

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MEDIT CORPORATION,

Petitioner,

v.

3SHAPE A/S,

Patent Owner.

Case No.: IPR2023-01315

U.S. Patent No. 10,695,151

SUPPLEMENTAL DECLARATION OF HASSAN FOROOSH, Ph.D.

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I, Hassan Foroosh, declare as follows:

I. INTRODUCTION

1. I have been retained by Medit Corporation (“Petitioner”) as an independent expert in this *inter partes* review before the United States Patent and Trademark Office (“PTO”) regarding U.S. Patent No. 10,695,151 (Ex. 1001, “the ’151 Patent”). Specifically, I have been asked to consider arguments made by Patent Owner in the Patent Owner Response as well as supporting opinions provided by Patent Owner’s expert, Dr. Saber, in Dr. Saber’s original and substitute declaration, and to provide my opinion in reply.

2. None of the arguments made by Patent Owner or opinions rendered by Dr. Saber change my opinions provided in my original declaration supporting the Petition.

3. I am being compensated at a consulting rate of \$550.00 per hour. No part of my compensation is dependent on the outcome of this proceeding or any other proceeding involving the ’151 Patent or any of its related patents. I have no other interests in this proceeding.

4. In preparing my supplemental declaration, I have considered the following additional material: the Initial Determination by the Patent Board (Paper 6, “Decision”), Patent Owner’s Response (Paper 10, “POR”), the Declaration of Dr.

Eli Saber dated June 14, 2024, the Substitute Declaration of Dr. Eli Saber dated July 24, 2024 (Ex. 2008, “Saber Substitute Decl.”), and the transcript of Dr. Saber’s deposition taken on August 8, 2024, in this proceeding along with the associated errata sheet that Dr. Saber submitted (Ex. 1019, “Saber Cross”).

II. KORTEN DOES NOT REQUIRE DETERMINING TOOTH SHADE VALUE BEFORE ASSOCIATING THE MEASURED COLOR WITH A COORDINATE IN THE 3D REPRESENTATION

5. I understand that Patent Owner and Dr. Saber have taken the position that Korten (Ex. 1009, “Korten”) requires a specific order of operation, as illustrated in Figure 2 of both the POR and Dr. Saber’s Substitute Declaration. According to the Patent Owner and its expert, Korten supposedly requires comparing the measured color with a reference color and determining validity *before* correlating the location of the color with a coordinate in the first 3D dentition model. *See, e.g.*, POR, 12-14. I disagree with these assertions.

6. In my opinion, Korten does not require the specific order of operation advanced by Patent Owner and Dr. Saber. Instead, Korten describes a series of embodiments where each embodiment builds upon and adds capabilities to earlier described embodiments. For example, Korten describes a first embodiment in which both shape and color data are captured from a patient’s dentition; in this embodiment, the location of the captured color data is correlated to a coordinate in the first 3D

dentition model. *See* Korten, 2:1-12. According to Korten, this system “is advantageous in that it provides for relatively precise color measuring and an association between measured colors and the location of these colors at a patient’s tooth.” *Id.* at 2:13-16.

7. In a later embodiment, Korten discloses that “the method further comprises the step of “matching at least the first color with a standard color from a standard color scheme,” such as the VITAPAN Classical tooth color scheme. *See id.* at 5:28-34. In my opinion, a POSITA would understand that this further embodiment builds upon the capabilities of the previous embodiment by adding the further step of determining the match between the first color and the reference color in a standard color scheme. In my opinion, a POSITA would understand that the first color has already been associated with a specific location of the first 3D dentition model in Korten at the time that this matching is performed.

8. Importantly, there is no disclosure in Korten related to this later embodiment that requires changing the order of steps in the previously disclosed embodiment in which color data was associated with a specific coordinate in the 3D representation. Accordingly, because the previous embodiment had already associated the first color with a coordinate in the first 3D dentition model (*i.e.*, the digital 3D representation), a POSITA reading this disclosure would understand that

the subsequent embodiment builds off this earlier described embodiment. Thus, a POSITA reading Korten would understand that after associating the first color with the coordinates in the first 3D dentition model, one could then use the first color to determine a matching reference color and the closeness (*i.e.*, accuracy) of that reference color.

9. In fact, Korten provides a motivation for a POSITA to associate the color data with a particular coordinate first, before determining the closest matching tooth shade. In particular, Korten discloses determining the validity of the measured color based upon the inclination between the optical sensor and the tooth surface. *See* Korten, 6:56-65. Korten further discloses that “[a] deviation between the measured inclination and [a] reference inclination may trigger a further method step of issuing an error signal or message and/or may cause skipping of the measured first color.” *See id.* at 6:65-7:2. In my opinion, the location of the measured color must be determined first in this embodiment so that the inclination value can be determined. Thus, the measured color would already be associated with a location on the first 3D dentition model before being used to determine the closest tooth shade. Moreover, in my opinion, a POSITA would want to use the inclination value to determine the validity of the measured color first before determining the closest

matching tooth shade: if the measured color is invalid, there would be no reason to find the tooth shade.

10. I understand that Dr. Saber has provided an opinion that Korten requires the specific order of operation, as shown in Figure 2 of his substitute declaration, because Korten describes capturing of shape and color data independently. *See* Saber Substitute Decl., ¶¶46-50. I disagree with Dr. Saber on this point, as well.

11. Upon my review of Korten, I see no portion in which the independent capture of shape and color data **requires** or even **suggests** that the closest tooth shade be determined before the color data is associated with a specific coordinate in the first 3D dentition model.¹ Instead, according to Korten, “[t]he independency of the capturing of the shape and the measuring of the color may for example be provided by the first and second sensor being based on different technical principles as described herein.” *See* Korten, 4:20-23.

12. According to Korten, for example, the shape data can be determined by “processing of a series of bit map images,” and lists a number of commercially available products that can perform this process. *See id.* at 4:24-40. Korten further

¹ To the contrary, as noted above, a POSITA would understand Korten to be teaching that the color measurement is associated with a coordinate location on the first 3D dentition model before the closest matching tooth shade is determined.

discloses at least one of these commercially available products determines shape data by “captur[ing] continuous 3D video images.” *See id.* Korten further discloses that the color data may be captured by using a spectrometer that has “a multiplicity of different color filters that are used in combination with a multiplicity of light sensors arranged behind such filters respectively.” *See id.* at 2:43-48. Accordingly, the shape and color data are obtained “independently” in Korten because the shape data is determined by processing a series of video images whereas the color data is obtained via color filtering technology. In my opinion, a POSITA would not understand that the use of independent technologies for determining shape and color data requires that the tooth shade be determined before the color data is associated with a specific coordinate, and I have seen no part of Korten that requires the specific order of steps shown in Figure 2 of Dr. Saber’s substitute declaration.

13. Further, in my opinion, if one applied this teaching from Korten to the disclosures of the ’151 Patent, the ’151 Patent would also show that the shape and color data can be obtained independently because of the different technical principles that are used to capture the respective sets of data. For example, the ’151 Patent teaches that shape data may be obtained using focus scanning technology in which a series of images of an object are captured at different focus plane positions via a set of focusing optics. *See* ’151 Patent, 11:9-33. The ’151 Patent further

teaches that color data may be obtained using a Bayer color filter in which red, blue, and green filters are used to capture light of the corresponding color. *See id.* at 15:28-30. Accordingly, in my opinion, because the '151 Patent discloses the use of two different technical principles to obtain shape data and color data, these processes are “independent” as that term is used in Korten.

III. THE MOTIVATION TO COMBINE KORTEN WITH LEHMANN II IS THE SAME FOR LIMITATIONS 1[B] AND 1[C] BECAUSE THESE LIMITATIONS ARE BOTH RELATED TO THE “BEST FIT” TECHNOLOGY

14. I understand that Patent Owner has argued that Petitioner has provided a motivation to combine various references with Korten based on “the subject matter of limitation 1[c]” but “does not address Petitioner’s reliance on Lehmann II for the subject matter of limitation 1[b].” *See* POR, 29.² I disagree with Patent Owner on this issue.

15. Patent Owner appears to be taking the position that limitations 1[b] and 1[c] have no relationship to one another such that each requires its own separate and

² I note that Dr. Saber has not provided an opinion regarding the motivation to combine specifically with respect to limitations 1[b] and 1[c]. *See* Saber Substitute Decl., ¶¶85-92. Further, to the extent Dr. Saber provides a discussion, it appears to be based on the technology disclosed in Lehmann I, not Lehmann II. *See, e.g., id.*, ¶87 (discussing use of solid state camera).

unique motivation to combine. This position is mistaken. In fact, limitations 1[b] and 1[c] are extremely interrelated with one another because one limitation recites determining a tooth shade value and the other limitation recites deriving a certainty score of that value.

16. The teachings of Lehmann II directed towards limitations 1[b] and 1[c] as part of the proposed combination are likewise highly related, as noted in the Petition in the discussion of the “best fit technology” described in Lehmann II. As explained in the Petition, Korten generally discloses “matching” the first color with one of the tooth shade reference colors. *See* Paper 1 (“Petition”), 31-32 (citing Korten, 5:28-34). This matching process corresponds to the “determining” step recited in limitation 1[b]. *See id.* at 25 (citing Korten, 5:28-34). The Petition further explained that Lehmann II “provid[es] a specific way for the matching process in Korten to be performed” by using the “best fit” process. *See id.* at 32. I agree with these statements in the Petition, which are consistent with statements in my original Declaration. *See id.* (citing Ex. 1015, ¶142).

17. Accordingly, in my opinion, the “best fit” process described in Lehmann II meets both the determining step of limitation 1[b] and the deriving step of limitation 1[c]. For this reason, the motivation to incorporate the “best fit” teachings from Lehmann II into the system disclosed in Korten apply to both of these

limitations, as described in the original Petition. Thus, in my opinion, Petitioner has provided sufficient motivation to combine the portions of Lehmann II related to limitations 1[b] and 1[c] with the system disclosed in Korten.

IV. A POSITA WOULD USE THE SAME TECHNIQUES FOR FINDING THE CLOSEST MATCHING COLOR IN A 2D REPRESENTATION AS WITH A 3D REPRESENTATION

18. Relatedly, I understand that the Board made the observation in its Decision that “[l]imitation 1[b] seems to require implementing teachings concerning two-dimensional color data from Lehmann II with three-dimensional color data collected at the step of limitation 1[a] by Korten’s system,” based on arguments made by the Patent Owner. *See* Decision, 31. I also understand that the Board invited the parties to further develop this issue at trial. I disagree with the arguments made by Patent Owner that led to this conclusion.

19. As an initial matter, in my opinion, limitation 1[b] (and corresponding limitations in claims 13 and 14) does not require that 2D color data from Lehmann II be implemented with 3D color data collected by Korten’s system at 1[a]. Instead, a POSITA reading claim 1 would understand that limitation 1[b] merely requires that the already collected color data from limitation 1[a] be used to find a matching tooth shade value. *See* ’151 Patent, 21:33-37. As Dr. Saber noted during his cross examination, the process for determining the tooth shade value based on a color

value does not change regardless of whether that color data comes from a 2D model or a 3D model, or as Dr. Saber put it, is “hanging on the wall.” *See* Saber Cross, 211:16-212:13. I agree with Dr. Saber to the extent he was testifying that a POSITA would use the same equations and processes for determining the tooth shade reference value in both the 2D instance and the 3D instance.

20. Accordingly, based on my experience and upon reviewing the record, in my opinion, once a color value is obtained as specified in limitation 1[a], there is no difference in using that color value to determine a tooth shade reference value as required by limitation 1[b] regardless of whether that color value is associated with a 2D model or a 3D model.

21. As a result, in my opinion, the supposed “difficulties” listed by Patent Owner and Dr. Saber are immaterial to the combinations being proposed by the Petitioner. *See* POR, 31-32; Saber Substitute Decl., ¶90. These supposed difficulties include:

- Registering the 2D color image acquired in Lehmann II into the 3D representation of Korten;
- Associating a Z-coordinate of Korten with the 2D color data of the color image acquired by the Lehmann II camera; and

- Registering the 2D color image acquired in Lehmann II into the 3D entity created by Korten, and then providing color values to the entity at the appropriately registered X-Y-Z points.

22. In my opinion, each of these supposed difficulties involve incorporating the 2D color measured by Lehmann II into the existing 3D representation created by Korten. But as previously noted, Korten ***already discloses*** that the 3D representation (*i.e.*, the first 3D dentition model) includes both shape and color data. I further understand that Patent Owner and Dr. Saber do not dispute this point, and further do not dispute that the system disclosed in Korten meets the requirements of limitation 1[a]. Because Korten already includes a 3D representation that has color data, a POSITA would not need to incorporate the 2D color data from Lehmann II into Korten's 3D representation because that 3D representation already has color data, thus rendering these supposed difficulties irrelevant to the proposed combination.

23. The final "difficulty" identified by Patent Owner and Dr. Saber relates to associating an existing shade guide acquired with a particular camera with the data gathered by Korten's imaging system. I disagree with Patent Owner and Dr. Saber as well on this point. In my opinion, Korten itself teaches that the first color is compared against a set of standard colors from a standard color scheme (*i.e.*, a tooth shade reference guide such as VITAPAN Classical shade guide, which Korten

described as “widely used”) to determine the closest matching color from that scheme. *See* Korten, 5:28-34. Accordingly, Korten already discloses to a POSITA that the colors from the tooth shade reference guide have been obtained to be compared against the first color. I have seen no opinion from Dr. Saber that Korten is somehow not enabling or is otherwise insufficient on this point.

24. To the extent that there is any doubt, however, in my opinion, a POSITA would be able to take the teachings from *Lehmann II* to overcome this supposed difficulty. For example, *Lehmann II* discloses “storing color information representative of the tooth shades that are captured with the same device or with a device calibrated within an acceptable margin as the device which captures the electronic images of the patient’s tooth.” *See* Ex. 1011 (“*Lehmann II*”), ¶016. In my opinion, it is well within the skill of a POSITA to incorporate this disclosure from *Lehmann II* into the system of Korten by, for example, having the same imaging device (*e.g.*, spectrometer) that measures tooth color also determine the color values for the tooth shade reference guide.

V. A POSITA COULD INCORPORATE THE CONCEPTS DISCLOSED IN PYE INTO THE SYSTEM OF KORTEN USING ELEMENTAL GEOMETRICAL CONCEPTS

25. In opposing the proposed combination of Pye with Korten in Ground 5, Patent Owner and Dr. Saber assert that “[n]either Petitioner nor its expert provide

any explanation how one might associate the areas or regions described in Pye with a point based system requiring the use of an X, Y, and Z coordinate system.” *See* POR, 48; *see also* Saber Substitute Decl., ¶125. I disagree with this assertion.

26. Pye discloses forming areas or regions by placing lines across the depiction of a tooth. *See* Ex. 1012 at Figure 5. The Patent Owner included Figure 5 from Pye in its POR, as did Dr. Saber in his substitute declaration. *See* POR, 47; *see* Saber Substitute Decl., ¶122. This figure shows a set of two lines extending horizontally across a depiction of a tooth to divide the tooth into 3 separate regions.

27. In my opinion, it would be well within the skill of a POSITA to use the points disclosed in Korten to implement the teachings of Pye related to forming these areas or regions. In particular, basic geometry provides that lines and planes may be defined using points – two points define a line, and three points define a plane. It would be well within capabilities of a POSITA to use the definition of a line or plane described in basic, elemental geometry to incorporate the teachings of Pye related to dividing a tooth up into different regions into the point-based 3D representation disclosed in Korten. Specifically, a POSITA would understand that the points in Korten could be used to define the lines or planes that are used to divide the depiction of the tooth into different regions as taught by Pye. Doing so also allows Korten to maintain the virtual array, thereby addressing the additional purported shortcoming

identified by Patent Owner and Dr. Saber. *See* POR, 48; *see also* Saber Substitute Decl., ¶125.

28. In my opinion, the other shortcomings identified by Petitioner and Dr. Saber related to the proposed combination of Korten and Pye relate to the process of incorporating 2D color data into a 3D representation. As noted above, in this proposed combination, that incorporation process has already been performed by Korten, which discloses a first 3D dentition model (*i.e.*, a 3D representation) that includes both color data and shape data. Accordingly, for the reasons discussed above, the purported difficulties identified by Petitioner and Dr. Saber are immaterial to the combination as proposed in the Petition.

VI. CONCLUSION

29. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: September 12, 2024

By: H. Foroosh