HW0288 Assignment 1 Introduction

by EEE SHOON ZHEN YONG

Declaration of Academic Integrity

HW0288 Engineering Communication II

Assignment title: Mobile Application for non-invasive detection of haemoglobin (Hb) level using deep learning models

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Tutorial group number: EE16

Tutorial day/time: Tuesday, 11.30am-1.30pm

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Declaration

I/we have read and understood the guidelines on academic integrity found at http://bit.ly/1PMaL42 and the penalties for academic dishonesty (as stated in *General instructions*), and declare that this assignment is my own work and does not involve plagiarism or collusion according to the University's honour code and pledge. Sources which I have included in my work have been appropriately referenced. I have also not submitted any part of this assignment for another course.

Date: 21/09/2022

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Mobile Application for non-invasive detection of haemoglobin (Hb) level using deep learning models

According to World Health Organization (WHO), about 118.54 million blood donations are collected worldwide [1]. A subfraction (9.75%) of blood donation attempts is deferred due to strict donation criteria. One major factor, accounting for almost a quarter of all deferrals, is on-the-spot measurement of the haemoglobin (Hb) level through finger prick test, which triggers low-haemoglobin deferrals (LHD) when the level falls below a predefined cut-off. [2] The predefined cut-off haemoglobin (Hb) level required to donate blood for female is 12.5g/dL and at least 13.0g/dL for males. The repeated LHD have detrimental impacts on donor return especially for those who spends time travelling to the donor centre but could not donate blood. Studies have shown that female donors make 32.25% fewer donation attempts after repeated LHD and male donors make 16.26% fewer donations attempts after repeated LHD [2].

Initial screening of haemoglobin (Hb) level through mobile application at home will reduce the amount of blood donation attempts being deferred and save blood donor's time from travelling. There are some existing methods that can measure haemoglobin (Hb) level non-invasively. One of the methods is through estimation of haemoglobin levels by analysing colour and metadata of fingernail bed with an accuracy of ±2.4g/dl and a sensitivity of 97%, [3]. Besides, HemaApp, a mobile application that shines light source through fingers and perform chromatic analysis to estimate haemoglobin level. The application achieves a sensitivity and precision of 85.7% and 76.5%. [4] Another approach introduces SSR spectroscopy that mathematically reconstruct high-resolution spectra of blood Hb from three colour values of the R, G, and B channels received by the built-in camera of a smartphone. To quantify blood Hgb levels non-invasively, SSR spectroscopy combines imaging of the palpebral conjunctiva (i.e., the inner eyelid) and spectroscopic quantification of total blood Hb content. Percentage differences of the spectroscopic and SSR blood Hb measurements from the clinical laboratory blood Hb values, returning 4.61% average for the hyperspectral imaging system and 6.01% on average for the mHematology application, [5] All the methods provide convenience for users to measure haemoglobin (Hb) level non-invasively. Nevertheless, the current suggested acceptance performance for blood Hb tests is ± 4% as requested by the Clinical Laboratory Improvement Amendments (CLIA) in the United States.

Therefore, the aim for this project was to develop a mobile application that able to measure haemoglobin (Hb) level accurately to suggested acceptance performance of ± 4% at home and promotes blood donation worldwide. Firstly, the proposed mobile application will consist of a feature that able to analyse images of the palpebral conjunctiva by deep learning models through Microsoft Azure Machine Learning services and provides accurate haemoglobin (Hb) level. Besides, users will use the mobile application to register for blood donation events to skip the queue. Furthermore, users will be provided information about blood donations and received real-time blood stock updates through the mobile application. These features will help to save blood donor's time and reduce the percentage of fewer donation attempts.

References

[1] World Health Organization, "Blood Safety and Availability", May. 26, 2022. [Online]. Available:https://www.who.int/news-room/fact-sheets/detail/blood-safety-and-availability

[2] Bruhin A., Goette L., Haenni S., Jiang L., Markovic A., Roethlisberger A., Buchli R. and Frey B.M. ,"The Sting of Rejection: Deferring Blood Donors due to Low Haemoglobin Values Reduces Future Returns," *Transfus Med Hemother*, vol. 47, no. 2, pp. 119–128, 2020.

[3] Mannino, R.G., Myers, D.R., Tyburski, E.A., "Smartphone app for non-invasive detection of anemia using only patient-sourced photos," *Nature Commun*, vol. 9, no. 4924, 2018. [Online]. Available: https://doi.org/10.1038/s41467-018-07262-2

[4] Edward Jay Wang, William Li, Doug Hawkins, Terry Gernsheimer, Colette Norby-Slycord, and Shwetak N. Patel.2 "*HemaApp: noninvasive blood screening of hemoglobin using smartphone cameras,*" September. 12, 2016. [Online]. Available: http://dx.doi.org/10.1145/2971648.2971653

[5] Sang Mok Park, Michelle A. Visbal-Onufrak, Md Munirul Haque, Martin C. Were, Violet Naanyu, Md Kamrul Hasan, and Young L. Kim, "mHealth spectroscopy of blood hemoglobin with spectral super-resolution". *Optica*, vol. 7, no. 6, pp. 563-573, 2022. [Online]. Available: https://opg.optica.org/optica/fulltext.cfm?uri=optica-7-6-563&id=431957

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FINAL GRADE

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GENERAL COMMENTS

Instructor

Hi Zhen Yong,

an above average score.

well done,

and keep up the good work.

Best

Dr Chew

PAGE 1

💬 **Comment 1**

cover page noted

PAGE 2

💬 **Comment 2**

title is specific and precise- good.

💬 **Comment 3**

good use of acronymns

💬 **Comment 4**

i see you are doing a funnel shape -from general to specific - which is in order.

💬 **Comment 5**

good use of transitional signals throughout

💬 **Comment 6**

research gap noted

Comment 7

objective noted

Comment 8

generally scope is outlined in a clear way.

Comment 9

references are consistent.