Dorsal Hand Vein Segmentation Using Vein-Generative Adversarial Network (V-GAN) Model

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Abstract. Difficulty in achieving intravenous access in some patients is a clinical problem due to extreme age, body size, and chronic disease patients. In biometric identification, hand vein patterns are useful when other external identifiers are more prone to be damaged or forged. To overcome these problems, near-infrared dorsal hand vein images are captured and segmented for vein extraction. However, the segmentation process becomes more challenging when the infrared im- ages suffer from extremely low contrast and distortion, indirectly affecting the segmentation process. Therefore, this work presents a method for generating an accurate map of dorsal hand vein patterns using deep learning Vein-Generative Adversarial Networks (V-GAN). The performance of V-GAN is measured in terms of accuracy, Area under Curve (AUC), F1-score, sensitivity, specificity, and dice-coefficient.

Keywords: Hand vein segmentation · Generative adversarial network

1 Introduction

A hand vein pattern is a large network of blood vessels beneath the skin of a person's hand. The most important properties of dorsal hand veins are – uniqueness, universality, collectability, performance, acceptability, circumvention, and permanence. Due to this, vein patterns verify individuals' unique identities based on their biometric features and properties. In biomedicine, the dorsal hand vein images guide paramedics in intrave- nous procedures in inserting a catheter into a vein to deliver medical fluids.

The problem with dorsal hand veins is that they may be hardly seen in visible light due to under-skin fat and blood occlusion. Only near-infrared (NIR) light veins can be visible through an image due to different infrared light responses towards different skin layers. Although the identification and verification based on hand veins through NIR imaging have been studied for many years, improvements still deem necessary particularly to overcome the challenging effects of environmental lighting, ambient temper- ature, and light scattering [1]. Hence, an acquired image usually is low in contrast, that vein patterns are not clearly distinguishable from their surroundings. Several approaches have been proposed to alleviate these factors' influence when extracting vein

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