



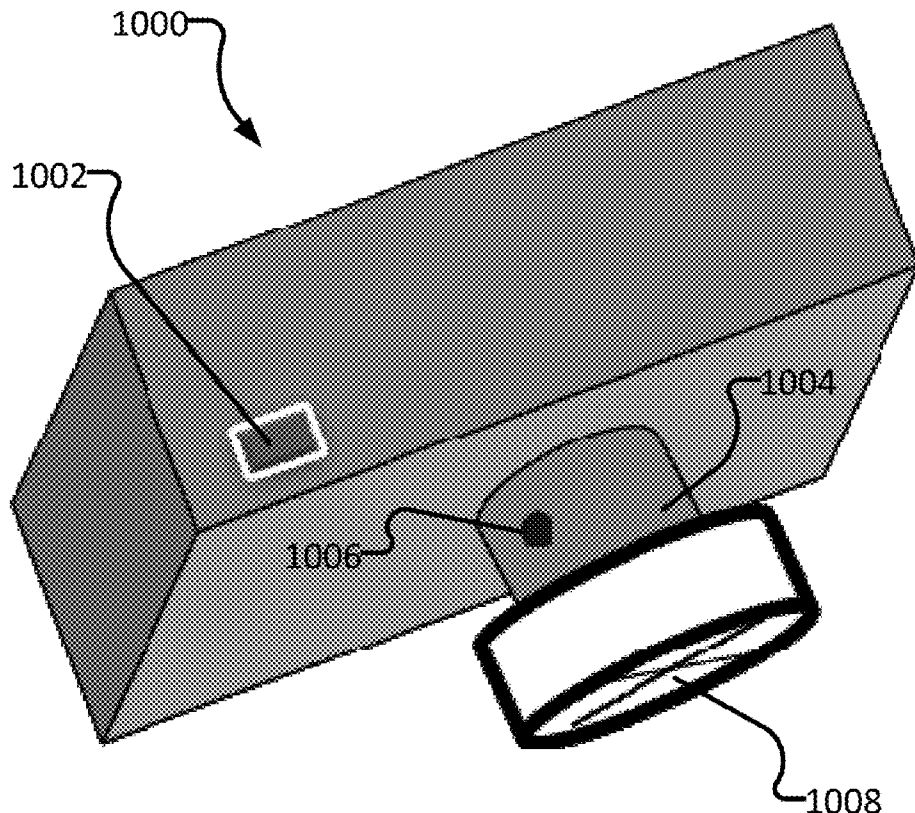
US 20180188108A1

(19) **United States**(12) **Patent Application Publication**
FAWZY(10) **Pub. No.: US 2018/0188108 A1**(43) **Pub. Date: Jul. 5, 2018**(54) **METHOD AND APPARATUS FOR SPECTRAL
REFLECTANCE IMAGING USING DIGITAL
CAMERAS**(71) Applicant: **Zycor Labs Inc.**, Richmond (CA)(72) Inventor: **Yasser FAWZY**, Vancouver (CA)(21) Appl. No.: **15/703,981**(22) Filed: **Sep. 13, 2017****Related U.S. Application Data**(60) Provisional application No. 62/396,730, filed on Sep.
19, 2016.**Publication Classification**(51) **Int. Cl.**
G01J 3/02 (2006.01)
G01J 3/28 (2006.01)
G01J 3/10 (2006.01)(52) **U.S. Cl.**CPC **G01J 3/027** (2013.01); **G01J 3/2823**
(2013.01); **G01J 2003/102** (2013.01); **G01J**
3/10 (2013.01); **G01J 3/0232** (2013.01)

(57)

ABSTRACT

A method and spectral light-based apparatus with an embedded (built-in) spectral calibration module for acquiring multi-spectral reflectance images from a digital camera are disclosed. The apparatus may be an attachment device, which may be integrated with a consumer digital camera (such as smartphone camera), and may measure and/or estimate spectral reflectance and true color values for an object recorded by the camera. An example apparatus comprises an array of monochromatic light sources, preferably pulsed LEDs, irradiating in a time-multiplexed manner to generate light spectra in the range of 400 nm-1000 nm, an optical lens to limit the field of view of the attached camera, an electro-mechanical shutter or plate with its inner (reflection) surface coated with a diffuse reflectance standard to ensure flat spectral response, and an interface module for synchronizing the time-multiplexed light spectra with the coated shutter opening and closing and with the digital frames acquired by the camera, such that the true spectral reflectance and true color value of an object can be measured.



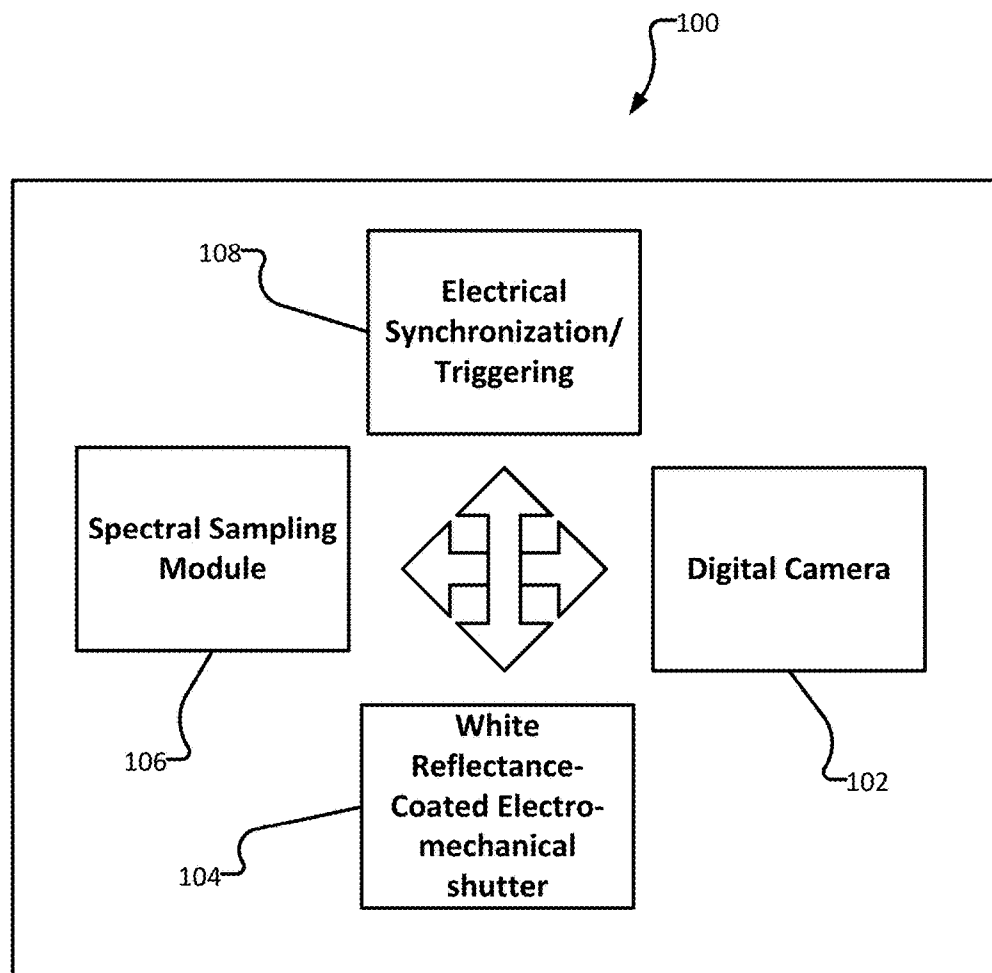


FIG. 1A

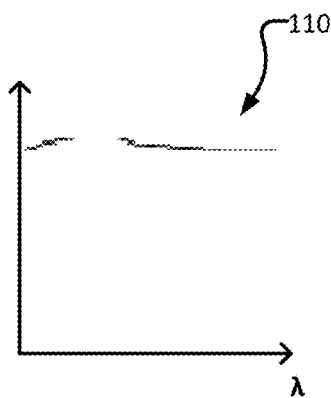


FIG. 1B

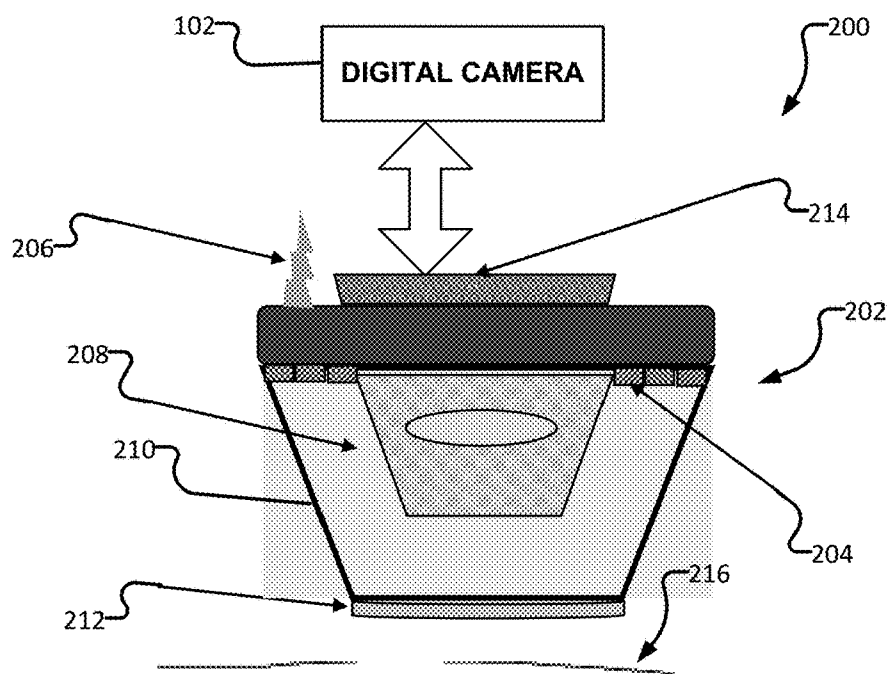


FIG. 2A

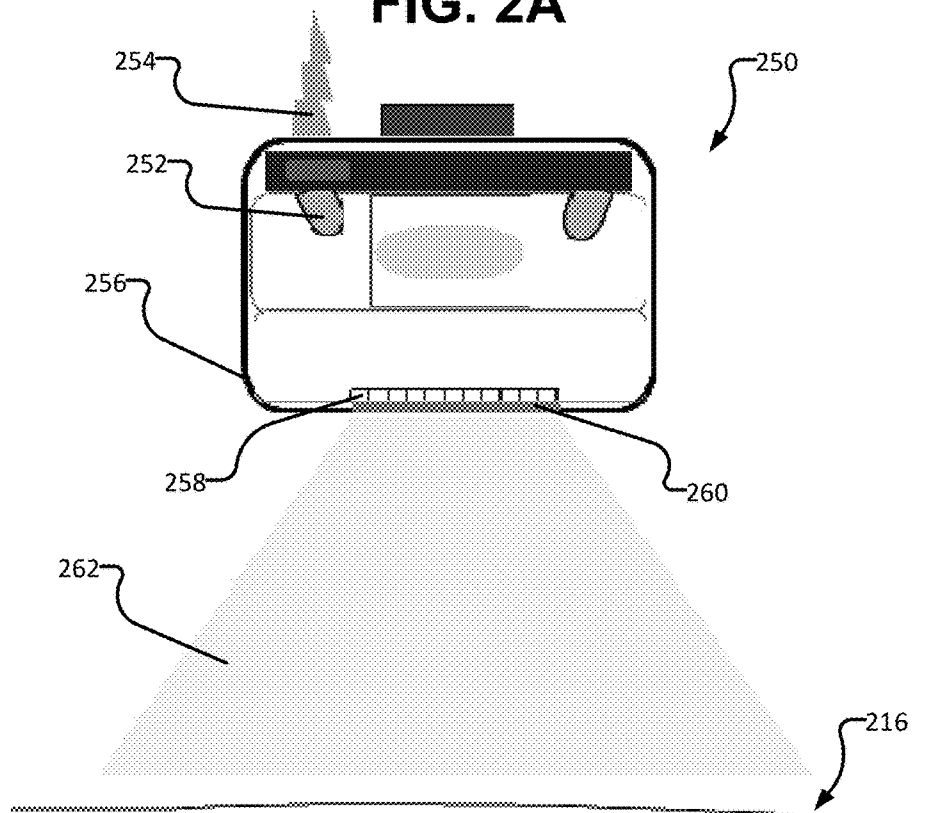


FIG. 2B

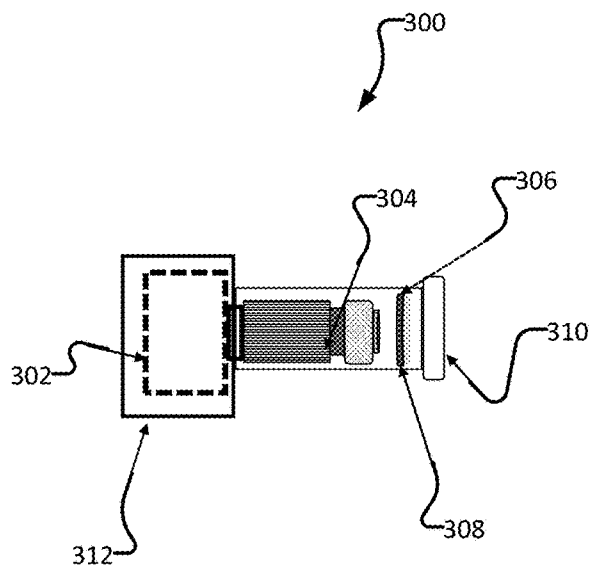


FIG. 3A

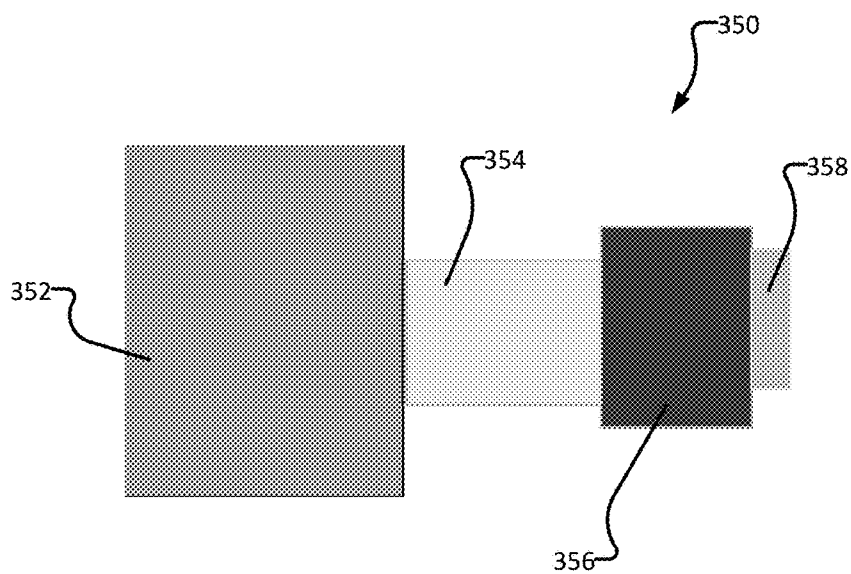
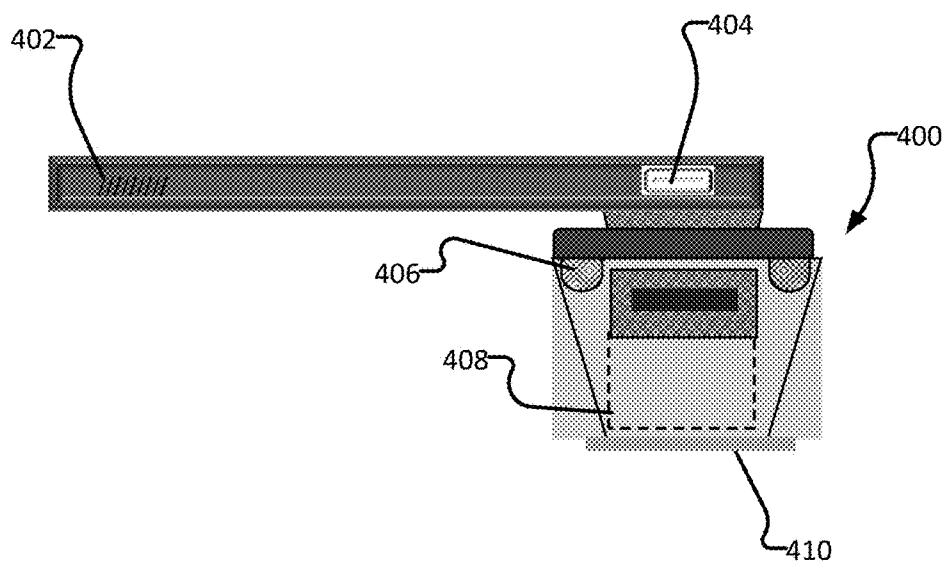
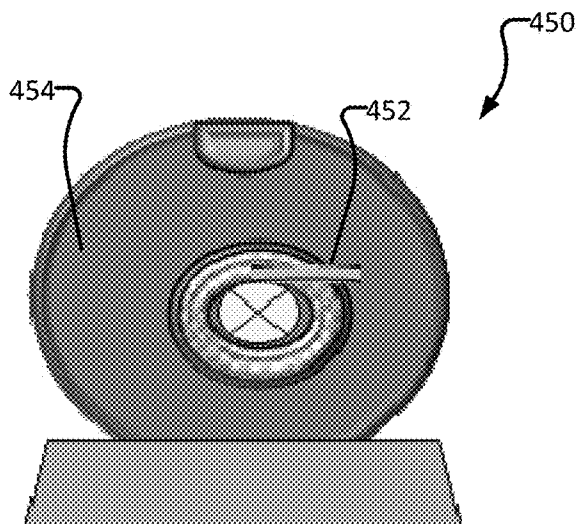


FIG. 3B

**FIG. 4A****FIG. 4B**

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