

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau

(43) International Publication Date
04 August 2022 (04.08.2022)



(10) International Publication Number
WO 2022/165278 A1

(51) International Patent Classification:
G06K 9/62 (2022.01) *G06V 10/44* (2022.01)

(21) International Application Number:
PCT/US2022/014449

(22) International Filing Date:
28 January 2022 (28.01.2022)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
63/143,673 29 January 2021 (29.01.2021) US

(71) Applicant: **ILLUMINA, INC.** [US/US]; 5200 Illumina Way, San Diego, California 92122 (US).

(72) Inventors: **GIETZEN, Kimberly Jean**; 5200 Illumina Way, San Diego, California 92122 (US). **LIU, Jingtao**;

5200 Illumina Way, San Diego, California 92122 (US).
TAO, Yifeng; 555 Hobart Street, Apt 1, Pittsburgh, Pennsylvania 15217 (US).

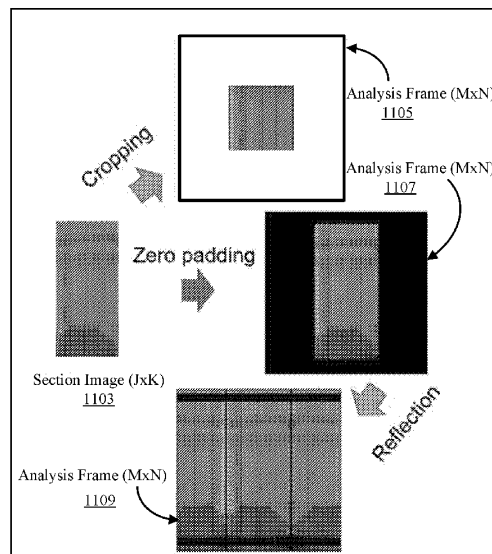
(74) Agent: **BEFFEL, JR., Ernest J.** et al.; Haynes Beffel & Wolfeld LLP, P.O. Box 366, 637 Main Street, Half Moon Bay, California 94019 (US).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW,

(54) Title: DEEP LEARNING-BASED ROOT CAUSE ANALYSIS OF PROCESS CYCLE IMAGES

Feature Engineering of Images for Input to CNN (1/2)

1100



Example of MxN 224 x 224 pixels

Example of JxK 180 x 80 pixels

FIG. 11A

(57) Abstract: The technology disclosed relates to training a convolutional neural network (CNN) to identify and classify images of sections of an image generating chip resulting in process cycle failures. The technology disclosed includes creating a training data set of images of dimensions MxN using labeled images of sections of image generating chip of dimensions JxK. The technology disclosed can fill the MxN frames using horizontal and vertical reflections along edges of JxK labeled images positioned in MxN frames. A pretrained CNN is further trained using the training data set. Trained CNN can classify a section image as normal or depicting failure. The technology disclosed can train a root cause CNN to classify process cycle images of sections causing process cycle failure. The trained CNN can classify a section image by root cause of process failure among a plurality of failure categories.

[Continued on next page]

SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*