US010841500B2

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

(10) **Patent No.: US 10,841,500 B2**
(45) **Date of Patent: *Nov. 17, 2020**

(54) **DUAL APERTURE ZOOM DIGITAL CAMERA**

(71) Applicant: **Corephotonics Ltd.**, Tel Aviv (IL)

(72) Inventors: **Gal Shabtay**, Tel Aviv (IL); **Ephraim Goldenberg**, Ashdod (IL); **Oded Gigushinski**, Herzlia (IL); **Noy Cohen**, Tel Aviv (IL)

(73) Assignee: **Corephotonics Ltd.**, Tel Aviv (IL)

(*) 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.

(21) Appl. No.: **16/368,222**

(22) Filed: **Mar. 28, 2019**

(65) **Prior Publication Data**

US 2019/0230291 A1 Jul. 25, 2019

Related U.S. Application Data

(63) Continuation of application No. 16/198,181, filed on Nov. 21, 2018, which is a continuation of application
(Continued)

(51) **Int. Cl.**
H04N 5/232 (2006.01)
H04N 5/225 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04N 5/23296*** (2013.01); ***G02B 13/009*** (2013.01); ***G02B 13/0015*** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,106,752 A 2/1938 Land
2,354,503 A 7/1944 Cox
(Continued)

FOREIGN PATENT DOCUMENTS

CN 101276415 A 10/2008
CN 102739949 A 10/2012
(Continued)

OTHER PUBLICATIONS

A compact and cost effective design for cell phone zoom lens, Chang et al., Sep. 2007, 8 pages.
(Continued)

Primary Examiner — Cynthia Segura
(74) *Attorney, Agent, or Firm* — Nathan & Associates; Menachem Nathan

(57) **ABSTRACT**

A dual-aperture zoom digital camera operable in both still and video modes. The camera includes Wide and Tele imaging sections with respective lens/sensor combinations and image signal processors and a camera controller operatively coupled to the Wide and Tele imaging sections. The Wide and Tele imaging sections provide respective image data. The controller is configured to combine in still mode at least some of the Wide and Tele image data to provide a fused output image from a particular point of view, and to provide without fusion continuous zoom video mode output images, each output image having a given output resolution, wherein the video mode output images are provided with a smooth transition when switching between a lower zoom factor (ZF) value and a higher ZF value or vice versa, and wherein at the lower ZF the output resolution is determined by the Wide sensor while at the higher ZF value the output resolution is determined by the Tele sensor.

18 Claims, 8 Drawing Sheets