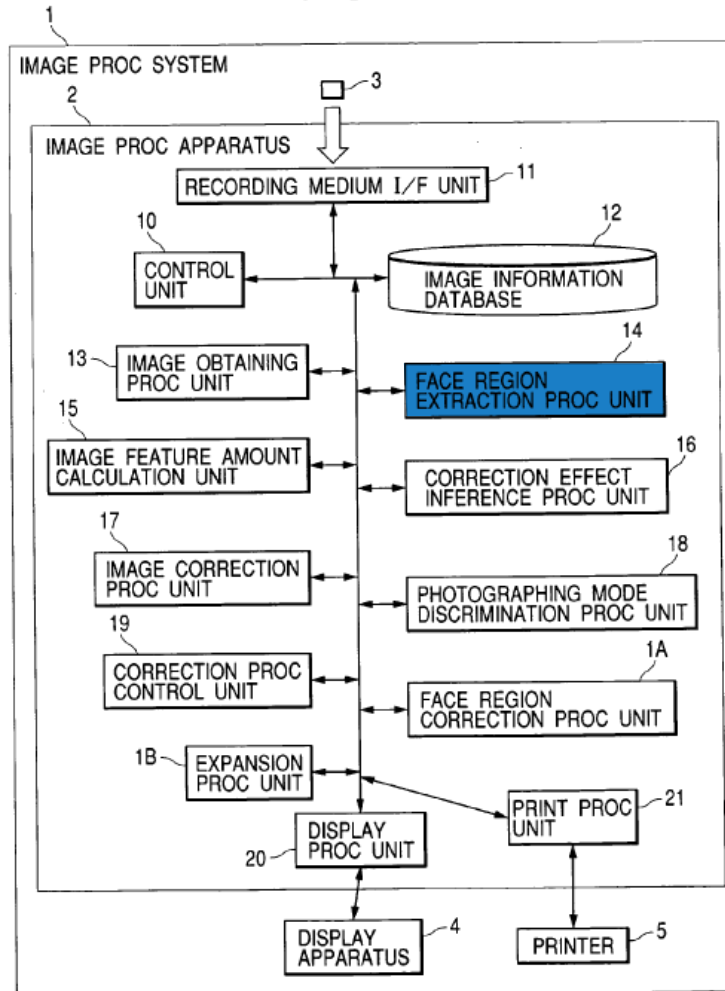
- c. [1.b]: “a specific subject area determination module that determines a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”

103. Yano discloses or suggests [1.b].

104. Yano discloses that the image processing apparatus includes a [face region extraction processing unit 14](#) (“specific subject area determination

module”) that “extracts the face region of the person” (“*determines a specific subject area*”) “from the image data obtained by the image obtaining processing unit 13” (“*in said photographed image*”). Yano, [0024].

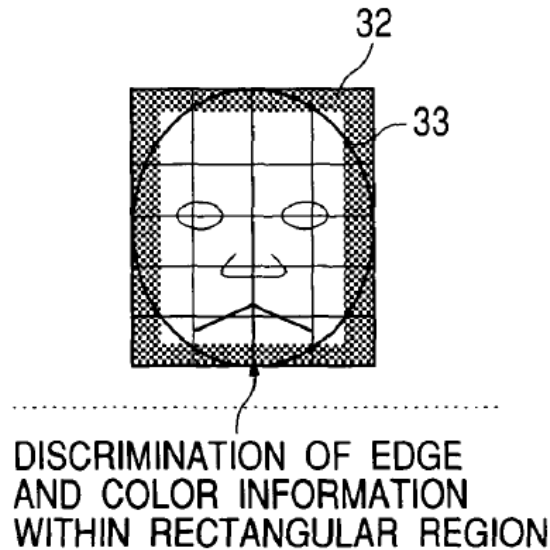
FIG. 1



Yano, FIG. 1 (annotated).

105. Each face region 33, one of which is depicted in Figure 3C, contains the face (“*specific subject*”) of “the person (subject)” in the photographed image. Yano, [0016], [0032]-[0034], FIG. 3C.

FIG. 3C



Yano, FIG. 3C.

106. Yano describes an exemplary face-region extraction, where the [face region extraction processing unit 14](#) identifies “a pair of eye candidates,” “sets a rectangular region 32” based on the positions of the eye candidates, and “determines a face region 33 based on the edge in the vicinity of the boundary of the rectangular region 32 and color information within the rectangular region.”

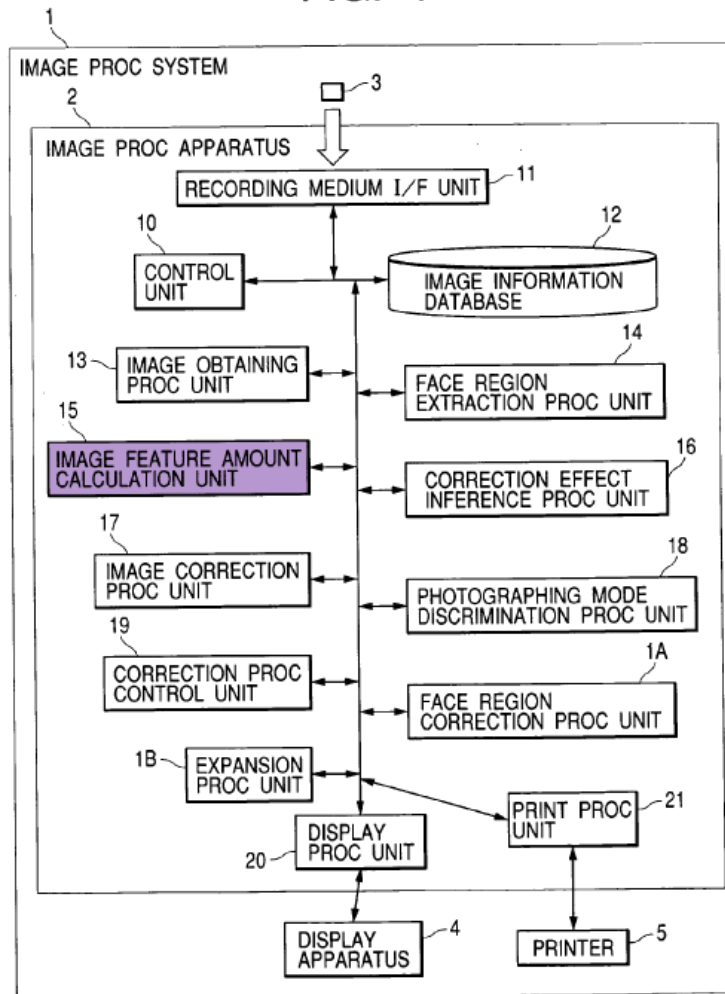
Yano, [0032]-[0034].

- d. **[1.c]: “a specific subject characteristic value calculation module that calculates a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area,”**

107. Yano discloses or suggests [1.c].

108. Yano discloses that the image processing apparatus includes an **image feature amount calculation unit 15** (“*specific subject characteristic value calculation module*”) that “calculates an image feature amount” (“*calculates a specific subject characteristic value*” that “*represents a characteristic of image data*”) “of the face region extracted from the image data by the face region extraction processing unit 14” (“*corresponding to said determined specific subject area*”). Yano, [0025]. For example, the **image feature amount calculation unit 15** calculates a “statistics value” (e.g., average hue value) of pixels within the face region. Yano, [0055]-[0057], [0061].

FIG. 1



Yano, FIG. 1 (annotated).

- e. [1.d]: “wherein said specific subject characteristic value calculation is executed using weighted distribution, and wherein said weighted distribution is set so as to be a weight in a center area of said specific subject area larger than a weight in an area outside said center area;”

109. Yano and Schroder render obvious [1.d].

110. Yano discloses several examples of a “statistics value” of the pixels within the face region, including their average hue value. Yano, [0055]-[0057],

[0061]. A POSITA would have found it obvious to calculate the average hue value using a weighted distribution that weights pixel values in a center area of the face region larger than pixel values in an area outside the center area, as disclosed in Schroder.

111. Schroder, like Yano, discloses an “automatic color correction” process that automatically detects, for example, “skin regions ... using a structural face detector.” Schroder, 17:11-33. Schroder usually refers to these regions as “reference parts” but in several instances uses the term “relevance parts” and states that a “relevance part” “is herein also called [a] ‘reference part.’”² Schroder, 3:53-65, 6:46-55, 9:30-36, 10:40-60, 17:17-22, 17:27-33. Based on a “characteristic color value” of the reference part and a “reference color” (e.g., “the color of skin”), Schroder’s process then determines a “transformation” that “represents a manipulation of the image data for correction purposes” and transforms “the color values of the image data” “[b]ased on the determined transformation.” Schroder, 4:12-49, 7:9-13, 10:35-11:11.

112. Similar to Yano’s “average hue of the flesh color in the face region,” Schroder discloses determining the color value of the reference part using “a

² Moving forward, I will use “reference part” for consistency and will modify any quotes using the term “relevance part” accordingly.

function of the color values of the pixels in the [reference] part.” Yano, [0061]; Schroder, 10:47-60. This function may calculate a characteristic color value (*“specific subject characteristic value”*) of the reference part using a weighted distribution by calculating a weighted average value that weights “the color values in the center of the [reference] part ... more ... than the color values of the pixels in the periphery of the reference part” (*“said weighted distribution is set so as to be a weight in a center area of said specific subject area larger than a weight in an area outside said center area”*). Schroder, 10:47-60, 10:63-11:6.

113. A POSITA would have been motivated to use Schroder’s function that weights color pixel values in the center of a reference part more than in its periphery to determine Yano’s average hue value of the flesh color in the face region because doing so would have placed greater emphasis on the hue values of pixels in the center of the face region, where viewers of the image are more likely to focus. Indeed, it was well known to calculate a weighted average value of an image region “using a weight distribution that assigns greater weight to areas intended to have” the proper value. European Patent Application EP1400923A2 (“Hayaishi”; Ex. 1019), [0110]. A POSITA would have seen the use of Schroder’s function to calculate Yano’s average hue value as the use of a known technique to improve Yano’s color balance correction in the same way as Schroder because it would have ensured that, when carrying out Yano’s color balance correction, the

hue values in the center of the face region are the closest to the “appropriate flesh color that human beings feel desirable.” Yano, [0054], [0060]-[0063].

114. Moreover, it was well known that determining a skin color of a face region for use in a color balance process “may be implemented in a wide variety of ways” and that ways of reducing the impact of “the transitions between the edge of the face region(s)” and adjacent features in the image were advantageous. Berge, [0021], [0034]-[0037]. A POSITA would have seen Schroder’s function as advantageous because it would have reduced the impact of pixels at the “periphery” of Yano’s face region, where head hair, facial hair, head coverings, scarfs, and other clothing were known to potentially impact the hue of pixels at the edge of the face region. Schroder, 10:51-56.

115. A POSITA would have had a reasonable expectation of success in using Schroder’s function to determine Yano’s average hue value because it would have required a POSITA to apply only conventional techniques (well-known mathematical calculations) on the hue values of pixels within Yano’s face region to predictably yield a weighted average hue value that weights hue values in the center of Yano’s face region more than hue values in its periphery. Yano already discloses that “the image feature amount calculation unit 15 calculates a hue” for each pixel within the face region and calculates “the average value,” so implementing this calculation using Schroder’s weighted distribution would have

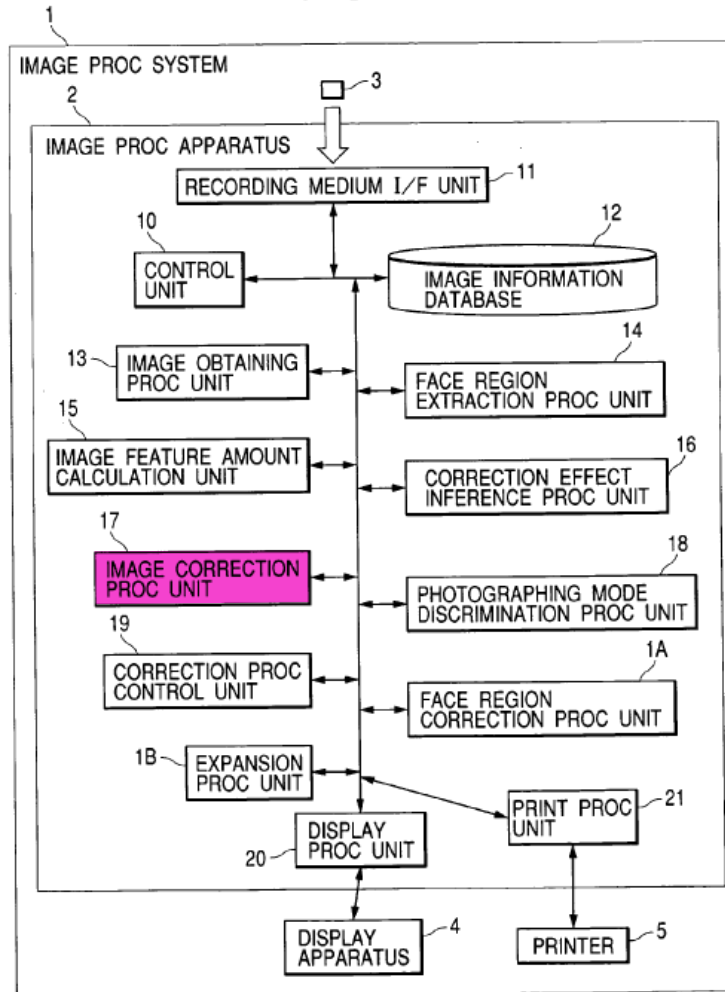
been a simple substitution of one known mathematical formula for another to predictably obtain a center-weighted average hue value for Yano's face region. Yano, [0055]-[0057]. Indeed, center-weighted averages like Schroder's function were well known to image-processing applications and commonly taught to college students learning about image processing as a way to improve characteristic values of image data, compared to using an unweighted average. For example, center-weighted low pass filter arrays, often called "noise cleaning masks," were commonly used for noise cleaning since at least the 1970s. Ex. 1020 ("Pratt"), pp. 319-321. Such center-weighted low pass filter arrays were used, for example, to suppress "the introduction of what appear to be 'edges' into places—like smooth facial features—where no such edges existed in the original image." Ex. 1021 ("Bayer"), 2:8-39. Since both Yano and Schroder disclose color balance correction that uses a reference skin color to correct the color of a face region, a POSITA would have reasonably expected Schroder's function to successfully calculate a center-weighted average hue value that predictably leads to Yano's color-balance-corrected face region including a desirable flesh color. Yano, [0054]-[0063]; Schroder, 4:12-46, 17:11-33.

- f. [1.e]: “a correction value calculation module that calculates a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”

116. Yano discloses or Yano and Schroder render obvious [1.e].

117. Yano discloses that the image processing apparatus includes an **image correction processing unit 17** (“*correction value calculation module*”) that “corrects the characteristic of the image data on the basis of the image feature amount.” Yano, [0027].

FIG. 1



Yano, FIG. 1 (annotated).

118. As part of this correction process, Yano discloses that “the **image correction processing unit 17** obtains the parameters for the color correction from the image feature amount of the face region 33” (“*said calculated specific subject characteristic value*”). Yano, [0060]. Yano also discloses that, “in advance, a range of hue of the flesh color that human beings feel desirable is checked in regard to each of various face images, and its center value and distribution value are

parameterized as a target value of the hue and stored in the **image correction processing unit 17**.” Yano, [0060]. The center value of the range of hue of desirable flesh color that is stored in advance discloses a preset characteristic target value.

119. Yano then discloses that the **image correction processing unit 17** applies a formula to correct the hue of “each pixel” that includes subtracting the “average hue of the flesh color in the face region” (“*said calculated specific subject characteristic value*”) from “the center value of the target value of the hue” (“*a preset characteristic target value*”). Yano, [0061]-[0063]. Yano’s calculation of this difference between the center value of the target hue range and the average hue value of the flesh color in the face region discloses calculating a correction value for color balance using said calculated specific subject characteristic value and a preset characteristic target value because Yano applies this difference (“*correction value*”) to “each pixel” in the image. Yano, [0061]-[0063].

120. To the extent Patent Owner contends or the Board finds that this does not disclose [1.e], Yano and Schroder render [1.e] obvious. As discussed above, Yano discloses that the image correction processing unit 17 applies a formula that uses the difference between the center value of the target hue range and the average hue value of the flesh color in the face region to every pixel in the image. Yano, [0061]-[0063]. A POSITA would have found it obvious to include a correction

value calculation module within the image processing apparatus that calculates this difference once and passes it to the image correction processing unit 17, as taught by Schroder, for use in Yano's formula.

121. Schroder discloses a similar color balance correction to Yano, where a photographic image processing device includes a “determination unit 500” that determines a “transformation T for the color correction” and passes the transformation to a “transforming unit 600” that “receives the image data from the receiving unit and transforms the image data in accordance with the transformation in order to obtain the corrected image data.” Schroder, 19:32-58, 11:7-58. Similar to Yano, Schroder's color correction is performed based on “color hue,” as well as saturation. Schroder, 7:20-30.

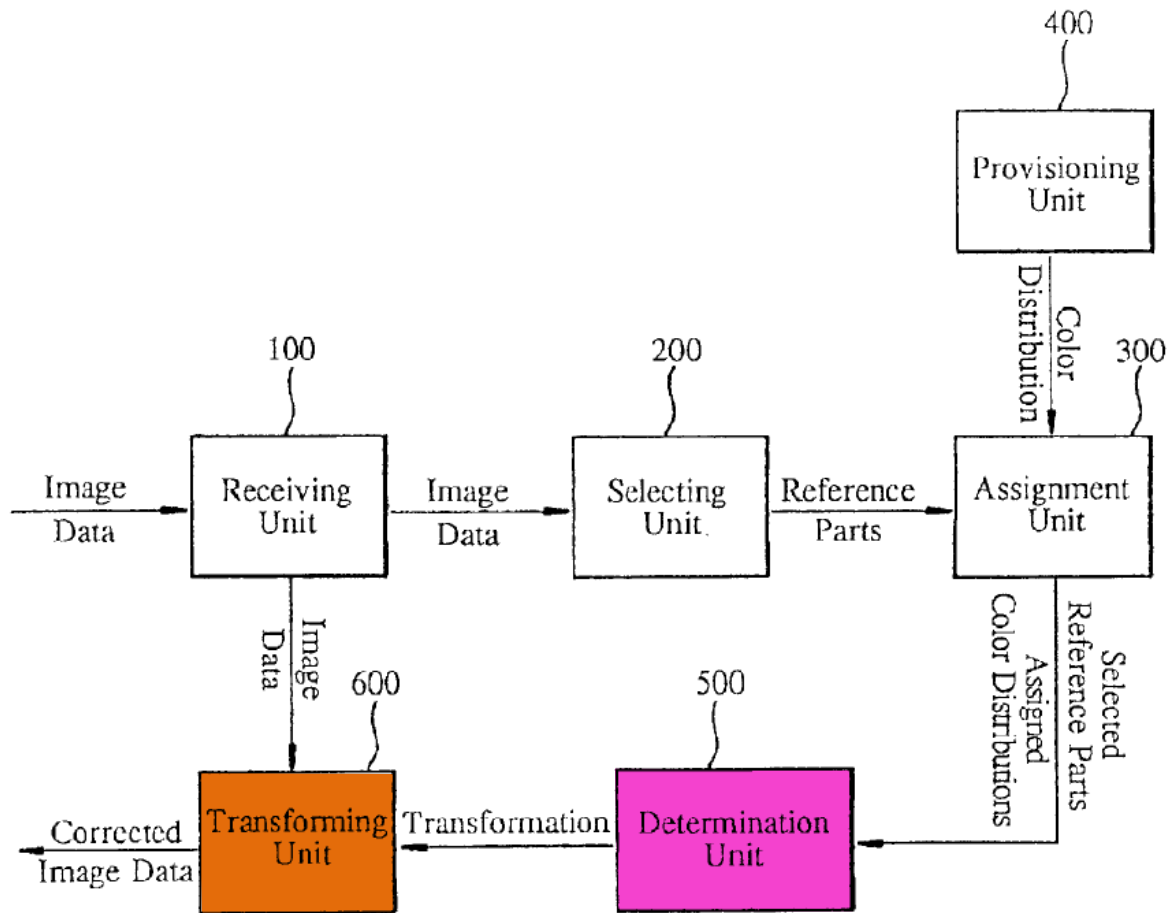


Figure 7

Schroder, FIG. 7 (annotated).

122. A POSITA would have been motivated to implement a correction value calculation module, as taught by Schroder, that calculates the transformation and passes it to Yano's image correction processing unit 17 to reduce the number of calculations performed by Yano's image processing apparatus. For example, Yano discloses that "each unit" in the image processing apparatus "may be

structured by a memory and a CPU so that the function of the unit is achieved by reading a program for achieving the function of each unit into the memory and then executing the read program by the CPU,” and that the program “may be a part of an application program for the entire image process.” Yano, [0035]. Yano also discloses that an image obtained by the image obtaining processing unit 13 may include “1280x960 pixels,” i.e., over 1 million pixels. Yano, [0032]. A POSITA would have recognized that including a correction value calculation module within the image processing apparatus that calculates the difference between the center value of the target hue range and the average hue value of the flesh color in the face region once and passes it to the image correction processing unit 17 for use in the formula would have improved the efficiency of Yano’s image processing apparatus by significantly reducing the number of calculations necessary to correct the hue values of the pixels.

123. A POSITA would have had a reasonable expectation of success in such a modification because it would have required a POSITA to apply only conventional software techniques for creating modules within a program that perform a calculation and pass the result to another module, which was well known at the time, as evidenced by Schroder’s disclosure of a similar image processing apparatus including determination unit 500 that determines a transformation and passes it to a transforming unit 600. Schroder, 19:50-58. Indeed, it was routine to

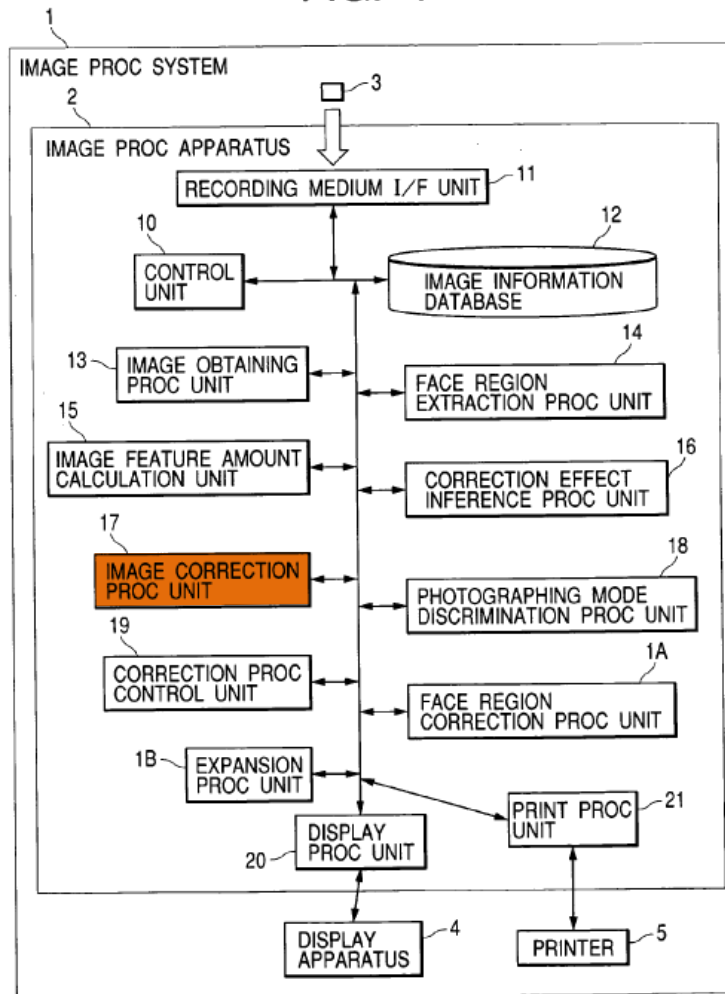
design programs that include a module for calculating a difference between two values and another module for correcting the color balance of an image using the result of the difference calculation. *E.g.*, Berge, [0024]-[0025], [0036]-[0037]; Schroder, 11:55-58, 19:50-58. Accordingly, this modification would have required merely the use of a known technique for defining a module that reduces the number of calculations in a program to improve Yano's color correction technique in the same manner as Schroder's, by making it more efficient.

- g. **[1.f]: “a correction execution module that executes said color balance correction on said image data using said calculated correction value.”**

124. Yano discloses or Yano and Schroder render obvious [1.f].

125. Yano discloses that the image processing apparatus includes an **image correction processing unit 17** (“*correction execution module*”) that obtains a corrected hue value for “each pixel” in the image and then “obtains the R, G and B component values in regard to each pixel so that the lightness and saturation values before the correction are maintained and the hue component is set to have the” corrected hue value (“*executes said color balance correction on said image data*”). Yano, [0027], [0060]-[0063].

FIG. 1



Yano, FIG. 1 (annotated).

126. Yano discloses or Yano and Schroder render obvious this color balance correction using the calculated correction value for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f. For example, Yano's formula for obtaining the corrected hue value for each pixel includes determining the difference between the center value of the target hue range and the average hue value of the flesh color in the face region ("calculated correction value"). Yano, [0061]-[0063]. To the extent

Patent Owner contends or the Board finds that this formula does not disclose using the calculated correction value, a POSITA would have found it obvious for the correction value calculation module to provide this difference value to the **image correction processing unit 17** for use in the color balance correction for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f.

2. Dependent Claims

- a. **Claim 3: “An image processing device according to claim 1, wherein said specific subject characteristic value includes a characteristic value relating to a hue of said specific subject.”**

127. Yano discloses or Yano and Schroder render obvious the additional limitations of claim 3 because, as discussed for [1.c], Yano discloses that the specific subject characteristic value includes the average hue value of the flesh color in the face region (“*said specific subject characteristic value includes a characteristic value relating to a hue of said specific subject*”) and, as discussed for [1.d], Yano and Schroder render obvious calculating the characteristic hue value using a function that weights hue values in the center of the face region more than hue values in its periphery. Yano, [0055]-[0057], [0061]; Schroder, 10:47-11:4; *supra* Sections VIII.B.1.d-VIII.B.1.e.

- b. Claim 4: “An image processing device according to claim 1, wherein said specific subject characteristic value includes a specific color characteristic value for representing a characteristic of pixel data included within said specific subject area, said pixel data belonging to a specific color range.”**

128. Yano discloses or Yano and Schroder render obvious the additional limitations of claim 4 because, as discussed for [1.c], Yano discloses that the specific subject characteristic value includes the average hue value of the flesh color in the face region (“*a specific color characteristic value for representing a characteristic of pixel data included within said specific subject area, said pixel data belonging to a specific color range*”), and, as discussed for [1.d], Yano and Schroder render obvious calculating the hue value using center-weighting. Yano, [0055]-[0057], [0061]; Schroder, 10:47-11:4; *supra* Sections VIII.B.1.d-VIII.B.1.e. For example, Yano discloses that “the image feature amount calculation unit 15 discriminates whether or not each pixel value within the extracted face region 33 belongs to the predetermined flesh color region,” a specific color range for flesh. Yano, [0055], [0034]. The image feature amount calculation unit 15 then uses the pixel data that belongs to the specific color range for flesh to “calculate[] the statistics value,” which includes calculating the “average hue of the flesh color in the face region 33,” a specific color characteristic value for representing a characteristic of the flesh color pixel data. Yano, [0055]-[0057], [0061].

c. Claim 5

- i. [5.a]: “An image processing device according to claim 4, wherein said specific color characteristic value includes a statistical value of pixel values of said pixel data belonging to said specific color range,”**

129. Yano discloses or Yano and Schroder render obvious the additional limitations of [5.a] because, as discussed for claim 4, Yano discloses that the specific subject characteristic value includes the average hue value of the pixel data belonging to “the predetermined flesh color region” of the flesh region (“*said specific color characteristic value includes a statistical value of pixel values of said pixel data belonging to said specific color range*”), and Yano and Schroder render obvious calculating the hue value of pixels belonging to the flesh color region using center-weighting. Yano, [0055]-[0057], [0061], [0034]; Schroder, 10:47-11:4; *supra* Section VIII.B.2.b. For example, Yano discloses that the average hue value is a “statistics value” (“*statistical value*”) of “the flesh color in the face region” (“*pixel values of said pixel data belonging to said specific color range*”). Yano, [0055]-[0057], [0061], [0034]. Yano also discloses using a second statistical value, the “standard deviation (square root of the distribution value)” of the hue of “the flesh color in the face region.” Yano, [0057], [0061]. This standard deviation statistical value is also used by the image correction processing unit,

along with the average hue statistical value, to calculate the corrected hue values.

Yano, [0057], [0061].

ii. [5.b]: “wherein said characteristic target value includes a preset pixel target value, and”

130. Yano discloses or suggests [5.b].

131. As discussed for [1.e], Yano also discloses that the “center value” of “a range of hue of the flesh color that human beings feel desirable” is a characteristic target value. Yano, [0060]-[0061]; *supra* Section VIII.B.1.f. This center value is a preset pixel target value because Yano discloses that it is determined “in advance” and “stored in the image correction processing unit 17” and is a target hue value for the flesh color pixels. Yano, [0060]-[0063]. Indeed, the '056 patent states that a target hue, like Yano's center value of a range of hues, is one example of a pixel target value. Ex. 1001, 9:11-15 (stating that “flesh color pixel target hue F (H)_target” is one “flesh color pixel target value[]”).

iii. [5.c]: “wherein said calculated correction value includes a correction value for eliminating or reducing a difference between said statistical value of pixel values and said pixel target value.”

132. Yano discloses or Yano and Schroder render obvious [5.c].

133. As discussed for [1.e], Yano discloses or Yano and Schroder render obvious calculating a correction value that is the difference between the center value of the target hue range and the center-weighted average hue value of the

flesh color in the face region. Yano, [0061]-[0063]; *supra* Section VIII.B.1.f. This correction value is for eliminating or reducing a difference between the center-weighted average hue value of the flesh color in the face region (“*statistical value of pixel values*”) and the center value of the target hue range (“*pixel target value*”) because Yano’s formula for determining the corrected hue values adds the difference between these two values—the correction value—to the “hue of the pixel before the correction” multiplied by a factor determined from the standard deviations of the desirable range of hues and the range of hues in the face region. Yano, [0056]-[0057], [0060]-[0061]. Accordingly, the difference between these two values is reduced or eliminated through using Yano’s formula for correcting the hue values.

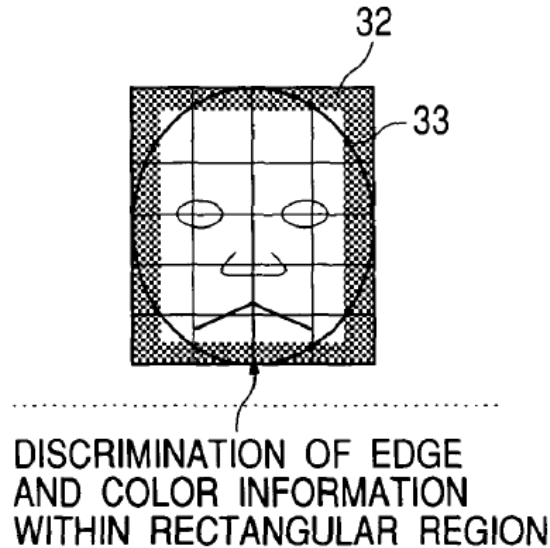
d. Claim 6

i. [6.a]: “An image processing device according to claim 4, wherein said specific subject includes a face part of a human subject, and”

134. Yano discloses or suggests the additional limitations of [6.a] because, as discussed for [1.b], the specific subject area is a face region 33, depicted below, that contains the face (“*specific subject*”) of “the person (subject)” in the photographed image. Yano, [0016], [0032]-[0034], FIG. 3C; *supra* Section VIII.B.1.c. Accordingly, the face (“*specific subject*”) includes a face part of “the

person (subject)” (“*a human subject*”) in the image. Yano, [0016], [0032]-[0034], FIGS. 3C.

FIG. 3C



Yano, FIG. 3C.

- ii. **[6.b]: “wherein said pixel data belonging to said specific color range includes flesh colored pixel data belonging to a color range corresponding to a flesh color of said human subject.”**

135. Yano discloses or suggests [6.b] because, as discussed for claim 4, the pixel data belonging to the specific color range that is used to calculate the “average hue of the flesh color in the face region” includes the hue values of pixels within the extracted face region 33 that belong to a “predetermined flesh color region” (“*flesh colored pixel data belonging to a color range corresponding to a*

flesh color of said human subject”). Yano, [0055]-[0057], [0061], [0034]; *supra* Section VIII.B.2.b.

- e. **Claim 7: “An image processing device according to claim 1, wherein said correction execution module executes said color balance correction using said calculated correction value when an area ratio of said specific subject area to a whole area of said photographed image is greater than a reference value.”**

136. Yano renders obvious the additional limitations of claim 7.

137. Yano discloses that its image correction processing unit 17 (“*correction execution module*”) executes the color balance using the calculated correction value, *supra* Section VIII.B.1.g ([1.f]), only when the image processing apparatus infers that “the correction effect can be obtained” by comparing “the area (the total number of pixels) of the face region 33 calculated by the image feature amount calculation unit 15” to “a predetermined threshold.” Yano, [0041]-[0043], [0058], FIG. 4 (S105). “[W]hen the area of the face region is larger than a predetermined value” (“*greater than a reference value*”), the image processing apparatus infers “that the correction effect can be obtained.” Yano, [0026], [0042], [0058]. Instead of comparing the area of the face region, as represented by the number of pixels in the face region, to a reference value, a POSITA would have found it obvious to compare the area of the face region, as represented by a ratio of the number of pixels in the face region to the total number of pixels in the image

(“an area ratio of said specific subject area to a whole area of said photographed image”), to a reference value to allow the use of the same reference value regardless of the image resolution.

138. A POSITA would have been motivated to implement Yano’s area comparison in this way because, as Yano recognizes, photographed images were known to include different resolutions having different numbers of total pixels. Yano, [0023], [0032]. Accordingly, if Yano’s comparison of the area of the face region to a predetermined value is carried out using absolute numbers of pixels, a POSITA would have recognized that Yano’s image processing apparatus would have had to store different predetermined values for each resolution of image. Implementing Yano’s comparison using ratios would have advantageously simplified this comparison by requiring the storage of only a single predetermined value applicable to all image resolutions that is compared to an area ratio calculated from the number of pixels within the face region and the total number of pixels in the image.

139. A POSITA would have had a reasonable expectation of success in implementing this comparison of an area ratio to a predetermined value because Yano already discloses that the image processing apparatus acquires “the number of pixels (or resolution)” from information specified in the image file and determines “the total number of pixels included in the face region.” Yano, [0023],

[0057]. Accordingly, determining the area ratio and comparing it to the predetermined value would have required a POSITA to apply only conventional calculations from readily available information and predictably compare the result to a value in the same manner as its comparison of “the area of the face region” to “a predetermined value.” Yano, [0026], [0041]-[0043], [0058].

3. Independent Claim 11

- a. **[11.pre]: “An image processing method for executing color balance correction on image data of a photographed image, said image processing method comprising:”**

140. If limiting, Yano discloses or suggests [11.pre] for the reasons discussed for [1.pre]. *Supra* Section VIII.B.1.a.

- b. **[11.a]: “acquiring said image data;”**

141. Yano discloses or suggests [11.a] for the reasons discussed for [1.a]. *Supra* Section VIII.B.1.b.

- c. **[11.b]: “determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”**

142. Yano discloses or suggests [11.b] for the reasons discussed for [1.b]. *Supra* Section VIII.B.1.c.

- d. **[11.c]: “calculating a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area,”**

143. Yano discloses or suggests [11.c] for the reasons discussed for [1.c].

Supra Section VIII.B.1.d.

- e. **[11.d]: “wherein said calculating said specific subject characteristic value is executed using weighted distribution, and wherein said weighted distribution is set so as to be a weight in a center area of said specific subject area larger than a weight in an area outside said center area;”**

144. Yano and Schroder render obvious [11.d] for the reasons discussed for [1.d]. *Supra* Section VIII.B.1.e.

- f. **[11.e]: “calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”**

145. Yano discloses or Yano and Schroder render obvious [11.e] for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f.

- g. **[11.f]: “executing said color balance correction on said image data using said calculated correction value.”**

146. Yano discloses or Yano and Schroder render obvious [11.f] for the reasons discussed for [1.f]. *Supra* Section VIII.B.1.g.

C. Ground 2: Yano, Schroder, and Steinberg Render Obvious Claims 2, 8, 12-16, and 18

1. Independent Claim 8

- a. [8.pre]: “An image processing device for executing color balance correction on image data of a photographed image, said image processing device comprising:”**

147. If limiting, Yano discloses or suggests [8.pre] for the reasons discussed for [1.pre]. *Supra* Section VIII.B.1.a.

- b. [8.a]: “an image data acquisition module that acquires said image data;”**

148. Yano discloses or suggests [8.a] for the reasons discussed for [1.a].
Supra Section VIII.B.1.b.

- c. [8.b]: “a specific subject area determination module that determines a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”**

149. Yano discloses or suggests [8.b] for the reasons discussed for [1.b].
Supra Section VIII.B.1.c.

- d. [8.c]: “a specific subject characteristic value calculation module that calculates a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;”**

150. Yano discloses or suggests [8.c] for the reasons discussed for [1.c].
Supra Section VIII.B.1.d.

- e. **[8.d]: “a correction value calculation module that calculates a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”**

151. Yano discloses or Yano and Schroder render obvious [8.d] for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f.

- f. **[8.e]: “a correction execution module that executes said color balance correction on said image data using said calculated correction value,”**

152. Yano discloses or Yano and Schroder render obvious [8.e] for the reasons discussed for [1.f]. *Supra* Section VIII.B.1.g.

- g. **[8.f]: “wherein when a plurality of said specific subject areas are determined, said specific subject characteristic value calculation is executed using weighted distribution, wherein said weighted distribution is set according to a size of each specific subject area on each specific subject characteristic value of said plurality of specific subject areas.”**

153. Yano and Steinberg or, alternatively, Yano, Schroder, and Steinberg render obvious [8.f].

154. Yano discloses that a plurality of face regions (“*specific subject areas*”) may be determined. Yano, [0034], [0046], [0050], [0059], [0063]. For example, Yano discloses that the steps for extracting a face region discussed for [1.b] may be used to extract “plural face regions 33” from an image. Yano, [0034]; *supra* Section VIII.B.1.c. When the face region extraction processing unit 14

extracts “plural face regions 33” (“*when a plurality of said specific subject areas are determined*”), the “average hue of the flesh color” (“*said specific subject characteristic value*”) used to calculate a correction factor for correcting the hue of each pixel in the image, *supra* Section VIII.B.1.f ([1.e]), is calculated “using the average value of the image feature amounts in the respective face regions 33” (“*each specific subject characteristic value of said plurality of specific subject areas*”). Yano, [0061], [0063].

155. When calculating Yano’s “average hue of the flesh color” based on “the image feature amounts in the respective face regions 33” of plural face regions, a POSITA would have found it obvious to implement Steinberg’s teaching of weighting the face regions based on their size, to set a weighted distribution according to the size of each face region on each average hue value of the face regions (“*said specific subject characteristic value calculation is executed using weighted distribution, wherein said weighted distribution is set according to a size of each specific subject area on each specific subject characteristic value of said plurality of specific subject areas*”), to emphasize the hue of larger face regions more than smaller face regions in Yano’s calculation of the overall average hue of the flesh color. Yano, [0061], [0063]; Steinberg, 17:1-13, 18:32-63.

156. Steinberg, similar to Yano and Schroder, discloses a “way to color-correct the image based on the skin tones of the faces” that can be “part of an

image enhancement software.” Steinberg, 17:1-6. These color corrections disclose color balance correction, for example, because they “may be global, affecting the entire image.” Steinberg, 17:6-13. Steinberg’s device loads “a default set of image attributes” related to “the overall color balance” and applies “a face detection process” to an image “to seek faces in the image.” Steinberg, 18:42-49. The device marks and labels each of the detected faces and assigns each face “a weight based on size of the faces” that “define[s] the importance of the face in relation to other faces detected.” Steinberg, 18:56-63, 12:9-19. Once identified, the attributes of the faces are compared to the default set of image attributes to determine “a potential transformation” that will cause the values to match. Steinberg, 19:8-12.

157. A POSITA would have been motivated to implement Steinberg’s assignment of a “weight based on size of the faces” to improve Yano’s calculation of an average hue of the flesh color in the plural face regions by placing greater importance on larger face regions and thus ensuring that, when an image includes two faces having different hues, the largest (and most important) face regions are corrected closest to the target hue value that “human beings feel [is] desirable.” Yano, [0060]-[0063]; Steinberg, 18:58-63, 12:9-19. This would have been advantageous, for example, because Yano discloses applying the same correction value “to each pixel” in the image, motivating a POSITA to place greater emphasis on the larger and more important face regions when calculating the correction

value. Yano, [0060]-[0063]. It was well known to determine the size of different objects in an image and place a greater weight on larger objects when determining how the image should be processed. Schroder, 3:15-20 (“Usually the color values are the more important the higher the abundance.”); Japanese Patent Publication No. JP2003-248825 (“Hibi”; Ex. 1012 (certified English translation)), [0024] (“The larger the size score, the greater the weight.”). To account for the relatively larger importance of larger detected faces, a POSITA would have been motivated to combine Yano and Steinberg to incorporate Steinberg’s disclosure of assigning a weight to each face based on its relative size to ensure that, if the average hues of the individual face regions differ, the more important face region, determined by its relative size, factors more into the overall average hue value than the less important face region.

158. A POSITA would have reasonably expected success in implementing Steinberg’s teaching of weighting face regions based on their size to set the weighted distribution according to the relative size of each face region on each average hue value of the plural face regions. Yano already discloses that, for each face region, the image processing apparatus determines “the area of the face region” relative to a “predetermined threshold value.” Yano, [0041]-[0043], [0058]-[0059]. Setting the weighted distribution for each average hue of the face regions would have required a POSITA to apply only conventional data processing

techniques to compare the known areas of each face region and set the relative weights accordingly, which was well known at the time. Steinberg, 18:58-63, 12:9-19; Hibi, [0025]-[0027]. Accordingly, a POSITA would have found it obvious to use the known technique of a weighted distribution that sets the weights based on the relative sizes of the face regions to predictably improve Yano's calculation of an overall average hue of the flesh color of the face regions by factoring the "importance of the face in relation to other faces detected" into the overall average hue. Steinberg, 18:58-63.

159. To the extent Patent Owner contends or the Board finds that each specific subject characteristic value of said plurality of specific subject areas must be calculated using a weighted distribution, a POSITA would have also found it obvious to calculate the average hue value in each of the respective face regions 33 (*"each specific subject characteristic value of said plurality of specific subject areas"*) using weighted distribution, as taught by Schroder, for the reasons discussed for [1.d]. Schroder, 10:40-11:4 (disclosing that multiple reference parts may be identified, where "a characteristic color value" of each reference part is an average value calculated using a function that weights "the color values in the center of the [reference] part ... more ... than the color values of the pixels in the periphery of the reference part"); *supra* Section VIII.B.1.e.

2. Independent Claim 12

- a. [12.pre]: “An image processing method for executing color balance correction on image data of a photographed image, said image processing method comprising:”**

160. If limiting, Yano discloses or suggests [12.pre] for the reasons discussed for [1.pre]. *Supra* Section VIII.B.1.a.

- b. [12.a]: “acquiring said image data;”**

161. Yano discloses or suggests [12.a] for the reasons discussed for [1.a].
Supra Section VIII.B.1.b.

- c. [12.b]: “determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”**

162. Yano discloses or suggests [12.b] for the reasons discussed for [1.b].
Supra Section VIII.B.1.c.

- d. [12.c]: “calculating a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;”**

163. Yano discloses or suggests [12.c] for the reasons discussed for [1.c].
Supra Section VIII.B.1.d.

- e. **[12.d]: “calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”**

164. Yano discloses or Yano and Schroder render obvious [12.d] for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f.

- f. **[12.e]: “executing said color balance correction on said image data using said calculated correction value,”**

165. Yano discloses or Yano and Schroder render obvious [12.e] for the reasons discussed for [1.f]. *Supra* Section VIII.B.1.g.

- g. **[12.f]: “wherein when a plurality of said specific subject areas are determined, said calculating said specific subject characteristic value is executed using weighted distribution, wherein said weighted distribution is set according to a size of each specific subject area on each specific subject characteristic value of said plurality of specific subject areas.”**

166. Yano and Steinberg, or Yano, Schroder, and Steinberg, render obvious [12.f] for the reasons discussed for [8.f]. *Supra* Section VIII.C.1.g.

3. Dependent Claims

- a. **Claim 13: “An image processing method according to claim 12, wherein said specific subject characteristic value includes a specific color characteristic value for representing a characteristic of pixel data included within said specific subject area, said pixel data belonging to a specific color range.”**

167. Yano discloses or Yano and Schroder render obvious the additional limitations of claim 13 for the reasons discussed for claim 4. *Supra* Section VIII.B.2.b.

- b. **Claim 14**

- i. **[14.a]: “An image processing method according to claim 13, wherein said specific color characteristic value includes a statistical value of pixel values of said pixel data belonging to said specific color range,”**

168. Yano discloses or Yano and Schroder render obvious the additional limitations of [14.a] for the reasons discussed for [5.a]. *Supra* Section VIII.B.2.c.i.

- ii. **[14.b]: “wherein said characteristic target value includes a preset pixel target value, and”**

169. Yano discloses or suggests [14.b] for the reasons discussed for [5.b].
Supra Section VIII.B.2.c.ii.

- iii. **[14.c]: “wherein said calculated correction value includes a correction value for eliminating or reducing a difference between said statistical value of pixel values and said pixel target value.”**

170. Yano discloses or Yano and Schroder render obvious [14.c] for the reasons discussed for [5.c]. *Supra* Section VIII.B.2.c.iii.

c. Claim 15:

- i. [15.a]: “An image processing method according to claim 13, wherein said specific subject includes a face part of a human subject, and”**

171. Yano discloses or suggests the additional limitations of [15.a] for the reasons discussed for [6.a]. *Supra* Section VIII.B.2.d.i.

- ii. [15.b]: “wherein said pixel data belonging to said specific color range includes flesh colored pixel data belonging to a color range corresponding to a flesh color of said human subject.”**

172. Yano discloses or suggests [15.b] for the reasons discussed for [6.b].
Supra Section VIII.B.2.d.ii.

- d. Claim 16: “An image processing method according to claim 12, wherein said executing said color balance correction on said image data using said calculated correction value is carried out when an area ratio of said specific subject area to a whole area of said photographed image is greater than a reference value.”**

173. Yano discloses or renders obvious the additional limitations of claim 16 for the reasons discussed for claim 7. *Supra* Section VIII.B.2.e.

4. Independent Claim 18

- a. [18.pre]: “A computer program product for executing color balance correction on image data of a photographed image, said computer program product comprising:”**

174. If limiting, Yano discloses or suggests [18.pre].

175. Yano discloses a “program product such as a computer-readable recording medium on which” a “program to achieve the functions of the processing units shown in FIG. 1 is recorded” (“*computer program product*”). Yano, [0035], [0068]-[0071]. Yano’s image processing apparatus processes “image data photographed (or shot) by a digital camera” (“*image data of a photographed image*”) based on this program. Yano, [0015], [0035], [0068]-[0071]. Accordingly, this computer program product is for executing color balance correction for the reasons discussed for [1.pre]. *Supra* Section VIII.B.1.a.

- b. [18.a]: “a computer readable medium; and”**

176. Yano discloses or suggests [18.a].

177. Yano discloses “a computer-readable recording medium” (“*computer readable medium*”), such as a “portable medium” (e.g., CD-ROM), “a storage such as a hard disk ... built in the computer system,” or RAM. Yano, [0035], [0068]-[0071].

c. [18.b]: “a computer program stored on said computer readable medium, said computer program comprising:”

178. Yano discloses or suggests [18.b].

179. Yano discloses that a “program to achieve the functions of the processing units shown in FIG. 1” (“*computer program*”) is stored on the computer-readable recording medium, where “the processing units may be operated by reading the program from the recording medium, and writing the read program into a computer system so as to operate the processing units.” Yano, [0068]-[0071]. Because the program “achieve[s] the functions of the processing units” that perform Yano’s color balance correction, *supra* Section VIII.C.1 (claim 8), a POSITA would have understood that the computer program comprises program instructions for performing each of the steps discussed below for [18.c]-[18.f]. Yano, [0035], [0068]-[0071], claims 10, 12.

d. [18.c]: “a program instruction for acquiring said image data;”

180. Yano discloses or suggests acquiring said image data for the reasons discussed for [1.a]. *Supra* Section VIII.B.1.b. Yano discloses a program instruction for performing this step for the reasons discussed for [18.b]. *Supra* Section VIII.C.4.c.

- e. **[18.d]: “a program instruction for determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”**

181. Yano discloses or suggests determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image for the reasons discussed for [1.b]. *Supra* Section VIII.B.1.c. Yano discloses a program instruction for performing this step for the reasons discussed for [18.b]. *Supra* Section VIII.C.4.c.

- f. **[18.e]: “a program instruction for calculating a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;”**

182. Yano discloses or suggests calculating a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area for the reasons discussed for [1.c]. *Supra* Section VIII.B.1.d. Yano discloses a program instruction for performing this step for the reasons discussed for [18.b]. *Supra* Section VIII.C.4.c.

- g. [18.f]: “a program instruction for calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”**

183. Yano discloses or Yano and Schroder render obvious calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f. Yano discloses a program instruction for performing this step for the reasons discussed for [18.b]. *Supra* Section VIII.C.4.c.

- h. [18.g]: “a program instruction for executing said color balance correction on said image data using said calculated correction value,”**

184. Yano discloses or Yano and Schroder render obvious executing said color balance correction on said image data using said calculated correction value for the reasons discussed for [1.f]. *Supra* Section VIII.B.1.g. Yano discloses a program instruction for performing this step for the reasons discussed for [18.b]. *Supra* Section VIII.C.4.c.

- i. **[18.h]: “wherein when a plurality of said specific subject areas are determined, said specific subject characteristic value calculation is executed using weighted distribution, wherein said weighted distribution is set according to a size of each specific subject area on each specific subject characteristic value of said plurality of specific subject areas.”**

185. Yano and Steinberg, or Yano, Schroder, and Steinberg, render obvious [18.h] for the reasons discussed for [8.f]. *Supra* Section VIII.C.1.g.

- 5. **Claim 2: “An image processing device according to claim 1 wherein said specific subject characteristic value calculation is executed by obtaining a weighted average value of each specific subject characteristic value of a plurality of specific subject areas.”**

186. As discussed in Section VIII.B.1, Yano and Schroder render obvious claim 1. Yano and Steinberg or Yano, Schroder, and Steinberg render obvious the additional limitations of claim 2 for the reasons discussed for [8.f]. *Supra* Section VIII.C.1.g.

D. Grounds 3-4: Yano and Kuwata (Ground 3) or Yano, Schroder, and Kuwata (Ground 4) Render Obvious Claims 9 and 17

1. Independent Claim 9

- a. **[9.pre]: “An image processing device for executing color balance correction on image data of a photographed image, said image processing device comprising:”**

187. If limiting, Yano discloses or suggests [9.pre] for the reasons discussed for [1.pre]. *Supra* Section VIII.B.1.a.

- b. [9.a]: “an image data acquisition module that acquires said image data;”**

188. Yano discloses or suggests [9.a] for the reasons discussed for [1.a].

Supra Section VIII.B.1.b.

- c. [9.b]: “a specific subject area determination module that determines a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”**

189. Yano discloses or suggests [9.b] for the reasons discussed for [1.b].

Supra Section VIII.B.1.c.

- d. [9.c]: “a specific subject characteristic value calculation module that calculates a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;”**

190. Yano discloses or suggests [9.c] for the reasons discussed for [1.c].

Supra Section VIII.B.1.d.

- e. [9.d]: “a correction value calculation module that calculates a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value,”**

191. Yano discloses or Yano and Schroder render obvious [9.d] for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f.

- f. **[9.e]: “wherein said calculated correction value includes a correction value weighted according to an area ratio of said specific subject area to a whole area of said photographed image; and”**

192. Yano and Kuwata render obvious [9.e].

193. Yano discloses that the image correction processing unit 17 obtains corrected hue values for “each pixel” in the image based on a formula that uses the difference between the “average hue of the flesh color in the face region” and “the center value of the target value of the hue.” Yano, [0061]-[0063]; *supra* Section VIII.B.1.f ([1.e]). Before applying this difference value to correct the hue values in the image, a POSITA would have found it obvious in view of Kuwata to multiply the difference by a ratio of “the area (the total number of pixels) of the face region 33 calculated by the image feature amount calculation unit 15” “to the total number of pixels” in the image (“*an area ratio of said specific subject area to a whole area of said photographed image*”) because Kuwata teaches that “regulating a degree of color adjustment” according to such a ratio beneficially allows color adjustment without significantly affecting “parts other than the flesh color part” and further teaches that such a “color adjustment is made according to a ratio of the number of object pixels to the total number of pixels.” Yano, [0057]-[0058]; Kuwata, [0067]-[0068], [0231]-[0238]. By multiplying the difference by the area ratio, a POSITA would have understood that the correction value calculation module, *supra* Section

VIII.D.1.e ([9.d]), calculates a correction value for color balance correction that includes a correction value weighted according to a ratio of the area of the face region to the area of the image (“*an area ratio of said specific subject area to a whole area of said photographed image*”).

194. Kuwata, like Yano, discloses a color adjustment process that identifies flesh-color-like pixels in an image, calculates a statistical value (e.g., an average value) representative of those pixels, and compares the statistical value to a predefined ideal flesh color. Kuwata, [0223]-[0231]. For example, Kuwata, like Yano, discloses using “a difference between an average value ... and an ideal value” to “provide clear flesh color.” Kuwata, [0224], [0231]-[0238]. To avoid potential adverse effects on areas other than the flesh color part, Kuwata multiplies this difference value by “a ratio of object pixels to the total number of pixels.” Kuwata, Abstract, [0232]-[0234], [0238]. Because digital images are made up of equally spaced rows and columns of pixels, this ratio is the ratio of the object area to the whole area of the photographed image. Kuwata, [0223] (“photographic color image data containing dot-matrix pixels”). The result of the difference between the average value and the ideal value multiplied by the area ratio discloses a correction value weighted according to an area ratio of said specific subject area to a whole area of said photographed image. Kuwata uses this correction value to prepare “a

tone curve” that represents how pixels in the image are “converted with a degree of enhancement regulated.” Kuwata, [0235]-[0238].

195. A POSITA would have been motivated to implement an area ratio based on the number of pixels in the face region and the total number of pixels in the image in the calculation of the correction value discussed for [9.d] to avoid adversely affecting colors outside the face region(s). *Supra* Section VIII.D.1.e. For example, Kuwata discloses that “it is not preferred to apply the difference as a degree of color adjustment intactly” because “if the same degree of color adjustment is applied to all the pixels, ... colors of pixels on any parts other than the flesh color part may be affected significantly,” resulting in “non-allowable color deviation.” Kuwata, [0068], [0231]-[0232]. A POSITA would have recognized that Yano’s formula for calculating corrected hues of the image data applies the difference between the average hue of the flesh color in the face region and the center value of the target value of the hue as a degree of color adjustment intactly and would have been motivated to incorporate an area ratio into its formula for calculating corrected hues to avoid the potential negative effects described in Kuwata. Given Yano already calculates “the area ... of the face region 33,” a POSITA would have been motivated to use this area in the calculation of its area ratio. Yano, [0057]-[0058].

196. A POSITA would have recognized that weighting the correction value based on the area of the face region in addition to or in lieu of Yano's correction effect inference that determines not to correct the hue of the image pixels if "the area of the face region 33 is smaller than a predetermined threshold value" would have been beneficial. Yano, [0041]-[0043], [0058]. For example, Yano discloses that correcting the face region "does not necessarily bring[] about a desirable image" "when the face of the person in the image is small." Yano, [0042], [0058]. One reason is that, when the face region is small, the image feature amount "is easily influenced by noises in the image," creating "a fear that the image feature amount becomes an inaccurate value" and that "a side effect due to the image correction occurs." Yano, [0042]. A POSITA would have recognized that implementing weighting the correction value based on the area ratio, as Kuwata teaches, even without Yano's correction inference, mitigates these fears because Yano's image processing apparatus would apply a relatively small degree of color adjustment due to the small area ratio. As such, implementing weighting the correction value based on the area ratio would have been a simple substitution of one known technique for another to obtain the predictable result of a color balance correction that avoids adversely affecting non-flesh areas when the face region is small. Moreover, even if the area of the face region exceeds Yano's predetermined threshold value, a POSITA would have seen the benefits of performing both

Yano's inference processing and Kuwata's weighting together, for example, to avoid adversely affecting the color of other non-flesh regions in the image.

197. A POSITA would have had a reasonable expectation of success in implementing weighting the correction value based on the area ratio because Yano already discloses that the image processing apparatus acquires "the total number of pixels included in the face region 33" and "the number of pixels (or resolution)" from information specified in the image file. Yano, [0023], [0057], [0061]. Accordingly, determining an area ratio based on number of pixels in the face region and the number of pixels in the image, multiplying it by the difference between the average hue value and the center value of the target value of the hue determined for [1.e], and passing the result to the correction execution module for use in correcting the hue values of each pixel would have required a POSITA to apply only conventional calculations from readily available information in the same manner as Kuwata's determination of the degree of color adjustment. Yano, [0026], [0041]-[0043], [0058]; Kuwata, [0231]-[0235]; *supra* Section VIII.B.1.f.

- g. [9.f]: "a correction execution module that executes said color balance correction on said image data using said calculated correction value."**

198. Yano discloses or Yano and Schroder render obvious [9.f] for the reasons discussed for [1.f]. *Supra* Section VIII.B.1.g.

2. Independent Claim 17

- a. [17.pre]: “An image processing method for executing color balance correction on image data of a photographed image, said image processing method comprising:”**

199. If limiting, Yano discloses or suggests [17.pre] for the reasons discussed for [1.pre]. *Supra* Section VIII.B.1.a.

- b. [17.a]: “acquiring said image data;”**

200. Yano discloses or suggests [17.a] for the reasons discussed for [1.a].
Supra Section VIII.B.1.b.

- c. [17.b]: “determining a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image;”**

201. Yano discloses or suggests [17.b] for the reasons discussed for [1.b].
Supra Section VIII.B.1.c.

- d. [17.c]: “calculating a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;”**

202. Yano discloses or suggests [17.c] for the reasons discussed for [1.c].
Supra Section VIII.B.1.d.

- e. **[17.d]: “calculating a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value,”**

203. Yano discloses or Yano and Schroder render obvious [17.d] for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f.

- f. **[17.e]: “wherein said calculated correction value includes a correction value weighted according to an area ratio of said specific subject area to a whole area of said photographed image; and”**

204. Yano and Kuwata render obvious [17.e] for the reasons discussed for [9.e]. *Supra* Section VIII.D.1.f.

- g. **[17.f]: “executing said color balance correction on said image data using said calculated correction value.”**

205. Yano discloses or Yano and Schroder render obvious [17.f] for the reasons discussed for [1.f]. *Supra* Section VIII.B.1.g.

E. Grounds 5-6: Yano and Nakamura (Ground 5) or Yano, Schroder, and Nakamura (Ground 6) Render Obvious Claim 10

1. Independent Claim 10

- a. **[10.pre]: “An image processing device for executing color balance correction on image data of a photographed image, said image processing device comprising:”**

206. If limiting, Yano discloses or suggests [10.pre] for the reasons discussed for [1.pre]. *Supra* Section VIII.B.1.a.

- b. [10.a]: “an image data acquisition module that acquires said image data[;]”**

207. Yano discloses or suggests [10.a] for the reasons discussed for [1.a].

Supra Section VIII.B.1.b.

- c. [10.b]: “a specific subject area determination module that determines a specific subject area in said photographed image, wherein said specific subject area contains a specific subject in said photographed image, and”**

208. Yano discloses or suggests [10.b] for the reasons discussed for [1.b].

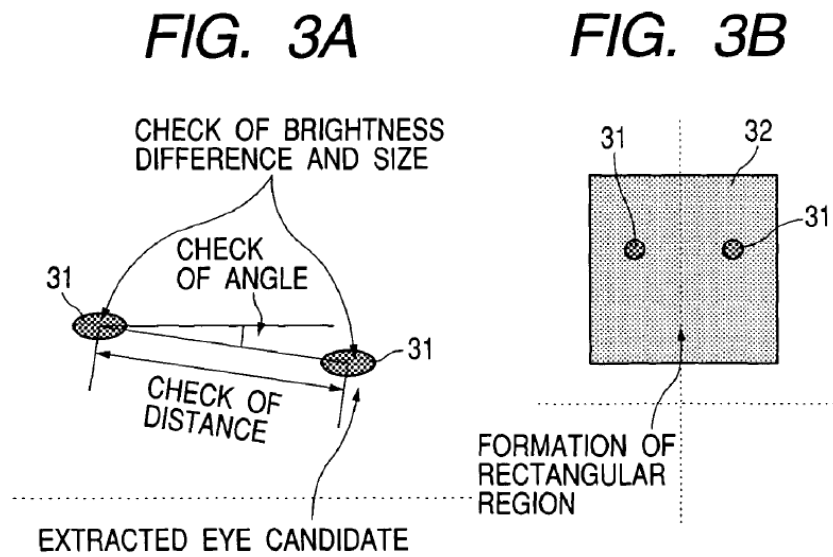
Supra Section VIII.B.1.c.

- d. [10.c]: “wherein said specific subject area determination module determines said specific subject area using pixel values of pixel data included in a target area for determination, and a position of said target area in said photographed image;”**

209. Yano and Nakamura render obvious [10.c].

210. Yano discloses a face region extraction processing unit (“*specific subject area determination module*”) that “extracts the face region of the person” (“*determines said specific subject area*”) based on the steps described as follows. Yano, [0024]. The face region extraction processing unit identifies candidates “of an eye image region” and determines whether a “pair of eye candidates actually indicates the eyes of the person.” Yano, [0032]-[0033]. If so, it extracts the pair of eye candidates. Yano, [0033]. Based on the relationship between “the two positions of the pair of eye candidates,” the face region extraction processing unit

“sets a rectangular region 32.” Yano, [0034]. These two steps are depicted below in Figures 3A-3B. The rectangular region 32 discloses a target area for determination of the face region.

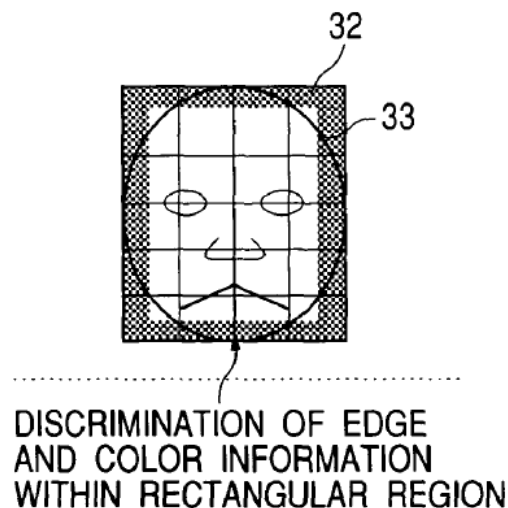


Yano, FIG. 3A-3B.

211. The face region extraction processing unit then “determines a face region 33 based on the edge in the vicinity of the boundary of the rectangular region 32 and color information within the rectangular region 32.” Yano, [0034]. For example, the face region extraction processing unit 14 determines whether “an edge component exceeding predetermined intensity occupies the region of a predetermined width in the vicinity of the boundary of the rectangular region 32 by a predetermined ratio or more” and determines whether “an average value of the pixel values within the rectangular region 32” are “within a previously set flesh color region.” Yano, [0034]. If both conditions are met, “the face region extraction

processing unit 14 extracts the region in question as the face region 33.” Yano, [0034]. Accordingly, Yano’s face region extraction processing unit 14 determines the face region 33 (“*specific subject area*”) using pixel values of pixel data included in the rectangular region 32 (“*target area for determination*”) by identifying pixels that exceed a “predetermined intensity” and calculating “an average value of the pixel values within the rectangular region 32.” Yano, [0034]. Figure 3C, below, depicts the face region 33 within the rectangular region 32. Yano, [0034], FIG. 3C.

FIG. 3C



Yano, FIG. 3C.

212. A POSITA would have found it obvious to implement Nakamura’s exclusion of potential face regions that contact the outer edge of the image based on the position of Yano’s rectangular region 32 in the photographed image

(*“a position of said target area in said photographed image”*) to improve the identification of face regions. Nakamura, like Yano, discloses extracting face regions in an image. Nakamura, 8:40-9:18, FIG. 2. Nakamura discloses that objects that are not faces, like *“the ground, tree trunks, clothes, and the like,”* often include hue values in the range of flesh color. Nakamura, 1:59-64, 2:21-25, 4:46-48. Because human faces *“usually exist[] at a central area of the original image,”* Nakamura teaches that the extraction of face regions can be improved by excluding *“regions of the image contacting the outer edge (frame of the image) of the original image”* because these regions *“are usually not characteristic images and are portions of the background or the like.”* Nakamura, 10:58-64.

213. A POSITA would have been motivated to implement Nakamura’s step of excluding color regions contacting the outer edge of the image by configuring its face region extraction processing unit 14 to consider the position of any rectangular regions 32 and extract a face region 33 only from rectangular regions 32 that do not contact the outer edge of the image. A POSITA would have understood that doing so would have improved Yano’s color balance correction because Nakamura discloses that the important regions of images *“usually exist[] at a central area of the original image”* and that color regions contacting the edge of the image are frequently not the important part of the image and are instead usually *“portions of the background or the like.”* Nakamura, 10:58-64. Because *“the image*

correction processing unit 17 corrects the characteristic of the image data on the basis of the image feature amount” in order to “generate the image of an appropriate flesh color that human beings feel desirable,” as Yano discloses, a POSITA would have been motivated to avoid including any faces that are not an important part of the image when calculating the feature amount. Yano, [0027], [0054], [0060]-[0063]; *supra* Section VIII.B.1.f ([1.e]). Implementing Nakamura’s exclusion of color regions that contact the edge would have lessened the likelihood that Yano’s image processing apparatus incorporates image data from background or unimportant regions into its average hue value used for image correction. A POSITA would have understood that excluding image data from background or unimportant regions when calculating the average hue value would have improved the likelihood that the flesh color of important faces in the corrected image would have a flesh color that human beings feel desirable.

214. A POSITA would have had a reasonable expectation of success because it would have required a POSITA to apply only well-known data processing techniques for locating boundaries of an image region and comparing them to the boundaries of the overall image, which was well known, as evidenced by Nakamura’s disclosure of applying a similar technique more than a decade before the ’056 patent’s earliest priority date. Nakamura, 10:54-11:19, FIG. 6. Yano also discloses other criteria for determining whether to extract a face region,

leading a POSITA to reasonably expect that Nakamura's exclusion of color regions contacting the edge of the image could likewise be successfully implemented.

Doing so would have merely required the combination of prior art elements according to known methods to predictably yield the result of a face region extraction processing unit 14 that performs the analysis of image data within a defined rectangular region 32, as described in [0034] of Yano, only if the rectangular region 32 is not contacting the edge of the image.

- e. **[10.d]: “a specific subject characteristic value calculation module that calculates a specific subject characteristic value, wherein said specific subject characteristic value represents a characteristic of image data corresponding to said determined specific subject area;”**

215. Yano discloses or suggests [10.d] for the reasons discussed for [1.c].

Supra Section VIII.B.1.d.

- f. **[10.e]: “a correction value calculation module that calculates a correction value for color balance correction using said calculated specific subject characteristic value and a preset characteristic target value; and”**

216. Yano discloses or Yano and Schroder render obvious [10.e] for the reasons discussed for [1.e]. *Supra* Section VIII.B.1.f.

- g. [10.f]: “a correction execution module that executes said color balance correction on said image data using said calculated correction value.”**

217. Yano discloses or Yano and Schroder render obvious [10.f] for the reasons discussed for [1.f]. *Supra* Section VIII.B.1.g.

* * *

218. 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.

219. 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.

220. 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