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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte WENDE ZHANG and JINSONG WANG

Appeal 2016-001767
Application 13/298,615
Technology Center 2400

Before CAROLYN D. THOMAS, ERIC B. CHEN, and
JOHN R. KENNY, *Administrative Patent Judges*.

CHEN, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134(a) from the final rejection of claims 1–20, all the claims pending in the application. We have jurisdiction under 35 U.S.C. § 6(b). We affirm-in-part.

STATEMENT OF THE CASE

Appellants' invention relates to distinguishing between daytime lighting conditions and nighttime lighting conditions based on a captured image by a vision-based imaging device along a path of travel. (Abstract.)

Claims 1, 3, and 9 are exemplary, with disputed limitation in italics:

1. A method of distinguishing between daytime lighting conditions and nighttime lighting conditions based on a captured image by a vision-based imaging device along a path of travel, the method comprising the steps of:

capturing an image by a vision-based imaging device;

selecting a region of interest in the captured image;

determining a light intensity value for each pixel within the region of interest;

generating a cumulative histogram based on light intensity values within the region of interest, the cumulative histogram including a plurality of category bins representing the light intensity values, each category bin identifying an aggregate value of light intensity values assigned to each respective category bin;

comparing an aggregate value within a predetermined category bin of the histogram to a first predetermined threshold; and

determining whether the image is captured during the daytime lighting conditions as a function of the aggregate value within the predetermined category bin.

3. The method of claim 2 *wherein the determination of whether the captured image is obtained during the daytime lighting conditions further comprises the step of determining whether the*

captured image includes a daylight blocking structure over the path of travel.

9. The method of claim 8 wherein determining that the capture image is obtained during nighttime lighting conditions further comprises the step of *determining whether the nighttime lighting conditions include substantial lighting for illumination the path of travel* in response to the aggregate value being greater than the first predetermined threshold, wherein determining an illumination of the path of travel comprises:

comparing an aggregate value of a second predetermined category bin of the cumulative histogram to a third predetermined threshold;

determining whether an aggregate value of the light intensity values within the second predetermined category bin is less than the third predetermined threshold; and

determining that the captured image includes the path of travel in the captured image is substantially illuminated in response to the second predetermined category being less than the third predetermined threshold.

Claims 1–3 and 6 stand rejected under 35 U.S.C. § 102(b) as anticipated by Zhu (US 2008/0069400 A1; Mar. 20, 2008).

Claims 4, 7–9, and 14–20 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Zhu.

Claim 5 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Zhu and Wildervanck (US 2008/0167810 A1; July 10, 2008).

Claims 10–13 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Zhu and Schofield (US 2003/0205661 A1; Nov. 6, 2003).

The Examiner has withdrawn the rejection of claim 1 under the judicially created doctrine of obviousness-type double patenting as

unpatentable over claims 20–23 of commonly owned Zhang (US 9,445,011 B2; Sept. 13, 2016). (Ans. 3.)

§ 102 Rejection—Zhu

Claims 1 and 6

First, we are unpersuaded by Appellants’ arguments (App. Br. 8–9; *see also* Reply Br. 2) that Zhu does not describe the limitation “generating a cumulative histogram based on light intensity values within the region of interest,” as recited in independent claim 1.

The Examiner found that the automatic context categorization of Zhu, which selects the lower two-thirds of image pixels and clusters images with similar histograms, corresponds to the limitation “generating a cumulative histogram based on light intensity values within the region of interest.” (Ans. 14–15; *see also* Final Act. 4–6.) We agree with the Examiner.

Zhu “relates to vision systems for vehicle detection that can adapt to changing visibility conditions.” (¶ 2.) Figure 1 of Zhu illustrates a series of images and related histograms captured in various lighting conditions (¶ 20) with “[a]utomatic context categorization of the input frames based on the histogram of pixel intensities” (¶ 43). Zhu explains that “the lighting context of an image will be defined from the histogram of its lower two-thirds” (¶ 53) such that “[i]mage samples are first grouped into a number of clusters, where images with similar histograms are categorized into a same cluster” (¶ 55). Because Zhu explains that the lower two-thirds of an image are used to generate the histogram and that such images are clustered by similar histograms, Zhu discloses the limitation “generating a cumulative histogram based on light intensity values within the region of interest.”

Appellants argue that “[i]n Zhu, histograms 105-108, illustrated in Fig. 1 of Zhu, show distributed histograms” and “[t]he Examiner relies on Par [0043] to describe the cumulative histogram; however, Par [0043] or any other section in Zhu fails to teach the cumulative histogram.” (App. Br. 8 (emphasis omitted).) In particular, Appellants argue that “[f]or the cumulative histogram represented by Fig. 4 [of the Specification], the counts of the all the bins leading up to a specified bin are added” and “each respective bin in the cumulative histogram maintains a running total of all the previous bins leading up to each specified bin, whereas distributive histograms maintain the allocation of values to their assigned bins (i.e., counts are not additive as the graph progresses).” (Reply Br. 2.) However, Appellants’ arguments are not commensurate in scope with claim 1, because the claim does not require each respective bin in the cumulative histogram to maintain a running total of all the previous bins leading up to each specified bin. Appellants have not pointed to any special definition of “cumulative histogram” from the Specification that would require a different interpretation.

Therefore, we agree with the Examiner that Zhu describes the limitation “generating a cumulative histogram based on light intensity values within the region of interest.”

Second, we are unpersuaded by Appellants’ arguments (App. Br. 9; *see also* Reply Br. 3) that Zhu does not describe the limitation “comparing an aggregate value within a predetermined category bin of the histogram to a first predetermined threshold,” as recited in independent claim 1.

The Examiner found that the identification of saturated images and assigning such saturated images to a separate cluster corresponds to the

limitation “comparing an aggregate value within a predetermined category bin of the histogram to a first predetermined threshold.” (Ans. 15; *see also* Final Act. 4–6.) We agree with the Examiner.

Zhu explains that “[f]or saturated images, majority of image pixels assume values only in the lowest (from 0 to 9 for 8 bit image) and highest bins (from 245 to 255 for 8 bit images) in their histograms” and “[i]t is straightforward to identify saturated images from their histograms by examining the percentage of pixels falling into the lowest and highest bins.” (¶ 69.) Thus, because the saturated images of Zhu for the lowest or highest bins (i.e., the claimed “a predetermined category bin”) would also produce corresponding frequency values (i.e., the y-axis in a histogram) for such bins, Zhu discloses the limitation “comparing an aggregate value within a predetermined category bin of the histogram to a first predetermined threshold.”

Appellants argue “Zhu describes identifying saturated images from their histograms by examining the percentage of pixels falling into the lowest and highest bins” and “[i]dentifying the percentage of pixels falling into the lowest and highest bins does not teach each category bin identifies an aggregate value of light intensity values assigned to each respective category bin.” (Reply Br. 3 (emphasis omitted); *see also* App. Br. 9.) However, because Zhu explains that histograms having values only in the lowest (from 0 to 9 for 8 bit image) and highest bins (from 245 to 255 for 8 bit images) are identified and such bins have corresponding frequency values, Zhu discloses the limitation “comparing an aggregate value within a predetermined category bin of the histogram to a first predetermined threshold.”

Therefore, we agree with the Examiner that Zhu describes the limitation “comparing an aggregate value within a predetermined category bin of the histogram to a first predetermined threshold.”

Third, we are unpersuaded by Appellants’ arguments (App. Br. 9–10) that Zhu does not describe the limitation “determining whether the image is captured during the daytime lighting conditions as a function of the aggregate value within the predetermined category bin,” as recited in independent claim 1.

The Examiner found that the four categories of Zhu, including Night, Low Light (LL), Daylight (DL) and Saturation, correspond to the limitation “determining whether the image is captured during the daytime lighting conditions as a function of the aggregate value within the predetermined category bin.” (Ans. 16; *see also* Final Act. 4–6.) We agree with the Examiner.

Figure 3 of Zhu illustrates “the type of image and histogram associated with a particular cluster of images” (¶ 69), including Night (¶ 70), Low Light (LL) (¶ 71), Day Light (DL) (¶ 72), and Saturated (¶ 73). Figure 3 also illustrates distinct histograms for Low Light (LL) and Day Light (DL) conditions. Furthermore, Figure 1 of Zhu illustrates histogram 108 for daylight conditions, with pixel values ranging from about 150 to about 180 (i.e., bins) with each pixel value corresponding to a specific frequency (i.e., y-axis on histogram 108) and illustrates histogram 105 for nighttime conditions, with pixel values ranging from about 25 to about 75, with each pixel value corresponding to a specific frequency.

Because the histograms for the Day Light (DL) cluster are distinct from the Low Light (LL) cluster of Zhu, including the frequency

corresponding to each pixel value, any determination of whether a histogram should be placed into the DL cluster would require a comparison to given frequency corresponding to a predetermined pixel value. Accordingly, Zhu discloses the limitation “determining whether the image is captured during the daytime lighting conditions as a function of the aggregate value within the predetermined category bin.”

Appellants argue “[w]hile Zhu describes determining a lighting condition based on illumination intensity values in a distributed histogram, Zhu does not teach the specific technique and associated limitations recited in claim 1” and “[t]he Examiner appears to be applying Zhu based on the end result of identifying the daylight lighting condition, and not on the process/steps used to identify the lighting condition.” (App. Br. 9–10.) However, as discussed previously, any comparison between two histograms would require comparing the frequencies (i.e., the y-axis of the histograms) at a predetermined pixel values (i.e., bins).

Therefore, we agree with the Examiner that Zhu describes the limitation “determining whether the image is captured during the daytime lighting conditions as a function of the aggregate value within the predetermined category bin.”

Accordingly, we sustain the rejection of independent claim 1 under 35 U.S.C. § 102(b). Claim 6 depends from claim 1, and Appellants have not presented any substantive arguments with respect to this claim. Therefore, we sustain the rejection of claim 6 under 35 U.S.C. § 102(b), for the same reasons discussed with respect to independent claim 1.

Dependent Claim 2

We are unpersuaded by Appellants' arguments (App. Br. 10–11; *see also* Reply Br. 4) that Zhu does not describe the limitation “wherein the determination that the image is captured during the daylight lighting conditions is based on the aggregate number being less than a first predetermined threshold,” as recited in dependent claim 2.

The Examiner found that the four categories of Zhu, including Night, Low Light (LL), Daylight (DL) and Saturation, correspond to the limitation “wherein the determination that the image is captured during the daylight lighting conditions is based on the aggregate number being less than a first predetermined threshold.” (Ans. 17; *see also* Final Act. 7.) We agree with the Examiner.

As discussed previously, Figure 1 of Zhu illustrates histogram 108 for daylight conditions, with pixel values ranging from about 150 to about 180 (i.e., bins) with each pixel value corresponding to a specific frequency (i.e., y-axis on the histogram) and illustrates histogram 105 for nighttime conditions, with pixel values ranging from about 25 to about 75, with each pixel value corresponding to a specific frequency. For example, from Figure 1, histogram 108 illustrates that for pixel values ranging from about 25 to about 75, the corresponding frequency is close to zero, and accordingly, discloses the limitation “wherein the determination that the image is captured during the daylight lighting conditions is based on the aggregate number being less than a first predetermined threshold.”

Appellants argue that “[t]he Examiner alleges that the determination performed by identifying the nearest centroid among the clusters implies that the inherent thresholds transition from one category to the next” and

“Applicant asserts that to anticipate the claim, the reference must teach each of the limitations and not infer the limitations.” (App. Br. 10 (emphasis omitted); *see also* Reply Br. 4.) Appellants further argue that “Zhu’s technique of utilizing a centroid is a completely different technique than that recited in claim 2 of determining whether the aggregate value of the predetermined category bin of the cumulative histogram is less than a first predetermined threshold” and “[w]hile Zhu describes a technique for determining the lighting condition, the process is different from the claimed process recited in claim 2.” (App. Br. 11.) However, as discussed previously, histogram 108 of Zhu illustrates that for pixel values ranging from about 25 to about 75, the corresponding frequency is close to zero, and accordingly, Zhu discloses the limitation “wherein the determination that the image is captured during the daylight lighting conditions is based on the aggregate number being less than a first predetermined threshold.”

Therefore, we agree with the Examiner that Zhu describes the limitation “wherein the determination that the image is captured during the daylight lighting conditions is based on the aggregate number being less than a first predetermined threshold.”

Accordingly, we sustain the rejection of dependent claim 2 under 35 U.S.C. § 102(b).

Dependent Claim 3

We are persuaded by Appellants’ arguments (App. Br. 11–12) that Zhu does not describe the limitation “wherein the determination of whether the captured image is obtained during the daytime lighting conditions further comprises the step of determining whether the captured image includes a

daylight blocking structure over the path of travel,” as recited in dependent claim 3.

The Examiner found that the image of low light condition of Zhu, which includes tunnels, corresponds to the limitation “wherein the determination of whether the captured image is obtained during the daytime lighting conditions further comprises the step of determining whether the captured image includes a daylight blocking structure over the path of travel.” (Ans. 19; *see also* Final Act. 8.) We do not agree.

Zhu explains that low light images “include images of dusk, dawn, or in tunnels with low ambient lights.” (§ 71.) Although the Examiner cited to the “tunnels with low ambient lights” of Zhu, the Examiner has provided insufficient evidence to support a finding that Zhu discloses the limitation “wherein the determination of whether the captured image is obtained during the daytime lighting conditions further comprises the step of determining whether the captured image includes a daylight blocking structure over the path of travel.” In particular, Zhu explains that such tunnel is associated with other low light images, such as dusk or dawn, rather than “a daylight blocking structure over the path of travel,” as claimed. (§ 71.) Thus, the Examiner had not demonstrated that Zhu discloses the limitation “wherein the determination of whether the captured image is obtained during the daytime lighting conditions further comprises the step of determining whether the captured image includes a daylight blocking structure over the path of travel.”

Accordingly, we are persuaded by Appellants’ arguments that “this referenced section of Zhu fails to describe the determination of whether the images include a daylight blocking structure captured during the daytime

lighting conditions” and “[t]he term low ‘ambient’ lights refers to the general lighting condition in a surrounding area, and that by itself does not teach the limitation of determining whether an image was captured during the daytime lighting condition while under a daylight blocking structure.” (App. Br. 11.)

Therefore, we do not agree with the Examiner that Zhu describes the limitation “wherein the determination of whether the captured image is obtained during the daytime lighting conditions further comprises the step of determining whether the captured image includes a daylight blocking structure over the path of travel,” as recited in dependent claim 3.

Accordingly, we do not sustain the rejection of dependent claim 3 under 35 U.S.C. § 102(b).

§ 103 Rejection—Zhu

Dependent Claims 4 and 7

Claims 4 and 7 dependent from claim 3. We do not sustain the rejection of claims 4 and 7 for the same reasons discussed with respect to rejection of claim 3 under 35 U.S.C. § 102(b) as anticipated by Zhu.

Dependent Claim 8

Although Appellants nominally argue the rejection of dependent claim 8 separately (App. Br. 14), the arguments presented do not point out with particularity or explain why the limitations of this dependent claim are separately patentable. Instead, Appellants merely argue that “[s]imilar to Appellants’ arguments set forth in support of claim 1, there is no description of an aggregate number within a predetermined category bin of the

cumulative threshold being compared to a first predetermined threshold” and “Appellant specifically utilizes a cumulative histogram as opposed to a distributive histogram for enhancing the operations and results from the described technique” (*Id.*) We are not persuaded by these arguments for the reasons discussed with respect to claim 1, from which claim 8 depends. Accordingly, we sustain this rejection.

Dependent Claim 9

We are persuaded by Appellants’ arguments (App. Br. 16–17) that Zhu does not describe the limitation “determining whether the nighttime lighting conditions include substantial lighting for illumination the path of travel,” as recited in dependent claim 9.

The Examiner found the four categories of Zhu, including Night, Low Light (LL), Daylight (DL) and Saturation, correspond to the limitation “determining whether the nighttime lighting conditions include substantial lighting for illumination the path of travel.” (Ans. 24; *see also id.* at 17, 19.) We do not agree.

As discussed previously, Figure 3 of Zhu illustrates “the type of image and histogram associated with a particular cluster of images” (¶ 69), including Night (¶ 70), Low Light (LL) (¶ 71), Day Light (DL) (¶ 72), and Saturated (¶ 73). Although the Examiner cited to Figure 3 of Zhu, including the Night, Low Light (LL), Daylight (DL) and Saturation clusters, the Examiner has provided insufficient evidence to support a finding that Zhu teaches the limitation “determining whether the nighttime lighting conditions include substantial lighting for illumination the path of travel.” In particular, Zhu explains certain images are clustered with either Night or

Low Light (LL) conditions, but is silent with respect lighting for either Night or Low Light conditions. Thus, the Examiner has not demonstrated that Zhu teaches the limitation “determining whether the nighttime lighting conditions include substantial lighting for illumination the path of travel.”

Accordingly, we are persuaded by Appellants’ arguments that “[w]hile Zhu describes a technique for determining whether the image includes night, low light, daylight, or saturation, the technique is entirely different from that recited in claim 9, and more specifically, there is no determination of whether the path of travel during the nighttime lighting condition includes substantial illumination.” (App. Br. 16–17.)

Thus, we do not agree with the Examiner that Zhu would have rendered obvious dependent claim 9, which includes the limitation “determining whether the nighttime lighting conditions include substantial lighting for illumination the path of travel.”

Therefore, we do not sustain the rejection of dependent claim 9 under 35 U.S.C. § 103(a).

Claim 14

Although Appellants nominally argue the rejection of dependent claim 14 separately (App. Br. 17), the arguments presented do not point out with particularity or explain why the limitations of this dependent claim are separately patentable. Instead, Appellants merely provide a conclusory statement that “Zhu fails to describe capturing multiple images over a period of time and cumulatively analyzing the multiple images for detecting the daylight conditions” and “[w]hile Zhu describes analyzing a respective image captured by the image capture device, there is no description in Zhu

of cumulatively analyzing multiple images for detecting daylight conditions.” (App. Br 17 (emphasis omitted).) Accordingly, Appellants have not presented any substantive arguments with respect to this claim. *See In re Lovin*, 652 F.3d 1349, 1357 (Fed. Cir. 2011) (“[T]he Board reasonably interpreted Rule 41.37 to require more substantive arguments in an appeal brief than a mere recitation of the claim elements and a naked assertion that the corresponding elements were not found in the prior art.”). We are not persuaded by these arguments for the reasons discussed with respect to claim 1, from which claim 14 depends. Accordingly, we sustain this rejection.

Claims 15–20

Claims 15 and 16 recite limitations similar to those discussed with respect to dependent claim 3. Claims 17–20 depend from claim 16. We do not sustain the rejection of claims 15 and 16, as well as dependent claims 17–20, for the same reasons discussed with respect to the rejection of dependent claim 3 under 35 U.S.C. § 102(b).

§ 103 Rejection—Zhu and Wildervanck

Claim 5 depends from claim 4. Wildervanck was cited by the Examiner for teaching the additional features of claim 5. (Ans. 10–11.) However, the Examiner’s application of Wildervanck does not cure the above noted deficiencies of Zhu. Accordingly, we do not sustain the rejection of dependent claim 5 under 35 U.S.C. § 103(a).

§ 103 Rejection—Zhu and Schofield

Claims 10–12

Claims 10–12 depend from claim 1 and Appellants have not presented any additional substantive arguments with respect to these claims. (App. Br. 22.) Therefore, we sustain the rejection of claims 10–12 under 35 U.S.C. § 103(a), for the same reasons discussed with respect to independent claim 1.

Claim 13

We are unpersuaded by Appellants’ arguments (App. Br. 21–22; *see also* Reply Br. 2–3) that the combination of Zhu and Schofield would not have rendered obvious dependent claim 13, which includes the limitation “wherein the selected region of interest represents an expected location of a skyline within the captured image.”

The Examiner found that the photosensor elements of Schofield, which detects portions of the scene just above the horizon, corresponds to the limitation “wherein the selected region of interest represents an expected location of a skyline within the captured image.” (Ans. 33; *see also* Final Act. 39.) In particular, the Examiner further found that “[i]t is well-known to the person of ordinary skill in the art at the time of the invention that the Earth’s horizon would be the selected location of skyline where sky would not be occluded.” (Ans. 33.) The Examiner concluded that “it would have been obvious . . . to modify the system disclosed by Zhu [to] add the teachings of Schofield . . . in order to selected region of interest represents an expected location of a skyline within the captured image.” (*Id.*) We agree with the Examiner.

Zhu explains that “the upper third of the frames shows large variations because of various objects that can occlude the sky, such as trees, mountains or buildings.” (¶ 53.) Zhu further explains that “[t]hese variations make it more complex to infer the lighting context” and “[c]onsequently the lighting context of an image will be defined from the histogram of its lower two-thirds.” (*Id.*)

Schofield relates to “controlling the vehicle’s headlamps in response to sensing the headlights of oncoming vehicles and taillights of leading vehicles.” (¶ 2.) Schofield explains that “[v]ehicle headlight dimming control 12 additionally includes an ambient light-sensing circuit 84 which receives an input from digital output signal 68” and “the photosensor elements in the sensed subset include sensors that detect portions of the forward-looking scene that are just above the earth’s horizon which is more indicative of the ambient light condition.” (¶ 30.) Because the photosensor element of Schofield detects the ambient light condition using the forward-looking scene near the earth’s horizon, Schofield teaches the limitation “wherein the selected region of interest represents an expected location of a skyline within the captured image.”

A person of ordinary skill in the art would have recognized that incorporating the known method of Schofield, in which using a forward-looking scene near the earth’s horizon is used to determine ambient light, with the known vision systems of Zhu for vehicle detection, would improve Zhu by providing the advantage of selecting a region more indicative of the ambient light condition. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) (“[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve

similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.”). Thus, we agree with the Examiner (Ans. 33) that modifying Zhu to incorporate Schofield would have been obvious.

Appellants argue that Zhu teaches sensing ambient light conditions on the earth’s horizon, whereas “Zhu specifically states that the sky is not utilized and avoided because of complexity issues,” and accordingly, “Zhu teaches away from the limitations of claim 13” and “Zhu and Schofield are not combinable since Zhu specifically negates the use of the sky for illumination analysis.” (App. Br. 22.) Contrary to Appellants’ arguments, Zhu describes an embodiment that excludes selecting the upper third of frames as a region of interest because large variations can be created in that upper third by various objects occluding the sky, such as trees, mountains, and buildings. (¶ 53.) Furthermore, the Examiner found, and Appellants do not dispute, that it was well known to a person of ordinary skill in the art that the horizon would not be a location where objects, such as trees, mountains, and buildings, would occlude the sky and create large variations. (Ans. 33.) Accordingly, Zhu would not teach away from its combination with Schofield or the use of the horizon, as a selected region of interest.

Thus, we agree with the Examiner that the combination of Zhu and Schofield would have rendered obvious dependent claim 13, which includes the limitation “wherein the selected region of interest represents an expected location of a skyline within the captured image.”

Accordingly, we sustain the rejection of dependent claim 13 under 35 U.S.C. § 103(a).

DECISION

The Examiner's decision rejecting claims 1, 2, and 6 under 35 U.S.C. § 102(b) is affirmed.

The Examiner's decision rejecting claim 3 under 35 U.S.C. § 102(b) is reversed.

The Examiner's decision rejecting claims 8 and 10–14 under 35 U.S.C. § 103(a) is affirmed.

The Examiner's decision rejecting claims 4, 5, 7, 9 and 15–20 under 35 U.S.C. § 103(a) is reversed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART