UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

JUMIO CORPORATION,
Petitioner

v.

FACETEC, INC.,
Patent Owner.

IPR2025-00108

U.S. Patent No. 11,693,938

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 11,693,938

Mail Stop PATENT BOARD
Patent Trial and Appeal Board
U.S. Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

Page

EXHIBIT LIST

Exhibit	Reference
1001	U.S. Patent No. 11,693,938 ("the '938 Patent")
1002	File History of the '938 Patent
1003	Declaration of Dr. Chris Daft
1004	Dr. Chris Daft Curriculum Vitae
1005	U.S. Patent 8,437,513 ("Derakhshani")
1006	U.S. Patent Application Publication 2011/0299741 ("Zhang")
1007	U.S. Patent Application Publication 2002/0113884 ("Tanii")
1008	U.S. Patent Application Publication 2014/0028823 ("Tahk")
1009	U.S. Patent Application Publication 2004/0239799 ("Suzuki")
1010	U.S. Patent Application Publication 2010/0014720 ("Hoyos")
1011	U.S. Patent 9,077,891
1012	U.S. Patent 8,965,064
1013	Zhengyou Zhang et al., *A Robust Technique for Matching Two Uncalibrated Images Through the Recovery of the Unknown Epipolar Geometry*, Institut National De Recherche En Informatique Et En Automatique (May 1994)
1014	U.S. Patent Application Publication 2010/0158319
1015	U.S. Patent Application Publication 2007/0127787
1016	U.S. Patent Application Publication 2004/0036574
1017	Eugene Hect & Alfred Zajac, *Optics*, Addison-Wesley Publishing Co. (1974)
1018	Anil K. Jain et al., *Introduction to Biometrics*, Springer (2011)
1019	B. Honlinger & H.H. Nasse, *Distortion*, Zeiss (Oct. 2009)
1020	Hue and Hatchet, *What is the Focal Plane?*, https://hueandhatchet.com/what-is-the-focal-plane/
1021	*Introduction to Astronomy*, https://physics.weber.edu/palen/phsx1040/lectures/ldistcomp.html

Exhibit	Reference
1022	Daniel Baker, *Face distortion is not due to lens distortion*, (May 5, 2012), https://bakerdh.wordpress.com/2012/05/05/face-distortion-is-not-due-to-lens-distortion/
1023	Richard Hartley & Andrew Zisserman, *Multiple View Geometry in Computer Vision*, Cambridge Univ. Press (2nd ed. 2011)
1024	Daniel Moreno & Gabriel Taubin, *Simple, Accurate, and Robust Projector-Camera Calibration*, Brown Univ., mesh.brown.edu/calibration/
1025	Serge Belongie, *CSE 252B: Computer Vision II, Lecture 4: Planar Scenes and Homography* (Apr. 7, 2004)
1026	Merriam-Webster's Collegiate Dictionary (11th ed. 2014)
1027	Laurenz Wiskott, *Face Recognition by Elastic Bunch Graph Matching* (1999)
1028	Axis Communications, *CCD and CMOS sensor technology: Technical White Paper* (2010)
1029	Jeff Meyer, *What is Depth of Field? How aperture, focal length and focus control sharpness*, Digital Camera World (July 17, 2013), https://prism.org.gg/wp-content/uploads/2016/07/Depth-of-Field.pdf
1030	Brian Klug, *Understanding Camera Optics & Smartphone Camera Trends, A Presentation by Brian Klug*, Anandtech (Feb. 22, 2013), https://www.anandtech.com/Show/Index/6777?cPage=2&all=False&sort=0&page=2&slug=understanding-camera-optics-smartphone-camera-trends
1031	*Portrait mode now available on iPhone 7 Plus with iOS 10.1*, Apple (Oct. 24, 2016)
1032	*The Timeline of Evolution of the Camera from the 1600s to 21st Century*, Capture.com (May 5, 2023), https://www.capture.com/blogs/insights/evolution-of-the-camera
1033	John Biggs, *A Nokia Camera Phone That's More Like a Camera With a Phone Attached*, The New York Times (Nov. 29, 2007), ttps://www.nytimes.com/2007/11/29/technology/personaltech/29phone.html

Exhibit	Reference
1034	U.S. Patent 7,412,081
1035	U.S. Patent 8,457,367
1036	U.S. Patent 8,260,008
1037	Zac Hall, *Over a decade of selfies, starting with iPhone 4*, 9to5Mac (July 1, 2021), https://9to5mac.com/2021/07/01/iphone-4-selfie-celebration/
1038	Duane C. Brown, *Decentering Distortion of Lenses*, Photogrammertic Engineering (1966)
1039	Reserved
1040	Reserved
1041	Minute Entry, *FaceTec, Inc. v. Jumio Corp.*, C.A. No. 24-cv-03623, ECF No. 38 (N.D. Cal. Sept. 18, 2024)
1042	Reserved
1043	Reserved
1044	Reserved
1045	Reserved
1046	Complaint, *FaceTec, Inc. v. Jumio Corp.*, C.A. No. 24-cv-03623, ECF No. 1 (N.D. Cal. June 14, 2024)
1047	Reserved
1048	Reserved

LISTING OF CHALLENGED CLAIMS

Reference	Claim Limitations
Claim 1	
1[pre]	A non-transient computer readable medium containing non-transitory machine executable code configured to determine if the three-dimensional shape is consistent with that of a human face, the non-transitory machine executable code configured to:
1[a]	receive or derive first biometric data from at least one first image of a user taken with a computing device camera located at a first distance from the user;
1[b]	receive or derive second biometric data from at least one second image of the user taken with the computing device camera located at a second distance from the user, the second distance being different than the first distance;
1[c]	compare the first biometric data with second biometric data for expected differences that result from characteristics of a human face and the at least one first image and the at least one second image being captured at different distances from the user;
1[d]	determine that the three-dimensional shape is not exhibited when the second biometric data does not have expected differences compared to the first biometric data, the expected differences comprising at least differences due to the change in the relative distance between the user's facial features and the camera when the at least one first image was captured at the first distance and the at least one second image was captured at the second distance, wherein the expected differences result from fish-eye type distortion in at least one of the at least one first image and the at least one second image and due to the three-dimensional nature of the human face and the change in distance between the camera and the user.
Claim 2	
2	The non-transient computer readable medium of claim 1 wherein the expected differences appear as changes in the relative size and shape of facial features of the user.
Claim 3	
3	The non-transient computer readable medium of claim 1 wherein determining that three-dimensionality is not exhibited happens during an authentication session.

Claim 4	
4	The non-transient computer readable medium of claim 1 wherein the computing device camera is part of a computing device and the machine executable code is configured to display an interface on the computing device's screen to guide the user to capture the at least one first image at the first distance and the at least on second image at the second distance.
Claim 5	
5[a]	The non-transient computer readable medium of claim 1 wherein the machine executable code is further configured to compare at least portions of the first data, second data, or both to enrollment data derived from an enrollment image, the enrollment image captured and stored prior to an authentication session; and
5[b]	determining the user is not authenticated when the first data, the second data, or both do not sufficiently correspond to the enrollment data.
Claim 6	
6	The non-transient computer readable medium of claim 1 wherein the computing device camera is part of a computing device and the computing device is a hand-held device, and the user holds the device at the first distance to capture the at least one first image and then holds the computing device at the second distance to capture the at least one second image.
Claim 7	
7	The non-transient computer readable medium of claim 1 wherein the first biometric data and the second biometric data comprise image data of facial features.
Claim 8	
8[pre]	A method for determining when a user, based on images of the user's face, does not exhibit three-dimensionality, the method comprising:
8[a]	capturing at least one first image of the user's face taken with a camera located at a first distance from the user's face, the camera associated with a computing device;
8[b]	processing the at least one first image or a portion thereof to create first data;
8[c]	moving the camera to a second distance from the user's face, where the second distance is different from the first distance;

8[d]	capturing, at the second distance, at least one second image of the user's face taken with the camera associated with the computing device;
8[e]	processing the at least one second image or a portion thereof to create second data;
8[f]	examining the first data and the second data to determine whether differences between the first data and the second data indicate an expected type of distorting change in at least one image that is consistent with a real person being imaged and which is indicative of three-dimensionality;
8[g]	determining the user's face is not three-dimensional when the first data and the second data do not have expected differences indicating the user exhibits three-dimensionality.
Claim 9	
9[a]	The method of claim 8 further comprising: capturing one or more additional images at distances from the user's face that are between the first distance and the second distance;
9[b]	for at least one of the one or more additional images, generating additional data;
9[c]	examining the additional data, the first data, and the second data, or portions thereof, to determine whether expected differences therebetween indicate the user's face exhibits three-dimensionality.
Claim 10	
10	The method of claim 8 further comprising displaying one or more prompts on a screen associated with the computing device to guide the user to capture the at least one first image at the first distance and the at least on second image at the second distance.
Claim 11	
11	The method of claim 10 wherein the one or more prompts are an on the screen shape within which an image of a face of the user is aligned during capture the at least one first image and the at least one second image.
Claim 12	
12	The method of claim 8 wherein the computing device is a hand-held device, and the user holds the computing device at the first distance from the user's face when capturing at least one first image and holds the computing device at the second distance from the user's face when capturing the at least one second image.

Claim 13	
13	The method of claim 8 wherein the first data and the second data comprise at least in part biometric data.
Claim 14	
14	The method of claim 8 wherein moving the camera comprises moving the camera linearly toward or away from the user's face.
Claim 15	
15	The method of claim 8 further comprising illuminate a screen of the computing device while capturing the at least one first image and/or the at least one second image to improve quality of an image being captured.
Claim 16	
16	The method of claim 8 wherein a face of the user is held steady when capturing the at least one first image and the at least one second image and the camera moves from the first location to the second location.
Claim 17	
17[pre]	A method, performed using a computing device, for providing authentication of a person during an authentication session, the method comprising:
17[a]	capturing a first image of a head of the person with a camera at a first distance from the person, the camera associated with the computing device;
17[b]	changing a distance between the person and the camera to a second distance, which is different from the first distance;
17[c]	capturing a second image of the head of the person with the camera at the second distance from the person;
17[d]	comparing one or more aspects of the head from the first image or first biometric data derived from the first image to one or more aspects of the head from the second image or second biometric data derived from the second image to determine whether expected differences are not present, wherein the expected differences:
17[e]	would be present when the first image and second images of the head of the person being captured at different distances has three-dimensional characteristics but not if the head did not have three-dimensional characteristics; and
17[f]	the expected differences result from differences in relative dimensions of a person's face appearing different when capturing

	images is done close to the person's face and far from the persons face; and
17[g]	if the expected differences are not present, denying authentication of the person and providing notice thereof to one or more of the person, a third party, or a software application, wherein the authentication is authentication of liveness, three-dimensionality, or both.
Claim 18	
18	The method of claim 17 wherein the steps of comparing, denying authentication, and providing notice are performed by a server that is remote from the computing device.
Claim 19	
19	The method of claim 17 wherein the authentication is authentication of three-dimensionality.
Claim 20	
20[pre]	A method for determining whether a user exhibits three-dimensionality, the method comprising:
20[a]	capturing at least one first image of a user's face taken with a camera located a first distance from the user, the camera associated with a computing device;
20[b]	processing the at least one first image or a portion thereof to create first data, the first data derived from the user's face;
20[c]	intentionally moving the camera from the first location to a second location, the second location being a second distance from the user, or the user moving to change a distance between the user and the camera from the first distance to the second distance;
20[d]	capturing at least one second image of the user's face taken with the camera located a second distance from the user, the second distance being different than the first distance;
20[e]	processing the at least one second image or a portion thereof to create second data, the second data derived from the user's face;
20[f]	analyzing the first data to determine at least if the first data exhibits first characteristics that indicate the first data was derived from an image of the user captured at the first distance;
20[g]	analyzing the second data to determine at least if the second data exhibits second characteristics that indicate the second data was derived from an image the user captured at the second distance, wherein the first characteristics or the second characteristics

	include at least distortion within the at least one first image or the at least one second image;
20[h]	determining the user does not exhibit the expected degree of three-dimensionality when either or both of the following occur:
20[h1]	the step of analyzing the first data determines the first data does not exhibit first characteristics that indicate the first data was derived from an image of the user captured at the first distance; or
20[h2]	the step of analyzing the second data determines the second data does not exhibit second characteristics that indicate the second data was derived from an image of the user captured at the second distance.
Claim 21	
21	The method of claim 20 further comprising displaying one or more prompts on a screen associated with the computing device to guide the user to capture the at least one first image at the first distance and the at least on second image at the second distance.
Claim 22	
22	The method of claim 20 wherein the at least one first image and the at least one second image are captured with a hand-held computing device, and the user holds the computing device at the first distance when capturing at least one first image and at the second distances when capturing the at least one second image.
Claim 23	
23	The method of claim 20 wherein the first data and the second data comprise at least in part biometric data.
Claim 24	
24	The method of claim 20 wherein the first data and the second data comprise at least in part image data of facial features.

I. INTRODUCTION

Unique biometric features such as fingerprints, eyes, and facial features are routinely used to authenticate a user's identity. But as long as biometric authentication has existed, spoofers have sought to trick these systems into thinking the real user is present.

A simple way to spoof a biometric-authentication system is to present a picture of the biological feature instead of the real thing. This attack has been mitigated in different ways for different biometric features. For fingerprints, sensors may check whether the object placed on the scanner conducts electrical current like a real finger. And facial-authentication systems have long used a variety of well-known camera-optics principles to verify the presence of a three-dimensional face rather than a two-dimensional picture.

U.S. Patent No. 11,693,938 ("the '938 Patent," Ex-1001) presents another facial-authentication system that purportedly seeks to distinguish real faces from pictures of a face. The only purported novelty, however, is the specific camera-optics principle used. But that principle was already known, and applying it for facial authentication was not new or non-obvious. For this reason, Jumio Corporation ("Petitioner") requests inter partes review ("IPR") of claims 1-24 ("Challenged Claims") of the '938 Patent.

II. GROUNDS FOR STANDING

Petitioner certifies the ’938 Patent is available for IPR and Petitioner is not barred or estopped from requesting IPR on the grounds herein. Petitioner files this Petition within one year of service of PO’s district court complaint (*see* Ex-1046).

III. STATEMENT OF PRECISE RELIEF REQUESTED FOR EACH CLAIM CHALLENGED

Petitioner respectfully requests review and cancellation under 35 U.S.C. §311 of the Challenged Claims in view of the following prior art and opinions of Dr. Chris Daft (“*Daft*,” Ex-1003):

Prior Art[1]
Derakhshani, U.S. Patent No. 8,437,513, filed August 10, 2012; issued May 7, 2013; prior art under 35 U.S.C. §§102(a)(1), (a)(2) (Ex-1005)
Zhang, U.S. Patent Application Publication No. 2011/0299741, filed June 8, 2010; published December 8, 2011; prior art under 35 U.S.C. §§102(a)(1), (a)(2) (Ex-1006)
Tanii, U.S. Patent Application Publication No. 2002/0113884, filed February 15, 2002; published August 22, 2002; prior art under 35 U.S.C. §§102(a)(1), (a)(2) (Ex-1007)
Tahk, U.S. Patent Application Publication No. 2014/0028823, filed May 22, 2013; published January 30, 2014; prior art under 35 U.S.C. §102(a)(2) (Ex-1008)
Suzuki, U.S. Patent Application No. 2004/0239799, filed on May 25, 2004; published on December 2, 2004; prior art under 35 U.S.C. §§102(a)(1), (a)(2) (Ex-1009)

Ground (all under 35 U.S.C. §103)	**Claims**	**References**
1A	1-10, 12-24	Derakhshani, Tanii
1B	11	Derakhshani, Tanii, Tahk
2A	1-3, 5-9, 12-14, 16-20, 22-24	Zhang, Tanii
2B	4, 10-11, 21	Zhang, Tanii, Tahk
2C	15	Zhang, Tanni, Suzuki

Daft, ¶¶98, 133.

[1] Applying post-AIA §102.

IV. ’938 PATENT OVERVIEW

A. Specification

The ’938 Patent is titled “Facial Recognition Authentication System Including Path Parameters,” was filed on August 27, 2020, and claims priority to several earlier applications dating back to August 28, 2014. Ex-1001, Cover; *Daft*, ¶76, 79.[2] For purposes of this petition only, Petitioner assumes the ’938 Patent is entitled to claim priority back to this date.

The ’938 Patent describes systems and methods to distinguish real, three-dimensional faces from two-dimensional pictures of a face during a facial-authentication process. Ex-1001, 1:66-2:2. To do so, the ’938 Patent proposes evaluating images captured by the facial-authentication system for well-known optical effects—such as the “fish-eye” effect—that naturally occur in images to different degrees due to the three-dimensionality of a face and the distance between the face and the camera. *Id.*, 28:37-61; *Daft*, ¶77. The patent proposes capturing at least *two* images of the face: one “close,” one “far.” Ex-1001, 29:6-22. If the face is three-dimensional, the “close” image should exhibit the known effects (fish-eye distortion), but the “far” image should have much less. *Id.*, 29:14-22. If both images

[2] Dr. Daft provides an overview of biometric authentication and camera optics at ¶¶37-53 (citing Ex-1017–19, Ex-1038).

lack such "expected" effects, however, it likely indicates a spoofing attempt using a two-dimensional picture. *Id*; *Daft*, ¶78.

B. Prosecution History

During prosecution, the Examiner issued a single prior-art rejection, which found the claims would be allowable if directed to evaluating images for "fish-eye" distortion. Ex-1002, 83-105. The Applicant amended one independent claim specifying this distortion, (*id.*, 65-71), but argued for the remainder that the prior art taught different comparisons than looking for "expected differences" or "distortions" (*id.*, 72-77). After a minor Examiner's Amendment, the patent issued. *Id.*, 18-28. None of the prior art presented here was before the Examiner. Ex-1001, Cover; *Daft*, ¶80.

V. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art ("POSITA") in August 2014 would have had a Bachelor's degree in electrical engineering, computer engineering, computer science, physics, or a related field, and two years' work experience related to biometrics, facial authentication, computer vision, and/or optics, such that they would have had significant academic and/or work experience in both software development and optics. *Daft*, ¶¶129-31. Formal education can substitute for work experience and relevant work experience could substitute for formal education. *Id*.

Dr. Daft was at least a POSITA in the field as of August 2014 and is qualified to offer opinions here. *Id.*, ¶1-53, 132.

VI. CLAIM CONSTRUCTION

Petitioner is unaware of any "prior claim construction determination" related to the '938 Patent. 37 C.F.R. §42.100(b); *Daft*, ¶¶81-82. No formal claim constructions are necessary "to resolve the controversy." *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) (cleaned up).

Although there are several indefiniteness issues, none preclude the Board from evaluating patentability here. *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 813 (Fed. Cir. 2021) ("[I]ndefiniteness...precludes a patentability determination only when the indefiniteness renders it logically impossible for the Board to reach…a decision"). For instance, although the claims require "expected differences" between two images, which may be indefinite, the prior art can be evaluated to determine whether it teaches specific types of distortion such as those identified in the '938 Patent (e.g., "fish-eye") that purportedly produce the "expected differences." Ex-1001, 28:37-61, 30:1-11. Moreover, although claim 1 specifies that biometric data is *received or derived* from images, but claim 7 says the biometric data *comprises* image data, this conflict can be ignored by treating image data that includes facial features *as* biometric data. Finally, claim 20 specifies evaluating data to determine the data does "not exhibit [first or second] characteristics," and although these terms are inherently unclear, it can again be assumed that the "characteristics" being evaluated are distortions like those the '938 Patent discloses. *Daft*, ¶¶83-86.

VII. DETAILED EXPLANATION OF GROUNDS

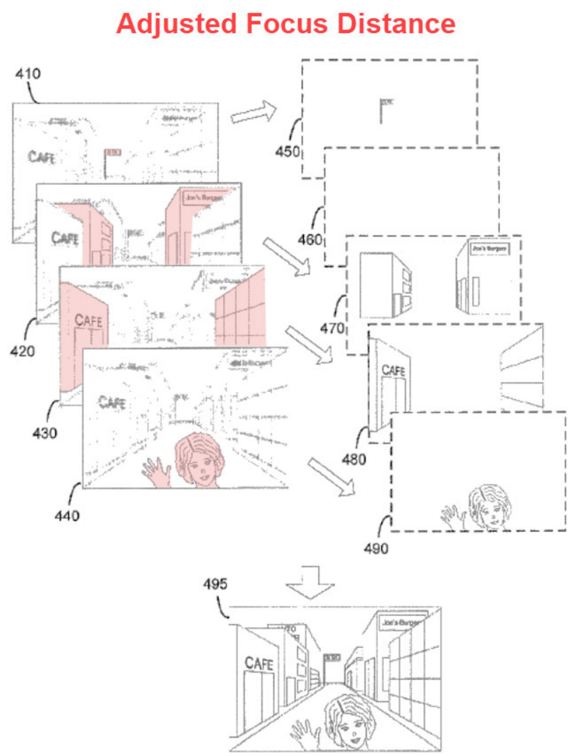
A. Ground 1A: Obviousness in view of Derakhshani and Tanii (Claims 1-10, 12-24)

1. Derakhshani (Ex-1005)

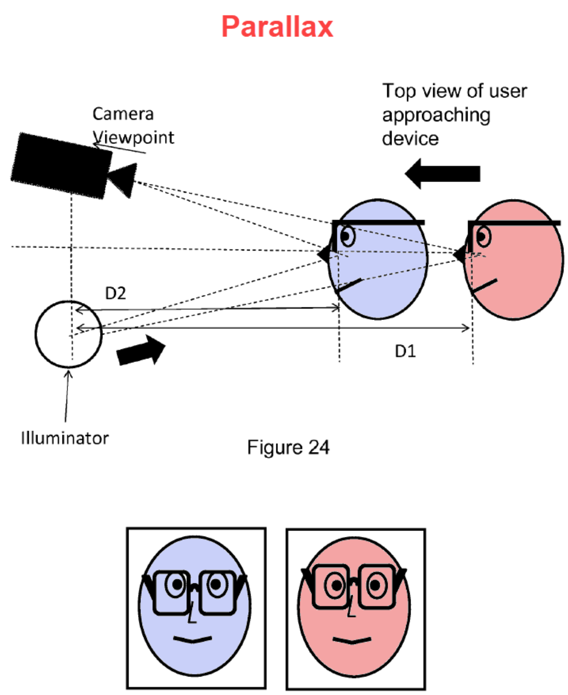
Derakhshani discloses a "biometric authentication" process using a device (e.g., computer or smartphone) that captures images with a camera. *Derakhshani*, 1:11-25, 5:22-27, 6:3-5, 9:10-22, 18:1-3; *Daft*, ¶¶99-100.

Although a user's identity is authenticated by evaluating the user's eyes, the authentication process also verifies whether the user's face is three-dimensional by calculating a "spatial metric" for the entire face. *Derakhshani,* Abstract (ocular authentication), 16:44-18:4 (three-dimensional verification). To verify three-dimensionality, Derakhshani exploits one or more known optics principles, such as: (1) adjusting the *focus* distance of the camera to determine whether different facial features exhibit different amounts of blur across multiple images, indicating the face has depth; and/or (2) evaluating whether "parallax" exists between two images captured from different camera positions, also indicating the face has depth. *Id.*, 16:44-17:11, 17:45-18:4; *Daft*, ¶¶101-02.

For the focus-distance approach, Derakhshani explains: "[a] landmark's representation in a particular image has a degree of focus that depends on how far the object corresponding to the landmark is from an in-focus point in the field of view of the sensor. Degree of focus is a measure of the extent…the image of the landmark is blurred by optical effects." *Derakhshani*, 16:54-59. Other prior art shows this principle in action, depicting several images (410, 420, 430, 440) captured at different focus distances, altering which objects are blurred and which are clear based on their distance from the camera:



See, e.g., Ex-1011, Fig. 4B (annotated); *Daft*, ¶¶103-04; Ex-1020, 4. For parallax, Derakhshani explains: "[a] plurality of images taken from different perspectives on the subject may result in landmarks within the images appearing to move by different amounts because of differences in their distance from the sensor." *Derakhshani*, 17:49-52. Other prior art likewise shows this principle in action, depicting how the position of a user's glasses relative to the eyes shift as the user moves toward the camera:



Ex-1012, Figs. 20, (bottom), 24 (top) (annotated); *Daft*, ¶¶105-06; Ex-1021.

2. Tanii (Ex-1007)

Tanii recognizes a well-known issue with certain camera systems: capturing a three-dimensional object (e.g., a face) at close range—especially when using a wide-angle lens common in mobile devices—can produce distortions in the resulting image based in part on the distance between the object and the camera. *Tanii*, [0005], [0007], [0009]; *Daft*, ¶¶109-10. Specifically, when an object (e.g., face) is close to the camera, it produces an "unnatural image…in which the perspective is exaggerated."

Fig.4A

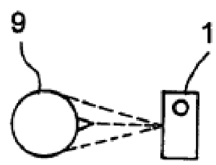
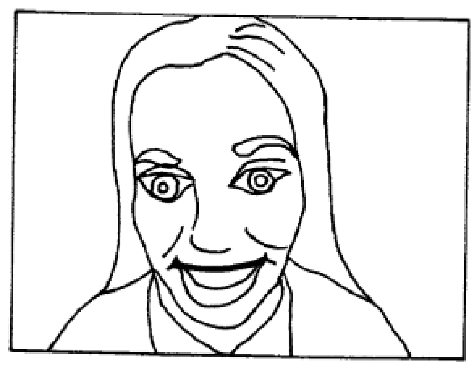


Fig.4B



Tanii, [0047], Figs. 4A-B. But when an object is further from the camera, "a natural image can be obtained."

Fig.3A

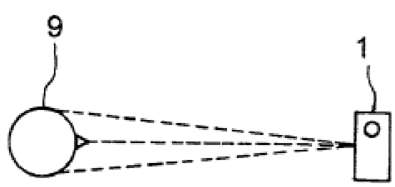
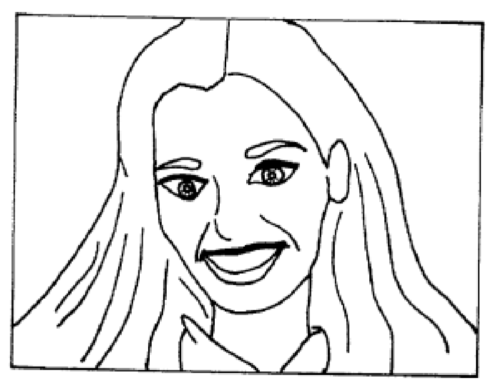


Fig.3B



Id., [0047], Figs. 3A-B; *Daft*, ¶111.

According to Tanii, this distortion arises because the face "has an essentially convex configuration that protrudes toward the [camera]," which causes the peripheral areas of the user to appear smaller relative to the center. *Tanii*, [0048].

Tanii then provides a procedure to correct this distortion by enlarging the image's peripheral areas relative to the center to produce an undistorted image. *Id*., [0056]; *Daft*, ¶¶111-13.

3. Motivation to Combine

A POSITA would have been motivated to combine Derakhshani and Tanii because both concern identifying and accounting for the three-dimensionality of a face when capturing an image. *Daft*, ¶603. They differ, however, in what principles are used to account for that three-dimensionality: Derakhshani uses changes in focus distance and/or parallax effect, (§VII.A.1-(Derakhshani)), whereas Tanii looks for distortions in a face caused by the interaction between the camera's lens and the distance from the imaged object, (§VII.A.2-(Tanii); *Daft*, ¶603). A POSITA would have appreciated, however, that Tanii merely recognizes an obvious alternative to evaluating the depth of a face—consistent with Derakhshani's existing two approaches—and a POSITA would have been motivated to incorporate Tanii's evaluation into Derakhshani. *Id*.

Specifically, a POSITA would have recognized Derakhshani's focus-distance approach and Tanii's evaluation of distance-induced distortions are both attributable to optical effects caused by (among other factors) distances between the camera and the object(s) being captured. *Derakhshani*, 16:57-60 ("Degree of focus is a measure of the extent to the image of the landmark is blurred by optical effects…(e.g., due to *diffraction* and convolution with the aperture shape."); *Tanii*, [0048] (noting the "unnatural image" is caused by the angles of the face relative to the angle of the camera lens); *Daft*, ¶604.

Derakhshani and Tanii differ, however, in the type of diffraction that occurs. *Daft*, ¶605. Specifically, Derakhshani leverages the blurring of objects at distances *other than* the camera's focal plane—often called a "bokeh" effect—which makes those objects appear unfocused. *Derakhshani*, 16:54-59; *Daft*, ¶605. By adjusting the focus distance and evaluating when objects (or features of an object) in an image are clear versus when they are blurry, distance information can be derived. *Derakhshani*, 16:51-63; *Daft*, ¶605.

Tanii, on the other hand, leverages geometric distortion arising from the interaction between the shapes of objects being imaged and the camera's lens. *Daft*, ¶606. As Tanii explains, the convex shape of a three-dimensional face near the lens exacerbates this type of distortion. *Tanii*, [0048]; *Daft*, ¶606. Thus, particularly when a camera incorporates a wide-angle lens, images of a face close to the camera—in which the face occupies most of the image—will exhibit significant distortion. *Tanii*, [0047]; *Daft*, ¶606. But when the face is further from the camera and occupies less of the image, less distortion will be apparent. *Tanii*, [0047]; *Daft*, ¶606. A POSITA would have appreciated, however, that when evaluating multiple images taken at either different *focus* distances (Derakhshani) or *actual* distances (Tanii), these different types of diffraction provide information about an object's depth. *Daft*, ¶607. In other words, a POSITA would have understood Tanii merely teaches an obvious alternative to Derakhshani's existing two approaches to evaluate whether a face being captured is three-dimensional. *Id*.

A POSITA would have also had particular motivation to substitute Derakhshani's existing approaches with Tanii's distance-induced distortion analysis. *Id*., ¶608. Specifically, a POSITA would have understood that implementing Derakhshani's focus-distance approach requires a camera with the ability to set a focal plane at a distance with extreme sensitivity to selectively blur nearby objects at different distances. *See Derakhshani*, 16:48-51; *Daft*, ¶608 (citing Ex-1029). A POSITA would have also understood the cameras often found in mobile devices do not have this ability; mobile devices typically incorporate wide-angle lenses to capture a wide field of view with a large depth of field because of their small size. *Tanii*, [0007]; *Daft*, ¶609 (citing Ex-1017, Ex-1030). In other words, a POSITA would have known there is not enough room in mobile devices to incorporate large image sensors and optics to fine-tune the focus distance to induce blurring of out-of-plane objects. *Daft*, ¶609; Ex-1031.

Accordingly, a POSITA would have been motivated to modify Derakhshani—especially when implementing biometric authentication in a mobile device as Derakhshani already envisions (*Derakhshani*, 5:23-26)—to capture at least two images at different *actual* distances and evaluate whether they exhibit different degrees of distance-induced (barrel/fish-eye), as Tanii suggests. *Daft*, ¶610. A POSITA would have found such a modification obvious because both techniques merely involve the application of well-known optics principles relating camera design and object distance from the camera, and Tanii already taught a mechanism to identify such distance-induced distortions and thus indicate when the face being captured has depth. *See, e.g.*, *Tanii*, [0056]; *Daft*, ¶610. This modification would have been nothing more than the use of a known technique (adjusting *actual* distance to evaluate depth based on distance-induced distortions) to improve similar devices (devices that adjust *focus* distance to evaluate depth based on lens-induced blurring), or a simple substitution of elements. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

Finally, although Derakhshani discloses a separate process to verify the three-dimensionality of a face using parallax, a POSITA would have understood that evaluating for distance-induced distortion consistent with Tanii would be easier for users on a mobile device. *Daft*, ¶611. Specifically, mobile devices (such as phones or laptops) typically capture images of users at arms-length distances. *Id*. And facial features do not have *significant* differences in their depth (on the order of a few centimeters, as opposed to meters between the face and a background). *Id*. Thus, to evaluate for parallax in a face at hand-held distances with suitable accuracy, a user may need to move the device around their head (or vice versa)—out of their direct line of sight—to create substantial differences in perspective and thus more parallax to accurately verify the three dimensionality of the face. *Id*. Evaluating instead for distance-induced distortions when the camera is held at different distances consistent with Tanii—and all within the user's direct line of sight—would therefore be easier to verify that a user's face is, in fact, three dimensional. *Id*. That said, a POSITA would have appreciated that evaluating for distance-induced distortion consistent with Tanii could be *supplemented* by also evaluating for any parallax effects that also arise from capturing images of the face from different distances. *Id*. In other words, a POSITA would have understood the techniques of Derakhshani and Tanii as complimentary and would have been motivated to use both or either, depending upon the application. *Id*.

4. Independent Claim 1

a. 1[pre]

If limiting, Derakhshani discloses or suggests 1[pre]. *Daft*, ¶¶612-14.

Derakhshani discloses a "computing device" with "a machine-readable repository," (*Derakhshani*, 7:15-23), that can run a "computer program" with "instructions that, when executed, perform one or more methods, such as those described," (*id.*, 22:51-64, 24:61-25:8). A POSITA would have understood

Derakhshani discloses a non-transient computer readable medium containing non-transitory machine executable code. *Daft*, ¶613.

Derakhshani further discloses the computer program involves an authentication process that verifies the user's face is three-dimensional by capturing multiple images of a user's face and calculating a "spatial metric" representing the face's three-dimensionality. *Derakhshani,* 1:11-25, 3:14-15, 16:44-18:4; *Daft*, ¶614.

b. 1[a]

Derakhshani discloses or suggests 1[a]. *Daft*, ¶¶615-19.

Derakhshani discloses, for three-dimensional verification, "two or more images of a subject" are captured using the computing device's camera. *Derakhshani*, 1:44-46, 16:44-17:11, 17:45-18:4. A POSITA would have understood Derakhshani captures an image at a first distance because some distance must exist between the user and camera to capture an image of the user's face. *Derakhshani*, 16:44-17:11; *Daft*, ¶617.

Derakhshani also discloses processing the images so that "a landmark (e.g., an iris, an eye corner, a nose, an ear, or a background object) may be identified and located in the plurality of images." *Derakhshani*, 16:44-54 (focus distance approach), 17:45-64 (parallax approach). A POSITA would have understood Derakhshani's facial-landmark identification constitutes deriving "biometric data" because the identification involves using a computer (which operates on data) to characterize the unique physical characteristics of an individual, which would include the positions of "landmarks" such as a user's eyes, nose, ears, and other features. *Daft*, ¶619 (citing Ex-1018).

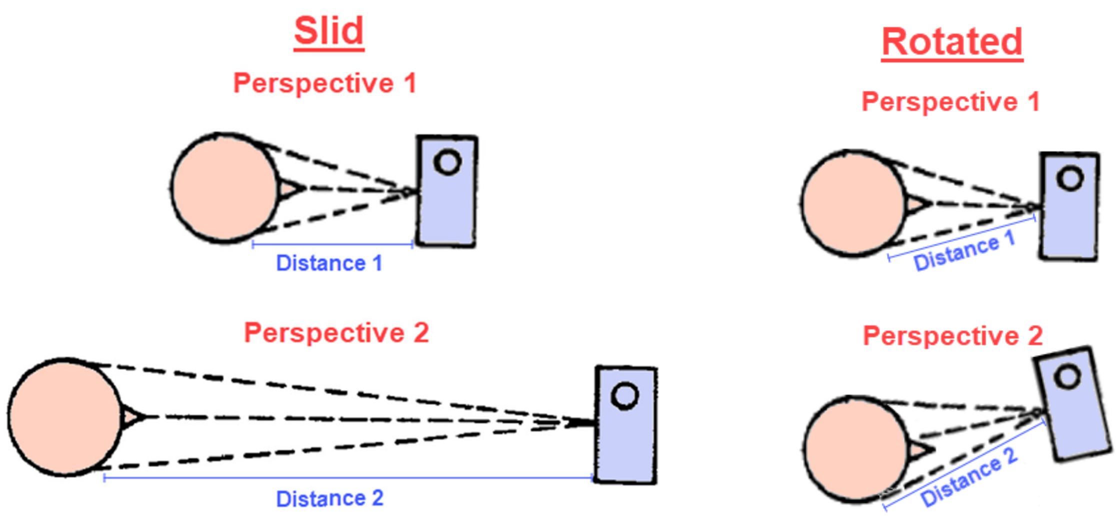
c. 1[b]

Derakhshani, alone or combined with Tanii, teaches 1[b]. *Daft*, ¶¶620-27.

Derakhshani discloses capturing "two or more images of a subject" using the camera. *Derakhshani*, 1:44-46, 16:44-17:11, 17:45-18:4; §VII.A.4.b-(1[a]). Derakhshani further discloses processing the images to extract biometric feature-point data from the images. §VII.A.4.b-(1[a]).

For Derakhshani's focus-distance approach, a POSITA would have understood the distance between the user and the camera would need to change if the camera has a fixed focus distance (like in many mobile devices). *Daft,* ¶621. In other words, a POSITA would have understood and found it obvious that when using Derakhshani's focus-distance approach with a fixed-focus-distance camera, Derakhshani captures multiple images from multiple distances. *Id*.

In addition, a POSITA would have understood Derakhshani's parallax approach captures multiple images from multiple distances, because Derakhshani discloses "[a] plurality of images [are] taken from different perspectives on the subject," such as: (1) when "a single camera [is] rotated or slid slightly"; (2) "a user is prompted to move" between image captures; or (3) the sensor moves naturally, such as "where the sensor is a camera in a hand-held user device (e.g., a smartphone or tablet) [that] may naturally move relative to the users face due to involuntary haptic motion." *Derakhshani*, 17:45-18:4. Thus, Derakhshani envisions capturing a second image after moving the camera, which a POSITA would have understood changes the distance from landmarks of the face, if not the entire face, as demonstrated below (showing an exemplary top-down view of a face and camera):



Daft, ¶¶622-25. Thus, a POSITA would have understood Derakhshani to disclose or suggest taking a second image of a user from a second distance that is different than the first to evaluate for parallax. *Id*.

But even if Derakhshani does not expressly disclose taking two images at different distances, doing so would have been obvious in view of other prior art. A POSITA would have understood, for instance, that distance-induced distortions indicate three-dimensionality of the object being captured, as Tanii teaches. *Tanii*,

[0048]; *Daft*, ¶626; §VII.A.3-(motivation). Accordingly, a POSITA would have been motivated to modify Derakhshani in view of Tanii to expressly capture a second image at a second distance, and look for different degrees of distance-induced distortions to verify the user's face is three-dimensional. *Daft*, ¶626; §VII.A.3-(motivation).

Finally, Derakhshani discloses deriving biometric data by processing the captured images—including the second image—to identify biometric "landmarks" in the face as part of the three-dimensional verification process. *Derakhshani*, 17:45-52; §VII.A.4.b-(1[a]); *Daft*, ¶627.

d. 1[c]

Derakhshani, alone or combined with Tanii, teaches 1[c]. *Daft*, ¶¶628-32.

Derakhshani discloses that, for either the focus-distance or parallax approach, biometric features are compared between each of the images to match them. *Derakhshani*, 16:66-17:2 ("comparing the degree of focus for a landmark in images with different focus distances"); 17:45-64 (evaluating relative displacement of identified landmarks); *Daft*, ¶629. Moreover, a POSITA would have appreciated that, when modifying Derakhshani to evaluate distance-induced distortions consistent with Tanii, biometric data would be compared between images to determine whether they exhibit distance-induced distortion. *Id.*, ¶632.

Derakhshani discloses comparing the first biometric data to the second biometric data to determine whether expected differences between the two exist. *Derakhshani*, 16:66-17:2 (focus distance), 17:55-59 (parallax). Specifically, Derakhshani's focus-distance approach looks for expected differences in the blurriness/clarity of facial landmarks by changing *actual* distance (for fixed-focus cameras), and the parallax approach looks for different relative displacements of landmarks by also changing *actual* distance. *See Derakhshani*, 16:66-17:2, 17:55-59; §VII.A.4.c-(1[b]); *Daft,* ¶629. And a POSITA would have appreciated that the expected differences result from characteristics of a human face because Derakhshani uses landmarks specific to the human face, such as "an iris, an eye corner, a nose, an ear," to make the comparison. *Derakhshani*, 16:51-52; *Daft*, ¶630.

Moreover, when combining Derakhshani and Tanii, a POSITA would have understood the biometric data from the first and second images would be compared (as Derakhshani already discloses for the focus-distance and parallax approaches) to determine whether the images exhibit expected differences in the amount of distance-induced distortion (as described by Tanii). §VII.A.3-(motivation); *Daft*, ¶632. A POSITA would have understood that evaluating for different degrees of distance-induced distortion relies on a well-known optical effect of camera systems—particularly wide-angle camera systems common in mobile devices—to provide an alternative or supplemental, user-friendly verification of three-dimensionality of a face. §VII.A.3-(motivation); *Daft*, ¶632.

e. 1[d]

Derakhshani combined with Tanii teaches 1[d]. *Daft*, ¶¶633-35.

Derakhshani discloses determining a face is ***not*** three-dimensional when the facial landmarks (e.g., biometric data) match between the two images. §VII.A.4.d-(1[c]); *Daft*, ¶634. For the focus-distance approach, a match exists if the facial landmarks do not exhibit different degrees of clarity (blurriness or clarity) between images, indicating the features are on the same plane (and thus lack depth). §VII.A.4.d-(1[c]); *Daft*, ¶634. For the parallax approach, a match exists if all facial landmarks are displaced by the same amount, again indicating the features are on the same plane. §VII.A.4.d-(1[c]); *Daft*, ¶634. Therefore, a POSITA would have understood that a face is determined ***not*** to be three-dimensional if the images do not exhibit these expected differences in clarity or relative displacement. *Id*.

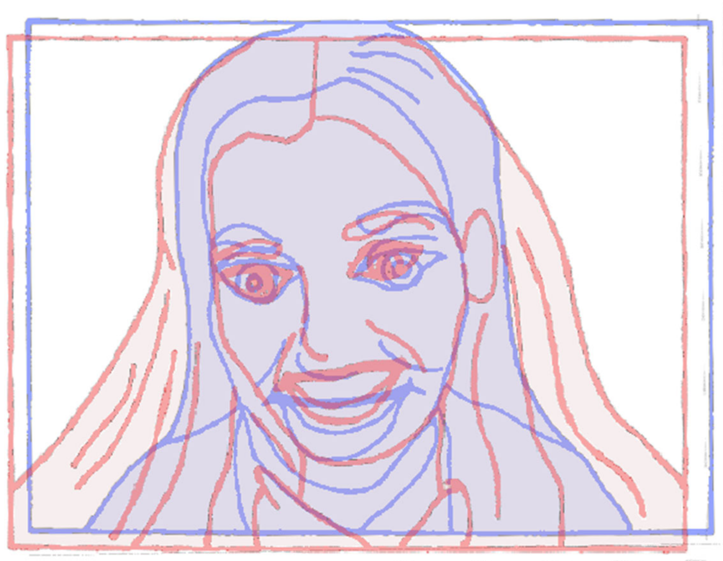
Although Derakhshani does not disclose that the expected difference is a "fish-eye" distortion caused by changing the distance between the camera and face, when modifying Derakhshani in view of Tanii, a POSITA would have understood that the combination would evaluate whether facial features exhibit different degrees of distance-induced, "fish-eye" distortion. §VII.A.3-(motivation); *Daft*, ¶635. And if the images captured at different distances do ***not*** contain different degrees of expected, distance-induced, "fish-eye" distortion, a POSITA would have understood that to be an indication that the face is not three dimensional. §VII.A.3-(motivation); *Daft*, ¶635.

5. Claim 2

Derakhshani, alone or combined with Tanii, teaches claim 2. *Daft*, ¶¶636-40.

Derakhshani uses facial landmarks, such as "an iris, an eye corner, a nose, an ear," to verify a face's three-dimensionality. *See Derakhshani*, 16:51-52. A POSITA would have understood that changing the distance between the face and camera inherently changes the size of facial landmarks (e.g., more distance means smaller features, and vice versa). *Daft*, ¶638. A POSITA would have further appreciated that Derakhshani's focus-distance and parallax approaches further look for changes in shape of the facial landmarks: changing focus distance changes the clarity of facial features, and changing perspective for parallax captures facial landmarks from different perspectives. *Id.*, ¶639 (citing Ex-1018).

When modifying Derakhshani in view of Tanii to look for different degrees of distance-induced distortion, however, Tanii teaches the expected differences in a face caused by distance-induced distortion is the relative size and shape of facial features of the user. *Tanii*, [0047] ("where the main object 9 and the cellular phone 1 are close together…an unnatural image results in which the perspective is exaggerated."), [0056] (describing "a warp in which the peripheral areas of the main object appear reduced in size relative to the center area").



Daft, ¶640. A POSITA would have therefore looked to these expected differences in size and shape of facial features to determine whether the face is three-dimensional. *Id*.

6. Claim 3

Derakhshani discloses or suggests claim 3's additional limitation. *Daft*, ¶¶641-43.

Derakhshani discloses calculating a "liveness score" during an authentication session. *Derakhshani*, 4:53-63; *Daft*, ¶642. Derakhshani also discloses the "liveness score" is based on "liveness metrics," including the "spatial metric" verifying the three-dimensionality of a user's face. *Derakhshani*, 14:59-63, 15:26-31, Fig. 7; *Daft*, ¶642. A POSITA would have understood that calculating Derakhshani's "spatial metric" (whether alone or combined with Tanii) occurs during an authentication session to determine whether a live, three-dimensional face is being presented for authentication. *See Derakhshani*, 9:39-48, 11:5-16; *Daft*, ¶643.

7. Claim 4

Derakhshani, alone or combined with Tanii, teaches claim 4. *Daft*, ¶¶644-46.

Derakhshani discloses implementing the invention in computing devices such as a "smart phone, a tablet computer, a television, a laptop computer, or a personal computer," (*Derakhshani*, 5:22-27), which incorporate a camera, (*id*., 5:23-27, 6:3-10), and a display, (*id*., 6:8-11, 9:22-24, 14:35-37, 22:33-38, 25:9-15). Derakhshani also discloses displaying prompts to guide the user when capturing images of the user's face for authentication, (*id.*, 5:23-32, 6:8-16, 9:22-26), including at more than one distance, (*id*., 17:64-66; §VII.A.4.c-(1[b]); *Daft*, ¶645).

When modifying Derakhshani to look for distance-induced distortions by capturing images at different distances, consistent with Tanii (§VII.A.4.c-(1[b]), a POSITA would have found it obvious to also provide an interface on the computing device's screen to guide the user and ensure the images are captured at the correct distances, as Derakhshani already discloses providing prompts to correctly orient the user relative to the camera. *Daft*, ¶646.

8. Claim 5

a. 5[a]

Derakhshani discloses or suggests 5[a]'s additional limitation. *Daft*, ¶¶647-48.

Derakhshani discloses capturing and analyzing multiple images of a user and comparing the user's features to a previously stored "reference record" (e.g., enrollment data) for authentication. *Derakhshani*, 4:19-24; 7:20-34; 8:60-64; 9:31-34; *Daft*, ¶648. To create the "reference record," the system captures reference images of the user during enrollment/registration—prior to a subsequent authentication/verification—extracts biometric features from the reference images, and stores the extracted features as the "reference record." *Derakhshani*, 7:19-34; 9:31-34; 13:62-14:9; *Daft*, ¶648. During the subsequent authentication process, Derakhshani compares the extracted features from the captured images (i.e., portions of the first data, second data, or both) to the user's reference record to determine a match score to verify the identity of the user, consistent with convention. *Derakhshani*, 9:59-67; 13:62-14:9; 17:32-36; *Daft*, ¶648 (citing Ex-1018).

b. 5[b]

Derakhshani discloses or suggests 5[b]'s additional limitation. *Daft*, ¶¶649-50.

During authentication, Derakhshani calculates a match score by comparing features extracted from the first and second image to the corresponding features in a reference record. *Derakhshani*, 13:62-14:9. Derakhshani also discloses that, when the match score is low—because the first or second data, or both, do not sufficiently correspond to the reference record—the user is not authenticated. *Id.*, 14:25-35; *Daft*, ¶650.

9. Claim 6

Derakhshani, alone or combined with Tanii, teaches claim 6. *Daft*, ¶¶651-53.

Derakhshani discloses the biometric-authentication process can be implemented on hand-held computing devices, such as "a laptop computer, a handheld computer…, a tablet computing device, a personal digital assistant (PDA), a cellular telephone…, a camera, a smart phone," and more, (s*ee, e.g.*, *Derakhshani*, 8:11-28, 18:1-4), which incorporate a camera, (*id*., 5:23-27, 6:3-10). Moreover, Derakhshani recognizes that, to verify three-dimensionality of the face, "a single camera may be rotated or slide slightly," or even a hand-held device "may naturally move relative to the users face due to involuntary haptic motion" that may sufficiently capture a parallax effect. *Id.*, 17:59-18:4. Tanii also notes that distance-induced distortions often occur in mobile devices that have incorporated wide-angle lenses, and the amount of distortion is dictated by the distance between the user and the camera. *Tanii*, [0007], [0047]-[0048], Figs. 3A-B, 4A-B; *Daft*, ¶652.

When verifying three-dimensionality of a user's face on a handheld mobile computing device consistent with Derakhshani (with or without Tanii) (§§VII.A.4.c-VII.A.4.e (1[b]-1[d])), a POSITA would have understood the user holds the computing device at a first distance for the first image, and a second distance for the second image (e.g., by extending and retracting the user's arm). *Daft*, ¶653. That is a convenient and obvious way of changing the distance between a hand-held device and the user's face, and Derakhshani envisions evaluating depth based on displacement of the user's arm holding the device. §VII.A.1-(Derakhshani); *Derakhshani*, 16:44-17:11, 17:45-18:4; *Daft*, ¶653.

10. Claims 7 and 24

Derakhshani discloses or suggests claims 7 and 24's additional limitation.[3] *Daft*, ¶¶654-55, 733.

Derakhshani discloses processing the captured images to identify and locate facial biometric "landmarks" (e.g., an iris, eye corner, nose, mouth, ear, etc.). *Derakhshani*, 16:44-54. A POSITA would have understood that Derakhshani's identification of facial landmarks from the captured images constitutes image data of facial features. *Daft*, ¶655.

---

[3] Claim limitations that depend from different independent claims but present materially similar claim language are analyzed together.

11. Independent Claim 8

a. 8[pre]

If the preamble is limiting, Derakhshani discloses or suggests it. *Daft*, ¶¶656-57.

Derakhshani discloses a method to determine whether images of a user's face do not exhibit three-dimensionality. §VII.A.4.a-(1[pre]); *Daft*, ¶657.

b. 8[a]

Derakhshani discloses or suggests 8[a] for the reasons discussed in §VII.A.4.b-(1[a]). *Daft*, ¶658.

c. 8[b]

Derakhshani discloses or suggests 8[b] for the reasons discussed in §VII.A.4.b-(1[a]); *Daft*, ¶659.

d. 8[c]

Derakhshani, alone or combined with Tanii, teaches 8[c]. *Daft*, ¶¶660-662.

Derakhshani (with or without Tanii) discloses capturing a series of images for verifying three-dimensionality of a user's face (§VII.A.4.c-(1[b])) by moving a camera relative to a user (*Derakhshani*, 17:59-18:4; §VII.A.9-(cl.6)). A POSITA would have understood either the camera would move from the first to the second distance, or the user would move in relation to the camera to capture multiple images at multiple distances. §VII.A.4.c-(1[b]); *Daft*, ¶661. Derakhshani also discloses using mobile-computing devices that incorporate a camera such as "smart phone[s]." *Derakhshani*, 5:22-27.

A POSITA would have therefore found it obvious to move the camera relative to the user's face because it is the more user-friendly of the two possible options for changing the distance between the user's face and the camera (either moving the camera or the user). §XII.A.7-(cl.6); *Daft*, ¶662.

e. 8[d]

Derakhshani, alone or combined with Tanii, teaches 8[d] for the reasons discussed in §VII.A.4.c-(1[b]). *Daft*, ¶663.

f. 8[e]

Derakhshani, alone or combined with Tanii, teaches 8[e] for the reasons discussed in §VII.A.4.c-(1[b]). *Daft*, ¶664.

g. 8[f]

Derakhshani, alone or combined with Tanii, teaches 8[f] for the reasons discussed in §§VII.A.4.d-VII.A.4.e (1[c]-1[d]). *Daft*, ¶665.

h. 8[g]

Derakhshani, alone or combined with Tanii, teaches 8[g] for the reasons discussed in §VII.A.4.e-(1[d]). *Daft*, ¶666.

12. Claim 9

a. 9[a]

Derakhshani, alone or combined with Tanii, teaches 9[a]. *Daft*, ¶¶667-70.

Derakhshani discloses "a plurality" of images are be captured to verify three-dimensionality. *Derakhshani*, 16:44-46 (focus-distance approach), 17:45-47 (parallax approach). A POSITA would have understood generally that capturing more images would be more accurate at verifying three-dimensionality because there would be more samples to evaluate, but may require more computational resources and time. *Daft*, ¶669. A POSITA would have found it obvious to capture *at least* two images of the face, or more to improve accuracy. *Id*.

Additionally, Tanii discloses that distance-induced distortions increase as distances between the face and camera decreases, (*see Tanii*, [0048]), and thus some intermediate set of distances would be expected to exhibit intermediate levels of distortion, (*Daft*, ¶670).

A POSITA would have therefore been motivated using either Derakhshani's or Derakhshani-Tanii's approaches to capture additional images at least one distance between the first and second distances to determine whether each exhibit an expected degree of distortion (whether blurring or distance-induced) to further confirm the three-dimensionality of the user's face. *Id*.

b. 9[b]

Derakhshani, alone or combined with Tanii, teaches 9[b]. *Daft*, ¶¶671-72.

Derakhshani discloses processing the images to identify feature landmarks in each of the images. §§VII.A.4.b-VII.A.4.c (1[a]-1[b]). A POSITA would have considered it obvious to process each captured image to generate biometric data to be used in a biometric-authentication process. *Daft*, ¶672.

c. 9[c]

Derakhshani, alone or combined with Tanii, teaches 9[c]. *Daft*, ¶¶673-75.

Derakhshani discloses verifying three-dimensionality by evaluating differences between the facial landmarks (e.g., data) using either the focus-distance or parallax approach. §§VII.A.4.d-VII.A.4.e (1[c]-[d]); *Daft*, ¶674. And Derakhshani and Tanii teach verifying three-dimensionality by evaluating expected differences caused by distance-induced distortion. §§VII.A.4.d-VII.A.4.e (1[c]-[d]); *Daft*, ¶674.

A POSITA would have understood that, when capturing additional images under any of the three approaches (focus distance, parallax, or distance-induced distortion), facial landmarks would be identified and compared to the first and second biometric data to determine whether expected differences exist. *See* §§VII.A.12.a (9[a]), VII.A.12.b (9[b]); *Daft*, ¶675.

13. Claims 10 and 21

Derakhshani, alone or combined with Tanii, teaches claims 10 and 21. *Daft*, ¶¶676-78, 730.

Derakhshani discloses displaying prompts to guide the user to capture facial images for authentication, (*Derakhshani*, 5:23-32, 6:8-16, 9:22-26), including at more than one distance (with or without Tanii), (*id.*, 17:64-66; §§VII.A.3 (motivation), VII.A.4.c (1[b]), VII.A.7 (cl.4); *Daft*, ¶¶677-78).

When modifying Derakhshani to look for distance-induced distortions by capturing images at different distances, consistent with Tanii (§VII.A.4.e-(1[d])), a POSITA would have found it obvious to also provide prompts to a user to ensure the images are captured at the correct distances, as Derakhshani already discloses providing prompts to correctly orient the user relative to the camera. *Daft*, ¶678.

14. Claims 12 and 22

Derakhshani, alone or combined with Tanii, teaches claims 12 and 22 for the reasons discussed in §VII.A.9-(cl.6). *Daft*, ¶¶679-80, 731.

Furthermore, a POSITA would have understood that, when adjusting the distance of a hand-held computing device, the device would move between a first distance *from the user's face* and a second distance *from the user's face* because Derakhshani and Tanii are both concerned with differences in images *of a user's face* captured in different conditions, including distances. §VII.A.4.c-(1[b]); *Daft*, ¶680.

15. Claims 13 and 23

Derakhshani discloses or suggests the additional limitations of claims 13 and 23. *Daft*, ¶¶681-82, 732.

Derakhshani discloses the first and second data comprise biometric data. §§VII.A.4.b-VII.A.4.c (1[a]-1[b]); *Daft*, ¶682.

16. Claim 14

Derakhshani, alone or combined with Tanii, teaches claim 14. *Daft*, ¶¶683-85.

Derakhshani discloses "[a] plurality of images [are] taken from different perspectives on the subject," *Derakhshani*, 17:45-18:4, including a camera that is "slid" or "rotated." §VII.A.4.c-(1[b]). A POSITA would have found it obvious to "slide" Derakhshani's camera linearly towards or away from the user's face when following the focus-distance approach (for fixed-focus-distance cameras) or to change perspectives for the parallax effect. §VII.C.3.c-(1[b]); *Daft*, ¶684.

Similarly, Tanii teaches images captured at different distances exhibit different degrees of distortion, and depicts a linear movement of the camera towards or away from the user. *Tanii*, [0047]-[0048], [0056], Figs. 3A-B, 4A-B. A POSITA would have therefore understood that, when combining Derakhshani and Tanii, two images would be captured at different distances, with the camera moving *linearly* towards or away from the user's face. *See* VII.A.4.c (1[b]); *Daft*, ¶685.

17. Claim 15

Derakhshani discloses or suggests claim 15's additional limitation. *Daft*, ¶¶686-88.

Derakhshani discloses calculating a "reflectance metric" that measures changes in surface glare on the eye due to light, such as the illumination of the screen. *Derakhshani*, 18:8-19. A POSITA would have understood that illuminating the screen while capturing the first and second images would improve the quality of the image for authentication purposes by inducing a glare in the eyes of the user. *Daft*¸¶687.

However, a POSITA would have also understood that using a "flash" of light during image capture was a well-known and conventional way to improve image quality, and particularly in dim-lit environments. *Daft*¸¶688. Thus, a POSITA would have also found it obvious to use a "flash" of light by illuminating the screen of the device to improve the overall image quality. *Id*.

18. Claim 16

Derakhshani, alone or combined with Tanii, teaches claim 16. *Daft*, ¶¶689-91.

Derakhshani (alone or combined with Tanii) discloses or suggests moving the camera to capture images at two different distances. §§VII.A.4.c-(1[b]), VII.A.16-(cl.14); *Daft*, ¶690. A POSITA would have understood that, when moving the camera to capture images from different distances, the user's face would be stationary (e.g., steady). *Id*., ¶691. A POSITA would have appreciated that holding the user's face steady and moving the camera closer and further away would be more user-friendly than requiring the user to move their head closer and further from the camera while holding the camera steady. *Id*.

19. Independent Claim 17

a. 17[pre]

If the preamble is limiting, Derakhshani discloses or suggests it. *Daft*, ¶¶692-94.

Derakhshani discloses a computer-implemented authentication method for authenticating a person during an authentication session. *See, e.g.*, *Derakhshani*, Abstract, 1:11-2:3; §§VII.A.4.a-(1[pre]), VII.A.8-(cl.5);[4] *Daft*, ¶694.

b. 17[a]

Derakhshani discloses or suggests 17[a] for the reasons discussed in §VII.A.4.b-(1[a]). *Daft*, ¶¶695-96.

A POSITA would have further understood that, when capturing an image of a user's face, the image would be of the user's head because the face is part of the head. *Id*., ¶696.

---

[4] Although "authentication" is used in other claims (e.g., claim 5) to refer to comparisons to enrollment data to authenticate a user's identity, claim 17 uses the term "authentication" to refer to authenticating the three-dimensionality of the face (e.g., limitation 17[g], claim 19). *Daft*, ¶693.

c. 17[b]

Derakhshani, alone or combined with Tanii, teaches 17[b] for the reasons discussed in §§VII.A.4.c-(1[b]), VII.A.11.d-(8[c]). *Daft*, ¶697.

d. 17[c]

Derakhshani, alone or combined with Tanii, teaches 17[c] for the reasons discussed in §§VII.A.4.c-(1[b]), VII.A.19.b-(17[a]). *Daft*, ¶698.

e. 17[d]

Derakhshani, alone or combined with Tanii, teaches 17[d] for the reasons discussed in §VII.A.4.d-(1[c]). *Daft*, ¶¶699-700.

A POSITA would have further understood, when comparing facial landmarks consistent with Derakhshani, that would be a comparison of "aspects of the head," because facial landmarks are present on the user's head. *Id*., ¶700.

f. 17[e]

Derakhshani, alone or combined with Tanii, teaches 17[e] for the reasons discussed in §§VII.A.3-(motivation), VII.A.4.e-(1[d]), VII.A.19.e-(17[d]). *Daft*, ¶701.

g. 17[f]

Derakhshani, alone or combined with Tanii, teaches 17[f] for the reasons discussed in §§VII.A.3-(motivation), VII.A.4.e-(1[d]), VII.A.19.e-(17[d]). *Daft*, ¶¶702-03.

Moreover, a POSITA would have understood that each of the approaches disclosed by Derakhshani (focus distance or parallax), or taught by Derakhshani combined with Tanii (distance-induced distortion), includes evaluating for expected differences in the relative dimensions of a user's face when one image is captured close and another image is captured far. §§VII.A.3-(motivation), VII.A.4.c-VII.A.4.e (1[b]-1[d]); *Daft*, ¶703. The focus-distance approach looks for which facial features are blurry and those that are clear in both a close and far image to derive the relative depth of those features. §§VII.A.3-(motivation), VII.A.4.e-(1[d]); *Daft*, ¶703. The parallax approach looks for changes in relative displacement of facial features between a close and far image. *Id.* And the distance-induced distortion approach looks for different degrees of distance-induced distortion between a close and far image. *Id.*

h. 17[g]

Derakhshani, alone or combined with Tanii, teaches 17[g] for the reasons discussed in §VII.A.4.e-(1[d]). *Daft*, ¶¶704-05.

Moreover, when authentication is rejected as a spoof attempt, Derakhshani discloses providing notice of the rejection to the user or a third party, and that the authentication is one of at least liveliness and/or three-dimensionality. *Derakhshani*, 4:53-63; 8:67-9:4; 11:17-26; *Daft*, ¶705.

20. Claim 18

Derakhshani discloses or suggests claim 18's additional limitation. *Daft*, ¶¶706-07.

Derakhshani discloses performing biometric authentication using a server remote from the computing device, including the comparing, denying authentication, and providing notice steps. *Derakhshani*, 9:27-30; 10:1-24, 11:22-26; *Daft*, ¶707.

21. Claim 19

Derakhshani discloses or suggests claim 19's additional limitation. *Daft*, ¶¶708-09.

Derakhshani discloses an authentication process that includes verifying the three-dimensionality of a user. *Derakhshani*, 9:59-67, 16:44-18:4; *Daft*, ¶709.

22. Independent Claim 20

a. 20[pre]

Derakhshani discloses or suggests 20[pre] for the reasons discussed in §§VII.A.4.a-(1[pre]), VII.A.11.a-(8[pre]). *Daft*, ¶710.

b. 20[a]

Derakhshani discloses or suggests 20[a] for the reasons discussed in §VII.A.4.b-(1[a]). *Daft*, ¶711.

c. 20[b]

Derakhshani, alone or combined with Tanii, teaches 20[b] for the reasons discussed in §VII.A.4.b-(1[a]). *Daft*, ¶712.

d. 20[c]

Derakhshani, alone or combined with Tanii, teaches 20[c] for the reasons discussed in §§VII.A.4.c-(1[b]), VII.A.11.d-(8[c]). *Daft*, ¶¶713-14.

Moreover, Derakhshani discloses the "sensor is moved about the subject to collect image data from different orientations relative to the subject," including by "rotat[ing] or slid[ing] the camera," (*Derakhshani*, 17:59-64), which a POSITA would have understood involves intentional movement. *Daft*, ¶714. Tanii explains the extent of distance-induced distortion depends on the distance between the user and the camera (*Tanii*, [0047]), and thus modifying Derakhshani with Tanii would also require intentional movement of the camera to induce different degrees of distance-induced distortion, (*Daft*, ¶714).

e. 20[d]

Derakhshani, alone or combined with Tanii, teaches 20[d] for the reasons discussed in §VII.A.4.c-(1[b]). *Daft*, ¶715.

f. 20[e]

Derakhshani, alone or combined with Tanii, teaches 20[e] for the reasons discussed in §VII.A.4.c-(1[b]). *Daft*, ¶716.

g. 20[f]

Derakhshani discloses or suggests 20[f]. *Daft*, ¶¶717-20.

Derakhshani discloses, for three-dimensional verification, "a landmark (e.g., an iris, an eye corner, a nose, an ear, or a background object) may be identified and located in the plurality of images." *Derakhshani*, 16:44-54 (focus distance approach), 17:45-64 (parallax approach).

A POSITA would have understood that, when analyzing the first and second images for facial landmarks, the landmarks would exhibit characteristics (e.g., size, distance from other landmarks, etc.) that indicates the image was taken at some given distance, because those types of characteristics of the landmarks depend on the distance between the user and the camera. *Daft*, ¶719. Moreover, a POSITA would have also understood that—when implementing Derakhshani's focus-distance or Derakhshani and Tanii's distance-induced distortion approaches—the images would be analyzed to determine which is closer and which is further to identify distortions in each image that indicate three-dimensionality of the face. *Id.*, ¶720.

h. 20[g]

Derakhshani, alone or combined with Tanii, teaches 20[g] for the reasons discussed in §VII.A.22.g-(20[f]); *Daft*, ¶¶721-22.

Moreover, when applying Derakhshani's focus-distance approach or the Derakhshani-Tanii distance-induced distortion approach, a POSITA would have understood that the images are analyzed to identify specific distortion characteristics (e.g., blurriness/clarity for focus-distance; barrel or fish-eye distortions for distance-induced distortion). §§VII.A.3-(motivation), VII.A.4.e-(1[d]); *Daft*, ¶722.

i. 20[h]

Derakhshani discloses or suggests 20[h]; *Daft*, ¶¶723-24.

As explained below, Derakhshani determines the user's face is not three-dimensional when there is a match between the biometric landmarks and no expected differences exist. *Derakhshani*, 16:44-18:4; *Daft*, ¶724.

j. 20[h1]

Derakhshani, alone or combined with Tanii, teaches 20[h1]. *Daft*, ¶¶725-27.

Derakhshani discloses determining a face is not three-dimensional when expected differences do not exist in the facial landmarks (e.g., biometric data) of the first and second images. §VII.A.4.e-(1[d]). A POSITA would have understood that, if neither the first nor second images display any expected distortion characteristics—whether focus-distance (Derakhshani) or the distance-induced distortion (Derakhshani and Tanii)—a determination is made that either the first or second image was not taken at a closer (e.g., first or second) distance from the face, because such distortion characteristics would be expected in at least one image. *Daft*, ¶727. In sum, a POSITA would have appreciated that if the "first" image is intended to be the "closer" image, then a lack of distortion characteristics in the "first" data would indicate the first data was not derived from an image of the user captured at the first (closer) distance. *Id*.

k. 20[h2]

Derakhshani, alone or combined with Tanii, teaches 20[h2] for the reasons discussed in VII.A.22.j (20[h1]). *Daft*, ¶¶728-29.

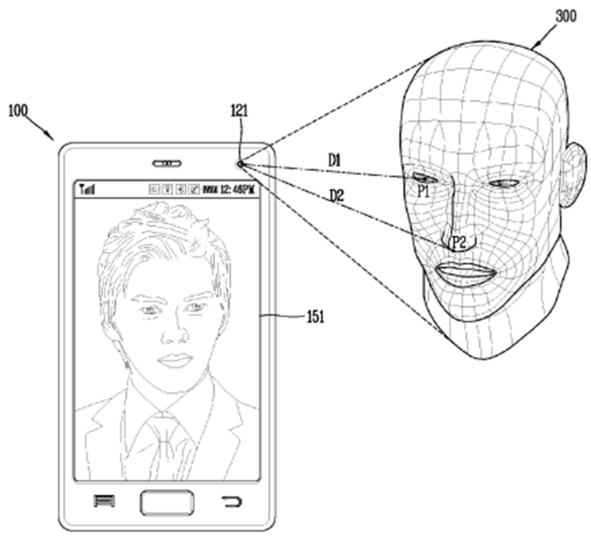
Moreover, a POSITA would have appreciated that if the "second" image is intended to be the "closer" image, then a lack of distortions characteristics in the "second" data would indicate the first data was not derived from an image of the user captured at the first (closer) distance. *Id*., ¶729.

B. Ground 1B: Obviousness in view of Derakhshani, Tanii, and Tahk (Claim 11)

1. Tahk (Ex-1008)

Tahk discloses a facial-recognition procedure for a mobile terminal (e.g., a cellphone) that captures at least two images of a user's face at different distances, and uses the "stereoscopic shape" of the user's face from those two images to distinguish between live, three-dimensional faces, and two-dimensional pictures of a face. *Tahk*, Abstract, [0023], [0117], [0122], [0130]-[0131].

FIG. 5



Tahk, Fig. 5; *Daft*, ¶122-23. To capture the one or more images, Tahk not only presents a live image of the user, but also provides users written prompts and oval overlays to ensure the user's face is appropriately distanced from the camera.

FIG. 8A

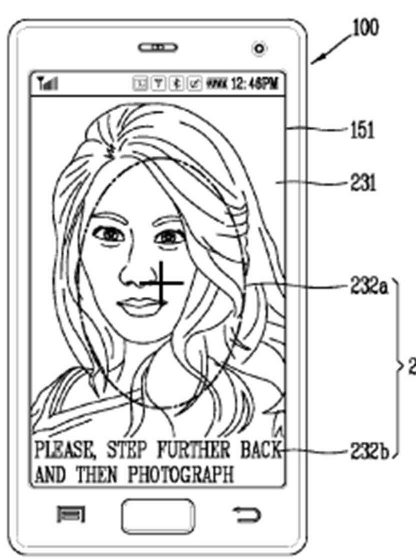
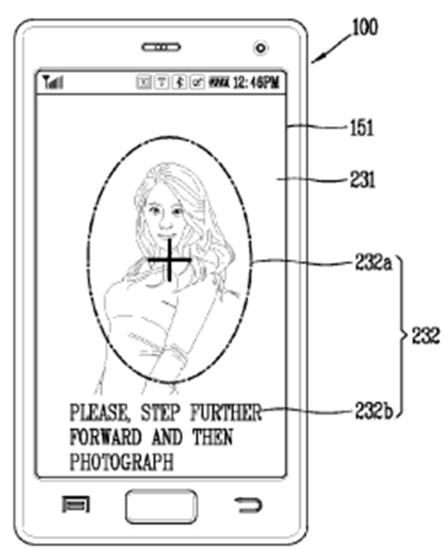


FIG. 8B



See, e.g., *Tahk*, Fig. 8A-B, [0118], [0129], [0135], [0139], [0143], [0144]; *Daft*, ¶124.

2. Motivation to Combine

A POSITA would have been motivated to combine Tahk with Derakhshani (with or without Tanii) because Derakhshani envisions prompting a user to capture a self-portrait. *See Derakhshani*, 5:23-32, 6:8-16, 9:22-26, 17:64-66. Tahk merely provides more-explicit, user-friendly ways of ensuring that a face presented for authentication is properly framed, which would be useful for the authentication procedure in Derakhshani and Tanii that requires multiple images of the face to be taken at different distances. *Daft*, ¶734. A POSITA would have understood that providing a user with real-time feedback regarding how the face is framed for imminent image capture would allow the user to adjust position relative to the camera, and on-screen prompts such as written instructions and ovals to frame the face would provide users clear instructions to ensure an image is captured that is useable for authentication. *Id.*, ¶735.

Moreover, providing real-time image feedback, written instructions, and oval shapes to frame a face during authentication were all well-known and conventional techniques at the time of the invention. *See, e.g.*, Ex-1009, 7:16-8:7, Figs. 6B-7C (live image previews and oval prompts); Ex-1010, 5:31-32 ("The computing device may present prompts that instruct the user to perform one or more liveness gestures"), 6:3-4 (same); Ex-1032. A POSITA would have therefore been motivated to implement these types of feedback to ensure that images are captured properly for facial authentication. *See Samsung Elecs. V. Lynk Labs, Inc.*, IPR2022-00100, Paper 30, 23-24, 34-35 (June 7, 2023) (conventional teachings supported by background references obvious); *Daft*, ¶736 (citing Ex-1034, Ex-1035).

3. Claim 11

Derakhshani combined with Tanii and Tahk teaches claim 11. *Daft*, ¶¶737-39.

Derakhshani, alone or combined with Tanii, teaches providing prompts for a user to properly frame themselves to capture images at different distances for biometric authentication. §VII.A.13-(cl.10); *Daft*, ¶738.

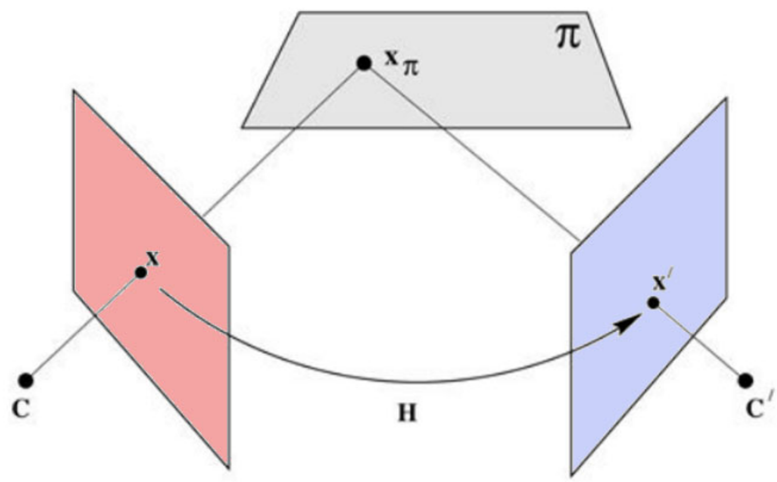
Although neither Derakhshani nor Tanii expressly teach using shape prompts, Tahk teaches that using shaped (oval) prompts to ensure images of the face are captured at the correct distances. *See, e.g.*, *Tahk*, Figs. 8A-B (presenting an oval-shaped prompt to frame the face at the correct distance). A POSITA would have been motivated to modify Derakhshani, alone or combined with Tanii, to provide shaped (oval) prompts because they are a natural shape to appropriately size and frame a face at different distances. §§VII.B.1-(Tahk); VII.B.2-(motivation); *Daft*, ¶739.

C. Ground 2A: Obviousness in view of Zhang and Tanii (Claims 1-3, 5-9, 12-14, 16-20, 22-24)

1. Zhang (Ex-1006)

Zhang discloses distinguishing "live faces" from two-dimensional pictures of a face during authentication. *See, e.g.*, *Zhang*, Title, Abstract, [0012], [0016]. To do so, Zhang's "image capture component" captures a series of images of a face. *Id.*, [0016]. The images are passed to a "live face detection module" that processes them to determine whether the face is live or not. *Id.*, [0017]; *Daft*, ¶¶114-16.

One way Zhang distinguishes three-dimensional faces from two-dimensional pictures is through a "homography based technique" that utilizes a well-known relationship that "two views of a flat (planar) surface are related based on a homography matrix." *Zhang*, [0024]. For background, a paper Zhang references in the specification (*id.*, [0027] (also written by Zhang)) briefly explains the theory behind similar transformations. Ex-1013, 6-7. When two images of the same scene are captured from different perspectives—e.g., when multiple cameras capture the same object from different positions, or a single camera captures the same object from different positions—a mathematical relationship exists between different points in the two images. *Id.*; *Daft*, ¶¶117-18.



Id.; Ex-1023, 40-41; Ex-1025. A homography matrix defines the relationship between these two perspectives, and enables, *inter alia*, one image (e.g., red) to be mathematically transformed to match the perspective of another image (e.g., blue) of the same scene (e.g., grey). *Daft*, ¶119; Ex-1024.

To accomplish this transformation, Zhang discloses that facial features are extracted and matched between the first and second images to serve as reference points relating the two perspectives. *Zhang*, [0027]-[0028] ("This matching of the feature points across the first and second images refers to identifying the locations of the same feature points in each of the two images."); *Daft*, ¶119. These matched feature points are inputs to generate the "homography matrix." *Zhang*, [0029].

After the homography matrix is calculated, it is applied to every pixel in the first image to generate "[a] warped image" intended to match the perspective of the second image. *Id.*, [0030]. The "warped" (transformed) image is compared to the second image. *Id.*, [0031]-[0032]. If the differences between the "warped" (transformed) image and second image meet a threshold, the image is determined to be a live, three-dimensional face. *Id.*, [0034]. Otherwise, the image is determined to be a two-dimensional "imposter." *Id.*; *Daft*, ¶120.

Zhang takes advantage of an assumption in homography that the object captured from different perspectives exists on a two-dimensional plane. *Id.*, ¶121. Because a picture of a face exists on a two-dimensional plane (the paper it is printed on), performing a homography transformation on the picture of a face should produce a near-identical image no matter into which perspective it is transformed. *Id*. A live, three-dimensional face, however, does not exist on a single plane (e.g., the nose is closer to the camera than the ears) and therefore produces distortions (e.g., the ears would distort relative to the nose) when an image of a live face is transformed from one perspective to another. *Id*.

2. Motivation to Combine

A POSITA would have been motivated to combine Zhang and Tanii because both concern identifying and accounting for the three-dimensionality of a face when capturing an image. *Daft*, ¶740. They differ, however, in what information is available to identify a face as three-dimensional: Zhang looks for distortions in a homography transform, whereas Tanii looks for distortions caused by the interaction between the user's face and the camera's lens. *Id*. A POSITA would have appreciated, however, that Tanii's teachings have broad application, including to Zhang. *Id*.

As Tanii recognizes, distance-induced distortions occur because of the interactions between the shape of the camera lens and shape of the face, and the extent of distortion depends upon the distance between the face and camera. §VII.A.2-(Tanii); *Tanii*, [0048]; *Daft*, ¶741. Accordingly, a POSITA would have understood from Tanii that, by taking two images from two different distances, different degrees of distance-induced distortion of the face indicates whether a face is three-dimensional. *Daft*, ¶741.

A POSITA would have therefore appreciated from Tanii that, even without modification, images captured by Zhang may exhibit distance-induced distortions, particularly when a wide-angle camera common in computers and mobile devices is used. *Id*., ¶742. However, a POSITA would have also appreciated that any distance-induced distortions would *enhance* Zhang's process because a homography transformation would not correct for distance-induced distortions. *Id*. For instance, applying a homography transformation to Tanii's Figure 4B (as Zhang's "first image") to compare to Figure 3B (as Zhang's "second image"), the transformation would not account for distortion-related differences, such as the missing ears in Figure 4B and the differences in relative distance between facial features. *Id*., ¶743.

Fig.4B

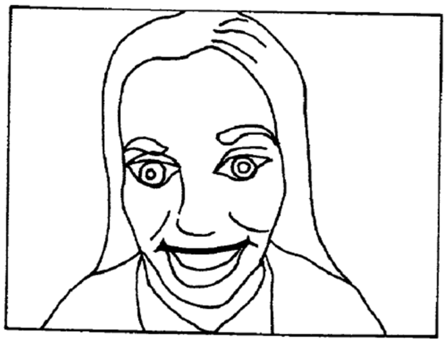
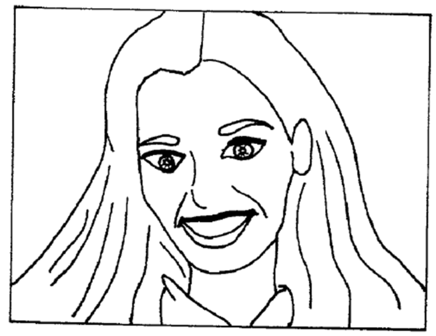


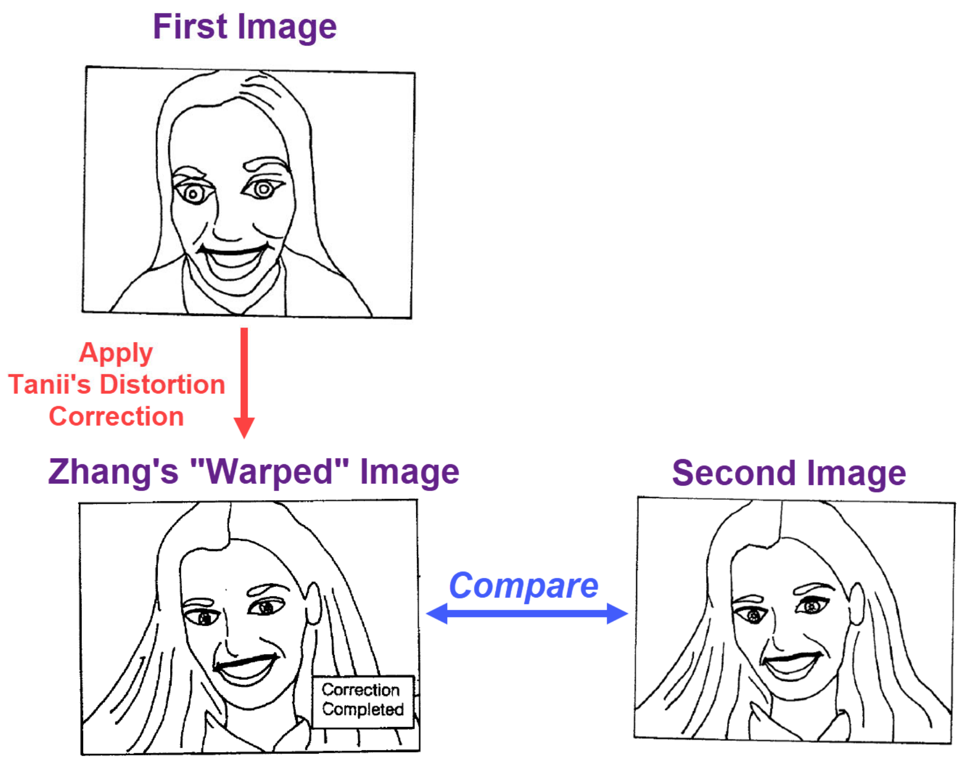
Fig.3B



Accordingly, a POSITA would have been motivated to use Zhang's existing process, but take advantage of the distance-induced distortions identified by Tanii by using a (wide-angle) camera that induces these distortions at different distances, and capturing two images of the face at different distances, because Zhang's procedure would identify the two images as different due to the differences in distance-induced distortion and verify three-dimensionality. *Id.*, ¶744.

But a POSITA would have also been motivated to modify Zhang's process in view of Tanii in either of two additional ways. *Id.*, ¶745.

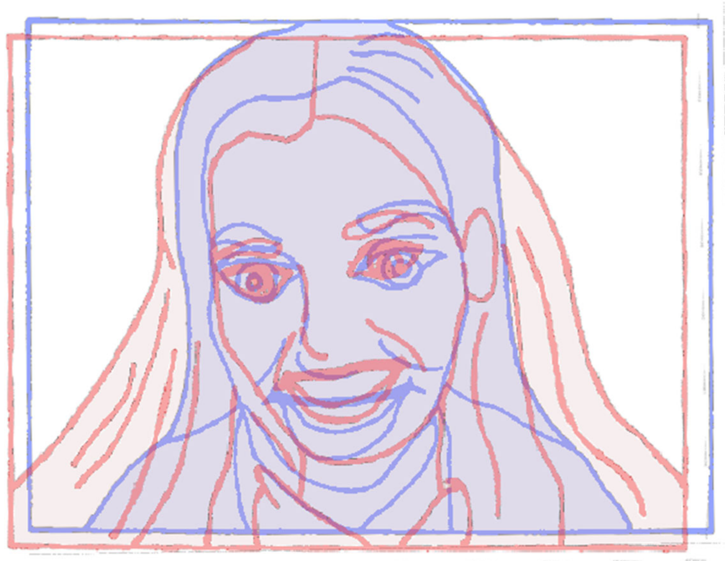
First, a POSITA would have been motivated to perform Zhang's three-dimensional verification process, but rather than "warp" one image using a homography transform to compare it to the second image and evaluate the two for differences, it would "warp" (i.e., correct) the "close" image using Tanii's distortion-correction procedure to compare it to the "far" image and evaluate the two for differences.



Tanii, Figs. 3B, 4B, 9; *Daft*, ¶746.

A POSITA would have understood that if the "warped" (corrected) image and second image are sufficiently similar, that indicates a three-dimensional face because Tanii is correcting for distortions attributable the three-dimensionality of the user's face. *Daft*, ¶747. A POSITA would have appreciated this modification would reduce spoofing of Zhang's system (which only evaluates whether a face is non-planar, which can be spoofed), and provides a simpler mathematical operation that may require less computational resources. *Id.*, ¶¶749-50 (citing Ex-1014).

Alternatively, a POSITA would have appreciated the combination of Zhang and Tanii could be further simplified by eliminating the need to mathematically transform one image. *Daft*, ¶748. Instead, when evaluating two images for different degrees of distance-induced distortion, the two images (one "close", one "far") could be compared directly to determine whether they exhibit expected differences in degree of distance-induced distortions. *Id*.



3. Independent Claim 1

a. 1[pre]

If the preamble is limiting, Zhang discloses or suggests it. *Daft*, ¶¶751-53.

Zhang discloses a computing device, (*Zhang*, [0013]), that can run "software, with instructions being executed" that can be stored in "computer readable media," (*id.*, [0066]-[0071], Fig. 6). A POSITA would have therefore understood that Zhang discloses a non-transient computer readable medium containing non-transitory machine executable code. *Daft*, ¶752.

Zhang further discloses computer-based methods "to determine whether a face in multiple images is a 3D structure or a flat surface," (*Zhang*, [0013], [0026], Figs 2-3, Abstract, [0003]), to "authenticate a user for particular access," (*id.*, [0012]; *Daft*, ¶753).

b. 1[a]

Zhang discloses or suggests 1[a]. *Daft*, ¶¶754-58.

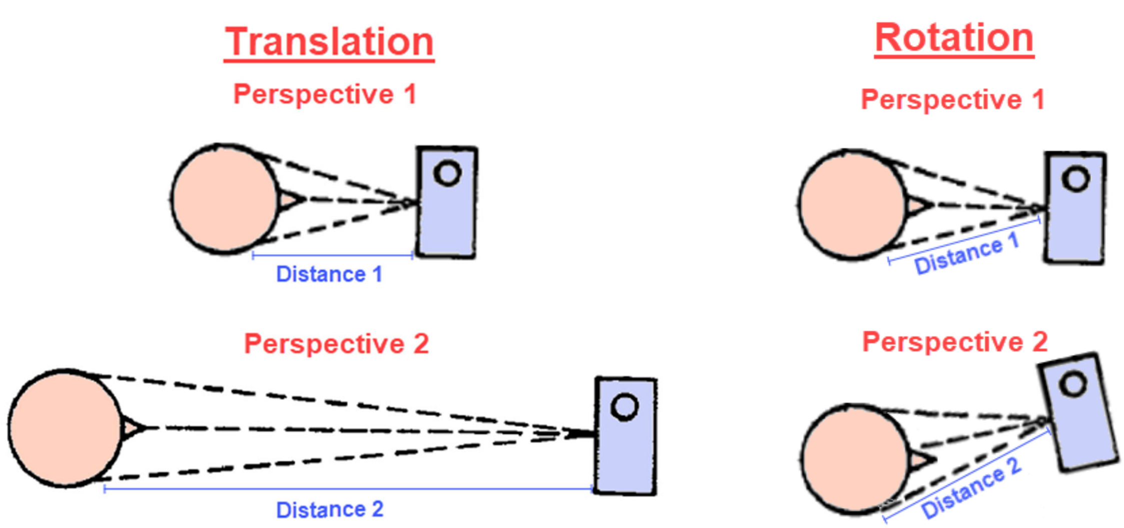
Zhang discloses authenticating a user by capturing a first image. *Zhang*, [0016] ("user 108 presents himself or herself to image capture component 102, allowing component 102 to capture images 106 of user 108."), [0021]. *Daft*, ¶755. A POSITA would have understood that Zhang's process captures an image at a first distance because some distance exists between the user and image capture component 102 in order to capture a picture of the user's face. *Zhang*, [0016]; *Daft*, ¶756 (citing Ex-1009, Ex-1028). Zhang then processes the image to derive feature-point biometric data. *Zhang*, [0026]-[0027]; *Daft*, ¶¶757-58.

c. 1[b]

Zhang alone, or combined with Tanii, teaches 1[b]. *Daft*, ¶¶759-62.

Zhang discloses authenticating a user by capturing a second image. *Zhang*, [0016] ("Image capture component 102 captures multiple images"). Zhang then processes the image to derive feature-point biometric data. *Id.*, [0026]-[0027]; *Daft*, ¶760.

Although Zhang does not expressly disclose that the second image is captured at a second distance different from the first distance, this would have been obvious to a POSITA. *Daft*, ¶761. Specifically, Zhang discloses "3D structure determination module 112" uses a "homography" technique to distinguish between a real face and a picture of a face by, *inter alia*, transforming a first image to the perspective of a second image and comparing the two. *Zhang*, [0024], [0026]-[0035]; *Daft*, ¶761. A POSITA would have understood that, to perform a homography transform, the "multiple images" Zhang captures are from different perspectives of the face. *Id*. And a POSITA would have further understood that, to capture multiple images from different perspectives, the position of the camera relative to the face changes—either by rotating/translating the position of the user or camera to the side, or changing the distance between the user and camera, as depicted below (showing a top-down view of a face and camera):



Not only would a POSITA have understood that providing images at different distances allows for a greater understanding of depth between objects in the scene, as explained in the Zhang paper (*Daft*, ¶761; Ex-1013, 22-25), but also that taking pictures at different distances with a camera lens that induces distortions would *enhance* the performance of Zhang's homography-transformation procedure. *Daft*, ¶761; §VII.C.2-(motivation). Thus, Zhang at least suggests this limitation.

Moreover, taking two images at different distances would have been obvious in view of other prior art. A POSITA would have understood that distortions caused by camera lenses can indicate depth in the object being captured, as exemplified by Tanii. *Daft*, ¶762; §VII.C.2-(motivation). Accordingly, to the extent Zhang does not disclose or suggest this limitation, a POSITA would have been motivated to modify Zhang in view of Tanii to capture a second image at a second distance, while taking advantage of these distance-induced distortions to distinguish between live, three-dimensional faces and two-dimensional pictures. *Daft*, ¶762; §VII.C.2-(motivation).

d. 1[c]

Zhang, alone or combined with Tanii, teaches 1[c]. *Daft*, ¶¶763-66.

After determining the homography matrix between the first and second images, a "warped" version of the first image is created and then compared to the second image to determine whether differences exist. *Zhang*, [0025], [0031]. As part of the comparison, "any of a variety of conventional face detection algorithms or face recognition algorithms can be used to detect the face within each image, and the selected locations are the locations that are part of a face within at least one of the warped and second images." *Zhang*, [0032]; *Daft*, ¶764.

A POSITA would have understood that Zhang discloses comparing a first biometric data (e.g., the facial-feature locations in the first warped image) and second biometric data (e.g., the facial-feature locations in the second image) for determining whether differences between the two exist, in which differences between the two images would be expected due to movement of the image capture component 102 (camera). *Daft*, ¶765. And a POSITA would have appreciated that any differences would be due to "characteristics" of the face—e.g., its three-dimensionality—because Zhang's homography transformation is expressly looking for a planar, two-dimensional face. *Id*.

However, a POSITA would have also been aware (as exemplified by Tanii) that differences between two images—with different degrees of distance-induced distortion—can also be used to distinguish between three-dimensional face and a two-dimensional picture. §VII.C.2-(motivation); *Daft*, ¶766. And a POSITA would have been motivated to utilize these expected differences as either a supplemental or alternative verification of three-dimensionality of a face. §VII.C.2-(motivation); *Daft*, ¶766. In doing so, a POSITA would have understood verification using distance-induced distortion matches the positions of features across first and second images—as Zhang already discloses. *Id*. But rather than use that comparison to calculate a homography matrix, the comparison would evaluate whether one image exhibits the expected distance-induced distortion when the user's face is captured at a close distance to the camera, and the other image does not exhibit similar distance-induced distortion when captured further from the camera. *Id*. Thus, a POSITA would have appreciated that, when modifying Zhang to evaluate differences caused by distance-induced distortions, the presence of such distortions (due to the change in distance of the camera) indicates a three-dimensional face. *Zhang*, [0025], [0034]; *Daft*, ¶766.

e. 1[d]

Zhang combined with Tanii teaches 1[d]. *Daft*, ¶¶767-69.

Zhang discloses "if the image differences [between the first and second image after undergoing homography transformation] does not meet the threshold value, then the face in the first and second images is determined to be a flat surface and thus a picture of a face." *Zhang*, [0034]; *see also id.*, [0031]-[0033] (explaining comparison process to identify expected differences). Zhang does not expressly disclose that the expected difference is a "fish-eye" type distortion induced by changing the distance between the camera and face. *Daft*, ¶768.

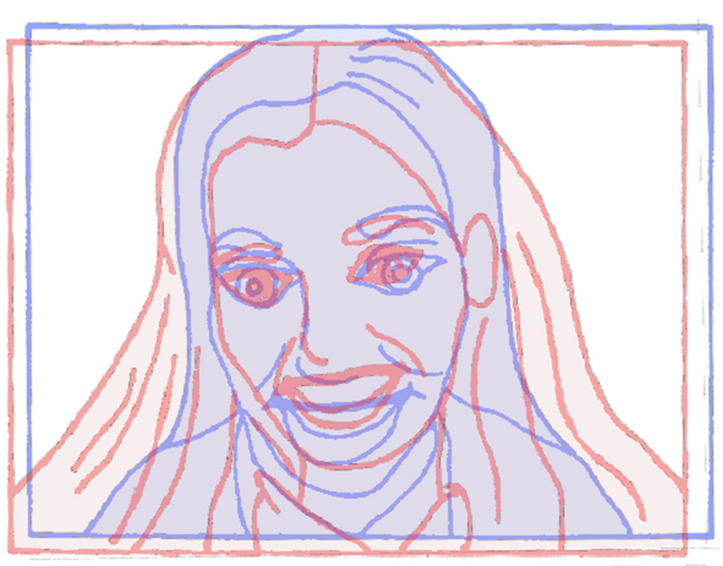
When modifying Zhang in view of Tanii, however, a POSITA would have understood that the images would be evaluated for different degrees of distance-induced, "fish-eye" distortion depending on their distance from the camera, because these types of distortions also indicate three-dimensionality similar to Zhang's homography approach. §VII.C.2-(motivation); *Daft*, ¶769. If the series of images do ***not*** contain different degrees of expected, distance-induced distortion when taken at different distances, a POSITA would have understood that would indicate the face is not three dimensional. §VII.C.2-(motivation); *Daft*, ¶769.

4. Claim 2

Zhang, alone or combined with Tanii, teaches claim 2. *Daft*, ¶¶770-72.

Zhang discloses differences between a homography-transformed first image and a second image would be expected for three-dimensional faces. *Zhang*, [0031]-[0034]. Moreover, a POSITA would have understood that, when applying a homography transformation to an image of a three-dimensional face, the transformation would induce expected differences in the size and shape of the facial features as a result of the transformation. *Daft*, ¶771.

Moreover, a POSITA would have understood that, when modifying Zhang in view of Tanii, expected differences in degree of distance-induced distortion would change the relative size and shape of facial features. *Daft*, ¶772. Specifically, Tanii teaches the expected differences in a face caused by distance-induced distortion is the relative size and shape of facial features of the user. *Tanii*, [0047] ("where the main object 9 and the cellular phone 1 are close together…an unnatural image results in which the perspective is exaggerated."), [0056] (describing "a warp in which the peripheral areas of the main object appear reduced in size relative to the center area.").



Daft, ¶772. A POSITA would have therefore looked to these expected differences in size and/or shape of facial features to determine whether the face is three-dimensional. *Id*.

5. Claim 3

Zhang discloses or suggests claim 3's additional limitation. *Daft*, ¶¶773-74.

Zhang discloses verifying the three-dimensionality of a user's face occurs during a facial authentication procedure, (*Zhang*, [0012]-[0013], [0016]), including determining that a face is *not* three-dimensional, (*id.*, [0018]; *Daft*, ¶774).

6. Claim 5

a. 5[a]

Zhang discloses or suggests 5[a]'s additional limitation. *Daft*, ¶¶775-77.

Zhang discloses that a user is authenticated "by comparing one or more of images 106 to previously captured images of the user 108." *Zhang*, [0017]. A POSITA would have understood that Zhang describes conventional biometric authentication that compares recently acquired biometric data to biometric data previously acquired during an enrollment process. *Daft*, ¶777 (citing Ex-1018).

b. 5[b]

Zhang discloses or suggests 5[b]'s additional limitation. *Daft*, ¶¶778-80.

Zhang discloses a conventional facial-authentication procedure by comparing biometric data to previously acquired biometric data during enrollment. §VII.C.6.a-(5[a]); *Daft*, ¶780. Zhang also discloses that images can be evaluated to determine whether they capture the same user's face by matching feature points across both images, consistent with conventional practices. *Zhang*, [0038].

Although Zhang does not expressly disclose *not* authenticating a user when the first or second data do not match enrollment data, §VII.C.6.a-(5[a]), a POSITA would have understood that Zhang's process would operate this way because authenticating a user's *identity*—and not just whether any face is three dimensional, which is Zhang's focus—is a central aspect of facial authentication systems. *Zhang*, [0001]; *Daft*, ¶¶779-80.

7. Claim 6

Zhang, alone or combined with Tanii, teaches claim 6's additional limitation. *Daft*, ¶¶781-83.

Zhang discloses implementing the facial-authentication process on hand-held computing devices, such as a cellular phone, digital camera or video camera. *Zhang*, [0013]. Moreover, Tanii notes that distance-induced distortions often occur in mobile devices that incorporate wide-angle lenses, and the amount of distortion is dictated by the distance between the user and the camera. *Tanii*, [0007], [0047]-[0048], Figs. 3A-B, 4A-B; *Daft*, ¶782.

When implementing a facial-authentication process on a handheld mobile computing device consistent with Zhang (alone or combined with Tanii) (*see* §VII.C.3.c (1[b])), a POSITA would have understood the user holds the computing device at a first distance for the first image, and a second distance for the second image (e.g., by extending and retracting the user's arm), because that is a convenient and obvious way of changing the distance between a hand-held device and the user's face. *Daft*, ¶783.

8. Claims 7 and 24

Zhang discloses or suggests claims 7 and 24's additional limitation. *Daft*, ¶¶784-85, 859.

Zhang discloses the biometric data is image data of facial features. *Zhang*, [0027] ("[O]ne or more feature points are extracted from two images… A variety of different feature points can be extracted, such as a corner of an eye, a corner of a mouth, a tip of a nose, and so forth."); *Daft*, ¶785.

9. Independent Claim 8

a. 8[pre]

If the preamble is limiting, Zhang discloses or suggests it. *Daft*, ¶¶786-87.

Specifically, in addition to computer-readable code, Zhang discloses a method to verify a user's face is three-dimensional based on images of the user's face. §VII.C.3.a-(1[pre]); *Daft*, ¶787.

b. 8[a]

Zhang discloses or suggests 8[a] for the reasons discussed in §VII.C.3.b-(1[a]). *Daft*, ¶788.

c. 8[b]

Zhang discloses or suggests 8[b] for the reasons discussed in §VII.C.3.b-(1[a]). *Daft*, ¶789.

d. 8[c]

Zhang, alone or combined with Tanii, discloses or suggests 8[c]. *Daft*, ¶¶790-92.

Specifically, Zhang, alone or combined with Tanii, discloses capturing a series of images as part of the verification process. §VII.C.3.c-(1[b]). A POSITA would have understood that, to capture multiple images at multiple distances, either the camera would move from the first to the second distance, or the user would move in relation to the camera. *Id.*; *Daft*, ¶791.

Because Zhang discloses using mobile-computing devices that incorporate a camera such as laptops and "wireless phone[s]," *Zhang*, [0013], it would have been obvious to a POSITA to move the camera in relation to the user's face because it is the more user-friendly of the two possible options for changing the distance between the user's face and the camera (either moving the camera or the user). *Daft*, ¶792.

e. 8[d]

Zhang, alone or combined with Tanii, teaches 8[d] for the reasons discussed in §VII.C.3.c-(1[b]). *Daft*, ¶793.

f. 8[e]

Zhang, alone or combined with Tanii, teaches 8[e] for the reasons discussed in §VII.C.3.c-(1[b]); *Daft*, ¶794.

g. 8[f]

Zhang combined with Tanii teaches 8[f] for the reasons discussed in §§VII.C.3.d-VII.C.3.e(1[c]-1[d]). *Daft*, ¶795.

h. 8[g]

Zhang, alone or combined with Tanii, teaches 8[e] for the reasons discussed in §VII.C.3.e-(1[d]). *Daft*, ¶796.

10. Claim 9

a. 9[a]

Zhang, alone or combined with Tanii, teaches 9[a]. *Daft*, ¶¶797-802.

Zhang discloses capturing a series of intermediate images between two non-adjacent (e.g., first and second) images. *Zhang*, [0035]-[0037]. A POSITA would have understood these intermediate images would be captured at positions between those of the first and second images. *Daft*, ¶800.

Additionally, Tanii discloses that distance-induced distortions increase as distances between the face and camera decreases. *See Tanii*, [0048]. A POSITA would have understood that a relationship exists between the degree of distance-induced distortion and distance: distortion increases as distance decreases, and vice versa. *Tanii*, [0048]; *Daft*, ¶801. A POSITA would have therefore been motivated to capture additional images at a distance between the first and second distance to determine whether the series of images each exhibit an expected degree of distance-induced distortion to further confirm the three-dimensionality of the user's face. *Daft*, ¶¶801-02.

b. 9[b]

Zhang, alone or combined with Tanii, teaches 9[b]. *Daft*, ¶¶803-05.

Zhang discloses processing an additional, intermediate image to obtain additional data. *Zhang*, [0036] ("the feature point extraction and feature point matching in acts 302 and 304 can be generated for each adjacent pair of images in the sequence, which can facilitate the feature matching process when matching features across two images with one or more intervening images."); *Daft*, ¶804.

Moreover, when modifying Zhang in view of Tanii, a POSITA would have found it obvious to acquire an additional image and extract additional data from the additional image to compare it to the positions of the data based on the first and second images. *See* §VII.C.10.a (9[a]); *Daft*, ¶805.

c. 9[c]

Zhang, alone or combined with Tanii, teaches 9[c]. *Daft*, ¶¶806-08.

Zhang discloses examining intermediate images and comparing them to the first and second images to determine whether expected differences exist. *Zhang*, [0036]-[0037]; *Daft*, ¶807.

A POSITA would have found it obvious, regardless of whether using Zhang's homography approach or Zhang-Tanii's distance-induced distortion approach—to examine the additional data and compare it to the first and second data to determine whether expected differences exist to further confirm the three-dimensionality of the user's face. *See* §§VII.C.10.a (9[a]), VII.C.10.b (9[b]); *Daft*, ¶808.

11. Claims 12 and 22

Zhang, alone or combined with Tanii, teaches claims 12 and 22 for the reasons discussed in §VII.C.7-(cl.6). *Daft*, ¶¶809-10, 857.

Furthermore, a POSITA would have understood that, when adjusting the distance of a hand-held computing device, the device would move between a first distance *from the user's face* and a second distance *from the user's face* because Zhang and Tanii are both concerned with differences in images *of a user's face* captured in different conditions, including distances. §VII.C.3.c-(1[b]); *Daft*, ¶810.

12. Claims 13 and 23

Zhang, alone or combined with Tanii, teaches claims 13 and 23. *Daft*, ¶¶811-12, 858.

Zhang, alone or combined with Tanii, discloses or suggests the first and second data comprise biometric data. §§VII.C.3.b-VII.C.3.c (1[a]-[b]); *Daft*, ¶812.

13. Claim 14

Zhang, alone or combined with Tanii teaches claim 14. *Daft*, ¶¶813-15.

Zhang discloses capturing "multiple images" from different perspectives, which a POSITA would have understood includes moving the camera linearly toward or away from a user's face. §VII.C.3.c-(1[b]); *Daft*, ¶814.

Similarly, Tanii teaches images captured at different distances exhibit different degrees of distortion, and depicts a linear movement of the camera towards or away from the user. *Tanii*, [0047]-[0048], [0056], Figs. 3A-B, 4A-B. A POSITA would have therefore understood that, when combining Zhang and Tanii, two images would be captured at different distances, with the camera moving *linearly* towards or away from the user's face. *Daft*, ¶815.

14. Claim 16

Zhang, alone or combined with Tanii, teaches claim 16. *Daft*, ¶¶816-17.

Zhang and Tanii both suggest moving the camera to capture images at two different distances. §§VII.C.3.c-(1[b]), VII.C.13-(cl.14). A POSITA would have understood that, when moving the camera to capture images from different distances, the user's face would be stationary (e.g., steady). *Daft*, ¶817. A POSITA would have appreciated that holding the user's face steady and moving the camera closer and further away would be more user friendly than forcing the user to move their head closer and further from the camera while holding the camera steady. *Id*.

15. Independent Claim 17

a. 17[pre]

If the preamble is limiting, Zhang discloses or suggests it. *Daft*, ¶¶818-19.

Zhang discloses a computer-implemented authentication method for authenticating a person during an authentication session. *See, e.g.*, *Zhang*, Abstract, [0001]; §§VII.C.3.a-(1[pre]), §VII.C.6-(cl.5); *Daft*, ¶819.

b. 17[a]

Zhang discloses or suggests 17[a] for the reasons discussed in §VII.C.3.b-(1[a]). *Daft*, ¶¶820-21.

A POSITA would have further understood that, when capturing an image of a user's face, the image would be of the user's head because the face exists on the head. *Daft*, ¶821.

c. 17[b]

Zhang, alone or combined with Tanii, teaches 17[b] for the reasons discussed in §§VII.C.3.c-(1[b]), VII.C.9.d-(8[c]); *Daft*, ¶822.

d. 17[c]

Zhang, alone or combined with Tanii, teaches 17[c] for the reasons discussed in §§VII.C.3.c-(1[b]), VII.C.15.b-(17[a]). *Daft*, ¶823.

e. 17[d]

Zhang, alone or combined with Tanii, teaches 17[d] for the reasons discussed in §VII.C.3.d-(1[c]). *Daft*, ¶¶824-25.

A POSITA would have further understood that, when comparing facial features, consistent with Zhang, that would be a comparison of "aspects of the head," because facial landmarks are present on the user's head. *Id.*, ¶825.

f. 17[e]

Zhang, alone or combined with Tanii, teaches 17[e] for the reasons discussed in §§VII.C.2-(motivation), VII.C.3.e-(1[d]), VII.C.15.e-(17[d]). *Daft*, ¶826.

g. 17[f]

Zhang, alone or combined with Tanii, teaches 17[f] for the reasons discussed in §§VII.C.2-(motivation), VII.C.3.e-(1[d]), VII.C.15.e-(17[d]). *Daft*, ¶¶827-28.

Moreover, a POSITA would have understood that the approaches disclosed by Zhang (homography), or Zhang combined with Tanii (distance-induced distortion), include evaluating for expected differences in the relative dimensions of a user's face when one image is captured close to the person's face and another image is captured far from the person's face. *Id.*, ¶828. Specifically, Zhang discloses performing a homography transformation, which a POSITA would have understood involves capturing multiple images from multiple perspectives (including distances) that induce distortions to facial features when the face is three-dimensional rather than a two-dimensional plane. §§VII.C.2-(motivation), VII.C.3.e (1[d]); *Daft*, ¶828. And Zhang-Tanii's distance-induced distortion approach looks for different degrees of distance-induced distortion between a close and far image. §§VII.C.2-(motivation), VII.C.3.e (1[d]); *Daft*, ¶828.

h. 17[g]

Zhang, alone or combined with Tanii, teaches 17[g] for the reasons discussed in §VII.C.3.e-(1[d]). *Daft*, ¶¶829-30.

Moreover, when authentication is rejected as a spoof attempt, Zhang discloses providing notice of the rejection to the user, and that the authentication is one of at least three-dimensionality. *Zhang*, [0003], [0017]; *Daft*, ¶830.

16. Claim 18

Zhang discloses or suggests claim 17's additional limitation. *Daft*, ¶¶831-34.

Zhang discloses the image-capture component and live-face-detection module (104) and 3D-structure-determination module (112) communicate and send data, including biometric facial feature data, over a variety of different networks, such as the Internet, a local area network (LAN), an intranet, etc. *Zhang*, [0014]. Although Zhang does not expressly state that the data is sent to a "server," that would have been obvious because servers were well known and conventional networking infrastructure for remote processing, including biometric processing. *Daft*, ¶¶833-34; Ex-1016, Abstract, [0040]-[0043]; Ex-1012, Fig. 1A, 5:24-50.

17. Claim 19

Zhang discloses or suggests claim 19's additional limitation. *Daft*, ¶¶835-36.

Zhang discloses an authentication process that includes verifying the three-dimensionality of a user. *Zhang*, [0003], [0017]-[0018]; *Daft*, ¶836.

18. Independent Claim 20

a. 20[pre]

Zhang discloses or suggests 20[pre] for the reasons discussed in §§VII.C.3.a-(1[pre]), VII.C.9.a-(8[pre]). *Daft*, ¶837.

b. 20[a]

Zhang discloses or suggests 20[a] for the reasons discussed in §VII.C.3.b-(1[a]). *Daft*, ¶838.

c. 20[b]

Zhang, alone or combined with Tanii, teaches 20[b] for the reasons discussed in §VII.C.3.b-(1[a]). *Daft*, ¶839.

d. 20[c]

Zhang, alone or combined with Tanii, teaches 20[c] for the reasons discussed in §§VII.C.3.c-(1[b]), VII.C.9.d-(8[c]). *Daft*, ¶¶840-41.

Moreover, a POSITA would have understood that any movement of the camera to change perspective (Zhang) or create a distance-induced-distortion effect (Zhang combined with Tanii) would involve *intentional* movement of the camera to induce these effects. *Id*., ¶841.

e. 20[d]

Zhang, alone or combined with Tanii, teaches 20[d] for the reasons discussed in §VII.C.3.c-(1[b]); *Daft*, ¶842.

f. 20[e]

Zhang, alone or combined with Tanii, teaches 20[e] for the reasons discussed in §VII.C.3.c-(1[b]); *Daft*, ¶843.

g. 20[f]

Zhang discloses or suggests 20[f]. *Daft*, ¶¶844-47.

Zhang discloses, as part of the verification process, "sub regions within a face (such as eyes, mouth, nose, and so forth)" are detected. *Zhang*, [0032]. A POSITA would have understood that, when analyzing the images for facial landmarks, the landmarks would exhibit characteristics (e.g., size, distance from other landmarks, etc.) that indicates the image was taken at some given distance, because those types of characteristics of the landmarks depend on the distance between the user and the camera. *Daft*, ¶846.

Moreover, when modifying Zhang in view of Tanii, a POSITA would have also understood that the first and second images would be analyzed to determine which is closer and which is further to determine which is expected to have more-significant distance-induced distortion. *Id*., ¶847.

h. 20[g]

Zhang, alone or combined with Tanii, teaches 20[g] for the reasons discussed in §VII.C.18.g-(20[f]). *Daft*, ¶¶848-49.

Moreover, when applying the Zhang-Tanii distance-induced distortion approach, a POSITA would have understood that the images are analyzed to identify specific distortion characteristics (e.g., distance-induced barrel or fish-eye distortions\). §§VII.C.2-(motivation), VII.C.3.e (1[d]); *Daft*, ¶849.

i. 20[h]

Zhang combined with Tanii teach limitation 20[h]. *Daft*, ¶¶850-51.

As explained in further detail below, Zhang determines that the user's face is not three-dimensional when there is no mismatch between the biometric landmarks and no expected differences exist. *Zhang*, [0031]-[0033]; *Daft*, ¶851.

j. 20[h1]

Zhang combined with Tanii teaches 20[h1]. *Daft*, ¶¶852-54.

Zhang discloses a face is not considered three-dimensional when expected differences do not exist in the facial landmarks (e.g., biometric data) of the first and second images. §VII.C.3.e-(1[d]). Thus, a POSITA would have understood that, if the first and second images match after one undergoes Zhang's homography transformation, a determination is made that the face is planar and not three dimensional. *Daft*, ¶853.

Moreover, when combining Zhang and Tanii, a POSITA would have found it obvious to determine whether the two images exhibit expected differences in distance-induced distortions. §VII.C.3.e-(1[d]); *Daft*, ¶854. In sum, a POSITA would have appreciated that if the "first" image is intended to be the "closer" image, then a lack of distortions (or characteristics, as claimed) in the "first" data would indicate the first data was not derived from an image of the user captured at the first (closer) distance. *Id*.

k. 20[h2]

Zhang, alone or combined with Tanii, teaches 20[h2] for the same reasons discussed in VII.C.18.j (20[h1]). *Daft*, ¶¶855-56.

Relatedly, a POSITA would have appreciated that if the "second" image is intended to be the "closer" image, then a lack of distortions (or characteristics, as claimed) in the "second" data would indicate the first data was not derived from an image of the user captured at the first (closer) distance. *Id*., ¶856.

D. Ground 2B: Obviousness in view of Zhang, Tanii, and Tahk (Claims 4, 10-11, 21)

1. Motivation to Combine

A POSITA would have been motivated to combine Tahk with Zhang, alone or combined with Tanii, because Tahk provides user-friendly ways of ensuring a face presented for authentication is framed properly for image capture, which a POSITA would have recognized as useful for the authentication procedure taught by the Zhang-Tanii combination that requires multiple images of the face. *Daft*, ¶860. A POSITA would have understood that providing a live preview would allow the user to adjust the position relative to the camera, and on-screen prompts such as written instructions and ovals to frame the face would provide express guidance to ensure an image is captured that is useable for authentication. *Id.*, ¶861.

Moreover, providing real-time image feedback, written instructions, and oval shapes to frame a face during an authentication process were well-known and conventional techniques at the time of the invention. *See, e.g.*, Ex-1009, 7:16-8:7, Figs. 6B-7C (live image preview and oval prompts); Ex-1010, 5:31-32, 6:3-4; Ex-1032. A POSITA would have therefore been motivated to implement these types of feedback to ensure images are captured properly for facial authentication. *See Samsung*, IPR2022-00100, Paper 30, 23-24, 34-35 (conventional teachings supported by background references obvious); *Daft*, ¶862 (citing Ex-1034, Ex-1035).

2. Claims 4, 10 and 21

Zhang combined with Tanii and Tahk teaches claims 4, 10, and 21. *Daft*, ¶¶863-66, 870.

Zhang discloses the camera is part of the computing device and is configured to take a series of images (*see, e.g.*, *Zhang*, [0013]-[0014], [0016], [0026], Figs. 1, 3), and a POSITA would have been motivated to take the series of images at different distances, §§VII.C.2-(motivation), VII.C.3.c-(1[b]). However, Zhang does not expressly disclose an interface that provides prompts to guide a user through different camera positions that would enhance calculations of the homography matrix. *Daft*, ¶864.

Tahk teaches an interface with one or more prompts on a screen to ensure images of the face are captured at the correct distances. *See, e.g.*, *Tahk*, Figs. 8A-B ("Please, step further back" and "Please, step further forward," and presenting an oval to frame the face at the correct distance). A POSITA would have been motivated by Tahk to modify Zhang (alone or combined with Tanii) to provide an interface that prompts a user to alter the distance of the camera to either capture sufficiently different images for a homography transformation (Zhang) or to capture an image with distance-induced distortion (Tanii) to distinguish a live, three-dimensional face from a two-dimensional photo. *Daft*, ¶865; §VII.D.1-(motivation).

3. Claim 11

Zhang combined with Tanii and Tahk teaches claim 11. *Daft*, ¶¶867-69.

Although neither Zhang nor Tanii expressly teach using prompts to guide a user during the facial-authentication process, Tahk does, including using oval prompts to frame a user's face. §VII.D.1-(motivation). A POSITA would have been motivated to modify Zhang, alone or combined with Tanii, to provide such oval-shaped prompts because they are a natural shape to appropriately size and frame a face at different distances. §§VII.B.1-(Tahk), VII.D.1-(motivation); *Daft*, ¶869.

E. Ground 2C: Obviousness in view of Zhang, Tanii and Suzuki (Claim 15)

1. Suzuki

Suzuki discloses that, in mobile computing devices with a user-facing camera, there are benefits to using the display of the device as an illumination source while capturing images of the user. *Suzuki*, [0009], [0019], [0021], [0024]-[0025]; *Daft*, ¶¶125-26.

2. Motivation to Combine

Zhang discloses implementing a process to verify the three-dimensionality of a user's face by capturing a series of images of a user using a mobile computing device, such as a phone. *See, e.g.*, *Zhang*, [0013]. For hand-held mobile devices in particular, a POSITA would have understood that the device would have a user-facing camera. *Daft*, ¶871; Ex-1037. But a POSITA would have also understood that cameras often utilize illumination sources, such as camera-flash systems or other lighting to improve the quality of the captured images (especially in low-light conditions). *Id.*, ¶872. Rather than provide a separate forward-facing flash module, however, a POSITA would have been motivated to use the device's existing, user-facing display to provide the illumination source for a user-facing camera, consistent with Suzuki. *Id*., ¶¶873-74. That way, capture-image quality would be improved without requiring a separate user-facing flash module. *Id*., ¶874.

3. Claim 15

Zhang combined with Tanii and/or Suzuki teaches claim 15's additional limitation. *Daft*, ¶¶875-76.

Neither Zhang nor Tanii disclose illuminating a device's screen to improve image quality. However, using a user-facing screen to serve as a camera's illumination source (or "flash") was well known, as exemplified by Suzuki. *Suzuki*, [0009], [0019], [0021], [0024]-[0025]; *Daft*, ¶876. A POSITA would have been motivated to modify Zhang to use a user-facing display (as Zhang already envisioned) as a light source for capturing an image to improve the quality of the image. §VII.E.2-(motivation); *Daft*, ¶876.

VIII. DISCRETIONARY DENIAL WOULD BE INAPPROPRIATE

A. *Fintiv*

Petitioner does not expect PO to raise *Fintiv* here, but even if it does, the Board should not deny institution on that basis.

In June 2024, PO filed suit against Petitioner (*FaceTec, Inc. v. Jumio Corp*., 3:24-cv-3623 (N.D. Cal.)) asserting infringement of four patents, including the '938 Patent. *See* Ex-1046. The Court set a trial date of August 10, 2026, which would be after any expected final written decision here (May 2026). Ex-1041. But

Petitioner also intends to request a stay of the district court litigation to allow the IPR to be decided.

Accordingly, discretionary denial under *Fintiv* is unwarranted.

B. 325(d)

The Board should not exercise its discretion under §325(d) to deny institution. *See Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8, 17–18 (Dec. 15, 2017) (precedential); *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6, 9–11 (Feb. 13, 2020) (precedential).

Considering the first part of the *Advanced Bionics* framework, including *Becton, Dickinson* factors (a), (b), and (d), a related Derakhshani publication (2014/0198959) was cited—but never applied—during prosecution. That is not a basis to invoke discretionary denial. *See GMG Prods. LLC v. Traeger Pellet Grills LLC*, PGR2019-00024, Paper 17, 27 (July 17, 2019) (finding listing on an IDS alone factor "does not favor denying institution" because "the Examiner did not provide any detailed assessment of [the prior art, and], instead, only indicat[ed] the references had been considered"). Regardless, the Examiner never considered Zhang, or any prior-art combination involving Tanii. Accordingly, the same or substantially the same art or arguments were not previously presented to or considered by the Office; there is no need to go to *Advanced Bionics* part two. But even if the Board were to reach step two, the Examiner materially erred by failing to apply Derakhshani's teachings, alone or combined with other art, related to verifying the three-dimensionality of a face presented for authentication.

IX. Conclusion

Inter Partes Review of the challenged claims is respectfully requested.

X. Mandatory Notices

A. Real Party in Interest

Petitioner identifies itself as real parties in interest.

B. Related Matters

To the best of Petitioner's knowledge, the '938 Patent has been involved in the following district court litigation:

FaceTec, Inc. v. Jumio Corporation, Case No. 5:24-cv-3623 (N.D. Cal.)

C. Notice of Counsel and Service Information

Lead Counsel:	**Backup Counsel:**
Jessica C. Kaiser, Reg. No. 58,937 kaiser-ptab@perkinscoie.com PERKINS COIE LLP 1900 Sixteenth St., Suite 1400 Denver, CO 80202-5255 (303) 291-2300 (telephone) (303) 291-2400 (fax)	Jon R. Carter, Reg. No. 75,145 Carter-ptab@perkinscoie.com PERKINS COIE LLP 1155 Avenue of the Americas, 22nd Fl. New York, NY 10036 Tel: (212) 261-6826 Fax: (212) 977-1649

Lead Counsel:	**Backup Counsel:**
	David Pekarek Krohn, Reg. No. 69,443 pekarekkrohn-ptab@perkinscoie.com PERKINS COIE LLP 33 East Main Street, Suite 201 Madison, WI 53703-3095 Tel: (608) 663-7460 Fax: (608) 663-7499
	Grant Kinsel Pro Hac Vice to be submitted kinsel-ptab@perkinscoie.com PERKINS COIE LLP 1201 Third Avenue, Suite 4900 Seattle, WA 98101-3099 Tel: (206) 359-8000
	John C. Moulder, Reg. No. 70,490 moulder-ptab@perkinscoie.com PERKINS COIE LLP 700 Thirteenth Street, N.W. Suite 800 Washington, DC 20005-3960 Telephone: (202) 654-3337
	Tyler Knox, Reg. No. 79,948 knox-ptab@perkinscoie.com PERKINS COIE LLP 1900 Sixteenth Street, Suite 1400 Denver, CO 80202 Tel: (303) 291-2300
	Matthew A. Lembo, Reg. No. 75,633 lembo-ptab@perkinscoie.com PERKINS COIE LLP 1155 Avenue of the Americas, 22nd Fl. New York, NY 10036 Tel: (212) 261-6826 Fax: (212) 977-1649

Respectfully submitted,

/ *Jessica Kaiser* /

Jessica Kaiser
Reg. No. 58,937
Attorney for Petitioner

PERKINS COIE LLP
1900 Sixteenth Street, Suite 1400
Denver, CO 80202-5255

Date: November 7, 2024

CERTIFICATE OF WORD COUNT UNDER 37 CFR §42.24(D)

Pursuant to 37 C.F.R. §42.24(a), Petitioner hereby certifies that portions of the above-captioned Petition for *Inter Partes* Review of U.S. Patent 11,693,938, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,907. Pursuant to 37 C.F.R. §42.24(a), this word count is in compliance and excludes the table of contents, table of authorities, mandatory notices under §42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing. This word count was prepared using Microsoft Word.

Respectfully submitted,

/ *Jessica Kaiser* /

Jessica Kaiser
Reg. No. 58,937
Attorney for Petitioner

Date: November 7, 2024
PERKINS COIE LLP
1900 Sixteenth Street, Suite 1400
Denver, CO 80202-5255

CERTIFICATE OF SERVICE

The undersigned hereby certifies that true copies of the Petition for *Inter Partes* Review of U.S. Patent No. 11,693,938 and supporting materials (Exhibits and Power of Attorney) were served via overnight delivery on the Patent Owner at the correspondence address of record as listed on PAIR:

WEIDE & MILLER, LTD.
10655 PARK RUN DRIVE
SUITE 100
LAS VEGAS, NV 89144

A courtesy copy was also sent via electronic mail to Patent Owner's litigation counsel listed below:

Nathaniel L. Dilger (CA Bar No. 196203)
Email: ndilger@onellp.com
Peter R. Afrasiabi (CA Bar No. 193336)
Email: pafrasiabi@onellp.com
Taylor C. Foss (CA Bar No. 253486)
tfoss@onellp.com
William J. O'Brien (CA Bar No. 99526)
Email: wobrien@onellp.com

Respectfully submitted,

/ *Jessica Kaiser* /

Jessica Kaiser
Reg. No. 58,937
Attorney for Petitioner

Date: November 7, 2024