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MACHINE VISION SYSTEM FOR IDENTIFICATION AND DETECTION OF HOLES IN OIL PIPES

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Abstract: In this, we introduce a new technique to identify and detect defect such as leakage by holes inside the tubes or pipes used in Oil and Fuel plants. This technique is based on the working principle of Image Processing on Capsule Endoscopy for GI (Gastrointestinal) tract. Capsule Endoscopy is considered as one of the greatest invention in the history of Bio-Medical application. Capsule endoscopy is a way to record images of the digestive tract for use in medicine. The capsule is the size and shape of a pill and contains a tiny camera. After a patient swallows the capsule, it takes pictures of the inside of the gastrointestinal tract. The primary use of capsule endoscopy is to examine areas of the small intestine that cannot be seen by other types of endoscopy. Similar approach is followed in this technique where a capsule containing a tiny camera is connected to a cable and cable is inserted into oil tubes to capture the images. These images are processed to identify the above mentioned defect using Image Processing concepts. A MATLAB application is developed for processing the images. This application uses mathematical morphology to remove the background noise from the image and the image is segmented based on the parameters of pixels. These segments are analysed for the shape, size and colour. The texture of the pixels is evaluated by using different available techniques of image processing. The proposed technique can provide a simple and highly efficient approach to serve the above mentioned purpose in the Oil and Fuel industry.
Keywords: Endoscopy, Capsule Endoscopy, MATLAB, Image processing, GI (Gastrointestinal) tract.

I. INTRODUCTION

Endoscopy is a medical procedure that uses tube-like instruments (called endoscopes) to look at the inside of the body. Endoscopy allows physicians to peer through the body's passageways. Endoscopy is the examination and inspection of the interior of body organs, joints or cavities through an endoscope. An endoscope is a device that uses fibre optics and powerful lens systems to provide lighting and visualization of the interior of a joint. The portion of the endoscope inserted into the body may be rigid or flexible, depending upon the medical procedure.

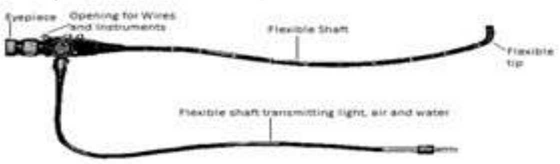

Fig.1Typical Endoscope

The modern era of endoscopy began with the development of fibreoptic instruments in the 1960s. An endoscope uses two fibre optic lines. A "light fibre" carries light into the body cavity and an "image fibre" carries the image of the body cavity back to the physician's viewing lens. There is also a separate port to allow for administration of drugs, suction, and irrigation. This port may also be used to introduce small folding instruments such as forceps, scissors, brushes, snares and baskets for tissue excision (removal), sampling, or other diagnostic and therapeutic work. Endoscopes may be used in conjunction with a camera or video recorder to document images of the inside of the joint or chronicle an endoscopic procedure. New endoscopes have digital capabilities for manipulating and enhancing the video images.

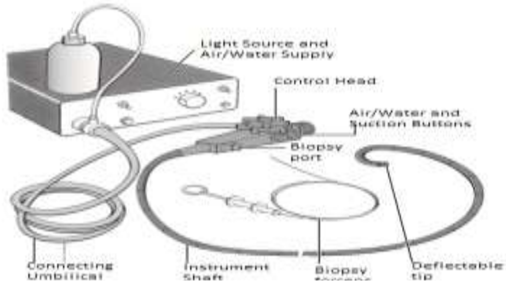

Fig.2 Fibreoptic Endoscope System

Fibreoptic Endoscope System are complex as shown in Fig 2 Basically, they consist of a control head and a flexible shaft with a manoeuvrable tip. The head is connected to a light source via an ‘umbilical’ cord, through which pass other tubes transmitting air, water and suction, etc. The suction channel is used for the passage of diagnostic tools (e.g. biopsy forceps) and therapeutic devices.Endoscopy can be used to diagnose various conditions by close examination of internal organ and body structures. Endoscopy can also guide therapy and repair, such as the removal of torn cartilage from the bearing surfaces of a joint. Biopsy (tissue sampling for pathologic testing) may also be performed under endoscopic guidance. Local or general anesthetic may be used during endoscopy, depending upon the type of procedure being performed. Internal abnormalities revealed through endoscopy include: abscesses, biliary (liver) cirrhosis, bleeding, bronchitis, cancer, cysts, degenerative disease, gallbladder stones, hernia, inflammation, metastatic cancer, polyps, tumors, ulcers, and other diseases and conditions. Fiber optic endoscopes now have widespread use in medicine and guide a myriad of diagnostic and therapeutic procedures including: Arthroscopy, Bronchoscopy, Colonoscopy, Colposcopy, Cystoscopy, Gastroscopy, Laparoscopy, Laryngoscopy etc.

II. CAPSULE ENDOSCOPY

Capsule endoscopy is mainly used for the GI Tract of human body. This Project is based on this concept and hence it is necessary to understand the details of capsule endoscopy which is described as below.

A. Biological Background

The human gastrointestinal tract or GI tract is an organ system responsible for consuming and digesting food stuffs absorbing nutrients and expelling waste. The GI tract includes all the structures between the mouth and anus. These structures are Oral Cavity, Esophagus, Stomach, Small Intestine, Large Intestine (transverse, ascending and descending Colon), Rectum and Anus.

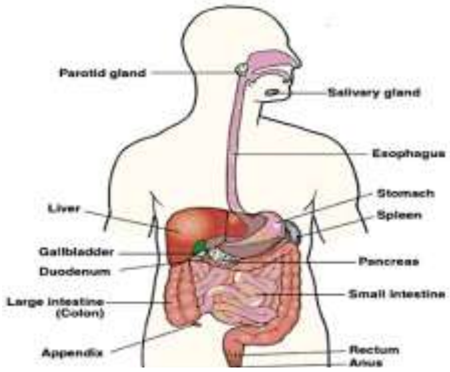

Fig.3 Digestive System

There are various abnormalities and diseases relates to GI tract such as hemorrhage, hiatal hernia, inflammation of the esophagus, gastric ulcers, polyps, tumors, colitis diverticula, Chrohn's disease, GI cancers, unexplained bleeding, unexplained iron deficiency and unexplained abdominal pain. These abnormalities are diagnosed by various endoscopy techniques and Capsule Endoscopy (CE) is identified as the best methodology to achieve the same. Aside from allowing the small bowel to be seen and examined, capsule endoscopy is painless and noninvasive. People who avoid GI screening because of the ‘gross’ factor of traditional endoscopic procedures may be more receptive towards capsule screening.

B. Capsule Endoscopy

This involves ingesting a small capsule (the size of a large vitamin tablet) which will pass naturally through your digestive system, taking pictures of the intestine. The images are transmitted to sensors attached to a data recorder held in a harness, which you will wear. The capsule is disposable and will be excreted naturally in your bowel movement.

C. Block Diagram of Capsule Endoscopy System

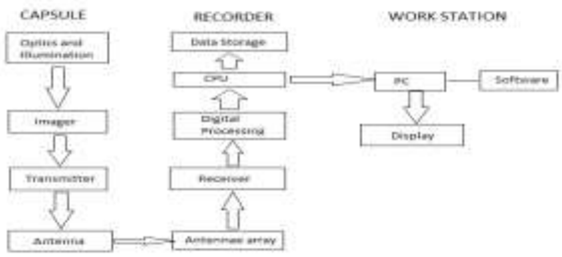

Fig.4 Block Diagram of the Capsule Endoscopy System

In the first stage the capsule acquires the images. Swallowable capsule will have built in camera, LED illumination system, Imager, Image Transmitter and an Antenna. The object inside the human body or more specifically GI tract is illuminated by the LED illumination system of the capsule, and the image is projected on the imager by an optical system. The captured image is then transmitted outside the body by means of the transmitter and antenna. In the second stage antennae array and the receiver collect the signal transmitted from the capsule. The received data is subsequently processed digitally and then stored in the data storage by CPU. This data is retrieved from the recorder and then transferred to the third component of the system called Workstation. Recorder is placed in recorder pouch which is attached to the sensor belt and worn around the patient’s waist. In this third stage the data is processed, analyzed and then further transmitted for the presentation onto the display. MATLAB applications are used for image processing which helps in the detection of the above mentioned abnormalities. Similar approach is followed in our technique in which capsule records the images of the inside part of the oil tubes and then MATALB application processes the image using the filtering and segmentation. It identifies and detected the leakage and presents defect i.e.hole on the display system. MATLAB applications can be written to process the images captured by the camera and identify the defect /hole in the oil pipes.

III. PROPOSED METHOD

This project includes two phases where phase 1 consists of capturing the images of pipes/tubes in oil industry and phase 2 consists of processing those images to identify the defective regions in the tubes. This project can be considered as an initial work or in engineering terms, proof of concept (PoC) with lot of future scope in oil industries. This is a first of a kind work which can server a great purpose in oil and chemical industries. In this project, we are working on phase 2 only in which we take a raw image of the defective pipes as the input and perform the image processing using a MATLAB program. Output of this program is an image with defect highlighted. Holes are considered as the defective regions in the program. This algorithm helps in identifying the hole regions on the pipes/tubes. MATLAB program written here for Image Processing consists of algorithm

A. Flow Diagram

Steps performed in the algorithm are depicted in the flow diagram below.

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B. Description of Algorithm

Algorithm is explained in the below steps.

Read the input images using the imread() function of the MATLAB Image Processing toolbox. These images are raw RGB images. Following images of the pipes having holes are taken as the input.

Fig.5 Input RGB Image 1

Fig.6 Input RGB Image 2

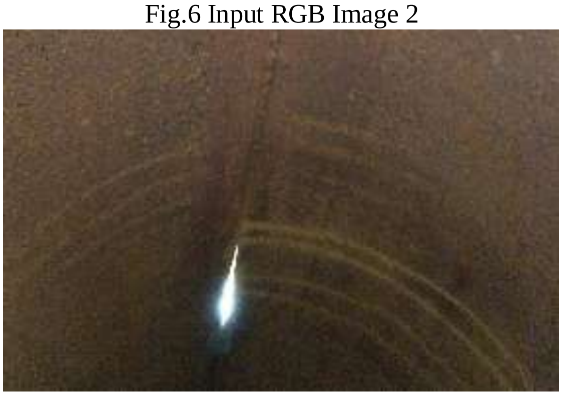

Fig.7 Input RGB Image 3

Each point (pixel) in the image is represented by a point in the first quadrant of the three-space as shown below.

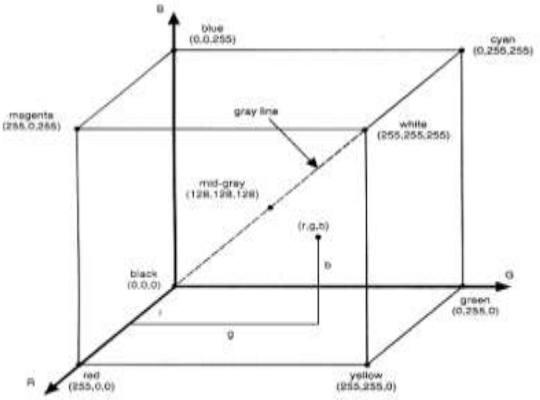

Fig.8 RGB Color Space

The origin of the RGB space (Red = 0, Green = 0, Blue = 0) represents black while the opposite corner (Red = max = 255, Green = max = 255, Blue = max = 255) represents white. Lines joining the two corners have equal values of red, blue and green. This produces various shades of gray. The locus of all these points is called gray line.In the RGB image, each pixel is composed of RGB values and each of these colors require 8 bit for its representation (Full color image). Hence each pixel is represented by 24 bits i.e. [R (8-bits), G (8-bits), B (8-bits)].imread() function reads the images and returns the pixel representation values of the images. These pixel values are stored as variables, say a1, a2 and a3.

Three RGB images read in step 1 are converted to the gray scale intensity images as shown below. Each pixel can have values ranging from 0 (black) to 255 (white). Gray scale images, as the name suggests have black, white and various shades of gray present in the image.

Fig.9 Gray Scale Image 1 for RGB Image 1

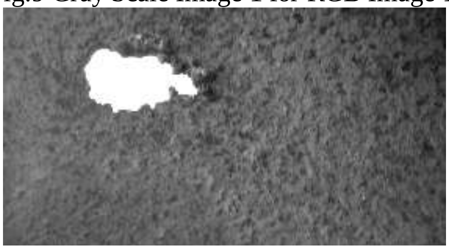

Fig.10 Gray Scale Image 2 for RGB Image 2

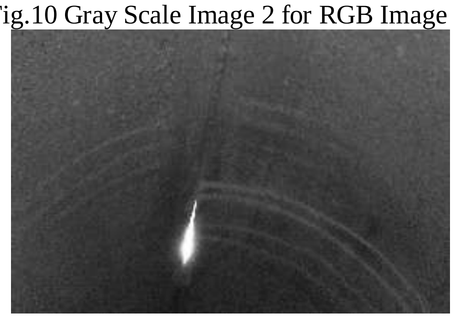

Fig.11 Gray Scale Image 3 for RGB Image 3

rgb2gray() function of the MATLABL is used to convert the RGB image to gray scale image passing the pixel representation (a1, a2 and a3 obtained in step i) as argument. This function returns the gray scale representation values, say b1, b2 and b3.

- Gray scale images are then converted to binary images in which holes can be easily identified as shown below.
- im2bw() function takes in the gray scale image (b1, b2 and b3 obtained in step ii) as the argument and returns the binary images, say c1, c2 and c3 as the output. It replaces all the pixels with luminance

greater than second argument value with the value 1 (white) and replaces all other pixels with the value 0 (black). Second argument value ranges between [0, 1]. If the second argument value is not passed, then this function uses the default value of 0.5.

Fig.12 Binary Image 1 for Gray scale Image 1

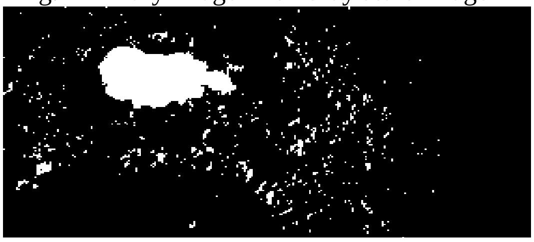

Fig.13 Binary Image 2 for Gray scale Image 2

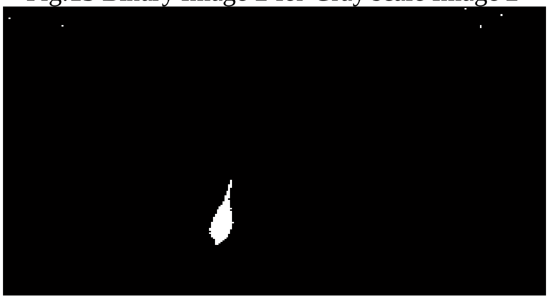

Fig.14 Binary Image 3 for Gray scale Image 3

As shown in the previous step, defected region (holes) are identified and shown in white color with rest of part of the image in black. For better visibility of the defected region, we are inverting the binary images c1, c2 and c3 using the imcomplement() function. In the final output images, defected regions are shown in black color and rest of the part is shown in white color.

Fig.15 Output Image1

Fig.16 Output Image2

Fig.17 Output Image 3

IV. RESULT

Result of the project is shown in the below figure. Input images with defected regions (holes) shown in the first row are processed using a MATLAB program which uses the algorithm explained in the above section and produces the output shown in the second row. Defected regions (holes) are clearly visible in the output.

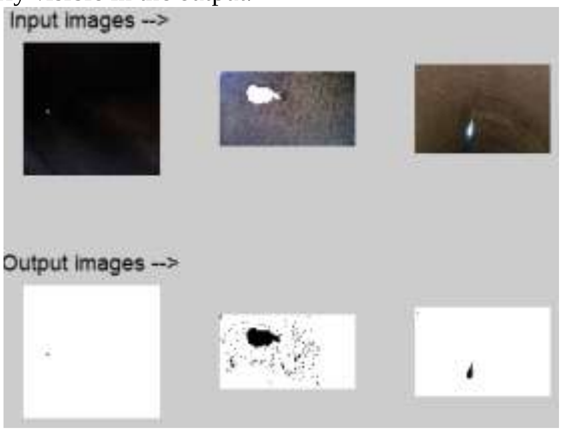

Fig.18 Final Result

V. CONCLUSION

This paper has proposed a new methodology for identifying and detecting the defective regions (holes) on the pipes/tubes in the oil and chemical industry. This methodology is based on the concept of Endoscopy. This has a lot of future scope and with further analysis, it can serve a great purpose in the oil/fuel/chemical industries and also in other industries where pipes/tubes are used.

VI. ACKNOWLEDGMENT

I would like to take the opportunity to express my heartfelt gratitude to the people whose help and co-ordination has made this project a success. I owe project success to our guide and convey my thanks to them. Lastly, I am also indebted to all those who have indirectly contributed in making this project a reality.

REFERENCES

[1] Emulation on Motion Tracking of Endoscopic Capsule inside Small Intestine.(Guanqun Bao, Liang Mi, and Kaveh Pahlavan, Fellow, IEEE.USA)
[2] Machine Vision System for Inspecting Flank Wear on Cutting Tools (R. Schmitt1, Y. Cai1 and A. Pavim1,2 1 Laboratory for Machine Tools and

Production Engineering, RWTH Aachen University, Aachen, Germany)

[3] The VN-Project: Endoscopic Image Processing for Neurosurgery(W. Konen1, M. Scholz2, S. Tombrock1 1 Zentrum für Neuroinformatik GmbH, Bochum, Germany).

[4] Engineering in Medicine and Biology Magazine,IEEE (Volume: 24, Issue: 4) Date of Publication: July-Aug. 2005. Removing JPEG Blocking Artifacts Using Machine Learning (Jonathan Quijas Olac Fuentes Department of Computer Science University of Texas at El Paso 978-1-4799-4053-0114/$31.00 ©2014 IEEE)

[5] A Novel Image Processing Filter Designed Using Discrete Fourier Invariant Signal (2014 International Conference on Electronic Systems, Signal Processing and ComputingTechnologies, 978-1-4799-2102-7/14 $31.00 © 2014 IEEE DOI 10.1109/ICESC.2014.88)

[6] Tumor Recognition in Wireless Capsule Endoscopy Images(1Suvidha Sawant, 2M. S. Deshpande 1,2Elec.& Telecommunication Department Bhivrabai Sawant College Of Engineering & Research Pune, India., IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 9, Issue 3 Ver. I (May – Jun. 2014), PP 104-109)

[7] Automated polyp detection in colon capsule endoscopy (Alexander V. Mamonov, Isabel N. Figueiredo, Pedro N. Figueiredo, Yen-Hsi Richard Tsai, arXiv:1305.1912v4 [cs.CV] 27 Mar 2014)

