

Patent Owner's Demonstratives for Oral Hearing

Mobileye v. Facet, IPR2024-01110

U.S. Patent No. 9,335,255

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(12) **United States Patent**
Retterath et al.

(54) **SYSTEM AND ASSESSMENT OF REFLECTIVE OBJECTS ALONG A ROADWAY**

(71) Applicant: **Facet Technology Corp.**, Eden Prairie, MN (US)

(72) Inventors: **James E. Retterath**, Excelsior, MN (US); **Robert A. Laumeyer**, Eden Prairie, MN (US)

(73) Assignee: **Facet Technology Corp.**, Eden Prairie, MN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

(60) Continuation of application No. 14/025,614, filed on Sep. 12, 2013, now Pat. No. 8,860,944, which is a division of application No. 13/205,337, filed on Aug. 8, 2011, now Pat. No. 8,660,311, which is a division of (Continued)

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G01N 21/55 (2014.01)
G01N 21/25 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **G01N 21/251** (2013.01); **G01N 21/55** (2013.01); **G01N 21/84** (2013.01); **G01S 17/06** (2013.01); **G08G 1/096758** (2013.01); **G08G**

(10) **Patent No.:** **US 9,335,255 B2**

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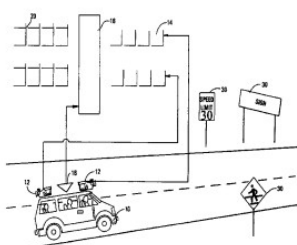
1/096783 (2013.01); **G01N 2201/06113** (2013.01); **G01N 2201/12** (2013.01)

(58) **Field of Classification Search**
CPC **G02B 5/124**; **G02B 1/04**; **G02B 1/105**; **G02B 1/18**; **G02B 2027/014**; **G02B 2027/0187**; **G02B 27/0101**; **G02B 5/0236**; **G02B 5/04**; **G02B 5/122**; **G02B 6/0018**; **G02B 6/0028**; **G02B 6/003**; **G02B 6/0065**; **G02B 6/00**
See application file for complete search history.

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3,636,250 A 1/1972 Haefl
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(Continued)
Primary Examiner—Michael P Stufira
(74) **Attorney, Agent, or Firm**—Patterson Thuenet Podersen, P.A.

(57) **ABSTRACT**
A system for the assessment of reflective surfaces disposed along a roadway repeatedly illuminates an area along the roadway that includes at least one reflective surface using a light source. Multiple light intensity values are measured over a field of view which includes at least a portion of the area illuminated by the light source. A computer processing system is used to identifying a portion of the light intensity values associated with a reflective surface and analyze the portion of the light intensity values to determine assessment for that reflective surface.

23 Claims, 19 Drawing Sheets



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MOBILEYE EXHIBIT 1001

(57)

ABSTRACT

A system for the assessment of reflective surfaces disposed along a roadway repeatedly illuminates an area along the roadway that includes at least one reflective surface using a light source. Multiple light intensity values are measured over a field of view which includes at least a portion of the area illuminated by the light source. A computer processing system is used to identifying a portion of the light intensity values associated with a reflective surface and analyze the portion of the light intensity values to determine assessment for that reflective surface.

'255 Patent, Abstract
(cited by POR at 3)

Claim construction: “a characterization profile of the at least one light intensity sensor” (‘255 Patent, cl. 15)

15. The automated method of claim 12, further comprising determining a luminance value utilizing the plurality of light intensity values and a characterization profile of the at least one light intensity sensor.

‘255 Patent, cl. 15

Claim Term	Patent Owner’s Construction	Petitioner’s Construction
a characterization profile of the at least one light intensity sensor	a compilation, presented in a usable format, of the description of the properties and performance characteristics of a sensor across various conditions POR at 14	a conversion factor to convert a light intensity value determined with at least one light intensity sensor into a luminance value Reply at 3

Intrinsic evidence for “a characterization profile of the at least one light intensity sensor”

light intensity sensor 280 pixels in the same way. By knowing the background or foreground color of the object of interest 460 along with the light intensity sensor's 280 ability to sense, or the light intensity sensor's 280 profile for a particular color, the intensity value 300 for a particular color can be converted into a luminance value. Light intensity sensor 280 characterization is essential for high precision computations since N photons of a given particular color (or wavelength) of light will represent a different gray value (intensity level) in the sensor than N photons of another color (or wavelength) of light. The look-up-table (LUT) 475 shown in FIG. 7 is a digital table stored in memory that uses the indexes of intensity (a single gray level value from the intensity measurement 300) and sheeting color to determine the luminance. The light intensity sensor characterization 275 is empirical information about the light intensity sensor 280 that is used to create the LUT 475. The same LUT 475 is used for computing foreground 510 and background luminance values 500.

'255 Patent, 11:43-60
(cited by POR at
17-18, 20-22, Surreply
at 8-12)

Intrinsic evidence for “a characterization profile of the at least one light intensity sensor”

In order to compute retroreflectivity (R_A), one needs to know the luminance of the reflected energy. Luminance (expressed in candelas per square meter, or cd/m^2) will vary according to the intensity sensor characterization profile 275 of the light intensity sensor(s) 280 and the color of the material from which light is reflected.

'255 Patent, 10:65-11:3 (cited by POR at 15, Surreply at 11)

Extrinsic evidence for “a characterization profile of the at least one light intensity sensor”

CMOS Image Sensors

Konstantin D Stefanov

5.1 Introduction

Electro-optical (EO) characterisation is fundamental to image sensor operation and development. It aims to experimentally measure the parameters of the sensor under different operating conditions. The results are used to select the optimal settings for the best sensor performance, and for a comparison with the estimations calculated during the design phase. Despite the highly powerful simulations and electronic design automation (EDA) tools, there is still no substitute to sensor characterisation. High quality, detailed characterisation can offer a wealth of information that can help optimise the sensor's operation and identify unexpected behaviour or design flaws. It also provides feedback to the simulation tools used in the design.

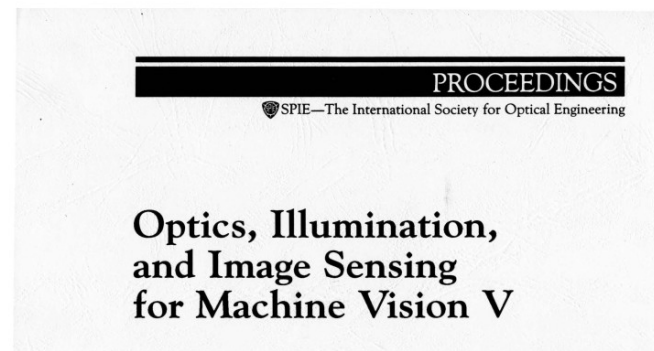
Ex. 2011, 10 (cited by POR at 16)

IOP ebooks

Lumia Does not Satisfy Claim 15 as Properly Construed

Lumia's calibration: does not take into account various conditions

POR at 14, 43-44



Ten signs were measured with the mobile system and compared to data obtained with a calibrated hand-held retroreflector. The signs used for this experiment had a white background color with background R' values ranging from approximately 4 to 350. Calibration of the system was accomplished by acquiring an image of a calibrated white sheeting material and computing a scale factor to convert the 8-bit digital gray levels of the calibration target image to R' values. Sixteen image samples were obtained for each sign using an observation angle of 0.2° and at a distance of 200 feet ("highway" mode). The same signs were measured by an Advanced Retro Technology 910F hand-held retroreflector (HHRR) calibrated with the same calibration target used to calibrate the MSMRTS. Six randomly distributed HHRR measurements of the sign background were made for each sign.

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Ex. 1014, 24 (cited by POR at 43-44)

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MOBILEYE EXHIBIT 1014

Claim 15: Petition's Motivation to Combine

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MOBILEYE GLOBAL, INC.,

Petitioner,

v.

MANDLI COMMUNICATIONS, INC.,

Patent Owner.

Case IPR2024-01110

Patent No. 9,335,255

PETITION FOR *INTER PARTES* REVIEW

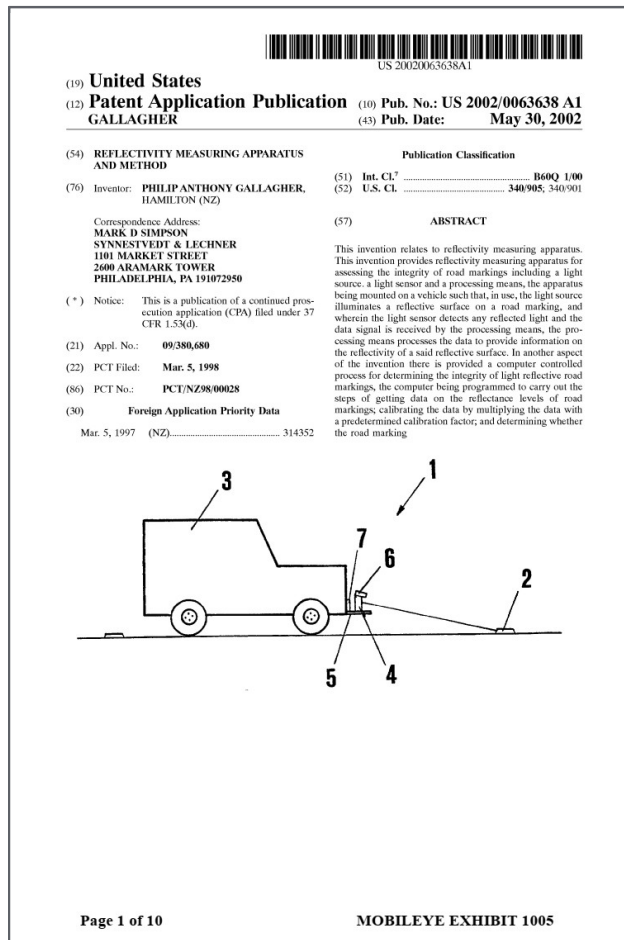
A POSITA would have found it obvious to implement Lumia's determining a luminance value utilizing the plurality of light intensity values and a characterization profile of the at least one light intensity sensor to allow Gallagher's apparatus to calculate the retroreflectivity of road markers. Thorpe ¶116. A POSITA would have been motivated to do so because, as was well known at the time, several road authorities specified minimum retroreflectivity values for road markings along a roadway. *E.g.*, Ex. 1019, 6, 8-11; Thorpe ¶116. Because Gallagher recognizes that "road[] authorities worldwide invariably advocate different standards for road markings" and expressed a desire to analyze the data "in a way and to an extent that meets the criteria of each country," a POSITA would have been motivated to implement Lumia's determining a luminance value to allow its apparatus to identify and tag any markers "that do not meet the predetermined minimum acceptable reflectance level" for countries that require a minimum retroreflectivity level for road markers. Gallagher, [0049], [0077]; Thorpe ¶116.

Pet at 46 (cited by POR at 34)

The Motivation is Met By the References Without Combining in the Manner Claimed

Gallagher: determines whether markers meet retroreflectivity standards without determining a luminance value

POR at 26



[0003] Road markings, and in particular RPM's, are periodically tested to ensure they continue to meet minimum standards of reflectivity/retroreflectivity. Many road authorities stipulate a minimum acceptable reflectance value for an RPM. A conventional method of checking RPM's is by way

[0058] Process step c. involves calibrating the data by multiplying the data with a predetermined calibration factor to calibrate for different positions in the light sensor module 6a.

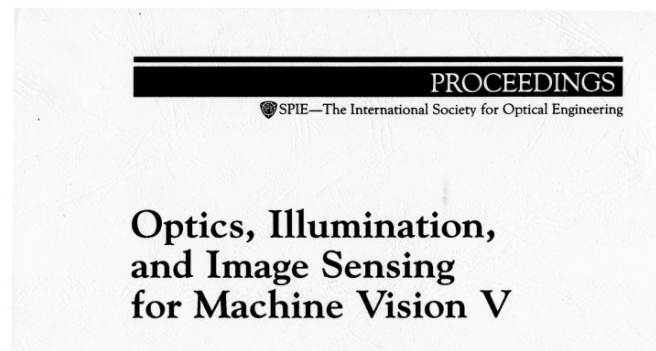
[0067] Process step h. involves determining the reflectance level of the road marker in a value of millicandela per Lux (CIL) or as a percentage of the predetermined standard reflectance level.

[0068] Process step i. involves activating the tagging means 16 to tag a road marker if it is determined as measuring a reflectivity less than the predetermined minimum acceptable reflectance level. It will be appreciated that by tagging the road marker, it can later be identified and replaced as required.

The Motivation is Met By the References Without Combining in the Manner Claimed

Lumia: calculates retroreflectivity values without determining luminance values

POR at 29



Ten signs were measured with the mobile system and compared to data obtained with a calibrated hand-held retroreflector. The signs used for this experiment had a white background color with background R' values ranging from approximately 4 to 350. Calibration of the system was accomplished by acquiring an image of a calibrated white sheeting material and computing a scale factor to convert the 8-bit digital gray levels of the calibration target image to R' values. Sixteen image samples were obtained for each sign using an observation angle of 0.2° and at a distance of 200 feet (“highway” mode). The same signs were measured by an Advanced Retro Technology 910F hand-held retroreflector (HHRR) calibrated with the same calibration target used to calibrate the MSMRTS. Six randomly distributed HHRR measurements of the sign background were made for each sign.



Ex. 1014, 24 (cited by POR at 28-29)

Petitioner's New "Units" Motivation to Combine is Improper New Reply Theory

Petition:

A POSITA would have found it obvious to implement Lumia's determining a luminance value utilizing the plurality of light intensity values and a characterization profile of the at least one light intensity sensor to allow Gallagher's apparatus to calculate the retroreflectivity of road markers. Thorpe ¶116. A POSITA would have been motivated to do so because, as was well known at the time, several road authorities specified minimum retroreflectivity values for road markings along a roadway. *E.g.*, Ex. 1019, 6, 8-11; Thorpe ¶116. Because Gallagher recognizes that "road[] authorities worldwide invariably advocate different standards for road markings" and expressed a desire to analyze the data "in a way and to an extent that meets the criteria of each country," a POSITA would have been motivated to implement Lumia's determining a luminance value to allow its apparatus to identify and tag any markers "that do not meet the predetermined minimum acceptable reflectance level" for countries that require a minimum retroreflectivity level for road markers. Gallagher, [0049], [0077]; Thorpe ¶116.

Reply:

levels." POR 34-36. But Gallagher instead determines a *different* value—coefficient of *luminous intensity*—not the coefficient of *retroreflectivity*. Gallagher, [0067], FIG. 5; Ex. 1003, ¶¶89, 116-117.

After Gallagher's computer processing system determines what data from its sensor indicates road markers, the system "determin[es] the reflectance level of the road marker in a value of millicandela per Lux (CIL)." Gallagher, [0066]-[0067]. Figure 5, below, represents the reflectance levels in "mcd/lux" for each of the front and rear faces of road markers along a stretch of road, as compared to a "threshold minimum acceptable reflectance level B." *Id.*, [0078]-[0079], FIG. 5.

Meanwhile, Lumia discloses that retroreflectivity is a different coefficient, expressed in millicandelas per lux *per meter squared*. See Lumia, 16; Ex. 2023, ¶¶71

■ ■ ■

millicandelas instead of candelas). This shows that Gallagher and Lumia disclose measuring different reflective properties and supports why a POSITA would have found it obvious to combine Gallagher and Lumia "to allow Gallagher's apparatus to calculate the retroreflectivity of road markers," as proposed in the Petition. Pet.

Petitioner's New Theory Based on Lumia's Equation 2 Fails

Lumia's Equation 2: Does not disclose determining luminance and then determining retroreflectivity—provides luminance if one already has retroreflectivity, or vice-versa

POR at 30-33, Surreply at 5-6

The goal of this system is to measure the Coefficient of Retroreflection, or R' , in units of candelas per footcandle per square foot. This can be expressed as:¹

$$R' = \frac{I}{E_n A} \quad (1)$$

where E_n is the normal illumination incident on the retroreflector, A is the area of the surface to be measured, and I is the reflected intensity. By suitable manipulation of these parameters, the retroreflectance can essentially be regarded as the absolute brightness of the retroreflective target for a given amount of incident illumination on the target. Arithmetically, this can be expressed as:

$$R' = \frac{L}{E_n} \quad (2)$$

where L is the luminance of the reflected light. Figure 2 shows the commonly accepted

Ex. 1014 at 16 (cited by POR at 30-32, Surreply at 5-6)

