IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Erez Galil	
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Title:	DYNAMIC RANGE CORRECTION BASED ON IMAGE CONTENT	

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 8,447,132 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42

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I. INTRODUCTION

Apple Inc. ("Apple" or "Petitioner") petitions for *Inter Partes* Review ("IPR") under 35 U.S.C. §§311–319 and 37 C.F.R. §42 of claims 1, 5-8, and 13 ("the Challenged Claims") of U.S. Patent No. 8,447,132 ("the '132 patent"). As explained below, there exists a reasonable likelihood that Petitioner will prevail in demonstrating unpatentability of at least one of the Challenged Claims based on teachings set forth in the references presented in this petition. Petitioner respectfully submits that an IPR should be instituted and the Challenged Claims canceled as unpatentable.

II. REQUIREMENTS FOR IPR UNDER 37 C.F.R. §42.104

A. Grounds for Standing Under 37 C.F.R. §42.104(a)

Petitioner certifies that the '132 Patent is available for IPR. The present petition is being filed within one year of service of a complaint against Petitioner alleging infringement of the '132 patent. *See Qualcomm Inc. v. Apple Inc*., Case No. 3:17-cv-02402-WQH-MDD (S.D. Cal.). Petitioner is not barred or estopped from requesting this review of the Challenged Claims on the below-identified grounds.

B. Challenge Under 37 C.F.R. §42.104(b) and Relief Requested

Petitioner requests IPR of the Challenged Claims on the grounds set forth in the table below, and requests that each of the Challenged Claims be held

unpatentable. An explanation of unpatentability under the statutory grounds below is provided in the form of detailed description that follows, indicating where each element can be found in the cited prior art, and the relevance of that art. Additional explanation and support for each ground of rejection is set forth in the Declaration of Dr. Larry Davis (APPLE-1003).

Ground	'132 Patent Claims	Basis for Rejection
Ground 1A	**1, 5-7**	**§102 and/or §103 – Needham alone and/or Needham in view of Nonaka**
Ground 1B	**8**	**§103 – Needham in view of Dvir and/or Needham in view of Nonaka and Dvir**
Ground 1C	**13**	**§103 – Needham in view of Gallagher and/or Needham in view of Nonaka and Gallagher**

Needham (APPLE-1004), Nonaka (APPLE-1005), Gallagher (APPLE-1006), and Dvir (APPLE-1007) qualify as prior art under 35 U.S.C. §102(b), as they were issued or published over a year prior to the December 9, 2009, priority date proclaimed by the '132 patent. None of these references were cited in any office action by the examiner during prosecution.

C. Claim Construction under 37 C.F.R. §42.104(b)(3)

Unless otherwise noted below, Petitioner submits that all terms should be given their plain meaning, but reserves the right to respond to any constructions that may later be offered by the Patent Owner or adopted by the Board. Petitioner is not waiving any arguments concerning indefiniteness or claim scope that may be raised in litigation.

"physical object of a predetermined type" (claims 1, 13)

The term "physical object of a predetermined type" should be construed as "something of a predetermined type which exists in the real (physical) world and which can be visually recognized as such by a human being when depicted in a digital image, and which excludes virtual or abstract objects and concepts such as pixels, data, and image characteristics and parameters." APPLE-1003, ¶21. Such a construction is consistent with the '132 patent, which explains that:

> The term "physical object" as used herein is to be understood in contrast with non-physical, virtual or abstract objects and concepts, such as pixels, data, and image characteristics and parameters. A physical object is something that exists in the real (physical) world and which can be visually recognized as such by a human being when depicted in a digital image.

APPLE-1001, 2:27-33. As examples, the '132 patent specification discloses that predetermined types of physical objects can include faces represented in a digital

image. *Id.*, 2:65-3:1.

III. SUMMARY OF THE '132 PATENT

A. Brief Description

The '132 patent describes correction of digital image data based on image content. APPLE-1001, 1:10-13. According to the '132 patent, "[k]nown prior techniques of dynamic range correction do not take into consideration or use the content of an image, at least to the extent such content has semantic significance (meaning) to a human viewer." *Id.*, 2:38-41. The '132 patent discloses a system that allegedly overcame this limitation by considering "the details of certain types of objects depicted in an image [that] often should have higher priority than the rest of the image." *Id.*, 2:41-44. The system includes an object detection unit that identifies predetermined types of physical objects, such as faces, represented in a digital image. *Id.*, 2:65-3:1. Based on the detection of a physical object, the system determines the digital gain to be applied to pixels in the image. *Id.*, 3:1-3. For example, a higher gain may be applied to pixels that are part of a face (i.e., the predetermined object) than for other pixels of the image. *Id.*, 3:6-8.

Fig. 6 (reproduced below) illustrates a process of dynamic range correction. *Id.*, 1:58-59. A pixel from an image is inputted, and a determination is made whether the pixel is part of a group of adjacent pixels that collectively represent a face. *Id.*, 6:34-38. If the pixel does not represent a face, a normal gain value is

selected. *Id.*, 6:38-40. If the pixel does represent a face, an alternative gain value is selected. *Id.*, 40-41. The selected gain value is applied to the input pixel intensity value. *Id.*, 41-44. The '132 patent includes 33 claims, of which claim 1 is independent and is directed towards the implementation as shown in Fig. 6.

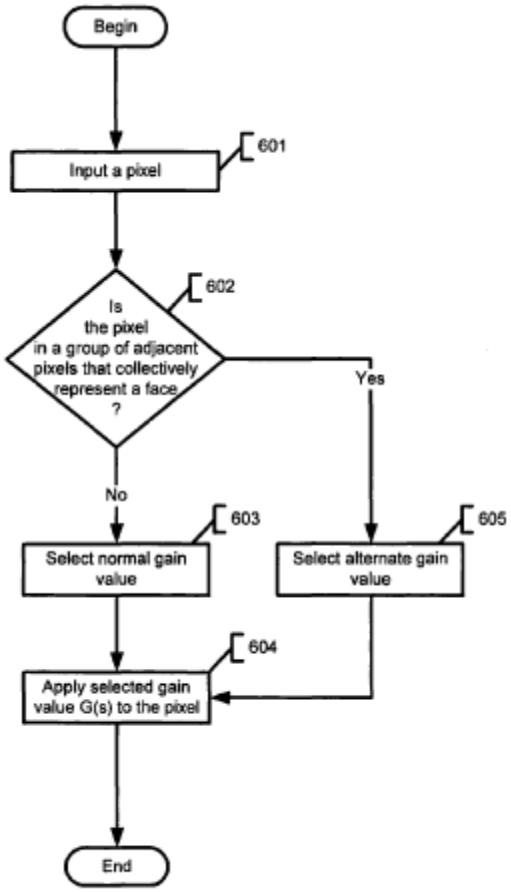

Fig. 6

B. Summary of the Prosecution History of the '132 Patent

Allowance of independent claim 1 was secured through an amendment that included "applying a first amount of the correction to the first portion of the digital image data" and "applying a second amount of the correction to a second portion

of the digital image data, wherein the first amount differs from the second amount, and wherein the first amount corresponds to a physical object of the predetermined type." APPLE-1002, 122, 129-131.

IV. THERE IS A REASONABLE LIKELIHOOD THAT AT LEAST ONE CLAIM OF THE '132 PATENT IS UNPATENTABLE

As detailed below, the Grounds show a reasonable likelihood that at least one claim of the '132 patent is unpatentable.

A. Ground 1A – Needham alone anticipates and/or Needham in view of Nonaka renders obvious claims 1 and 5-7

There is a reasonable likelihood that claims 1 and 5-7 of the '132 patent are anticipated by Needham alone and/or rendered obvious by Needham in view of Nonaka. APPLE-1003, ¶¶45-63. Moreover, to the extent that Patent Owner argues that any element of these claims is not expressly disclosed by this combination, such element would be obvious in view of these references and the knowledge of a POSITA. *See id.*

Overview of Needham[1]

Needham, titled "Feature-based Image Correction," relates to "content based digital image processing." APPLE-1004, [0001]. Needham describes an

[1] Petitioner hereby expressly incorporates the entirety of this discussion regarding Needham into the element-by-element analysis of Grounds 1A-1C.

automatic feature detection unit that detects, from a digital image, predetermined types of image features (e.g., a human face and a building) specified by feature types and constructs a corresponding feature description for each detected image feature. *Id*., [0017], [0020], [0024], [0026], [0028], [0030].

A correction unit receives the feature description for the detected image feature and retrieves the corresponding correction parameters. *Id.*, [0035]. In accordance with the retrieved correction parameters, the correction unit performs a correction operation (e.g., enhancing the brightness or contrast) on the detected image feature according to the feature description and an operational parameter (e.g., an intensity upper bound or dynamic range) that may be defined as a function of statistical properties of the detected image feature. *Id.*, [0029], [0032]. The correction unit can apply different types or amounts of correction to different image features. *Id.*, [0020], [0022], [0028].

Overview of Nonaka[2]

Nonaka describes processing a digital image of a backlight scene having a large luminance difference between a person in the foreground and the background to raise the brightness of the image in order to improve visibility of the person.

[2] Petitioner hereby expressly incorporates the entirety of this discussion regarding Nonaka into the element-by-element analysis of Grounds 1A-1C.

APPLE-1005, [0003], [0005], [0008]-[0009], [0043]-[0044]. The processing can include amplification of luminance and/or contrast emphasis according to the luminance of the different regions of the image. *Id.*, [0029], [0033].

Nonaka's system includes a face detecting section 11 and an optimization processing section 5b. The face detecting section 11 detects whether a human face exists in the image. *Id.*, [0042], [0059]-[0060], [0063]. If a face is detected, the face detecting section 11 outputs the size and position of the detected face, and the optimization processing section 5b performs optimization processing to correct the brightness and emphasize the contrast of the face portion and the person. *Id.*, [0042], [0058], [0064]-[0066]. The amounts of amplifying correction and contrast emphasis applied to the landscape portion of the image can be different than the amounts of amplifying correction and contrast emphasis applied to the person portion of the image. *Id.*, [0047]-[0050].

Needham-Nonaka Combination[3]

Incorporation of Nonaka's teachings improves Needham's system by providing functionality for improving visibility of a person in a backlit scene.

[3] Petitioner hereby expressly incorporates the entirety of this discussion regarding the Needham-Nonaka combination into the element-by-element analysis of Grounds 1A-1C.

APPLE-1005, [0003], [0005], [0008]-[0009], [0043]-[0044]; APPLE-1003, ¶¶61-62. A POSITA would have been led by Nonaka to modify Needham to apply amplifying correction and contrast emphasis (i.e., dynamic range correction), enabling both the person and landscape portions of an image to be more easily distinguished and perceived. APPLE-1003, ¶¶61-62.

Several additional reasons also would have prompted a POSITA to combine the features of Nonaka with the teachings Needham. First, Needham and Nonaka both relate to digital image processing, and specifically to dynamic range correction of digital image data. APPLE-1004, [0001], [0019]-[0022]; APPLE-1005, [0006], [0029], [0033]; APPLE-1003, ¶62. Needham expressly states that its system may include a camera, and Nonaka describes a camera and a method of controlling a camera. APPLE-1004, [0015]; APPLE-1005, [0010]; APPLE-1003, ¶62.

Second, design incentives would also have prompted a POSITA to look to Nonaka to improve the camera of Needham. Nonaka describes processing image data at a high speed so that the image signal from an image pickup device is substantially displayed in real time, and processing image data to enable both the person and landscape portions of an image to be more easily distinguished and perceived during the display of the image for monitoring while the user is shooting the image. APPLE-1005, [0027], [0032]-[0033]. A POSITA would have found it

desirable to process image data at high speed and to improve visibility while the user is shooting the image, and Nonaka describes well-known components and techniques for doing so. APPLE-1003, ¶63. Combining Nonaka's camera and method of controlling a camera with the teachings of Needham produces no more than expected results and is within the capability of a POSITA, and so would have been obvious to a POSITA. *Id*., ¶63; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Thus, a POSITA implementing a camera based on the teachings of Needham would have been motivated to look to Nonaka, would have understood that Nonaka's features could be combined with Needham, and would have found it obvious to do so. APPLE-1003, ¶63.

1. Claim 1

[1p] A method comprising:

Needham alone and/or Needham in view of Nonaka provides element [1p]. APPLE-1003, ¶¶45-63. Needham describes an automated feature-based image correction mechanism in a computing device that performs feature-based image correction operations (i.e., a method). APPLE-1004, [0015], [0029] ("FIG. 5 is an exemplary flowchart for an automated feature-based image correction mechanism…"), [0033] ("FIG. 8 is an example flowchart for the feature-based correction unit…"), Figs. 5, 8. In addition, Nonaka discloses "a method of controlling a camera" to improve visibility of an image. APPLE-1005, [0010],

[0046], [0061] ("a procedure of control processing during the photographing"), Fig. 8.

[1a] determining whether a first portion of digital image data represents a physical object of a predetermined type;

Needham alone and/or Needham in view of Nonaka provides element [1a]. APPLE-1003, ¶¶45-63. Needham relates to "content based digital image processing." APPLE-1004, [0001]. Needham discloses that "the automated feature detection unit 250 detects, from the input image 110, the types of image features that are specified by the feature types 220" and "a specified image feature may correspond to a human face, a building, an animal, etc." *Id.*, [0017], [0026], [0028], [0029], [0030] ("An image feature corresponds to an area in the input image 110"), Fig. 2 (automatic feature detection unit 250), Figs. 3, 4, Fig. 5 (step 540). Because Needham is related to digital image processing, a POSITA would have recognized that Needham's input image contains digital image data. APPLE-1003, ¶45.

Needham's "image feature" corresponds to the claimed "physical object of a predetermined type." *Id*; APPLE-1001, 2:18-35 ("A physical object is something that exists in the real (physical) world and which can be visually recognized as such by a human being when depicted in a digital image."). Needham teaches correcting portions of the input image representing the individual image features. APPLE-1004, [0019], [0020]-[0023], [0027]-[0029], [0035], Fig. 8 (step 870).

Nonaka describes a camera 10 that includes an AFE section 4 that "converts an analog image signal output from the image pickup device 3 into digital image data." APPLE-1005, [0024], [0026], Fig. 1. The camera 10 also includes a face detecting section 11 that "detects, by use of the [digital] image data, whether or not a human face exists." *Id.*, [0036], [0042], [0059], [0063], Figs. 1, 7A, 7B, 8 (step S10-S12). A human face corresponds to the claimed "physical object of a predetermined type." APPLE-1001, 2:18-21, 2:65-3:3 ("predetermined types of physical objects (e.g., faces)"). In Nonaka, "when the face is detected, the face detecting section 11 outputs a size and a position of the face in the screen." APPLE-1005, [0042].

[1b] determining a correction to apply to the first portion of the digital image data, based on a determination that the first portion of the digital image data represents a physical object of the predetermined type, wherein the determined correction is matched to the predetermined type;

Needham alone and/or Needham in view of Nonaka provides element [1b]. APPLE1003, ¶¶45-63. Needham teaches that feature-based image correction is performed based on configuration parameters that include feature type(s), feature weight(s), and correction parameter(s). APPLE-1004, [0024], Fig. 2 (items 215, 220, 230, 240). A correction parameter defines the correction operation (e.g., maximize the intensity dynamic range (i.e., enhance the contrast)) and the operational parameter (e.g., specified dynamic range) used during the correction

operation. *Id.*, [0019]-[0020], [0024], [0031]-[0032], Fig. 7. Needham discloses that "the specified dynamic range 760 may be defined as a function of statistical properties of one or more image features detected from the input image 110." *Id.*, [0032]. Needham also discloses:

> When a correction operation is applied to the entire input image, ***the statistical properties of the detected features may be used to determine how the overall correction may be performed***. For example, the intensity dynamic ranges of all the detected human faces may be used to determine how the intensity dynamic range of the entire input image should be corrected so that the contrast within these faces can be enhanced. When a correction operation is applied to an individual image feature, ***the correction performed on the image feature may be based on both the specified correction parameter(s) 240 as well as the feature weight 230*** (if such weight is specified for the image feature).

Id., [0027] (emphasis added). Thus, Needham teaches that a correction parameter and a feature weight may be defined on an image feature (e.g., the detected human face) and applied to the image feature. *Id.*, [0019]-[0020], [0031].

Needham further teaches retrieving the corresponding correction parameter for each detected image feature. *Id.*, [0035]. A feature-based correction unit performs the specified correction operation according to the operational parameter and the feature weight, based on a feature description (which includes the feature type and feature location) corresponding to the detected image feature. *Id.*, [0026]-

[0027], [0029] ("The correction is made in accordance with the specified correction parameters and the detected image features."), [0030], [0035], Figs. 2, 6. Thus, Needham teaches determining the correction parameter and the feature weight corresponding to (i.e., matched to) the detected image feature, based on a feature description (which includes the feature type and feature location) corresponding to the detected image feature. Needham also teaches determining a correction to apply to the first portion of the digital image data, based on a determination that the first portion of the digital image data represents a physical object of the predetermined type, wherein the determined correction is matched to the predetermined type.

Nonaka teaches that bright regions and dark regions of an image are each appropriately subjected to correction, such as luminance amplification and/or contrast emphasis, based on a luminance value of the region. APPLE-1005, [0029], [0033]. When Nonaka's system detects a face in a dark backlit region of the image, an optimization processing section 5b corrects the brightness of the face and emphasizes the contrast to improve visibility of the face in the dark backlit region. *Id.*, [0029], [0050], [0058], [0064], Fig. 1. Nonaka's system does not perform optimization processing when no face is detected. *Id.*, [0058]. Thus, Nonaka teaches determining a correction to apply to the first portion of the digital image data, based on a determination that the first portion of the digital image data

represents a physical object of the predetermined type, wherein the determined correction is matched to the predetermined type.

[1c] applying the determined correction to the first portion of the digital image data to enhance a visual characteristic of the first portion of the digital image data, by applying a first amount of the correction to the first portion of the digital image data; and
applying a second amount of the correction to a second portion of the digital image data, wherein the first amount differs from the second amount, and wherein the first amount corresponds to a physical object of the predetermined type.

Needham alone and/or Needham in view of Nonaka provides element [1c]. APPLE1003, ¶¶45-63. For the reasons discussed above with respect to element [1b], Needham teaches applying the determined correction to the first portion of the digital image data. APPLE-1004, [0019]-[0020], [0026]-[0027], [0029]-[0031], [0035], Figs. 2, 6. Needham also teaches that the correction can include enhancing image feature characteristics for technical or aesthetic purposes. *Id.*, [0017], [0020] ("maximizing the intensity dynamic range (i.e., enhance the contrast) may be performed on a human face image feature"). Additionally, Needham teaches applying a first amount of the correction, corresponding to the physical object of the predetermined type, to the first portion of the digital image data, and applying a second, different amount of the correction to a second portion of the digital image data:

Different image features may also be considered with different

> importance. For example, human faces may be considered as more important than buildings in the input image 110. To accomplish this for example, ***weights may be assigned to different image features*** to specify their relative importance. Such weights may be used to control the correction parameter(s) during the correction. For instance, ***if the correction operation of maximizing intensity dynamic range is applied to both human faces and buildings and a human face feature has a higher weight than a building feature, the intensity dynamic range used for correcting human faces in an image may be larger (corresponding to higher contrast) than that used for correcting buildings in an image.*** In this way, the human faces may be corrected so that they become more visible than buildings.

Id., [0022] (emphasis added). In other words, Needham discloses applying a weight assigned to human face features (i.e., a first amount of the correction corresponding to the physical object of the predetermined type) when correcting the dynamic range of a human face, and applying a lower weight assigned to building features (i.e., a second, different amount of the correction) when correcting the dynamic range of buildings.

To the extent that Needham's teachings of applying weights to control correction parameters are considered to not *explicitly* disclose applying different amounts of the correction, such a feature was commonly known in similar prior art digital image processing systems. Nonaka discloses that the optimization processing section 5b performs amplifying correction of the landscape portion of

the image with a "gain 1," which raises the luminance of the landscape from E0 to E1, and performs contrast emphasis processing of the landscape to raise the contrast from ΔE0 to ΔE1. APPLE-1005, [0048], Fig. 4A. Because the amount of "gain 1" cannot secure sufficient visibility of the person (including the face) in the backlit region without saturating the landscape, the optimization processing section 5b performs the correction processing of the person with a "gain 2," which is "a correction value larger than that of the gain 1," to raise the luminance of the person from F0 to F2. *Id.*, [0049]-[0050], Fig. 4A. The optimization processing section 5b also performs large contrast emphasis processing, as compared with the contrast emphasis processing of the landscape, of the person to raise the contrast of the person from ΔF0 to ΔF2. *Id.*, [0050], Fig. 4A.

Thus, Nonaka teaches applying a first amount of the correction (e.g., "gain 2") to the first portion (e.g., face portion) of the digital image data and applying a second, different amount of the correction (e.g., "gain 1") to a second portion (e.g., landscape portion) of the digital image data, where the first amount (e.g., "gain 2") corresponds to backlit faces. To the extent needed, a POSITA would have recognized that the predictable modification to Needham, as suggested by Nonaka, would include Needham's system using gain as a correction parameter for dynamic range correction and applying different amounts of gain to different image features. APPLE-1003, ¶62.

2. Claim 5

A method as recited in claim 1, wherein applying the determined correction to the first portion of the digital image data comprises applying a first amount of a parameter to the first portion to enhance the visual characteristic, wherein the first amount of the parameter is different from a second amount of the parameter applied to a second portion of the digital image data, resulting in a first portion of a digital image that corresponds to the first portion of digital image data being brighter than if the second amount of the parameter were applied to both the first portion and the second portion of the digital image data.

Needham alone and/or Needham in view of Nonaka provides claim 5. APPLE1003, ¶¶45-63. As discussed above with respect to elements [1b] and [1c], Needham teaches applying a first amount (e.g., feature weight assigned to human face features) of a parameter (e.g., intensity dynamic range) to the first portion (e.g., a detected human face) to enhance the visual characteristic, where the first amount of the parameter is different from a second amount (e.g., feature weight assigned to building features) of the parameter applied to a second portion (e.g., the detected buildings) of the digital image data. APPLE-1004, [0019]-[0020], [0022], [0026]-[0027], [0029]-[0031], [0035], Figs. 2, 6. Needham discloses that "[i]n this way, the human faces may be corrected so that they become more visible than buildings." *Id.*, [0022]. Thus, Needham teaches that applying different amounts of the parameter to different portions results in the first portion being more visible than the second portion.

To the extent that Needham is considered to not *explicitly* disclose that applying different amounts of the parameter to different portions results in a first portion of a digital image that corresponds to the first portion of digital image data being brighter than if the second amount of the parameter were applied to both the first portion and the second portion of the digital image data, such a feature was commonly known in similar prior art digital image processing systems. As discussed above with respect to element [1c], Nonaka discloses that the optimization processing section 5b performs amplifying correction of the landscape portion of the image with a "gain 1," which raises the luminance of the landscape from E0 to E1. APPLE-1005, [0048], Fig. 4A. ***Because the "gain 1" cannot secure sufficient visibility of the person (including the face) in the backlit region*** without saturating the landscape, ***the optimization processing section 5b performs the correction processing of the person with a "gain 2," which is "a correction value larger than that of the gain 1," to raise the luminance of the person from F0 to F2***. *Id.*, [0049]-[0050] (emphasis added), Fig. 4A. As shown in Nonaka's Fig. 4A reproduced and annotated below, applying gain 2 to the backlit region including the face (i.e., the first portion) results in the first portion being brighter than if gain 1 (i.e., the second amount of the parameter) were applied to both the first portion and the second portion of the digital image data. APPLE-1003, ¶57.

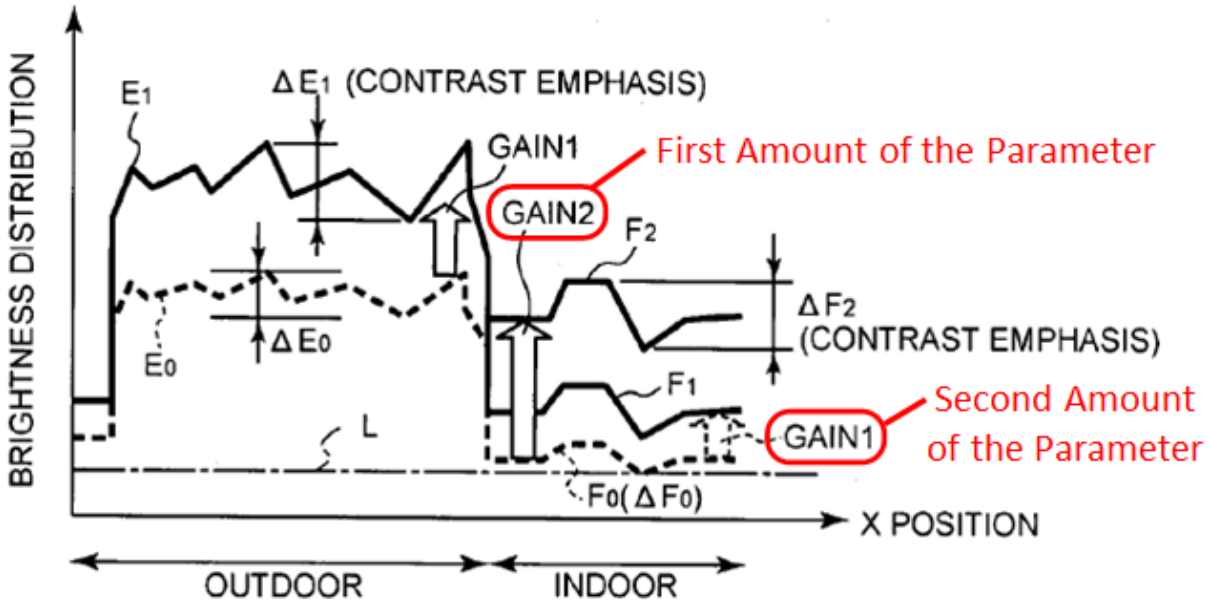

Fig. 4A (Nonaka)

APPLE-1005, Fig. 4A (annotated); APPLE-1003, ¶57.

3. Claim 6

A method as recited in claim 1, wherein the predetermined type of physical object represents facial attributes.

For the same reasons as discussed above with respect to elements [1a]-[1c], Needham alone and/or Needham in view of Nonaka provides claim 6. APPLE1003, ¶¶45-63. Needham discloses that "a specified image feature may correspond to a human face." APPLE-1004, [0017]. Nonaka also discloses detecting whether or not a human face exists in image data thereby integrating Needham's teaching of an image corresponding to a human face. APPLE-1005, [0036], [0042], [0059], [0063], Figs. 1, 7A, 7B, 8 (step S10-S12).

4. Claim 7

A method as recited in claim 1, further comprising:
[7a] determining that the second portion of the digital image data does not represent a physical object of the predetermined type; and

Needham alone and/or Needham in view of Nonaka provides element [7a]. APPLE-1003, ¶¶45-63. As discussed above with respect to element [1a], Needham discloses that "the automated feature detection unit 250 detects, from the input image 110, the types of image features that are specified by the feature types 220" and "a specified image feature may correspond to a human face, a building, an animal, etc." APPLE-1004, [0017], [0026], [0028], [0029], [0030] ("An image feature corresponds to an area in the input image 110"), Fig. 2 (automatic feature detection unit 250), Figs. 3, 4, Fig. 5 (step 540). Needham describes an example (discussed above with respect to element [1c] of claim 1) where Needham's system determines that the first portion of the digital image data represents a human face (i.e., the claimed physical object of the predetermined type) and the second portion of the digital image data represents a building. *Id*., [0017], [0022]. Accordingly, Needham teaches determining that the second portion of the digital image data (e.g., the building) does not represent a physical object of the predetermined type (e.g., a human face).

Nonaka describes that the camera 10 includes a face detecting section 11 that "detects, by use of the image data, whether or not a human face exists."

APPLE-1005, [0036], [0042], [0059], [0063], Figs. 1, 7A, 7B, 8 (step S10-S12). In Nonaka, "when the face is detected, the face detecting section 11 outputs a size and a position of the face in the screen." *Id*., [0042]. Based on Nonaka's teachings of determining the position of the face in the image data, a POSITA would have understood that Nonaka teaches determining that the other portions of the image data do not include the face. APPLE-1003, ¶55.

[7b] determining a different amount of gain to apply to the second portion than an amount of gain determined for the first portion.

For the reasons discussed above with respect to element [1c], Needham alone and/or Needham in view of Nonaka provides element [7b]. APPLE-1003, ¶¶45-63. The Needham-Nonaka combination determines a first amount of gain (e.g., "gain 2") to apply to the first portion (e.g., face portion) of the digital image data and determining a second, different amount of gain (e.g., "gain 1") to apply to the second portion (e.g., landscape portion) of the digital image data. APPLE-1005, [0049]-[0050], Fig. 4A.

B. Ground 1B – Dvir combines with Needham alone or with Needham in view of Nonaka to render obvious claim 8

There is a reasonable likelihood that claim 8 of the '132 patent is rendered obvious by Needham in view of Dvir or Needham in view of Nonaka and Dvir. APPLE-1003, ¶¶45-74. Moreover, to the extent that Patent Owner argues that any element of claim 8 is not expressly disclosed by the combinations, such element

would be obvious in view of these references and the knowledge of a POSITA. *See id.*

Overview of Dvir[4]

Dvir, titled "Dynamic Range Compensation by Filter Cascade," describes dynamic range enhancement using a cascade of nonlinear edge preserving filters and nonlinear pixel point operations. APPLE-1007, [0001], [0005]-[0006]. Dvir's description of its embodiments is very similar to, and in some instances exactly the same as, the '132 Patent's description of the filtering and non-linear combining block 205 and other components of the DRC 117 shown in Figs. 2-4. *Compare* APPLE-1007, [0012]-[0036], Figs. 2-4 *with* APPLE-1001, 3:28-58, 3:65-4:50, 5:15-51, 6:45-9:53, Figs. 3, 4.

Like the '132 patent, Dvir's DRC 117 includes a filtering and non-linear combining block 205 where low pass filtering and non-linear combining are performed to produce a filtered image. APPLE-1007, [0018]. In the basic embodiment, block 205 includes two cascaded 2-dimensional low-pass filters using narrow and wide neighborhoods of the pixel being treated. *Id.*, [0019]. The output of the filter is a filtered image F(s) that is the linear combination of the

[4] Petitioner hereby expressly incorporates the entirety of this discussion regarding Dvir into the element-by-element analysis of Ground 1B.

output of the first stage and the low-pass filtered signal of the second stage. *Id.*, [0020]. The filtered image F(s) is applied to a gain look-up table 207 to determine the gain values G(s). *Id.*, [0018], [0025].

Needham-Dvir and Needham-Nonaka-Dvir Combinations[5]

The Needham-Dvir and Needham-Nonaka-Dvir combinations provide dynamic range correction using a cascade of nonlinear edge preserving filters and nonlinear pixel point operations to calculate the pixel gain. APPLE-1007, [0006], [0012]. Indeed, incorporation of Dvir's teachings further improves Needham's system (and thus, the Needham-Nonaka combination) by providing functionality for refining the estimate of the enhancement gain for the current pixel. APPLE-1007, [0014]. A POSITA would have been led by Dvir to modify Needham and/or the Needham-Nonaka combination to determine the gain for dynamic range correction using a cascade of nonlinear edge preserving filters and nonlinear pixel point operations in order to achieve superior image quality. APPLE-1003 ¶71-72.

Several additional reasons also would have prompted a POSITA to combine the features of Dvir with Needham and/or the Needham-Nonaka combination.

[5] Petitioner hereby expressly incorporates the entirety of this discussion regarding the Needham-Dvir and Needham-Nonaka-Dvir combinations into the element-by-element analysis of Ground 1B.

First, Needham, Nonaka, and Dvir all relate to digital image processing, and specifically to dynamic range correction of digital image data. APPLE-1004, [0001], [0019]-[0022]; APPLE-1005, [0006], [0029], [0033]; APPLE-1007, [0001], [0005]; APPLE-1003, ¶73. Needham and the Needham-Nonaka combination provide a system for dynamic range correction of an image, but does not explain in detail any particular technique for determining the amount of gain to apply. Dvir describes a technique for dynamic range correction that uses a cascade of nonlinear edge preserving filters and nonlinear pixel point operations to calculate the pixel gain. APPLE-1007, [0006], [0012]. In addition, Needham, Nonaka, and Dvir all describe systems for digital cameras. APPLE-1004, [0015]; APPLE-1005, [0010]; APPLE-1007, [0015]; APPLE-1003, ¶73.

Second, design incentives would also have prompted a POSITA to look to Dvir to improve Needham and/or the Needham-Nonaka combination. Dvir describes techniques for correcting a digital image that use the current pixel in conjunction with a plurality of signals derived from one or more successively widening neighborhoods to refine the estimate of the enhancement gain for the current pixel. APPLE-1007, [0014]. A POSITA would have found it desirable to refine the estimate of the enhancement gain for a pixel in order to achieve superior image quality, and Dvir describes well-known components and techniques for doing so. APPLE-1007, [0005]; APPLE-1003, ¶74. Combining Dvir's dynamic

range correction technique with Needham and/or the Needham-Nonaka combination produces no more than expected results and is within the capability of a POSITA, and so would have been obvious to a POSITA. *Id*., ¶74; KSR, 550 U.S. at 417. Thus, a POSITA implementing the teachings of Needham and Nonaka would have been motivated to look to Dvir, and would have found it obvious to do so. APPLE-1003, ¶74.

1. Claim 8

A method as recited in claim 7, wherein determining the amount of gain to apply to the first portion of the digital image data comprises:
determining the amount of gain to apply to the first portion of the digital image data so as to maintain local contrast of the first portion of the digital image data.

The Needham-Dvir and/or Needham-Nonaka-Dvir combination provides claim 8. APPLE-1003, ¶¶45-74. As discussed above with respect to elements [1b]-[1c], Needham, alone and in combination with Nonaka, determines an amount of gain to apply to the first portion to adjust the contrast of the first portion. APPLE-1004, [0019]-[0020], [0022], [0024], [0027], [0031]-[0032], Fig. 7; APPLE-1005, [0029], [0033], [0049]-[0050], [0058], [0064], Fig. 4A. Needham and the Needham-Nonaka combination are complemented by the common knowledge of a POSITA who is aware of similar prior art digital image processing systems that determine the amount of gain to apply to the first portion so as to maintain local contrast of the first portion.

For instance, Dvir describes a dynamic range compensation (DRC) unit that includes cascaded two-dimensional low-pass filters. APPLE-1007, [0005]-[0006], [0012]-[0013], [0019]-[0026], Figs. 3, 4. Dvir discloses that the number of cascaded stages of the filters can be adaptively selected depending on the image content to control local contrast of the image. *Id*., [0033]-[0036]. Dvir also discloses that user preference for the amount of local contrast can also be used to adaptively determine the number of cascaded stages of the filters. *Id.*, [0034].

Based on the disclosures of Dvir, a POSITA would have been motivated to adaptively select the number of cascaded stages of the filters based on the image content and user preference so as to maintain local contrast of the first portion of the digital image data. APPLE-1003, ¶71. Moreover, to maintain local contrast of the first portion of the digital image data, a POSITA would have corrected dynamic range by employing Dvir's cascaded two-dimensional low-pass filters from which the number of stages can be adaptively selected. *Id.* In these ways, a POSITA would have expected success and improvement through the integration of these features of Dvir into Needham alone, or into the Needham-Nonaka combination. *Id.*

C. Ground 1C – Gallagher combines with Needham alone or Needham in view of Nonaka to render obvious claim 13

There is a reasonable likelihood that claim 13 of the '132 patent is rendered obvious by Needham in view of Gallagher and/or Needham in view of Nonaka and

Gallagher. APPLE-1003, ¶¶45-63, 75-83. Moreover, to the extent that Patent Owner argues that any element of claim 13 is not expressly disclosed by this combination, such element would be obvious in view of these references and the knowledge of a POSITA. *See id.*

Overview of Gallagher[6]

Gallagher describes processing a digital image based on semantic information in the image. APPLE-1006, 1:6-13, 3:39-48. In Gallagher, a digital image is processed by a gain map generator to create a gain map that indicates the gain of a correction operation on a pixel-by-pixel or region-by-region basis. *Id.*, 6:25-30. The gain map generator includes a subject matter detector that creates a belief map $M_1(x,y)$ specifying the probability that a pixel or region in an image represents a target subject matter such as human flesh. *Id.*, 6:38-40, 6:55-58. The belief map $M_1(x,y)$ is combined with a target correction level T_1 for the subject matter to produce a gain map for the subject matter. *Id.*, 6:58-61. The value of the gain map at any particular pixel (x,y) represents the gain parameter of the correction and is related to the subject matter detected at the corresponding image

[6] Petitioner hereby expressly incorporates the entirety of this discussion regarding Gallagher into the element-by-element analysis of Ground 1C.

location. *Id*., 6:31-7:33.

Needham-Gallagher and Needham-Nonaka-Gallagher Combinations[7]

The Needham-Gallagher and Needham-Nonaka-Gallagher combinations each use a gain map as an operational parameter for dynamic range correction and modifies the gain map with the weight assigned to the image feature based on the feature description specifying the location of the image feature. APPLE-1003, ¶¶80-81. Indeed, incorporation of Gallagher's teachings further improves Needham (and thus, the Needham-Nonaka combination) by providing functionality for applying a correction operation on a pixel-by-pixel or region-by-region basis based on semantic information in the image. APPLE-1006, 6:25-30; APPLE-1003, ¶¶80-81. A POSITA would have been led by Gallagher to modify Needham and/or the Needham-Nonaka combination to generate a gain map for dynamic range correction and using the gain map to correct the image as suggested by Gallagher. APPLE-1003, ¶81.

Several additional reasons also would have prompted a POSITA to combine the features of Gallagher with Needham and/or the Needham-Nonaka combination.

[7] Petitioner hereby expressly incorporates the entirety of this discussion regarding the Needham-Gallagher and the Needham-Nonaka-Gallagher combinations into the element-by-element analysis of Ground 1C.

First, Needham, Nonaka, and Gallagher all relate to digital image processing. APPLE-1004, [0001]; APPLE-1005, [0033]; APPLE-1006, 1:6-7; APPLE-1003, ¶82. The processing techniques described in Needham, Nonaka, and Gallagher all include feature detection and gain adjustments. APPLE-1004, [0002]-[0003], [0017], [0026], [0028], [0029], [0030], Figs. 2-5; APPLE-1005, [0036], [0042], [0049]-[0050], [0059], [0063], Figs. 1, 4A, 7A, 7B, 8 (step S10-S12); APPLE-1006, 2:37-40, 3:45-48, 6:25-7:33, 8:22-24, Fig. 5; APPLE-1003, ¶82.

Second, design incentives would also have prompted a POSITA to look to Gallagher to improve Needham and/or the Needham-Nonaka combination. Gallagher describes techniques for correcting a digital image without amplifying noise. APPLE-1006, 2:21-24. Increasing the visibility of features in an image may also increase the visibility of noise in the image. APPLE-1003, ¶83; APPLE-1009, 159 ("As often is the case with histogram equalization of smooth, noisy regions, this image shows significant enhancement of the noise."), 192 ("Bringing out detail of this nature by expanding the dynamic range of the intensity levels also enhanced noise"). A POSITA would have found it desirable to adjust the amount of correction of digital image data based on both the content of the image and the amount of noise in the image, and Gallagher describes well-known components and techniques for doing so. APPLE-1003, ¶83. Combining Gallagher's image correction technique with Needham and/or Needham-Nonaka produces no more

than expected results and is within the capability of a POSITA, and so would have been obvious to a POSITA. *Id*., ¶83; KSR, 550 U.S. at 417. Thus, a POSITA implementing Needham and/or Needham-Nonaka would have been motivated to look to Gallagher, and would have found it obvious to do so. APPLE-1003, ¶83.

1. Claim 13

A method as recited in claim 7, wherein determining the amount of gain to apply to the first portion of the digital image data comprises:
modifying a gain map based on the determination that the first portion of the digital image data represents a physical object of the predetermined type; and
wherein applying the determined amount of gain to apply to the first portion of the digital image data comprises obtaining the amount of gain to apply to the first portion of the digital image data from the gain map.

The Needham-Gallagher and/or Needham-Nonaka-Gallagher combinations provide claim 13. APPLE-1003, ¶¶45-63, 75-83. As discussed above with respect to elements [1b]-[1c], Needham, alone and in combination with Nonaka, determines an amount of gain to apply to the first portion of the digital image data and applying the determined amount of gain to the first portion of the digital image data. APPLE-1004, [0019]-[0020], [0022], [0026]-[0027], [0029]-[0031], [0035], Figs. 2, 6; APPLE-1005, [0049]-[0050], Fig. 4A. Needham teaches determining the correction parameter and the feature weight corresponding to the detected image feature and applying the weight assigned to human face features to control the correction parameter when correcting the dynamic range of a human face.

APPLE-1004, [0019]-[0020], [0022], [0026]-[0027], [0029]-[0031], [0035], Figs. 2, 6. Nonaka teaches that the correction parameter for correcting dynamic range is gain. APPLE-1005, [0049]-[0050], Fig. 4A.

To the extent that any of the elements of claim 13 are considered to not be *explicitly* disclosed by Needham alone and Needham in combination with Nonaka, such a feature was commonly known in similar prior art digital image processing systems. For instance, Gallagher teaches generating a gain map that indicates an amount of correction to be applied to image pixels and using the gain map to correct the image. APPLE-1006, 2:37-40. The gain map in Gallagher is generated based on the subject matter (e.g., human face, building, cloud, sky, grass, background) detected in the image. *Id.*, 3:45-48, 6:31-7:33, Fig. 5.

Gallagher's system generates the gain map by modifying a gain map T_0 for a pure background image based on a subject matter belief map $M_1(x,y)$ and a target correction amount T_1 for the detected subject matter (e.g., human flesh). *Id*., 6:55-7:20, Fig. 5. After generating the gain map, Gallagher's system corrects the image according to the gain map. *Id*., 8:22-24. A POSITA would have recognized that the predictable modification to Needham and the Needham-Nonaka combination as suggested by Gallagher would include Needham's system (and thus, the Needham-Nonaka combination) using a gain map T_0 for a pure background image as an operational parameter for dynamic range correction and modifying the gain map T_0

based on the feature description specifying the location of the image feature and the weight assigned to the image feature. APPLE-1003, ¶¶80-81.

V. PAYMENT OF FEES – 37 C.F.R. § 42.103

Petitioner authorizes the Patent and Trademark Office to charge Deposit Account No. 06-1050 for the fee set in 37 C.F.R. §42.15(a) for this Petition and further authorizes payment for any additional fees to be charged to this Deposit Account.

VI. CONCLUSION

Claims 1, 5-8, and 13 of the '132 patent are invalid pursuant to the Grounds set forth above. Accordingly, Petitioner requests inter partes review of claims 1, 5-8, and 13.

VII. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Petitioner, Apple Inc., is the real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

The '132 patent is the subject of a civil action in *Qualcomm Inc. v. Apple Inc.*, Case No. 3:17-cv-02402-WQH-MDD (S.D. Cal.). Petitioner is filing concurrently an IPR petition challenging claims 1, 5-8, 11, and 14 of the '132 patent based on different and non-redundant grounds.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Apple provides the following designation of counsel.

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D. Service Information

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Respectfully submitted,

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter partes* Review totals 7,074 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated June 26, 2018

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on June 26, 2018, a complete and entire copy of this Petition for *Inter partes* Review and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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