

**UNITED STATES PATENT AND TRADEMARK OFFICE**

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**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

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VUSIONGROUP SA,  
Petitioner

v.

HANSHOW TECHNOLOGY CO., LTD.,  
Patent Owner.

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IPR2024-01045

U.S. Patent No. 11,087,272

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**PETITION FOR *INTER PARTES* REVIEW  
OF U.S. PATENT NO. 11,087,272**

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

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**EXHIBIT LIST**

| <b>Exhibit</b> | <b>Reference</b>                                                                                                                                               |
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| 1001           | U.S. Patent No. 11,087,272 (“’272 patent” or “’272Pat”)                                                                                                        |
| 1002           | File History of the ’272 patent (“’272Pat File History”)                                                                                                       |
| 1003           | Declaration of Dr. Andrew Wolfe in Support of Petition                                                                                                         |
| 1004           | Dr. Andrew Wolfe Curriculum Vitae                                                                                                                              |
| 1005           | U.S. Patent Application Publication 2017/0178060 (“Schwartz”)                                                                                                  |
| 1006           | U.S. Provisional Application 62/269,899 (“Schwartz-Provisional”)                                                                                               |
| 1007           | U.S. Patent Application Publication 2015/0262116 (“Katircioglu”)                                                                                               |
| 1008           | U.S. Patent Application Publication 2017/0193430 (“Avegliano430”)                                                                                              |
| 1009           | U.S. Patent Application Publication 2015/0235157 (“Avegliano157”)                                                                                              |
| 1010           | U.S. Patent Application Publication 2015/0055855 (“Rodriguez”)                                                                                                 |
| 1011           | U.S. Patent Application Publication 2016/0171707 (“Schwartz ’707”)                                                                                             |
| 1012           | Declaration of June Munford                                                                                                                                    |
| 1013           | Peter Carbonetto, et al., <i>A Statistical Model for General Contextual Object Recognition</i> , Dept. of Comput. Sci., Univ. of B.C. (“Carbonetto”)           |
| 1014           | Mark Everingham, et al. <i>“Hello! My name is... Buffy – Automatic Naming of Characters in TV Video”</i> Dept. of Eng’g Sci. (“Everingham”)                    |
| 1015           | Marian George & Christian Floerkemeier, <i>Recognizing Products: A Per-Exemplar Multi-Label Image Classification Approach</i> Dept. of Comput. Sci. (“George”) |

| Exhibit | Reference                                                                                                                                                                                    |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1016    | Nishant Kejriwal, et al., <i>Product Counting Using Images with Application to Robot-based Retail Stock Assessment</i> Innovation Lab (“Kejriwal”)                                           |
| 1017    | Swagat Kumar, et al., <i>Remote Retail Monitoring and Stock Assessment Using Mobile Robots</i> , Innovation Lab (“Kumar”)                                                                    |
| 1018    | Michele Merler, et al., <i>Recognizing Groceries in situ Using in vitro Training Data</i> IEEE (2007) (“Merler”)                                                                             |
| 1019    | Yair Movshovitz-Attias, et al., <i>Ontological Supervision for Fine Grained Classification of Street View</i> , IEEE (2015) (“Movshovitz-Attias”)                                            |
| 1020    | Gül Varol & Ridvan Salih Kuzu, <i>Toward Retail Product Recognition on Grocery Shelves</i> , Dept. of Comput. Eng’g & Elecs. Eng’g (“Varol”)                                                 |
| 1021    | Tom Yeh, et al., <i>Searching the Web with Mobile Images for Location Recognition</i> MIT CSAIL (2004) (“Yeh”)                                                                               |
| 1022    | Tom Mitchell, <i>Machine Learning</i> (1997) (“Mitchell”)                                                                                                                                    |
| 1023    | Complaint, <i>Hanshow Tech. Co., Ltd. v. SES-Imagotag SA et al.</i> , Case No. 2:23-cv-00617 (E.D. Tex. Dec. 19, 2023), ECF No. 1                                                            |
| 1024    | Waiver of Service, <i>Hanshow Tech. Co., Ltd. v. SES-Imagotag SA et al.</i> , Case No. 2:23-cv-00617 (E.D. Tex. Jan. 11, 2024), ECF No. 9                                                    |
| 1025    | Unopposed Motion to Reset Trial Date and Amend Docket Control Order, <i>Hanshow Tech. Co., Ltd. v. SES-Imagotag SA et al.</i> , Case No. 2:23-cv-00617 (E.D. Tex. Apr. 17, 2024), ECF No. 28 |
| 1026    | Plaintiffs’ Disclosure of Asserted Claims and Infringement Contentions, <i>Hanshow Tech. Co., Ltd. v. SES-Imagotag SA et al.</i> , Case No. 2:23-cv-00617 (E.D. Tex.), Mar. 20, 2024         |
| 1027    | U.S. Provisional Application 62/314,785 (“785Provisional”)                                                                                                                                   |
| 1028    | U.S. Provisional Application 62/427,509 (“509Provisional”)                                                                                                                                   |

## LISTING OF CHALLENGED CLAIMS

| Reference      | Claim Limitation                                                                                                                                                                                                                                                                      |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Claim 1</b> |                                                                                                                                                                                                                                                                                       |
| 1.0            | A method comprising:                                                                                                                                                                                                                                                                  |
| 1.1            | capturing one or more images of a portion of a shelf with a camera;                                                                                                                                                                                                                   |
| 1.2            | detecting and reading content of a shelf label on the portion of the shelf within the one or more images;                                                                                                                                                                             |
| 1.3            | defining one or more product facing bounding boxes surrounding one or more corresponding facings of a product within the one or more images;                                                                                                                                          |
| 1.4            | associating the shelf label content with each of the one or more product facing bounding boxes that includes and defines each of the one or more corresponding product facings;                                                                                                       |
| 1.5            | cross-correlating the one or more product facing bounding boxes and one or more other product facing bounding boxes across one or more stores by matching the shelf label content with other shelf label content associated with the one or more other product facing bounding boxes; |
| 1.6            | building training data based on the association of the shelf label content with the cross-correlated product facing bounding boxes;                                                                                                                                                   |
| 1.7            | using the training data to build a product classifier; and                                                                                                                                                                                                                            |
| 1.8            | using the product classifier to classify an item as the product.                                                                                                                                                                                                                      |
| <b>Claim 2</b> |                                                                                                                                                                                                                                                                                       |
| 2              | The method of claim 1, wherein capturing one or more images comprises capturing the one or more images with a camera attached to a moveable robot.                                                                                                                                    |
| <b>Claim 3</b> |                                                                                                                                                                                                                                                                                       |
| 3              | The method of claim 1, further comprising using manual input to identify potential inventory designated in the one or more product facing bounding boxes.                                                                                                                             |

| Reference      | Claim Limitation                                                                                                                                                                                                                                      |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Claim 4</b> |                                                                                                                                                                                                                                                       |
| 4              | The method of claim 1, wherein using the training data to build a product classifier comprises integrating training to: (1) learn product image descriptors and (2) classify items into a neural network.                                             |
| <b>Claim 5</b> |                                                                                                                                                                                                                                                       |
| 5              | The method of claim 1, wherein associating the shelf label content with each of the one or more product facing bounding boxes comprises manually associating the shelf label content with each of the one or more product facing bounding boxes.      |
| <b>Claim 6</b> |                                                                                                                                                                                                                                                       |
| 6              | The method of claim 1, wherein associating the shelf label content with each of the one or more product facing bounding boxes comprises automatically associating the shelf label content with each of the one or more product facing bounding boxes. |
| <b>Claim 7</b> |                                                                                                                                                                                                                                                       |
| 7.0            | The method of claim 1, wherein capturing one or more images of a portion of a shelf comprises capturing one or more images of a portion of a shelf in a first store; and further comprising:                                                          |
| 7.1.1          | capturing one or more further images of portion of another shelf in a second store;                                                                                                                                                                   |
| 7.1.2          | reading content of another shelf label on the portion of the other shelf within the one or more further images;                                                                                                                                       |
| 7.1.3          | defining one or more other product facing bounding boxes surrounding one or more other corresponding facings of another product within the one or more further images; and                                                                            |
| 7.1.4          | associating the other shelf label content with each of the one or more other product facing bounding boxes that includes and defines each of the one or more other corresponding product facings;                                                     |
| 7.2            | wherein cross-correlating comprises cross-correlating the one or more product facing bounding boxes and the one or more other product facing bounding boxes across the first store and the                                                            |

| Reference       | Claim Limitation                                                                                                                                                                                                                                                                      |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | second store by matching the shelf label content with the other shelf label content; and                                                                                                                                                                                              |
| 7.3             | wherein building training data comprises building the training data based on the association of the shelf label content and the other shelf label content with the cross-correlated product facing bounding boxes correlated across the first store and the second store.             |
| <b>Claim 8</b>  |                                                                                                                                                                                                                                                                                       |
| 8               | The method of claim 7, wherein capturing one or more further images comprises capturing the one or more further images subsequent to capturing the one or more images.                                                                                                                |
| <b>Claim 9</b>  |                                                                                                                                                                                                                                                                                       |
| 9               | The method of claim 7, wherein capturing one or more further images comprises capturing the one or more further images prior to capturing the one or more images.                                                                                                                     |
| <b>Claim 10</b> |                                                                                                                                                                                                                                                                                       |
| 10.0            | A method comprising:                                                                                                                                                                                                                                                                  |
| 10.1            | capturing one or more images of a portion of a shelf with a camera;                                                                                                                                                                                                                   |
| 10.2            | detecting and reading content of a shelf label on the portion of the shelf within the one or more images;                                                                                                                                                                             |
| 10.3            | defining one or more product facing bounding boxes surrounding one or more facings of a product within the one or more images;                                                                                                                                                        |
| 10.4            | associating the shelf label content with each of the one or more product facing bounding boxes that includes and defines each of the one or more corresponding product facings;                                                                                                       |
| 10.5            | cross-correlating the one or more product facing bounding boxes and one or more other product facing bounding boxes across one or more stores by matching the shelf label content with other shelf label content associated with the one or more other product facing bounding boxes; |

| Reference       | Claim Limitation                                                                                                                                                                                                                                                                    |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10.6            | building training data based on the association of the shelf label content with the cross-correlated product facing bounding boxes;                                                                                                                                                 |
| 10.7            | using the training data to build a product classifier; and                                                                                                                                                                                                                          |
| 10.8            | using the product classifier to perform an inventory management activity related to the product.                                                                                                                                                                                    |
| <b>Claim 11</b> |                                                                                                                                                                                                                                                                                     |
| 11.0            | The method of claim 10, wherein capturing one or more images of a portion of a shelf comprises capturing one or more images of a portion of a shelf in a first store; and further comprising:                                                                                       |
| 11.1.1          | capturing one or more further images of a portion of another shelf in a second store;                                                                                                                                                                                               |
| 11.1.2          | reading content of another shelf label on the portion of the other shelf within the one or more further images;                                                                                                                                                                     |
| 11.1.3          | defining one or more other product facing bounding boxes surrounding one or more other corresponding facings of another product within the one or more further images; and                                                                                                          |
| 11.1.4          | associating the other shelf label content with each of the one or more other product facing bounding boxes that includes and defines each of the one or more other corresponding product facings;                                                                                   |
| 11.2            | wherein cross-correlating comprises cross-correlating the one or more product facing bounding boxes and the one or more other product facing bounding boxes across the first store and the second store by matching the shelf label content with the other shelf label content; and |
| 11.3            | wherein building a training data comprises building the training data set based on the association of the shelf label content and the other shelf label content with the cross-correlated product facing bounding boxes correlated across the first store and the second store.     |

| Reference       | Claim Limitation                                                                                                                                                                                                                                       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Claim 12</b> |                                                                                                                                                                                                                                                        |
| 12              | The method of claim 11, wherein capturing one or more further images comprises capturing the one or more further subsequent to capturing the one or more images.                                                                                       |
| <b>Claim 13</b> |                                                                                                                                                                                                                                                        |
| 13              | The method of claim 11, wherein capturing one or more further images comprises capturing the one or more further images prior to capturing the one or more images.                                                                                     |
| <b>Claim 14</b> |                                                                                                                                                                                                                                                        |
| 14              | The method of claim 10, wherein capturing one or more images of a portion of a shelf with a camera comprises capturing the one or more images with a camera attached to a moveable robot.                                                              |
| <b>Claim 15</b> |                                                                                                                                                                                                                                                        |
| 15              | The method of claim 10, further comprising using manual input to identify potential inventory designated in the one or more bounding boxes.                                                                                                            |
| <b>Claim 16</b> |                                                                                                                                                                                                                                                        |
| 16              | The method of claim 10, wherein the one or more bounding boxes surround gaps between potential inventory.                                                                                                                                              |
| <b>Claim 17</b> |                                                                                                                                                                                                                                                        |
| 17              | The method of claim 10, wherein associating the shelf label content with each of the one or more product facing bounding boxes comprises automatically associating the shelf label content with each of the one or more product facing bounding boxes. |
| <b>Claim 18</b> |                                                                                                                                                                                                                                                        |
| 18.0            | A system comprising:                                                                                                                                                                                                                                   |
| 18.1            | a processor;                                                                                                                                                                                                                                           |
| 18.2            | system memory coupled to the processor and storing instructions configured to cause the processor to:                                                                                                                                                  |
| 18.3            | capture one or more images of a portion of a shelf with a camera;                                                                                                                                                                                      |

| Reference       | Claim Limitation                                                                                                                                                                                                                                                                    |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18.4            | detect and reading content of a shelf label on the portion of the shelf within the one or more images;                                                                                                                                                                              |
| 18.5            | define one or more product facing bounding boxes that surround an surrounding one or more corresponding facings of a product within the one or more images;                                                                                                                         |
| 18.6            | associate the shelf label content with each of the one or more product facing bounding boxes that includes and defines each of the one or more corresponding product facings;                                                                                                       |
| 18.7            | cross-correlate the one or more product facing bounding boxes and one or more other product facing bounding boxes across one or more stores by matching the shelf label content with other shelf label content associated with the one or more other product facing bounding boxes; |
| 18.8            | build training data based on the association of the shelf label content with the cross-correlated product facing bounding boxes;                                                                                                                                                    |
| 18.9            | use the training data to build a product classifier; and                                                                                                                                                                                                                            |
| 18.10           | use the product classifier to perform one or more of: (1) an inventory management activity related to the product or (2) classifying an item as the product.                                                                                                                        |
| <b>Claim 19</b> |                                                                                                                                                                                                                                                                                     |
| 19.0            | The system of claim 18, wherein instructions configured to capture one or more images of a portion of a shelf comprise instructions configured to capture one or more images of a portion of a shelf in a first store; and further comprising instructions configured to:           |
| 19.1.1          | capture one or more further images of a portion of another shelf in a second store;                                                                                                                                                                                                 |
| 19.1.2          | read content of another shelf label on a portion of the other shelf within the one or more further images;                                                                                                                                                                          |
| 19.1.3          | define one or more other product facing bounding boxes surrounding one or more other corresponding facings of another product within the one or more further images; and                                                                                                            |

| Reference       | Claim Limitation                                                                                                                                                                                                                                                                                          |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19.1.4          | associate the other shelf label content with each of the one or more other product facing bounding boxes that includes and defines each of the one or more other corresponding product facings;                                                                                                           |
| 19.2            | wherein instructions configured to cross-correlate the one or more product facing bounding boxes and the one or more other product facing bounding boxes across the first store and the second store by matching the shelf label content with the other shelf label content; and                          |
| 19.3            | wherein instructions configured to build a training data comprising building the training data sent based on the association of the shelf label content and the other shelf label content with the cross-correlated product facing bounding boxes correlated across the first store and the second store. |
| <b>Claim 20</b> |                                                                                                                                                                                                                                                                                                           |
| 20              | The system of claim 18, wherein instructions configured to capture one or more further images comprise instructions configured to capture the one or more further images subsequent to capturing the one or more images.                                                                                  |
| <b>Claim 21</b> |                                                                                                                                                                                                                                                                                                           |
| 21              | The system of claim 18, wherein instructions configured to capture one or more further images of another portion of a shelf comprise instructions configured to capture the one or more further images.                                                                                                   |

**I. INTRODUCTION**

Petitioner respectfully requests *inter partes* review (“IPR”) of claims 1-21 (“Challenged Claims”) of U.S. Patent 11,087,272 (EX1001).

**II. GROUNDS FOR STANDING (37 C.F.R. § 42.104(a))**

Petitioner certifies the ’272 patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR. Petitioner files this Petition within one year of service of PO’s complaint on December 19, 2023. EX1023, EX1024.

**III. STATEMENT OF PRECISE RELIEF REQUESTED FOR EACH CLAIM CHALLENGED**

Petitioner requests review and cancellation of the Challenged Claims<sup>1</sup> in view of:

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<sup>1</sup> Petitioner does not concede any Challenged Claim satisfies other requirements for patentability that cannot be raised in IPR, including 35 U.S.C. §§101, 112.

| Prior Art                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Schwartz (EX1005), filed May 25, 2016; published June 22, 2017; priority to Provisional Application 62/269,989 (EX1006) filed December 18, 2015; prior art under 35 U.S.C. §102(a)(2) <sup>2</sup> |
| Katircioglu (EX1007), filed March 16, 2014; published September 17, 2015; prior art under 35 U.S.C. §§102(a)(1),(a)(2)                                                                             |
| Avegliano430 (EX1008), filed December 31, 2015; published July 6, 2017; prior art under 35 U.S.C. §102(a)(2)                                                                                       |
| Avegliano157 (EX1009), filed February 13, 2015; published August 20, 2015; prior art under 35 U.S.C. §§102(a)(1),(a)(2)                                                                            |
| Rodriguez (EX1010), filed August 1, 2014; published February 26, 2015; prior art under 35 U.S.C. §§102(a)(1),(a)(2)                                                                                |

| Ground<br>(35 U.S.C. §103) | Claims                    | References                               |
|----------------------------|---------------------------|------------------------------------------|
| 1                          | 1, 3-13, 15-21            | Schwartz, Katircioglu                    |
| 2                          | 2, 14                     | Schwartz, Katircioglu,<br>Avegliano430   |
| 3                          | 1, 3-6, 10, 15-18, 20-21  | Avegliano157, Rodriguez                  |
| 4                          | 2, 7-9, 11-14, 16, and 19 | Avegliano157, Rodriguez,<br>Avegliano430 |

#### IV. '272 PATENT OVERVIEW

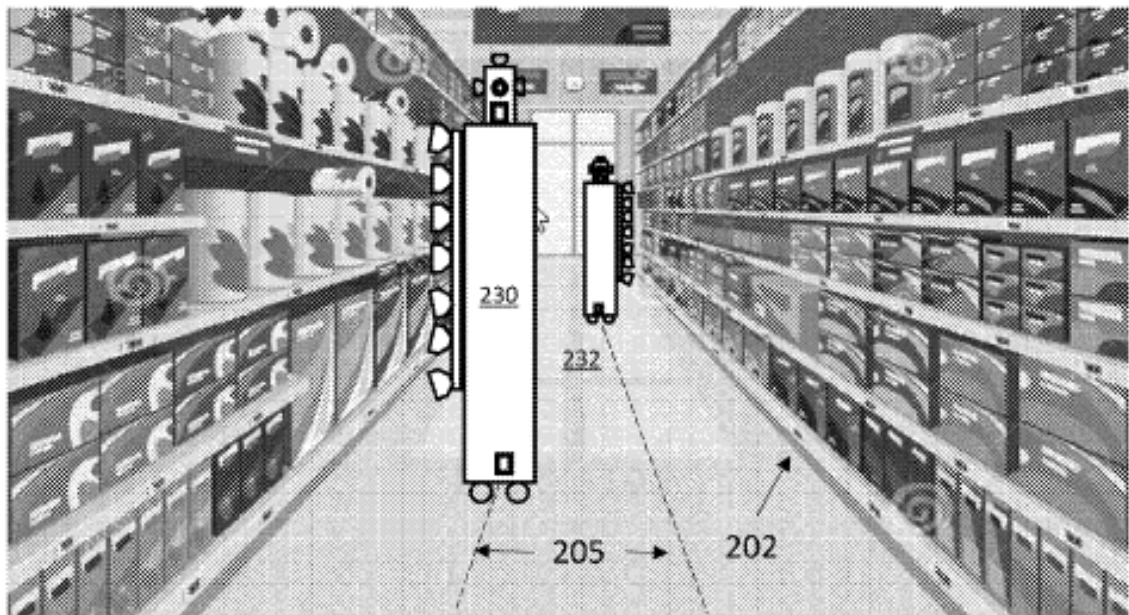
##### A. Specification

The '272 patent is titled “System and Method for Locating, Identifying and Counting Items.” '272Pat, Title; *Declaration of Dr. Andrew Wolfe* (EX1003) (“*Wolfe*”), ¶81. The patent describes problems with monitoring and tracking product

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<sup>2</sup> The cited statutory law refers to enactments of the America Invents Act.

inventory using planograms. '272*Pat.*, 1:27-53. “Planogram” is an industry term that refers to a drawing or plan for displaying merchandise in a retail store. *Wolfe*, ¶81. The '272 patent proposes mounting an image capture unit and processing module on an autonomous robot depicted in Figure 2, below.



'272*Pat.*, Fig. 2, 2:4-28, 3:10-23.

This robot-mounted image capture system stitches captured shelf label and product images together into a “realogram”—what is actually on the shelves, as opposed to what is planned by the planogram (*Wolfe*, ¶82)—according to the following steps:

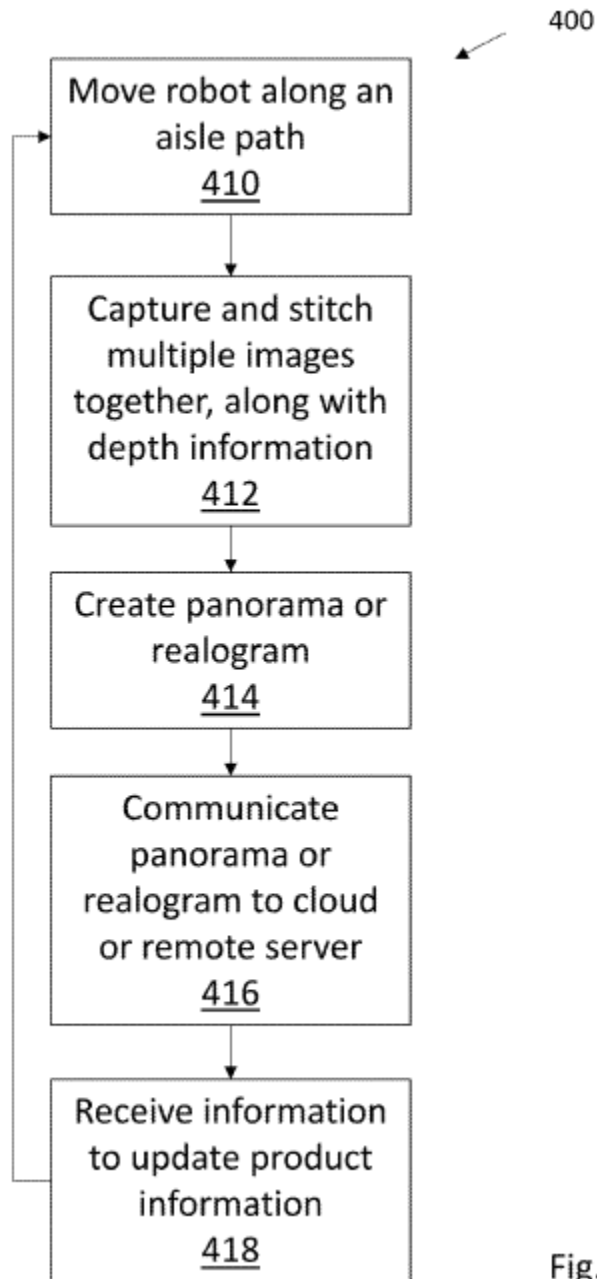
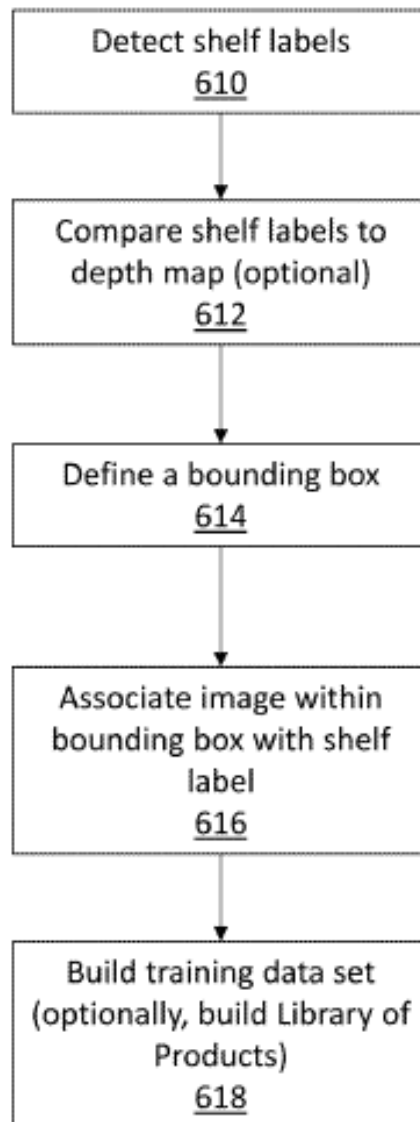


Fig. 4

'272Pat., Fig. 4, 5:48-54, 7:27-56.

The robot-mounted system captures and processes images of product-affiliated shelf labels with images contained within bounding boxes to build a training data set, used to train a product classifier in steps:



*Id.*, Fig. 6, 1:65-2:3, 7:27-56, 8:1-41, 10:65-12:60. *Wolfe*, ¶¶82-83.

## **B. Prosecution History**

The '272 patent issued from U.S. Application 15/471,722 ("722 Application"), claiming priority to provisional applications 62/314,785 (EX1027) and 62/427,509 (EX1028) filed on March 29, 2016, and November 29, 2016, respectively. '272*Pat.*, (60). Examiner required Applicant to elect a species of claims

for examination. EX1002, 80-84. Applicant elected claims 1-10 and 15-26. *Id.*, 89-95; *Wolfe*, ¶84.

Examiner rejected the claims over different prior art combinations. *Id.*, 105-15, 154-69, 218-32. Applicant narrowed the claim scope with amendments adding features, e.g., training and using a product classifier, defining and associating product facing bounding boxes with shelf labels, and cross-correlating product facing bounding boxes across. EX1002, 136-41, 205-12; *Wolfe*, ¶85.

In the Notice of Allowance, Examiner distinguished limitations 1.4-1.5 from (i) Zimmerman because it does not associate product facing bounding boxes that include and define each of the one or more corresponding product facings, and (ii) Ihara because it does not match shelf label content with other shelf label content associated with product facing boxes across stores. EX1002, 275-77; *Wolfe*, ¶¶86-87.

## **V. THE '272 PATENT'S PRIORITY DATE IS ITS FILING DATE**

### **A. Neither the '785 nor '509 Provisionals Provide Written Description Support for the '272 Patent Claims**

The Board can consider the challenged claims' priority date. *See Parus Holdings, Inc. v. Google LLC*, 70 F.4th 1365, 1374 (Fed. Cir. 2023); *Indivior UK Ltd. v. Dr. Reddy's Lab 'ys S.A.*, 18 F.4th 1323, 1328-30 (Fed. Cir. 2021). A priority claim to an earlier application is valid only if the earlier application, *inter alia*, provides adequate written description for the claims pursuant to §112. 35 U.S.C.

§120; *Anascape, Ltd. v. Nintendo of Am., Inc.*, 601 F.3d 1333, 1335 (Fed. Cir. 2010); *Alcon Rsch. Ltd. v. Barr Labs., Inc.*, 745 F.3d 1180, 1190–91 (Fed. Cir. 2014).

The '785Provisional fails to disclose building training data based on bounding box images as claimed; it never even mentions “training data” (or even “training”). EX1027. The '785Provisional discloses an approach based on extracting descriptors using known algorithms such as “SIFT”. *Id.*, 4; *Wolfe*, ¶89. POSITAs would have understood training data is a set of known mappings between inputs and outputs. *Wolfe*, ¶89. The '272 patent claims require building training data based on the “association of the shelf label content with the...product facing bounding boxes.” '272Pat, claims 1, 10, 18. So the training data required by the '272 patent claims is a set of known mappings between an identifier of the product (e.g., “Cheerios”) and a set of images of the product (pictures of boxes of Cheerios captured from the store shelves). *Wolfe*, ¶90. But the algorithms disclosed by '785Provisional use only the images themselves, not the association with the shelf label content. EX1027, 4. The '272 patent expressly distinguishes that product descriptor approach from the claimed approach of training classifiers using bounding box images. '272Pat, 12:8-40. The latter is described only in the later '509Provisional. *Wolfe*, ¶91. Accordingly, the challenged claims are not entitled to the priority date of the earlier '785Provisional.

Each challenged claim is directed to a method (claims 1, 10) and system (claim 18) limitations reciting a data cross-correlating step [1.5/10.5/18.6].

Neither the '785 nor '509 Provisionals provides support for the “cross-correlating” limitations 1.5/10.5/18.6. The applications disclose building a library of products using storewide price tags and labels to an *instant* store rather than cross-correlating *product facing bounding boxes* generated in real-time *across stores* per claims 1, 10, and 18.<sup>3</sup> EX1027, 4, 6, 10; EX1028, 5, 24; *Wolfe*, ¶¶92-93.

Because the '272 claims are not supported by either provisional, their effective filing date is March 28, 2017 (the non-provisional application filing date). *Wolfe*, ¶¶94-95.

## VI. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art (“POSITA”) in November 2016 would have had a Bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field, and two or more years of work experience or research related to computer vision, image analytics, machine learning, artificial intelligence or automated object recognition methods and systems, or equivalent training and work experience in the field. Formal education can substitute for work

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<sup>3</sup> All emphases added unless noted otherwise.

experience and relevant work experience could substitute for formal education. *Wolfe*, ¶29.

Dr. Wolfe was at least a POSITA in the field of technology of the '272 patent, is familiar with U.S. patent law, and is therefore qualified to opine on what POSITAs would have known and understood as of November 2016 to form the basis of his analysis and opinions. *Wolfe*, ¶¶1-80, 344.

## **VII. Claim Construction**

Petitioner is unaware of any “prior claim construction determination” related to the '272 patent. 37 C.F.R. §42.100(b). No formal claim constructions are necessary “to resolve the controversy.” *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) (internal quotation marks and citation omitted).

37 C.F.R. §42.104(b)(3) requires a petition to include, for any means-plus-function limitations, “the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function.” Because no claim terms in the Challenged Claims recite “means,” there is a rebuttable presumption that §112(f) does not apply. *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1348 (Fed. Cir. 2015). If the Board finds the presumption is overcome for the “processor” and “product classifier” limitations, Petitioner identifies the disclosure

describing the corresponding structure.<sup>4</sup> *See WSOU Invs. LLC v. Google LLC*, No. 2022-1063, 2023 WL 6889033, at \*3 (Fed. Cir. Oct. 19, 2023).

**A. “processor”**

|                  |                                                                                                                                                                                                                             |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Claims</b>    | 18                                                                                                                                                                                                                          |
| <b>Structure</b> | Processing modules for computing, a server. <i>See, e.g.</i> , '272 patent, Abstract, Fig. 1 (122), Fig. 3 (318), Fig. 4 (416), 1:61-64, 2:6-15, 2:21-27, 3:14-23, 5:4-20, 5:67-6:3, 6:61-7:9, 7:9-26, 7:43-47, 12:63-13:2. |

**B. “product classifier”**

|                  |                                                                                                                                                                     |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Claims</b>    | 1, 10, 18                                                                                                                                                           |
| <b>Structure</b> | A robot, set of robots, or cloud server implementing a convolutional, feedforward, or recurrent neural network. <i>See, e.g.</i> , '272 patent, 12:24-40, 12:61-66. |

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<sup>4</sup> Petitioner contends the “processor” and “product classifier” terms are indefinite for lack of sufficient structure, but that the Board can still address their unpatentability over the prior art. *See Sony Elecs. Inc. v. Jawbone Innovations, LLC*, IPR2023-01352, Paper 9, 47 (Mar. 7, 2024) (quoting *Samsung Elecs. Am., Inc. v. Prisua Eng'g Corp.*, 948 F.3d 1342, 1353 (Fed. Cir. 2020)); *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 813 (Fed. Cir. 2021).

Petitioner believes no other express constructions are necessary. The remainder of the claims should be given their plain and ordinary meaning.<sup>5</sup> *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (en banc); *Wolfe*, ¶¶120-121.

## VIII. DETAILED EXPLANATION OF GROUNDS

### A. Ground 1: Obviousness Over Schwartz and Katircioglu (Claims 1, 3-13, 15-21)

#### 1. Schwartz

Schwartz (EX1005) is analogous art. *Wolfe*, ¶¶96-97.

Schwartz was filed as U.S. Patent Application No. 15/164,633 (“Schwartz Application”) on May 25, 2016, published on June 22, 2017, and claims priority to provisional application 62/269,899 (EX1006) (the “Schwartz-Provisional”) filed on December 18, 2015. *Schwartz*, Cover. *Wolfe*, ¶98.

Schwartz discloses matching planograms by capturing store shelf images with a client device camera to create a “realogram.” *Schwartz*, Title, Fig. 1 (115a), [0045], [0071], [0128], [0130]. Captured images include products, e.g., “breakfast cereal boxes in a retail supermarket.” *Id.*, [0053]. *Wolfe*, ¶103.

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<sup>5</sup> Petitioner reserves all rights to raise claim construction arguments in other forums or to address construction of any terms PO may argue in this proceeding.

An image recognition application 103 determines which objects are included in the images using feature extraction and database matching of object attributes including its identifier. *Schwartz*, [0059], [0072], Fig. 3 (step 304), [0116]. Specifically, the image identifier may include a “symbolic identifier,” including a universal product code (UPC). *Id.*, [0073], [0132]. The captured images used to identify products include shelf label information:

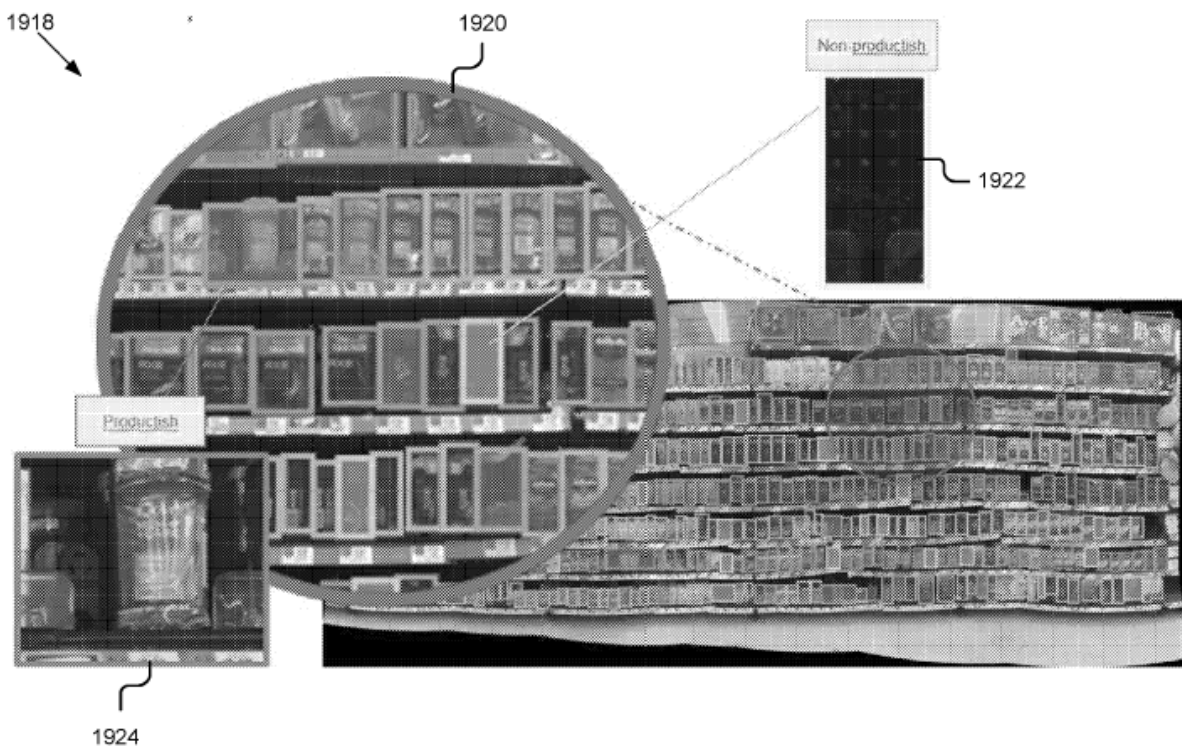


Figure 19D

*Id.*, Fig. 19D. Image attributes are collected across multiple stores and at multiple times. *Id.*, [0080]-[0081]; *Wolfe*, ¶104.

A data stream generator feeds this information to a classification module to identify a product. *Schwartz*, Fig. 3 (step 308), [0117]. The classification module

may, e.g., identify an unindexed product and its features from an image and combine that information with information from other stores to correctly index that product as a new product. *Id.*, [0090], [0100]. *Wolfe*, ¶105.

Different algorithms identify a product from a realogram by matching them to known and weighted best-fit candidates, such as product-specific heuristics and a “productish” algorithm. *Schwartz*, [0142]-[0143],[0156], [0158], [0165]-[0167]. Infusing “real world ground truth data” informs and improves the algorithm. *Id.*, [0080], [0166]; *Wolfe*, ¶106.

**a. Schwartz Qualifies as Prior Art by its 2016 Filing Date**

Schwartz is prior art because it has an effective filing date, May 25, 2016, prior to the March 28, 2017 filing date to which the '272 patent is entitled, as explained above. *See* §V; 35 U.S.C. §102(a)(2); *Wolfe*, ¶¶98-100.

**b. Schwartz also Qualifies as Prior Art by its 2015 Effective Filing Date**

Schwartz is also entitled to the effective filing date of the Schwartz-Provisional—December 18, 2015. 35 U.S.C. §§102(a)(2), §102(d)(2). “[T]here is no need to evaluate whether any claim of [Schwartz]...is *actually entitled to priority* or benefit under 35 U.S.C. 119, 120,” only that Schwartz “meet[s] the ‘ministerial requirements’ of §§119 and 120.” *Penumbra, Inc. v. RapidPulse, Inc.*, IPR2021-01466, Paper 34, 32 (Mar. 10, 2023) (precedential as to §II.E.3) (citing

MPEP §2154.01(b)) (emphasis in original). Schwartz meets these requirements: it names the same inventors, claims the benefit of the Schwartz-Provisional, and its underlying application was filed during the 12-month pendency of Schwartz-Provisional. 35 U.S.C. §119(e)(1) (a non-provisional patent application must be “filed not later than 12 months after the date on which the provisional application was filed”); *compare* Schwartz-Provisional, 8<sup>6</sup> (listing provisional filing date on 2015-12-18), 11 (listing inventor Edward L. Schwartz), *with* Schwartz, Cover (filed May 25, 2016 by applicant and inventor Edward L. Schwartz), Cover and [0001] (claiming priority to the Schwartz-Provisional). Therefore, Schwartz “shall have the same effect...as though filed on the date of [its] prior application.” 35 U.S.C. §120; *Wolfe*, ¶101.

The cited portions of Schwartz relied upon in Grounds 1-2 are replicated in the Schwartz-Provisional in all but a few exceptions described below. *Penumbra*, IPR2021-01466, Paper 34, 33-35; *Wolfe*, ¶¶99-101.

## **2. Katircioglu**

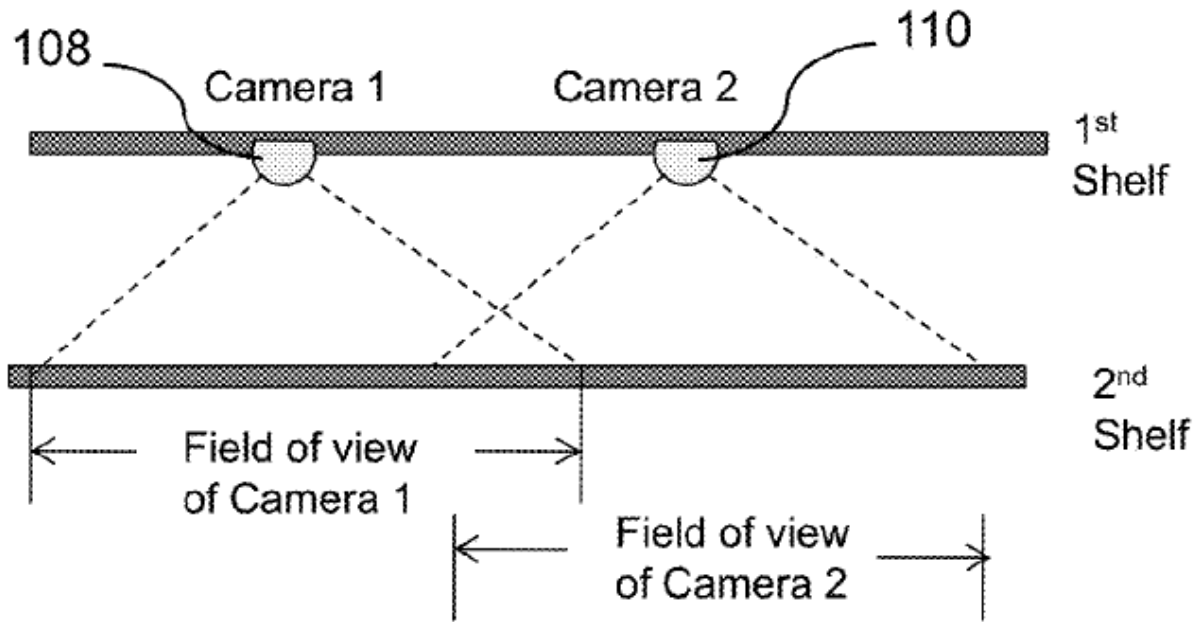
Katircioglu (EX1007) is analogous art. *Wolfe*, ¶107. Katircioglu discloses “machine vision technology for shelf inventory management.” *Katircioglu*, Title.

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<sup>6</sup> This Schwartz-Provisional citation refers to external page numbering, but all other citations correspond to internal paragraph numbering.

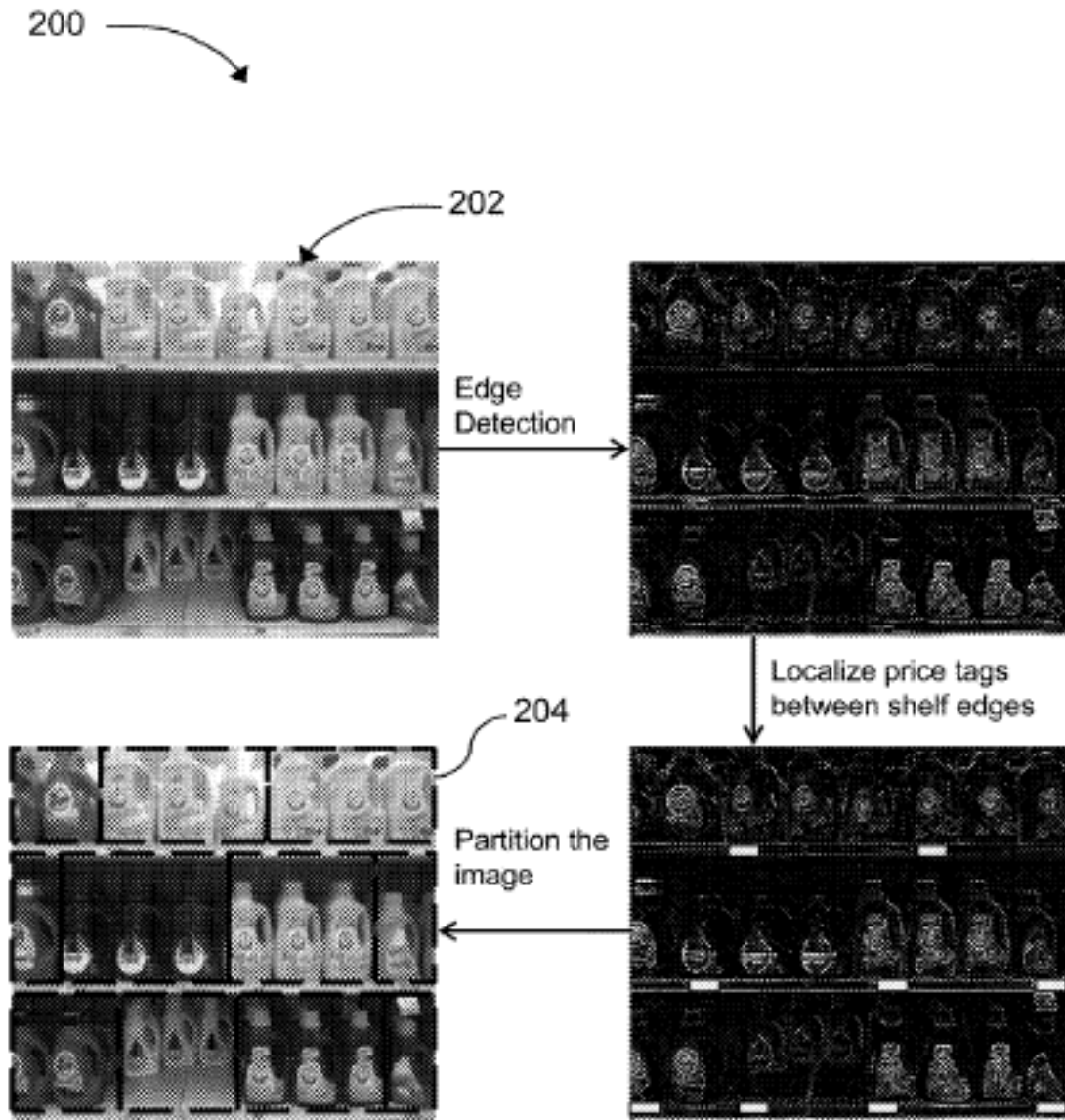
Katircioglu's system includes cameras that captures an image of items on a shelf, an image-count correlation database that stores historical images of product types on a shelf, and a product inventory database that stores a product shelf inventory count associated with each of the products. *Katircioglu*, [0004]. The cameras are arranged on shelves to capture images of products and their identifier tags—e.g., price tags—on a shelf from across an aisle as shown below. *Id.*, [0022], [0024].





*Id.*, Figs. 1A-B (combined); *Wolfe*, ¶108.

The system uses edge detection, a well-known form of creating bounding boxes (*Wolfe*, ¶109) to partition a captured digital image into products and their affiliated identifier tags—“patches”—using a process of segmentation shown below. *Katircioglu*, [0024].



*Id.*, Fig. 2; *Wolfe*, ¶109.

Segmented patches (also termed product inventory images), are correlated to product inventory database-stored images of product types (Fig. 7) quantified (Fig. 3A) in a matching process shown below. *Id.*, [0025], [0038].

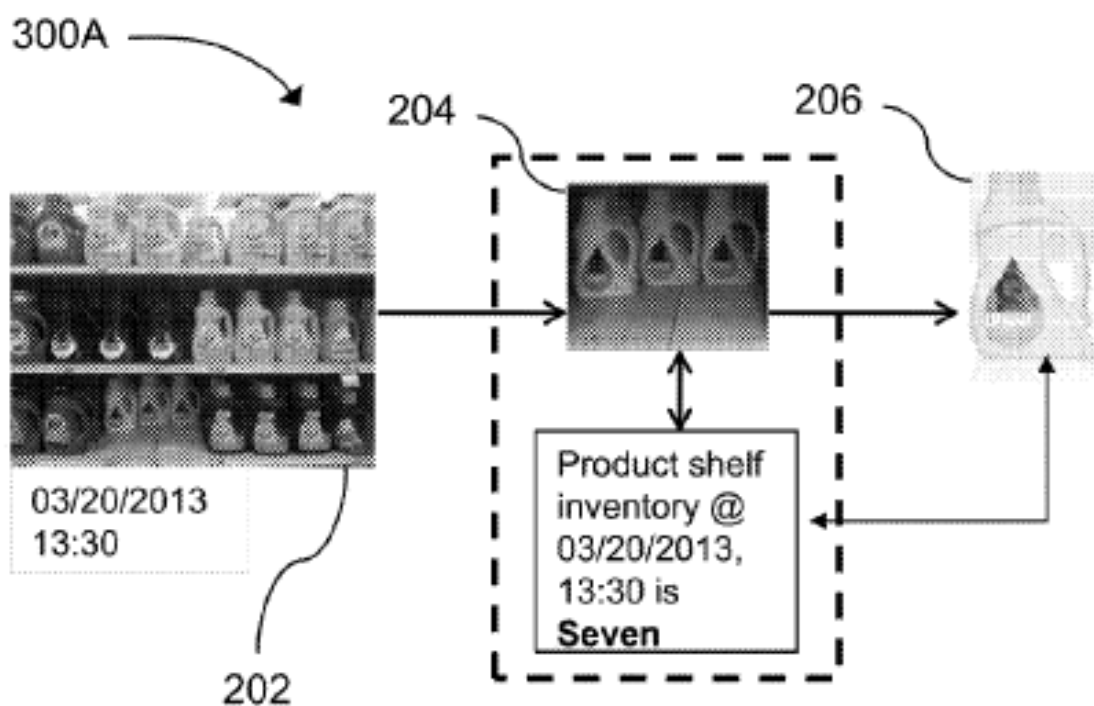
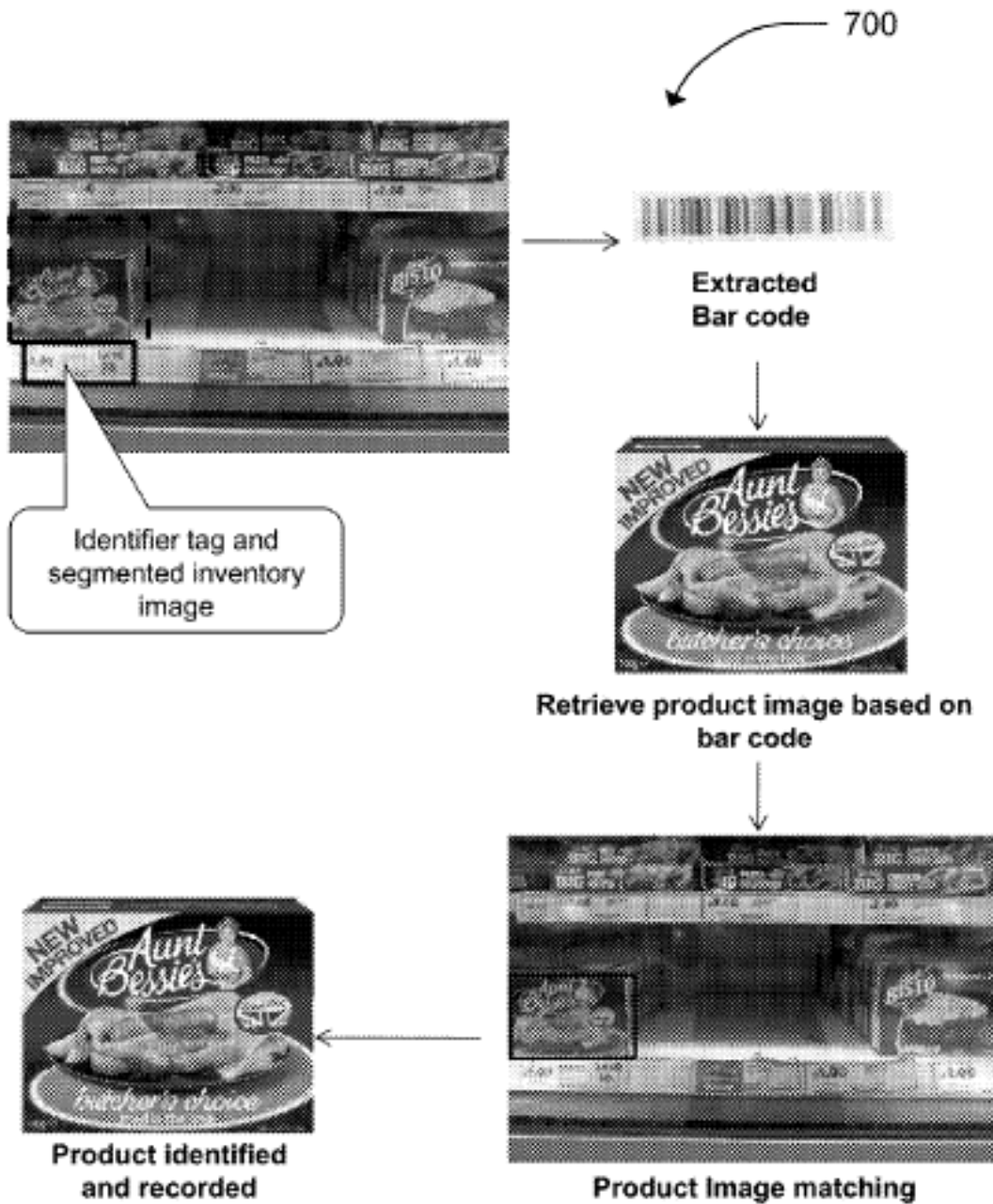


**Fig. 3A**

*Id.*, Fig. 3A (depicting image count correlation).



*Id.*, Fig. 7 (depicting product identifier tag-based identification). The system builds product image and shelf inventory data correlation pairs over time, creating an expansive volume of data processed with machine learning techniques. *Id.*, [0027]-[0028], [0040]; *Wolfe*, ¶110.

### 3. Motivation to Combine Schwartz and Katircioglu

POSITAs would have been motivated to combine Schwartz and Katircioglu. Both references describe the need to mitigate out-of-stock inventory situations that lower sales—and therefore store revenue—because customer cannot buy products that are not on a shelf. *Schwartz*, [0005]; *Katircioglu*, [0003]. Both propose automated, camera-capture and image recognition solutions that reduce restocking latency. *Schwartz*, [0005]-[0006]; *Katircioglu*, [0003]-[0004]. Schwartz generates shelf inventory images captured by cameras in multiple stores (even competitor stores) at multiple times to inform a given store’s inventory status—this creates a massive volume of noisy image data. *Schwartz*, [0081]-[0086]; *Wolfe*, ¶122. Schwartz uses the UPC label on a product to identify the “ground truth” of the identity of the product in the image. *Schwartz*, [0134]. This mapping of identifier (based on UPC label) to product image is then used to train a machine learning system. *Id.*, *Wolfe*, ¶122.

POSITAs would have looked to Katircioglu to improve the training of this machine learning system because it uses “certain data clustering or machine learning approaches...and machine learning techniques” to manage the increasing volume of data in its correlation database. *Katircioglu*, [0028]; *Wolfe*, ¶123; *see also KSR Int’l Co., v. Teleflex, Inc.*, 550 U.S. 398, 41 (2007) (obvious to apply a known technique to a piece of prior art ready for improvement). Schwartz’s technique relies on the

*UPC label on the product* itself (which may not always be visible or readable) as real world ground truth to identify a product, but POSITAs would have been motivated to capture Katircioglu’s *shelf labels* system (e.g., Figure 7) to provide the product identity ground truth because that label always faces a camera or person looking at its associated product while a UPC may be on the back of a product’s packaging. *Wolfe*, ¶123. That association of product identifier from the shelf label, with the images of the products themselves in the Schwartz-Katircioglu combination would be training data for the product classifier disclosed by Schwartz. *Id.*.

POSITAs would have had a reasonable expectation of success for this combination because, “[o]ne skilled in the art will recognize the method of implementing [these] clustering and machine learning techniques.” *Katircioglu*, [0028]; *Wolfe*, ¶124; *KSR*, 550 U.S. at 398, 407, 419 (obvious when the prior art itself offers some teaching, suggestion, or motivation to combine prior art references).

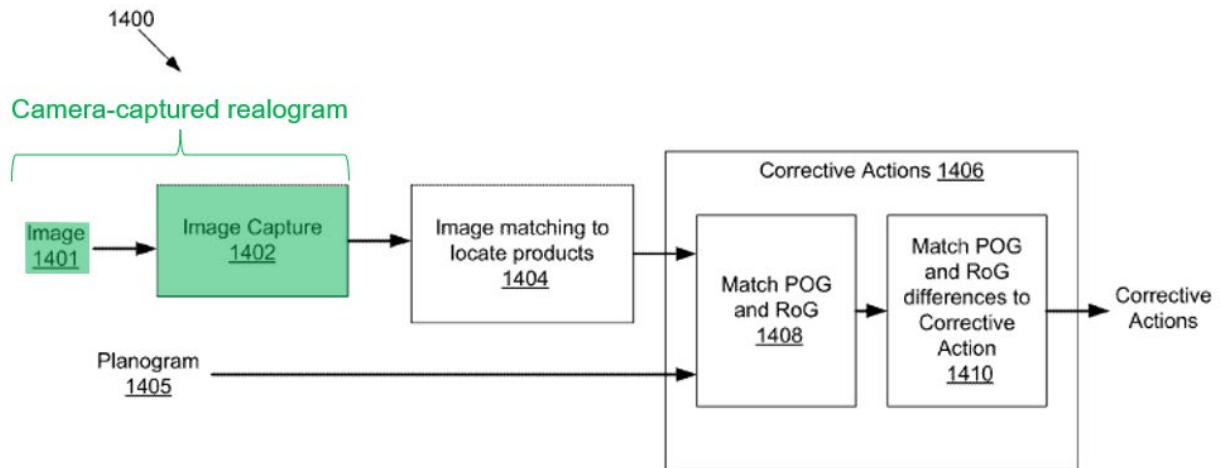
#### **4. Independent Claim 1**

##### **a. 1.0**

If limiting, Schwartz teaches 1.0. *Wolfe*, ¶125. Schwartz discloses “methods and systems for planogram matching.” *Schwartz*, Abstract, Figs 1-2, [0006], [0051]; *Wolfe*, ¶¶125-26.

**b. 1.1**

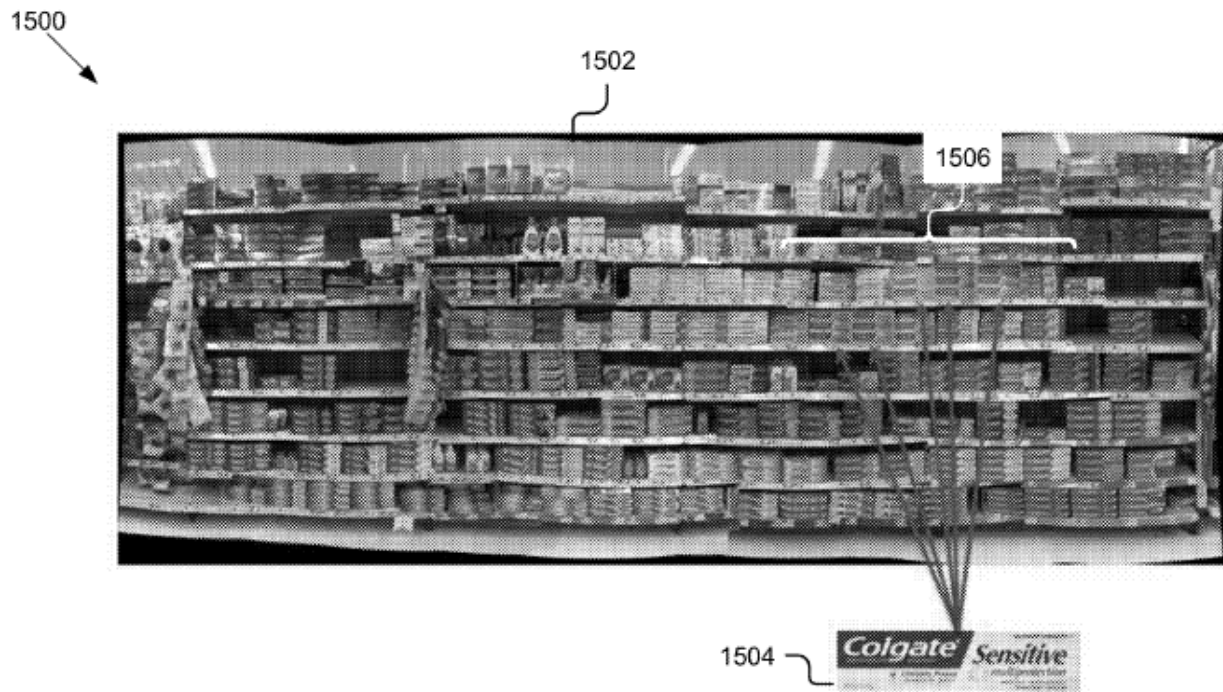
Schwartz teaches 1.1. *Wolfe*, ¶127. Schwartz captures an image of a store shelf—“realogram” 1401—with a camera as the first step 1402 of a planogram matching process. *Schwartz*, [0049], [0128], [0130]:



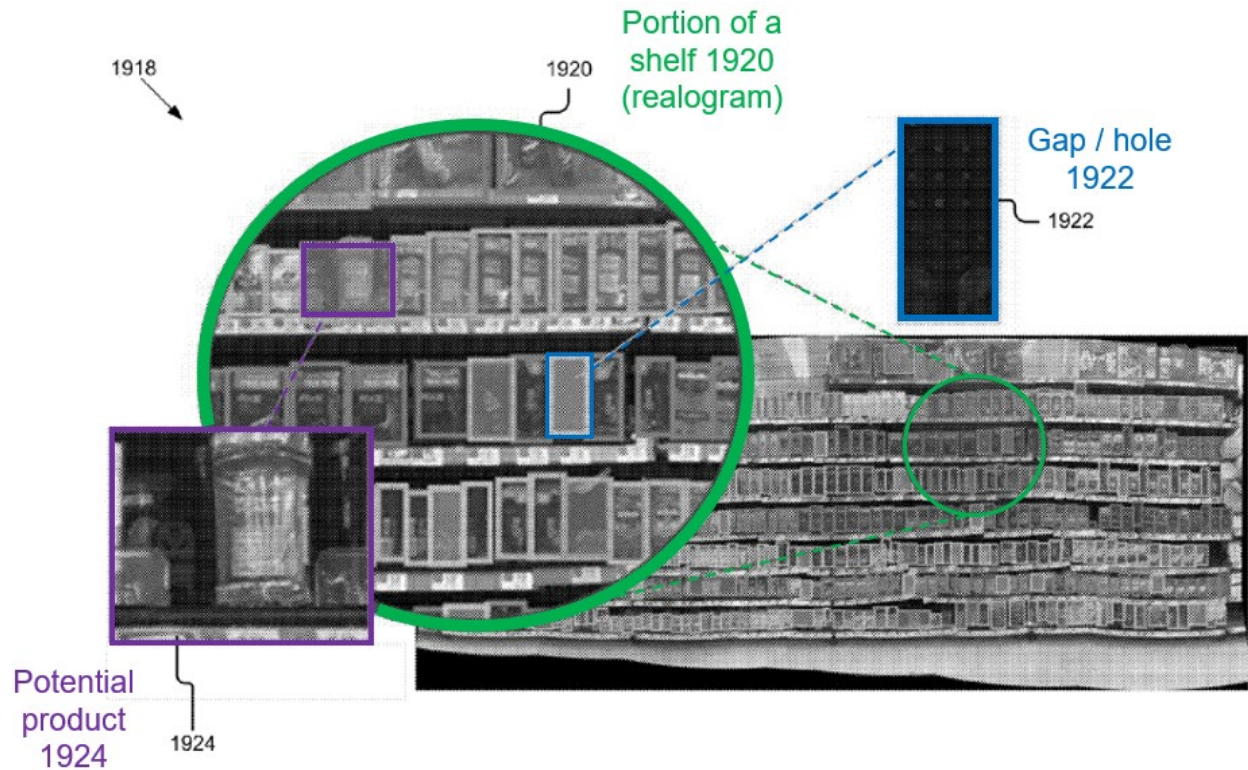
*Id.*, Fig. 14A (item 1401, step 1402) (annotated). *Wolfe*, ¶¶127-28.

**c. 1.2**

Schwartz alone, or in combination with Katircioglu, teaches 1.2. *Wolfe*, ¶129. *Schwartz*’s image processing module “determines a unique identifier for an object identified from the one or more received images.” *Schwartz*, [0073]. The system can also determine attributes such as “packaging identifier” and “shelf identifier” from the image. *Id.*, [0076]. The identifiers can include a product’s specific UPC. *Id.*, [0137]; *Wolfe*, ¶129. By example, Schwartz identifies a Colgate toothpaste product 1504 in a realogram:



*Id.*, Fig. 15A, [0137]. Although Schwartz discloses that identifiers are generally on the products themselves, Schwartz suggests it also detects and reads content from shelf labels. *Wolfe*, ¶129. Specifically, Schwartz identifies “gaps” in realogram images, lacking potential products:



*Id.*, Fig. 19D, [0137], [0151]. In this situation, POSITAs would have understood Schwartz cannot identify what product should have been shelved within that gap without reading the content on the shelf label below the gap. *Wolfe*, ¶¶130-31.

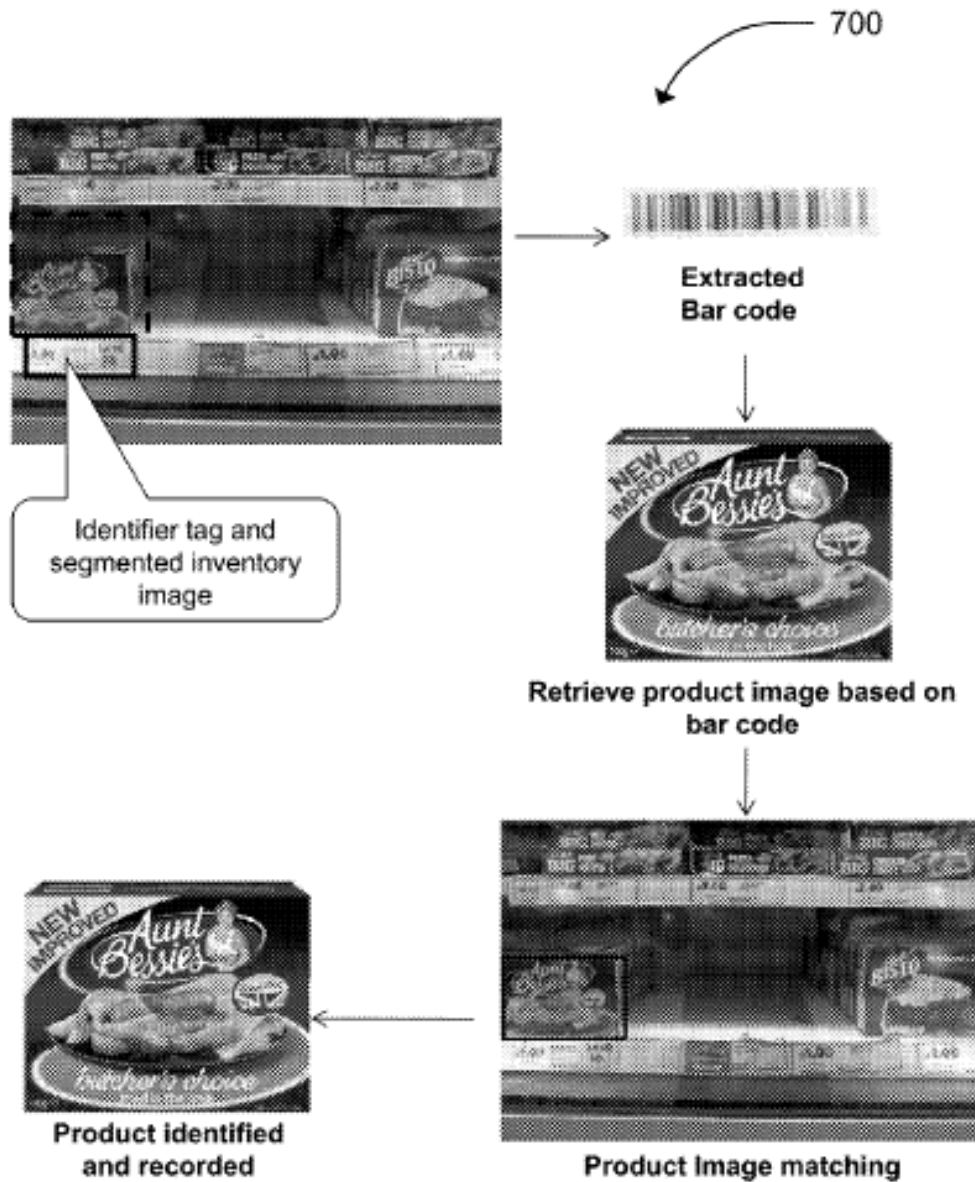
POSITAs would have understood, and found it obvious that Schwartz's image processor detects and reads product-affiliated (UPC) data on a product's shelf label in addition to or instead of a UPC on product packaging because (i) placement of aisle-facing shelf labels with UPC information was a well-known and common technique used at the relevant time allowing store employees to manually scan and place products at appropriate shelf locations with handheld scanners, (ii) Schwartz

identifies gaps, where no products including UPCs can be seen, and (iii) Schwartz seeks to improve manual planogram inventory compliance methods by automating the shelf label reading process with a camera capture technique. *Schwartz*, [0166]; *Wolfe*, ¶132.

Further, POSITAs would have recognized Schwartz analyzes the shelf label content of each product captured in a realogram because its image processing module determines product metadata including a “price of the product as sold in the retailer store,” which at the relevant time was commonly displayed only on a shelf label unique to a store and not the product packaging. *Schwartz*, [0076], [0109], [0117]; *Wolfe*, ¶133 (explaining a 20 oz. bottle of Coke looks the same in Seattle or Atlanta, but its price will likely vary between stores in the two different locations offering different sale promotions).

If PO argues Schwartz does not teach detecting and reading shelf label content, Katircioglu does. Katircioglu expressly discloses product identifier tags used for product identification and/or as price tags. *Katircioglu*, [0024]. These tags are “positioned proximate to the items on the shelves” and include “barcodes...associated with a segmented inventory image and pre-captured product image” that are “extracted from the identifier tag to identify the product type of the items on the shelf.” *Id.*, [0038]. As shown below, the pre-captured image barcode is

matched to barcode data in an inventory database to retrieve the associated product image, and “the product identification is confirmed.” *Id.*



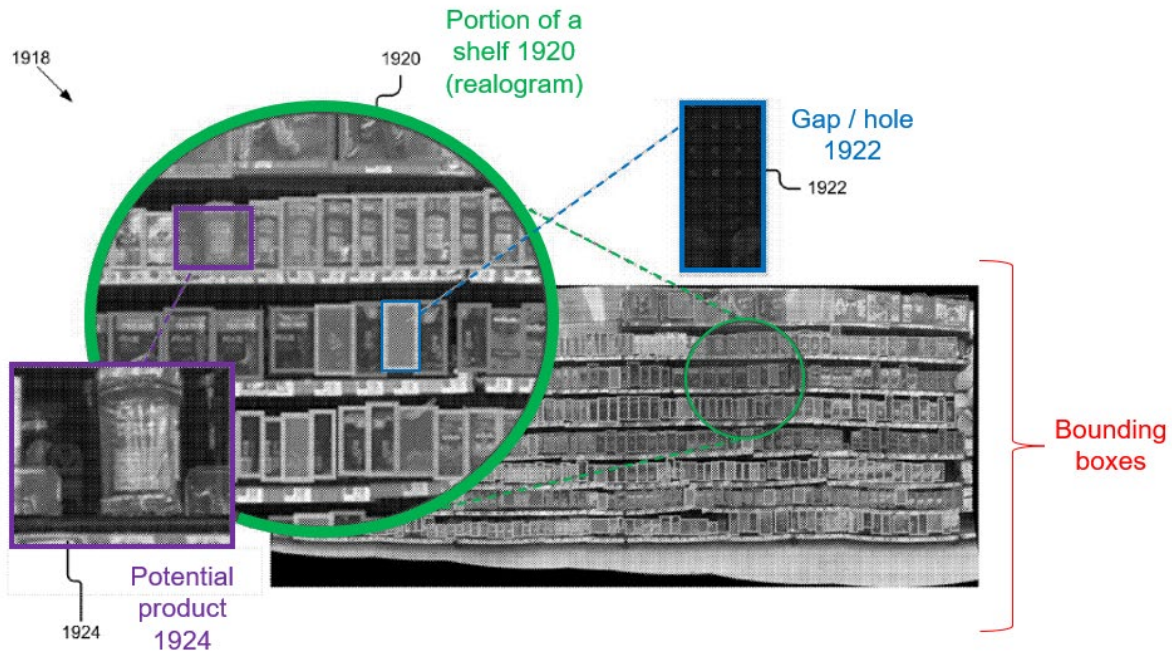
*Id.*, Fig. 7; *Wolfe*, ¶134.

POSITAs would have found it obvious to modify Schwartz with Katircioglu for the reasons and with the reasonable expectation of success discussed in §VIII.A.3, above and would have further understood UPCs and barcodes both encode identifiers of products. *Wolfe*, ¶¶135-36.

**d. 1.3**

Schwartz-Katircioglu teaches 1.3. *Wolfe*, ¶137. Per §VIII.A.4.b, above, a realogram includes a plurality of images taken by a camera of aisle-facing products.

Schwartz's includes a gap detection module that processes a realogram with three processing filters including an edge/line detector to delineate between potential products, non-products, and shelf gaps. *Schwartz*, [0151]. Potential products are bounded in boxes:



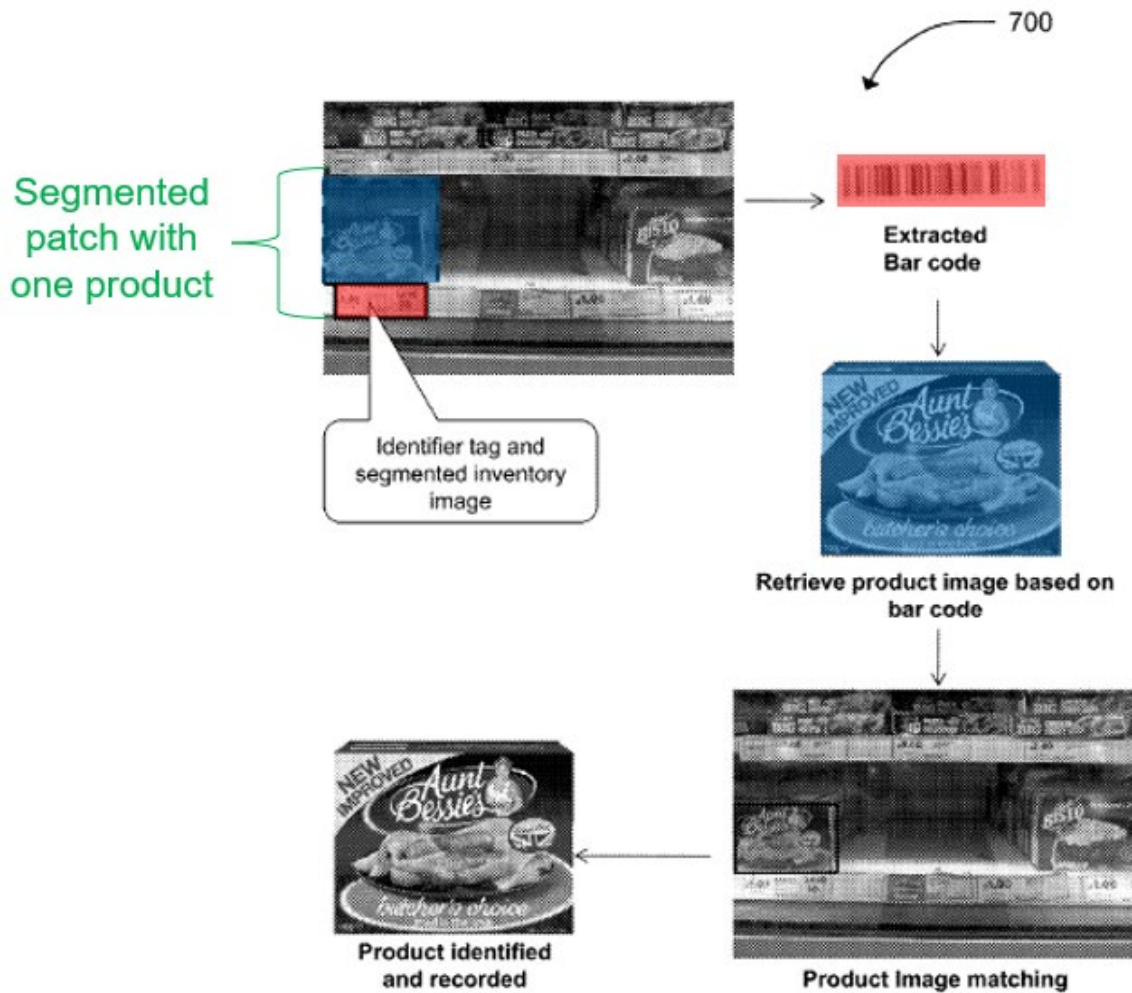
*Schwartz*, Fig. 19D (annotated); *Wolfe*, ¶138.

In addition to *Schwartz*, *Katircioglu* also teaches defining product facing bounding boxes within images. *Katircioglu* teaches a segmentation process for portioning a digital image into patches using a variety of edge detection methods and recognition of identifier tags “located on the shelves and captured in the shelf image.” *Katircioglu*, [0024]. POSITAs would have recognized these techniques and steps as well-known techniques. *Wolfe*, ¶139. As a result, “each image patch only contains one specific product” as shown below. *Katircioglu*, [0024]-[0025], [0037].



Fig. 6

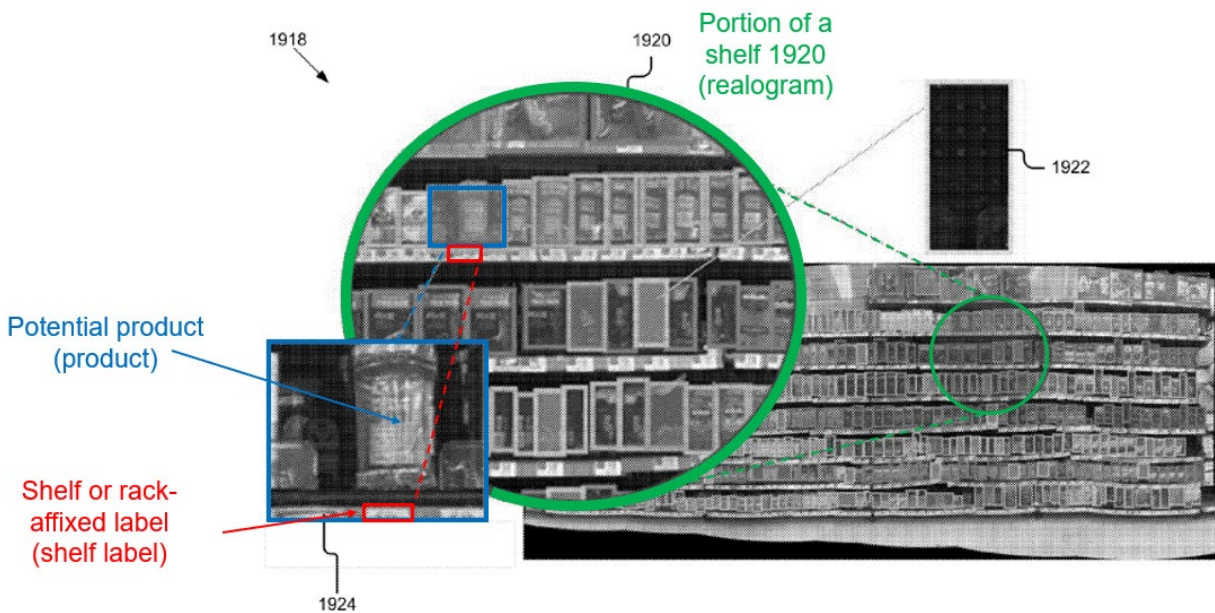
*Id.*, Fig. 6 (annotated).



*Id.*, Fig. 7 (annotated); *Wolfe*, ¶¶139-40.

e. 1.4

Schwartz-Katircioglu teaches 1.4. *Wolfe*, ¶141. Schwartz's captured image 1401 (realogram) shows a label affixed to a rack located beneath a product:



*Schwartz*, Fig. 19D (annotated). POSITAs would have understood this label to include a product identifier—i.e., a UPC 1416—because *Schwartz* further discloses matching the UPC in image 1401 with a planogram 1405 to “identify visually similar products and generate real world ground truths” as shown below. *Id.*, [0131]; *Wolfe*, ¶¶141-42.

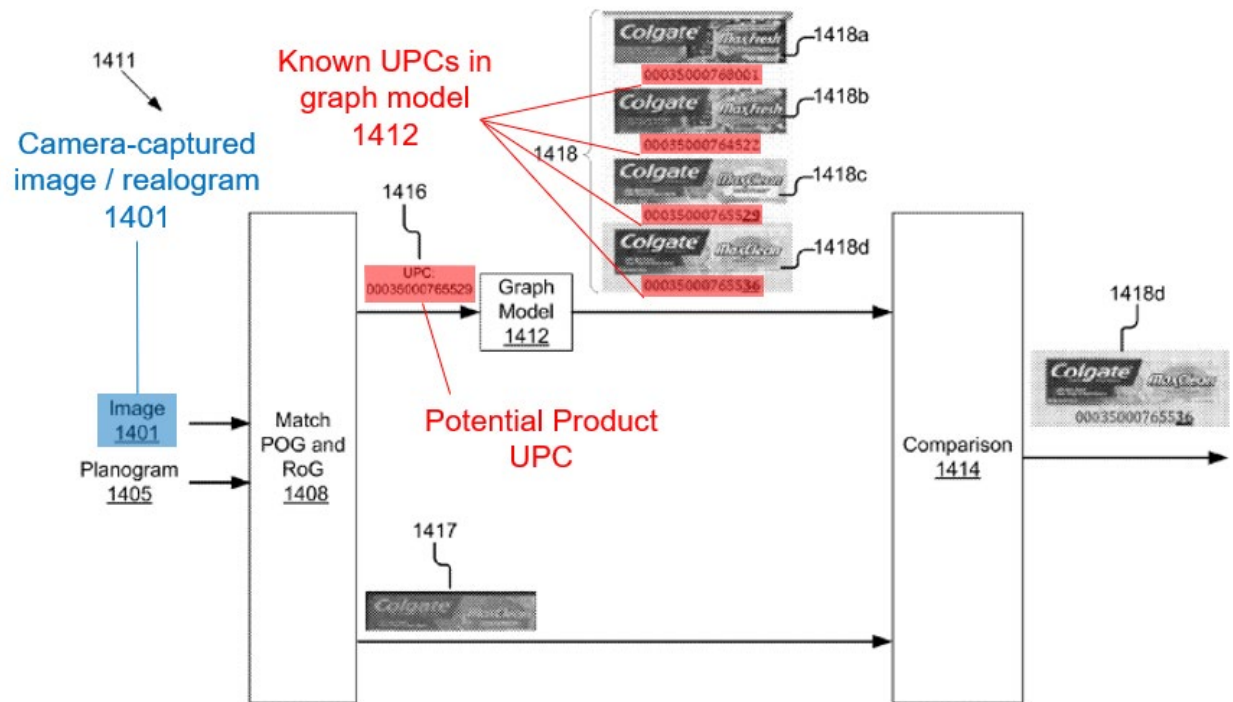
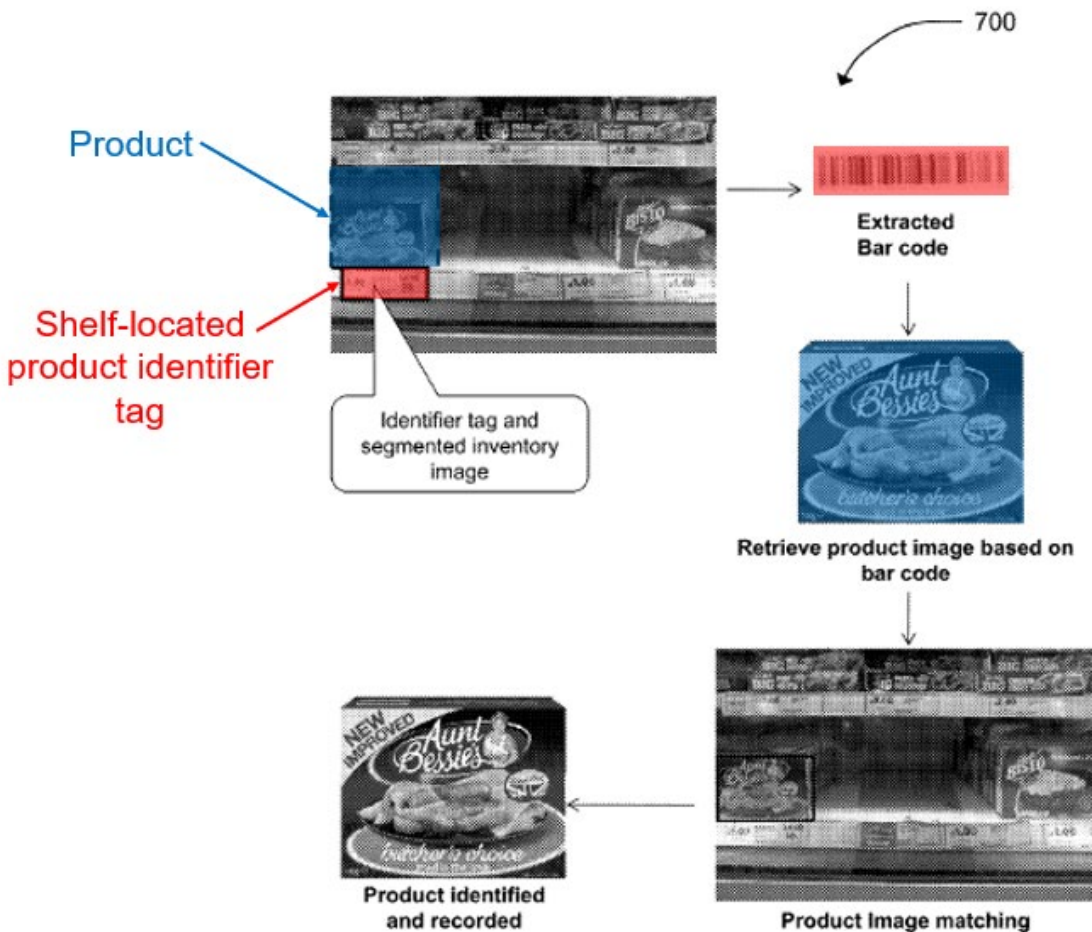


Figure 14B

*Id.*, Fig. 14B (annotated). Real world ground truth data includes images of “actual scenes” “with corresponding labels such as product locations and UPCs that are used for algorithm performance valuation, system validation and testing and training of matching learning algorithms.” *Id.*, [0134]. Schwartz uses a “similar product graph model” 1412 to compare the UPC of the expected product 1416 to that of known symbolic identifiers (i.e., UPCs) of known products. *Id.*, [0132]. An image detection block 1432 recognizes a product UPC from image 1401 to identify a product and further “output[s] bounding boxes or bounding polygons indicating locations of products.” *Id.*, [0135]. POSITAs would have recognized that because Schwartz discloses image detection that analyzes a realogram to (i) identify a product UPC

and (ii) draw bounding boxes around that product, each UPC is therefore associated with the single bounded product because Schwartz determines product-affiliated information along with the product within this finite image. *Schwartz*, [0076], [0151]; *Wolfe*, ¶142.

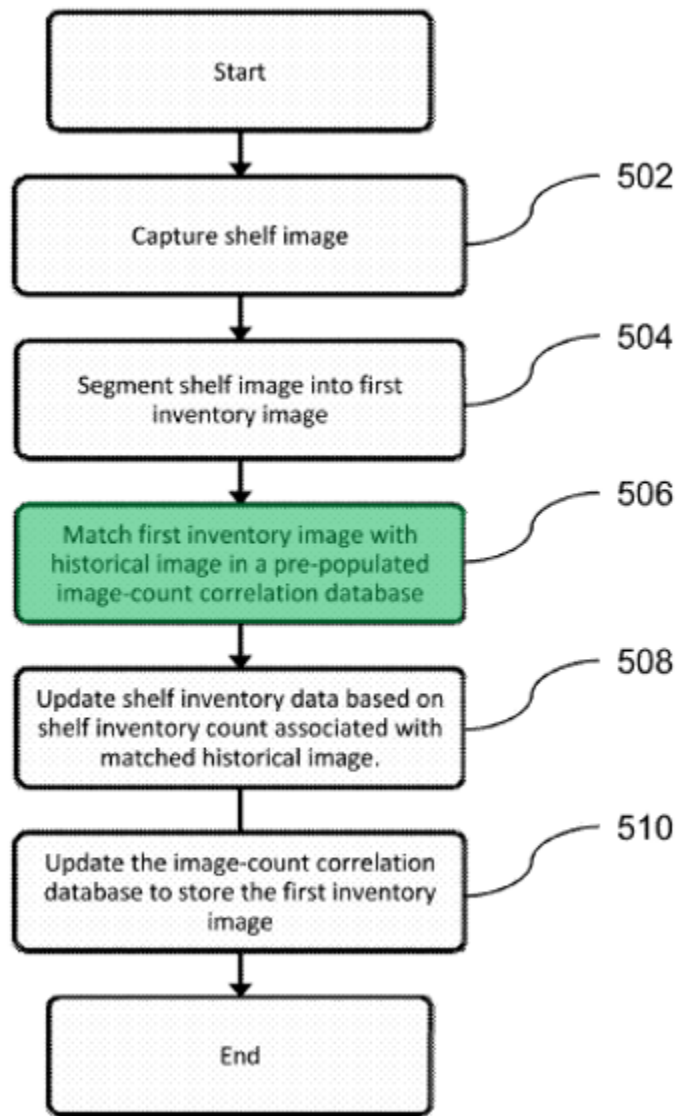
If PO argues Schwartz does not teach associating shelf label content with product facing bounding boxes, the combination with Katircioglu does. Katircioglu teaches that “identifier tags *associated with the items* are located on the shelves and *are captured in the shelf image 202*” as shown below. *Katircioglu*, [0024].



*Katircioglu*, Fig. 7 (annotated).

Specifically, Figure 7 depicts a process “for identifying and verifying products utilizing identifier tags...positioned proximate to the items on the shelves” that further include “barcodes...associated with a...pre-captured product image.” *Id.*, [0038]; *Wolfe*, ¶¶143-44.

POSITAs would have recognized this automated processing occurs in step 506 of Figure 5 (below) of *Katircioglu*’s system for “automated monitoring of shelf inventory.” *Katircioglu*, Fig. 5 (506), [0001], [0003], [0032]-[0036]; *Wolfe*, ¶145.



*Id.*, Fig. 5 (annotated).

Schwartz-Katircioglu therefore associates shelf label content (Katircioglu Figure 7) with product images from Schwartz's realogram. *Wolfe*, ¶¶146-47.

**f. 1.5**

Schwartz-Katircioglu teaches 1.5. *Wolfe*, ¶148. Per §VIII.A.4.e, Schwartz-Katircioglu captures, analyzes, and edge detects rectangular boundaries of product

and their corresponding shelf labels. Further, Schwartz “aggregates and summarizes” object (i.e., product) information received “from images of multiple stores of the same or different type” and “with the same or different local demographics”; the data is “collected over time.” *Schwartz*, [0081]. Specifically, the data comes from images “taken from a single visit to a single store, multiple visits to a single store, and multiple visits to multiple stores” where the store may even be substituted for a “warehouse, stockroom, store room, cabinet, etc.” *Schwartz*, [0083].

POSITAs would have recognized Schwartz collects and correlates product identification and affiliates shelf label content (e.g., price) information with that of a planogram for a store, and *cross-correlates* that product and affiliated shelf label information *across* stores, store types, and time because this enables, e.g., store A to identify a new, unindexed product C stocked in a different warehouse B and newly appearing in store A to update and ensure planogram compliance showing store A now stock product C to satisfy inventory audits. *Schwartz*, [0083], [0090], [0100]; *Wolfe* ¶¶148-49.

Further, POSITAs would have understood the same product is often positioned in multiple locations of a single store. *Wolfe*, ¶150. For example, candy bars may be included in an aisle, as well as near the check-out register. *Id.* When images of those candy bars are collected, POSITAs would have found it obvious to keep all images of the same product together. *Id.* *Schwartz-Katircioglu*, which

associates product images with shelf label content, would provide such cross-correlation. *Id.*, ¶¶150-51.

**g. 1.6<sup>7</sup>**

Schwartz-Katircioglu teaches 1.6. *Wolfe*, ¶152. Per §§VIII.A.4.e-VIII.A.4.f, Schwartz-Katircioglu teaches associating shelf label content with cross-correlated product facing bounding boxes.

Schwartz “generate[s] real world ground truth results of matching the planogram 1405 and the image 1401 to identify products.” *Schwartz*, [0134]. Schwartz’s real world ground truth data comprises “images with corresponding labels such as product locations and UPCs...used for algorithm performance evaluation, system validation and testing and training of matching learning algorithms.” *Id.* Schwartz also discloses “synthetic ground truth,” where the “true labels” are known as part of the creation process. *Id.* Schwartz includes image-derived product information aggregated “from a single visit to a single store, multiple visits to a single store, and multiple visits to multiple stores.” *Schwartz*, [0080], [0081], [0083]; *Wolfe*, ¶153.

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<sup>7</sup> Petitioner reserves the right to raise 35 U.S.C. §112 in other forums and proceedings.

Additionally, Katircioglu teaches capturing product inventory data across time in an “ongoing process” of “image and inventory *data correlation building*.” *Katircioglu*, [0027]. Katircioglu applies “machine learning approaches...[and] techniques” to this data. *Id.*, [0028]. *Wolfe*, ¶154.

POSITAs would have understood Schwartz-Katircioglu uses the association of the product identifier from the shelf label as the ground truth for the identification of the products in the bounding boxes of the realogram images to train a machine learning system, such as a Convolutional Neural Network, to recognize other images of the same product. *Schwartz*, [0080], [0134], [0135]; *Wolfe*, ¶¶155-56 (discussing Mitchell).<sup>8</sup>

**h. 1.7<sup>9</sup>**

Schwartz teaches 1.7. *Wolfe*, ¶157. Schwartz includes a classification module 207 that receives a data stream “that includes product information of a retail

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<sup>8</sup> *Mitchell* and other references identified below are cited in this Petition to demonstrate POSITA’s knowledge and/or as evidence supporting motivation to combine. *KSR*, 550 U.S. at 420. These exhibits are not part of the unpatentability grounds.

<sup>9</sup> *See supra* note 7.

environment” generated from synthetic and real-world ground truths. *Schwartz*, Fig. 2 (207), [0083], [0134]; *Wolfe*, ¶157. The classification module “may determine...conditions and extract...data from the data stream...” *Schwartz*, [0084]-[0094]. Classification may also occur using a “Convolutional Neural Network (CNN) classifier.” *Id.*, [0135].

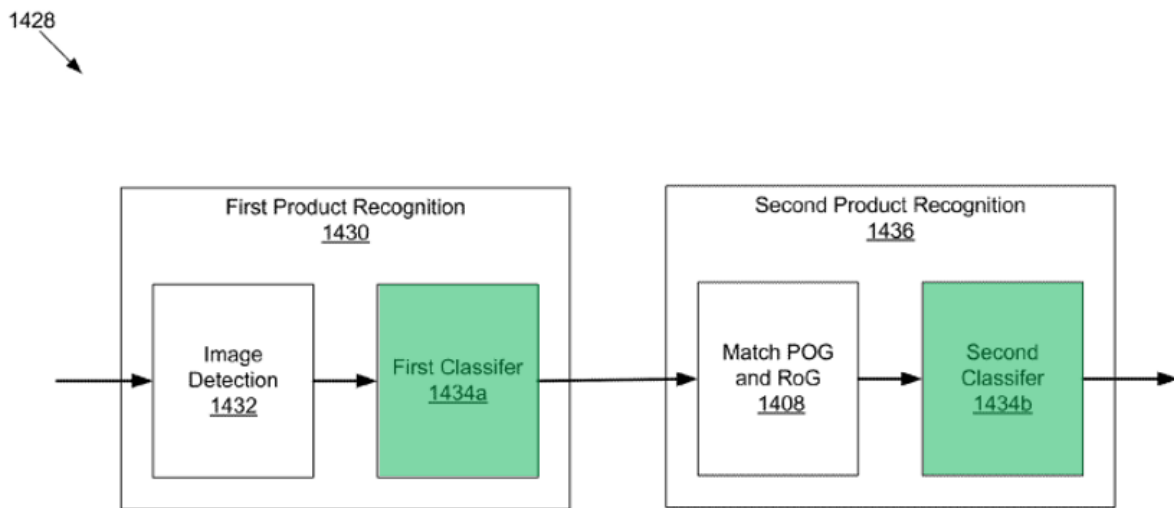
It would have been well known to POSITAs to use training data consisting of images mapped to product identifiers to build a product classifier that could recognize a later, unidentified image, as a particular product. *Wolfe*, ¶158.

If “product classifier” is construed as MPF, *Schwartz* discloses or suggests the structure discussed in §VII. *Schwartz* discloses the product classifier being implemented in a “Convolutional Neural Network.” *Schwartz*, [0135]. *Schwartz* further discloses a “recognition server,” which POSITAs would have understood, or found it obvious, is implemented as a cloud server. *Id.*, [0047]-[0048]; *Wolfe*, ¶¶159-60.

**i. 1.8**

*Schwartz* teaches 1.8. *Wolfe*, ¶161. Per §VIII.A.4.b, *Schwartz* discloses receiving a generated data stream (training data) at a classification module (product classifier) to extract (classify) “a portion of” data. *Schwartz*, [0084]-[0094]. Specifically, classification module 207 includes software instructions “to provide the functionality for *classifying* conditions of a data stream.” *Id.*, [0082]. The

classification module receives a data stream “that includes product information of a retail environment” and “extracts a portion of data from the data stream based on the condition.” *Schwartz*, Fig. 2 (207), [0083]. Further, the classification module may include two classifiers to both identify a product by UPC and its location using a Convolutional Neural Network (CNN) classifier, shown below. *Id.*, [0135]; *Wolfe*, ¶161.



*Schwartz*, Fig. 14C (annotated).

It would have been well known to POSITAs to use a product classifier that could recognize an image as a particular product. *Wolfe*, ¶¶162-63.

## 5. Independent Claims 10, 18

Schwartz-Katircioglu teaches claims 10 and 18 for substantially the same reasons as claim 1, per §VIII.A.4, because the claims are substantively identical.

Compare limitations 10.0-10.8, 18.3-18.10, with limitations 1.0-1.8. *Wolfe*, ¶¶164, 167.

The table below correlates the reasons why Schwartz-Katircioglu teaches 10.0-10.8 and 18.3-18.10. *Wolfe*, ¶¶165, 170.

| Substantially Similar Limitation(s) | Reference  |
|-------------------------------------|------------|
| 1.0/10.0                            | VIII.A.4.a |
| 1.1/10.1/18.3                       | VIII.A.4.b |
| 1.2/10.2/18.4                       | VIII.A.4.c |
| 1.3/10.3/18.5                       | VIII.A.4.d |
| 1.4/10.4/18.6                       | VIII.A.4.e |
| 1.5/10.5/18.7                       | VIII.A.4.f |
| 1.6/10.6/18.8                       | VIII.A.4.g |
| 1.7/10.7/18.9                       | VIII.A.4.h |
| 1.8/10.8/18.10                      | VIII.A.4.i |

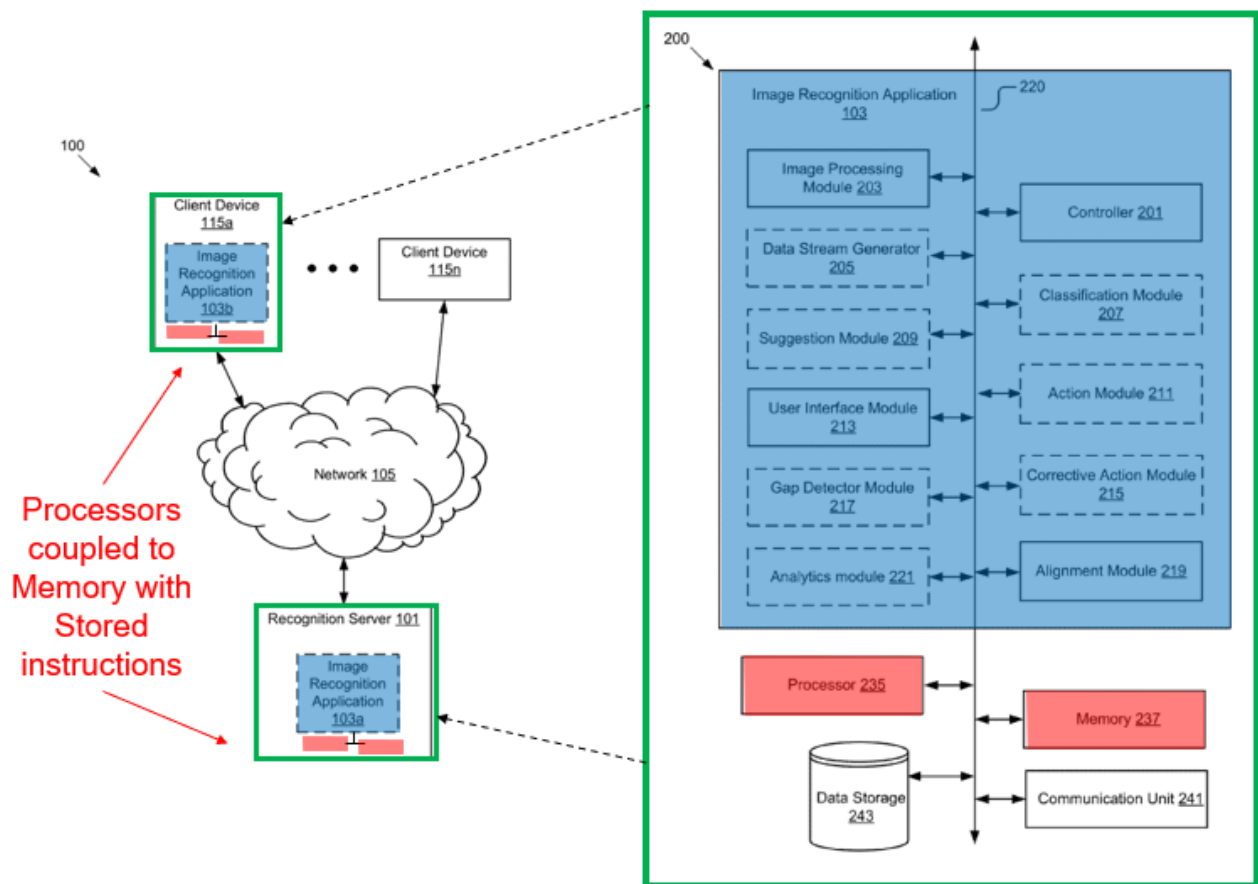
**a. 10.8, 18.10**

As to “using the product classifier to perform an inventory management activity related to the product,” in 10.8 and 18.10, Schwartz teaches the “classification module” determines an out-of-stock condition. *Schwartz*, [0084], [0117]. Katircioglu discloses a system for inventory management. *Katircioglu*, [0004]-[0006], [0025]-[0027]; *Wolfe*, ¶¶166-67.

**b. 18.0-18.2**

As to “system comprising: a processor” and a “system memory coupled to the processor...storing instructions configured to cause the processor” to execute the

same steps as recited in claim 1, Schwartz’s “method and systems for planogram matching” executes the steps described in claim 1 with an image recognition application running on a computing device with processor 235 coupled via bus 220 to memory 237 storing executable instructions as shown below. *Schwartz*, Abstract, [0058]-[0061], [0072], [0116].



*Id.*, Figs. 1-2 (200, 235) (annotated); *Wolfe*, ¶¶167-68.

If “processor” is construed as MPF, Schwartz teaches the structure discussed in §VII. Schwartz teaches processing modules for computing, *Schwartz*, Fig. 2 (200,

235), [0058]; *Wolfe*, ¶169. Schwartz further discloses a server in the form of a “recognition server.” *Id.*, [0047]-[0048]; *Wolfe*, ¶169.

## **6. Claims 3, 15**

Schwartz teaches the additional limitations of claims 3 and 15. *Wolfe*, ¶171. At times a “product cannot be definitely identified,” by Schwartz, so “manual scoring of images and evaluation of planogram compliance” may be required. *Schwartz*, [0166]; *Wolfe*, ¶171. Specifically, “human make final decisions about what the true labels are....” *Schwartz*, [0134]; *Wolfe*, ¶¶171-73.

## **7. Claim 4**

Schwartz teaches claims 4’s additional limitations. *Wolfe*, ¶174.

Schwartz determines a new product condition from the generated data, then extracts a portion of that product’s data from the data. *Schwartz*, [0090]. The classifier then extracts and *combines* this data with additional information “obtained from other resources” including “competitors’ on-shelf inventory that was collected during one or more visits to the competitors’ store” to then “identify the product and index the product in the database.” *Id.*; *Wolfe*, ¶175.

Schwartz further discloses a product classifier, built from the training data as discussed above, in the form of a “Convolutional Neural Network.” *Schwartz*, [0135]; *Wolfe*, ¶¶176-77.

## **8. Claim 5**

Schwartz teaches claim 5's additional limitations of *manually* associating the shelf label content with product facing bounding boxes because the “productish analysis” further allows “*manual scoring* of images and evaluation of planogram compliance” when “a product...cannot be definitely identified....” *Schwartz*, [0166]. Schwartz discloses that “[w]hile algorithms may assist in generating ground truth data, *humans make final decisions* about what the true labels are.” *Id.*, [0134]. Additionally, the image recognition application provides real world ground truth data “with assistance from a user....” *Id.*; *Wolfe*, ¶¶178-80.

#### **9. Claims 6, 17**

Schwartz-Katircioglu teaches the additional limitations of claims 6 and 17 for the same reasons as discussed for claim 1.4, showing association without human intervention, above. *See* §VIII.A.4.e; *Wolfe*, ¶181.

POSITAs would have recognized Schwartz automatically associates products with their symbolic identifiers (e.g., UPC) when classifying products in realograms because Schwartz teaches extracting both products and their affiliated shelf identifier and price information in the same realogram. *Id.*, Fig. 19D, [0053], [0091], [0124]; *Wolfe*, ¶182.

Katircioglu teaches price and product “identifier tags [are] *associated* with the items...located on the shelves and are captured in the shelf image 202.” *Katircioglu*,

[0024]. Barcodes on the identifier tags are “*associated* with a segmented inventory image and pre-captured product image.” *Id.*, [0038]; *Wolfe*, ¶¶183-84.

#### 10. Claims 7, 11, 19

Schwartz-Katircioglu teaches claims 7, 11, and 19 for substantially the same reasons as claim 1 (§VIII.A.4), because the claims are substantively identical. *Compare* limitations 7.0-7.3, 11.0-11.3, and 19.0-19.3, *with* limitations 1.2-1.6. *Wolfe*, ¶185.

The table below correlates the reasons why Schwartz-Katircioglu teaches claims 7, 11, and 19. *Wolfe*, ¶¶185-95.

| Substantially Similar Limitations | Reference  |
|-----------------------------------|------------|
| 1.0/7.0/11.0/19.0                 | VIII.A.4.a |
| 1.1/7.1.1/11.1.1/19.1.1           | VIII.A.4.b |
| 1.2/7.1.2/11.1.2/19.1.2           | VIII.A.4.c |
| 1.3/7.1.3/11.1.3/19.1.3           | VIII.A.4.d |
| 1.4/7.1.4/11.1.4/19.1.4           | VIII.A.4.e |
| 1.5/7.2/11.2/19.2                 | VIII.A.4.f |
| 1.6/7.3/11.3/19.3                 | VIII.A.4.g |

Claims 7, 11, and 19 differ from claim 1 by “capturing one or more images of a portion of a shelf in *a first store*” and “*second store*” as recited in 7.0 and 7.1.1, but Schwartz teaches these limitations for the same reasons discussed for 1.1 (“capturing one or more images of a portion of a shelf with a camera”) and 1.5 (“cross correlating...product facing bounding boxes...*across one or more stores*”).

*See* §§VIII.A.4.b, VIII.A.4.f. *Wolfe*, ¶185. Specifically, Schwartz generates a data stream of images including “product information of a retail environment” “taken from a single visit to a single store, multiple visits to a single store, and multiple visits to multiple stores.” *Schwartz*, [0083]. POSITAs would have therefore recognized, and found it obvious, that Schwartz captures realograms from at least a first and second (multiple) stores that are separate (e.g., one is a “competitor” to the other). *Id.*, [0090]; *Wolfe*, ¶185.

#### **11. Claims 8, 12, 20**

Schwartz teaches the additional limitations of claims 8, 12, and 20. *Wolfe*, ¶196. Schwartz “aggregates and summarizes” product information received “at different time[s] and provides *time series data* of objects to the data stream generator.” *Schwartz*, [0078], [0081]. The images are “collected over time,” and are “taken from a single visit to a single store, multiple visits to a single store, and multiple visits to multiple stores.” *Schwartz*, [0081], [0083].

POSITAs would have recognized, and found it obvious, images are captured across time and across stores to create a relative sequence of captured image respective a store. *Wolfe*, ¶197.

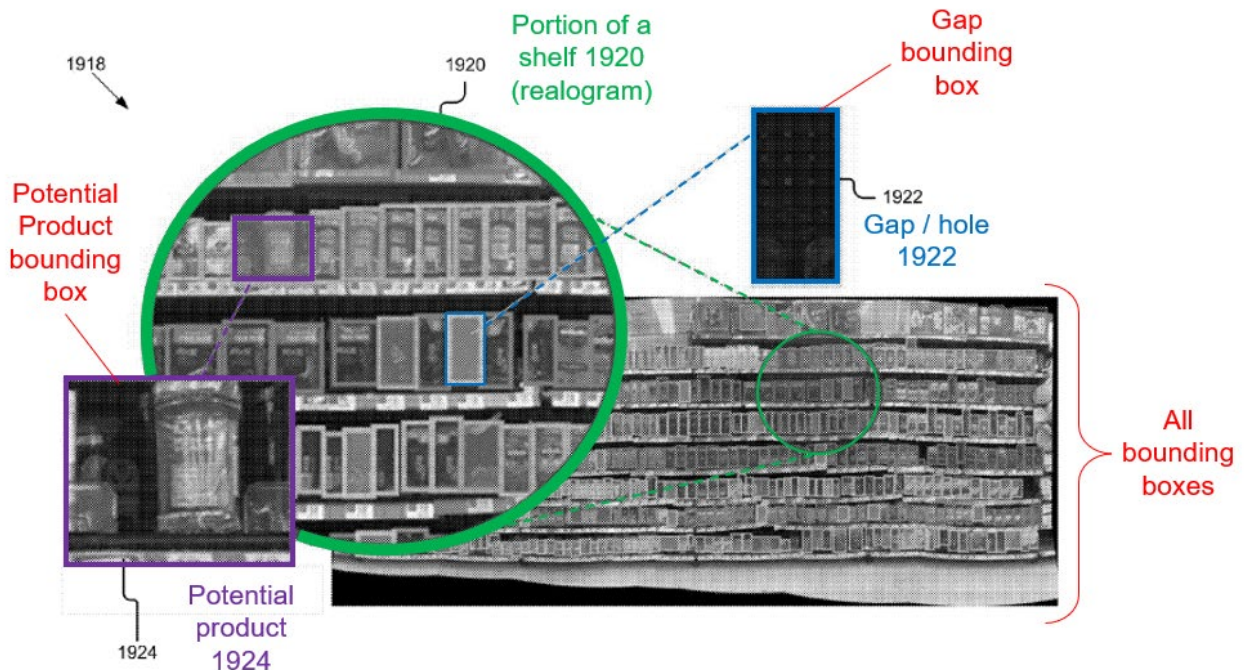
#### **12. Claims 9, 13**

Schwartz-Katircioglu teaches claims 7 and 11. *See* §§VIII.A.10. Schwartz discloses or suggests the additional limitations of claims 9 and 13 for the reasons

and image capture timing (“prior to”) discussed in claims 8, 12, and 20. *See* §VIII.A.11; *Wolfe*, ¶198.

### 13. Claim 16

Schwartz teaches claim 16’s additional limitations. *Wolfe*, ¶199. Schwartz discloses a “gap detector module” that “perform[s] gap detection and ‘productish’ analysis” including “reviewing gaps and doing further analysis to determine the probability that the gaps may include an image of a product that cannot be definitively identified.” *Schwartz*, [0166]. The gap detector module uses filters and edge detection to delineate rectangular boundaries of “gap areas” that are either “holes” 1922 (i.e., bona fide gaps) or “potential products” 1924 as shown below. *Id.*, [0151].



*Id.*, Fig.19D (annotated); *Wolfe*, ¶199.

#### **14. Claim 21**

Schwartz teaches claim 21's additional limitations. *Wolfe*, ¶200. Per claims 8, 12, and 20, Schwartz “aggregates and summarizes” product information received “at different time[s] and provides *time series data* of objects to the data stream generator.” *Schwartz*, [0078], [0081]. The images are “collected over time,” and are “taken from a single visit to a single store, multiple visits to a single store, and multiple visits to multiple stores.” *Schwartz*, [0081], [0083], [0090]. POSITAs would have recognized, and found it obvious that Schwartz captures a plurality of images (“further images”) across time and store space. *Wolfe*, ¶200.

#### **B. Even if the '272 Patent Gets Its Earliest Provisional Date, Schwartz Renders Claims 1, 3-13, and 15-21 Obvious**

##### **1. Schwartz Is Entitled to Its Provisional Date**

In §VIII.A, the Petition explains how Schwartz-Katircioglu teaches claims 1, 3-13, 15-21 if Schwartz is entitled to its publication date. *Wolfe*, ¶201.

PO may argue the '272 patent is entitled to the filing date of '785Provisional—which it is not. Even if it were, Schwartz would nevertheless be prior art because it is entitled to the date of the Schwartz-Provisional. *See* §§VIII.A.1.c-VIII.A.1.d. Therefore, Schwartz antedates even the earliest possible priority date of the '272 patent. *Wolfe*, ¶202. As tabulated, the Schwartz-Provisional discloses or suggests claims 1, 3-13, and 15-21 with like disclosure:

| Claims              | Schwartz                                                                                           | Schwartz-Provisional                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| 1.0/10.0            | Figs. 1-2, Abstract, [0006], [0051]                                                                | Figs. 1-2, Abstract, [0003], [0048]                                                                     |
| 18.0-18.2           | Figs. 1-2, Abstract, [0047]-[0048], [0058]-[0061], [0072], [0116]                                  | Figs. 1-2, Abstract, [0044]-[0045], [0053]-[0056], [0067], [0111]                                       |
| 1.1/10.1/18.3       | Fig. 14A, [0049], [0128], [0130]                                                                   | Fig. 14, [0046], [0122], [0124]                                                                         |
| 1.2/10.2/18.4       | Figs. 14A, 15A, 19D, [0073], [0076], [0109], [0117], [0130], [0137], [0142]-[0143], [0151], [0166] | Figs. 14, 15A, 19D; [0068], [0071], [0104], [0112], [0124]-[0125], [0130]-[0131], [0136]-[0137], [0151] |
| 1.3/10.3/18.5       | Fig. 19D, [0151]                                                                                   | Fig. 19D, [0136]                                                                                        |
| 1.4/10.4/18.6       | Figs. 14B <sup>10</sup> , 19D, [0076], [0131]-[0132], [0134]-[0135], [0151]                        | Fig. 19D, [0071], [0136]                                                                                |
| 1.5/10.5/18.7       | [0081], [0083], [0090], [0100]                                                                     | [0076], [0078], [0085], [0095]                                                                          |
| 1.6/10.6/18.8       | [0080]-[0081], [0083], [0134]-[0135]                                                               | [0075], [0078]                                                                                          |
| 1.7/10.7/18.9       | Fig. 2, [0047]-[0048], [0083]-[0094], [0134]-[0135]                                                | Fig. 2, [0044]-[0045], [0078]-[0089]                                                                    |
| 1.8/10.8/18.10      | Figs. 2, 14C, [0082]-[0094], [0117], [0135]                                                        | Fig. 2, [0077]-[0089], [0112]                                                                           |
| 3, 15               | Figs. 1-2, [0066], [0068], [0134], [0166]                                                          | Figs. 1-2, [0061], [0063], [0151]                                                                       |
| 4                   | [0090], [0135]                                                                                     | [0085], [0110]                                                                                          |
| 5                   | [0134], [0166]                                                                                     | [0151]                                                                                                  |
| 6/17                | Fig. 19D, [0053], [0091], [0124]                                                                   | Fig. 19D, [0050], [0071], [0086], [0118], [0125], [0136]                                                |
| 7.0/11.0/19.0       | [0083], [0090]                                                                                     | [0078], [0085]                                                                                          |
| 7.1.1/11.1.1/19.1.1 | <i>See 7.0</i>                                                                                     | <i>See 7.0</i>                                                                                          |

<sup>10</sup> Petitioner highlights disclosure only appearing in Schwartz.

|                     |                                   |                          |
|---------------------|-----------------------------------|--------------------------|
| 7.1.2/11.1.2/19.1.2 | <i>See</i> 7.0, 1.2               | <i>See</i> 7.0, 1.2      |
| 7.1.3/11.1.3/19.1.3 | <i>See</i> 7.0, 1.3               | <i>See</i> 7.0, 1.3      |
| 7.1.4/11.1.4/19.4   | <i>See</i> 7.0, 1.4               | <i>See</i> 7.0, 1.4      |
| 7.2/11.2/19.2       | <i>See</i> 7.0, 1.5               | <i>See</i> 7.0, 1.5      |
| 7.3/11.3/19.3       | <i>See</i> 7.0, 1.6               | <i>See</i> 7.0, 1.6      |
| 8/12/20             | [0078], [0081], [0083],<br>[0090] | [0076], [0078], [0085]   |
| 9/13                | <i>See</i> 8, 12, 20              | <i>See</i> 8, 12, 20     |
| 16                  | Fig. 19D, [0151], [0166]          | Fig. 19D, [0136], [0151] |
| 21                  | [0078], [0081], [0083],<br>[0090] | [0076], [0078], [0085]   |

## 2. Schwartz Renders the Claims Obvious, Based Solely on What is in Schwartz-Provisional

Schwartz (publication) discloses a few additional details to what was disclosed in Schwartz-Provisional. *Compare Schwartz-Provisional*, Fig. 14, [0124]-[0125], *with Schwartz*, Figs. 14A-C, [0130]-[0137]. Even if Schwartz-Provisional does not provide sufficient written description for the items highlighted above (Figures 14B, 14C, [0131], [0132], [0134], [0135]), the limitations that cite those disclosures (1.4, 1.6, 1.7, 1.8, 10.4, 10.6, 10.7, 10.8, 18.1, 18.6, 18.8, 18.9, 3, 5, 15) would have been obvious based on other disclosures of Schwartz supported by Schwartz-Provisional. *Wolfe*, ¶203.

Limitations 1.4, 10.4, and 18.6 cite to Figure 14B and paragraphs [0131]-[0132] and [0134]-[0135] of Schwartz as disclosing using the UPC captured in an image to identify a product. Even without these disclosures, it would have been obvious to use a UPC code to identify a product. *Wolfe*, ¶204. And even without

such knowledge, this limitation would still be taught by Katircioglu's reading of barcodes on identifier tags. *Id.*

Limitations 1.6, 1.7 and 1.8 (and the corresponding limitations of claims 10 and 18) relate to building training data, building a product classifier, and using a product classifier, respectively. While the analysis cites Figure 14C and paragraph [0134]-[0135] of Schwartz for the disclosure of a Convolutional Neural Network classifier, training and using classifiers was well known in the art, even without such disclosure, and would have been obvious to use in the Schwartz-Katircioglu combination. *Wolfe*, ¶205.

Claims 3 and 15 recite using manual input to identify potential inventory. Claim 5 recites manually associating shelf label content with bounding boxes. While the analyses above cite paragraph [0134], it would have been obvious to a POSITA to have human intervention to make final decisions on determining what labels apply to images. *Wolfe*, ¶206.

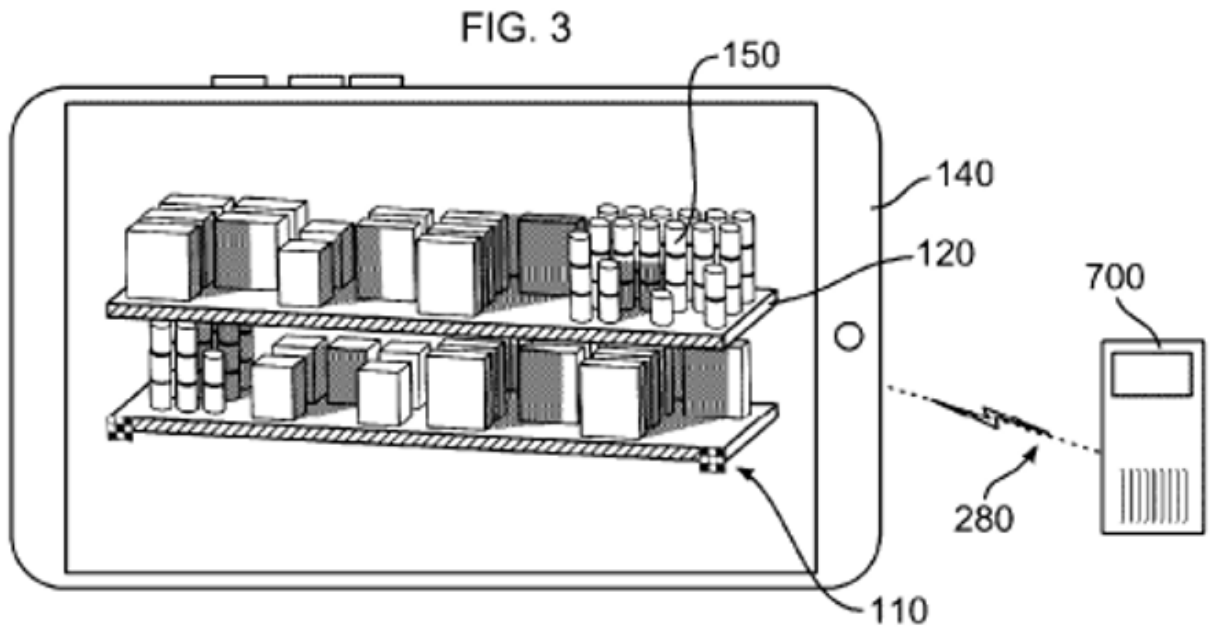
While the analysis for claim 4 cites paragraph [0135], the limitation is met even without that disclosure by paragraph [0090].

**C. Ground 2: Obviousness over Schwartz, Katircioglu, and Avegliano430 (Claims 2, 14)**

**1. Avegliano430**

Avegliano430 (EX1008) is analogous art. *Wolfe*, ¶111.

Avegliano430 discloses “identifying spaces on shelves which are not full of objects” by “obtaining an image of the shelf...using a device having a camera...and a computer” containing “software configured to analyze the image” to identify a shelf, its storage area and any vacant areas on it. *Avegliano430*, [0003]. In one embodiment, Avegliano430 captures images of products 150 sitting on shelves 120 using a digital camera in a smartphone “or other portable computing device” 140. *Id.*, [0022].



*Id.*, Fig. 3. In another embodiment, Avegliano430 avoids the need for an “employee [to] carry out such image gathering” by flying an unmanned aerial vehicle (UAV) or drone 200 carrying cameras 220 and depth measuring devices 222 along rows of displayed product and gathering image data. *Id.*, [0034].

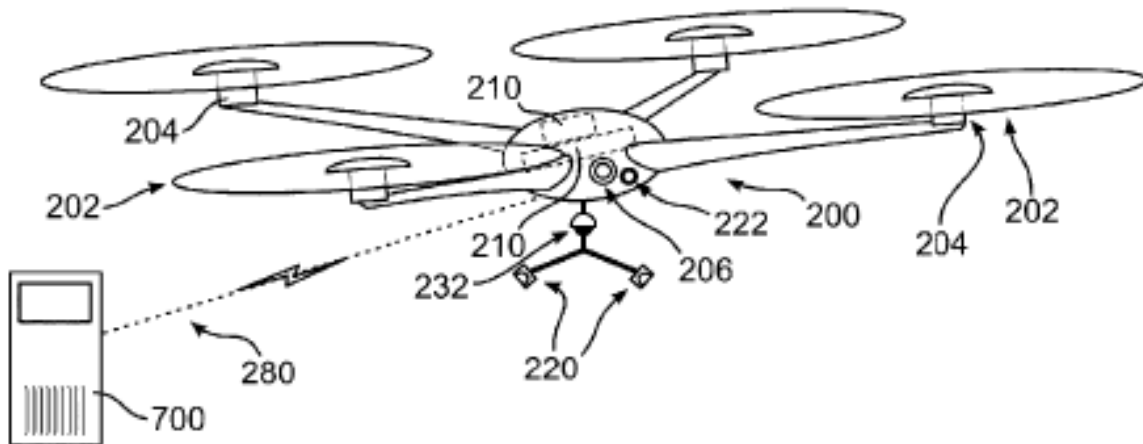


FIG. 5

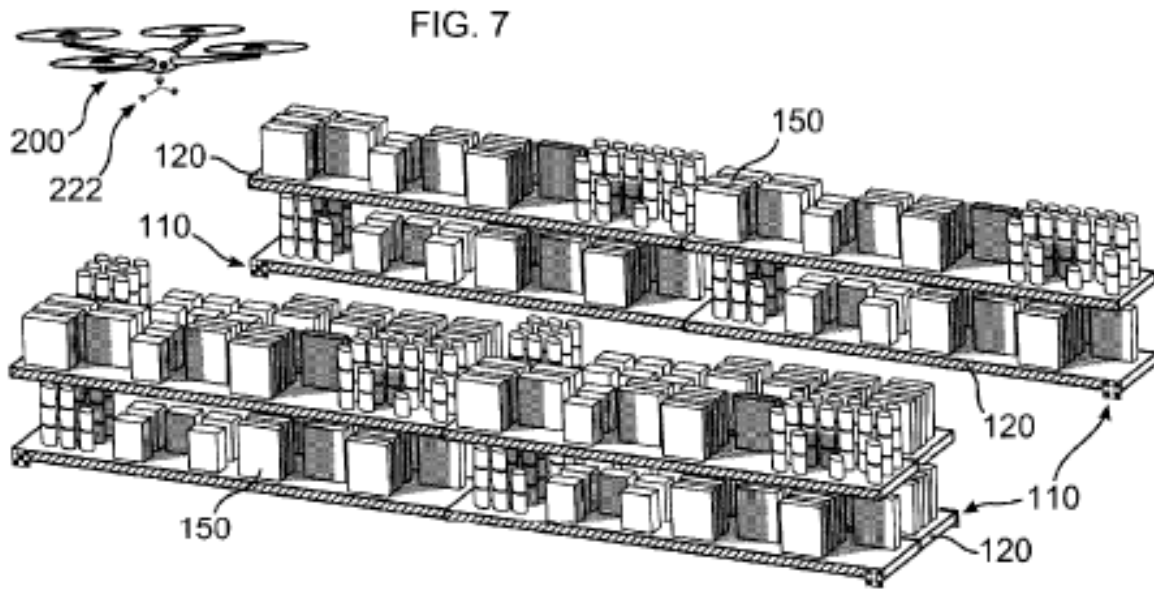


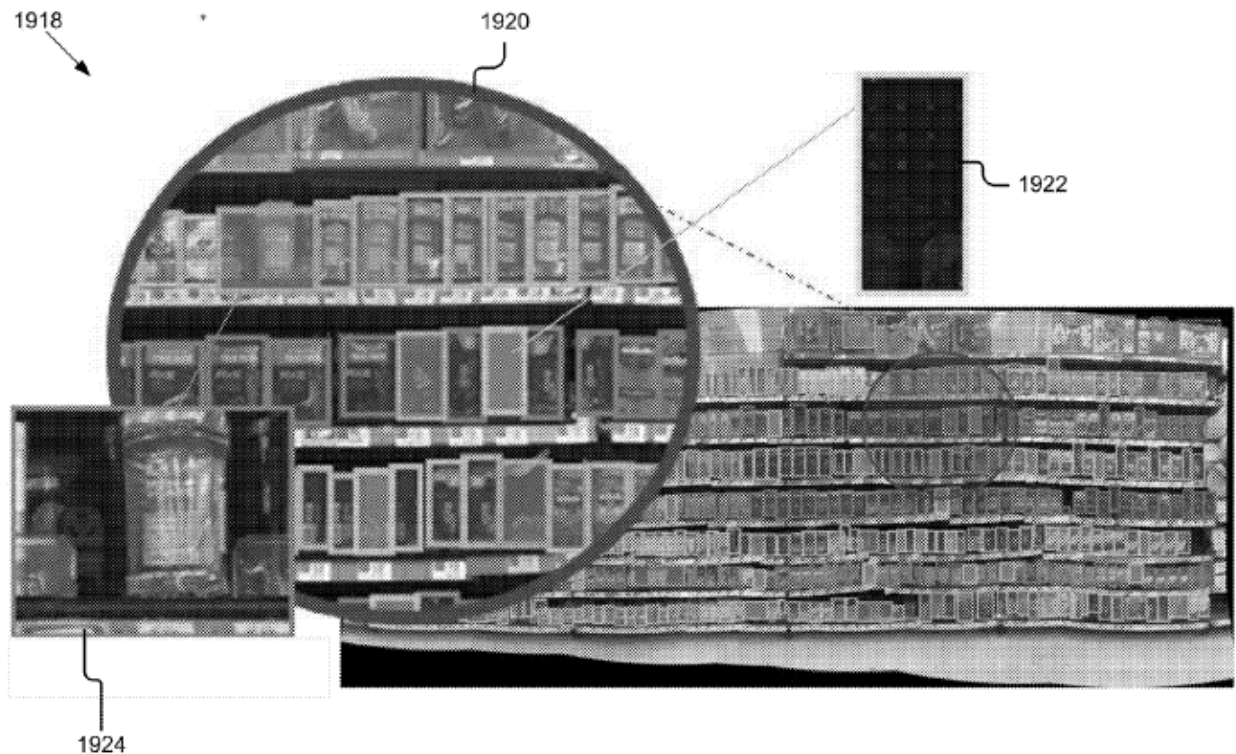
FIG. 7

*Id.*, Figs. 5, 7; *Wolfe*, ¶112.

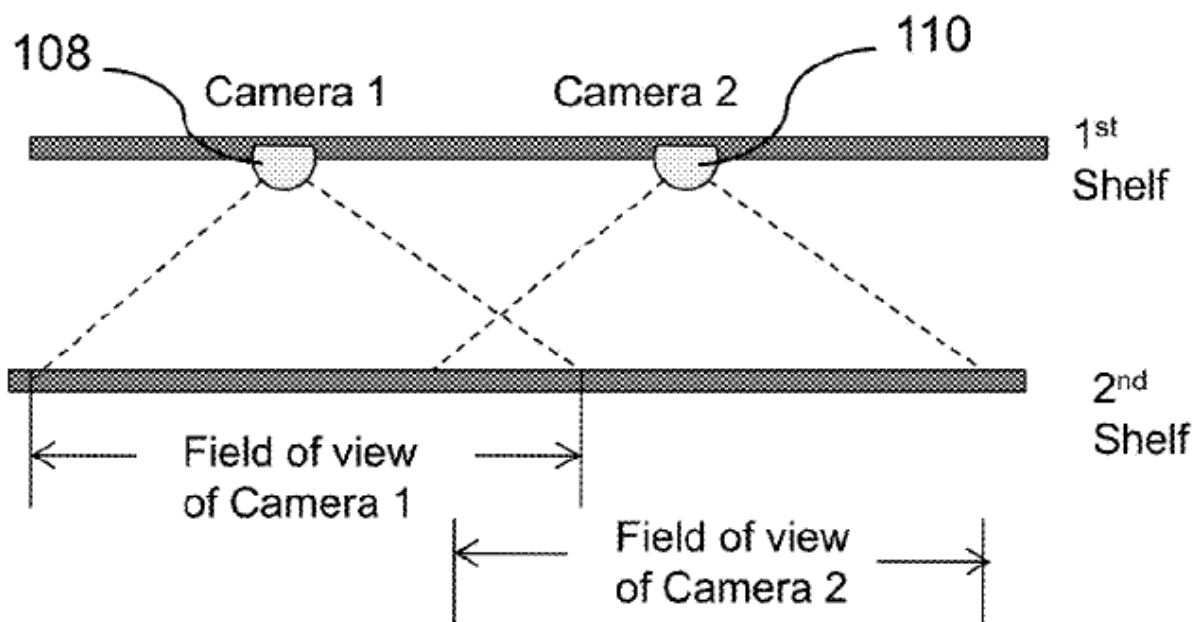
## 2. Motivation to Combine Schwartz, Katircioglu, and Avegliano430

POSITAs would have been motivated to further modify Schwartz alone or the Schwartz-Katircioglu combination with Avegliano430. Schwartz alone, or in

combination with Katircioglu, teaches an automated, camera-capture and image recognition solution that reduces the latency of restocking. *Schwartz*, [0005]-[0006]; *Katircioglu*, [0003]-[0004]. Schwartz generates shelf inventory images captured by to create an expansive library of image data useful for indexing known and unknown products in a database. *Schwartz*, [0081]-[0086]; *Wolfe*, ¶207. Schwartz alone and in combination with Katircioglu uses lower elevation, user-held cameras and shelf-installed cameras that can be obscured by normal retail employee and customer foot and cart traffic from the vantage points shown below. *Schwartz*, [0049], [0128], [0130], [0151]; *Katircioglu*, [0022], [0024].

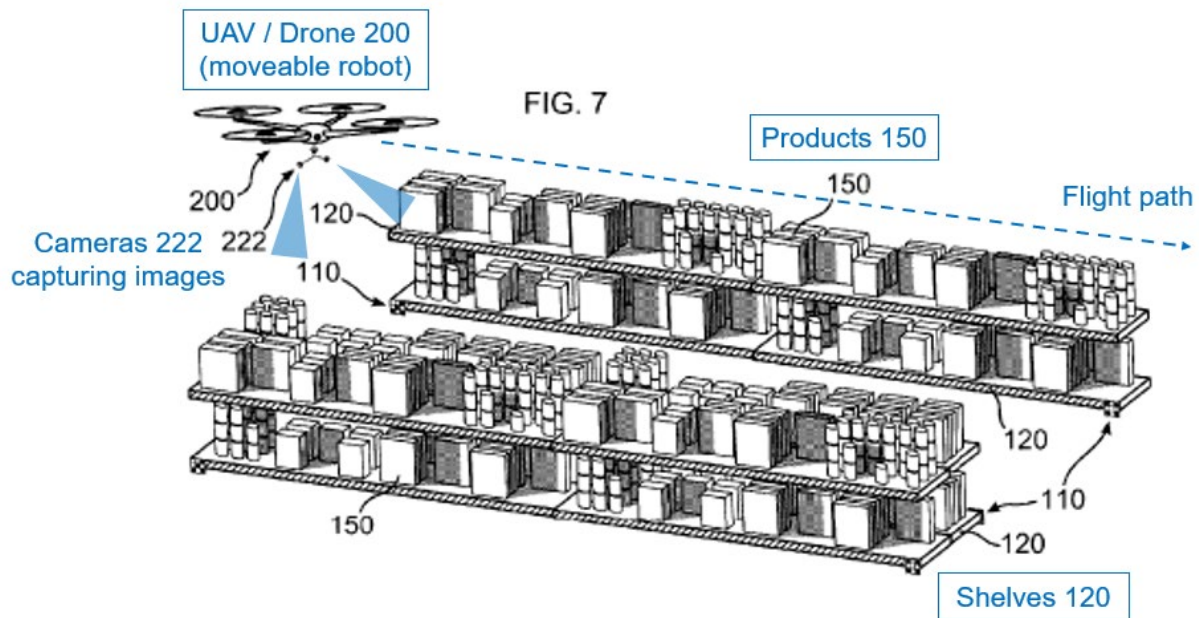


*Schwartz*, Fig. 19D.



*Katircioglu*, Figs. 1A-B (combined); *Wolfe*, ¶207.

POSITAs would have looked to Avegliano430 to solve this problem because it flies an unmanned aerial vehicle (UAV), or drone, carrying cameras along rows of displayed products to gather image data. *Avegliano430*, [0034]-[0039]. As depicted below, the drone flies at an angle above foot and cart traffic, allowing it to monitor inventory at any time (store open or closed), even in areas with more foot traffic. *Id.*, [0039].



*Id.*, Fig. 7 (annotated). *Wolfe*, ¶208.

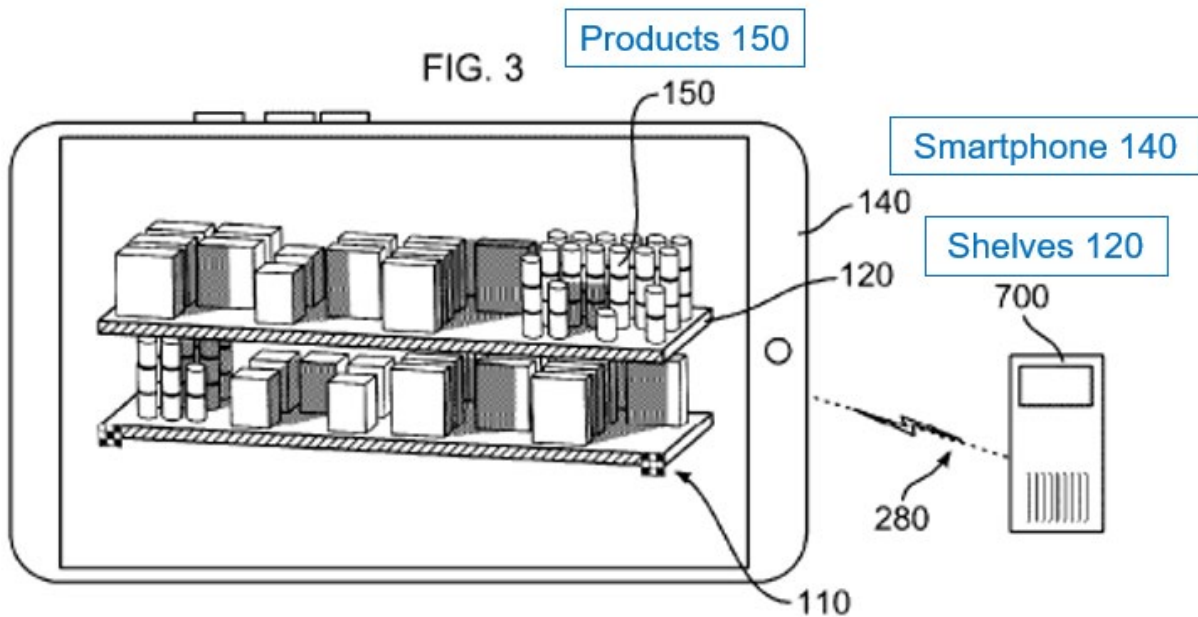
A POSITA would have been motivated to make this combination to provide real-time stocking level information for quicker replenishment, which creates more retail sales and resulting revenue. *Id.*, [0050]; *Wolfe*, ¶209; *see also KSR*, 550 U.S.

at 417 (obvious to apply a known technique to a known device ready for improvement to yield predictable results).

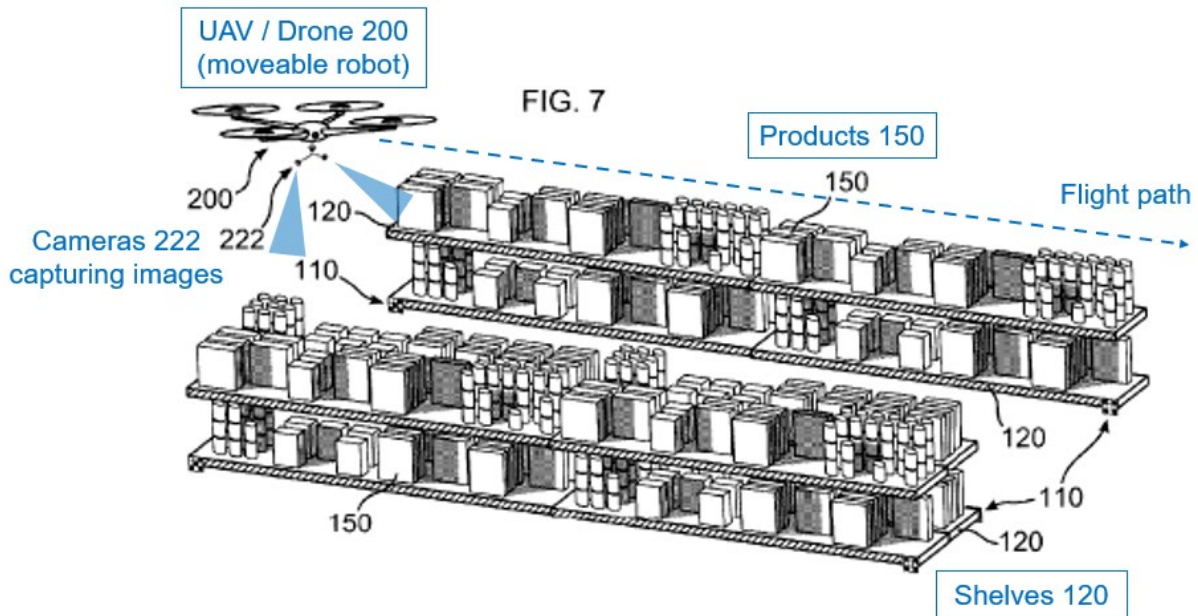
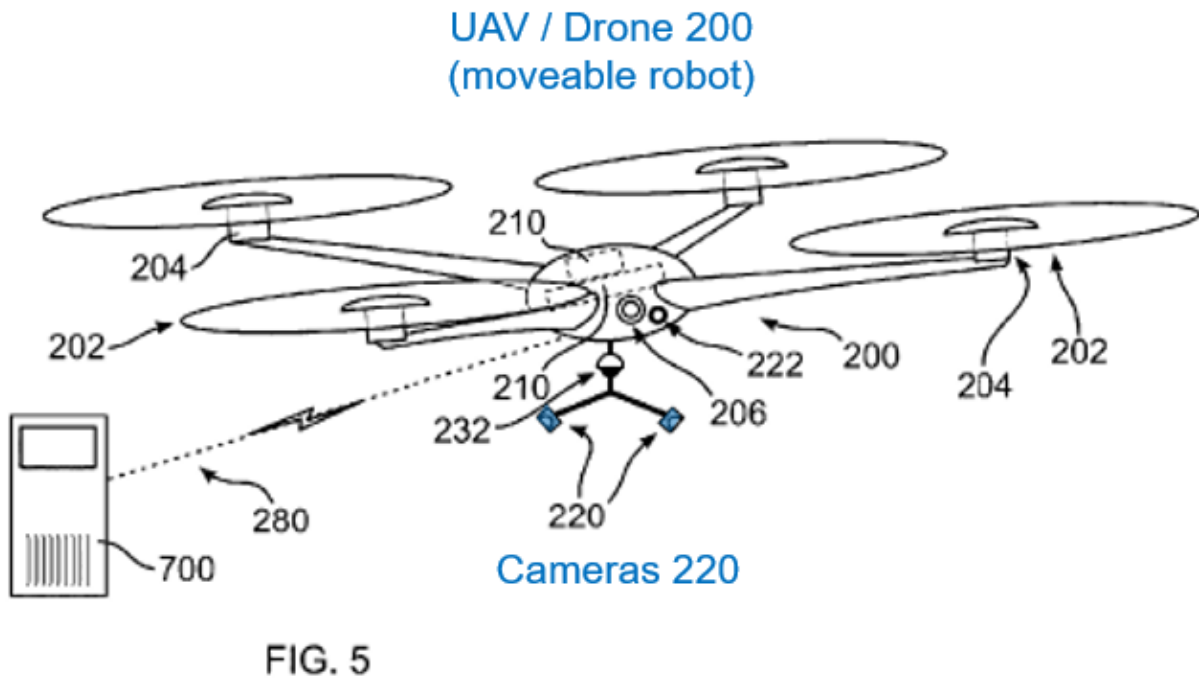
POSITAs would have had a reasonable expectation of success for applying Avegliano430's drone to the Schwartz-Katircioglu combination because Avegliano430 teaches both embodiments as viable alternatives. *Avegliano430*, [0022], [0034]. POSITAs would have understood drone capture or client device capture would be useful in different retail stores selling different products based on type, size, and demand of product in a given retail environment. *Wolfe*, ¶¶210-11; *see also KSR*, 550 U.S. at 416 (obvious to substitute one element for another to yield a predictable result), 419 (obvious when the prior art itself offers some teaching, suggestion, or motivation to combine prior art references).

### **3. Claims 2, 14**

Avegliano430 teaches claims 2, 14's additional limitations. *Wolfe*, ¶212. Avegliano430 discloses capturing an image of a shelf section using a smartphone or other portable computing device camera as shown below. *Avegliano430*, [0022].



*Id.*, Fig. 3 (annotated). Avegliano430 also discloses an alternative embodiment that uses an unmanned aerial vehicle (UAV) or drone carrying cameras and depth measuring devices along rows of displayed product and gathering image data. *Id.*, [0034]-[0039].



*Id.*, Figs. 5, 7 (annotated). Avegliano430's UAV/drone operates remotely, semi-autonomously, or fully autonomously. *Id.*, [0035], [0037], [0039]. Wolfe, ¶¶212-15.

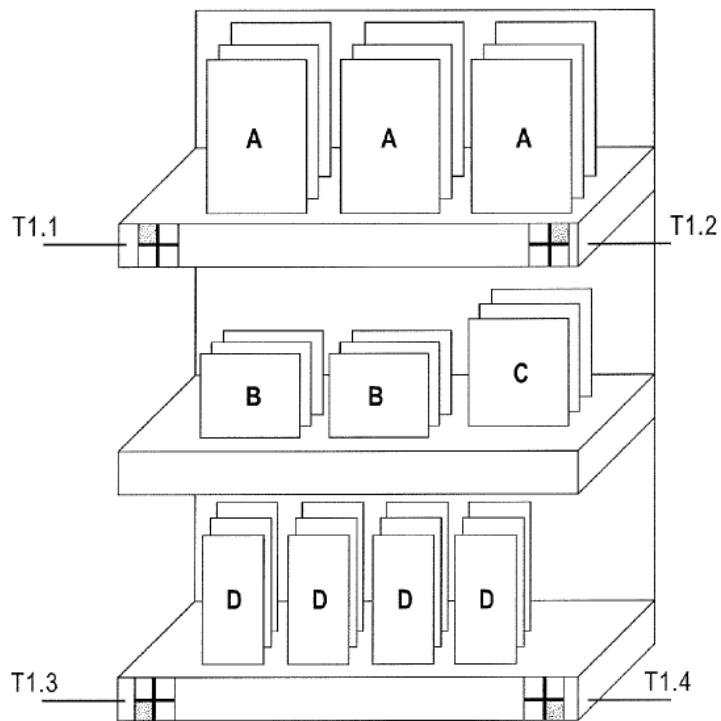
**D. Ground 3: Obviousness Over Avegliano157 and Rodriguez (Claims 1, 3-6, 10, 15-18, 20-21)**

**1. Avegliano157**

Avegliano157 (EX1009) is analogous art. *Wolfe*, ¶113.

Avegliano157 is directed toward “mobile device[-]based inventory management and sales trends analysis in a retail environment.” *Avegliano157*, Title. Avegliano157 discloses a retail store server receiving a product’s availability data. *Id.*, Abstract, [0016]. Products are identified “using tags attached to the shelves.” *Id.*, Abstract, [0016], Figs. 3-4. The identified tags and products can be mapped to a shelf “to define which products are displayed in a rack of shelves.” *Id.*, [0060]. Thus, the products can be identified in the image by “reading product templates related to the identified tags,” and “a list of identified products and their quantities” can be transmitted to the server. *Id.*, [0018]. A first image processing application identifies the tags, while a second image processing application identifies the products in the image. *Id.*, [0019].

Shelf rack S1



*Id.*, Fig. 3-4. *Wolfe*, ¶114.

The images to be processed are collected by applications on mobile devices, used by both customers and employees (“stockists”). *Avegliano* 157, [0046]. For example, these images can be captured as a “stockist courses through a store...” *Id.*, [0059]. A warning message is triggered “if the retail store shelf is empty.” *Id.*, [0017]. *Wolfe*, ¶115.

## 2. Rodriguez

Rodriguez (EX1010) is analogous art. *Wolfe*, ¶116.

Rodriguez is directed toward “improving object recognition, e.g., at supermarket checkouts—such as by machine learning or image fingerprinting.” *Rodriguez*, [0009]. “In the prior art, training of machine-learning systems typically proceed[ed] with reference to...high quality imagery” even though the testing data included images of “relatively inferior quality.” *Id.*, [0076]. Rodriguez discloses the prior art systems were trained exclusively with high-quality images, performed poorly when tested with low-quality images. *Id.* Therefore, Rodriguez captures images of retail products in a real-world retail setting, such as at point-of-sale checkout stations or by customers during shopping, and uses these images as training data to build a product classifier. *Id.*, [0009], [0160]-[0162], [0186]; *Wolfe*, ¶117.

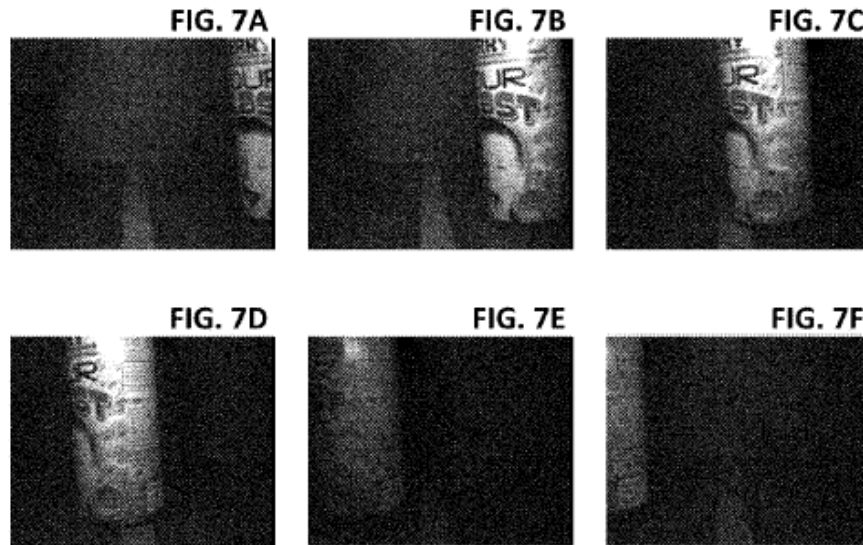
At checkout, the point-of-sale product scanner captures different images of the same item with varying angles, focus, and lighting, yielding “degraded depiction[s] of the item.” *Rodriguez*, [0079]-[0080], [0159]-[0161]. “[W]ithin store environments, images may be captured by other than cameras at point-of-sale checkout stations.” *Id.*, [0186]. With their smartphones or other mobile devices, customers can “capture still and/or video imagery from aisles of a supermarket, while doing their shopping.” *Id.* Unlike the prior art, “imagery gathered during normal operation of a retail store is used as training imagery for a machine-learning system.” *Id.*, [0081]. Through image processing, a machine-readable identifier (e.g.,

barcode) is detected, and data can be decoded from the identifier. *Id.*, [0009], [0159], [0162]; *Wolfe*, ¶118.

Once the item is identified by its barcode, the images and associated product identification are used to train a classifier that can recognize the products even in “degraded images.” *Rodriguez*, Abstract, [0009], [0018], [0159], Figs. 6, 7A-7F. The product image and identifier (e.g., barcode) can serve as ground truth data “to label the product depicted in the sequence of imagery.” *Id.*, [0085], [0166]. These “input samples” are submitted “as a training set to a classifier.” *Id.*, [0173]-[0174]. Restated, “[t]hese image frames—together with the identification information—are provided to a [classification system]..., to train it to recognize such items [in a test image] without resort to barcode decoding.” *Id.*, [0186].



FIG. 6



*Id.*, Figs. 6, 7A-F; *Wolfe*, ¶119.

### **3. Motivation to Combine Avegliano157 and Rodriguez**

POSITAs would have been motivated to combine Avegliano157 and Rodriguez. *Wolfe*, ¶216. Both describe the need to identify products in a real-world retail environment. *Avegliano157*, Abstract, [0016], Figs. 3-4; *Rodriguez*, Abstract, [0009], [0081], [0086]. Both accomplish this task by capturing an image featuring products, such as products placed on shelves in a retail store, with a camera and processing this image. *Avegliano157*, Abstract, [0016], [0019], Figs. 3-4; *Rodriguez*, [0009], [0186]. Additionally, both propose identifying products by reading a tag, including tags attached to the shelves and barcodes located on the products. *Avegliano157*, [0016], [0018]-[0019]; *Rodriguez*, [0009], [0166].

Rodriguez captures images either at checkout or in the aisles of the store. *Rodriguez*, [0009], [0186]. Rodriguez also identifies a product by its barcode. *Id.*, [0009]. POSITAs would have recognized that the product-affixed barcode is necessarily seen at checkout because it must be scanned for purchase, that barcode is not necessarily visible when stocked on a shelf. *Wolfe*, ¶217. An alternative product identifier would be beneficial to enhance Rodriguez's system. *Id.* In *Avegliano157*, the products are identified in captured images by matching objects in the captured images to product templates that were retrieved from a database based on contents of the shelf tags. *Avegliano157*, [0042]. *Avegliano157* teaches an alternative product identifier that POSITAs would have been motivated to add to the system disclosed by Rodriguez. *Wolfe*, ¶218. In the combined Rodriguez-*Avegliano157* system, shelf images would be captured in the aisles, and the particular products would be identified by the shelf labels, similar to identifying the products by barcode at checkout. *Id.* The images of the products associated with the shelf label—per *Avegliano157*—would be used to train a classifier to recognize those products. *Id.*

*Avegliano157* uses height and width of the product to determine coordinates of a bounding box that surrounds the product facing, which is further used to identify the product, which does not expressly disclose any detailed image processing

algorithms or techniques to complete the matching and identification processes. *Id.*, [0062]-[0063], Figs. 3-7.

POSITAs would have looked to Rodriguez. Rodriguez discloses machine-learning based image processing techniques to identify and recognize objects efficiently and reliably. *Rodriguez*, Abstract, [0019], [0159]. It was well known to POSITAs that machine-learning based image processing is a popular solution for object identification in images. *Wolfe*, ¶¶219-20. Indeed, “[d]eep learning is emerging—and machine learning and neural networks technology are re-emerging—as promising solutions to a great variety of problems,” including in machine identification of retail store imagery. *Rodriguez*, [0019], [0073]-[0076]; *Wolfe*, ¶220; *see also KSR*, 550 U.S. at 407, 419 (obvious when the prior art itself offers some teaching, suggestion, or motivation to combine prior art references). Rodriguez discloses machine learning techniques and details of object identification processes in image processing using feature points, weighting functions, and filtering techniques to identify products reliably and accurately in images captured in supermarkets. *Rodriguez*, [0083]-[0092], [0127]-[0131], Figs. 6, 7A-7F; *Wolfe*, ¶220.

Combining Avegliano<sup>157</sup> and Rodriguez would have used a known technique (object identification based on machine learning) to improve the similar Avegliano<sup>157</sup> method (object identification process for images captured in

supermarkets, using shelf labels for identification) in the same way (to ensure reliable and accurate object identification). *Wolfe*, ¶221; *KSR*, 550 U.S. at 417.

Like Rodriguez, Avegliano<sup>157</sup> captures images of products in retail stores and reads tags to identify the products. *Avegliano*<sup>157</sup>, [0016]; *Rodriguez*, [0009]. Avegliano<sup>157</sup> captured images using either a mobile application designed for stockists or another mobile application for consumers to report a product missing from a shelf. *Avegliano*<sup>157</sup>, [0046]. Both mobile application capture images of supermarket aisles using a regular mobile device during normal supermarket operations (i.e., uneven illumination conditions). *Wolfe*, ¶222. POSITAs would have recognized this results in low quality images, which affects the accuracy of the product identification process. Rodriguez addresses this problem: “[a]n object of certain aspects of the present technology is to improve object recognition from **degraded imagery**.” *Rodriguez*, [0078]. Rodriguez’s object identification process works with “images...degraded by blur, inferior lighting, etc.” *Rodriguez*, Abstract, [0009], [0161]-[0165]; *Wolfe*, ¶222. Rodriguez accomplishes this by training the system on images that are low-quality. *Rodriguez*, [0009]. Although Rodriguez focuses on capturing such images at checkout, POSITAs would have understood, and found it obvious, that capturing images in the aisles would provide valuable training data, where the ultimate product classifier identifies products in that same environment. *Wolfe*, ¶222.

Modifying Avegliano157 based on Rodriguez would have used a known technique (object identification in low-quality images) to improve the similar Avegliano157 method (object identification process for images captured less than ideal conditions) in the same way (to ensure reliable and accurate object identification). *Wolfe*, ¶223; *KSR*, 550 U.S. at 417.

Using real-world images of retail products as training data for a classifier was well within the skill of POSITAs and would have required nothing more than the application of known, conventional techniques (building a classifier with images of retail products as the training data) to yield predictable results (classifying retail products located on shelves using the classifier). *Wolfe*, ¶224; *KSR*, 550 U.S. at 416.

#### **4. Independent Claim 1**

##### **a. 1.0**

If limiting, Avegliano157 teaches 1.0. *Wolfe*, ¶225. Avegliano157 discloses “a method for calculating sales trend of a product at a store shelf” including steps of receiving “picture acquired of the product on the shelf [and] identifying products on the shelf using tags attached to the shelves.” *Avegliano157*, Abstract, [0016]. Avegliano157’s Figure 3 is “a method...for identifying products on tagged shelves.” *Id.*, [0062].

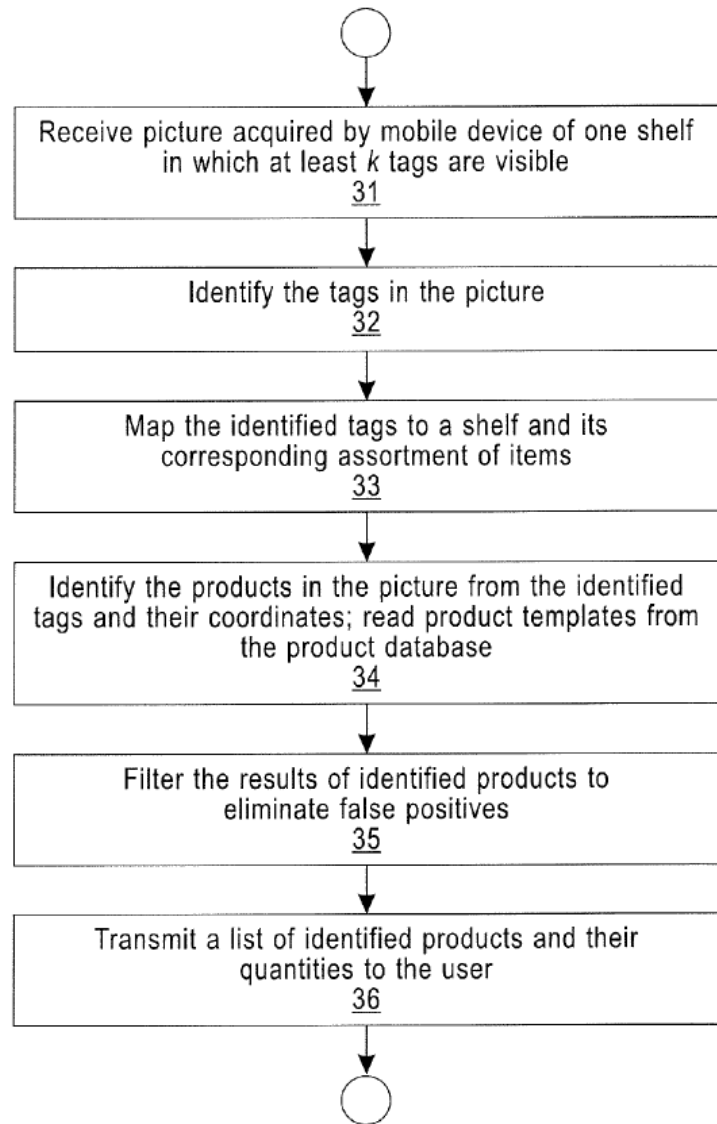


**FIG. 3**

*Id.*, Fig. 3; *Wolfe*, ¶225.

An image processing module of a retail store server 12 (blue) calls multiple applications (red) for capturing and processing images, such as a first image processing application for identifying tags and a second image processing

application for identifying products in the pictures. *Avegliano157*, Abstract, Figs. 1-3, [0019], [0056].

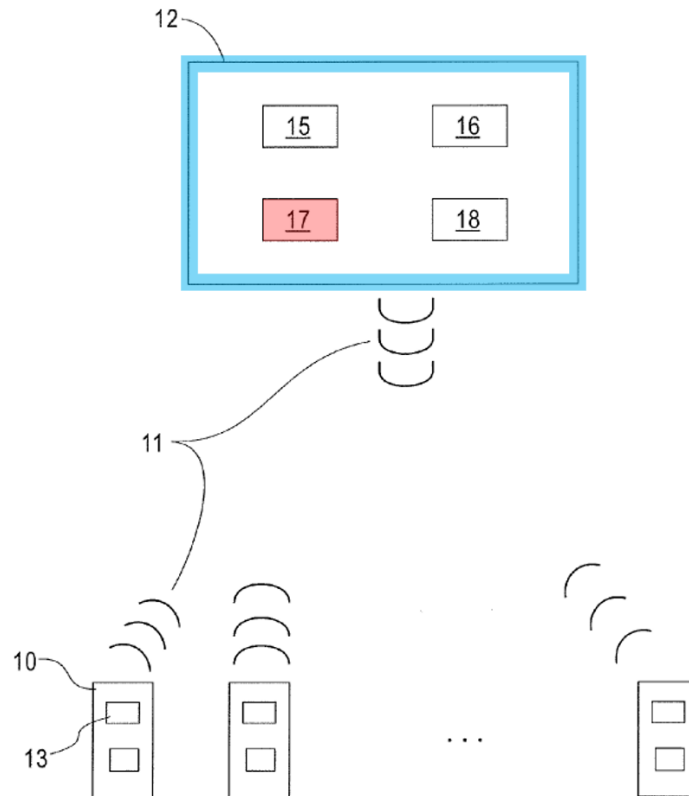


FIG. 1

*Id.*, Fig. 1; *Wolfe*, ¶¶226-27.

**b. 1.1**

*Avegliano157* teaches 1.1. *Wolfe*, ¶228.

*Avegliano157* receives “availability data of a product measured on a shelf in the retail store from a portable device.” *Avegliano157*, [0016]. It is “in the form of a picture acquired of the product on the shelf.” *Id.* In Figure 3 below, at step 31 “a

picture is acquired by the mobile device of one shelf in which at least  $k$  tags are visible, and is transmitted to the remote server.” *Id.*, [0062].

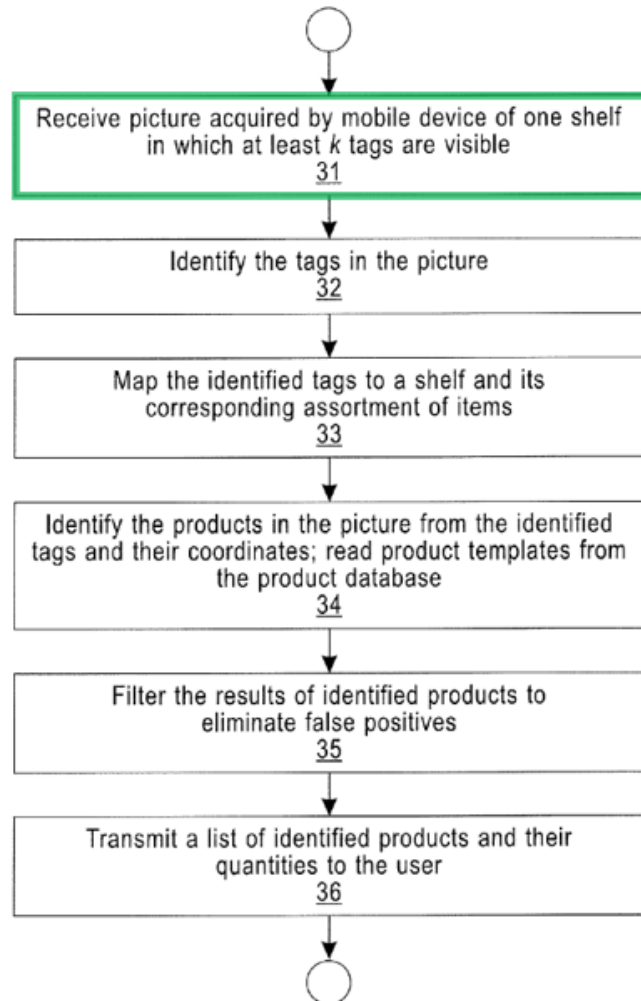


**FIG. 3**

*Id.*, Fig. 3 (step 31) (annotated). The captured image contains a shelf rack S1 with different types of products A-D and multiple tags T1.1-T1.4 (red) “attached to each store shelf rack.” *Id.*, [0056], [0063].

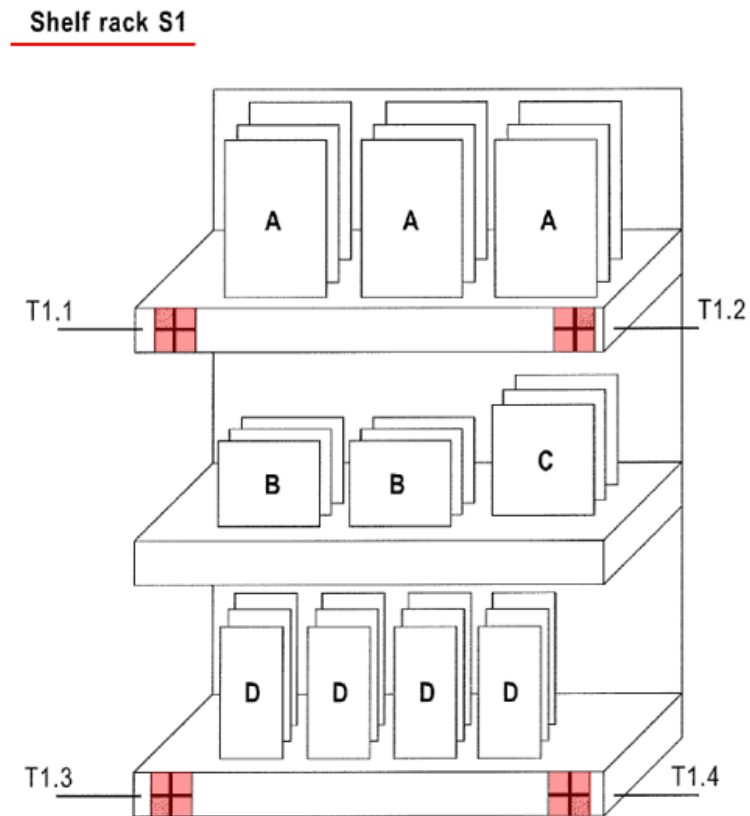


**FIG. 4**

*Id.*, Fig. 4 (annotated). Images are captured using “a camera application on the mobile devices that can take pictures of the shelves and transmit them to the server.” *Id.* [0056], [0060]; *Wolfe*, ¶¶228-29.

**c. 1.2**

Aveglano157 teaches 1.2. *Wolfe*, ¶230.

Avegliano157 places sets of tags on supermarket shelves that are “distributed so that whenever a picture of a shelf is taken, at least k tags are displayed in the picture.” *Avegliano157*, [0060]. The unique pattern printed on the tag “enables the tag to be **mapped to its location**.” *Id.*, [0063]. “When a user takes a picture of an arbitrary shelf, the first image-processing application identifies the current shelf from the tags.” *Id.*

At Figure 3, step 32, the server identifies tags within the images. *Id.*, [0062]. At step 33, the server uses the identified tags, their coordinates, and the captured image, “to map the tags to a shelf and its corresponding assortment of items.” *Id.*

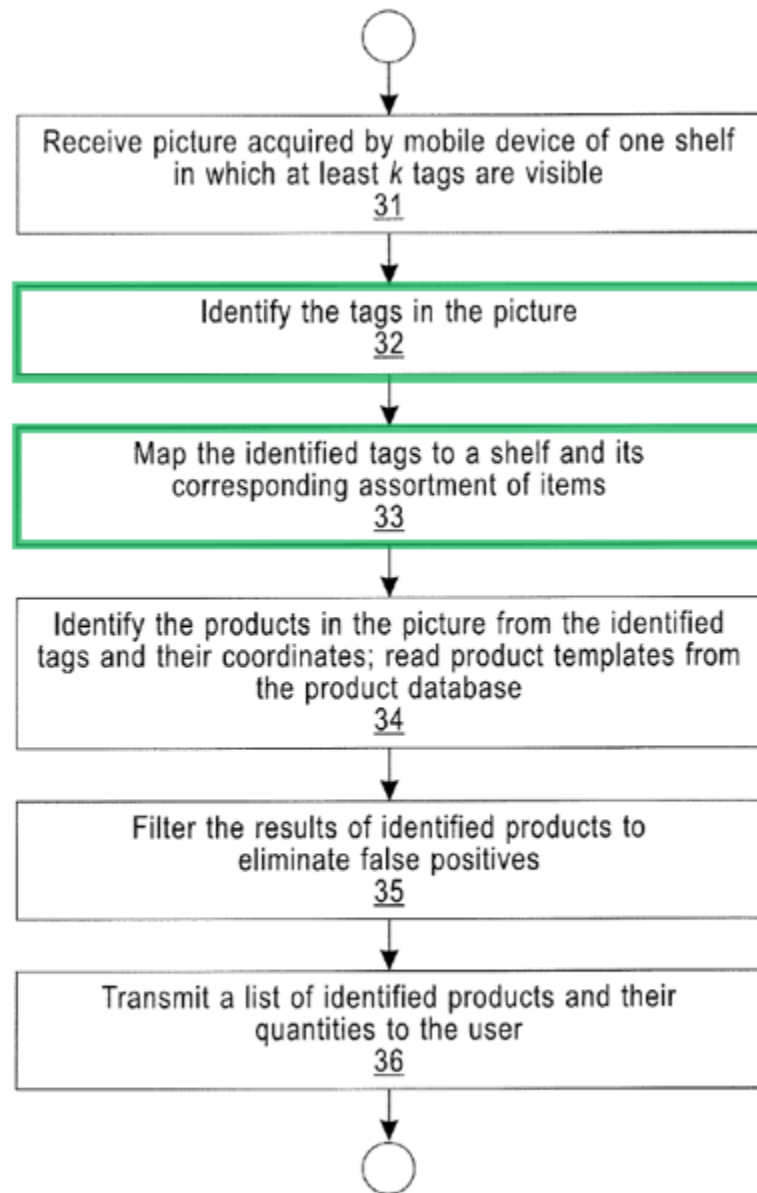


**FIG. 3**

*Id.*, Fig. 3 (annotated); *Wolfe*, ¶¶230-32.

**d. 1.3**

Avegliano157 teaches 1.3. *Wolfe*, ¶233.

Per §VIII.D.4.b, an image of tagged supermarket shelves captured by a using mobile device includes a plurality of shelf tags and aisle-facing products. *Wolfe*, ¶233. *Avegliano157*'s Figure 4 shows a shelf rack S1 with tags (red) and four types of products A, B, C, and D (yellow) placed on three shelves. *Avegliano157*, [0063].

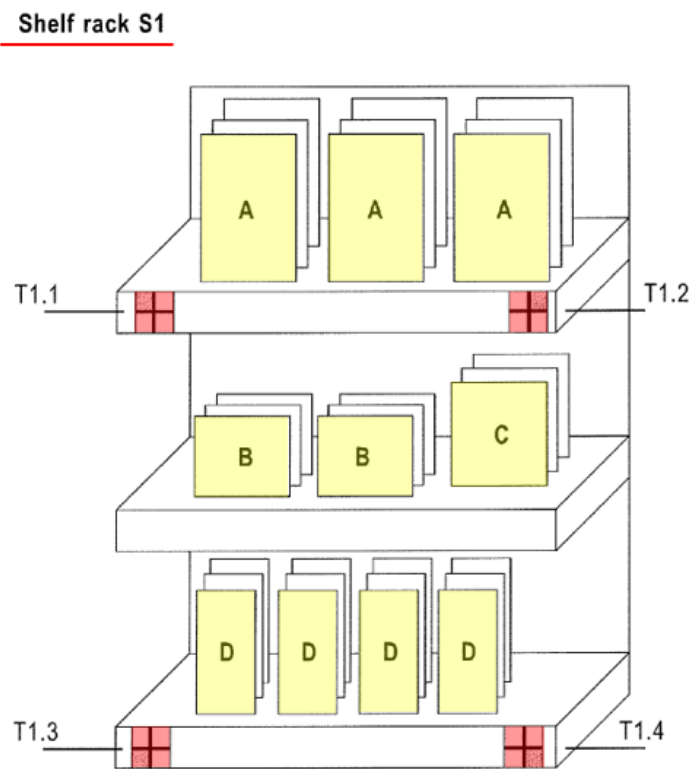


FIG. 4

*Id.*, Fig. 4 (annotated).

After the user “takes a picture of an arbitrary shelf, the first image-processing application identifies the current shelf from the tags, and then retrieves its list of products associated with the current shelf from the product database.” *Avegliano157*, [0063]. Information on each product’s width and height is also retrieved:

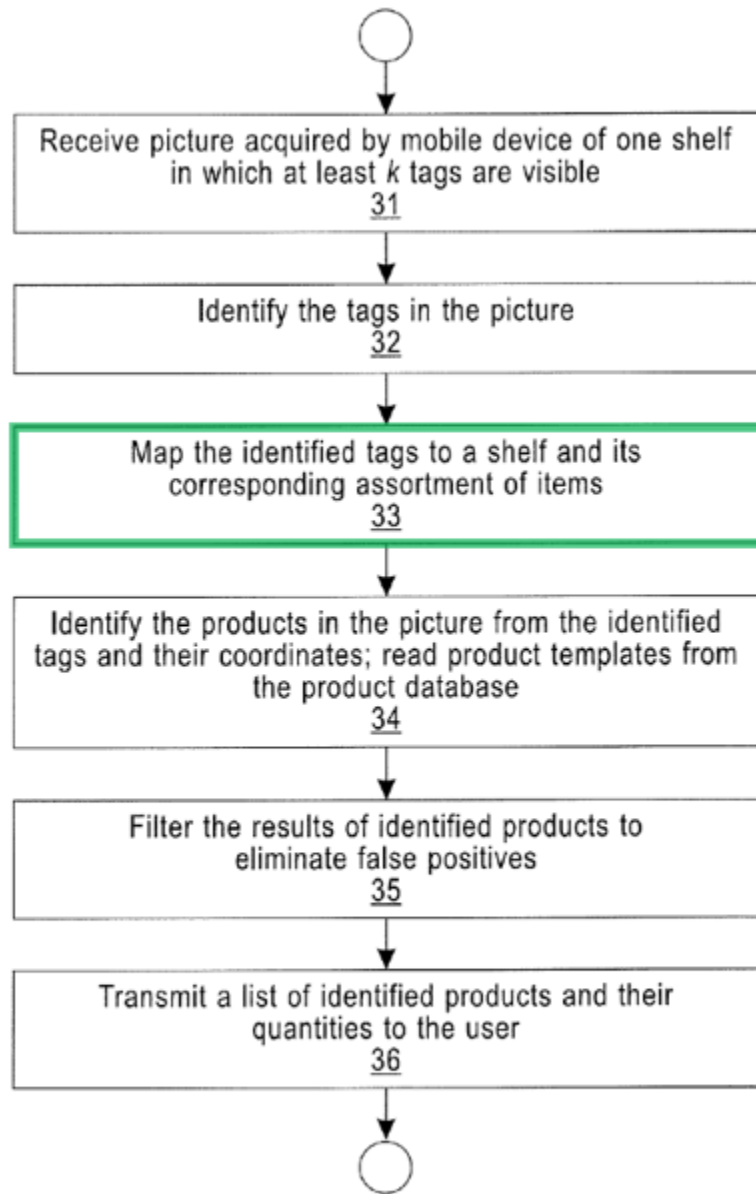


**FIG. 3**

*Id.*, Fig. 3 (annotated); *Wolfe*, ¶234. Fig. 6 (below) shows the height and width refer to dimensions of the product facing defined by its horizontal and vertical boundaries, which may differ across different types of products. *Wolfe*, ¶235.

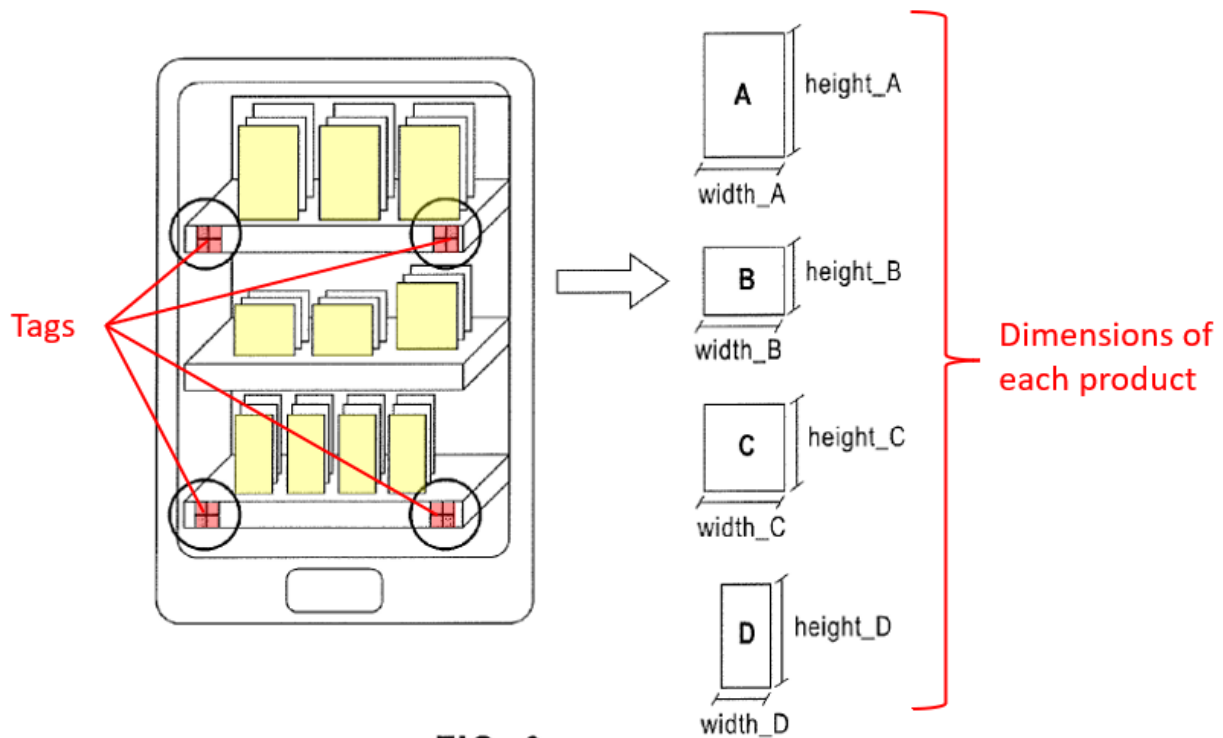


FIG. 6

*Id.*, [0040]-[0041], [0056], [0063], Fig. 6 (annotated); *Wolfe*, ¶¶234-35.

Using the height and width information for each of the products, “the second image-processing application attempts to match the template to every item from the list in the image using the height and width information....” *Avegliano* 157, [0063]. Using the product’s dimension information to identify products within the image can “increase recognition accuracy and [] filter false positives.” *Id.*, [0062]. Per Fig. 7 (below), height and width of product A detects product A and coordinates of its product facing within the image. *See id.*, [0062]-[0063], Fig. 7; *Wolfe*, ¶236.

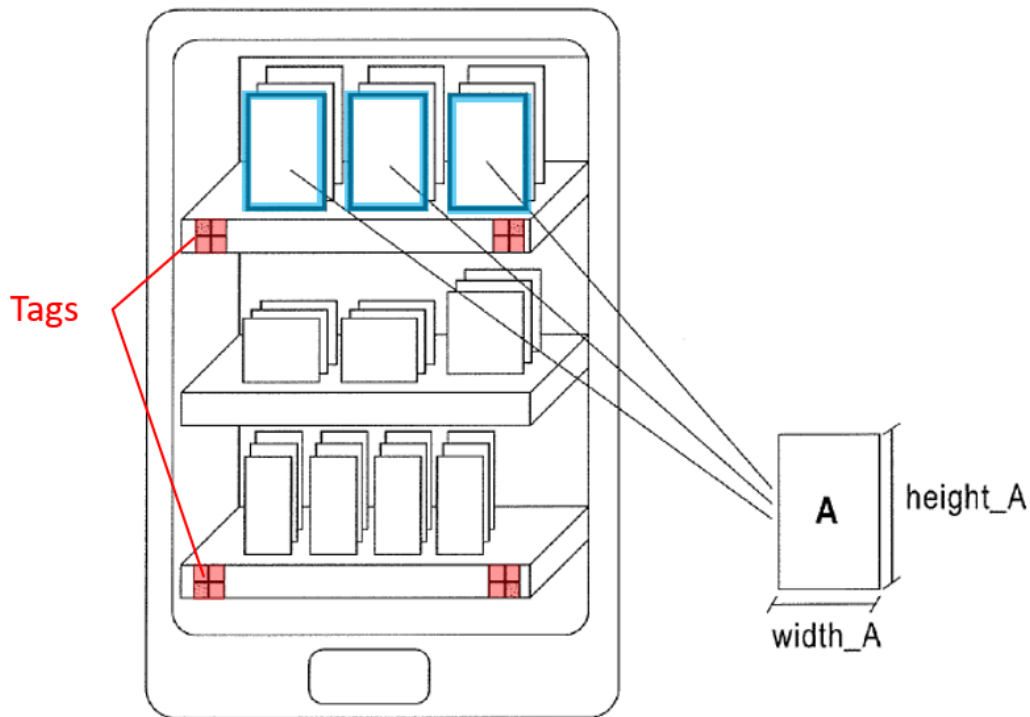


FIG. 7

*Id.*, Fig. 7 (annotated). The determined coordinates for product A define a boundary (blue box, bold in original) within the image that contours and surrounds its product facing. *Wolfe*, ¶237. POSITAs would have understood, and found it obvious, that the coordinates in an image form a rectangular boundary surrounding the product because the coordinates are mathematically related to the actual height and width of the product facing. *Id.* The proportional relationship depends on the distance and angle between the product and the camera. *Id.* “[K]nowing the distance between the tags in the picture and in the actual shelf, can help the product identification method.” *Avegliano157*, [0052]. POSITAs would have understood the same mathematical

relationship between the tag separation depicted in the picture and as measured on the actual shelf also applies to the dimensions of the product in the captured image and the actual dimensions of the product. *Wolfe*, ¶¶237-38.

**e. 1.4**

*Avegliano157* teaches 1.4. *Wolfe*, ¶239.

Per §§VIII.D.4.c and VIII.D.4.d, *Avegliano157* identifies shelf tag content to determine the location and products stored on the shelf, and receives product dimension information to determine coordinates that represent a rectangular bounding box surrounding a product facing. *Avegliano157*, [0020], [0029], [0061]-[0062], Figs. 3-7; *Wolfe*, ¶240. Therefore, the shelf tag is associated with the rectangular bounding box that surrounds a product facing.

“A set of items can be mapped to a shelf, and each set of tags is mapped to a shelf, to define which products are displayed in a rack of shelves.” *Avegliano157*, [0060]. Identifying products on a supermarket shelf includes identifying shelf tags in the captured images using patterns on the tag. *Id.*, [0063], Fig. 3 (step 32), Fig. 4. The identified shelf tags are then mapped to a certain shelf and its corresponding assortment of items. *Id.*, [0063], Fig. 3 (step 33), Figs. 5-6. In step 34, based on the identified corresponding assortment of items, dimensions of products (e.g., height and width of the product facing) from the assortment of items are used to determine

coordinates that represent a rectangular boundary of the products. *Avegliano157*, [0016]-[0020], [0027],[0029], [0061]-[0063], Figs. 3-7; *Wolfe*, ¶¶241-43.

**f. 1.5**

*Avegliano157* teaches 1.5. *Wolfe*, ¶244.

Per §VIII.D.4.e, *Avegliano157* captures and identifies shelf tags to determine corresponding products, and uses product dimensions of the corresponding products to detect coordinates that represent rectangular boundaries of corresponding products. *Id.*

*Avegliano157* teaches temporal aggregation of retail product and affiliated shelf label information to ensure, *inter alia*, minimizing out-of-the-shelf products. *Wolfe*, ¶245. *Avegliano157* recognizes a need for “real time visibility on consumption and consumption speed information of [MCP]’s products at distribution points and the retailer shelf.” *Avegliano157*, [0006]. *Avegliano157* determines product availability data by identifying products on shelves. *Avegliano157*, Abstract, [0016], [0021], [0030], [0033], [0046]-[0048], [0057]-[0059], [0065]; *Wolfe*, ¶245. “Two kinds of mobile applications can be used: one, designed for stockists, can be used to collect data regarding the number of products in the shelf and turnover of products in a period of time; and another for consumers can be used to report that a product is missing on the shelf.” *Avegliano157*, [0046].

Using both mobile applications results in receiving multiple images of product shelves over time.

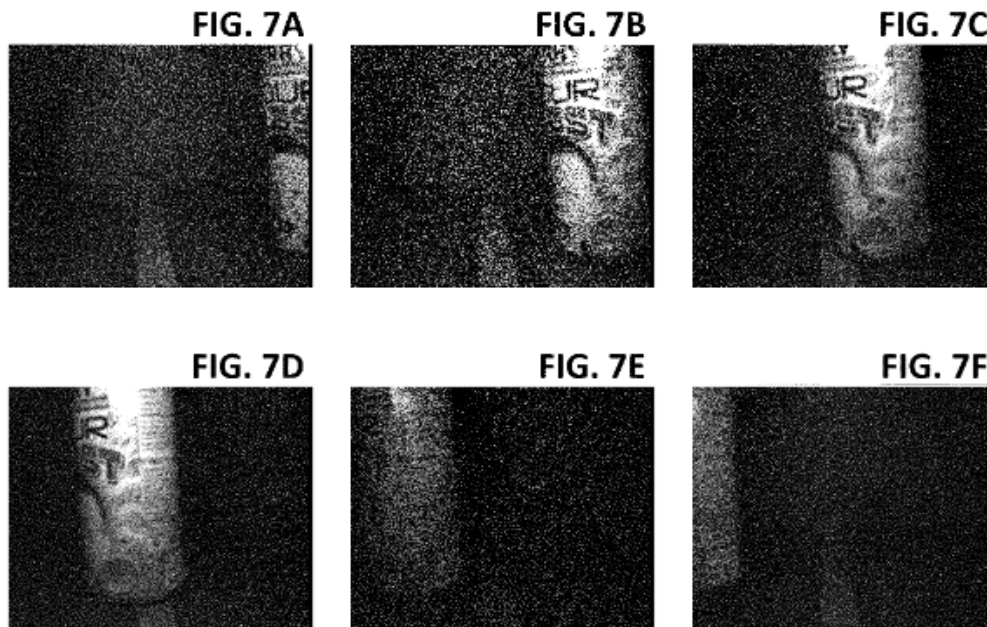
POSITAs would have recognized that determining sales velocity and sales trend over “a period of time” entails *cross-correlating* product and affiliated shelf tag information *across* images taken at different points of time. *See Avegliano157*, [0016], [0021], [0030]-[0033], [0046]-[0048], [0057]-[0059]; *Wolfe*, ¶246.

*Avegliano157* also teaches spatial aggregation of retail product and affiliated shelf label information. *Wolfe*, ¶247. POSITAs would have recognized that *Avegliano157*’s “vendor-managed inventory (VMI) business model,” achieves improved efficiency in a multi-retailer scenario would entail *cross-correlating* product and affiliated shelf tag information *across* multiple retailers, store types, and time because this enables a more accurate determination and evaluation across multiple stores in a geographical region. *See Avegliano157*, [0011]-[0013], [0056]; *Wolfe*, ¶¶248-50.

If PO argues *Avegliano157* does not teach this limitation, Rodriguez does.

Rodriguez teaches it is advantageous to provide many training images to improve “classification accuracy.” *Rodriguez*, [0052], [0087], [0159]. Rodriguez captures many product images over time, such as “a sequence of images captured by a point-of-sale product scanner during a checkout procedure.” *Id.*, [0160], [0082] (images captured at “30 frames per second”). Figs. 7A-7F depict images obtained

when a “can is swept through a supermarket checkout area.” *Id.*, [0089]; Figs. 7A-7F. Although the images are “degraded imagery,” Rodriguez improves “object recognition from degraded imagery.” *Id.*, [0078]; *Wolfe*, ¶¶251-52.



*Rodriguez*, Figs. 7A-F.

The captured images contain “machine-readable identifier” such as “a barcode.” *Id.*, [0159]. When “a box of Cheerios cereal [passes] in front of such a system, a series of up to a dozen images may be captured,” and after the barcode is identified, these images are grouped together because “all of these images are known to depict a box of Cheerios cereal.” *Id.*, [0082]-[0083]. “Each of the images can be tagged with label information indicating that it depicts a box of Cheerios cereal, and can be provided to a learning system as a training image.” *Id.*, [0083]. POSITAs

would have understood Rodriguez's images are temporally separated. *Id.*, [0082]; *Wolfe*, ¶¶253-55.

In addition to grouping temporally-separated images, Rodriguez groups images captured at different locations. Images captured in “aisles of a supermarket” are “processed using barcode... or other techniques [] to identify one or more objects.” *Rodriguez*, [0186]. Additionally, POSITAs would have recognized Rodriguez captures images at different point-of-sale checkout stations, which are grouped together when customers bring the same product (e.g., Cheerios) to different checkout stations. *Wolfe*, ¶256.

Per §VIII.D.3, POSITAs would have been motivated to implement Rodriguez's method of machine-learning based image processing techniques in Avegliano157 to identify and recognize objects efficiently and reliably. *Rodriguez*, Abstract, [0019], [0159]. POSITAs would have recognized capturing many images of the same product over time and/or space and providing those images to its learning system (Rodriguez) can be readily implemented into a method of gathering images over space (Avegliano157), e.g., both Avegliano157 and Rodriguez capture images in aisles and use label information (barcodes and shelf tags) to identify objects. These images are similarly “provided to a system” as training images. *Id.*, [0186]; *Wolfe*, ¶257.

POSITAs would have known the same product is often displayed in multiple locations (e.g., aisles, aisle endcaps, near point-of-sale checkout counters, and/or in different stores). *Wolfe*, ¶258. POSITA would have understood a person walking through the supermarket would have captured images of the same product displayed at different locations. *Id.* Capturing images from multiple locations would be beneficial to meeting Rodriguez’s goal of capturing as many training images as possible to improve the “classification accuracy.” *Rodriguez*, [0052]. Further, POSITAs would have understood that capturing more training images in an environment like that for which the classifier will be used for prediction (i.e., store shelves) provides increasingly accurate results. *Wolfe*, ¶¶258-59.

**g. 1.6<sup>11</sup>**

Avegliano157-Rodriguez teaches 1.6. *Wolfe*, ¶260.

Per §§VIII.D.4.e-VIII.D.4.f, Avegliano157 alone or Avegliano157-Rodriguez associates shelf tag content with cross-correlated product facing bounding boxes. If PO argues Avegliano157 does not teach building training data, Rodriguez does. *Id.*

“[I]magery gathered during normal operation of a retail store is used as training imagery for a machine-learning system.” *Rodriguez*, [0081]. In the training system operation, “one of these captured images may be selected as the best, and is

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<sup>11</sup> See *supra* note 7.

processed to identify the product (e.g., by decoding the product's barcode information).” *Id.*, [0083]. Additionally, each image depicting the same item “can be tagged with label information... and can be provided to a learning system as a training image.” *Id.* “All such information can serve as ‘ground truth’ data, to label the product depicted in the sequence of imagery captured by the point-of-sale system, permitting such imagery to serve as training data for a supervised learning system.” *Id.*, [0085]; *Wolfe*, ¶261.

POSITAs would have understood Rodriguez builds training data in a way that would have allowed Avegliano157 to identify products on a retail store shelf accurately and quickly. *Wolfe*, ¶¶262-63.

Per §VIII.D.3, POSITAs would have been motivated to modify or supplement Avegliano157’s object identification system using Rodriguez’s machine-learning based object identification system to perform object identification with improved accuracy. *Wolfe*, ¶264. The Avegliano157-Rodriguez combination would use the Avegliano157’s shelf label in place of Rodriguez’s barcode on the product for product identification. *Id.* The association of product identifier (from the shelf label), as described in §VIII.D.4.d, and the images collected from the bounding boxes, as described in §VIII.D.4.e, provides the training data for Rodriguez’s product classifier. *Id.*, ¶¶264-65.

**h. 1.7<sup>12</sup>**

Avegliano157-Rodriguez teaches 1.7. *Wolfe*, ¶266.

Per §VIII.D.4.g, images captured in a retail store are “used as training imagery for a machine-learning system.” *Rodriguez*, [0081]. Once the object’s identity is known, Rodriguez uses such information “in training a classifier (e.g., a machine learning system) to recognize the object from others of the captured images.” *Id.*, Abstract, [0127], [0131], [0134]-[0142], [0182]; *Wolfe*, ¶¶267-68.

**i. 1.8**

Avegliano157-Rodriguez teaches 1.8. *Wolfe*, ¶269.

Per §VIII.D.4.h, Rodriguez discloses the trained classifier (e.g., a machine learning system) “recognize[s] the object from others of the captured images.” *Rodriguez*, Abstract, [0127], [0131], [0134]-[0142], [0182]. The recognized object is a product. *See id.*, [0088]-[0092]; *Wolfe*, ¶¶270-71.

**5. Independent Claims 10, 18**

Avegliano157-Rodriguez teaches claims 10 and 18 for substantially the same reasons as claim 1, per §VIII.D.4, because the claims are substantively identical. *Compare* claim limitations 10.0-10.8, 18.3-18.10 *with* claim limitations 1.0-1.8; *Wolfe*, ¶272, 275.

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<sup>12</sup> *See supra* note 7.

The table below correlates the reasons why Avegliano157-Rodriguez teaches claim limitations 10.0-10.8 and 18.3-18.10. *Wolfe*, ¶¶273, 279.

| Substantially Similar Limitation(s) | Reference  |
|-------------------------------------|------------|
| 1.0/10.0                            | VIII.D.4.a |
| 1.1/10.1/18.3                       | VIII.D.4.b |
| 1.2/10.2/18.4                       | VIII.D.4.c |
| 1.3/10.3/18.5                       | VIII.D.4.d |
| 1.4/10.4/18.6                       | VIII.D.4.e |
| 1.5/10.5/18.7                       | VIII.D.4.f |
| 1.6/10.6/18.8                       | VIII.D.4.g |
| 1.7/10.7/18.9                       | VIII.D.4.h |
| 1.8/10.8/18.10                      | VIII.D.4.i |

**a. 10.8, 18.10**

As to “using the product classifier to perform an inventory management activity related to the product,” in 10.8 and 18.10, Avegliano157 discloses “method steps for managing inventory and sales trends in a retail environment using mobile devices.” *Avegliano157*, [0030]; *id.*, Title, Abstract, [0045], [0056], [0074]. POSITAs would have understood the product identification and classification process of the Avegliano157-Rodriguez combination would achieve Avegliano157’s goal of “near real time” inventory management and minimizing “out-of-the-shelf conditions.” *Avegliano157*, [0005]-[0009], [0022], [0043], [0047]-[0049], [0055]; *Wolfe*, ¶¶274-75.

**b. 18.0-18.2**

As to “system comprising: a processor” and a “system memory coupled to the processor...storing instructions configured to cause the processor” to execute the same steps as recited in claim 1, Avegliano157 teaches “a non-transitory program storage device readable by a computer” that when executed by the computer, “perform[s] the method steps for managing inventory and sales trends in a retail environment using mobile devices.” *Avegliano157*, [0030], [0040], [0066]-[0076]. Avegliano157’s Figure 9 illustrates “an exemplary computer system for implementing a method for managing inventory and sales trends in a retail environment using mobile devices,” and the computer system 91 (blue) includes “a central processing unit (CPU) 92” (red) connected via bus 94 to memory 93 that stores Avegliano157’s CPU-executable routine and further includes “micro instruction code.” *Id.*, [0074]-[0075], Fig. 9.

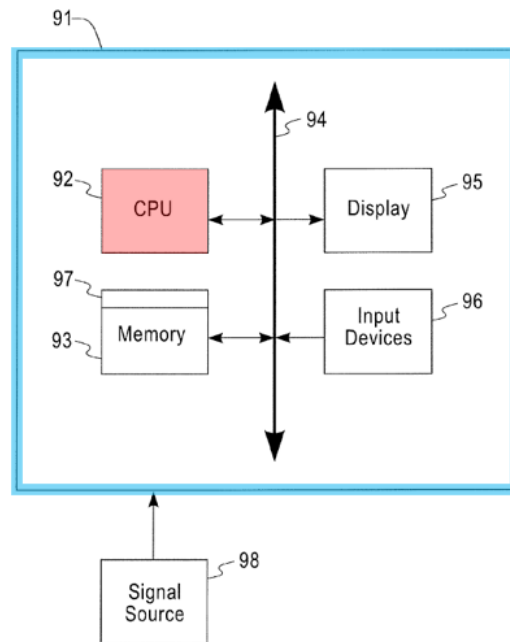


FIG. 9

*Avegliano157*, Fig. 9 (91, 92) (annotated), [0074]-[0075]; *Wolfe*, ¶¶276-77.

If “processor” is construed as MPF, *Avegliano157-Rodriguez* teaches the structure in §VII. As discussed above, *Avegliano157* discloses computer system 91 and CPU 92 for executing “programs of instructions” to “perform the method steps for managing inventory and sales trends in a retail environment using mobile devices.” *Avegliano157*, [0030], [0040], [0066]-[0076], Fig. 9 (91, 92); *Wolfe*, ¶278.

## 6. Claims 3, 15

*Avegliano157-Rodriguez* teaches claims 3 and 15’s additional limitations. Per §VIII.D.4.f, *Avegliano157* determines product availability data by identifying products on shelves. *Avegliano157*, Abstract, [0016], [0021], [0030], [0033], [0046]-[0048], [0057]-[0059], [0065]; *Wolfe*, ¶280. Product identification uses

images taken by “[a] mobile application, deployed on customers and merchant devices.” *Id.*, [0048]. A mobile application is designed “for consumers [] to report that a product is missing on the shelf.” *Id.*, [0046]. Avegliano157 uses missing product information extracted from captured images to manage store inventory. *Avegliano157*, Abstract, [0016], [0021], [0030], [0033], [0046]-[0048], [0057]-[0059], [0065]; *Wolfe*, ¶280. Alternatively, “information regarding the description, quantity, and location of missing items on each shelf of the store” “can be entered manually by the employee.” *Avegliano157*, [0064]; *Wolfe*, ¶¶280-81.

#### **7. Claim 4**

Rodriguez teaches claim 4’s additional limitations. *Wolfe*, ¶282.

Rodriguez recognizes that “machine learning and neural network technology are re-emerging [] as promising solutions to a great variety of problems,” so “Neural Networks and associated learning methods (e.g., RNN, Refractory neural nets and vision) may also be applied to design an object classifier.” *Rodriguez*, [0004], [0019], [0124]; *Wolfe*, ¶¶283-85.

#### **8. Claim 5**

Avegliano157-Rodriguez teaches claim 1. *See* §VIII.D.4. *Wolfe*, ¶286.

Rodriguez discloses “a supervised learning system.” *Rodriguez*, [0083]-[0085]. “In the case of supervised learning, the classifier designer controls labeling of training signals as being in [or] out of a desired class.” *Id.*, [0049]. This enables

the “classifier designer” to train the system’s response based on “whether [the training signal] has the features of the desired classification or not.” *Id.*; *Wolfe*, ¶287. POSITAs would have understood the classifier designer is a person controlling labeling of the product and manually associating the label content with potential product candidates based on whether the images contain the features of the desired classification. *Wolfe*, ¶¶287-88.

## **9. Claims 6, 17**

*Avegliano157-Rodriguez* teaches claims 6 and 17’s additional limitations for the same reasons per claim 1.4, showing association between shelf tag content and product facing bounding boxes without human intervention. §VIII.D.4.e; *Wolfe*, ¶289.

*Avegliano157*’s solution is “a fully automatic procedure” that obtains “an identification with high accuracy and speed by taking a picture of a shelf rack.” *Avegliano157*, [0015]; *see also id.*, [0051], [0064]. The list of products can “be retrieved automatically from tagged shelves.” *Id.*; *Wolfe*, ¶¶290-91.

## **10. Claim 16**

*Avegliano157* teaches claim 16’s additional limitations. *Wolfe*, ¶292.

Per §VIII.D.4.f, *Avegliano157* determines product availability data by identifying products on shelves. *Avegliano157*, Abstract, [0016], [0021], [0030], [0033], [0046]-[0048], [0057]-[0059], [0065]; *Wolfe*, ¶293. The product

identification uses images taken by “[a] mobile application, deployed on customers and merchant devices” “for consumers [] to report that a product is missing on the shelf.” *Id.*, [0046], [0048]. Specifically, data of “missing product items on a shelf acquired by the mobile application is in the form of a picture” and “[t]he method includes identifying products on the shelf using tags attached to the shelves.” *Id.*, [0026]. As such, Avegliano157 uses missing product information extracted from captured images to determine sales velocity and trends, which in turn can be used to manage store inventory. *Avegliano157*, Abstract, [0016], [0021], [0024], [0026] [0030], [0033], [0046]-[0048], [0057]-[0059], [0065]; *Wolfe*, ¶293.

If PO argues Avegliano157 does not expressly disclose “missing product items” on a shelf are represented by a gap between adjacent inventory products, POSITA would have found it obvious that missing products from retail store shelf leave behind a vacant shelf area where the missing products are supposed to be displayed. *Wolfe*, ¶294. It would also have been obvious to POSITAs to identify the “missing product items” on shelves using the method for identifying products that are present, such as matching at least the product’s height and width from the product template to the height and width of vacant space on the identified shelf and determine the coordinates of an area on the shelf where the product is supposed to be. *Avegliano157*, [0051]-[0053], [0061]-[0063]; *Wolfe*, ¶296.

Avegliano157 identifies missing products in the same manner as the '272 patent identifies “gaps between products” to “identify or locate missing products.” Avegliano157 uses the width of a vacant shelf area (e.g., shelf area without product facing present) to determine the type of missing product. *Avegliano157*, [0051]-[0053], [0061]-[0063]; *Wolfe*, ¶297. The '272 patent also identifies gaps between products for identifying “missing/absent inventory.” '272*Pat*, 8:16-17; *Wolfe*, ¶¶297-98.

#### **11. Claim 20**

Avegliano157-Rodriguez teaches claim 20's additional limitations. *Wolfe*, ¶299.

Per §§VIII.D.4.f-VIII.D.6, Avegliano157 calculates sales velocity and trends uses “[a] mobile application, deployed on customers and merchant devices to periodically monitor product sales velocity.” *Avegliano157*, [0046]-[0048]. Using both mobile applications results in receiving multiple images of product shelves through a period of time. *Wolfe*, ¶300.

POSITAs would have recognized images are captured across time and across stores to create a relative sequence of captured images. To determine “sales velocity” or “sales trend,” the mobile application would capture a first set of images depicting a product on the shelf, and after “a period of time,” it would capture another set of

images of the same shelf to determine if that product is missing (e.g., sold out). *Wolfe*, ¶301.

## **12. Claim 21**

Avegliano157-Rodriguez teaches claim 21's additional limitations. *Wolfe*, ¶303. Per claim 20, Avegliano157 receives multiple images of product shelves through a period of time ("further images") to determine "sales velocity" and "sales trend." *Avegliano157*, [0046]-[0048]; *Wolfe*, ¶¶303-04.

### **E. Ground 4: Obviousness Over Avegliano157, Rodriguez, and Avegliano430 (Claims 2, 7-9, 11-14, 16, 19)**

#### **1. Motivation to Combine Avegliano157-Rodriguez with Avegliano430**

POSITAs would have been motivated to further combine Avegliano157-Rodriguez with Avegliano430. *Wolfe*, ¶305.

Avegliano157-Rodriguez teaches an object identification solution that begins with capturing images in real-world retail stores, and continues with reading contents of shelf tags within the images to identify products on the shelf and building a product classifier based on the image and the shelf tag's content. *Avegliano157*, Abstract, [0016], [0018]-[0019], Figs. 3-4; *Rodriguez*, Abstract, [0009], [0081], [0086], [0166], [0186]. Avegliano157 describes "systems and methods for managing inventory and analyzing sales trends in a retail environment using mobile devices" to "minimize the time of out-of-the-shelf situations." *Avegliano157*, [0045], [0047],

Fig. 4; *Wolfe*, ¶306. Avegliano157 relies on an employee or a customer walking around the aisles taking photos of the shelves and products using mobile devices. *Avegliano157*, [0048], [0056]. However, as Avegliano157 acknowledges, “shelf monitoring in supermarkets is necessary” to avoid “items going out of stock,” but “[m]onitoring products in supermarket is an intensive work typically performed by the employees.” *Id.*, [0010]; *Wolfe*, ¶306.

POSITAs would have looked to Avegliano430 for help with this problem at least for reasons similar to those described in §VIII.C.2 because Avegliano430 discloses flying an unmanned aerial vehicle (UAV) that carries cameras and moves along rows of displayed products to gather image data of the shelves and products. *Avegliano430*, [0034]-[0039]; *Wolfe*, ¶307. Avegliano430’s drone is fully autonomous and helps obtain “near or real-time information relating to a current stocking level of display shelves” without “human intervention.” *Avegliano430*, [0018], [0035], [0039], [0050]; *Wolfe*, ¶307; *KSR*, 550 U.S. at 417 (obvious to apply a known technique to a known device ready for improvement to yield predictable results). This improvement relieves employees from labor-intensive work and improves flexibility. *Wolfe*, ¶308.

It would have been obvious to POSITAs to substitute Avegliano157-Rodriguez’s cameras for Avegliano430’s drone cameras because Avegliano430 discloses capturing images by the drone and/or the employee. *Avegliano430*, [0022],

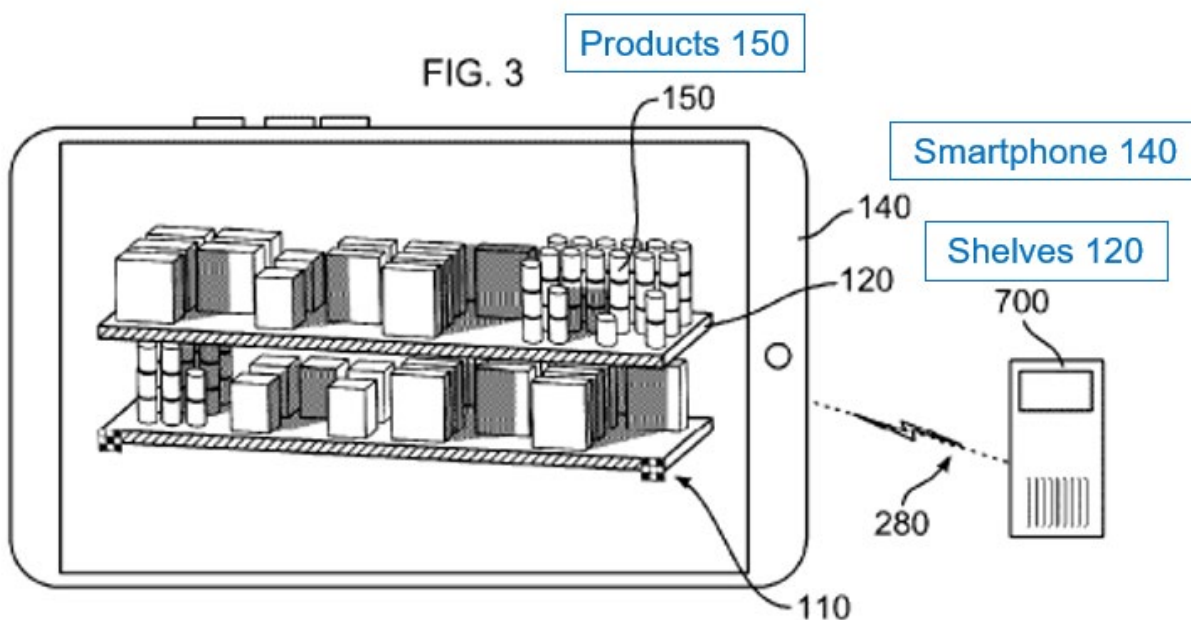
[0034]; *Wolfe*, ¶309; *see also KSR*, 550 U.S. at 401, 416 (obvious to substitute one known element for another to obtain predictable results). Also, like *Avegliano*157-Rodriguez, *Avegliano*430 discloses capturing images of products in retail stores and reading tags, which are referred to as markers, to identify products. *Avegliano*157, [0016]; *Rodriguez*, [0009]; *Avegliano*430, [0003]-[0005]; *KSR*, 550 U.S. at 417 (obvious to use a known technique to improve a similar device in the same way); *Wolfe*, ¶310. Additionally, it would have been obvious to modify *Avegliano*157-Rodriguez using *Avegliano*430’s computer system that detects missing objects from vacant areas and “leverage[s] information for multiple store locations.” *Avegliano*430, [0003], [0022], [0026]; *Wolfe*, ¶311. Data derived from multiple stores is processed to determine “restocking needs,” “sale velocity,” and more. *Avegliano*430, [0040]. POSITAs would have been motivated to use *Avegliano*430’s computer system to track sales velocity and trends across multiple stores regionally or nationwide. *Wolfe*, ¶312. *KSR*, 550 U.S. at 417 (obvious to use a known technique to improve a similar device in the same way).

POSITAs would have had a reasonable expectation of success of implementing (1) the drone image capture system and (2) the computer system supporting capturing and analyzing images across stores in the *Avegliano*157-Rodriguez combination because this modification represents nothing more than the combination of known elements used according to their ordinary and expected

operations. *Wolfe*, ¶313; *KSR*, 550 U.S. at 407, 419 (obvious when the prior art itself offers some teaching, suggestion, or motivation to combine prior art references). *Avegliano*157 also shares inventorship with *Avegliano*430. *ZUP, LLC v. Nash Mfg, Inc.*, 896 F.3d 1365, 1371-73 (Fed. Cir. 2018) (upholding invalidity for obviousness over combination of two patents to the same inventor directed to solving the same problem because the “motivation to combine may be found explicitly or implicitly in... ‘interrelated teachings of multiple patents’”). *Wolfe*, ¶314. The combination was well within the skills of POSITAs and would have required nothing more than the application of known, conventional techniques (utilizing a drone to capture images of retail products on shelves and capturing and analyzing images across stores). *Avegliano*430, [0039]; *KSR*, 550 U.S. at 416; *Wolfe*, ¶315.

## **2. Claims 2, 14**

*Avegliano*430 teaches claims 2, 14’s additional limitations. *Wolfe*, ¶316. As discussed in §VIII.C.3, *Avegliano*430 captures an image of a shelf section using a smartphone (Fig. 3) or an automatic drone (Figs. 5-7). *Avegliano*430, [0022], [0034]-[0039].



*Id.*, Fig. 3 (annotated).

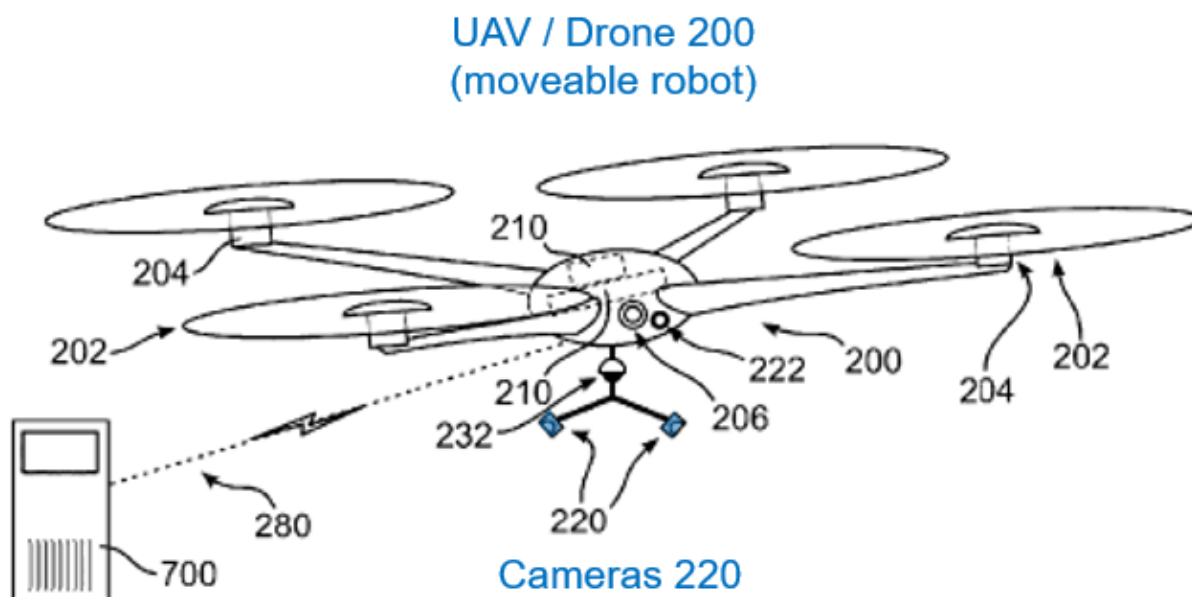
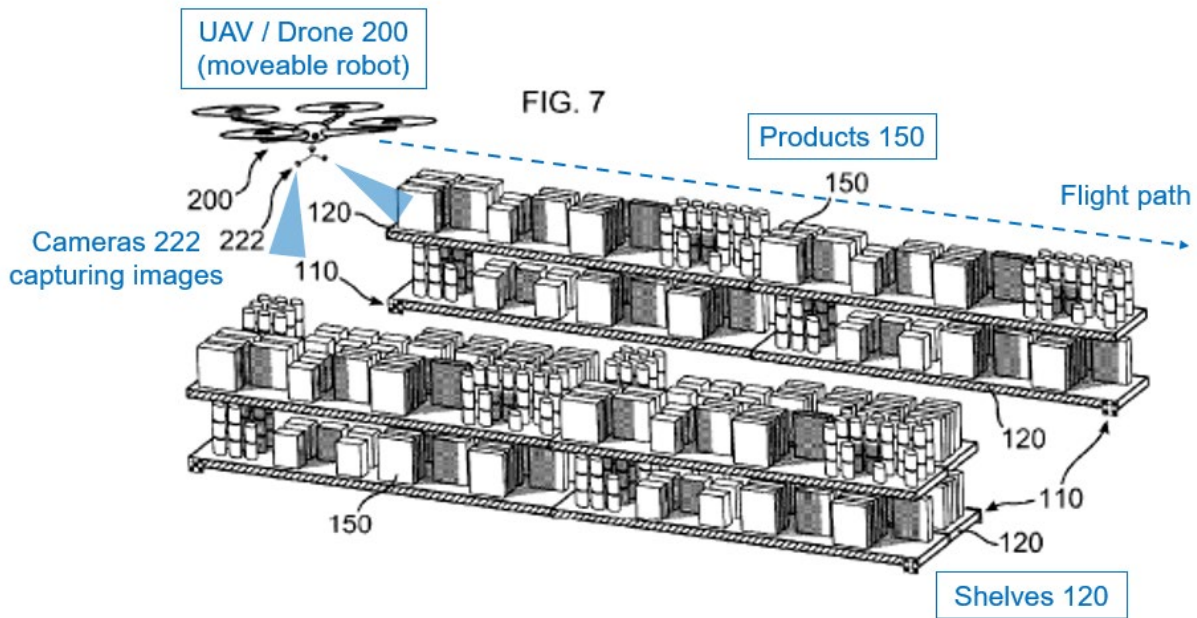


FIG. 5



*Id.*, Figs. 5, 7 (annotated); *Wolfe*, ¶¶316-19.

### 3. Claims 7, 11, 19

Avegliano157-Rodriguez teaches claims 7, 11, and 19 for substantially the same reasons as claim 1 (§VIII.D.4) because the claims are substantively identical. *Compare* limitations 7.0-7.3, 11.0-11.3, and 19.0-19.3 *with* limitations 1.2-1.6. *Wolfe*, ¶¶320-36.

The table below correlates the reasons why Avegliano157-Rodriguez teaches claims 7, 11, and 19. *Wolfe*, ¶¶334, 336.

| Substantially Similar Limitations | Reference  |
|-----------------------------------|------------|
| 1.0/7.0/11.0/19.0                 | VIII.D.4.a |
| 1.1/7.1.1/11.1.1/19.1.1           | VIII.D.4.b |
| 1.2/7.1.2/11.1.2/19.1.2           | VIII.D.4.c |
| 1.3/7.1.3/11.1.3/19.1.3           | VIII.D.4.d |

|                         |            |
|-------------------------|------------|
| 1.4/7.1.4/11.1.4/19.1.4 | VIII.D.4.e |
| 1.5/7.2/11.2/19.2       | VIII.D.4.f |
| 1.6/7.3/11.3/19.3       | VIII.D.4.g |

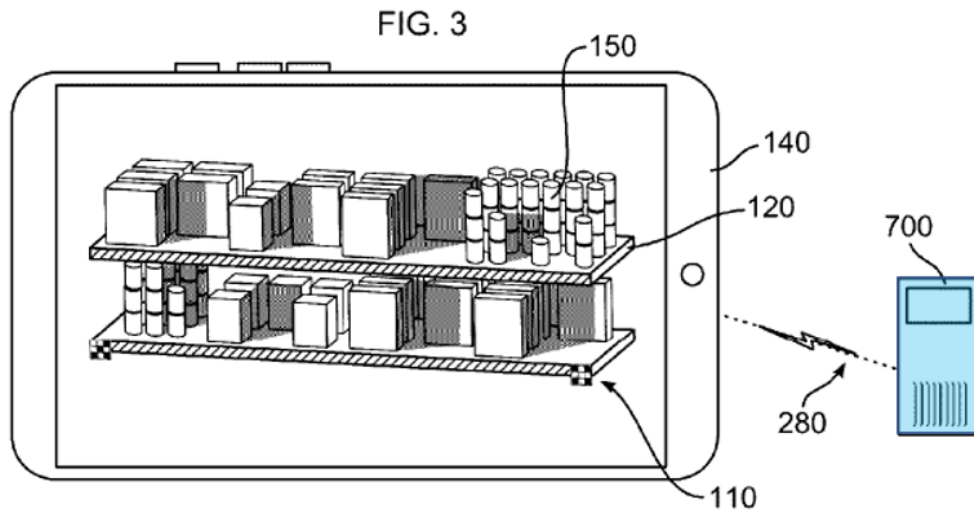
Claims 7, 11, and 19 differ from claim 1 by “capturing one or more images of a portion of a shelf in *a first store*” and “*second store*” as recited in 7.0 and 7.1.1, Avegliano157-Rodriguez teaches 7.0 for the same reasons as 1.1 (“capturing one or more images of a portion of a shelf with a camera”) and 1.5 (“cross correlating...product facing bounding boxes...*across one or more stores*”). §§VIII.D.4.b, VIII.D.4.f; *Wolfe*, ¶322. Specifically, Avegliano157-Rodriguez captures images and identifies objects in at least one store. *Wolfe*, ¶322.

Per §§VIII.D.4.f-VIII.D.4.i, Avegliano157 teaches spatial aggregation that determines sales velocity, sales trend, and real-time inventory status to benefit “scenarios with several retailers and several producers.” *Avegliano157*, [0050]. *Wolfe*, ¶320.

If PO argues that Avegliano157-Rodriguez does not teach capturing images across stores and perform object identification in images captured across stores, Avegliano430 does.

Per §§VIII.C.1, VIII.E.1, like Avegliano157 and Rodriguez, Avegliano430 discloses capturing images of store shelves to identify products and determine “what objects are missing from the vacant areas.” *Avegliano430*, [0003], [0026]; *Wolfe*,

¶¶321, 325-26. Avegliano430 further discloses “it can be advantageous to obtain and process the image data at a remote server” to “leverage information for multiple store locations.” *Avegliano430*, [0022]. Specifically, “shelf images can be identified as to a store location, time of day, shelf section, or any other criteria” and sent to “remote server 700.” *Id.*



*Id.*, Fig. 3 (remote server 700, blue). Data derived from images from multiple stores can be processed to determine “restocking needs,” “sale velocity,” and “comparison of sales using different placement locations.” *Avegliano430*, [0040]. Therefore, Avegliano430 teaches capturing images from multiple stores and sending the captured images to remote server 700 for object identification and determination of sales trend across multiple stores. *Wolfe*, ¶¶325-26. It would have been obvious to POSITAs that comparison of sales between a first store and a second store includes

capturing images from the first and second stores and comparing their sales by analyzing the captured images. *Wolfe*, ¶326.

#### **4. Claims 8, 12**

Avegliano157-Rodriguez-Avegliano430 teaches claims 8 and 12 for the same reasons as claims 1, 10, 18, and 20 and because Avegliano430 discloses executing this step at multiple store locations. *See* §§VIII.D.4, VIII.D.5, VIII.D.6, VIII.D.12; *Wolfe*, ¶337. POSITAs would have understood there are only three temporal relationship between the capture times of two images: before, after, or at the same time. *Id.* It would have been obvious for POSITAs to try any of those three options with a reasonable expectation of success. *Id.*; *see KSR*, 550 U.S. at 421 (obvious to try an option within a finite number of identified, predictable solutions for anticipated solutions within the technical grasp of POSITAs). In fact, POSITAs would have been motivated to sequentially take the shelf images and send the images to remote server 700 to avoid overwhelming the computation power of server 700. *Wolfe*, ¶337.

#### **5. Claims 9, 13**

Avegliano157-Rodriguez-Avegliano430 teaches the additional limitations of claims 9 and 13 for the reasons and image capture timing (“prior to”) discussed in claims 8 and 12. §VIII.E.6; *Wolfe*, ¶338.

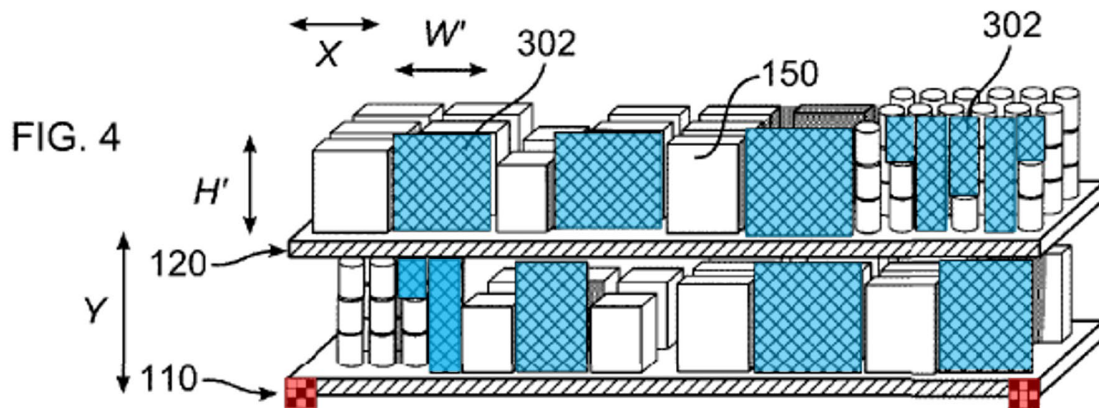
## 6. Claim 16

Avegliano157-Rodriguez-Avegliano430 teaches claim 16's additional limitations. *Wolfe*, ¶339.

Per §VIII.D.4.f and VIII.D.11 Avegliano157 determines product availability data by identifying products on shelves. *Avegliano157*, Abstract, [0016], [0021], [0030], [0033], [0046]-[0048], [0057]-[0059], [0065]; *Wolfe*, ¶340. The product identification uses images taken by “[a] mobile application, deployed on customers and merchant devices” “for consumers [] to report that a product is missing on the shelf.” *Avegliano157*, [0046], [0048]. Specifically, data of “missing product items on a shelf acquired by the mobile application is in the form of a picture” and “[t]he method includes identifying products on the shelf using tags attached to the shelves.” *Id.*, [0026]. As such, Avegliano157 uses missing product information extracted from captured images to determine sales velocity and trends, which in turn can be used to manage store inventory. *Id.*, Abstract, [0016], [0021], [0024], [0026] [0030], [0033], [0046]-[0048], [0057]-[0059], [0065]; *Wolfe*, ¶340.

Although Avegliano157 does not expressly disclose “missing product items” on a shelf represented by a gap between adjacent inventory products, Avegliano430 does. In the same field of endeavor, Avegliano430 discloses “an image obtained of shelf 120, together with marker 110” are used to determine “a size of vacant areas upon a shelf 120.” *Avegliano430*, [0018]. Vacant areas are “areas of the shelves [that]

do not have product extending to the forward region of the shelf, which is indicative of a less than fully stocked condition.” *Id.*, [0024], Fig. 4 (annotated, showing shelves 120, markers 110 (red), and vacant areas 302 (blue)). *Wolfe*, ¶341.



*Avegliano157*, Fig. 4.

“Once it is determined which display row has missing product, the size of the vacant area can be determined with reference to objects of known dimension within the image.” *Id.*, [0028]. *Avegliano430* uses “known [product] height and width” to identify the missing product. *Avegliano430*, [0029]; *id.*, Figs. 3-4, 7 [0028]-[0032], [0040]-[0053]. It would also have been obvious to POSITAs to identify *Avegliano157*’s “missing product items” on shelves using *Avegliano430*’s method for identifying missing products. *Wolfe*, ¶342; *see KSR*, 550 at 417 (obvious to apply a known technique to a piece of prior art ready for improvement).

Avegliano157-Rodriguez-Avegliano430's processes of identifying missing products operate in the same manner as the processes of identifying "gaps between products" to "identify or locate missing products" described in the '272 patent. *Wolfe*, ¶343. Avegliano157 and Avegliano430 use the width of a vacant shelf area (e.g., shelf area without product facing present) to determine the type of missing product. *Avegliano157*, [0051]-[0053], [0061]-[0063]; *Avegliano430*, [0028]-[0032], [0040]-[0053]; *Wolfe*, ¶343. In the same way, the '272 patent identifies gaps between products for identifying "missing/absent inventory." '272Pat, 8:16-17; *Wolfe*, ¶343.

#### **IX. DISCRETIONARY DENIAL WOULD BE INAPPROPRIATE**

Petitioner does not expect PO to raise 35 U.S.C. §325(d) because Schwartz differs from the Schwartz references cited during prosecution. '272Pat., Cover.

Petitioner does not expect PO to raise *Fintiv*. Although trial is currently scheduled for October 20, 2025, slightly before the expected FWD (December 2025), that trial date conflicts with case dispositive deadlines in a related matter between the parties in the same court. EX1025, 1. Petitioner has proposed to move (and Patent Owner did not oppose) the trial date to January 12, 2026, after the expected FWD deadline in this IPR. *Id.* The *Fintiv* factors do not support discretionary denial here, regardless of the trial date. Interim Procedure for Discretionary Denials (June 21,

2022)).<sup>13</sup> *Fintiv* factor 2 is neutral because the current trial date is within a month of the projected FWD, and as noted above, the parties expect the trial date to be delayed. *Fintiv* factor 3 weighs in favor of institution because it is early in the district court proceeding, with little investment by the court or parties. The parties have not yet exchanged terms for claim construction, and the court has not issued any substantive orders. Under *Fintiv* factor 4, this petition challenges claims 1-21, which includes non-overlapping claims 2, 14, 20, and 21 of the '272 patent omitted from the E.D. Tex. litigation. EX1026. Finally, given the strong (or compelling) merits of the petition, *Fintiv* factor 6 weighs heavily in favor of institution (or precludes discretionary denial altogether).

## **X. Conclusion**

For the foregoing reasons, Petitioner respectfully requests that the Board institute *inter partes* review trial and cancel the challenged claims as unpatentable.

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<sup>13</sup> [https://www.uspto.gov/sites/default/files/documents/interim\\_proc\\_discretionary\\_denials\\_aia\\_parallel\\_district\\_court\\_litigation\\_memo\\_20220621\\_.pdf](https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf)

## **XI. Mandatory Notices**

### **A. Real Party in Interest**

Petitioner identifies itself as the real party in interest. Out of an abundance of caution, Petitioner discloses VusionGroup GmbH and Captana GmbH as potential real parties in interest.

### **B. Related Matters**

To the best of Petitioner's knowledge, the '272 patent has been involved in one district court litigation, *Hanshow Technology Co., Ltd. v. SES-imagotag SA, et al.*, Case No. 2:23-cv-00617 (E.D. Tex.). EX1023.

To the best of Petitioner's knowledge, the '272 patent has not been challenged in any *inter partes* review prior to this proceeding.

### **C. Notice of Counsel and Service Information**

Pursuant to 37 C.F.R. §§42.8(b)(3), 42.8(b)(4) and 42.10(a), Petitioner appoints the following counsel in the table below:

| <b>LEAD COUNSEL</b>                                                                                                                                                            | <b>BACK-UP COUNSEL</b>                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Jessica Kaiser (Reg. No. 58,937)<br>kaiser-ptab@perkinscoie.com<br>PERKINS COIE LLP<br>1900 Sixteenth Street, Suite 1400<br>Denver, CO 80202-5255<br>Telephone: (303) 291-2300 | Matthew J. Moffa (Reg. No. 58,860)<br>moffa-ptab@perkinscoie.com<br>PERKINS COIE LLP<br>1155 Avenue of the Americas 22nd Floor<br>New York, NY 10036-2711<br>Phone: 212.262.6900<br><br>John C. Moulder (Reg. No. 70,490)<br>moulder-ptab@perkinscoie.com<br>PERKINS COIE LLP<br>700 Thirteenth Street, N.W. Suite 800 |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>Washington, DC 20005-3960<br/>Telephone: (202) 654-3337</p> <p>David Pekarek Krohn (Reg. No. 69,443)<br/>pekarekkrohn-ptab@perkinscoie.com<br/>PERKINS COIE LLP<br/>33 East Main Street, Suite 201<br/>Madison, WI 53703-3095<br/>Telephone: (608) 663-7460</p> <p>Yuanfeng Gao (Reg. No. 79,573)<br/>gao-ptab@perkinscoie.com<br/>PERKINS COIE LLP<br/>700 Thirteenth Street, N.W. Suite 800<br/>Washington, DC 20005-3960<br/>Telephone: (202) 654-6200</p> <p>Tyler Knox (Reg. No. 79,948)<br/>knox-ptab@perkinscoie.com<br/>PERKINS COIE LLP<br/>1900 Sixteenth Street, Suite 1400<br/>Denver, CO 80202<br/>Tel: (303) 291-2300</p> <p>Grant Kinsel<br/><i>Pro Hac Vice</i> to be submitted<br/>kinsel-ptab@perkinscoie.com<br/>PERKINS COIE LLP<br/>1201 Third Avenue, Suite 4900<br/>Seattle, WA 98101-3099<br/>Phone: 206.359.8000</p> |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Petitioner consents to electronic service at the following email address: SES-imagotag-IPRs@perkinscoie.com.

**D. Power of Attorney**

A power of attorney is filed herewith according to 37 C.F.R. §42.10(b).

Respectfully submitted,

*/ Jessica Kaiser /*

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

PERKINS COIE LLP  
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Date: June 20, 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 11,087,272, 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 13,950. 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: June 20, 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. 11,087,272 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 Patent Center:

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

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