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BLEEDING DETECTION THROUGH WIRELESS CAPSULE ENDOSCOPY (WCE)

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ABSTRACT *-The wireless capsule endoscopy (WCE), is an imaging technology which is recently established and doesn't require any wired device. This device detects abnormalities in GI tract i.e.(colon, esophagus, small intestine and stomach). A WCE video consists of 57000 images. It is very hard to examine by clinicians. To determine bleeding images out of fifty seven thousand WCE images makes the task very hard and expensive. Here,[19] our goal is to develop an automatic obscure bleeding detection method by using super pixel segmentation and[4] support vector machine (SVM) classifier. In this paper, SVM and super pixel segmentation is used for this problem. Our experiments show that SVM and super pixel segmentation[19] can be very efficient and may yield very high accuracy rate.*

Index Terms— WCE, Bleeding Detection, Super Pixel Segmentation, Support Vector Machine.

1. INTRODUCTION

[4]Wireless capsule endoscopy (WCE), is an imaging capsule. It is used to [12]view the whole gastrointestinal (GI) tract i.e. (colon, esophagus, small intestine and stomach). [20]The entire small intestine can be examined through this technique without pain, sedation, or air insufflations. WCE has [12]obtained approval from the U.S. Food and Drug administration in August 2001 for the purpose of "visualization of the small bowel mucosa" It is used [12]as a tool for the detection of abnormalities of the small bowel. Wireless capsule endoscopy (WCE) can directly take digital images in the gastrointestinal tract of the patient. The major problem which is [12]associated with this technology is that too many images are needed to be manually examined by the clinicians. To reduce the computational complexity grouping of pixels through super pixel segmentation is done. It maintains high diagnostic accuracy.

In this system, a patient swallows a capsule which consists of high resolution[19] color camera, a wireless transmitter, a battery, and lights. Once it is activated, this camera will take[19] 57,000 color images through its 8-hour of journey in the digestive tract. The images are continuously transmitted to a storage device. Then all the images are collected and are examined by physician. He will examine the images to see if there are any[19] signs of diseases, e.g. bleeding, tumor. If there is such a sign, then determination is done where it occurs. This process usually takes few hours for physician to complete the process with accuracy.

WCE imaging is [19]a binary classification problem. Computerized diagnosis is done to assist the physicians to review the images and identify the possible signs. Classifications of the images can be finished in few minutes by using [19]a well designed computer aided diagnosis system. Among most of [19]the classification algorithms, such as neural networks, find similar, and decision trees, we focus mainly on SVM (support vector machine). SVM method was [19]proposed by Vapnik in 1979. SVM has gained a lot of popularity in the past two decades. Since then, it has been applied to many problems including text categorization, face detection, and bioinformatics. The [19]SVM methods are also applied to medical diagnosis particularly for tumor detection in endoscopy color images. In this

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paper, by using the SVM method and the Super Pixel Segmentation bleeding detection are done. Here, new features of extraction methods are proposed [19]that has been proved effective and efficient. The comparison of performance of our classifier is done with different other methods and techniques.

This paper consists of section 1 Introduction. Section 2 consists of related works .Section 3 consist of Existing methods and section 4 consist of proposed methods. Section 5 consist of how to use wireless capsule .Section 6 consist of working of wireless capsule. Section 7 consists of SVM. Section 8 consists of super pixel segmentation and Section 9 consists of conclusion followed by disclosure and reference.

2. RELATED WORKS

Recognization of intestinal lumen image refers to the classic endoscopy which mostly systems report in the literature survey. To motivate and help the physician SVM and super pixel method are used to [21]individuate lumen region and to avoid the collision of the endoscope instrument with the intestinal mucosa. [21]The Region growing Segmentation extracts a lumen from gray level endoscopic images. Clinical uses are not much investigated for the detection of images with lumen in WCE videos. To find the contractions and to examine the intestinal motility some works study the general problems. The method of image detection which is defective is the main idea which is mainly exploited in this work. [21]It is initially proposed for face detection. This technique is based on the use of simple features which are calculated in a new representation of the image. [21]These are based on the concept of integral image. The boosted classifier [21]provides a robust and fast detection and minimizes the errors. [21]This strategy has been proven effective to recognize various kinds of images. [21]Several methods are used for the different recognition problems, like face, hands and legs.

Patients who are suffering from [22]obscure GI bleeding all had undergone radiography of the small bowel. [22]Some had undergone EGD and colonoscopy. [22]All have normal results. VCE detects abnormal findings of about 83%.

[22]Ulcers, erosions, and angiodysplasias are the most frequent lesions. [22]Among these patients, the definite bleeding source was found about 76%.

KEY POINTS

WCE has many advantages as compared to traditional diagnostic studies.

- It can view the entire small intestine without pain, sedation or air insufflations.
- [1]The Wireless Capsule Endoscopy is superior to push enteroscopy.

SEVERAL OTHER TRIALS

WCE is highly effective in diagnosing obscure GI bleeding. [22]When EGD, colonoscopy, push enteroscopy, small bowel radiography, enteroclysis, tagged red blood cell scans, angiography, computed tomography, and MRI failed to show the bleeding source then WCE was successful.

LIMITATIONS OF THE TRIALS

[22]The results are encouraging although, but still they have certain limitations:

- They are mostly uncontrolled.
- [1]The Data are not available for long-term outcomes.
- The study has [22]failed to explain that if the lesions which are detected by WCE were the actual source of bleeding or not.

3. EXISTING METHODS

[23]The existing methods are classified as:

- Image based methods
- Pixel based methods
- Patch based methods

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IMAGE BASED METHODS:

Here the bleeding regions are detected using 54 statistical features [12]which are calculated from a color histogram of six color components named as R, G, B, H, S, and V.

All the intensity values of color are combined together to form a feature vector for classification. Other image based methods work similarly but use different features or classifiers to detect the bleeding regions. The image based method uses the image as a whole and often fails to detect small bleeding regions. The image based methods are fast but the performances are often poor.

PIXEL BASED METHODS:

In pixel based detection, a method is proposed to detect bleeding pixels by using probabilistic neural network. By Thresholding in RGB It distinguishes the bleeding and nonbleeding pixels. Maximization clustering method is used here. [23]The R, G, B color features are used for producing the maximum estimations. The bleeding and nonbleeding pixel intensity often has overlapping in each color channel. The other methods used for classifying at pixel level works better but suffers from high computational cost.

PATCH BASED METHODS:

Between accuracy and speed to achieve tradeoff, a patch based method is used which is based on chrominance moments combined with local binary pattern (LBP) texture. Each WCE image is divided into 64 patches. The 36 most informative patches are classified by multilayer perception (MLP) neural network. This method achieved high sensitivity but has low specificity and accuracy. The shape, location, and size of each bleeding region differ much. They divide every image into blocks uniformly.. Moreover, MLP is unsuitable for the non linear pattern recognition problem and are often evolved from linear perception.

There are some Limitations of Existing Methods .These limitations are given below:

- Time consuming process.
- Users aren't able to get the exact result.
- High computational cost.
- [23]However, a major problem associated with this technology is that too many images need to be manually examined by clinicians
- Processing time is high
- Accuracy of the output images are not cleared .

4. PROPOSED METHODS

Here, we first detect the edge pixels. Then uses the morphological dilation to locate and remove the edge regions. Instead of processing each pixel or dividing the image uniformly, we group the pixels based on color and location through super pixel segmentation. High sensitivity means high capability of detecting bleeding frames. High specificity means high capability of avoiding false detection. Accuracy is used for the evaluation of the [20]overall performance of the proposed method. The features of each super pixel is extracted using the red ratio in RGB space and are fed into Support vector machine (SVM) for the classification.

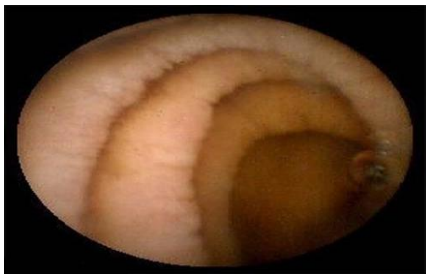

FIG 1. Scalloping and mucosal fissures

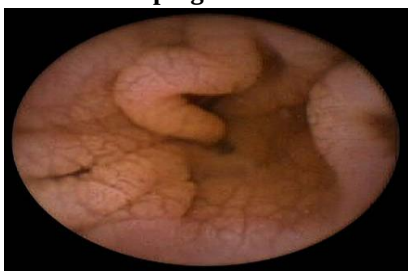

FIG 2. Mosaic pattern of mucosa

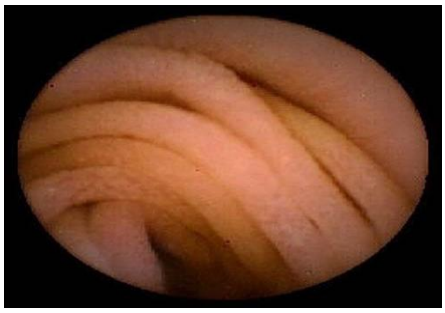

FIG 3. Layering of folds

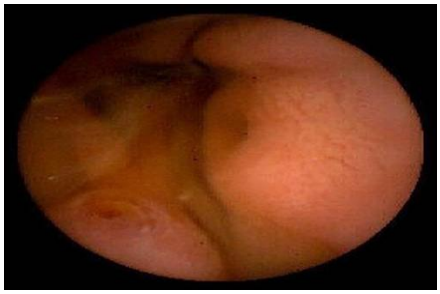

FIG 4. Ulcerated nodular mucosa in duodenal biopsy specimens.

FIG5. Ulceration in distal jejunum

The advantages of Proposed Methods are:

- Less time consuming Process.
- Able to get the Result as User expected.
- Low computational complexity.
- Low computational maintains.
- High performance as pixel based method.
- High accuracy and easy to find the diseases.

5. HOW TO USE THE WIRELESS CAPSULE

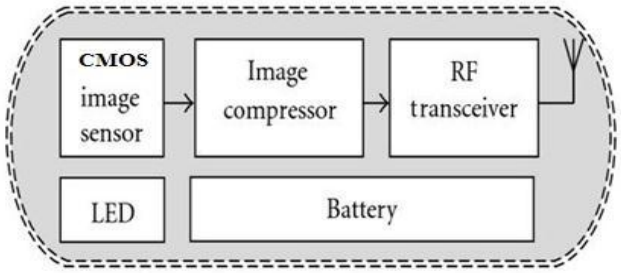

FIG 6: Block diagram of a pill cam

[22]Patient must fast for 12 hours before the process and should not take any medicines that could delay gastric emptying. Bowel Preparation is not necessary. Then, at the medical center the sensors, data recorder, and battery pack are attached. After swallowing the capsule with a small amount of water the patients are free to leave for their usual activities. They are allowed to drink clear liquids 2 hours after capsule ingestion and to eat a light meal 4 Hours later. [22]The Patients returns to the hospital after 8 hours. Then the data recorder is removed, and the images are downloaded and are processed. Patients can resume their regular diet and activities afterwards. [22]They are advised to avoid magnetic resonance imaging (MRI) and radio transmitters until the disposable Capsule passes in the stool, typically within 10 to 48 hours. They are asked to notify the physician if they develop nausea, vomiting, or abdominal discomfort or if they do not see the capsule passed in the stool within 1 week.

6. WORKING OF WIRELESS CAPSULE

The WCE has four main components. They are:

- The capsule
- Eight sensors
- A data recorder
- A computer Workstation.

The Wireless Capsule Endoscopy, which is measured 26mm × 11mm, is a pill-shaped device which consist of a [22]color camera, six light-

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emitting diodes, a radio transmitter, an antenna and two batteries with 8-hours of backup.

The capsule is propelled by peristalsis which Starts to work and record the [22]images through the GI tract. The capsule acquires two high - quality video images per seconds. The images which are recorded by the camera are then sent to a data recorder which is attached to the waist. This process takes 8 hours of time [6]until the WCE battery ends.
[6]Finally, all the image data in the data recorder are downloaded into a computer workstation and the physicians can view the images and analyze the different diseases in GI tract.

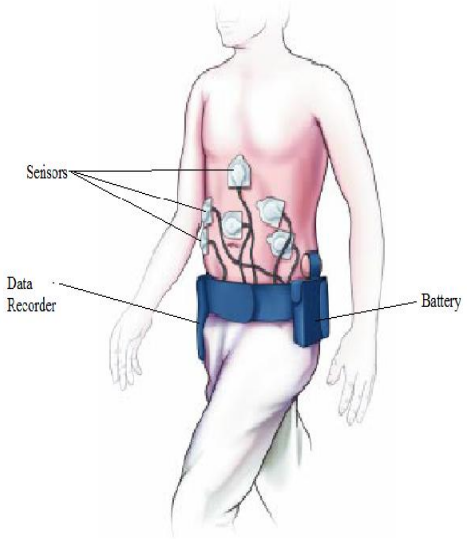
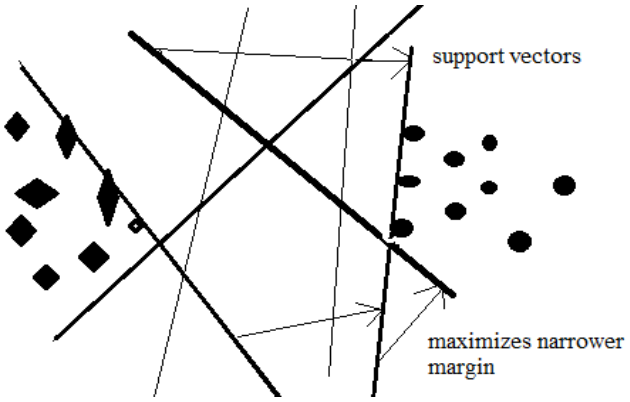


FIG 7: Components of a wireless capsule

7. SUPPORT VECTOR MACHINE (SVM)

SVM is a binary classifier. It was proposed by Vapnik in 1979. It has gained popularity in the past two decades.

The SVM method is also used in medical diagnosis for the detection of tumor and bleeding in endoscopy color images. The main aim of a [25]SVM is to separate two classes with decision surface that has maximum margin.



The decision function specifies the subset of training sample.
[27]It is seen by many as most successful current text classification method.

SVM classifier can be [24]classified into two. They are:

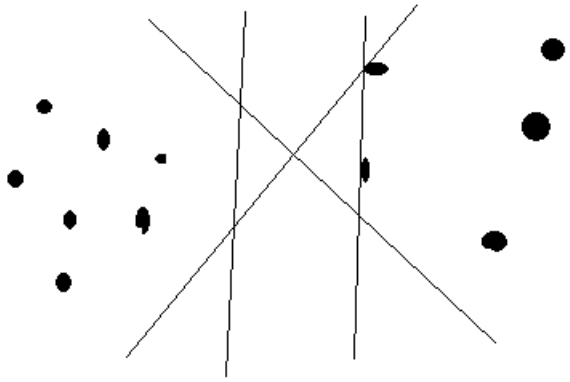
- Linear SVM
- Non linear SVM

LINEAR SVM

Linear SVM is the new and the fastest learning (data mining) algorithm for solving classification problem from the large data sets.

It creates an SVM model in a cpu time which scales linearly with the size of the training data set. When the accuracy is required the performance is high.

FOR EXAMPLE



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Here the lines in the figure represent the decision boundary.

$ax + by – c = 0$

[27]It maximizes the distance between the hyperplane and the "difficult points" which are close to the decision boundary.

If there are no points near the decision surface, then there are no uncertain classification decisions.

[27]Here, some methods find a separating hyperplane, but not the optimal one.

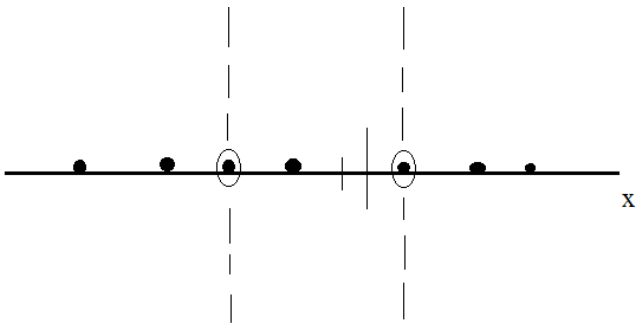
For e.g: perception

FEATURES OF LINEAR SVM

- It is very efficient when dealing with extra large data sets.
- Provides solution for classification problems with any number of classes.
- It works with high dimensional data.
- It does not need expensive computing resources.
- It is ideal for contemporary applications.

NON-LINEAR SVM

In non linear SVM the margins are soft. It is easier to find separating hyperplane. It transfers X_i to a higher dimensional space to make classes linearly separable.



Here, in this figure the [27]original space can always be mapped to some high dimensional feature space where the training set is separable.

ADVANTAGE OF SVM

- The SVM aims at minimizing the error on the high dimensional space. Therefore, it is called as structural risk minimization.
- [25]SVM is used to verify text region for achieving a lower false alarm rule.
- It makes the data separable since the kernel implicitly contains non – linear transformation.
- By introducing kernel, SVM gains flexibility.
- SVM delivers a unique solution since the optimality problem is convex.

DISADVANTAGE OF NON – PARAMETRIC TECHNIQUES

- It lacks the transparency result.

COMPARISON OF SVM AND NEURAL NETWORK

SVM

It is a new concept. It has a proper generalization property. It is hard to learn using QP techniques. By using kernels, complex function can be learned.

NEURAL NETWORK

Generalized well but it doesn't have mathematical foundation. In incremental fashion it can be learned easily. To learn complex function complex multi layer Structure is used.

8. SUPER PIXEL SEGMENTATION

Super pixel is becoming popular for the use in computer applications. There are few algorithms that give output to a number of regular compact super pixels with a low computational cost. By introducing a novel algorithm called as SLIC (Simple linear iterative clustering) it efficiently generates compact, uniform super pixels. It is easy to use because of simplicity.

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SLIC segmentation is an efficient cluster technique. It is similar to K-mean cluster method. The clustering distance between two different pixels is weighted by the color distance and space distance.

Images segmented using SLIC into super pixels

PROPERTIES OF SUPER PIXEL

- Super pixel is fast to compute, memory efficiency and simple to use.
- Super pixel should stick to image boundary.
- In a pre-processing step it reduces the computational complexity.
- When it is used for segmentation purpose, the super pixels should increase both the speed and also improve the quality of the result.

ADVANTAGE OF SUPER PIXEL SEGMENTATION

- [26]Pixel can be represented in arrays without any pointers.
- It is easy to sub – sample pixels uniformly and use multi – scale methods.
- The n^{th} pixel has the consistent created position in the image.
- The n^{th} pixel has a consistent relationship with the $(n-1)^{th}$ pixel.

9. CONCLUSION

[23]In this work a method for bleeding region detection is proposed at super pixel level for WCE images. Instead of processing each pixel or dividing the image, grouping of pixels are done adaptively based on color and location through super pixel segmentation. The computational complexity can be reduced a lot compared to pixel based methods while high performance can be maintained. Furthermore, the influence of edge pixels are removed and introduced the red ratio features in the RGB color space, which proved to be better than traditional features on bleeding detection. Experimental results showed that the proposed method perform significantly in terms of sensitivity and accuracy.

DISCLOSURE

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REFERENCES

[1] A.Ali, J. Santisi, and J.Vargo, "Video capsule endoscopy: A voyage beyond the end of the scope," *Clevel. Clin. J.Med.*, vol. 71, no. 5, pp. 415–425, 2004.

[2] G. Zuckerman, C. Prakash, M. Askin, and B. Lewis, "AGA technical review on the evaluation and management of occult and obscure gastrointestinal bleeding," *Gastroenterology*, vol. 118, no. 1, pp. 201–221,2000.

[3] N. Lee and G.Eisen, "10 years of capsule endoscopy: An update," *Expert Rev. Gastroenterol. Hepatol.*, vol. 4, no. 4, pp. 503–512, 2010.

[4] J. Liu and X. Yuan, "Obscure bleeding detection in endoscopy images using support vector machines," *Opt. Eng.*, vol. 10, no. 2, pp. 289–299, 2008.

[5] B. Giritharan, X. Yuan, J. Liu, B. Buckles, J. Oh, and S. Tang, "Bleeding detection from capsule endoscopy videos," in *Proc. 30th Annu. Int. Conf.*

IEEE Eng. Med. Biol. Soc., Aug. 2008, pp. 4780–4783.

[6] B. Li and M.Q.H. Meng, "Texture analysis for ulcer detection in capsule endoscopy images," *Imag. Vis. Comput.*, vol. 27, no. 9, pp. 1336–1342, 2008.

[7] P. Khun, Z. Zhuo, L. Yang, L. Liyuan, and L. Jiang, "Feature selection and classification for wireless capsule endoscopic frames," in *Proc. Int.Conf. Biomed. Pharmaceut. Eng.*, Dec. 2009, pp. 1–6.

[8] G. Pan, G. Yan, X. Qiu, and J. Cui, "Bleeding detection in wireless capsule endoscopy based on probabilistic neural network," *J. Med. Syst.*, vol. 35, no. 6, pp. 1477–1484, 2011.

[9] A. A. Al-Rahayfeh and A. A. Abuzneid, "Detection of bleeding in wireless capsule endoscopy images using range ratio color," *Int. J. Multimedia Appl.*, vol. 2, no. 2, pp. 1–10, 2010.

[10] P. Lau and P. Correia,"Detection of bleeding patterns in wce video using multiple features," in *Proc. IEEE 29th Annu. Int. Conf. Eng. Med. Biol. Soc.*, Aug. 2007, pp. 5601–5604.

[11] B. Li and M. Meng, "Computer-aided detection of bleeding regions for capsule endoscopy images," *IEEE Trans. Biomed. Eng.*, vol. 56, no. 4, pp. 1032–1039, Apr. 2009.

[12] Y. Fu, M. Mandal, and G. Guo, "Bleeding region detection in wce images based on color features and neural network," in *Proc. IEEE 54th Int. Midwest Symp. Circuits Syst.*, Aug. 2011, pp. 1–4.

[13] Lee Jeongkyu, Oh JungHwan, , Yuan Xiaohui, and Tang Shou-Jiang, "Automatic classification of digestive organs in wireless capsule endoscopy videos," in *SAC '07: Proceedings of the 2007 ACM symposium on Applied computing*, 2007, pp.1041–1045.

[14] Suvidha Sawant, M.S.Deshpande, "Tumor Recognition in Wireless Capsule Endoscopy Images," *e-ISSN: 2278-1676, p-ISSN: 2320-3331, Vol. 9, Issue 3 Ver. I (May – Jun. 2014), PP 104-109.*

[15] Yanan Fu, Wei Zhang, Mrinal Mandal, "Computer-Aided Bleeding Detection in WCE Video,"IEEE Journal Of Biomedical And Health Informatics, VOL. 18, NO. 2, MARCH 2014

[16] Giovanni Gallo, Alessandro Torrisi, "Boosted Wireless Capsule Endoscopy Frames Classification," PATTERNS 2011 :The Third International Conferences on Pervasive Patterns and Applications, Copyright (c) IARIA, 2011. ISBN: 978-1-61208-158-8

[17] Laura Auria, Rouslan A. Moro, "Support Vector Machines(SVM) as a Technique for Solvency Analysis," German Institute for Economic Research

Mohrenstr. 58, DIW Berlin, 2008.

[18] ZhaocongWu, Zhongwen Hu, Qian Fan, "Super pixel based unsupervised change detection using multi-dimensional change vector analysis and SVM-based classification," Remote Sensing and Spatial Information Sciences, Volume I-7, 2012 , XXII ISPRS Congress, 25 August – 01 September 2012.

[19] www.cse.unt.edu, Internet Source

[20] Fu, Yanan, Haiying Liu, Yu Cheng, Tingfang Yan, Teng Li, and Max Q.-H. Meng. "Key-frame selection in WCE video based on shot detection", Proceedings of the 10th World Congress on Intelligent Control andAutomation, 2012.

[21] thinkmind.org,Internet Source

[22] Ccjm.org, Internet source

[23] Y. Fu, M. Mandal,Wei Zhang and Max Q.H.Meng, " Computer - aided bleeding detection in wce video"

IEEE journal of Biomedical and health informatics, VOL 18, NO.2, March 2014.

[24] Ying Li. "Combination of SVM Knowledge for Microcalcification Detection in Digital Mammograms", Lecture Notes in Computer Science, 2004

[25] Yun-Cai Liu. "Caption location and extraction in digital video based on SVM", Proceedings of 2004 International Conference on Machine Learning and Cybernetics (IEEE Cat No 04EX826) ICMLC-04, 2004

[26] Graham Jones. "Superpixel lattices", 2008 IEEE Conference on Computer Vision and PatternRecognition, 06/2008

[27] handel.mba.ntu.edu.tw, Internet Source