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Edge Imaging Calculations for Limb Wound Cure

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ABSTRACT
Surgeon treating skin wound usually meets a problem that patient would not willing to take a photo. If we have no such a photo, its hard to compare wound recovery condition in a time line. This study started a plan using edge computing via computer camera to assist surgeon to evaluate the patients' limb wounds. After papers review, although numerical literatures related to edge image calculation, these is only small part of literatures focusing on limb wound cure. The free software of this application is hard available. Thus, we make a plan to do this study. The proposed software searched the limb wound image via edge device of laptop. The red distinct and ratio of bleeding and non-bleeding parts would the judgment criteria. It would real-time output on the screen and the patient or nurse would know the wound recover condition. The innovation part of this design was there was no need to upload the photos to webserver, and the answer would know immediate. The camera can rotate if the wound image is not clear. The ratio of bleeding and non-bleeding parts almost was a constant value by the same patient within a day. The experimental results showed that it would an useful tool for wound cure. The future suggestions is combine giving medicine for limb wound nursing.
KEYWORDS: *Surgeon treating, skin wound, limb wound, edge computing, computer vision.*

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I. INTRODUCTION

Surgeon treating skin wound usually meets a problem that patient would not willing to take a photo. If we have no such a photo, its hard to compare wound recovery condition in a time line. This study started a plan using edge computing via computer camera to assist surgeon to evaluate the patients' limb wounds. This paper would decompose how to make it works.

II. LITERATURE REVIEW

In 1997, we starts to find the related study. Hansen *et al*. [1] used image processing to burns and pressure ulcers in the wound early stages. They found mild, moderate and severe injuries within 30 minutes after injury can be analyzed by image processing in statistically significant difference. Oduncu *et al*. [2] used image processing for the color analysis of chronic wounds on the skin. The software analyzed wound boundaries in leg ulcer imaging, knowing the amount of slough at the wound site. Except medical doctor judgment, the software would shorten the time to evaluate the results to the patients. The results were compared by deriving Kappa (K) statistic, they found that image process has the potential to analyze the chronic skin wounds. Wannous *et al*. [3] designed color wound assessment tool using a simple free handled digital camera. The color and texture were classified by their software, achieving 88% cover rate. The granulation recognition rate was 75%; the slough recognition rate was 60%. The slough showed darker color, and less red color. Prichayudh *et al*. [4] they evaluated mechanism of injuries, injury severity score, ischemic time, color and capillary refill of skin; color,

consistency, and contractility of muscles to know 52 patients wound recovery condition. If limb wounds worsen, amputation is a treatment option. Eardley *et al*. [5] stated bacterial would influence tissue degradation and healing. Infection is the main complication of limb injuries. In nursing aspect, gauze applying would determine the recovery condition. Bouldin *et al*. [6] expressed that they found rural veterans had fewer outpatient wound care visits. It also has similar number of inpatient wound care. To follow-up 234 veterans' wounds, higher among rural veterans, and the hazard of death was lower.

Peral *et al*. [7] stated that in a diabetic skin, there are some skin macules characterization on their skin. Due to blood vessel damage, vascular macules and petechiae would occur. The research use artificial neural network (ANN) to classify skin color and area. The results showed accurate rate was 97.5%. The medical doctor would trance the macules by a time line. The assistance tool would assist medical doctor to cure the patients. Lawrence *et al*. [8] system reviewed dark skin, burn site on neck and upper limb, multiple surgical procedures, meshed skin graph, time to healing, and burn severity literatures. They found burn severity and location had a modest relationship with psychosocial. It maybe the epidemiology of scars and the burden of scars would make the influence on human behavior.

Yang *et al*. [9] used image analysis method for skin defects calculation. The accurate error rate was -3.39% ~ + 3.05%. From their research, we would know image analysis can be applied into skin defects calculation. Bennett *et al*. [10] stated that patients with pressure ulcers are under injuries due to prolonged pressure. Thermal images was applied into detect a patient wound, who's right foot staying 112 days on a hospital. The case report showed thermal images would earlier known the damage than other approaches. The imaging tool was successful to treat that problem. Jessee [11] studied the correlation between limb wound outcomes and the presence of a caregiver during clinic visits. She divided patients as two groups. One is more frequent accompanied by a caregiver, the other one is not. The result showed that accompanied one strongly higher healing rate than alone. In his research, let us think about maybe AI can generate higher healing rate or not. Li *et al*. [12] developed an automatic stop bleeding device to handle where the medical staff cannot approach the wounded to make the timely rescue. The robot would search limb wound and try to stop the bleeding. In their study, we would know maybe we can apply our research into this kind of application.

Chemello *et al*. [13] used AI methodologies to treat identify foot ulcers based on image recognition. Deep learning of AI techniques were applied. Liu *et al*. [14] stated bleeding conditions on the skin caused many red skin areas. Assessment of blood loss and blood supply can know the wound recovery rate. They observed 12 patients and not occurred the infection. Chen *et al*. [15] stated the vitamin D effectively treat chloasma and promote wound healing. The subjects were 480 patients, finding that vitamin D effected on the wound healing process. Cao and Wang [16] used CNN techniques of AI to do image recognize limb wound care in children. The subjects were 92 children from Jan 2022 to June 2023. They found wound infection rate, wound healing time, wound pain scores, parental knowledge scores, and satisfaction with care were efficient improved. Sharma *et al*. [17] studied acne, eczema or atopic dermatitis, and melanoma by CNN of AI. The accuracy of machine learning was 95.6%. The techniques were integrated image processing, image enhancement, machine learning and segmentation.

Although numerical literatures related to edge image calculation, these is only small part of literatures focusing on limb wound cure. The free software of this application is hard available. Thus, we make a plan to do this study.

III. PROBLEM STATEMENT

Patients would not willing to take a photo due to personal body privacy. They don't want leave any evidence which is closed or related to reproductive organs or female chest. But it is difficult to surgeon under the skin wound nursing and cure. Therefore, supposed that if we have an AI, it can analyze the skin wound and output data, we really needn't take any photo to record under the skin wound nursing and cure and raising the patients body privacy. In this research, we did not use AI term, its related to computer vision and pattern reorganization, and skin wound calculation.

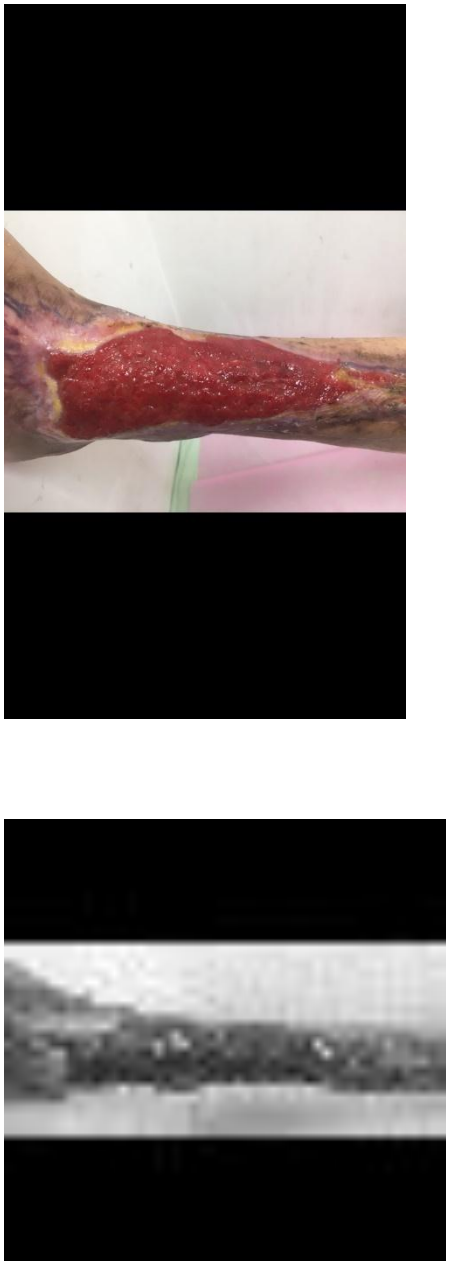

Figure 3.1 A Patient Limb Wound (Original vs. Image Transferred)

Figure 3.2 A Patient Limb Wound Gray Image Pixel Matrix

The computer process flowchart also showed in Figure 3. In the beginning, nurse or medical doctor lunches continuous camera, then the computer software would pick up one photo within Mpeg4 file. Then to gray and zoom out the photo. After that, numerical computing red distinct, the same as Figure 2. Finally, To output the estimation value and go back to receive the next photo. In this procedure, edge device of analyzing wound are completed.

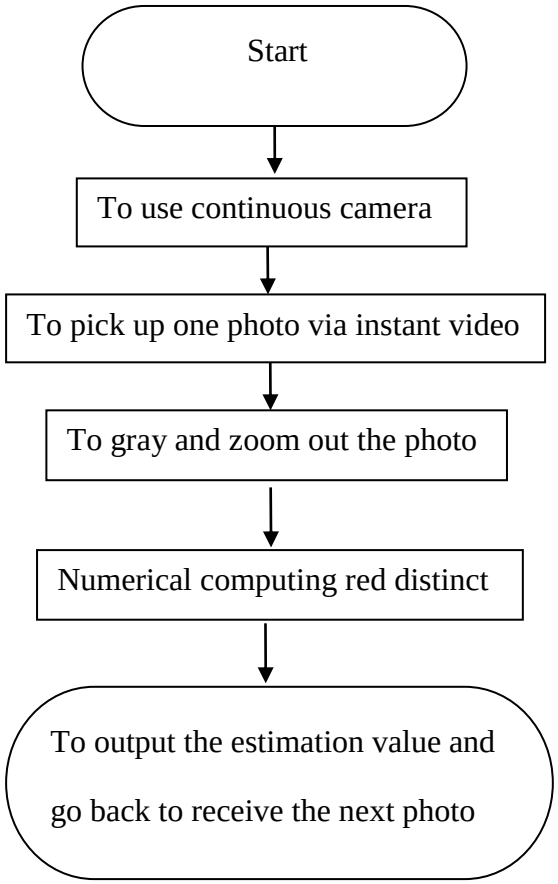

Figure 3.3 A Flow Chart of the Proposed Approach

4 CASE Detection

The software would search the limb wound image via edge device of laptop. The red distinct and ratio of bleeding and non-bleeding parts would the judgment criteria. It would real-time output on the screen and the patient or nurse would know the wound recover condition.

The innovation part of this design was there was no need to upload the photos to webserver, and the answer would know immediate. The camera can rotate if the wound image is not clear. The ratio of bleeding and non-bleeding parts almost was a constant value by the same patient within a day.

5 Benefit for this Application

Nowadays, chips is not small enough. Even we can show the overlap AR image on the AR glasses, it still needs a laptop class computer for calculation. At least, we find the following advantages:

(1) New AI for medical diagnosis updates frequently. Some limb wound cure at outdoor may be a good chance for computer aid medicine application.
(2) To help patient or nurses to evaluate limb wound nursing.
(3) To output the color digital data, it would help medical doctor to find numeric evidence.
(4) Due to image numeric data, it maybe let computer more smart by classification and correlation computing.

6 CONCLUSION

The experimental results showed that it would an useful tool for wound cure. In original idea, we tried for many years for obtaining practices approach. Now it proved it's works. The future suggestions is combine giving medicine for limb wound nursing. Hopes that it can be used to a clinic environment.

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