Development of Diabetic Retinopathy Consultation System (DRCS)

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ABSTRACT – Diabetic Retinopathy (DR) is a disorder of the retinal vasculature due to long-standing diabetes mellitus and can result in blindness. Screening of DR is essential for both early detection and early treatment. The objective of this research is to develop a web-based decision support system for DR screening and classification in eye fundus images. In addition, the research will convey the diabetic retinopathy information content based on the users' needs with a web-based environment. Since the detection of DR is challenging due to the complex characteristics of the DR features, the skill-less and junior medical officers in health clinics would find difficulties in the DR detection and diagnose process and need to refer to the senior medical officers or the ophthalmologist located at the hospital. Therefore, this system would provide a better way for the communication between the medical officers in health clinics and the ophthalmologists in hospital in the diabetic retinopathy screening process. The system also will be a medium for all the medical officers in health clinics in learning DR screening process in more effective from the experienced ophthalmologist and communicate among them. The web-based system id developed using the Agile Software Development Model. It is envisaged that the proposed decision support system for clinical screening would greatly contribute to and assist the management and the detection of diabetic retinopathy.

1. INTRODUCTION

Global Data on Visual Impairment, a 2010 article by the World Health Organization (WHO) stated that globally, the number of visually impaired people of all ages was estimated to be 285 million, where 39 million are blind and 246 million suffered from low vision [1]. DR commonly affects both eyes and can lead to vision loss if it is not promptly treated [2].

DR screening is a complicated process, as there are various signs of that need to be identified and detected in order to achieve a complete screening system. In order to avoid blindness, the main aim of DR screening is to analyse if people need referral for further treatment [3]. Besides, the problem occurs in this situation when the skill-less and junior medical officers in health clinics find difficulties in the DR detection and diagnosis process and need to refer to the senior medical officers or the ophthalmologist. The objective of this research is to develop a web-based decision support system for DR screening and classification in eye fundus images. In addition, the research aims to study the DR information content including the screening and diagnosis. The proposed system is developed by using HTML, PHP, JavaScript, JQUERY, CSS and SQL with the CMS WordPress platform. The proposed system also will be a reference to all the registered users, which are the medical officers, as a teaching and learning tool in exploring this eye disease.

2. METHODOLOGY

This section outlines the research process to accomplish the objectives of this research. The methodology chosen for this project is the Agile Software Development Model. This model is the iterative development process and development process practices that focus on collaboration of people involved and provide a better procedure to allow revisions and evolution of web application requirements [4]. The iteration begins with planning phase to identify the desired goals and risks. Then, requirement analysis phase to define the project deliverables and requirements. In order to gather the user requirements, a preliminary study was conducted. An online questionnaire was delivered to 202 medical doctors from one hospital and 32 health clinics in Melaka. The survey comprised of 4 sections, which are demographic, computer literacy/skills, current DR screening practice and expected outcome. The survey concluded that this system is highly required and important to assist the consultation among the medical doctors. Next, proceed to designing phase to design the system's flow. After that, building phase which turn the design into a prototype. Finally, the testing phase of the prototype system with the medical doctors.

3. DEVELOPMENT

The development of a computer-based consultation system with imaging tool is crucial to effectively assist the communication among the medical experts in detecting important features on the fundus images and classify patients into the correct retinopathy stages. The developed web-based for the medical system provides a profit from consulting that can now easily acquired online and take a new direction in the medical field. The demands to build web applications are growing substantially as the new web application offers innovative services or solutions to online users [5].

Figure 1 Homepage of DRCS

Figure 2 Hospital Registration Form

Figure 3 Case Form

Figure 4 Upload Fundus Image

Figure 1 to Figure 4 show the development interfaces of the DRCS. Figure 1 contains the general information of DR, while Figure 2 shows the registration form for new health clinic and hospital. As for Figure 3, this part is important for the medical doctors and ophthalmologists to consult the case. Meanwhile, Figure 4 shows the upload fundus image platform that will contain the image plugins for the image editing features.

The system offers several features through the implementation of the plugins in order to produce a reliable and efficient system. The core feature is the DRCS plugin used for the main system, generate form, upload image, respond case and edit hospital list. Besides, image or photo editor plugin is implemented to support the image uploaded basic editing, for example, applying filter, adding text, crop, rotate and others image processing features. Also, the image editor provides more advanced editing such as adjusting RGB, brightness, contrast, hue and saturation. Moreover, the system offers the capability of basic image processing techniques to produce high-quality fundus images, which are the input of the eye screening. The techniques enable the image data improvement, involving the enhancement of some image characteristics or features for the next stage of processing. Despite the existence of a range of image processing techniques, the need for highly effective and specialized image processing techniques in this case cannot be over emphasized.

4. CONCLUSIONS

This paper covers the analysis, design and development phases of DRCS. The project will contribute to medical and education fields. In addition, through this application, it makes the users familiar with the computer technology that is very useful for them. Results of this research will give positive impacts to the medical and education as it helps improve the quality and efficiency of eye disease management among the medical experts. This project will be a benchmark for other eye diseases, like glaucoma, cataract, hypertensive retinopathy and so on. Next stage will be continued with the testing phase in order to evaluate effectiveness and usability of DRCS.

REFERENCES

[1] World Health Organization (2012) Global Data on Visual Impairments 2010. Geneva:WHO.

[2] Centre for Eye Research Australia (2013) Diabetic Retinopathy [online] available from <http://www.cera.org.au/uploads/pdf/FS_DR.pdf> [6 November 2019]

[3] Taylor, R. and Batey, D. (2012) Type 2 Diabetes, in Handbook of Retinal Screening in Diabetes: Diagnosis and Management, Second Edition.

[4] Gordiyenko, S. (2015) Website Development Process: Full Guide in 7 Steps [online] available from <https://xbsoftware.com/blog/website-development-process-full-guide/>.

[5] Kohan, B. (n.d) Guide to Web Application Development [online] available from <https://www.comentum.com/guide-to-web-application-development.html>.