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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Cimbria Srl
Petitioner

v.

3U Vision SRL
Patent Owner

PGR2024-00018
Patent 11,666,947

PETITION FOR POST-GRANT REVIEW OF US PATENT 11,666,947 CHALLENGING CLAIMS 1-15 UNDER 35 U.S.C. §§321-329 AND 37 C.F.R. §42.200, ET SEQ.

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I. MANDATORY NOTICES

A. Real Party-in-Interest

Pursuant to 37 C.F.R. §42.8(b)(1), Cimbria SRL ("Cimbria" or "Petitioner") certifies that Cimbria is the real party-in-interest. AGCO Corporation, Cimbria's ultimate parent, participated in the preparation of this Petition and is also a real party in interest with respect to this Petition. Cimbria certifies that no other party exercised control or could exercise control over Cimbria's participation in this proceeding, the filing of this petition, or the conduct of any ensuing trial.

B. Related Matters

According to assignment records, US Patent 11,666,947 ("'947 Patent" (EX1001)) is owned by 3U Vision SRL ("3U Vision" or "Patent Owner").

As of the filing date of this petition, '947 Patent is not the subject of any district court proceedings.

C. Counsel

Brett C. Booth (Reg. No. 69,033) will act as lead counsel; Brian C. Park (Reg. No. 45,519) will act as back-up counsel.

D. Service Information, Email, Hand Delivery and Postal

Cimbria consents to electronic service at brett.booth@stoel.com and kyle.woodhouse@agcocorp.com. Petitioner can be reached at Stoel Rives LLP, 201 South Main Street, Suite 1200, Salt Lake City, UT 84111, Tel: (801) 328-3131, Fax:

(202) 663-6363, and AGCO Corporation, 420 W. Lincoln Blvd., Hesston, KS 67062, (316) 227-0094.

II. CERTIFICATION OF GROUNDS FOR STANDING

Petitioner certifies pursuant to Rule 42.204(a) that the patent for which review is sought is available for post grant review and that Petitioner is not barred or estopped from requesting a post grant review challenging the patent claims on the grounds identified in this Petition.

III. TIME FOR FILING PETITION

The '947 Patent was granted on June 6, 2023 and the present Petition is being filed on or before the date that is nine months after the date of the grant of the patent (March 6, 2024). 35 U.S.C. §321(c); 37 C.F.R. §42.202.

IV. OVERVIEW OF CHALLENGE AND RELIEF REQUESTED

Pursuant to Rules 42.22(a)(1) and 42.204(b)(1)–(2), Petitioner challenges claims 1-15 of '947 Patent.

A. Prior Art Patents and Printed Publications

The following references predating the October 21, 2020 effective filing date of '947 Patent are pertinent to the grounds of unpatentability explained below:[1]

[1] '947 Patent issued from a patent application filed after enactment of the America Invents Act ("AIA"). Accordingly, AIA statutory framework applies.

1. G. ElMasry, N. Mandour, S. Al-Rejaie, E. Belin, D. Rousseau, "Recent Applications of Multispectral Imaging in Seed Phenotyping and Quality Monitoring—An Overview," *Sensors* 2019 ("ElMasry" (EX1002)), prior art under 35 U.S.C. §102(a)(1).

2. US Patent 4,558,786 (filed June 15, 1983); published December 17, 1985) ("Lane" (EX1003)), prior art under 35 U.S.C. §102(a)(1) and 102(a)(2).

3. UK Patent Application GB2578180 (filed on December 4, 2019; published on April 22, 2020) ("Gerken" (EX1004)), prior art under 35 U.S.C. §102(a)(1) and 102(a)(2).

4. US Patent 9,795,996 (filed January 15, 2016); first published US Patent Publication 2016/0129480 on May 12, 2016 and later US Patent 9,795,996 on October 24, 2017 ("Adams" (EX1005)), prior art under 35 U.S.C. §102(a)(1) and 102(a)(2).

5. US Patent 5,508,512 (filed January 24, 1995; published April 16,1996) ("Gray" (EX1006)), prior art under 35 U.S.C. §102(a)(1) and 102(a)(2).

6. US Patent 10,911,731 (filed September 26, 2017; first published US Patent Publication 2018/0020200 January 18, 2018 and later US Patent 10,911,731 February 2, 2021) ("Hagiwara" (EX1007)), prior art under 35 U.S.C. §102(a)(1) and 102(a)(2).

7. US Patent Publication 2020/0088580 (filed September 12, 2019; published March 19, 2020) ("Darty" (EX1008)), prior art under 35 U.S.C. §102(a)(1) and 102(a)(2).

B. Grounds for Challenge

Petitioner requests cancellation of claims 1-15 of '947 Patent. Specific grounds are as follows:

- Ground 1: Claims 1-15 are unpatentable under 35 U.S.C. §112(b);
- Ground 2: Claims 1-3, 6, and 10 are unpatentable under 35 U.S.C. §103 over ElMasry;
- Ground 3: Claims 4, 7, and 8 are unpatentable under 35 U.S.C. §103 over ElMasry and Lane;
- Ground 4: Claim 5 is unpatentable under 35 U.S.C. §103 over ElMasry, Lane, and Gerken.
- Ground 5: Claim 9 is unpatentable under 35 U.S.C. §103 over ElMasry and Adams.

- Ground 6: Claims 11, 12, and 15 are unpatentable under 35 U.S.C. §103 over ElMasry and Gray.
- Ground 7: Claim 13 is unpatentable under 35 U.S.C. §103 over ElMasry, Gray, and Hagiwara.
- Ground 8: Claim 14 is unpatentable under 35 U.S.C. §103 over ElMasry, Gray, and Darty.

This Petition, supported by the declarations of Dr. David Schaafsma ("Schaafsma Declaration") and Dr. Sylvia Hall-Ellis ("Hall-Ellis Declaration"), demonstrates it is more likely than not Petitioner will prevail in cancellation of at least one challenged claim. 35 U.S.C. §324(a).

V. TECHNOLOGY BACKGROUND

'947 Patent claims only known concepts related to automated sorting systems.

Automated sorting systems emerged as early as the 1930s.[2] Satake US Vision Systems introduced its first infrared-based automated sorter in 1986[3] and MSS introduced a Near Infrared (NIR)-based sorting system in 1998.[4] Schaafsma Declaration, 9-12. By 2013, Tom Pearson, an engineer at Amgen Inc. (Thousand Oaks, California), and other associates (Maghirang and Dowell) published a paper[5] ("Pearson") outlining experiments performed with a fully automated multispectral sorting device using three visible and three NIR LEDs. Schaafsma Declaration, 13. Fig. 3 of Pearson (below) illustrates the sorting device.

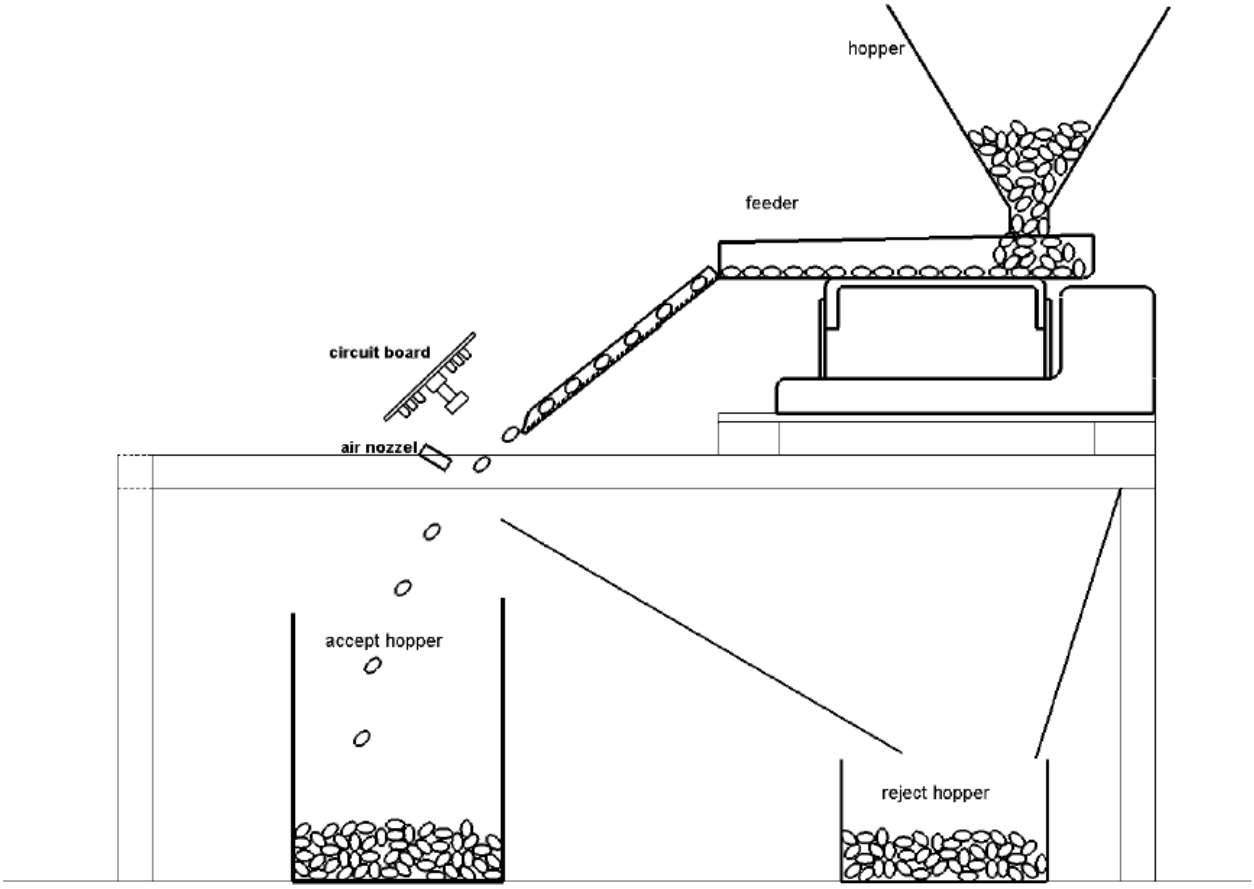
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[2] Satake USA Vision Systems brags a 1935 successful installation of automatic sorting machines (www.satake-usa.com/sorting-overview/, reproduced in EX1011)

[3] Satake introduced Shell-ex in 1986, the first sorter to use infrared technology for pecan, almond, and walnut sorting (www.satake-usa.com/sorting-overview/) (EX1011)

[4] MSS CartonSort™ and PlasticSort™, both NIR-based sorting systems for separating plastic containers and beverage cartons from mixed recyclables (mssoptical.com/about/history) (EX1012)

[5] Tom Pearson, Elizabeth Maghirang, and Floyd Dowell, "A Multispectral Sorting Device for Wheat Kernels," Colombia International Publishing, *American Journal of Agricultural Science and Technology* (2013) 2: 45-60 (EX1013)



Pearson, Fig. 3

Pearson indicates "multispectral data were collected by rapidly (~12 kHz) blinking one LED at a time and subsequently measuring the reflected light from wheat kernels as they dropped off a feeder chute," and "[a] microcontroller was used to direct the LED pulses, digitize the analog signal from the photodiode, perform signal processing, and apply classifications." Pearson, 45. Pearson continues "[s]orting was accomplished through activation of an air valve that diverted the wheat kernels per the classification assignment." *Id.* Accordingly, automated

multispectral imaging systems operating in the infrared spectrum, similar to sorting machines claimed in ’947 Patent, were known as early as 2013.

The idea of sequentially and alternately turning on infrared light sources in different time periods is, however, much older than 2013 (Pearson). For example, U.S. Patent 4,418,359 to Stapleton (“Stapleton”) originally published November 29, 1983 (nearly 40 years before the October 21, 2020 effective filing date of ’947 Patent), disclosed this idea. Stapleton disclosed a “trichroic system of image scanning which provides pulses which correspond to infrared wavelengths or bands of the image being scanned” (Stapleton, 2:6-11), and “[i]n a trichoic system operation there is usually provided the spectral separation of incident radiation into three spectral bands, each of which may be detected by a single detector in time sequence” (Stapleton, 2:14-17).

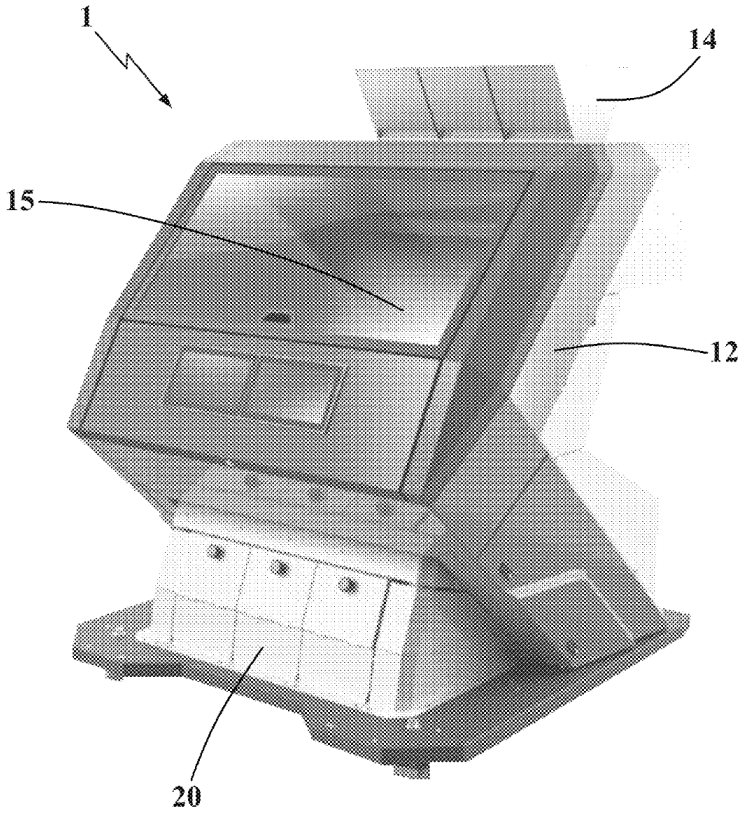
Stapleton also disclosed associating measurement signals corresponding to different wavelength bands with different RGB color channels to generate a false color image, which is another idea from claim 1 of ’947 Patent. Specifically, Stapleton disclosed assigning “subtractive colors -Red, (cyan) -Green (magenta) and -Blue (yellow) … to the wavelengths to determine the presence of targets” (2:14-29), “visible colors of the CRT, (or any other type of display) are assigned to the trichroic infrared signals” (4:44-46), and “[s]ubtractive colors -R, -G, and -B are assigned to infrared wavelengths $\eta 3 \geqq \eta 2 \geqq \eta 1$ respectively” (4:47-50).

While Stapleton does not discuss these ideas in the context of automated sorting systems, Stapleton illustrates these ideas were known nearly 40 years before the effective filing date of '947 Patent. Prior art references and materials discussed below illustrate examples of how these and the other claimed ideas have since been implemented in the art of automated sorting systems prior to the effective filing date of '947 Patent. In view of grounds presented below, claims 1-15 are unpatentable.

VI. OVERVIEW OF '947 Patent

A. Summary of '947 Patent

'947 Patent discloses "machines for the sorting of products, … for identifying, within a bulk product, specific solid elements to be separated." '947 Patent, 1:6-9. The challenged claims are directed to a selector machine. '947 Patent describes selector machine 1 illustrated in FIGS. 1-4.



’947 Patent, FIG. 1

“[S]elector machine 1 is intended to be employed in the food industry … to identify in a bulk product (in particular granular), such as for example dried fruit (peanuts, walnuts, almonds), seeds, grain, or the like, elements which must be discarded before product packaging, which can for example be the shells of the dried fruit, discards of the working of the food product or other non-edible foreign bodies.” *Id*., 3:34-42. ’947 Patent also discloses “selector machine 1 can be employed in the industry of waste recovery.” *Id*., 3:43-47.

As shown in FIGS. 2-4 (below), “selector machine 1 comprises a conveyance system 2, which is arranged for advancing, along an advancement path A, at least

one bulk product comprising multiple solid elements to be selected" (*Id*., 3:48-51), and " slide 15, along which the bulk product descends via gravity in order to be distributed and advance along the advancement path A" (*Id*. 3:60-64). Selector machine 1 "comprises an optical detection system 3" (*Id*., 4:9-11) including emitter device 4 (*Id*., 4:12-13), "optical sensor 5" (*Id*., 4:15), and "electronic control unit 6" (*Id*., 4:22). Emitter device 4 "comprises at least three IR sources 8, each of which arranged for emitting electromagnetic radiations 40 in a corresponding distinct spectral band 80 in the infrared spectrum" (*Id*., 5:6-9). Electronic control unit 6 "alternately turn[s] on the IR sources 8 one after another in corresponding and separate time intervals T_{ON} and the optical sensor 5 … detect[s], in each time interval T_{ON}, corresponding reflected radiations RF coming from the product irradiated by the corresponding IR source 8, and [generates] corresponding measurement signals." *Id*., 5:18-21. "[E]lectronic control unit 6 comprises … a processing module 9, which is provided with three chromatic channels 10 of a RGB color space," and associates "measurement signals corresponding to each IR source 8 with a corresponding chromatic channel 10 in order to compose a false color synthesis image of the product." *Id*., 5:26-34.

'947 Patent discloses "electronic control unit 6 turns on in a first time interval T_{ON} a first of the IR sources with the other IR sources 8 inactive" (*Id*., 5:38-40), "bulk product is only irradiated with electromagnetic radiations 40 at the spectral

band 80 of the aforesaid IR source 8" (*Id*., 5:40-42), irradiated product "reflects the reflected radiations RF … in the corresponding spectral band 80, which are received by the optical sensor 5 in order to generate a measurement signal" (*Id*., 5:42-47), and "such measurement signal is mapped on a first of the chromatic channels 10 of the processing module 9, as represented in FIG. 2" (*Id*., 5:56-58).

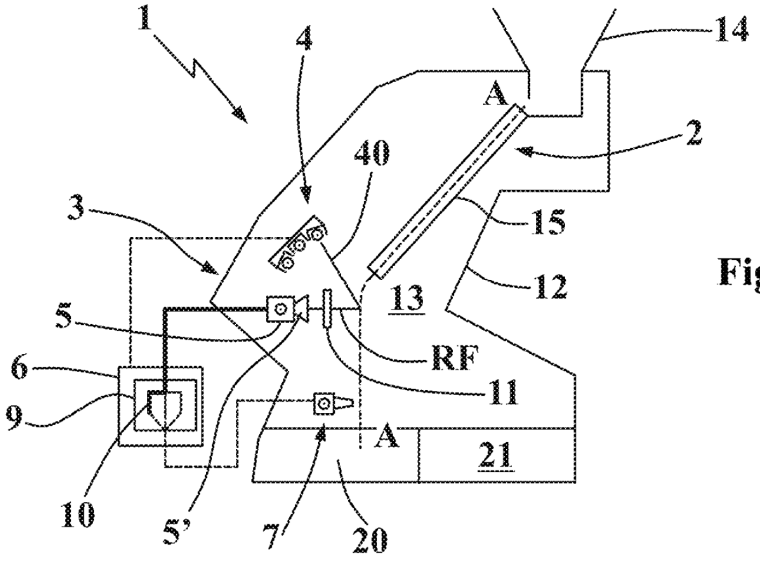


Fig. 2

'947 Patent, FIG. 2

"In a successive second time interval T_{ON}, the first of the IR sources 8 is deactivated by the electronic control unit 6 and a second of the aforesaid IR sources 8 is turned on" (*Id*., 5:60-63), and the optical sensor 5 "generates a second measurement signal which is associated by the processing module 9, as represented in FIG. 3, with a second of the chromatic channels 10" (*Id*., 5:65-6:2).

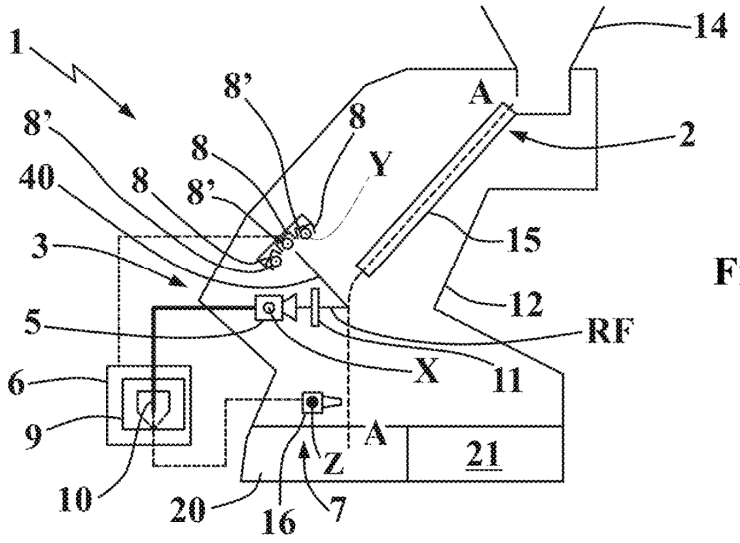


Fig. 3

'947 Patent, FIG. 3

"The same process is repeated with a third of the IR sources 8, such that the optical sensor 5 generates a measurement signal that is mapped by the processing module 9, as represented in FIG. 3, with a third of the chromatic channels 10." *Id*., 6:2-6.

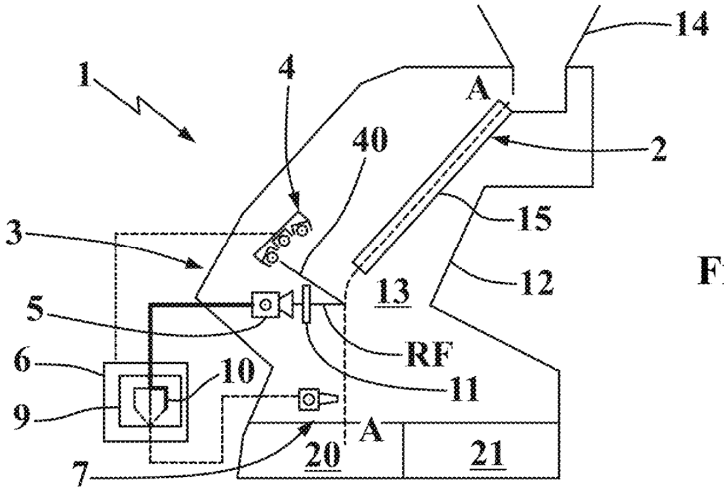


Fig. 4

'947 Patent, FIG. 4

"[T]hresholding software … defines the criteria with which the electronic control unit 6 determines, based on the synthesis images, the elements to be selected and, consequently, the control signals to be sent to the expulsion device 7." *Id*., 6:9-15. "[C]ontrol signals are adapted to drive the expulsion device 7 to eliminate from the advancement path A specific solid elements of the product, which are selected based on the information acquired from the optical detection system 3." *Id*., 3:43-47.

'947 Patent admits most of the elements of claim 1 and dependent claims 2-3 and 6 were known in the art before the effective filing date of '947 Patent. Specifically, "State of the Art" section of '947 Patent indicates "[k]nown on the market are selector machines … employed in order to separate, within a product constituted by multiple objects, specific objects to be selected or to be discarded." *Id*., 1:23-26. '947 Patent continues "[a]s is known, the selector machines are generally provided with a conveyance system on which a flow of a bulk product is made to advance," and "[s]elector machines also comprise an optical detection system arranged for acquiring and analyzing images of the flow of bulk product, so as to distinguish, in the bulk product, the solid elements to be separated or discarded." *Id*., 1:27-44. '947 Patent indicates "[s]uch detection system is adapted to send control signals, based on the information obtained from the acquired images, to an expulsion device … actuatable to remove the selected solid elements from the

bulk product, for example through the emission of compressed air jets." *Id*., 1:45-49.

"State of the Art" section also indicates "the optical detection system comprises optical emitters (e.g. constituted by LEDs) adapted to emit electromagnetic radiations towards the bulk product, and one or more optical sensors arranged for receiving the radiations reflected from the bulk product in order to obtain images of the product on the basis of which, by means of suitable thresholding algorithms, an electronic control unit determines which are the elements to be removed." *Id*., 1:50-57. '947 Patent concedes "it is known to employ emitters and optical sensors that also operate in the near infrared spectrum" to "distinguish, in the bulk product, solid elements substantially having the same color in the visible light spectrum." *Id*., 1:57-61.

'947 Patent makes additional admissions outside of "State of the Art" regarding what was known. For example, '947 Patent discusses "at least one thresholding software, per se of known type (and hence not discussed hereinbelow), which defines the criteria with which the electronic control unit 6 determines, based on the synthesis images, the elements to be selected and, consequently, the control signals to be sent to the expulsion device." *Id*., 6:9-15. '947 Patent also admits "as is known, the LEDs 8' of the IR sources 8 can have a spectral band 80 with emission wider than that of interest, for example extended for an interval of wavelengths for

about one hundred or two hundred nanometers, with maximum intensity at a central wavelenth, for example indicated by the LED manufacturer, and intensities decreasing the further the wavelength is from such central wavelength." *Id*., 9:55-62.

Remaining portions of claim 1 that '947 Patent arguably does not admit were prior art boil down to: (1) alternately activating separate infrared sources corresponding to separate infrared spectral bands one after another in corresponding separate time intervals; and (2) associating measurement signals corresponding to different bands with different RGB color channels to generate a false color image. Accordingly, any distinctions of claim 1 over what '947 Patent ***admits*** was prior art are tenuous.

Even these ideas were known in the art before the effective filing date. ElMasry indicates "multispectral images may be acquired under different illumination conditions at different '*discrete*' wavelength bands," and "using various illuminants of different spectral power distribution depends on '*sequentially*' illuminating the scene with different narrow-band wavelength light sources." ElMasry, 10-11. But sequentially and alternately turning on light sources in different time periods is older than ElMasry (2019), as discussed above with reference to Stapleton.

ElMasry and Stapleton (see above regarding Stapleton) disclosed associating measurement signals corresponding to different wavelength bands with different RGB color channels to generate false color images before the effective filing date of '947 Patent. ElMasry disclosed "[t]he number of these greyscale slices is equivalent to the number of wavelength bands used during image acquisition," and "any three of these grey sub-images (slices) could be easily concatentated one after another (one slice for each color channel) to form a pseudo-color image". ElMasry, 11-12. ElMasry, Figures 2(h)-(i) show these slices mapped to RGB channels.

Given ideas bridging the already narrow gap between claim 1 and AAPA were known for nearly 40 years before the effective filing date, '947 Patent never should have issued.

B. Level of Ordinary Skill in the Art

A POSITA at the effective filing date would have a B.S. degree in Electrical Engineering, Physics, Chemistry, or an equivalent field, and at least 2-3 years of academic or industry experience in engineering related to optical sorting systems. Schaafsma Declaration, 21.

C. Prosecution History

'947 Patent issued from US Patent Application 17/505,866 ("'866 Application"), filed October 20, 2021. Prosecution History (October 20, 2021)

EX1015. '866 Application claims priority to Italian Patent Application 202020000005884, filed October 21, 2020.

During prosecution, one office action issued rejecting claims 1-3, 6-7, and 9-10 as obvious based on Lane, US Patent 5,157,426 to Kronberg ("Kronberg"), and legal precedent. Prosecution History (October 13, 2022) EX1015. Claims 4, 5, 8, and 11-15 were rejected as obvious based on Lane, Kronberg, legal precedent, US Patent Publication 2011/0002536 to Thomasson et al., and US Patent Publication 2017/0059406 to Pelletier et al. *Id*.

Applicant responded by amending claim 1 to recite:

> … associating the measurement signals corresponding to each said IR source ~~(8)~~ with a corresponding chromatic channel of said chromatic channels ~~(10) in order to compose~~ and for composing a false color synthesis image of said at least one product by means of three said measurement signals acquired every three successive said time intervals; said electronic control unit ~~(6)~~ being configured to generate said control signals as a function of said synthesis image.

Prosecution History (January 11, 2023) EX1015. Applicant argued "[n]o prior art of record teaches or suggests to generate a false color synthesis image by processing '*three said measurement signals acquired every three successive said time intervals*," "Lane teaches merely to compare the values of the different IR signals and does not give any prompt to use them to generate a false color image," and "Kronberg does not teach to '*composing a false color synthesis image […] by means of three said measurement signals acquired every three successive time intervals*',

because on the contrary, the multi-spectral camera used in Kronberg acquires at the same time the measurement signals of all the spectral bands ….” *Id*.

Applicant argued “this claimed configuration … can’t be derived by simply changing the number of emitter and/or the respective light frequencies, but it is necessary to arrange a specific configuration wherein the measurement signals of every three successive time intervals are associated to the corresponding three chromatic channels to generate a false color synthesis image.” *Id*.

A first Notice of Allowance thereafter issued. Prosecution History (January 27, 2023) EX1015. It stated “Applicant’s amendments and arguments (1/11/2023) overcome the cited prior art of record,” “the amended features of composing a false color synthesis of said at least one product using three measurement signals acquired at three successive time intervals render the invention novel and non-obvious over the prior art,” and “the prior art does not teach the claimed spectral bands and the different time intervals as noted by Applicant.” *Id*.

Following the first Notice of Allowance, Applicant filed an IDS disclosing US and foreign patent references and non-patent literature. Prosecution History (March 23, 2023) EX1015. A second Notice of Allowance issued without further clarifying reasons for allowance. Prosecution History (April 11, 2023) EX1015.

If the examiner had the benefit of reviewing the combination of references cited in this petition, he would not have allowed this application.

VII. CLAIM CONSTRUCTION

"In a post-grant review proceeding, a claim of a patent … shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent." 37 C.F.R. §42.200(b). The "ordinary and customary meaning" refers to the understanding of "a [POSITA]." *See, e.g.*, *Laitram Corp. v. NEC Corp.*, 163 F.3d 1342, 1346 (Fed. Cir. 1998). The understanding of a claim term to a POSITA must be considered "not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005).

Should Patent Owner, to avoid prior art, contend a claim term has a construction different from its ordinary and customary meaning, Patent Owner's appropriate course is to seek claim amendments to expressly correspond to its contentions. *See* 77 Fed. Reg. 48,756-01, 48,764 (Aug. 14, 2012).

A. "electronic control unit"

"Electronic control unit" should be construed using 35 U.S.C. §112(f) means-plus-function interpretation, as outlined in section VIII.A.1. "Electronic control

unit" includes nonce term "unit" recited with functional terms "electronic control," and would not have conveyed definite structure to a POSITA. Claim 1 does not otherwise recite definite structure for "electronic control unit." Accordingly, "electronic control unit" should "be construed to cover corresponding structure, material, or acts described in the specification and equivalents thereof." 35 U.S.C. §112(f).

The specification does not define "electronic control unit." However, the specification states "[a]dvantageously, the electronic control unit 6 comprises at least one electronic processor suitably implemented in a corresponding circuit board," and "[s]uitably, the processing module 9 can be integrated in the aforesaid electronic processor, for example by means of a corresponding software, or obtained with a distinct firmware." '947 Patent, 8:30-35. The specification continues "[a]dvantageously, the electronic control unit 6 can be integrated in the optical sensor 5, in particular in the video camera of the latter (obtained for example with a smart camera)." *Id.*, 8:36-39). The specification also indicates "the electronic control unit 6 is provided with a synchronized control module." *Id.*, 9:18-20. The specification indicates "electronic control unit 6 is provided with at least one thresholding software, per se of known type (and hence not discussed hereinbelow)." *Id.*, 6:9-11. The specification further indicates "electronic control unit 6" is "operatively connected to said optical sensor 5" (4:22-23) and "operatively

connected to the emitter device 4" (5:18-19). The specification further discloses the electronic control unit:

- "turns on in a first time interval T_{ON} a first of the IR sources with the other IR sources 8 inactive" (5:38-40)
- "receive[s] the measurement signals" (4:21-22)
- processes a grayscale image "as computer data by the software of the electronic control unit 6" (5:48-51)
- deactivates "the first of the IR sources 8" and turn on "a second of the aforesaid IR sources 8" (5:60-63)
- "alternately turn[s] on the IR sources 8 one after the other in corresponding and separate time intervals T_{ON}" (5:18-21)
- "send[s], to the IR sources 8, trigger signals 60, 60'" (9:14-16)
- "generat[es] the aforesaid trigger signals 60, 60' in groups of three" (9:18-23)
- "associate[s] the measurement signals corresponding to each IR source 8 with a corresponding chromatic channel 10 in order to compose a false color synthesis image of the product" (5:31-34)
- identifies "solid elements of the bulk product" (7:58-60 and 8:28-29)
- determines, "based on the synthesis images, the elements to be selected and, consequently, the control signals to be sent to the expulsion device 7" (6:9-15)

- "generate[s] the control signals, and then identify the elements to be selected, as a function of the aforesaid synthesis image" (5:35-37)
- "emit[s] control signals, which are sent to an expulsion device 7 in order to remove the selected elements from the product," (4:24-26)

Accordingly, "electronic control unit" should be construed to be at least one electronic processor implemented in a circuit board and programmed with software/firmware with a synchronized control module, a processing module, and thresholding software to perform the functions outlined above, including turning on and off IR sources, receiving and processing measurement signals to generate a false color synthesis image, identifying solid elements of the false color image to be removed, and generating and emitting control signals to an expulsion device to remove the selected elements.

B. "processing module"

"processing module" should be construed using 35 U.S.C. §112(f) means-plus-function interpretation. "Processing module" includes nonce term "module" recited with functional term "processing," and would not have conveyed definite structure to a POSITA. Claim 1 does not otherwise recite definite structure for "processing module." Rather, claim 1 recites that "processing module" is:

- "provided with at least three chromatic channels of a RGB color space"

- "arranged for associating the measurement signals corresponding to each said IR source with a corresponding chromatic channel"
- "arranged for … composing a false color synthesis image of said at least one product by means of three said measurement signals acquired every three successive said time intervals"

None of these elements provides definite structure. Accordingly, under 35 U.S.C. §112(f), "processing module" should "be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof."

The specification does not define "processing module." However, the specification indicates "[s]uitably, the processing module 9 can be integrated in the aforesaid electronic processor, for example by means of a corresponding software, or obtained with a distinct firmware." *Id*., 8:32-35. Processing module 9 "is provided with three chromatic channels 10 of a RGB color space, i.e. in particular a channel of the red R, a channel of the green G and a channel of the blue" (5:26-30). The specification indicates that "processing module 9":

- "associate[s] the measurement signals corresponding to each IR source 8 with a corresponding chromatic channel 10 in order to compose a false color synthesis image of the product" (5:30-6:8)
- "generates the synthesis image starting from the reduced quantity of data contained in the only three measurement signals mapped in the chromatic

channels 10, employing algorithms that are typical of the RGB color space, which require easier implementation with respect to the typical algorithms of infrared image processing" (7:13-19).

Accordingly, "processing module" should be construed to be software or firmware executed by an electronic processor to associate measurement signals corresponding to each IR source with a chromatic channel of the RGB color space, and generate a false color synthesis image employing image processing typical of RGB color spaces.

VIII. SPECIFIC GROUNDS FOR PETITION

Pursuant to Rule 42.204(b)(4)-(5), the following sections (as supported by Schaafsma Declaration, 22-53) detail grounds of unpatentability for claims 1-15 of '947 Patent.

A. Ground 1: Claims 1-16 are unpatentable under 35 U.S.C. §112(b)

Claim 1 of '947 Patent recites a nonce word in conjunction with functional claim elements, triggering a means-plus-function interpretation under 35 U.S.C. §112(f) (see section VIII.A.1). The specification fails to provide sufficient algorithmic structure for at least one functional element associated with the nonce word. Thus, claim 1 is invalid for failure to particularly point out and distinctly

claim the subject matter regarded as the invention under 35 U.S.C. §112(b). Dependent claims 2-15 fail to remedy the indefiniteness of claim 1, rendering claims 2-15 invalid under 35 U.S.C. §112(b).

1. "electronic control unit" should be interpreted using a means-plus-function interpretation

The term "electronic control unit" should be interpreted under 35 U.S.C. §112(f) (means-plus-function) because claim 1 recites function for "electronic control unit" without reciting structure for performing the recited function. In determining whether a claim term should be interpreted under 35 U.S.C. §112(f), "[t]he standard is whether the words of the claim are understood by [POSITAs] to have a sufficiently definite meaning as the name for structure," and "[w]hen a claim term lacks the word 'means,' the presumption can be overcome and §112, para. 6 will apply if the challenger demonstrates that the claim term fails to 'recite sufficiently definite structure' or else recites 'function without reciting sufficient structure for performing that function.'" *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1349 (Fed. Cir. 2015) (citing *Greenberg v. Ethicon Endo-Surgery, Inc.*, 91 F.3d 1580, 1583 (Fed. Cir. 1996), and quoting *Watts v. XL Sys., Inc.*, 232 F.3d 877, 880 (Fed. Cir. 2000)). "Generic terms such as 'mechanism,' 'element,' 'device,' and other nonce words that reflect nothing more than verbal constructs may be used in a claim in a manner that is tantamount to using the word 'means' because they

'typically do not connote sufficiently definite structure' and therefore may invoke § 112, para. 6." *Id*. at 1350 (quoting *Mass. Inst. of Tech. & Elecs. for Imaging, Inc. v. Abacus Software*, 462 F.3d 1344, 1354 (Fed. Cir. 2006)). Accordingly, a claim element should be interpreted under 35 U.S.C. §112(f) if the claim term uses a nonce word with functional language without reciting a sufficiently definite structure.

Claim 1 recites "electronic control unit," which includes a nonce word with functional language that should trigger means-plus-function interpretation. The term "electronic control unit" includes the nonce word "unit," which, similar to the term "module" in *Williamson*, does not convey a definite structure, and is merely a verbal construct that is used tantamount to the term "means." *See Diebold Nixdorf, Inc. v. ITC*, 899 F.3d 1291, 1297 (Fed. Cir. 2018) ("We conclude that the term 'cheque standby *unit*' is subject to the application of §112, para. 6." (emphasis added)). The additional words "electronic control" do not appear to clarify any definite structure, but rather appear to be functional terms. For example, the term "electronic control" in combination with the term "unit" appears to suggest that the "unit" performs some sort of "electronic control."

Claim 1 recites several functional elements for "electronic control unit," including:

- "an electronic control unit operatively connected to said optical sensor in order to receive said measurement signals, and arranged for emitting control signals;"
- "said electronic control unit is operatively connected to said emitter device and is arranged for alternately turning on said IR sources one after the other, in corresponding and separate time intervals;"
- "said electronic control unit comprises a processing module,"
- "said electronic control unit being configured to generate said control signals as a function of said synthesis image."

Each of these recitations for "electronic control unit" uses functional language and fails to identify a definite structure for the "electronic control unit." Schaafsma Declaration, 27. Although claim 1 recites "said electronic control unit comprises a processing module," the "processing module" does not provide further structural definiteness to "electronic control unit" because "processing module" is another example of a functional recitation ("processing") made in conjunction with another nonce word (*i.e.*, "module"), which also does not indicate a definite structure. *See Williamson* at 1350 ("'Module' is a well-known nonce word that can operate as a substitute for 'means' in the context of §112, para. 6," and "the word 'module' does not provide any indication of structure because it sets forth the same black box recitation of structure for providing the same specified function as if the term

'means' had been used."). As a result, "processing module" should itself trigger a further means-plus-function interpretation because functional language is recited for the term "processing module" without indicating a definite structure.

Since claim 1 does not provide a definite structure for "electronic control unit," a means-plus-function interpretation under 35 U.S.C. §112(f) should be employed.

2. Claim 1 is indefinite because the specification fails to identify an algorithm for at least one means-plus-function clause of claim 1

Claim 1 is indefinite under 35 U.S.C. §112(b) because the specification does not identify an algorithm for the means-plus-function claim element "generate said control signals as a function of said synthesis image."

Pursuant to 35 U.S.C. §112(b), "[t]he specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention."[6] "[A] patent must

[6] The definiteness requirement of 35 U.S.C. §112(b) is a carryover from the pre-AIA 35 U.S.C. §112, second paragraph definiteness requirement. As both definiteness requirements are essentially the same, this discussion cites to court opinions that refer to both 35 U.S.C. §112(b) (AIA) and 35 U.S.C. §112, second paragraph (pre-AIA).

be precise enough to afford clear notice of what is claimed, thereby "'appris[ing] the public of what is still open to them.'" *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 899 (2014) (second brackets in original). "[A] patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Id.* at 901.

35 U.S.C. §112(f) provides that "[a]n element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof."[7] The definiteness requirement is particularly exacting for means-plus-function claim elements because "[t]o meet the definiteness requirement, structure disclosed in the specification must be clearly linked to and capable of performing the function claimed by the means-plus-function limitation."

[7] The means-plus-function provision of 35 U.S.C. §112(f) is a carryover from the pre-AIA 35 U.S.C. §112, sixth paragraph means plus function provision. As both means-plus-function provisions are essentially the same, this discussion cites to court opinions that refer to both 35 U.S.C. §112(f) (AIA) and 35 U.S.C. §112, sixth paragraph (pre-AIA).

Default Proof Credit Card Sys. v. Home Depot U.S.A. Inc., 412 F.3d 1291, 1299 (Fed. Cir. 2005). Moreover, "[w]here there are multiple claimed functions, … the patentee must disclose adequate corresponding structure to perform all of the claimed functions." *Williamson* at 1351-52 (citing *Noah Sys., Inc. v. Intuit Inc.*, 675 F.3d 1302, 1318-19 (Fed. Cir. 2012)).

Accordingly, a claim is indefinite under 35 U.S.C. §112(b) if (a) the specification does not make clear a link between a corresponding structure and even one means-plus-function claim element, or (b) the specification fails to disclose structure capable of performing the function of even one means-plus-function claim element.

a) The specification does not clearly link "said electronic control unit being configured to generate said control signals as a function of said synthesis image"

"'[S]tructure disclosed in the specification is "corresponding" structure only if the specification or prosecution history clearly links or associates that structure to the function recited in the claim.'" *Med. Instrumentation & Diagnostics Corp. v. Elekta AB*, 344 F.3d 1205, 1210 (Fed. Cir. 2003) (quoting *B. Braun Med. v. Abbott Lab'ys*, 124 F.3d 1419, 1424 (Fed. Cir. 1997)). "[I]f a [POSITA] would be unable to recognize the structure in the specification and associate it with the corresponding function in the claim, a means-plus-function clause is indefinite." *Williamson*, 792

F.3d at 1352 (citing *Noah System*, 675 F.3d at 1312, in turn citing *AllVoice Computing PLC v. Nuance Commc'ns, Inc.*, 504 F.3d 1236, 1241 (Fed. Cir. 2007)).

In *Default Proof Credit Card System*, 412 F.3d at 1299, patent owner argued Figure 2 clearly linked a point-of-sale (POS) terminal to "'means for dispensing at least one debit card'" as the corresponding structure. *Id*. at 1296 (citation omitted). The Federal Circuit, however, was not persuaded, at least partly because Figure 2 conflicted with other intrinsic evidence including hardware depicted in Figure 1 and the claim language itself. *See Id*. at 1300.

Similarly, any limited link that '947 Patent provides for a corresponding algorithm to "generate said control signals as a function of said synthesis image," as recited in claim 1, is unclear because intrinsic evidence (the specification) contradicts this already limited link. For example, the only statement Petitioner could find in '947 Patent that could arguably link "generate said control signal as a function of said synthesis image" to structure is:

> Advantageously, the electronic control unit 6 is provided with at least one thresholding software, per se of known type (and hence not discussed hereinbelow), which defines the criteria with which the electronic control unit 6 determines, based on the synthesis images, the elements to be selected and, consequently, the control signals to be sent to the expulsion device 7.

'947 Patent, 6:9-15. In contrast, '947 Patent states "electronic control unit 6 is adapted to generate the control signals, and then identify the elements to be selected,

as a function of the aforesaid synthesis image." *Id*., 5:35-37. Accordingly, on the one hand, the specification at 6:9-15 appears to attribute a "consequently to" correspondence of "generate said control signals" to thresholding software selecting elements from the synthesis image. On the other hand, the specification at 5:35-37 places the selecting of elements from the synthesis image after the control signal generation. Thus, although at first glance the specification at 6:9-15 may appear to correspond, in a limited way, the thresholding software with generation of the control signals, contradictory intrinsic evidence (5:35-37) at least renders this correspondence between the thresholding software and "generate said control signals" unclear.

As the association between the thresholding software and the generation of the control signals is not clear, claim 1 is indefinite under 35 U.S.C. §112(b).

b) Thresholding software cannot perform the claimed "generate said control signal as a function of said synthesis image" function

Claim 1 is also indefinite because the "thresholding software" mentioned in the specification cannot perform the claimed "generate said control signals as a function of said synthesis image" function.

"In cases … involving a claim limitation that is subject to [§112], para. 6 that must be implemented in a special purpose computer, this court has consistently required that the structure disclosed in the specification be more than simply a

general purpose computer or microprocessor." *Williamson*, 792 F.3d at 1352 (citing *Aristocrat Techs. Austl. Pty Ltd v. Int'l Game Tech.*, 521 F.3d 1328, 1333 (Fed. Cir. 2008), in turn citing *WMS Gaming, Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1348 (Fed. Cir. 1999)). "We require that the specification disclose an algorithm for performing the claimed function." *Williamson*, 792 F.3d at 1352 (citing *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1367 (Fed. Cir. 2008)). "The algorithm may be expressed as a mathematical formula, in prose, or as a flow chart, or in any other manner that provides sufficient structure." *Id*. (citing *Noah Sys.*, 675 F.3d at 1312, in turn citing *Finisar Corp. v. DirectTV Group, Inc.*, 523 F.3d 1323, 1340 (Fed. Cir. 2008)). "The correct inquiry is to look at the *disclosure* of the patent and determine if one of skill in the art would have understood that *disclosure* to encompass" the algorithm "and been able to implement such" an algorithm, "not simply whether one of skill in the art would have been able to" write a software program to perform the means-plus-function claim element. *Med. Instrumentation*, 344 F.3d at 1212.

In *Noah Systems*, a specific means-plus-function claim limitation included two different functional elements. 675 F.3d at 1314. The Federal Circuit required the specification to "address both aspects of this functional language" (*Id*. (citing *Default Proof Credit Card Sys.*, 412 at 1298)), and "'corresponding structure … must include all structure that actually performs the recited function'" (*Id*. (quoting

Default Proof Credit Card Sys., 412 F.3d at 1298, and citing *Cardiac Pacemakers, Inc. v. St. Jude Med. Inc.*, 296 F.3d 1106, 1119 (Fed. Cir. 2002)).

The Federal Circuit in *Noah System* determined that, while the specification described some structure for one element of the means-plus-function limitation, the specification did not describe structure for the other. *See Id*. at 1314. The Federal Circuit was not persuaded by arguments that "individuals of ordinary skill in the art would understand how to accomplish the function described with the assistance of such off the shelf software." *Id*. at 1317.

Similarly, the specification of '947 Patent does not provide structure for "generate said control signals as a function of said synthesis image." For one thing, the specification provides no algorithm for linking image spatial parameters (e.g., position, trajectory, velocity, etc.) of the false color synthesis image with specific points along the advancement path A associated with the expulsion device (e.g., nozzles 16). The specification indicates "nozzles 16 are placed below the optical detection system 3," and "are directed towards the advancement path A" (4:53-55), but does not disclose how electronic control unit relates this geometry of nozzles and advancement path to spatial parameters of the false color synthesis image.

The specification also provides no algorithm for timing generation of control signals to deliver air jets to points along the advancement path at the time selected elements from the false color synthesis image occupy those points. The specification

even acknowledges variations in drop speed of solid elements could cause air jets from nozzles to arrive early or late with respect to the solid element identified by the electronic control unit. *See* 8:24-29. The specification does not provide an algorithm for dealing with timing complications resulting from this variation in drop speed, or with time delays such as image processing delay and delay associated with delivering air jets after providing control signals to nozzles 16.

Since the specification does not disclose an algorithm for "generate said control signals as a function of said synthesis image," claim 1 is indefinite for failure to particularly point out and distinctly claim what is regarded as the invention.

As indicated in *Noah System*, 675 F.3d at 1314, the specification "must include all structure that actually performs the recited function." Even assuming, *arguendo*, that a POSITA may have understood that conventional thresholding software ('947 Patent, 6:9-15) may be used to select objects to be removed ('947 Patent, 1:55-57), a POSITA would have understood that thresholding software does not itself generate control signals to control an expulsion device. Rather, a POSITA would have understood that an additional algorithm beyond thresholding would be needed to coordinate arrival of elements selected from the synthesis image for removal with air jets from the nozzles. Schaafsma Declaration, 28-29, 43. '947 Patent discloses no such algorithm. Accordingly, '947 Patent does not disclose the

algorithm that performs "generate said control signals as a function of said synthesis image," and claim 1 is indefinite under 35 U.S.C. §112(b).

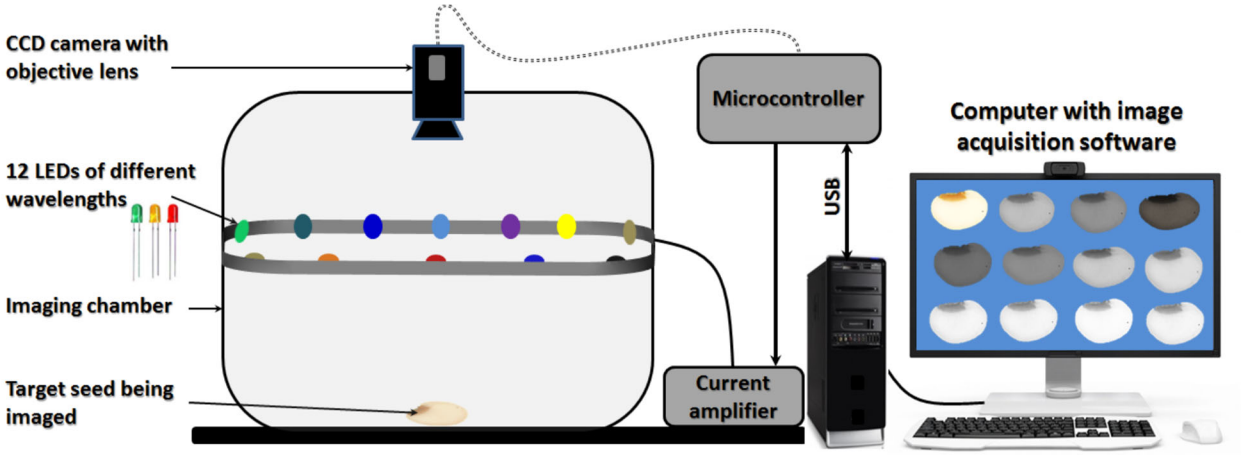
B. Ground 2: Claims 1-3, 6, and 10 are rendered obvious by ElMasry

1. Overview of ElMasry

ElMasry is not of record in '947 Patent. ElMasry was publically available on March 4, 2019. Hall-Ellis Declaration (EX1010), 44, 47, 60. Exhibit 1002 is a true and correct copy of the print copy of ElMasry stored at National Library of Medicine that Dr. Hall-Ellis obtained. Hall-Ellis Declaration, 44. The MARC records attached to her declaration demonstrate that the journal in which ElMasry appears was appropriately cataloged and indexed (first by the University of California – San Diego – San Diego Libraries) including with the subject matter descriptors "Detectors $v Periodicals" "Biosensors $v Periodicals," and "Chemical detectors $v Periodicals" and available to the public from many other libraries, all as of at least March 4, 2019. Hall-Ellis Declaration, 49-51. As such, ElMasry is prior art.

ElMasry "give[s] a birds-eye view of all recent approaches in the acquisition, processing and reproduction of multispectral images for various applications in seed quality assessment and seed phenotyping issues," with a "focus[] on fully-operated multispectral imaging systems for quality assessment of different sorts of seeds."

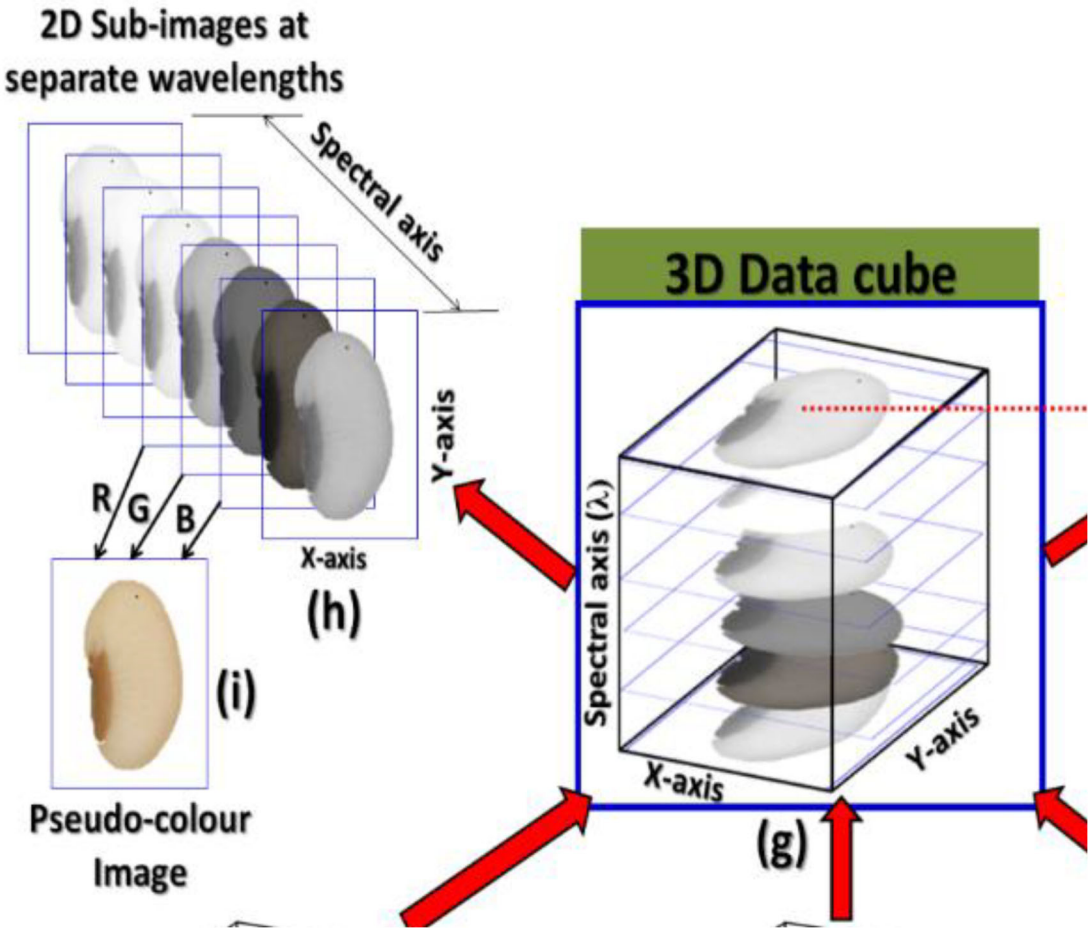
ElMasry, 1. ElMasry, Figure 3(below), illustrates an example of an "illumination-based multispectral imaging system."



ElMasry, Figure 3

ElMasry discloses "[t]his demonstrative system is supported with an array of 12 LEDs of different nominal emission wavelengths," and "[e]ach LED is sequentially switched on for a definite period during image acquisition and synchronized with the camera trigger". ElMasry, 12. ElMasry continues "[a]s a result of turning on the LEDs one after another, a total of 12 greyscale images were acquired by the monochromatic camera (as shown in the computer screen in Figure 3) which combined altogether to form one multispectral image." *Id*. ElMasry disclosed "[s]imilar to the usual RGB image which composed of a cube with only three greyscale slices (i.e., R, G and B color channels) in the wavelength dimension, the spectral image is composed of many greyscale slices," "[t]he number of these greyscale slices is equivalent to the number of wavelength bands used during image

acquisition," and "any three of these grey sub-images (slices) could be easily concatenated one after another (one slice for each color channel) to form a pseudo-color image for target samples as shown in Figure 2i." ElMasry 9-10. Figures 2g-2i of ElMasry are shown below to illustrate mapping of greyscale images corresponding to three wavelength bands to RGB color channels to form a pseudo-colour image.



ElMasry, Figures 2(g)-2(i)

ElMasry discloses "[d]ata extracted from images can be used to describe differences among samples (e.g., variety discrimination [and/or] seed health

detection) or to predict quality parameters such as chemical combustion (proteins, lipids, moisture, etc.)." *Id*. 13. ElMasry continues "applying this technology in seed quality evaluation is based basically on the rigorous understanding of … how to link seed quality parameters with the information available in the images." ElMasry, 14. ElMasry discloses "independent multispectral imaging systems with different designs have been used successfully in different sort[s] of applications in detection and identifying numerous quality features of different seed cultivars." ElMasry, 14.

ElMasry discusses various examples that used multispectral images to discriminate between samples. *See* ElMasry, 14-23. ElMasry classfied these examples into the following categories:

- seed purity and variety discrimination (*Id*., 14-17)
- prediction of seed structure (*Id*., 17-19)
- prediction of seed viability, germination ability and vigor (*Id*., 19-20)
- detection of defects, infection, and seed health (*Id*., 20-23)
- detection of pest infestation (*Id*., 23)

ElMasry provides a summary of seed type, applications (attributes), spectral range (nanometers (nm)), number of wavelengths, data modeling methods, and references to cited documents for these exampls in Table 1 (*Id*., 24):

Table 1. Recent applications of multispectral imaging systems in phenotyping and quality evaluation of various seeds.

Seed Type	Applications (Attributes)	Spectral Range	No. of WL	Data Modeling	References
Spinach	Seed health detection	395–970	19	CDA	[78]
	Prediction of germination & germ length	395–970	19	PLSDA	[35]
Tomato	Variety identification	375–970	19	PCA & nCDA	[94]
	Variety identification	375–970	19	nCDA	[95]
	Cultivar discrimination	375–970	19	PLSDA & SVM-DA	[79]
Wheat	Characterization of desiccation	360–950	8 × 3	PCA	[12]
	Seed health & variety separation	375–970	19	nCDA & k-NN	[81]
	Seed authentication	375–970	19	nCDA	[99]
	Fungal contamination detection	360–950	8 × 3	PCA & MLR	[74]
	Identification of the histological origin	360–950	8 × 3	PCA & LDA	[73]
	Variety discrimination, fungal detection & prediction of protein content	470–1070	6	LDA	[62]
Rice	Discrimination between transgenic & non-transgenic seeds	405–970	19	PLSDA, LS-SVM & PCA-BPNN	[76]
	Variety discrimination	365–970	46	k-NN & nCDA	[65]
	Breed identification	540 & 575	2	Blob analysis	[98]
Maize	Histologic labeling of seed parts	436–546	12	LDA	[101]
	Discrimination between haploid and diploid kernels	375–970	19	nCDA	[77]
	Defect detection	375–970	19	PCA & PLSDA	[43]
Triticale	Seed health & variety separation	375–970	19	nCDA & k-NN	[81]
Sunflower	Detection of mold and insect infestation	405–970	19	LDA & PCA-CA	[110]
Castor	Viability prediction	375–970	19	nCDA	[102]
Hazelnut	Detection of aflatoxin contamination	400–600	14	LDB	[108]
Chili pepper	Detection of aflatoxin contamination	400–600	14	LDB	[108]
Soybean	Discrimination between conventional and transgenic seeds	405–970	19	PLSDA, LS-SVM & PCA-BPNN	[96]
Pea	Discrimination among maize, pea, soybean & wheat	360–950	8 × 3	PLS-DA	[100]
Barely	Greening detection	580–730	3	Band ratio	[97]

WL: Wavelength; CDA: normalized canonical analysis; nCDA: normalized canonical analysis; PCA: Principle component analysis; PLS: partial least squares; PLS-DA: partial least squares-discriminant analysis; SVM: Support vector machine; SVM-DA: Support vector machine-discriminant analysis; k-NN: k-nearest neighbor algorithm; LDA: linear discriminant analysis; LS-SVM: Least squares support vector machine; BPNN: Back-propagation neural network; MLR: multilinear regression; LDB: local discriminant bases (LDB) algorithme; PCA-CA: Principle component analysis-cluster analysis.

ElMasry, Table 1

Some examples discussed in ElMasry used infrared wavelengths to discriminate between samples. For example, ElMasry discusses spectral imaging systems that used:

- Eight LEDs operating in the 360-950 nm range including LEDs operating at 875 and 950 nm. ElMasry, 17.
- three visible and three NIR LEDs having peak emission wavelengths at 850, 940, and 1070 nm. ElMasry, 18.
- NIR spectroscopy. ElMasry, 19.
- visible and NIR lighting (375-970 nm). ElMasry, 19.
- visible and near infrared (395-970 nm) lighting. ElMasry, 19-20.

- wavelength bands in the range of 375-970 nm, which overlaps NIR. ElMasry, 21.
- UV, visible, and NIR lighting (375-970 nm), with NIR wavelengths 890 and 940 nm associated with fat and 970 nm associated with water. ElMasry, 21
- visible and NIR (405-970 nm) lighting, including 850, 910, and 970 nm in the NIR range. EMasry, 23.

ElMasry indicates "it is extremely important to develop a computer-integrated system that has the ability to deliver a large amount of seeds to the imaging system (e.g., through a conveying system) and subsequently sort the seeds into different fractions using robotic picking or some kind of pneumatic or mechanical gate system". ElMasry, 25. ElMasry discusses an example in which "multispectral data of wheat kernels were rapidly collected by operating one LED at a time and consequently recording the reflected light from wheat kernels as they dropped off a 20-cm long feeder chute," and "[s]orting of kernels was conducted by pneumatic system in which an air vavle diverted the wheat kernels to the classification assignment." ElMasry, 18.

2. Claim 1 is obvious in view of ElMasry

a) [preamble]: "A selector machine, comprising:"

ElMasry teaches "real-time seed monitoring systems that meet the requirements of the modern industrial control and sorting systems" (ElMasry, 26), and "a computer-integrated system that has the ability to deliver a large amount of seeds to the imaging system (e.g., through a conveying system) and subsequently sort the seeds into different fractions using robotic picking or some kind of pneumatic or mechanical gate system" (ElMasry, 25). The "real-time sorting systems" and "computer-integrated system" are examples of "selector machines."

ElMasry also discusses "[a] fully mechanized LED-pulsed multispectral system … for sorting wheat kernels," and "[s]orting of kernels was conducted by pneumatic system in which an air valve diverted the wheat kernels to the classification assignment." ElMasry, 18.

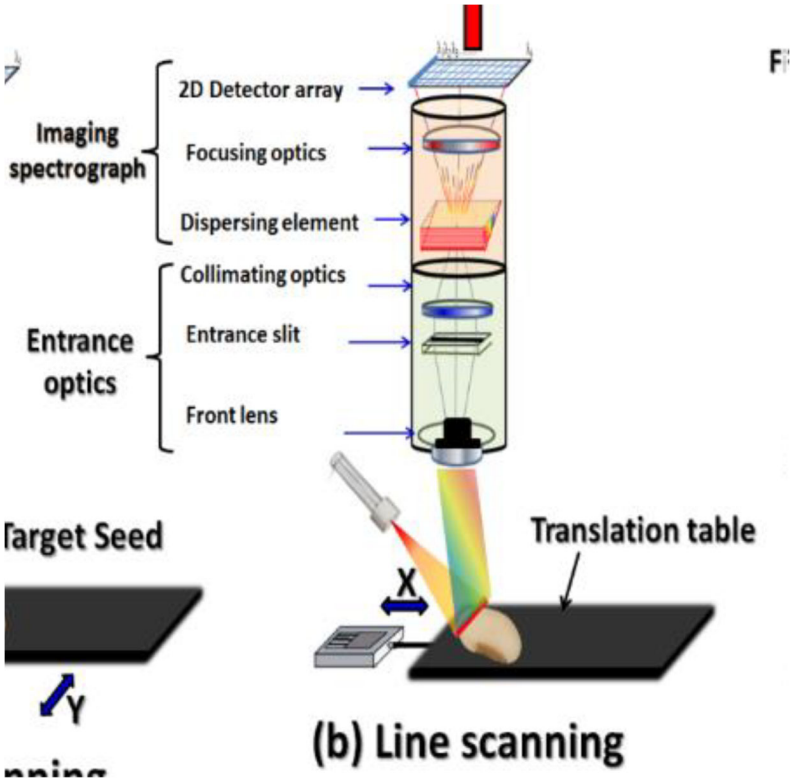
This is also AAPA because "State of the Art" section of '947 Patent admits "[k]nown on the market are selector machines, of automated type, which are employed in order to separate, within a product constituted by multiple objects, specific objects to be selected." '947 Patent, 1:23-26.

b) [1a] "a conveyance system, which is arranged for advancing along an advancement path, at least one bulk product comprising multiple solid elements to be selected;"

ElMasry teaches "a computer-integrated system has the ability to deliver a large amount of seeds to the imaging system (e.g., through a conveying system) and

subsequently sort the seeds." ElMasry, 25. The "conveying system" advances the large amount of seeds (at least one bulk product comprising multiple solid elements to be selected) along an advancement path to the imaging system.

ElMasry provides some examples of a "conveyance system," including one in which wheat kernels were "dropped off a 20-cm long feeder chute." ElMasry, 18. ElMasry provides another example that "mov[es] the target sample systematically in X direction only," and "the examined objects are scanned during their movement on a conveyor under the imaging system," as shown in ElMasry, Figure 2b (below). *See* ElMasry, 8-9.



ElMasry, Figure 2(b)

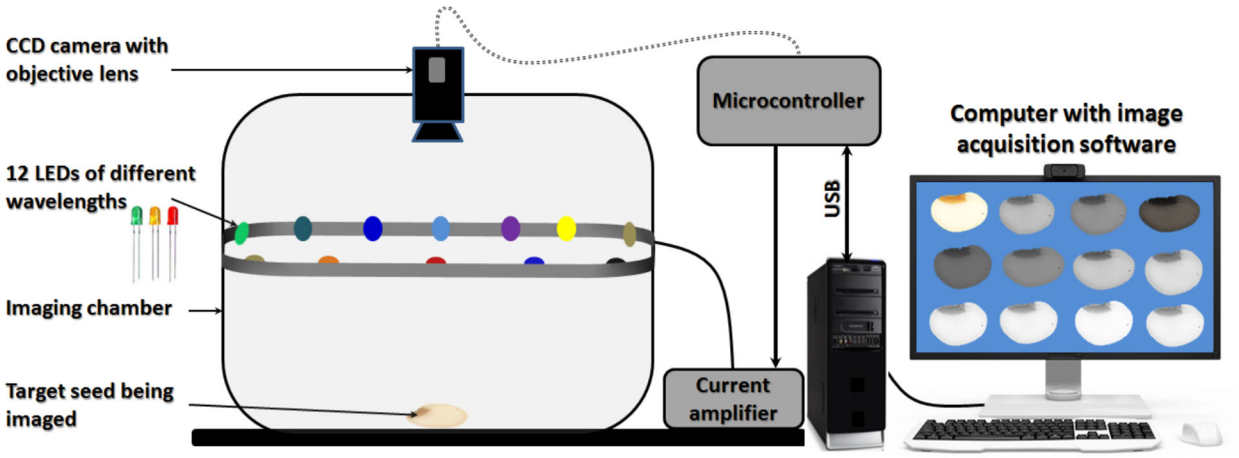
The conveyor is a translation table and the advancement path extends in the X direction.

Thus, ElMasry teaches this limitation.

This is also AAPA because "State of the Art" section of '947 Patent admits "[a]s is known, the selector machines are generally provided with a conveyance system on which a flow of a bulk product is made to advance, at its interior comprising multiple solid elements which must be distinct and separated from each other." '947 Patent, 1:27-31.

c) [1c] "an optical detection system comprising:"

ElMasry teaches "a multi-LED multispectral imaging system" (ElMasry, 12) illustrated in Figure 3 (below):



ElMasry, Figure 3

ElMasry teaches this "system is supported with an array of 12 LEDs of different nominal emission wavelengths," and "[a]s a result of turning on the LEDs one after

another, a total of 12 greyscale images were acquired by the monochromatic camera." ElMasry, 12. ElMasry refers to the image acquisition equipment as "optical devices" (ElMasry, 12), and indicates "different multispectral device designs could be manufactured … for detecting various quality traits" (ElMasry, 10). Accordingly, the 12 LEDs and monochromatic camera in the multi-LED multispectral imaging system amount to an optical detection system.

Therefore, ElMasry teaches this limitation.

This is also AAPA because "State of the Art" section of '947 Patent admits known selector machines "comprise an optical detection system arranged for acquiring and analyzing images of the flow of bulk product". '947 Patent, 1:41-44.

d) [1d] "an emitter device arranged for emitting, towards said advancement path, electromagnetic radiations adapted to hit said at least one product;"

ElMasry teaches "multispectral images could be acquired by illuminating the sample with narrow-wavelength-range light emitting diodes (LEDs) of known spectra." ElMasry, 11. ElMasry also teaches "operating one LED at a time and consequently recording the reflected light from wheat kernels as they dropped off a 20-cm long feeder chute." ElMasry, 18. Accordingly, LEDs emitted electromagnetic radiation toward the wheat kernels while on their advancement path as they dropped off the feeder chute.

Thus, ElMasry teaches this limitation.

"State of the Art" section of '947 Patent admits known optical detection systems "comprise[] optical emitters … adapted to emit electromagnetic radiations towards the bulk product," ('947 Patent, 1:50-52) and "acquiring and analyzing images of the flow of bulk product" ('947 Patent, 1:41-44). Acquiring images of the flow of bulk product implies the optical emitters emit the electromagnetic radiation toward the flow of bulk product on its advancement path. Schaafsma Declaration, 32.

e) [1e] "an optical sensor directed towards said advancement path and arranged for receiving reflected radiations coming from said at least one product irradiated by said electromagnetic radiations,"

ElMasry teaches "[a]s a result of turning on the LEDs one after another, a total of 12 greyscale images were acquired by the monochromatic camera". ElMasry, 12. ElMasry also teaches "the object is lit with a set of distinct LED illuminations and a synchronized monochromatic or RGB camera captures the corresponding images" (ElMasry, 11), and "[r]eflectance configuration, in which the light source and the camera are in the same direction, is very common in … multispectral imaging" (ElMasry, 10). Accordingly, in the reflectance configuration, where ElMasry teaches that the object (the at least one product) is lit with LED illuminations (electromagnetic radiations directed towards the advancement path), the camera

(optical sensor) would be in the same direction as the light source (directed toward the advancement path).

ElMasry teaches that "the second method for image acquisition (Figure 2b) records the data line by line by moving the target sample systematically in X direction only," and "light reflected from the line is dispersed by a two-dimensional dispersing element (spectrograph) and then recorded on a two-dimensional detector array." ElMasry, 9. In this example, the detector array (optical sensor) is directed toward the path traveled by the sample (at least one bulk product) to receive reflected radiations from the sample as it travels along a path in the X direction.

ElMasry teaches an example where "multispectral data of wheat kernels were rapidly collected by operating one LED at a time and consequently recording the reflected light from wheat kernels as they dropped off a 20-cm long feeder chute." ElMasry, 18. Thus, an optical sensor is directed toward the advancement path as wheat kernels (at least one bulk product) drop off the feeder chute to receive reflected radiations from the wheat kernels irradiated by the LEDs.

Accordingly, ElMasry teaches this limitation.

This is also AAPA. "State of the Art" section of '947 Patent admits the known selector machine includes an optical detection system comprising "one or more optical sensors arranged for receiving the radiations from the bulk product in order

to obtain images of the product" ('947 Patent, 1:50-57), and "acquiring and analyzing images of the flow of bulk product" ('947 Patent, 1:42-44).

f) [1f] "and for transducing said reflected radiations into corresponding measurement signals;"

ElMasry teaches "[a]s each discrete wavelength light source illuminates the sample, a 2D greyscale image is acquired using a camera with a uniform wavelength response" (ElMasry, 11) and "a total of 12 greyscale images were acquired." ElMasry, 12. '947 Patent indicates that grayscale images are a preferred form of the measurement signals. '947 Patent, 5:42-48.

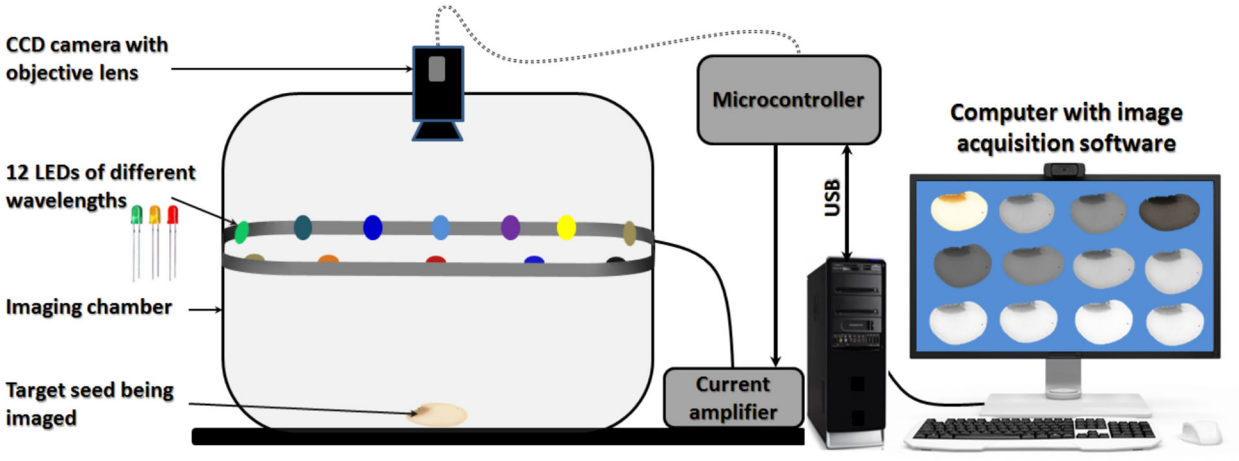
Therefore, ElMasry teaches this limitation.

This is also AAPA. "State of the Art" section of '947 Patent admits the optical detection system of the known selector machine comprises "one or more optical sensors arranged for receiving the radiations reflected from the bulk product in order to obtain images." '947 Patent, 1:50-57.

g) [1g] "an electronic control unit operatively connected to said optical sensor in order to receive said measurement signals, and arranged for emitting control signals;"

ElMasry teaches "[e]ach LED is sequentially switched on for a definite period during image acquisition and synchronized with a camera trigger using a pre-programmed microcontroller," and "a total of 12 greyscale images were acquired by the monochromatic camera (as shown in the computer screen in Figure 3)."

ElMasry, 12. ElMasry, Figure 3 (below), shows the computer and microcontroller (an electronic control unit) operatively connected to the camera (an optical sensor) and displaying greyscale images on the computer display, showing that the microcontroller and the computer receive measurement signals from the camera.



ElMasry, Figure 3

ElMasry also teaches this "computer-integrated system … has the ability to … sort the seeds into different fractions using robotic picking or some kind of pneumatic or mechanical gate system". ELMasry, 25. ElMasry discusses a "pneumatic system in which an air valve diverted the wheat kernels to the classification assignment." ElMasry, 18. The computer and/or the microcontroller of ElMasry, Figure 3, would emit control signals to control robotic picking, pneumatic, or mechanical gate systems. Schaafsma Declaration, 27-29.

Thus, ElMasry teaches this limitation.

This is also AAPA. "State of the Art" section of '947 Patent admits the known optical detection system comprises "one or more optical sensors … to obtain images of the product on the basis of which, by means of suitable thresholding algorithms, an electronic control unit determines which are the elements to be removed," and "[s]uch detection system is adapted to send control signals, based on the information obtained from the acquired images, to an expulsion device (such as solenoid valves) actuatable to remove the selected solid elements from the bulk product, for example through the emission of compressed air jets." '947 Patent, 1:45-57.

h) [1h] "an expulsion device connected to said optical detection system in order to receive said control signals, which are adapted to drive said expulsion device to eliminate, from said advancement path, specific solid elements of said at least one product;"

ElMasry teaches "a computer-integrated system" to "sort the seeds into different fractions using robotic picking or some kind of pneumatic or mechanical gate system." ElMasry, 25. Thus, ElMasry teaches various expulsion devices, including robotic picking, pneumatic, or mechanical gate systems, that would connect to and receive control signals from an optical detection system (e.g., from the computer and microcontroller combination of Figure 3) to drive the expulsion device to eliminate specific solid elements (e.g., seeds) from an advancement path defined by the conveying system. Schaafsma Declaration, 33.

ElMasry teaches "recording the reflected light from the wheat kernels as they dropped off a 20-cm long feeder chute," and "[s]orting of the wheat kernels … by pneumatic system in which an air valve diverted the wheat kernels to the classification assignment." ElMasry, 18. This pneumatic system (an expulsion device) eliminates solid elements such as seeds (e.g., wheat kernels) from their advancement path as they drop from the feeder chute responsive to control signals.

Accordingly, ElMasry teaches this limitation.

This is also AAPA. "State of the Art" section of '947 Patent admits the known detection system "is adapted to send control signals, based on the information obtained from the acquired images, to an expulsion device (such as … solenoid valves) actuatable to remove the selected solid elements from the bulk product, for example through the emission of compressed air jets." '947 Patent, 1:45-49.

i) [1i] "wherein: said emitter device comprises at least three IR sources, each of which is arranged for emitting electromagnetic radiations in a corresponding separate spectral band in the infrared spectrum;"

ElMasry teaches "an array of 12 LEDs of different nominal emission wavelengths" (ElMasry, 12), and "multispectral images may be acquired under different illumination conditions at different '*discrete'* wavelength bands" (ElMasry, 11).

ElMasry discusses several examples where at least three infrared light sources emit electromagnetic ratiations in separate infrared spectral bands, which could be implemented into the 12 LED system of ElMasry. These examples include multispectral systems using:

- Three visible and three near-infrared LEDs for sorting wheat kernels, the three near-infrared LEDs having peak emission wavelengths at 850, 940, and 1070 nm. *See* ElMasry, 18.
- UV, visible, and NIR regions (375-970 nm) with 19 discrete wavelengths, to visualize a mean difference between sound and defected seeds, including NIR wavelengths 890 and 940 nm being associated with fat and 970 nm being associated with water. ElMasry, 21
- Visible and NIR ranges (405-970 nm), including 850, 910, and 970 nm in the NIR range, and, infested sunflower seeds showed higher spectral reflectance in the range of 780-970 nm of the NIR range. EMasry, 23.

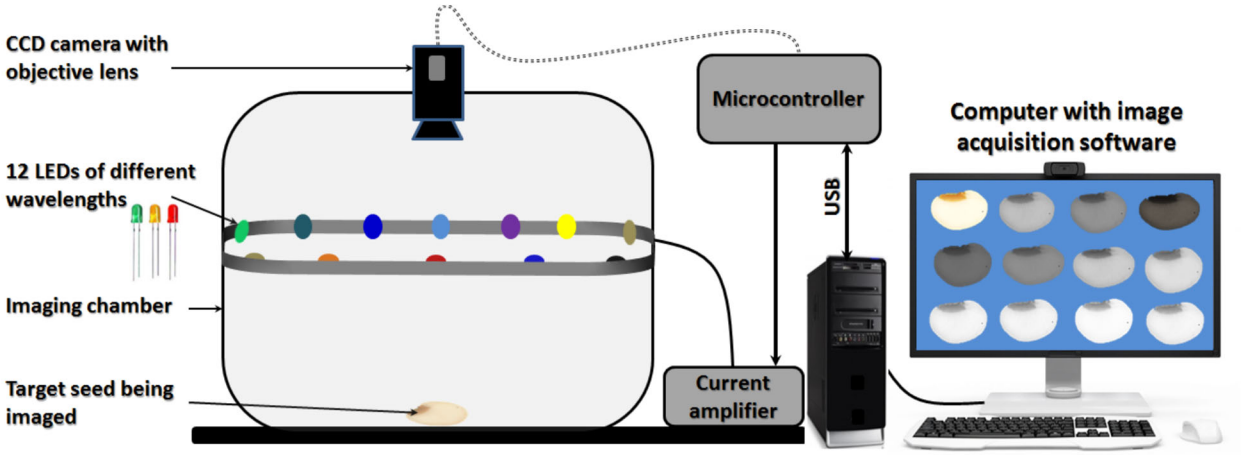
Therefore, ElMasry teaches this limitation.

"State of the Art" section of '947 Patent also admits "it is known to employ emitters and optical sensors that also operate in the near infrared spectrum," and "elements having the same color in the visible spectrum generally have chemical-

physical characteristics that determine a different absorption spectrum at the infrared wavelengths." '947 Patent, 1:60-65.

j) [1j] "said electronic control unit is operatively connected to said emitter device and is arranged for alternately turning on said IR sources one after the other, in corresponding and separate time intervals;"

ElMasry teaches "multispectral images may be acquired under different illumination conditions at different 'discrete' wavelength bands," "using various illuminants of different spectral power distribution depends on 'sequentially' illuminating the scene with different narrow-band wavelength light sources," and "activating the illuminations one by one." ElMasry, 10-11. ElMasry also teaches "[e]ach LED is sequentially switched on for a definite period during image acquisition and synchronized with a camera trigger using a pre-programmed microcontroller." ElMasry, 12. Accordingly, the microcontroller, alternately turns on the LEDs, which as discussed in section VIII.B.2.*i*), include at least three IR LEDs, one after the other in corresponding separate time intervals. Schaafsma Declaration, 30, 37, 40. Also, ElMasry, Figure 3 (below), shows the computer and microcontroller (an electronic control unit) operatively connected to 12 LEDs (an emitter device) via a current amplifier.



ElMasry, Figure 3

Thus, ElMasry teaches this limitation.

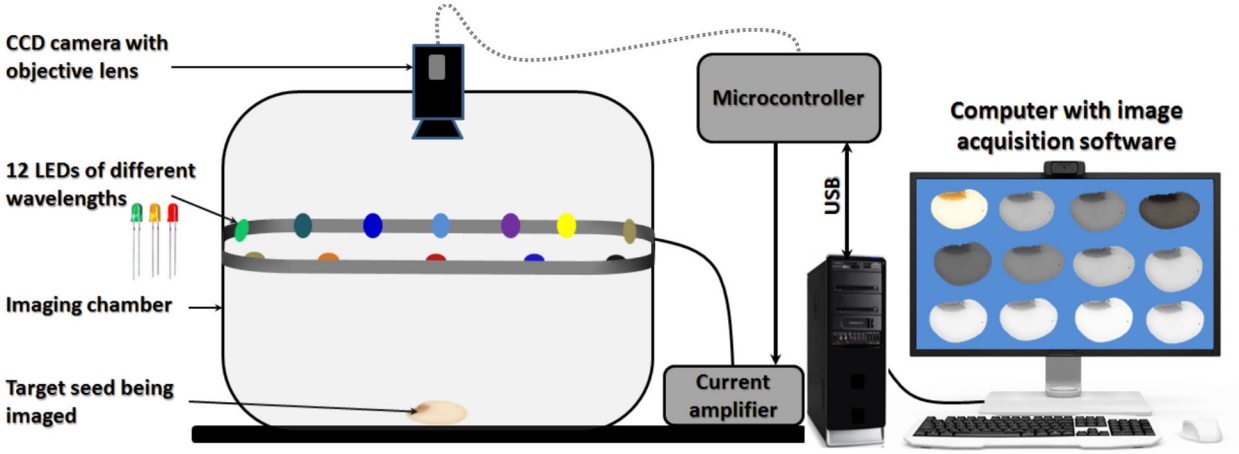
k) [1k] "said optical sensor is arranged for detecting, in each said time interval, corresponding said reflected radiations coming from said at least one product irradiated by the corresponding said IR source, and to generate corresponding said measurement signals;"

ElMasry teaches "[b]y taking greyscale images under the illumination of these LEDs in turn, … one can build up a set of registered images," and "the object is lit with a set of distinct LED illuminations and a synchronized monochromatic or RGB camera captures the corresponding images." ElMasry, 11. These captured greyscale images are measurement signals (see section VIII.B.2.*f*), each of which corresponds to one of the LED wavelength bands.

Accordingly, ElMasry teaches this limitation.

l) [1l] "said electronic control unit comprises a processing module,"

As discussed in section VII.B., "processing module" is software/firmware to perform RGB image processing. ElMasry teaches that "decreasing cost and increasing power of computer hardware and software packages for image processing have made image analysis systems more attractive in automatic inspection of different aspects of quality evaluation and sorting processes." ElMasry, 5. ElMasry, Figure 3 (below) indicates the computer (an "electronic control unit" with the microcontroller) includes image acquisition software:



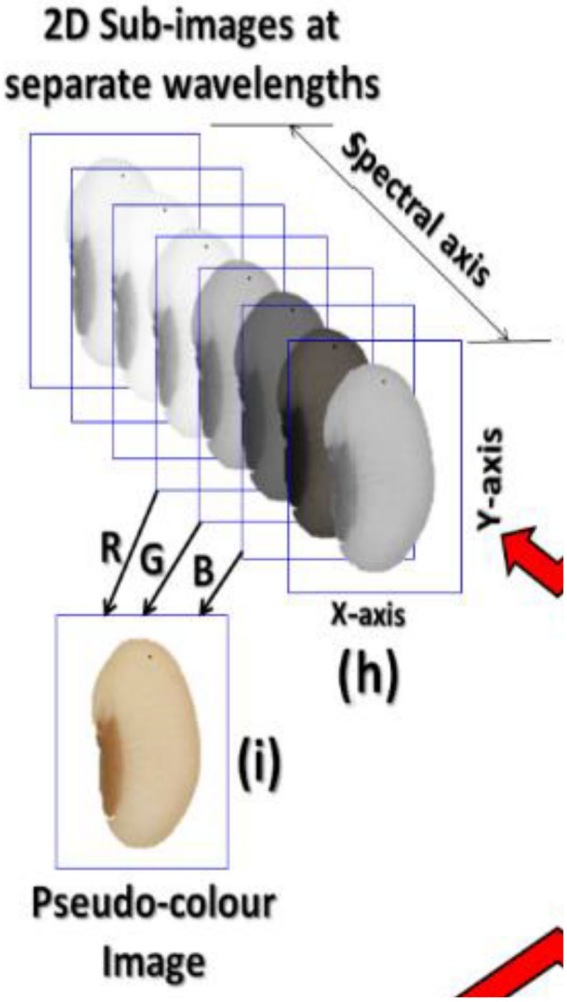
ElMasry, Figure 3

ElMasry indicates this system "is supplemented with special software package for acquiring [and] processing the images of the samples." ElMasry, 12. Accordingly, the computer and microcontroller combination (an electronic control unit) includes the image acquisition software (a processing module).

Thus, ElMasry teaches this limitation.

m) [1m] "which is provided with at least three chromatic channels of a RGB color space and"

ElMasry teaches "a total of 12 greyscale images were acquired by the monochromatic camera … which combined altogether to form one multispectral image." ElMasry, 12. ElMasry also teaches "[a]s a means of simplicity, any three of these grey sub-images (slices) could be easily concatenated one after another (one slice for each color channel) to form a pseudo-color image for the target sample as shown in Figure 2i." ElMasry, 10. ElMasry, Figure 2i shows the color channels are chromatic channels (RGB channels) of an RGB color space:



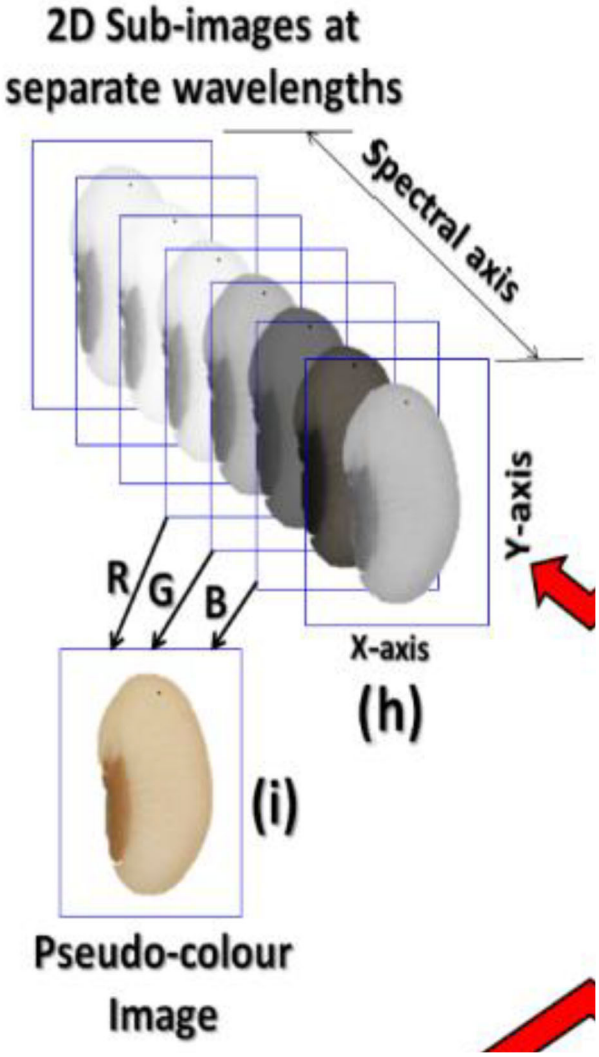
ElMasry, Figures 2(h)- 2(i)

Accordingly, ElMasry's image acquisition software (a processing module) includes three chromatic channels of an RGB color space.

Thus, ElMasry teaches this limitation.

n) [1n] "is arranged for associating the measurement signals corresponding to each said IR source with a corresponding chromatic channel of said chromatic channels and"

ElMasry, Figure 2i shows the color channels are chromatic channels (RGB channels) of an RGB color space, and three of the greyscale images (measurement signals) are associated with corresponding chromatic channels (RGB channels):



ElMasry, Figures 2(h)- 2(i)

Thus, the image acquisition software (processing module) associates three of the greyscale images (measurement signals with a corresponding RGB chromatic channel.

ElMasry discusses an example where NIR wavebands 890 and 940 nm are associated with fat and 970 nm is associated with water. ElMasry, 21-22. Since ElMasry indicates lipids and moisture are relevant to predicting seed quality (ElMasry, 13), a POSITA would have been motivated to map greyscale images corresponding to three wavelength bands centered at 890, 940, and 970 nm to the RGB channels to generate the pseudo-color image to discriminate between seeds based on fat and water content in the pseudo-colour image. Schaafsma Declaration, 53.

Thus, ElMasry teaches this limitation.

o) [1o] "for composing a false color synthesis image of said at least one product by means of three said measurement signals acquired every three successive said time intervals;"

ElMasry teaches "[a]s a means of simplicity, any three of these grey sub-images (slices) could be easily concatenated one after another (one slice for each color channel) to form a pseudo-color image for the target sample as shown in Figure 2i." ElMasry, 10. Accordingly, image acquisition software (processing module) composes a pseudo-color image (a false color synthesis image) of the target sample with any three greyscale images (measurement signals).

ElMasry teaches "[u]sing fewer wavebands can lead to faster sensor systems and shorter acquisition time." ElMasry, 8. Accordingly, a POSITA taking

advantage of the simplicity of using three slices to form a pseudo-color image, would also use as few wavebands as possible (in this case only three wavebands mapped to the three color channels), not activating lights or capturing images for unused wavebands to achieve a faster sensor system and shorter acquisition time. Schaafsma Declaration, 26. Also, one example of three infrared wavebands a POSITA may use includes 890, 940, and 970 nm example for separating seeds based on fat and water content. Schaafsma Declaration, 53.

ElMasry further teaches "using fewer wavebands in multispectral imaging designs can lead to … increasing the number of samples inspected per second." ElMasry, 26. This increased number of samples inspected per second implies that the multispectral image system would repeatedly cycle through activating the three LEDs, acquiring multiple pseudo-colour images to inspect multiple samples. ElMasry also teaches "[i]n each movement in the X-direction, a 2-D image … is recorded." ElMasry, 9.

Therefore, ElMasry teaches this limitation.

p) [1p] "said electronic control unit being configured to generate said control signals as a function of said synthesis image."

ElMasry teaches as much for this limitation as disclosed by '947 Patent. Schaafsma Declaration, 27-29. ElMasry teaches "[d]ata extracted from images can be used to describe differences among samples". ElMasry, 13. Accordingly, as a

large amount of seeds is delivered to the imaging system (ElMasry, 25) and the imaging system generates a multispectral image (ElMasry, 12), or more simply a pseudo-color image (ElMasry, 10), differences among samples (e.g., seeds) are detected. ElMasry discusses image processing techniques that differentiate between samples in an image including edge detection, filtering, band ratio, thresholding, skeletonization, and texture analysis algorithms. ElMasry, 13.

ElMasry teaches a computer-integrated system sorts seeds delivered to the imaging system using robotic picking or some kind of pneumatic or mechanical gate system into different fractions. ElMasry, 25. Accordingly, the computer and microcontroller combination (electronic control unit) would use image processing techniques disclosed by ElMasry (e.g., edge detection, filtering, band ratio, thresholding, skeletonization, texture analysis algorithms, etc.) on the pseudo-color image (a false color synthesis image) generated responsive to delivery of a large amount of seeds to the imaging system to extract data from the pseudo-color image to detect differences among samples of the seeds and select seeds to be diverted to different fractions. The computer and microcontroller combination would sort the seeds into different fractions by generating control signals to drive the robotic picking, pneumatic, or mechanical gate system. Schaafsma Declaration, 27-31. Control signals would be generated based on targets selected by processing the

pseudo-colour image, making the control signals a function of the pseudo-colour image.

Thus, ElMasry teaches this limitation.

This is also AAPA because "State of the Art" section of '947 Patent admits "[s]uch detection system is adapted to send control signals, based on information obtained from the acquired images, to an expulsion device (such as a solenoid valves) actuatable to remove the selected solid elements from the bulk product, for example through the emission of compressed air jets" ('947 Patent, 1:41-49), and "by means of suitable thresholding algorithms, an electronic control unit determines which are the elements to be removed" ('947 Patent, 1:50-57). '947 Patent also admits thresholding software is "per se of known type (and hence not discussed hereinbelow)," and "defines the criteria with which the electronic control unit determines, based on the synthesis images, the elements to be selected and, consequently, the control signals to be sent to the expulsion device." '947 Patent, 6:9-15.

3. Claim 2 is obvious in view of ElMasry

a) "The selector machine of claim 1, wherein the spectral band of the electromagnetic radiations emitted by each said IR source is contained within the short wave infrared spectrum"

ElMasry teaches "multispectral imaging provides calibrated reflectance data at multiple '*discrete*' wavelength bands spaced over an extended spectral range from ultraviolet (UV) to near infrared (NIR) region (Figure 2)." ElMasry, 7. ElMasry teaches the NIR region includes the shortwave-infrared (SWIR) spectrum. See ElMasry, 4 ("the shortwave near infrared (SWNIR) region (750-1700 nm) or the whole near infrared range (780-2500)"). Accordingly, ElMasry teaches the multispectral imaging system may use LEDs at discrete SWIR frequency bands. ElMasry provides an example of multispectral imaging in the UV, visible, and NIR regions (375-970 nm) with NIR wavelengths 890 and 940 nm associated with fat and 970 nm associated with water. ElMasry, 21.

Thus, ElMasry teaches this limitation.

This is also AAPA because "State of the Art" section of '947 Patent admits "it is known to employ emitters and optical sensors that also operate in the near infrared spectrum," and "elements having the same color in the visible spectrum generally have chemical-physical characteristics that determine a different absorption spectrum at the infrared wavelengths." '947 Patent, 1:60-65. Accordingly, '947 Patent admits it was known to use emitters in NIR spectrum, which ElMasry indicates encompasses 780-2500 nm range, and which overlaps SWIR range 750-1700 nm ("SWNIR" in ElMasry). ElMasry, 4.

4. Claim 3 is obvious in view of ElMasry

a) "The selector machine of claim 1, wherein the wavelengths of said spectral band are substantially comprised between 900 nm and 2200 nm"

ElMasry teaches "spectrometer devices may cover the whole near infrared (NIR) range (780-2500 nm)," and "NIRS technology depends on the absorption of the near infrared radiation by major constituents such as protein, lipids, carbohydrates and water resulting in a distinctive spectral pattern corresponding to the energy absorption and molecular vibrations relating to overtones and combination of C-H, N-H and O-H functional groups." ElMasry, 4. ElMasry's NIR range 780-2500 nm covers the between 900 nm and 2200 nm range of claim 3.

ElMasry also provides examples where three SWIR (750-1700 nm) sources emitted electromagnetic ratiations in separate spectral bands, any of which could be implemented into the 12 LED system of ElMasry:

- Three visible and three near-infrared LEDs having peak emission wavelengths at 850, 940, and 1070 nm. ElMasry, 18.
- UV, visible, and NIR regions (375-970 nm) with NIR wavelengths 890, 940, and 970 nm. ElMasry, 21.
- Visible and NIR ranges (405-970 nm), including 850, 910, and 970 nm in NIR ElMasry, 23.

Accordingly, ElMasry teaches three or more infrared light sources that emit electromagnetic radiation in separate NIR spectral bands.

Although ElMasry's NIR range extends beyond the "between 900 nm and 2200 nm" range and each above example includes one LED outside the "between 900 nm and 2200 nm" range, the combination of the three examples identifies four peak wavelengths of interest at 910, 940, 970, and 1070 nm, which are within "between 900 nm and 2200 nm" range.

Also, a POSITA would have identified the wavelengths just outside of "between 900 nm and 2200 nm" (850 and 890 nm) as being "between 900 nm and 2200 nm", as recited in claim 3, based on the rules of rounding and the apparent significant digits in the hundreds of nanometers for the boundaries of the claimed peak wavelength range. The Federal Circuit generally follows a significant-figure meaning when interpreting specific numeric values recited in patent claims. *See Viskase Corp. v. Am. Nat'l Can Co.*, 261 F.3d 1316, 1320 (Fed. Cir. 2001). According to the significant-figure meaning, a claimed numerical value is construed to cover numerical values having greater precision than the claimed numerical value and that round according to standard scientific convention to the claimed numerical value. *See Id.*; *see also U.S. Phillips Corp. v. Iwasaki Elec. Co.*, 505 F.3d 1371, 1377-78 (Fed. Cir. 2007) (endpoints of a claimed range "should not be read … with greater precision than the claim language warrants"). This interpretation applies

even to numerical values not modified by terms of approximation such as "about" or "substantially." *See AstraZeneca AB v. Mylan Pharms. Inc.*, 19 F.4th 1325, 1341-42 (Fed. Cir. 2021) (the term 0.001% was construed as .0005% to .00149% absent any terms of approximation such as "about" or "substantially").

The boundaries of the claimed peak wavelength range are 900 nm and 2200 nm, which are expressed as hundreds of nanometers. If 850 nm and 890 nm were rounded according to conventional rules of rounding to the nearest hundred nanometers, both would be rounded up to 900 nm, which is within the claimed "between 900 nm and 2200 nm" range. Accordingly, even absent the "substantially" term of approximation recited for "between 900 nm and 2200 nm", peak wavelength ranges of 850 nm and 890 nm would fall within "between 900 nm and 2200 nm". Thus, each of the three above-identified examples of ElMasry would be understood by a POSITA to include three spectral bands "substantially comprised between 900 nm and 2200 nm." The inclusion of the term of approximation "substantially" may even extend the bottom range of the "between 900 nm and 2200 nm" range below 850 nm.

Thus, ElMasry teaches this limitation.

This is also AAPA because "State of the Art" section of '947 Patent admits "it is known to employ emitters and optical sensors that also operate in the near infrared spectrum." '947 Patent, 1:60-65. Accordingly, '947 Patent admits it was

known to use emitters in the NIR spectrum, which ElMasry indicates encompasses 780-2500 nm, and which includes the "between 900 nm and 2200 nm" range.

5. Claim 6 is obvious in view of ElMasry

a) "The selector machine of claim 1, wherein each said IR source comprises at least one LED"

ElMasry teaches that "a multi-LED multispectral imaging system … is supported with an array of 12 LEDs of different nominal emission wavelengths." ElMasry, 12.

Accordingly, ElMasry teaches the limitations of claim 6.

These limitations are also AAPA because the "State of the Art" section of '947 Patent admits that the known optical detection system "comprises optical emitters (e.g., constituted by LEDs) adapted to emit electromagnetic radiations towards the bulk product." '947 Patent, 1:50-52.

6. Claim 10 is obvious in view of ElMasry

a) "The selector machine of claim 1, wherein said electronic control unit is arranged for sending, to said IR sources, trigger signals synchronized with said processing module"

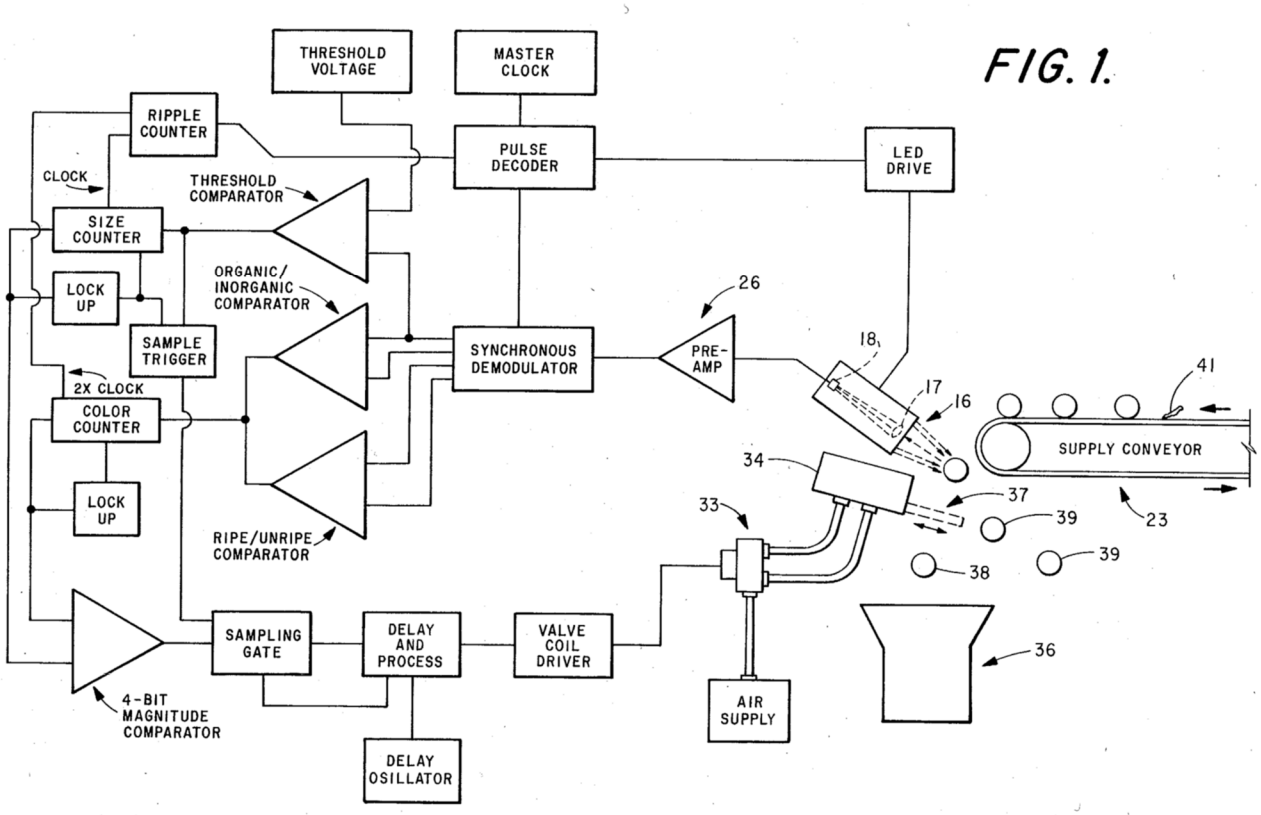
ElMasry teaches "[e]ach LED is sequentially switched on for a definite period during image acquisition and synchronized with the camera trigger using a pre-programmed microcontroller." ElMasry, 12. Accordingly, ElMasry teaches the pre-programmed microcontroller (at least part of an electronic control unit) sends, to the

LEDs (IR sources), trigger signals synchronized using the programming, e.g., software (a processing module) for the pre-programmed microcontroller. Thus, ElMasry teaches this limitation.

C. Ground 3: Claims 4, 7, and 8 are rendered obvious by ElMasry and Lane

1. Overview of Lane

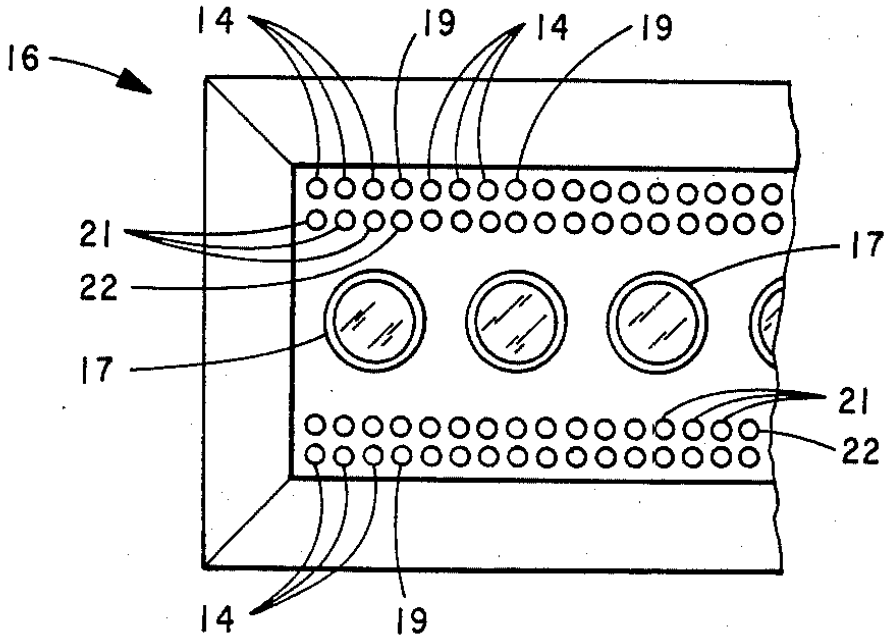
Lane discloses sorting systems that use a pulsating, multiple frequency illumination source with a synchronous detection system to determine whether objects are acceptable or unacceptable and to remove objects determined to be unacceptable. Lane, 1:5-19. Lane, FIG. 1 (below) illustrates the system.



Lane, FIG. 1

This sorting system includes an "illuminator/detector assembly 16 … positioned off the end of the supply conveyor 23" (Lane, 6:63-68) including "a line of detector lenses 17 for collecting reflected light and concentrating same upon rearwardly positioned detectors 18" (Lane, 5:47-50). Lane also discloses "[r]ows of light emitting diodes straddle the line of detector lenses 17," and "[t]his arrangement of L.E.D.s extends across the entire assembly 16, in effect creating a distributive illumination source … so as to expose the subject articles in free fall … to the sequence of light wave pulses, and each detector lens intercepts the reflected light pulses from articles." Lane, 6:12-7:2. FIG. 4 of Lane, shown below, illustrates a front view of the illuminator/detector assembly 16.

FIG. 4.



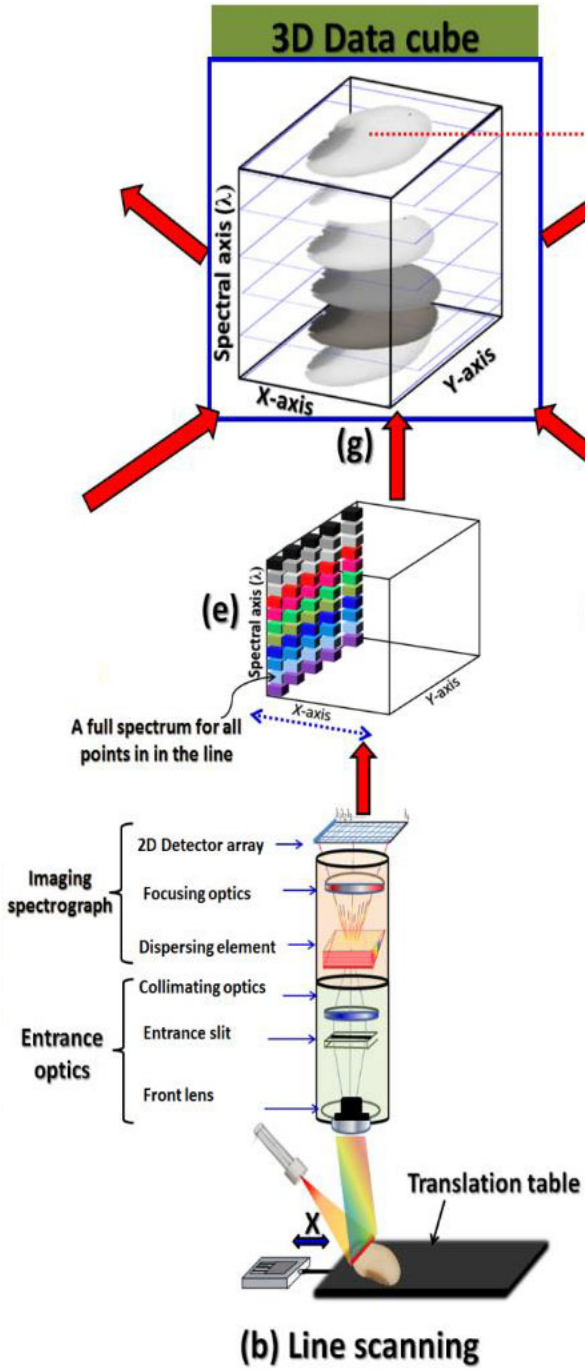
Lane is analogous art to '947 Patent, and therefore may be used as prior art to the claims of '947 Patent, because '947 Patent and Lane are from the same field of endeavor. As discussed above, '947 Patent is from the field of selector/sorter systems for sorting bulk product including solid elements. By comparison, Lane states that "[t]he invention relates generally to devices for sorting ripe from unripe comestibles, and for sorting comestibles from extraneous, inorganic matter." Lane, col. 1, lines 6-8. Thus, both '947 Patent and Lane are from the field of selector/sorter systems for sorting bulk product including solid elements.

2. Claim 4 is obvious in view of ElMasry and Lane

a) "The selector machine of claim 1, wherein said optical sensor comprises at least one row of optical transducers extended along an extension direction substantially transverse to said advancement path."

ElMasry teaches recording "the data line by line by moving the target sample systematically in X direction only." ElMasry, 9. ElMasry, Figures 2(b), 2(e), and 2(g) (below), illustrate a translation table moving the target sample in the X direction, and entrance optics and imaging spectroscopy receiving reflected radiation from the target sample as it moves along its advancement path in the X direction. ElMasry discloses that "the light reflected from the line is dispersed by a two-dimensional dispersing element (spectrograph) and then recorded on a two-dimensional detector array in which one spatial dimension was used to record the dispersed light from the line at constituent wavelengths," and "[i]n each movement

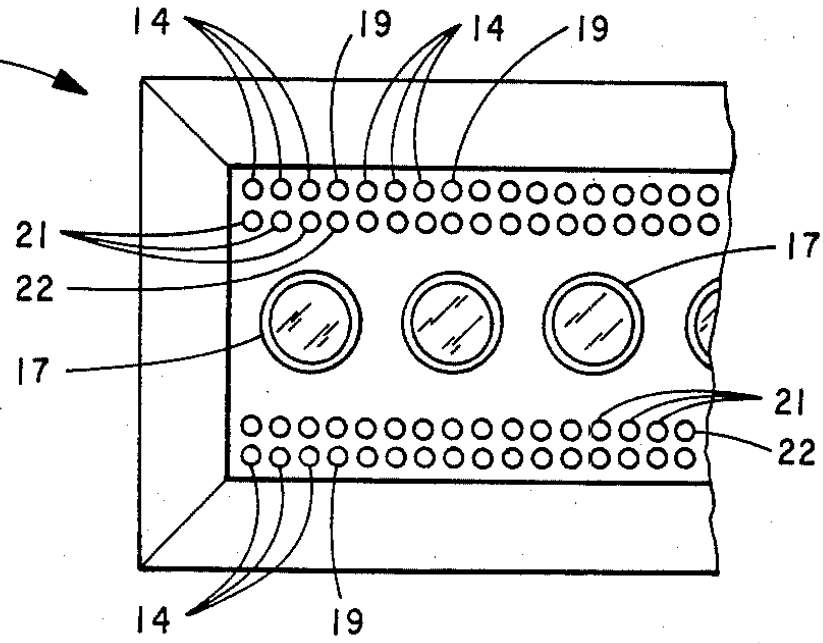
in the X-direction, a 2-D image (y,λ) having one spectral dimension (λ) and one spatial dimension (y) is recorded." ElMasry, 9. FIG. 2(e) illustrates that the detector array includes elements extending in lines in a Y direction perpendicular to the X-axis. Accordingly, the detector array of Figure 2(b) extends in lines along an extension direction transverse to the X direction advancement path of the target sample.



ElMasry, Figure 2(b)

Lane also teaches "the illuminator/detector assembly 16 includes a line of detector lenses 17 for collecting reflected light and concentrating same upon rearwardly positioned detectors 18." Lane, 5:47-50. Since the detector lenses 17 extend in a line (shown in FIG. 4, below), detectors 18 behind the detector lenses 17 would also extend in a line. Schaafsma Declaration, 36.

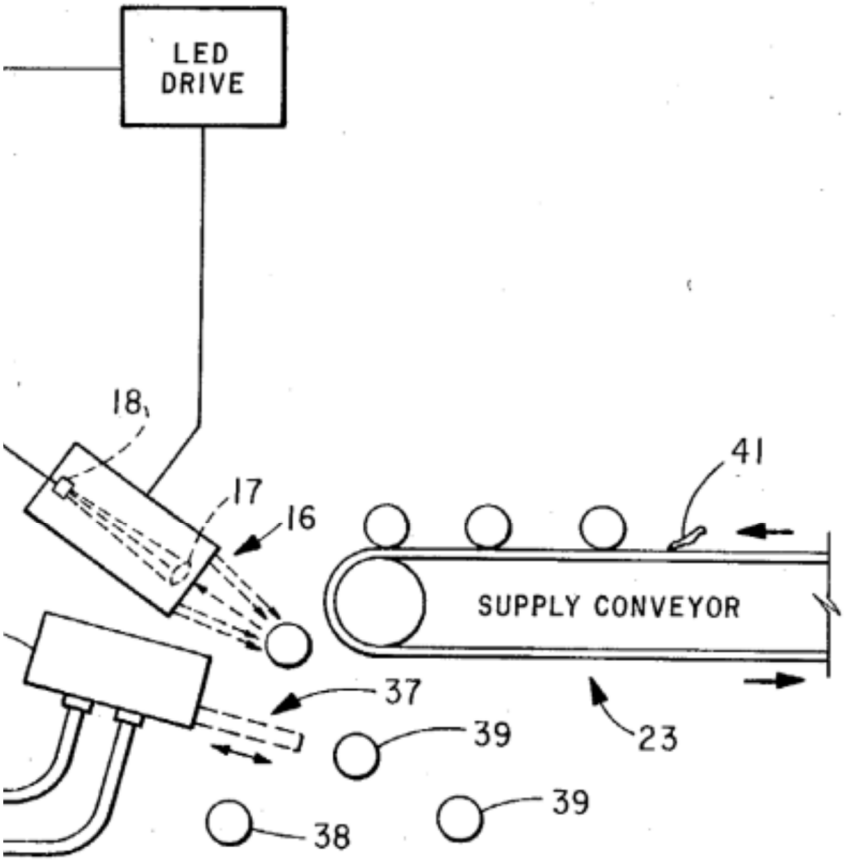
FIG. 4.



Lane, FIG. 4

An inspection of Lane, FIGs. 4 and 1 (a portion of FIG. 1 shown below) suggests the row of detector lenses 17, and by extension the row of detectors 18 behind the detector lenses 17, extend transversely to the advancement path of items as they drop off the supply conveyor 23. Schaafsma Declaration, 36.

FIG. 1.



Portion of Lane, FIG. 1

Lane teaches that "[r]ows of light emitting diodes straddle the line of detector lenses 17" (Lane, 6:12-22), which extends transverse to an advancement direction of objects to be sorted. Also, FIGS. 1 and 4 of Lane illustrate rows of LEDs 14, 19, 21, and 22 extending transversely to the advancement direction and in parallel to the line of detector lenses 17. Lane further teaches "[b]y distributing the creation of each illumination pulse among a plurality of L.E.D.s, certain problems associated

with extraneous 'white flash', or specular reflection phenomenon are alleviated." Lane, 6: 35-38. Lane also teaches that "the placement of the detector lenses 17 with respect to the illuminating light emitting diodes provides improved reflectance sampling of the articles to be sorted," "ensures maximum reflectance levels for given incident light levels," and "improves the accuracy of the collected data, thereby enhancing the overall reliability of the sorter." Lane, 6:51-54.

It would have been obvious to a POSITA to position LEDs in rows in parallel with rows of detector elements with the rows oriented transverse to the path of the objects to be sorted similarly as taught by Lane. Specifically, a POSITA would be motivated to avoid problems associated with extraneous "white flash" or specular reflection phenomenon and to achieve improved reflectance sampling of articles to be sorted, maximized reflectance levels, and improved accuracy and reliability, as explained by Lane. Schaafsma Declaration, 38. Arranging detectors and LEDs in rows (taught by Lane) would not change the principle of operation of the imaging system of ElMasry and the results would be predictable. Schaafsma Declaration, 38.

A claim is obvious where all the elements of a claim were known in the prior art (as shown for claim 4), where a POSITA could have combined the elements as claimed by known methods with no change to their respective functions, and where the combination would have yielded nothing more than predictable results to a

POSITA. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). "Where, as here, all claim limitations are found in a number of prior art references, the factfinder must determine '[w]hat the prior art teaches, whether it teaches away from the claimed invention, and whether it motivates a combination of teachings from different references.'" *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1360 (Fed. Cir. 2006) (quoting *In re Fulton*, 391 F.3d 1195, 1199-1200 (Fed. Cir. 2004)).

In this case, Lane motivates combining teachings of Lane and ElMasry, specifically to reduce the problems associated with the extraneous "white flash" or specular reflection phenomenon and to achieve the improved reflectance sampling of the articles to be sorted, increased reflectance levels, and improved accuracy and reliability, as explained by Lane. Schaafsma Declaration, 38. POSITA would have had a reasonable expectation of success in combining the teachings of ElMasry with those of Lane because both ElMasry and Lane discuss similar types of sorting systems for sorting agricultural/food products. Aligning optical transducers in a row transverse to an advancement path of the products, as taught by Lane, would not change the principle of operation of the optical transducers of ElMasry. Schaafsma Declaration, 38.

Accordingly, the combination of ElMasry and Lane render claim 4 obvious.

3. Claim 7 is obvious in view of ElMasry and Lane

a) The selector machine of claim 6, wherein each said IR source comprises at least one row of LEDs; wherein said at least one row of LEDs is extended along an extension direction substantially transverse to said advancement direction.

Lane teaches "[r]ows of light emitting diodes straddle the line of detector lenses 17" (Lane, 6:12-22), which as discussed above (section VII.C.2.a), extend transverse to an advancement direction of objects to be sorted. Also, Lane teaches "red L.E.D.s 14 extend across the uppermost and lowermost rows in groups of three," "[b]etween each group of three red L.E.D.s is an IR 1 L.E.D. 19, producing pulses at approximately 800 nm," "[t]he two innermost rows of light emitting diodes include groups of green L.E.D.s, spaced by an IR2 L.E.D. 22, producing pulses at 990 nm," and "[t]his arrangement of L.E.D.s extends across the entire assembly 16, in effect, creating a distributive illumination source." Lane, 6:12-22.

It would have been obvious to a POSITA to arrange the LEDs of the various multispectral imaging systems of ElMasry in lines transverse to an advancement path of objects to be sorted, as taught by Lane, in order to alleviate problems associated with white flash and specular reflection phenomenon, as well as improve reflectance sampling of articles to be sorted, ensure maximum reflectance levels, and improve the accuracy of the collected data to enhance reliability of the sorter. Schaafsma Declaration, 32, 35-36, and 38.

Accordingly, the combination of ElMasry and Lane teaches these elements of claim 7.

4. Claim 8 is obvious in view of ElMasry and Lane

a) The selector machine of claim 4, wherein each said IR source comprises multiple rows of LED;

As discussed above (section VIII.C.2.a) and VIII.C.3.a)), it would have been obvious to modify the multispectral imaging systems taught by ElMasry to include multiple rows of LEDs, as taught by Lane (*see* Lane 6:3-22 and FIGS. 1 and 4).

b) wherein said rows of LED are placed with said extension directions substantially parallel to the extension direction of said rows of optical transducers.

As discussed above (section VIII.C.2.a) and VIII.C.3.a)), it would have would have been obvious to a POSITA to arrange the LEDs of the various multispectral imaging systems of ElMasry in multiple lines transverse to an advancement path of objects to be sorted, as taught by Lane.

D. Ground 4: Claim 5 is rendered obvious by ElMasry, Lane, and Gerken

1. Overview of Gerken

Gerken discloses a "camera system, comprising at least one infrared detector device that is sensitive to electromagnetic radiation in the shortwave infrared region from approximately 900 nm to approximately 1700 nm." Gerken, 1:5-7. Gerken

discloses "the present invention is based on the object of developing a camera system … able to produce spectral information items relating to a picture recorded in the shortwave infrared." Gerken, 2:7-10.

Gerken, FIG. 1 (below) illustrates a camera system 1. Camera system 1 includes "at least one infrared detector device 2 that is sensitive to electromagnetic radiation in the shortwave infrared range from approximately 900 nm to approximately 1700 nm and that has a plurality of sensor elements … arranged next to one another in rows and columns for capturing individual spatial picture elements," and "at least one optical unit 3 that images electromagnetic radiation (indicated by a dashed line L) incident on the camera system 1 onto the at least one infrared detector device 2". Gerken, 9:13-32.

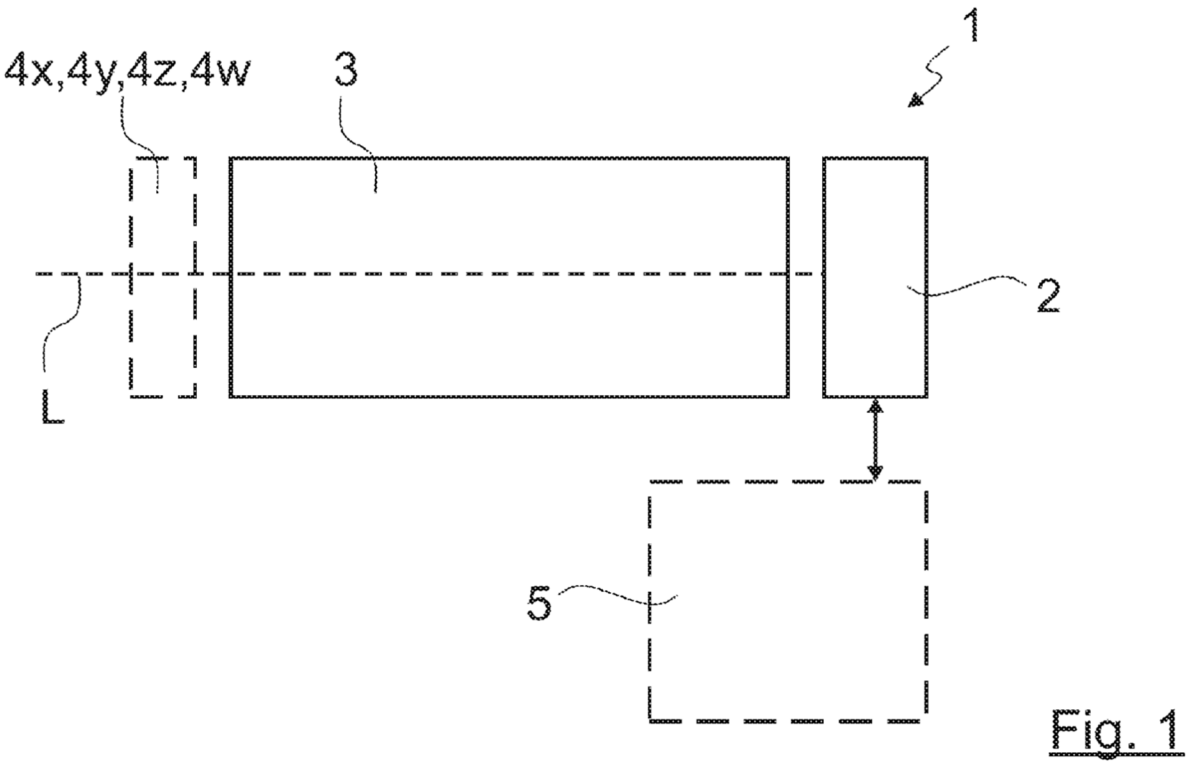


Fig. 1

Gerken, FIG. 1

Gerken is analogous art to ’947 Patent, and therefore may be used as prior art because teachings of Gerken are reasonably pertinent to ’947 Patent. For example, ’947 Patent indicates “a sensor with wide spectrum can be employed as optical sensor 5, which is only capable of acquiring measurement signals that depend on the mean of the intensity of all the reflected radiations RF incident thereon, independent on their wavelength.” ’947 Patent, 6:38-42. ’947 Patent also discloses “spectral band 80 of the electromagnetic radiations 40 emitted by each IR source 8 is advantageously contained within the short wave infrared spectrum, which is known

in the technical jargon of the field with the initials "SWIR" (Short Wave Infrared)." '947 Patent, 7:20-24. Gerken is reasonably pertinent to '947 Patent at least because Gerken teaches optical detectors capable of detecting within the spectral band identified as advantageous by '947 Patent. Specifically, Gerken discloses that "[t]wo-dimensional InGaAs detectors for detection in the shortwave infrared region from 900 nm to 1700 nm can be used."

2. Claim 5 is obvious in view of ElMasry, Lane, and Gerken

a) "The selector machine of claim 4, wherein said optical transducers are InGaAs solid state transducers.

Gerken teaches "at least one infrared detector device can be an InGaAs (indium-gallium-arsenide) detector" and "[t]wo-dimensional InGaAs detectors for detection in the shortwave infrared region from 900 nm to 1700 nm can be used." Gerken, 5:28-32. Gerken continues teaching "[s]uch infrared detector devices have a plurality of sensor elements arranged next to one another in lines and columns for capturing individual picture element (pixels) (e.g., with a resolution of 640 x 512 pixels)." Gerken, 5:32-6:2.

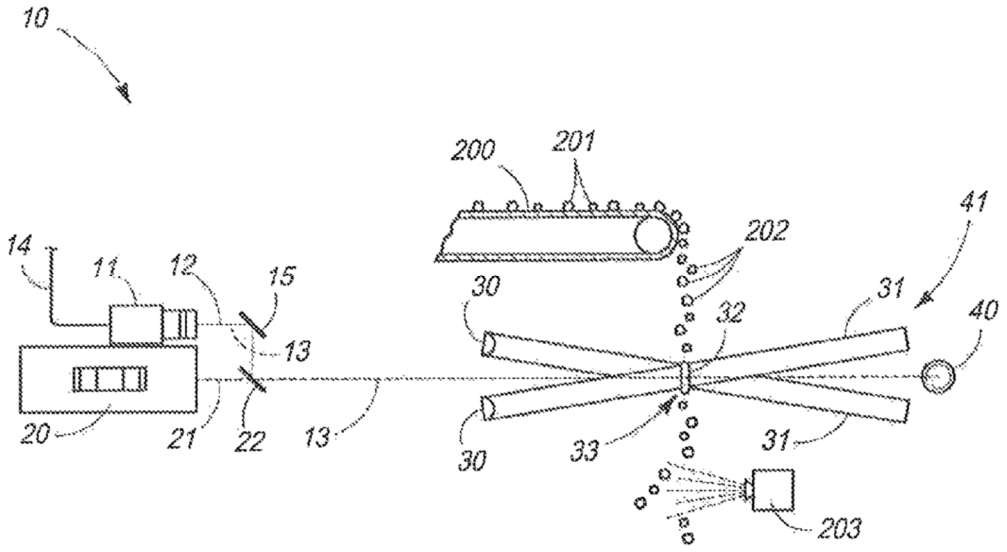
It would have been obvious to a POSITA to use Gerken's InGaAs detectors sensitive in the 900-1700 nm SWIR range in ElMasry's multispectral imaging systems to "cover the … shortwave near infrared (SWNIR) region (750-1700 nm)" (ElMasry, 4), and where "wavelengths related to NIR wavelengths 890, 940 nm (associated with fat) and 970 nm (associated with water) are considered as relevant

wavelengths for discrimination" (ElMasry, 21). Schaafsma Declaration, 19. This combination of Gerken's InGaAs detectors with ElMasry's imaging system would yield predictable results because the elements would perform the same functions discussed in ElMasry and Gerken (Schaafsma Declaration, 19), and a claim is obvious where all the elements of a claim were known in the prior art (as has been shown above with ElMasry and Lane for claim 5), where a POSITA could have combined the elements as claimed by known methods with no change to their respective functions, and where the combination would have yielded nothing more than predictable results to a POSITA. (*KSR*, 550 U.S. at 416).

E. Ground 5: Claim 9 is rendered obvious by ElMasry and Adams

1. Overview of Adams

Adams discloses "a method and apparatus for sorting a stream of products". Adams, 1:5-15. A sorting apparatus 10 is illustrated in Adams, FIG. 1E (below).



Adams, FIG. 1E

Adams teaches first, second, and third illuminators 30 (Adams, 17:2-35), which "when energized, emit electromagnetic radiation which lies in a range of about 400 nanometers to about 1,600 nanometers" (Adams, 18:30-33). Adams also teaches "controller 183 is operable to individually and sequentially energize, and then render operable the respective first, second and third illuminators 30, and associated image capturing devices 11 in a predetermined pattern, so that only one illuminator 30, and the associated image capturing device 11, is energized or rendered operable during a given time period." Adams, 17:45-56.

Adams teaches illumination and image scanning takes place in a relatively short amount of time. For example, "the predetermined pattern of energizing the respective illuminators 30, and forming an image signal 187, with the associated image capturing devices 11, further comprises the steps of first rendering operable the first illuminator 30, and associated image capturing device 11 for a first pre-determined period of time; second rendering operable the second illuminator, and associated image capturing device for a second predetermined period of time, and third rendering operable the third illuminator 30 and associated image capturing device 11 for a third pre-determined period of time," "the first, second and third predetermined time periods are sequential in time," and "energizing the respective

illuminators 30 in a pre-determined pattern and image capturing devices takes place in a time interval of about 50 microseconds to about 500 microseconds." Adams, 18:6-27.

Adams is analogous art, and therefore may be used as prior art to '947 Patent, because both are from the same field of selector/sorter systems for sorting bulk product including solid elements.

2. Claim 9 is obvious in view of ElMasry and Adams

a) The selector machine of claim 1, wherein said optical sensor has an acquisition frequency substantially comprised between 15 and 25 kHz.

ElMasry teaches "[a]s the multispectral imaging system is constructed using fewer spectral channels, this implies shorter acquisition and processing times than the hyperspectral imaging system" (ElMasry, 7), "[u]sing fewer wavebands can lead to faster sensor systems and shorter acquisition time" (ElMasry, page 8), and "using fewer wavebands … can lead to faster sensor systems, thus reducing total integration time and increasing the number of samples inspected per second" (ElMasry, page 26). '947 Patent indicates that using fewer wavebands in multispectral imaging designs makes the between 15 and 25 kHz acquisition rate possible. *See* '947 Patent, 6:58-7:19; Schaafsma Declaration, 47. Adams teaches a system that takes advantage of using only three spectral channels to achieve an acquisition rate overlapping "between 15 and 25 kHz."

Adams teaches "the predetermined pattern of energizing the respective illuminators 30, and forming an image signal 187, with the associated image capturing devices 11, further comprises the steps of first rendering operable the first illuminator 30, and associated image capturing device 11 for a first pre-determined period of time; second rendering operable the second illuminator, and associated image capturing device for a second predetermined period of time, and third rendering operable the third illuminator 30 and associated image capturing device 11 for a third pre-determined period of time," "the first, second and third predetermined time periods are sequential in time," and "the step of energizing the respective illuminators 30 in a pre-determined pattern and image capturing devices takes place in a time interval of about 50 microseconds to about 500 microseconds." Adams, 18:6-27. This 50 microsecond cycle corresponds to 20 kHz, which lies within the claimed 15-25 kHz range.

It would have been obvious to a POSITA to operate ElMasry's multispectral imaging systems at 15-25 kHz acquisition frequency because ElMasry would lead a POSITA to use only three wavebands (Schaafsma Declaration, 25-26, 40) (also taught by Adams), and Adams and '947 Patent indicate 15-25 kHz is possible when using three wavebands (Schaafsma Declaration, 47). Accordingly, ElMasry and Adams render claim 9 obvious.

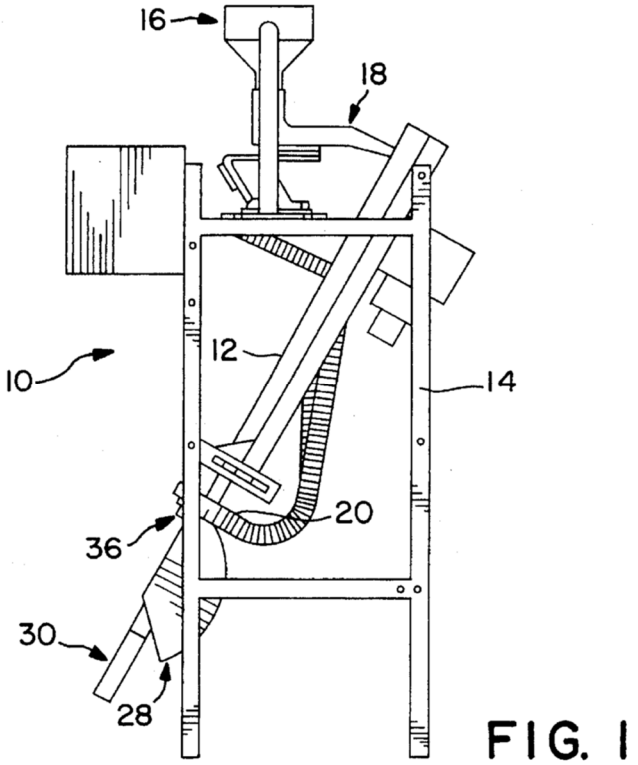
A claim is obvious where all elements of a claim were known in the prior art (as shown above for claim 9), where a POSITA could have combined the elements as claimed by known methods with no change to their respective functions, and where the combination would have yielded predictable results to a POSITA. *KSR*, 550 at 416. "Where, as here, all claim limitations are found in a number of prior art references, the factfinder must determine '[w]hat the prior art teaches, whether it teaches away from the claimed invention, and whether it motivates a combination of teachings from different references.'" *DyStar*, 464 F.3d at 1360 (quoting *In re Fulton*, 391 F.3d at 1199-1200).

In this case, ElMasry provides motivation to combine the teachings of Adams with those of ElMasry. As discussed above, it would have been obvious to reduce the number of spectral channels, as taught by ElMasry, to three (also taught by Adams), to achieve about a 20 kHz acquisition frequency (taught by Adams), which lies within the claimed 15-25 kHz acquisition frequency range. Schaafsma Declaration, 25-26, 40, 47. A POSITA would have had a reasonable expectation of success in combining the teachings of ElMasry and Adams because reducing the number of spectral channels to three (taught by Adams) would not change the principle of operation of the imaging system of ElMasry. Schaafsma Declaration, 26.

F. Ground 6: Claims 11, 12, and 15 are rendered obvious by ElMasry and Gray

1. Overview of Gray

Gray discloses "a high[-]speed sorter for separating nonstandard fungible products or items from a passing stream or flow of such products" (Gray, 3:33-36), which is illustrated below.



Gray, FIG. 1

"[P]roduct feeds from hopper 16 … to channels 12" (Gray, 3:33-44), "[a]n optical viewer or sensor 20 … is located toward the bottom part of the channel," (Gray, 3:64-67) and "[a]s the flow of products passes past the sensor, nonstandard or substandard products are sensed or detected" (Gray, 3:64-67). "This sensing can be

… in two separated spectral ranges … or in a plurality of spectral ranges for multichromatic detection," "a 'spectral range' can be wholly or partially in the nonvisual spectrum," and "[f]or example, sensing in the infrared range is commonly done." Gray, 4:7-14.

Gray teaches "[p]roducts 59 pass through the optical viewing station and are illuminated by one or more light sources 61" (Gray, 5:16-18), as illustrated below.

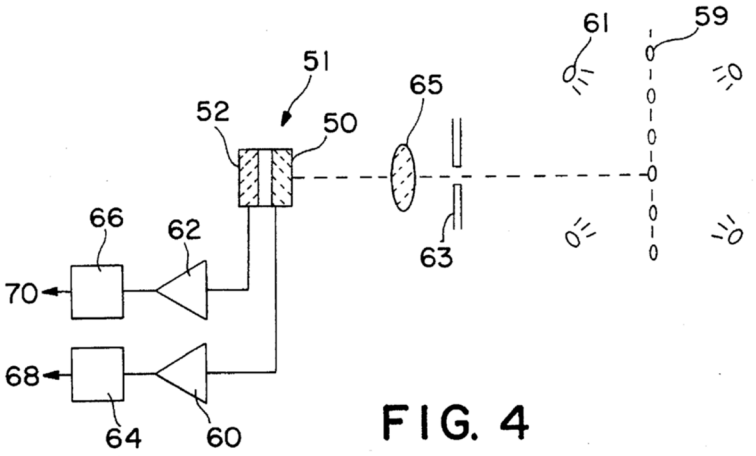


FIG. 4

Gray, FIG. 4

Gray discloses "a light source is a wide band incandescent or fluorescent light," and "[r]adiation reflections from the products pass through a viewing window 63 to be received by a twin peak optical filter 65 placed in front of sandwich detector 51." Gray, 5:18-22. Gray discloses "[o]ptical filter 65 has transmission properties such as shown in FIG. 6." Gray, 5:22-26. Gray, FIG. 6 illustrates example transmission properties of optical filter 65 (below).

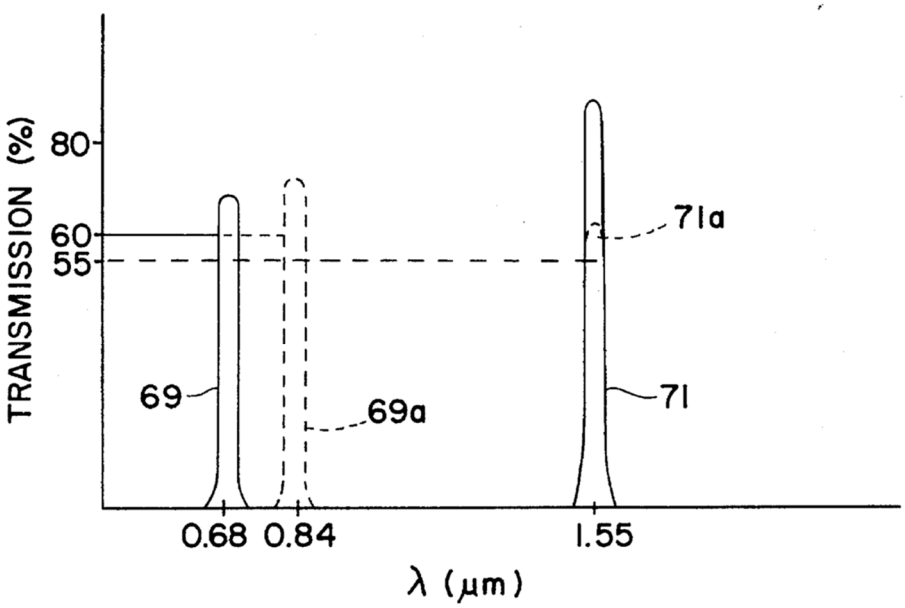


FIG. 6

FIG. 6 of Gray

Although Gray discloses optical filter 65 has two peaks corresponding to two passbands, Gray clarifies "[f]urther additional optional embodiments can be chosen by … using optical filters 65 having more than two peaks." Gray, 6:27-31. Accordingly, Gray discloses that optical filter 65 may include three or even more peaks corresponding to three or more optical passbands.

Gray is analogous art, and therefore may be used as prior art to '947 Patent, because both are from the same field of endeavor (selector/sorter systems for sorting bulk product including solid elements).

2. Claim 11 is obvious in view of ElMasry and Gray

a) The selector machine of claim 1, further comprising a bandpass filter provided with at least three narrow spectral bands, each of which extended for a subset of wavelengths of the spectral band of a corresponding IR source;

ElMasry teaches using bandpass filters having passbands centered at different illumination frequencies of interest to filter out illumination outside frequency bands of interest. Specifically, ElMasry teaches "multispectral cameras can filter light reaching the surface of the image detector by utilizing specific band-pass filters to permit recording concurrent images at various wavebands." ElMasry, 10. ElMasry also teaches "a rotating filter wheel (Figure 2c) or a tunable filter such as liquid crystal tunable filter (LCTF) or an acousto-optic tunable filter (AOTF) for sequential changing the wavelength at which the image is acquired," and "[f]or capturing an image at a new wavelength, the filter mechanism must be operated to the desired filter." ElMasry, page 9. ElMasry, however, discusses "using various illuminants of different spectral power distribution" by "'*sequentially*' illuminating the scene with different narrow-band wavelength light sources" as an alternative to "using filter wheel or tunable filters." *See* ElMasry, 10-11.

'947 Patent admitted "as is known, the LEDs 8' of the IR sources 8 can have a spectral band 80 with emission wider than that of interest." '947 Patent, 9:55-62. Thus, '947 Patent admits it was known that IR LEDs, such as those of ElMasry,

could have a spectral band with emission wider than that of interest. Schaafsma Declaration, 49.

The spectral bands of IR LEDs of ElMasry being wider than those of interest may pose a problem to operation of automatic sorter systems because the images captured with wider than desired emission bands would potential have overlapping spectral bands of interest. Schaafsma Declaration, 49. This overlap could take a toll on a sorting system's ability to differentiate between different items to be sorted. Schaafsma Declaration, 49. Accordingly, the use of bandpass filters in combination with the various illuminants of different spectral power distribution, which ElMasry teaches in the same context of filtering out illumination outside frequency bands of interest, would have been obvious to a POSITA to solve the problems arising from emission in spectral bands wider than those of interest for the various IR LEDs. Schaafsma Declaration, 49. Gray teaches "a single multipeak optical filter … for passing at least two defined light frequency spectrums" (Gray, col. 2:25-34), and "using optical filters 65 having more than two peaks" (Gray, 6:27-31). Gray teaches using a multipeak optical filter 65 in conjunction with a "wide band incandescent or fluorescent light" to filter out illumination of the wide band light outside frequency bands of interest ("Optical filter 65 has transmission properties such as shown in FIG. 6, wherein the percentage of transmission is defined at two peaks, namely peak 69, centered at 0.68 [μm] ([680 nm]) and peak 71 centered at 1.55 [μm] (1550 nm),"

and "[t]he first of these peaks is located in the broad spectral response range of silicon device 50 … and the second of these peaks is located in the broad spectral response range of germanium device 52"). Gray, 5:18-26. Accordingly, Gray teaches that the optical filter 65 is used to filter out illumination outside frequency bands of interest.

Gray even teaches that the peaks of the optical filter 65 may be centered at infrared wavelengths. *See* Gray, 4:10-14 and 6:27-31 ("a 'spectral range' can be wholly or partially in the visual spectrum or can be wholly or partially in the nonvisual spectrum," and "sensing in the infrared range is commonly done").

It would have been obvious to a POSITA to use the multipeak optical filter 65 of Gray with the sorting devices taught in ElMasry to filter out a subset of the illumination from the IR LEDs in the sequential illumination approach taught by ElMasry because a POSITA would have recognized that the IR LEDs in the sequential illumination approach taught by ElMasry can have a spectral band with emission wider than that of interest (AAPA) (Schaafsma Declaration, 49). *See Al-Site Corp. v. VSI Int'l, Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) ("A suggestion or motivation to combine generally arises in the references themselves"). A POSITA would have recognized that the optical filter 65 of Gray would reduce overlap between the spectral bands of interest, which would improve image accuracy, and

consequently enable more accurate sorting of the sorting systems taught by ElMasry. Schaafsma Declaration, 49.

A claim is obvious where all the elements of a claim were known in the prior art (as shown above with ElMasry and Gray for claim 11), where a POSITA could have combined the elements as claimed by known methods with no change to their respective functions, and where the combination would have yielded nothing more than predictable results to a POSITA. *KSR*, 550 U.S. at 416. "Where, as here, all claim limitations are found in a number of prior art references, the factfinder must determine '[w]hat the prior art teaches, whether it teaches away from the claimed invention, and whether it motivates a combination of teachings from different references.'" *DyStar*, 464 F.3d at 1360 (quoting *In re Fulton*, 391 F.3d at 1199-1200).

In this case, AAPA identifies a known problem in systems like those discussed in ElMasry (emissions wider than that of interest), and Gray teaches a solution to the problem (multiband bandpass filters). Schaafsma Declaration, 49. A POSITA would have had a reasonable expectation of success in combining the teachings of ElMasry with those of Gray because doing so would not change the principle of operation of the imaging system of ElMasry or the filters of Gray and is consistent with the principle of operation of the bandpass filters already taught by ElMasry. Schaafsma Declaration, 49.

Thus, ElMasry and Gray render this element obvious.

b) said bandpass filter being positioned in a manner such to intercept said electromagnetic radiations emitted by said IR sources or said reflected radiations coming from said at least one product.

ElMasry teaches "there are two possibilities in locating the filters: either in front of the camera or at the broadband light source". ElMasry, 9. Similarly, Gray teaches "[r]adiation reflections from the products pass through a viewing window 63 to be received by a twin peak optical filter 65 placed in front of sandwich detector 51." Gray, 5:19-26. Accordingly, both ElMasry and Gray teach placement of a filter in front of a camera/detector, which would intercept electromagnetic radiations emitted by IR sources or reflected radiations coming from a product.

Accordingly, ElMasry and Gray render claim 11 obvious.

3. Claim 12 is obvious in view of ElMasry and Gray

a) The selector machine of claim 11, wherein said bandpass filter is positioned between said advancement path and said optical sensor in order to intercept the reflected radiations coming from said at least one product.

As discussed above in section VIII.F.2.b), ElMasry and Gray teach placement of a filter in front of a camera/detector (*see* ElMasry, 9 and Gray, 5:19-26), which would intercept electromagnetic radiations reflected from a product. Schaafsma Declaration, 34.

4. Claim 15 is obvious in view of ElMasry and Gray

a) The selector machine of claim 11, wherein the narrow spectral bands of said bandpass filter are not overlapped on each other.

ElMasry teaches "multispectral imaging provides calibrated reflectance data at multiple '*discrete*' wavelength bands spaced over an extended spectral range from ultraviolet (UV) to [NIR]," and "[t]he resulting multispectral image is a stack of many greyscale sub-mages showing the exact relative light reflectance at many non-overlapping '*discrete*' wavelength bands along a range beyond the human visual perception." ElMasry, 7. As a result, a POSITA using the optical filter 65 of Gray with the multispectral imaging systems of ElMasry would design the optical filter 65 of Gray so passbands of optical filter 65, which are subsets of the already non-overlapping wavelength bands of ElMasry, do not overlap. Schaafsma Declaration, 49.

Thus, ElMasry and Gray render claim 15 obvious.

G. Ground 7: Claim 13 is rendered obvious by ElMasry, Gray, and Hagiwara

1. Overview of Hagiwara

Hagiwara discloses an image capturing device "including: an image-capturing unit that is photosensitive to light in an invisible band" and "conversion of image-capturing data generated from an output signal of the image-capturing unit into visible color space image data" (Hagiwara, 1:12-44). Hagiwara discloses "a

bandpass filter arranged on each photoelectric converting unit of the image sensor." Hagiwara, 4:54-56.

Hagiwara is analogous art to '947 Patent, and therefore may be used as prior art to '947 Patent, because the teachings of Hagiwara are reasonably pertinent to '947 Patent. Hagiwara teaches "an image capturing device" (Hagiwara, 1:12-13) that may be used for the "optical sensor" or the "linear video camera" of '947 Patent (*see* '947 Patent, 5:21-25 and 7:61-64). Schaafsma Declaration, 45. Accordingly, a POSITA would have understood that "image-capturing unit" of Hagiwara is reasonably pertinent to "optical sensor" of '947 Patent.

2. Claim 13 is obvious in view of ElMasry, Gray, and Hagiwara

a) The selector machine of claim 11, wherein said bandpass filter is positioned between said advancement path and said optical sensor in order to intercept the reflected radiations coming from said at least one product;

As discussed above in section VIII.F.2.b), ElMasry and Gray teach placement of a filter in front of a camera/detector (see ElMasry, 9 and Gray, 5:19-26), which would intercept electromagnetic radiations reflected from a product. Accordingly, ElMasry and Gray both teach this element of claim 13.

b) wherein said bandpass filter is mounted on said optical sensor.

ElMasry teaches "[i]n the traditional mono CCD cameras, the sensor is coded with a mosaic arrangement of pigments that transmit red, green, and blue." ElMasry,

6. Coding a sensor with a mosaic arrangement to transmit red, green, and blue amounts to a multiband bandpass optical filter mounted on the optical sensor passing red, green, and blue light. Schaafsma Declaration, 38. Accordingly, ElMasry illustrates it was known to mount a multiband optical bandpass filter on an optical sensor. Schaafsma Declaration, 34.

Hagiwara similarly teaches "a bandpass filter arranged on each photoelectric converting unit of the image sensor 100" (Hagiwara, 4:54-56), and "[t]he NIR1 filter, the NIR2 filters and the NIR3 filter are allocated like a Bayer array …" (Hagiwara, 4:62-64). Accordingly, Hagiwara teaches that the bandpass filters passing IR wavebands (NIR wavebands) may also be mounted on an image sensor. Schaafsma Declaration, 34, 45.

It would have been obvious to mount the optical filter 65 of Gray on an image sensor of the multispectral imaging systems of ElMasry because ElMasry and Hagiwara provide examples of bandpass filters on image sensors, and replacing the image sensors of ElMasry with the optical filter 65 of Gray on the image sensors would be no more than combining familiar elements according to known methods that yield the predictable result of filtering out portions of light arriving at the image sensors. Schaafsma Declaration, 34, 45. *See KSR*, 550 U.S. at 416-17 ("The combination of familiar elements according to known methods is likely to be

obvious when it does no more than yield predictable results," and "[i]f a [POSITA] can implement a predictable variation, [§103] likely bars its patentability.").

Thus, ElMasry, Gray, and Hagiwara render claim 13 obvious.

H. Ground 8: Claim 14 is rendered obvious by ElMasry, Gray, and Darty

1. Overview of Darty

Darty discloses "hyperspectral/multispectral imaging systems, methods and devices for determining hyperspectral/multispectral signature(s) of a region of interest (ROI)". Darty, [0096]. Darty, Figure 8 (below) illustrates image device 800, which "generally includes an imaging unit 802 and a control module 812 in electrical communication with the imaging unit," and "the image device includes … illumination assembly 804". Darty, [0159]. Darty also teaches "the imaging unit includes a lens assembly 806, a spectral filter unit 808 in optical communication with the lens assembly, and a photosensor unit 810 in optical communication with the spectral filter unit." Darty, [0161].

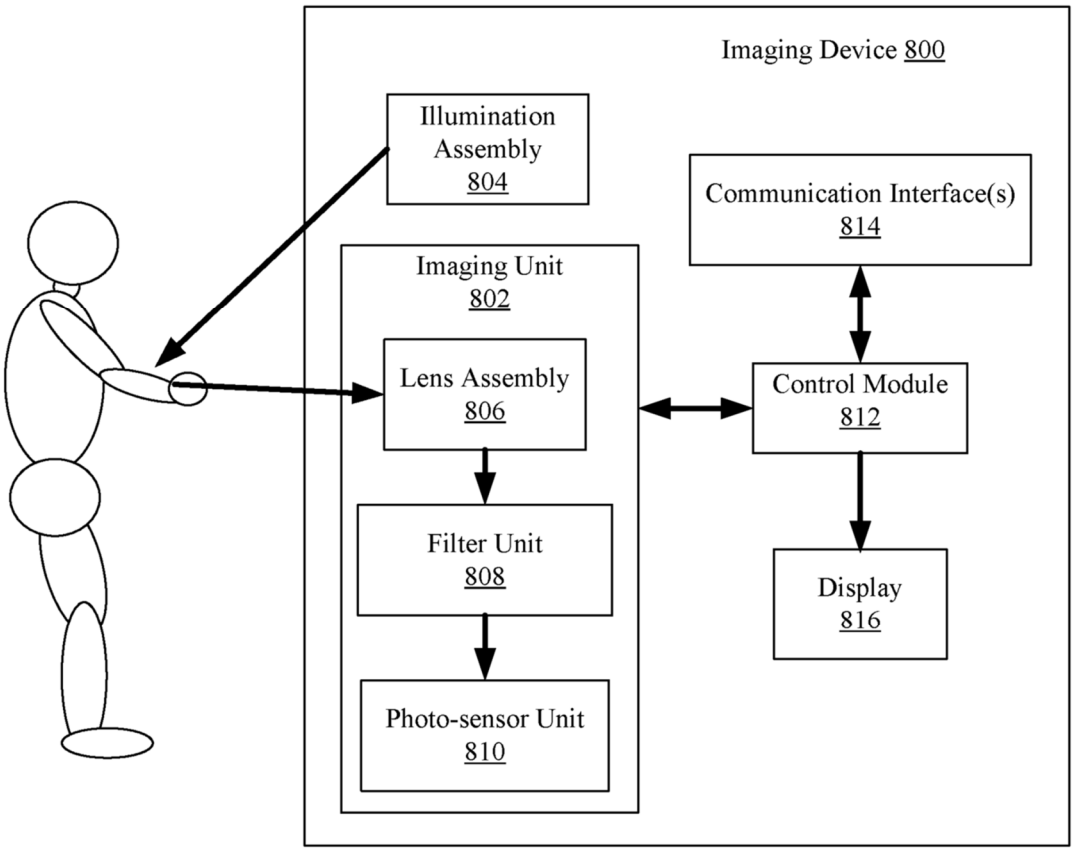


Figure 8

Darty, Figure 8.

"[S]pectral filter unit 808 is characterized by the first and second pluralities of spectral bands and is used to filter the light," and "spectral filter unit 808 can include one or more spectral filters." Darty, [0162]. "A spectral filter generally includes an array of filter elements (e.g., filter elements 211 disclosed herein …) … [that] can be described in terms of their spectral 'bandpass,' e.g., the span of component wavelengths allowed to pass through the filter," and "the bandpass filter

is characterized by both its characteristic or center wavelength and its spectral [FWHM] bandwidth." Darty, [0162].

Darty provides examples of FWHM spectral bands of bandpass filters, such as spectral filter unit 808 of Figure 8, which includes an array of filter elements 211. For example, "a filter element is a bandpass filter, e.g., a filter that allows only radiation having a wavelength in a certain range to pass, while blocking passage of other wavelengths," and "the FWHM spectral bandpass of a filter element 211 … is no more than about 100 nm, preferably no more than about 50 nm, more preferably no more than about 25 nm." Darty, [0162].

Darty is analogous art, and therefore may be used as prior art to the claims of '947 Patent, because the teachings of Darty are reasonably pertinent to '947 Patent. Darty teaches hyperspectral/multispectral imaging devices and methods (Darty, [0096]) and '947 Patent discloses spectral imaging techniques used specifically in a sorting device. A POSITA would have understood that the spectral imaging techniques taught by Darty would be reasonably pertinent to the sorting device of '947 Patent. Schaafsma Declaration, 20.

2. Claim 14 is obvious in view of ElMasry, Gray, and Darty

a) The selector machine of claim 11, wherein each said narrow spectral band of said bandpass filter has a bandwidth substantially comprised between 15 and 35 nm.

ElMasry teaches "[t]he method of wavelength selection should also identify the optical center frequency and bandwidth (FWHM) that provide optimal discrimination". ElMasry, 26. ElMasry teaches "a filter wheel for holding 12 different band-pass filters with 10 nm [FWHM] in the range of 400-510 nm and two other filters at 550 and 600 nm with 70 and 40 nm FWHM, respectively." ElMasry, 23. While this example is directed to wavebands outside the infrared spectrum, FWHM bandwidths of this example fall in a 10-70 nm range, encompassing the "between 15 and 35 nm" range of claim 14. Tight spacing between peak wavelengths of NIR wavebands of another example discussed in ElMasry (ElMasry, 21) suggests wavebands of the bandpass filter, to avoid waveband overlap, would be around 30 nm or less, overlapping the claimed "between 15 and 35 nm" range. Schaafsma Declaration, 48, 53. A POSITA would therefore have considered and used FWHM spectral bandwidths between 15 and 35 nm based on ElMasry alone, depending on application specific factors for optimizing discrimination of objects to be sorted. Schaafsma Declaration, 53.

Darty identifies a "no more than about 25 nm" FWHM passband. *See* Darty, [0164]. In a specific example of a bandpass filter where each of the center frequencies are in "the infrared or near infrared range," Darty teaches "[FWHM] of less than 20 nm" (Darty, [0179]), which overlaps with "bandwidth substantially comprised between 15 and 35 nm" of claim 14.

It would have been obvious to a POSITA to use the "preferably no more than about 25 nm" or "less than 20 nm" FWHM passbands of Darty for the multiband optical bandpass filter of Gray in the imaging systems of ElMasry because ElMasry teaches the selection of an appropriate FWHM passband is an application specific design choice based on optimization of discrimination of objects to be sorted and the passbands of examples disclosed in ElMasry and Darty overlap the claimed range. Schaafsma Declaration, 48, 53. "'[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation,'" and "'[a] *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art.'" *E.I. Dupont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018) (quoting *In re Aller*, 220 F.2d 454, 456 (CCPA 1955), and *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003)).

Ranges disclosed in ElMasry and Darty overlap the claimed "between 15 and 35 nm" range. Furthermore, ElMasry identifies width of the spectral band as a variable for optimizing discrimination between objects identified using ElMasry's imaging system. Thus, the prior art defines spectral bandwidth as "result-effective." *See In re Applied Materials, Inc.*, 692 F.3d 1289, 1295 (Fed. Cir. 2012) (citing *In re Antonie*, 559 F.2d 618, 620 (CCPA 1977)).

Accordingly, ElMasry, Gray, and Darty render claim 14 obvious.

IX. CONCLUSION

Based on the foregoing, claims 1-15 of ’947 Patent are unpatentable. Petitioner requests institution of Post Grant Review to cancel these claims.

Respectfully Submitted,

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Table of Exhibits for U.S. Patent 11,666,947 Petition for Post Grant Review

Exhibit	Description
1001	US Patent 11,666,947
1002	ElMasry, Gamal, Nasser Mandour, Salim Al-Rejaie, Etienne Belin, and David Rousseu, "Recent Applications of Multispectral Imaging in Seed Phenotyping and Quality Monitoring—An Overview," *Sensors*, vol. 19 (March 2019), article 5.
1003	US Patent 4,558,786 to Lane
1004	GB Patent Application Number 2578180 to Gerken et al.
1005	US Patent 9,795,996 to Adams et al.
1006	US Patent 5,508,512 to Gray et al.
1007	US Patent Publication 2018/0020200 to Hagiwara et al.
1008	US Patent Publication 2020/0088580 to Darty et al.
1009	Schaafsma Declaration
1010	Hall-Ellis Declaration
1011	Satake Website
1012	MSS Optical Website
1013	Pearson, Tom, Elizabeth Maghirang, and Floyd Dowell, "A Multispectral Sorting Device for Wheat Kernels," Colombia International Publishing, *American Journal of Agricultural Science and Technology* (2013) 2: 45-60
1014	US Patent 4,418,359 to Stapleton
1015	Prosecution History of US Patent 11,666,947
1016	Curriculum Vitae of David Schaafsma, PhD
1017	Curriculum Vitae of Sylvia Hall-Ellis, PhD

CERTIFICATE UNDER 37 CFR §42.24(d)

Under the provisions of 37 CFR §42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for Post Grant Review totals 18,529 which is less than the 18,700 words allowed under 37 CFR §42.24(a)(1)(ii).

Respectfully submitted,

Dated: February 26, 2024

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CERTIFICATE OF SERVICE

I hereby certify that on February 26, 2024, I caused a true and correct copy of the foregoing materials:

- Petition for Post Grant Review of U.S. Patent No. 11,666,947 Under 35 U.S.C. §321-329 and 37 C.F.R. §42.200, ET SEQ.
- Exhibit List
- Exhibits for Petition for Post Grant Review of U.S. Patent No. 11,666,947 (EX1001-1017)
- Power of Attorney
- Fee Authorization
- Word Count Certification Under 37 CFR §42.24(d)

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