한국정보전자통신기술학회논문지(jkiiect)'15-10, Vol.8 No.5
논문 15-08-05-367 http://dx.doi.org/10.17661/jkiiect.2015.8.5.367

Development of an algorithm for Detecting Symptom level in patients with Scleroderma

Jin-Hyeong Jeong, Ki-Young Lee, Min-yeong Kim, Nam-Sun Kim Sang-Sik Lee*

Abstract In this study, locality of scleroderma was detected. Diagnostic method is difficult for scleroderma (skin curing; Scleroderma), and it is done by comparing the images of the normal subjects to the scleroderma patients, after performing monochrome processing. The saturation, brightness, and contrast are adjusted, and they were converted by using the process of Well Filter. As a result, the images were able to be used to clearly distinguish the symptoms of scleroderma. In addition, in a video of a healthy person, the line of sight of the observation given the image of scleroderma patients above sea level of height as 0 °is to implement the closing process to the rear Well Filter even only in so that the horizontal plane, and out at intervals of graph the amplitude difference of the video have I asked. The diagnostic criteria were determined for the healthy subjects and the scleroderma patients.

요 약 본 연구에서는 피부 경화증 환자의 증상정도 알고리즘을 개발하였다. 진단 방법은 피부경화증을 흑백처리 한 후 정상인의 이미지와 비교하였다. 채도, 밝기 및 콘트라스트 조정의 필터를 프로세스를 통해 변환 하였다. 그 결과 화상이 선명한 경화증의 증상을 구별하는데 사용될 수 있었다. 건강한 사람의 영상에서 경화증 환자의 이미지를 주고 폐쇄 프로세스를 적용하여 진폭의 차이로 정상인과 피부 경화증 환자를 결정하였다.

Keywords : Scleroderma, Skin, Rough, Well Filter, Elevation, Length, Brightness, Saturation

1. INTRODUCTION

The cause of Scleroderma is not clearly known, and it is known as an autoimmune disease. The diagnosis is largely obtained through medical aspects, and the symptoms, histological examination, and blood test are used.[1-4] Therefore, scleroderma is not only based on the findings from a few tests, and an early diagnosis is extremely difficult. Therefore, medical image processing can be used to easily diagnose scleroderma. The aim of the present study is to propose methods of recognizing the important factors of advanced stage.[5,8,9]

2. MATERIALS AND METHODS

In this study, we reviewed the clinical images of scleroderma patients, such as the findings of skin lesions, image processing by Well Filter, and Elevation technique.[10, 11] The site-specific symptoms of scleroderma were compared by the naked eye, and a healthy person and scleroderma patient were used as subjects to establish the standards. In order to search for the expression and normal skin lesions more objectively, Well Filter and Elevation were used for the images, and the analysis study was performed through a process technology.[12]

Black and white effects are caused by the brightness of each pixel on a certain reference

* Corresponding Author : Biomedical Engineering, Catholic Kwandong University, Gangneung, Korea(lsskyj@cku.ac.kr)
Received September 3, 2015 Revised September 10, 2015 Accepted September 18, 2015

Fig. 1. Algorithm for conversion system of image processing 1

Fig. 2. Conversion system of image processing algorithm 2

value. The process of converting into two values of black and white was used. Each pixel of the image has a RGB value from 0 to 255, and the average value of the RGB is the brightness of each pixel. For the pixel (x, y) of brightness, T represents a value of the formula shown in Equation 1 below, as a reference for the (x, y).

$$(x,y) = \text{Black}(f(x,y) > T)$$
$$(x,y) = \text{Black}(f(x,y) \leq T) \quad \cdots(1)$$

Expression adjustment of brightness, contrast, and saturation of the above is a process that converts the brightness and turbidity into the darkness of the adjustment and the color of the light.

Although the Well Filter was used in this study as a closed process, it is a method for generating an image containing only the dark color. [11]

Elevation is the line of sight in the observation of an object, at above sea level. The processing technology we used performed conversion at an angle of the horizontal plane.

Well Filter, as described in the first algorithm, is also called as the closing process, in which the length is the distance of pixels between the two endpoints.

To reliably determine the application of this algorithm with scleroderma, the skin of a generally healthy person and of a scleroderma patient was examined. The symptoms were shown by the display of skin conditions, and the photograph was obtained for comparison.[6] In addition, by applying the technique Elevation, which is a coarse algorithm based on a photograph, the differences in amplitude were obtained. The criteria for a healthy person's image and scleroderma patient's image are shown.[7]

The first algorithm was applied in this study, and it was conducted in the same way as the procedure from Figure 1 below. After giving a black and white effect on the image brightness and contrast, closed circuit Well Filter is obtained by adjusting the saturation and the image processing. Through such image processing for the skin image of a healthy person and a scleroderma patient, it was found that it can be discriminated by the naked eye.

The process is as shown in Figure 1.

The following Figure 2 shows a flow chart, where the Elevation technique is applied to the second algorithm in this study. The Elevation techniques were used at above sea level of 0 °. After deriving the chart format, closure processing techniques of Well Filter was included to obtain the sharpness of the

image and the peak and bottom amplitudes of the difference.

3. RESULTS AND DISCUSSION

After giving a black and white effect to the image, by using the first algorithm, the saturation, brightness, and contrast were adjusted. The image processing Well Filter was finally a closed circuit, which is the verification of the algorithm. For the symptoms, another classification of scleroderma patients was applied by using the first algorithm. In the following Figure 3, equally represented algorithm was applied to a healthy person's video and a scleroderma patient's image, for the comparison.

Fig. 3. The first algorithm applied to the image. Normal picture is shown from left to right. The algorithm is applied to the normal person's imaging and scleroderma patient's imaging

Figure 4 below is a comparison of the image with symptoms on the knee. To give a black and white effect on image brightness and contrast, the color saturation was adjusted. The images of the healthy person and scleroderma patients were compared by applying well Filter. Looking at the left picture of Figure 4, the video image of the knee in a healthy subject is expressed in black. On the other hand, the image of the scleroderma patients is represented by white, and it is possible to see and identify with the naked eye.

Fig. 4. Comparing experimental results 2

The following Figure 5 shows the fingers of the normal image, and video image processing algorithm was applied to the first image of the fingers, shown by scleroderma patients. Compared to the original image, the colored portion was expressed by black and it can be determined easily. Scleroderma finger portion of the photos below were used to confirm that it is expressed in fine white.

Fig. 5. The first algorithm applied to the image of the finger. Normal picture is shown from left to right. The algorithm is applied to normal image and scleroderma patient's imaging

By applying the first algorithm as above, it was found that also easily determined that the human eye and detectable lesions in scleroderma. After thus subjected to the first algorithm, by applying a second algorithm expresses the roughness of scleroderma patients. Seen from Figure 6, were expressed in a graph of the roughness amplitude of healthy subjects video and scleroderma patients images shown equal.

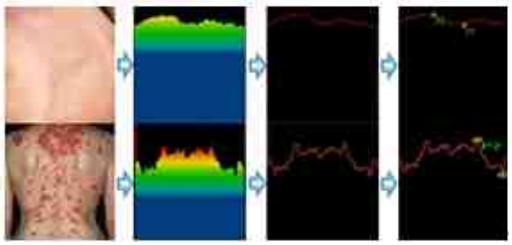


Fig. 6. The amplitude of elevation expressed by applying the graph image

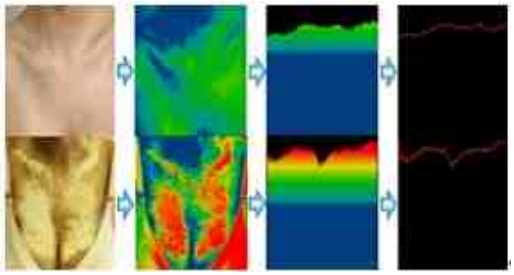


Fig. 7. Elevation technique applied on the chest and amplitude of the graph image

The following Figure 7 shows the pictures representing the roughness of the amplitude for the healthy person and scleroderma patient on the chest.

Table 1. Healthy subjects of the video and scleroderma amplitude of the lesion site

Case	Position	Maximum Amplitude	
		Center X	Center Y
1	P1	3	76
	P2	2	41
2	P1	126	61
	P2	255	10
3	P1	171	43
	P2	99	20
4	P1	114	101
	P2	87	39

Table 1 shows the roughness on the chest, by applying the Elevation method I with the amplitude based on the graph. The chest image of a healthy person has the maximum amplitude value of 71, and the minimum amplitude value is 43. Amplitude between the two was measured at 28. The maximum amplitude for the chest of scleroderma patient was 61, and the minimum amplitude was 6. Then, the amplitude value between the two can be measured at 55, which shows that the difference in amplitude is larger than a healthy person, in the chest image. Next, the amplitude difference was found from the back contour. Maximum amplitude value of healthy individuals based on black contour was 46, and the minimum amplitude value was 21. Amplitude between the two was measured at 21, the maximum amplitude value of the back image of scleroderma patients was 111, and the minimum amplitude value was measured at 41. The amplitude difference between the two is larger than the amplitude image of 70.

5. CONCLUSION

In this study, algorithm was developed, which divides the symptoms classifications of

scleroderma patients. After the image is given in black and white, the first algorithm was applied by adjusting the brightness and contrast. Then, the saturation and the image processing are obtained to form a closed circuit Well Filter. The difference in the amplitude is obtained, which represents the roughness of the image by applying the Elevation technique and a second algorithm. The expression of scleroderma patients were checked in a more objective way, according to the different conditions, and the characteristics were displayed.

The amplitude was represented by graph, by expanding the roughness of the symptoms of scleroderma. At the starting point, there was no clear standard; but in this study, the criteria were derived to be used to easily diagnose scleroderma.

There are different collecting methods for the patients' imaging. Furthermore, the image processing and work also contains the possibility of errors. The degree of consistency is determined by the image processing, and the digitized graphic patterns are believed to be great tools.

REFERENCES

[1] B. K. Walder F.R.A.C.P "Do Solvents Cause Scleroderma?" 2008 International Journal of Dermatology Volume 22, Issue 3, pages 157 - 158.

[2] Cantwell, Jr A.R. · Craggs E. · Wilson J.W. · Swatek F. "Acid-Fast Bacteria as a Possible Cause of Scleroderma." 1968 ;136:141 - 150 (DOI:10.1159/000254093)

[3] Noel R. Rosea, Constantin Bonab "Defining criteria for autoimmune diseases." 2003 Immunology Today Volume 14, Issue 9, Pages 426 - 430

[4] William A. D'Angelo, James F. Fries, Alfonse T. Masi. Dr.P.H. Lawrence E. Shulman, M.D., Ph.D "Pathologic observations in systemic sclerosis (scleroderma) ☆: A study of fifty-eight autopsy cases and fifty-eight matched controls" 1968 Volume 46, Issue 3, , Pages 428 - 440

[5] LeRoy EC1, Black C, Fleischmajer R, Jablonska S, Krieg T, Medsger TA Jr, Rowell N, Wollheim F." Scleroderma (systemic sclerosis): classification, subsets and pathogenesis." 1988 15(2):202-205

[6] Arabadzhiev T. I., Dimitrov, G. V., Dimitrova, N. A., 2005, "Simulation analysis of the performance of a novel high sensituve index for quantifying M-wave spectral changes during fatigue," J. Electromyography and Kinesiology Vol. 15, pp. 149-158

[7] Ament W, Bonga GJ, Hof AL, Verkerke GJ., 1996, "Electromyogram median power frequency in dynamic exercise at medium exercise intensities," Eun J Appl Physiol, Vol. 74, pp. 180-186

[8] S.C. Orphanoudakis, "Supercomputing in Medical Imaging" 1988 IEEE Eng Med Biol, vol. 7, 16-20

[9] McAuliffe, M.J. "Medical Image Processing, Analysis and Visualization in clinical research" Computer-Based Medical Systems, 2001. CBMS 2001. Proceedings. 14th IEEE Symposium on. Page 381-386.

[10] Lee, Ki-Young. "study on symptom level for patient with Scleroderma" 2011 The Korea Institute of Information Electronic Communication Technology Vol.4 No.1

P.231-234

[11] Carol M. Artlett, Ph, J. Bruce Smith, Sergio A. Jimenez. “Identification of Fetal DNA and Cells in Skin Lesions from Women with Systemic Sclerosis” 1998 338:1186-1191 DOI: 10.1056/NEJM 199804233381704

[12] Carol M. Artlett, Ph, J. Bruce Smith, Sergio A. Jimenez. “Identification of Fetal DNA and Cells in Skin Lesions from Women with Systemic Sclerosis” 1998 338:1186-1191 DOI: 10.1056/NEJM199804233381704

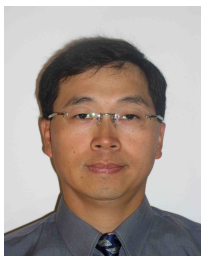
Author Biography

정 진 형(Jin-Hyoung Jeong) **[정회원]**

- 2012년 2월 : 가톨릭관동대학교 의료공학과 졸업 (학사)
- 2014년 2월 : 가톨릭관동대학교 일반대학원 졸업 (공학석사)
- 현재: 가톨릭관동대학교 일반대학원 의료공학과 박사과정

<관심분야> 의용메카트로닉스, 디지털 신호처리, 영상처리,

이 기 영(Ki Young Lee) **[종신회원]**



1987-1988년 한국전자통신 연구소 연구원
1992년 명지대학교 박사
2003-2004년 미주리주립대학 교환교수
2011년 성균관대학교 박사
1993년-현재 가톨릭관동대학교 의료공학과 교수

<관심분야> 의용전자, 생체 신호처리, 기계 요소학, 디지털 신호처리

김 민 영(Min-yeong Kim)

2012년 2월: 가톨릭관동대학교 의료공학과 졸업(학사)
2012 ~ 2014년: 메디룬
2015년 ~ 현재: 소닉 월드

<관심분야> 의용메카트로닉스, 디지털 신호처리, 의용전기전자

김 남 선(Nam - Sun Kim)

- 1987년 2월 : 이화여자대학교 졸업
- 1991년 ~ 1994: 영동대학교 교수
- 1995년 ~ 현재 : 가톨릭관동대학교 교수

<관심분야> 간호학, 의료기기

이 상 식(Sang-Sik Lee) **[종신회원]**

- 1993-2000년 LG전선(주)
- 1996-2000년 성균관대학교 박사
- 2001-2004년 (주)미도테크
- 2004-2010년 성균관대학교 연구교수
- 2011-현재 가톨릭관동대학교 의료공학과 교수

<관심분야> 의용메카트로닉스, u-Health, 생체역학, 의용전기전자