ISSN 2395-1621

Design and Development of Industrial Radiograph Digitizer

[#1]Mr.Chiraj P. Sawarbandhe, [#2]Dr.S.S.Khedkar

[1]cpsawarabandhe@gmail.com
[2]sandip171180@gmail.com

[#1]M.tech student dept. Mechanical Engineering, Yeshwantrao Chavan College of Engineering Nagpur, India

#[2]Assistant Professor Dept. Mechanical Engineering, Yeshwantrao Chavan College of Engineering, Nagpur, India

ABSTRACT

Industrial radiography is a famous technique for the identification and evaluation of discontinuities, or defects, such as cracks, porosity and foreign inclusions. The poor quality of radiographic images is due to the physical nature of radiography as well as small size of the defects and their poor orientation relatively to the size and thickness of the evaluated parts. Digitization techniques allow the interpretation of the image to be inspected, avoiding the presence of human operators making the inspection system more reliable, reproducible and faster. This paper describes our attempt to develop and implement digitizer system for the purpose of automatic defect detection in radiographic images, because of the complex nature of the considered images, and in order that the detected defect region represents the most accurately possible the real defect.

Keywords— digitizer, radiographic images, inspection;

ARTICLE INFO

Article History

Received: 28th February 2016

Received in revised form :

1st March 2016

Accepted: 3rd March 2016

Published online :

5th March 2016

I.INTRODUCTION

Since last two decades, radiographic testing became the accepted method for the quality control of castings via visual or computer-aided analysis of X-ray images. The purpose of this non-destructive testing method is to locate casting defects which may be located inside the casting and are not detectable to the naked eye. It is particularly important for critical applications where valve casting failure can be resulted in to sudden terrible disaster, such as in petrochemical refineries, oil and natural gas plants, and pneumatic applications. Radiographic films usually have noise and deficient contrast due to intrinsic factors involved in the inspection technique, such as non-uniform illumination and the limited range of intensities of the image capture device. Noise in scanned radiographic images is usually characterized as randomly spread pixels, with intensity values that are different from their neighboring pixels. The evolution of Intelligent Fault Diagnosis system for valve casting is a complex phenomenon. There are many factors affecting the performance of intelligent fault diagnosis system. Digital image processing techniques are employed to reduce the noise effects and to improve the contrast, so that the principal objects in the image become more apparent than the background. Generally, digitization in itself is not a method of preservation of documentary heritage although it does help to protect precious documents from excessive handling. It allows the preservation of a facsimile of the document (not the document itself) and ensures multiple access, with due respect for intellectual property and other rights, to the content. Documents with text and images that are to be kept as originals after digitization may be digitized to a higher or lower level of detail. The reason for making the digital copies will define the choice of resolution and bit depth which may have an impact on costs, production flow as well as the long-term preservation. For audio and video documents, however, digitization is the only viable method for long-term preservation, because, apart from carrier instability, dedicated replay equipment is rapidly vanishing. The time window left for the replay of audio and video originals may only be 15 years, which adds urgency to the situation. Audio-visual documents must be digitized with appropriate digital resolution, and that capture resolution must equal or exceed the quality of original as, in the long-term, the digital master file will be the only version available. Film preservation is adopting digitization out of necessity as manufacture of analogue photochemical film is fading.

Digital master files are a facsimile of the original document; they must not be enhanced, restored, or otherwise altered. Digitized materials should enjoy the same intellectual property copyright protection level as the original. Primary consideration should be accorded to accessibility and traceability of information when digitizing important items. This is accomplished through the development of complete and detailed metadata, as well as documentation of the process including technical specifications and resolution settings. Digital conversion and metadata creation should be synchronized as far as possible thus enabling permanent access to all the relevant attributes of the object. Digitization is also not a method for the intellectual property protection of documentary heritage; digitization raises intellectual property issues, which should be identified and managed. Digitization should take into consideration and be done in respect of intellectual property law. When digitizing material, preference should be given to openly defined formats which are widely used and supported. They should be suitable for long-term preservation have a long life expectancy and be easily migrated as when the need arises. Ideally, multiple copies should be made and stored in professional repositories at different locations and regularly checked. The digital master that is created should not be enhanced or altered. It should represent the original as closely as possible. The budget allocation for digitization must allocate funds for long-term preservation. The digitized collection will require permanent management to ensure its safety. It will also have to adapt to new preservation standards and practices that take into account technological developments.

II.LITRATURE REVIEW

Wafik Harara et al [1] this paper explains the difference between the types of digital radiography detectors used to replace film and when transition from analogue film radiography to digital radiography can be a practical technique for the NDT organization. E. Deprins et al [2] This paper gives an overview of Using a digital radiography system gives not only the advantages of the manipulation of digital images, but also the digital data that is associated with it. Smart methods to associate cassettes and storage screen with expose images enhance the workflow of the NDT processes, and avoid human errors. Bhaun Lawson et al [3] this paper described application of machine vision, incorporating neural networks, which aims to fully automate real time radiographic inspection in welding processes, is described. The current methodology adopted comprises two dustings stages the segmentation of weld from the background content of the radiographic image, and the segmentation of suspects defect areas inside the weld region itself.Domingo Mery et al [4] this paper presents a new method for inspecting aluminium castings automatically from a sequence of radioscopic images taken at different positions of the casting.W. A. Graeme et al [5] NDT radiographs can now be digitized without significant information loss. Defect recognition and image analysis can be improved, analysis time can be reduced, and film consumption can be lowered. The result is an overall increase in productivity for radiographic inspection. Thomas Jaeger et al [6] in this article the fundamental principles of various methods for the automated detection of die casting defects have been explained. These methods have appeared in the literature in the past twenty years and show the development of this sector in the areas of industry and academia. The detection approaches were divided roughly into three groups: reference methods, methods without a priori knowledge and computer tomography. As a result of its peak detection performance, the methods of the first group have become most widely established in industrial applications. These methods suffer from the complicated configuration of their filtering, which is tailored to the test piece. Typically, this optimization process takes two or more weeks, independently of whether it is performed manually or automatically. The prerequisite for the use of a method from the second group is the existence of common properties which define all casting defects well and also differentiate them from design features of the test pieces. These prerequisites are often fulfilled only in special testing situations. The industrial use of computer tomography for the inspection of die cast parts for the automotive industry is currently limited to the areas of materials research and development as well as to the inspection of especially important and expensive parts .

VIDAR's NDT PRO Industrial Film Digitizer [7]
VIDAR's NDT PRO Industrial Film Digitizer offers the NDT market a more cost effective alternative for digitizing film. With VIDAR's next-generation proprietary High Definition CCD (HD-CCD) technology, and its unique ADC (Automatic Digitizer Calibration) feature, there is virtually no variation in image quality and ensures excellent grayscale reproduction in every image. Unlike other digitizers that require biannual calibration and/or cleaning, VIDAR digitizers need no maintenance or calibration, saving substantial dollars annually. Meets all standards for ISO 14096 Class DS and ASME Section V. Domingo Merry [8] in this paper we presented a general overview of computer vision methodologies that have been used in X-ray testing. The presented applications on X-ray testing follows this general schema, where depending on the way the X-ray images are acquired and analyzed, each step can be (or can be not) used. In the presented applications, we observe that there are some areas, like casting inspection, where automated systems are very effective; and other application areas, like baggage screening, where human inspection is still used. Additionally, there are certain application areas, like weld and cargo inspection, where the inspection is semiautomatic. Finally, there is some research in food analysis where they are beginning to be characterized using X-ray imaging. It is clear that many research directions have been exploited, some very different principles have been adopted and a wide variety of algorithms have been developed for very different applications. Nevertheless, automated X-ray testing remains an open question because it still suffers from: i) loss of generality because approaches developed for one application may not be used in other one; ii) deficient detection accuracy because commonly there is a fundamental trade–off between false alarms and miss detections; iii) limited robustness because prerequisites for the use of a method are often fulfilled in simple cases only. Domingo Mery et al [9] in this paper author presented a general overview of computer vision methodologies that have been used in X-ray testing, as illustrated in diagram of Fig. 1. The presented applications on X-ray testing follow this general schema, where depending on the way the X-ray images are acquired and

analyzed, each step can be (or not be) used. In the presented applications, we observed that there are some areas, such as casting inspections, where automated systems are very effective; and other application areas, like baggage screening, where human inspection is still used.

Domingo Mery et al [10] in this paper author presented the use of a generic methodology that can be used to detect regular prohibited items (like razor blades and guns) in baggage's automatically yielding promising results. The proposed approach is an application of state-of-art computer vision techniques. It filters out false positives resulting from segmentation steps performed on single views of an object by corroborating information across multiple views. Using multiple views (instead of one) the matching accuracy and robustness (i.e., tolerance to false positive detections) of the detection of physical features on an object is increased. The detection method is image-based (2D appearance-based detection). By using multiple views, the method is able to increase the detection rates and robustness of 2D feature detection, in comparison to application of the same method in a single image. We believe that our methodology is a useful alternative for assisting human operators in baggage screening.

VIDAR NDTPRO User Guide [11] The VIDAR NDTPRO Industrial Film Digitizer is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the Digitizer can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Digitizer as recommended, according to the maximum output power of the communications equipment. For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer

Mery Domingo et al [12] this accessible textbook presents an introduction to computer vision algorithms for industrially-relevant applications of X-ray testing. Features: introduces the mathematical background for monocular and multiple view geometry; describes the main techniques for image processing used in X-ray testing; presents a range of different representations for X-ray images, explaining how these enable new features to be extracted from the original image; examines a range of known X-ray image classifiers and classification strategies; discusses some basic concepts for the simulation of X-ray images and presents simple geometric and imaging models that can be used in the simulation; reviews a variety of applications for X-ray testing, from industrial inspection and baggage screening to the quality control of natural products; provides supporting material at an associated website, including a database of X-ray images and a Matlab toolbox for use with the book's many examples. Domingo Merry et al [13] A new method for automated flaw detection in aluminum castings using multiple view geometry has been developed. Our method is very efficient because it is based on a two-step analysis: identification and tracking. The idea was to try to imitate the way a human inspector inspects radioscopic images. First relevant details (potential defects) are detected, followed by tracking them in the radioscopic image sequence. In this way, the false detections can be eliminated without discriminating the real flaws. The great advantage of our first step is the use of a single filter to identify potential defects, which is independent of the structure of the specimen. Nevertheless, its disadvantages are the false positive percentage is enormous, the true positive percentage could be poor if the flaws to be detected are very small and located at the edge of a structure, and the identification of regions is time consuming. Contrarily, the second step is highly efficient in both discrimination of false detections and tracking of real defects, and is not time consuming, due to the use of the multiple-view tensors.

III.PROBLEM STATEMENT

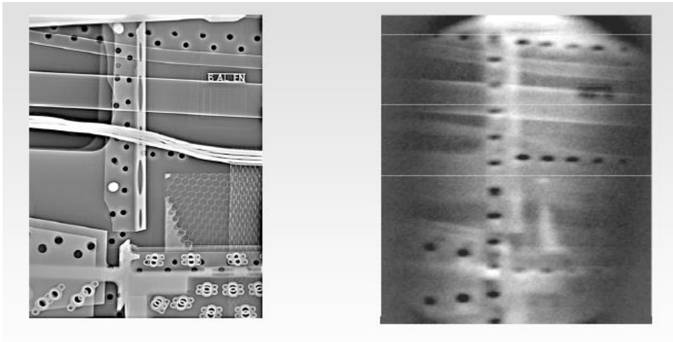

Fig.1 Difference between digitizer image and conventional system

There are several fundamental difference between digitizer image and conventional digital system in terms of physical process involved in image acquisition. Different processes introduce different constraint on factor determining image quality such as spatial resolution, contrast, and noise.

objective

The main objectives of the project work are:

- To construct a simple and economic digitizer for industrial radiograph used for defect detection.
- To minimize time required for the inspection of defects.
- To study the different technologies applied for Digitisation process.
- To provide solution for improper light illumination and noise involve in existing digitizing process.

IV.CONSTRUCTION AND WORKING

An apparatus for evaluating an X-ray imaging system, which comprises of a glass frame for receiving a sheet of photographic film, led panel that emits light in response being positioned within said that emitted light will strike the sheet of photographic film. Further comprises a mechanism for resetting imaging system. glass frame having a section for receiving a sheet of photographic film, an intensifier screen of a material that emits light in response to being stuck by X-rays, and positioned within said glass frame so that such emitted light strikes the sheet of photographic film, a light sensor within said glass frame and producing an electrical signal representing an intensity of light emitted. Thus imaging system is capable for capturing various images of radiographic film, which can be edited. It converts the radiographic image into a digital picture for review on a computer monitor. The digital image is then stored and can be post processed by changing the magnification, orientation, brightness and contrast.

Light source

To provide solution for improper light illumination and noise involved in existing digitizing process.Radiographic film requires intensity 100,000 candela/m^2.Uniform light source with desired Intensity ,16 watts Led panel which provide required light intensity.

Fig.2 light source

Frame

Provides rigid support to the light source and imaging system. It guides light source and radiographic film. Based on focal length of imaging system 20 cm height of frame mounts camera. Camera captures image for the digitisation of radiographic films.

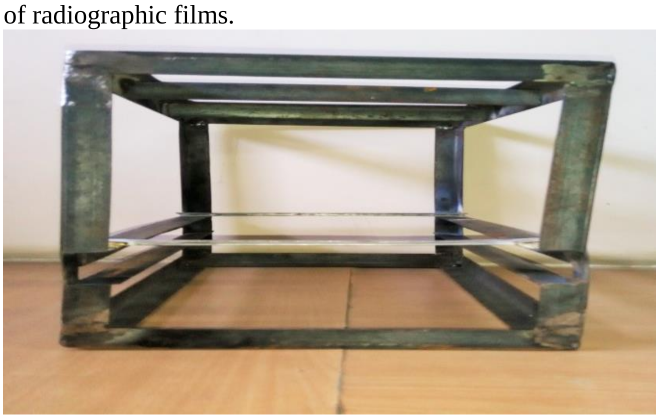

Fig.3 Frame

Enclouser

Entire assembly enclosed into Chamber which avoids Scattering of light.

Imaging system

The main techniques for image processing used in X-ray testing, presents a range of different representations for X-ray images, explaining how these enable new features to be extracted from the original image, examines a range of known X-ray image classifiers and classification strategies. Captures X-ray images and presents simple geometric and imaging models that can be used in the simulation.

V.EXPERIMENT

Thus imaging system is capable for capturing various images of radiographic film, which can be edited. It converts the radiographic image into a digital picture for review on a computer monitor.

Fig.4 Experiment

IV.RESULT

Digital radiography is the most accurate form of inspection system than the other radiographic and NDT processes. It helps to detect the defects in the casting more precisely with high quality and magnified image.

Fig.5 X-ray image

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