An Intelligent Scalp Inspection and Diagnosis System for Caring Hairy Scalp Health

Jian-Ping Su†, Liang-Bi Chen†, Chia-Hao Hsu†, Wei-Chien Wang‡, Cheng-Chin Kuo†,
Wan-Jung Chang†*, Wei-Wen Hu†, and Da-Huei Lee†
†Department of Electronic Engineering, Southern Taiwan University of Science and Technology, Tainan, Taiwan
‡Science and Engineering Faculty, Queensland University of Technology, Brisbane, Australia
{liangbichen, *allenchang}@stust.edu.tw

***Abstract*—This paper proposes an intelligent scalp inspection and diagnosis system based on the deep learning techniques for caring hair scalp health. The proposed system can automatically recognize the status of the user's scalp. Moreover, we can continuously increase in the number of samples to enhance the accuracy rate by adopting deep learning techniques. The proposed system consists of a scalp detector, an app running on a tablet, and a cloud management platform. The scalp detector will be connected with the tablet via Wi-Fi wireless network. Thus, a scalp photo can be captured via the proposed scalp detector. The scalp photo will be recognized by scalp detector, and the recognized result of the scalp will also be sent and displayed to the tablet. As a result, we can get the quantitative data on the scalp, including bacteria, allergies, dandruff, grease, and hair loss. Moreover. The experimental results showed that the accuracy can be achieved 90.909%.**

Keywords—expert system; deep learning; intelligent diagnosis system; scalp inspection; machine learning

I. INTRODUCTION

Recently, a survey from the World Health Organization (WHO) points out that about 70% adults have scalp issues. The cause of the issues, includes genetic, endocrine, disease, and other internal factors. However, to face such increasingly serious scalp problems, nowadays, the dedicated services of scalp physiotherapy have been appeared.

The current process stage of physical therapy identifies the state of the patient's scalp by manual recognition, which causes the accuracy of scalp examination, depending on the scalp physiotherapist professions. Hence, this paper proposes an intelligent scalp inspection and diagnosis system based on the deep learning techniques for caring hair scalp health. Moreover, we can continuously increase in the number of samples to enhance the accuracy rate by adopting VGG-net deep learning techniques [3]. The proposed system consists of a scalp detector, an app running on a tablet, and a cloud management platform. The scalp detector will be connected with the tablet via Wi-Fi wireless network. Thus, a scalp photo can be captured via the proposed scalp detector.

The scalp photo will be recognized by scalp detector, and the recognized result of the scalp will also be sent and displayed to the tablet. And then, we can get the quantitative data on the scalp, including bacteria, allergies, dandruff, grease, and hair loss. A professional physiotherapist can provide comprehensive hair scape care and maintenance for different customers. Besides, scalp information of the customers can be recorded in our proposed cloud management platform. Moreover, a professional big data analysis can be provided. The customers can also check the state of their scalp maintenance. As a result, the proposed system can provide a better scalp physiotherapy services. Compared to the other existing products (scalp detector), the proposed scalp detector has a unique automatic scalp recognized function which is a higher accurate deep learning-based scalp image recognition technique.

This work is supported in part by the Ministry of Science and Technology (MoST), Taiwan, under grant, MOST 107-2637-E-218-003. *Corresponding author: Prof. Wan-Jung Chang.*

II. THE PROPOSED SYSTEM

The system architecture of the proposed system is shown in Fig. 1. The related photos of user scalp can be captured by the proposed scalp detector. The proposed system can identify the current status of scalp health by the deep-learning-based predictor. Hence, we can continuously increase in the number of samples to enhance the accuracy rate by adopting VGG-net deep learning techniques [3].

The status of scalp can be displayed for the user via a tablet. An information platform based on the cloud is also developed for the purpose of the on-line deep learning database training and membership management.

Moreover, this platform can provide related data analysis which can help related enterprises (nursing consultation & professional treatment) to understanding the customer of potential needs for providing related services in scalp care.

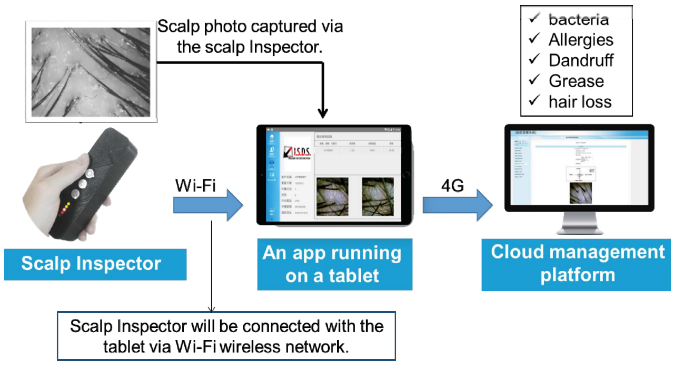

Fig. 1. System architecture of the proposed system.

III. PROTOTYPE AND DEMONSTRATION

The proposed system is composed of a scalp detector, a dedicated app running on a tablet, and a cloud management platform. The hardware prototype of scalp detector is shown in Fig. 2. The 3D printing prototype of scalp detector is shown in Fig. 3. A dedicated app running on a tablet is shown in Fig. 4. A cloud management platform is shown in Fig. 5.

As a result, the prototype and related experimental results are provided in this paper, including hardware design, software design, and 3D printing prototype to prove the technical feasibility of the proposed ideas. This proposed system has successfully applied to do real scalp detection and analysis of a program actually executed as shown in Fig. 6.

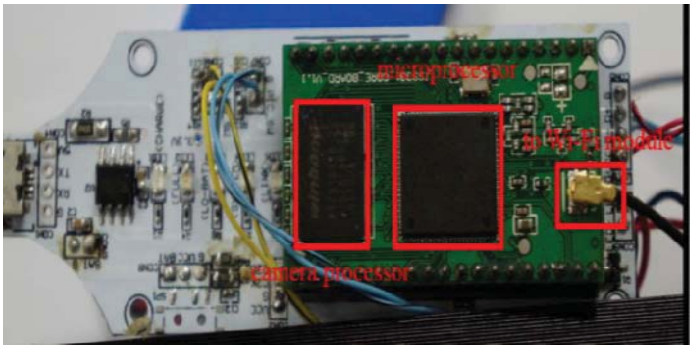

Fig. 2. The hardware prototype of scalp detector.

Fig. 3. The 3D printing prototype of scalp detector.

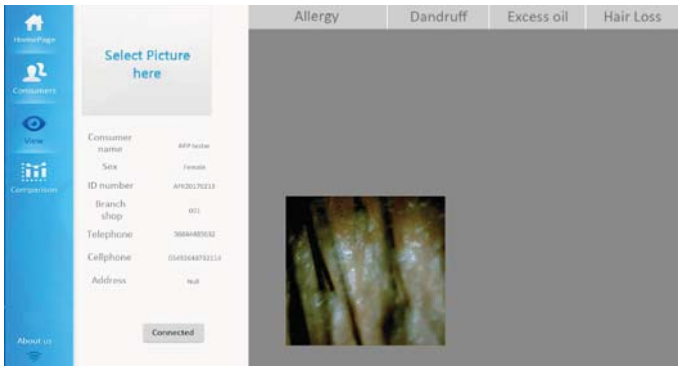

Fig. 4. A dedicated app running on a tablet.

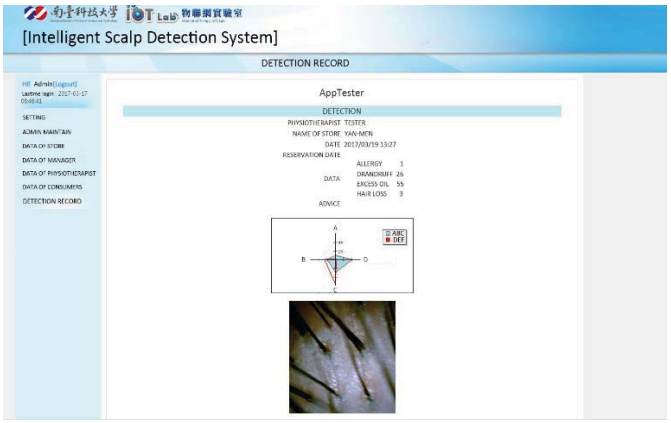

Fig. 5. A cloud management platform.

Fig. 6. A real scalp detection and analysis of a program actually executed.

IV. CONCLUSION

In this paper, an intelligent scalp inspection and diagnosis system based on the deep learning techniques has been proposed for caring hair scalp health. We have also searched many countries patents, including Taiwan, U.S., and China. There are not related patents pending.

To the best of our knowledge, there are no related automatically recognized products on the current markets in the world. In the current market, only manual inspection methodology by a professional physiotherapist is appeared. In other words, we are the first applying deep learning based techniques to hair scalp inspection for the caring scalp health purpose. Moreover, the experimental results of our proposed system showed that the accuracy can be achieved 90.909% that is over human average accuracy.

REFERENCES

[1] K. Chatfield, K. Somonyan, A. Vedaldi, and A. Zisserman, "Return of the devil in the details: delving deep into convolutional nets," in *Proc. British Machine Vision Conference (BMVC)*, pp. 1-11, 2014.

[2] H.-C Shih and B.-S. Lin, "Hair segmentation and counting algorithms in microscopy image," in *Proc. IEEE International Conference on Consumer Electronics (ICCE'15)*, pp. 612-613, 2015.

[3] W.-C. Wang, L.-B. Chen, and W.-J. Chang, "Development and experimental evaluation of machine-learning techniques for an intelligent hairy scalp detection system," *Applied Sciences*, vol. 8, no. 6, article 853, 2018.