



US00RE38716E

(19) **United States**
(12) **Reissued Patent**
Caspi et al.

(10) **Patent Number: US RE38,716 E**
(45) **Date of Reissued Patent: *Mar. 22, 2005**

(54) **AUTOMATIC VISUAL INSPECTION SYSTEM**

FOREIGN PATENT DOCUMENTS

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(*) Notice: This patent is subject to a terminal disclaimer.

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(21) Appl. No.: **09/607,318**

(22) Filed: **Jun. 30, 2000**

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Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **5,774,572**
Issued: **Jun. 30, 1998**
Appl. No.: **08/061,344**
Filed: **May 17, 1993**

(57) **ABSTRACT**

A binary map of an object having edges is produced by first producing a digital grey scale image of the object with a given resolution, and processing the grey scale image to produce a binary map of the object at a resolution greater than said given resolution. Processing of the grey scale image includes the step of convolving the 2-dimensional digital grey scale image with a filter function related to the second derivative of a Gaussian function forming a 2-dimensional convolved image having signed values. The location of an edge in the object is achieved by finding zero crossings between adjacent oppositely signed values. Preferably, the zero crossings are achieved by an interpolation process that produces a binary bit map of the object at a resolution greater than the resolution of the grey scale image. The nature of the Gaussian function whose second derivative is used in the convolution with the grey scale image, namely its standard deviation, is empirically selected in accordance with system noise and the pattern of the traces on the printed circuit board such that the resulting bit map conforms as closely as desired to the lines on the printed circuit board.

U.S. Applications:

(63) Continuation of application No. 07/961,070, filed on Oct. 14, 1992, now abandoned, which is a continuation of application No. 07/804,511, filed on Dec. 10, 1991, now abandoned, which is a continuation of application No. 06/684,583, filed on Dec. 20, 1984, now abandoned.

(51) **Int. Cl.⁷** **G06K 9/00**
(52) **U.S. Cl.** **382/141**
(58) **Field of Search** 364/724.12, 728.03,
364/728.05; 358/137, 140; 382/141, 199,
276, 278, 298, 258, 145, 148

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98 Claims, 5 Drawing Sheets

