

# 健康快拍

## Health Gather

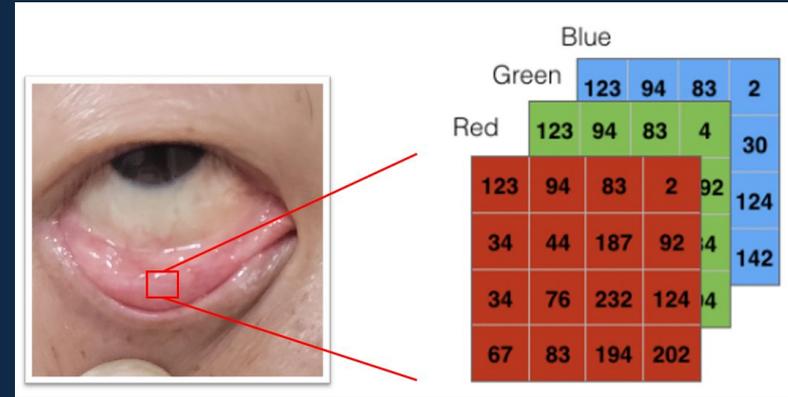
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Give you 24 hours of silent companionship

# Principles of Pathology

In anemia diagnosis, the color characteristics of the eyelid, particularly the degree of pallor, are key indicators. In healthy individuals, the eyelid appears reddish, reflecting sufficient levels of hemoglobin in the blood. However, when anemia occurs, hemoglobin levels drop, and the color of the eyelid tends to become pale, as the blood's oxygen-carrying capacity decreases, affecting oxygen supply to tissues.

Technically, changes in eyelid color can be captured using image processing methods. Specifically, the image processing system can decompose the eyelid image into red, green, and blue channels, and compare the value of the red channel against other color channels. Studies have shown that anemic patients often exhibit lower red channel values, with RGB channel values being similar, causing the eyelid to appear pale or pinkish. This phenomenon serves as a potential indicator for quantifying hemoglobin levels, providing a non-invasive approach for evaluating anemia.



# Detection Process

Selecting a picture from your gallery or taking a new photo with the device's camera



Use our app to crop the eye area

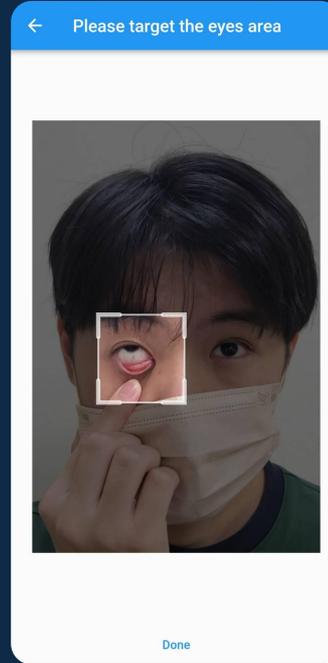
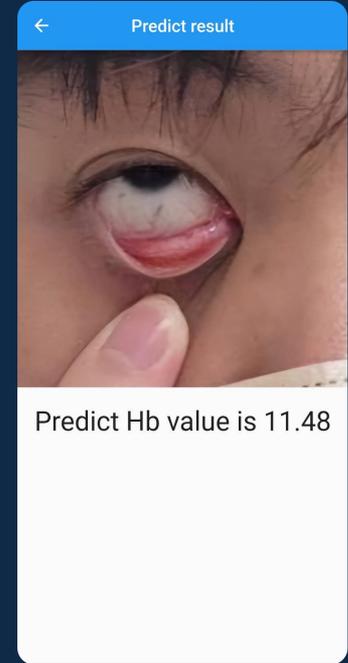


Image-based symptom detection



# Application Principles

## Data Preprocessing



To address the issue of glare in the images, we implemented two methods. First, we used the HSV color space to filter out glare points with excessively high brightness or low saturation. The second method involved converting the image to grayscale and using threshold operations to detect and correct over-bright areas.

During the image segmentation stage, the UNet model was employed to automatically segment the eyelid region, allowing for precise extraction of anemia-related features. The UNet architecture consists of an encoder and a decoder: the encoder progressively captures critical features within the image to locate the eyelid, while the decoder restores these features to accurately mark the eyelid area.

## Deep Learning Classification



In deep learning classification, a deep learning model is employed to classify anemia images, using a hemoglobin (Hb) concentration threshold of 12 g/dL to determine anemia presence. The model leverages multi-level feature extraction to automatically identify anemia-related features, such as color variations in the eyelid area. To improve the model's generalization, data augmentation techniques are applied during training to diversify the dataset, enhancing the model's performance on new data and strengthening the stability and accuracy of the classification results. The model achieved an accuracy of 85% to 90% on the test set, demonstrating its reliability in anemia detection.

## Regression Analysis



Regression analysis is used to quantify the severity of a patient's anemia by examining trends in hemoglobin levels. This analysis selects features closely related to eyelid color—such as hue, saturation, brightness, the R channel, the difference between R and GB channels, and grayscale—to estimate hemoglobin levels. Linear and polynomial regression models are employed to precisely predict hemoglobin fluctuations, while mean squared error (MSE) and the coefficient of determination ( $R^2$ ) are used to assess model performance, ensuring both predictive accuracy and interpretability.

# Clinical Trials

Our team, having received approval from the Institutional Review Board, has initiated clinical trials at Shuang Ho Hospital and the Hemodialysis Center of New Civil Hospital.



TMU-IRB Form/MS-20200117

**Taipei Medical University**  
Certificate of TMU-JIRB Approval Issue Date: 2023/06/18

TMU-IRB No.: N20220187  
Protocol Title: Detect the patient's jaundice and anemia with a smartphone  
Principal Investigator: Fu-Wu Liu  
CO-Investigator: Chang-chang-chun, Chiu-In Chou  
Study Member: Xiang Jun, Zhang  
Study Site: TMU/Shuang Ho Hospital/TMU-Hsin-Kuo-Min Hospital/TMU-Hsin-Kuo-Min Hospital  
Protocol Version/Date: Version 6/0202/05/28  
Informed Consent Form: Version 6/0202/06/07  
Case Report Form: Version 2/8/2022/04/28

The above study will be approved by expedited review process of the TMU-Joint Institutional Review Board in meeting #11-07-2020(20230712), duration of validity is from 2023/06/18 to 2023/06/17, and must be monitored by TMU-JIRB.

According to Ministry of Health and Welfare and the relevant regulations, follow-up procedures and requirements are as below:

- Continuing Report: Continuous report frequency is every 12 months. The report should be submitted in 2 months before the end of validity (2023-04-17). The trial study cannot going if the continuing report not approved yet.
- Final Report: The report should be submitted when the trial study complete. TMU-JIRB will withdraw the approval of this trial study if the report is not submitted final report within three months from the date of validity of this trial study. Also, request principal investigator's right of new trial study application in accordance with TMU-JIRB SOP for three months.
- Serious Adverse Events(SAE) Report: The investigator is required to report in accordance with "Regulations for Good Clinical Practice" and "Procedures for Reporting Serious Adverse Drug Reaction".

Chairman:  
*Wen-Hsiung Lin*

臺北醫學大學醫務院  
人體研究倫理委員會  
Taipei Medical University  
Institutional Review Board

本申請案經本會審查通過  
The TMU-Joint Institutional Review Board approved this application according to written specific procedures and applicable laws and regulations.  
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**臺北醫學大學醫務院聯合人體研究倫理委員會**  
TMU-Joint Institutional Review Board

受試者同意書

計畫名稱: 藉由智慧型手機偵測患者貧血與貧血的狀況

執行單位:  
雙和醫院新國民醫院再臺北科技大學

計畫主持人: 盧柏文 職稱: 主治醫師 聯絡電話: 0970747500  
共同主持人: 張玉春 職稱: 教授 聯絡電話: 09211092636  
協同主持人: 鄭浩霖 職稱: 主治醫師 聯絡電話: 0975010881

受試者姓名: \_\_\_\_\_ 性別: \_\_\_\_\_

年齡: \_\_\_\_\_  
疾病號碼: \_\_\_\_\_  
通訊地址: \_\_\_\_\_  
電話: \_\_\_\_\_

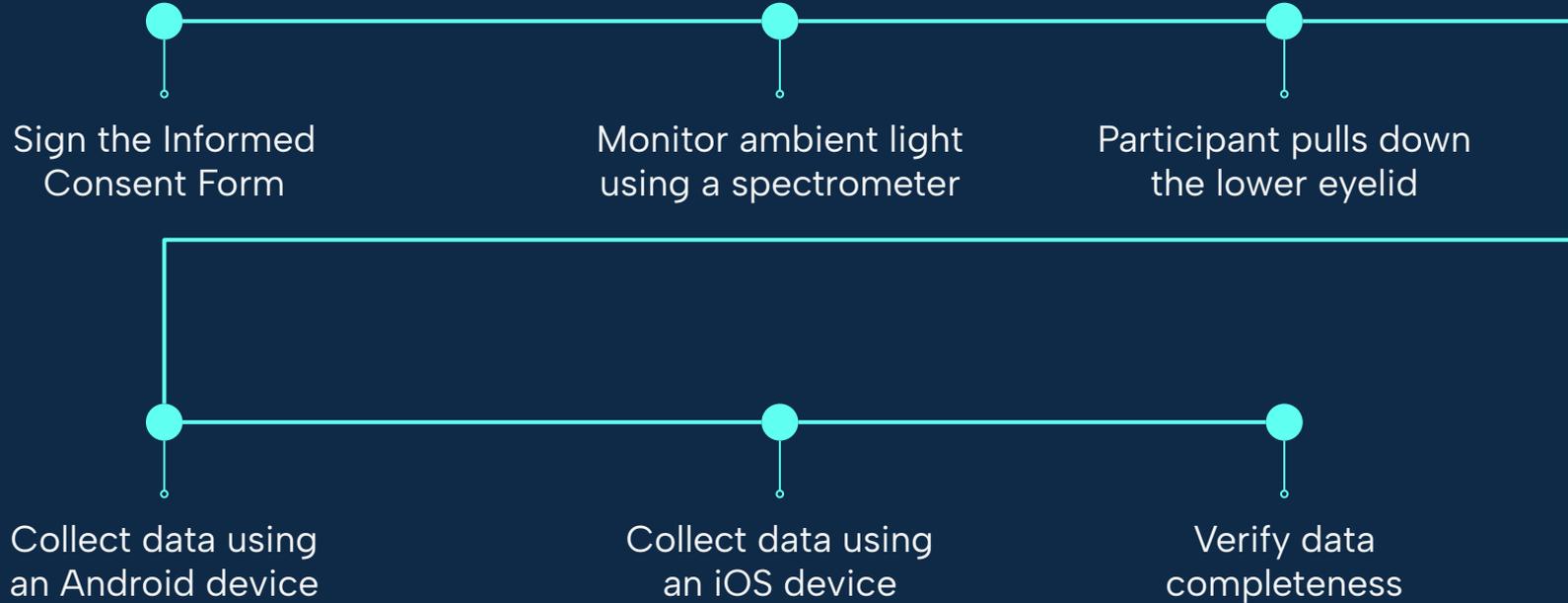
簽署聯絡人姓名(請受試者關係): \_\_\_\_\_  
通訊地址: \_\_\_\_\_  
電話: \_\_\_\_\_

1.試驗/研究背景與試驗/研究藥品/器材產品現況:  
貧血是一個全球性的公共衛生問題，對人體健康產生重大影響，世界衛生組織 (WHO) 估計約有 20 億人患有貧血，其定義為血紅蛋白(hemoglobin, Hb) 濃度低於平均值。貧血被定義為血液循環的紅血球細胞減少(Hb) 濃度降低。因此，它使血液輸送氧氣的能力降低。這些因素可以單獨出現，但經常相互關聯。它也是學齡兒童和孕婦患病率比老年增加的原因。2002 年，根據性貧血被認為是近幾十年來全球負擔的最嚴重問題之一。貧血發展後，通常情況下，Hb<9-10 g/dL 不會出現明顯症狀，因為人體會執行代償機制，例如增加輸出的血量，通過这种方式釋放的氧氣量繼續維持不變。當代體不能從足夠數量的氧氣時，就會出現疲勞、面色蒼白、易怒、心悸加劇、失眠、頭暈等多種症狀。不管貧血如何，由於嚴重程度的貧血會隨著體能的可用而並發或加重，儘管它們都有利於患者生命狀況的改善。在許多情況下，必須根據Hb水平對患者進行輸血。這種做法可以每天流動的幅度較大。貧血是通過測量血紅蛋白水平來評估的，血紅蛋白是紅細胞中的一種蛋白質，是貧血最可靠的指標，因為Hb為身體的所有細胞提供氧氣。診斷貧血的標準方法主要依賴於血液 Hb 的侵入性測定。複雜的採血會導致患者的不適

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# Clinical Trials



# Phase Results



- To date, we have successfully enrolled over 350 participants, and recruitment is actively ongoing.
- A preliminary design for the measurement mobile application has been completed.
- An anemia detection model was initially developed with an accuracy of over 90%.

# National Science and Technology Council Approval

Our team has been supported by the National Science and Technology Council under Project Nos. 113-2221-E-027-039, 112-2221-E-027-099, and 111-2221-E-027-042, underscoring the study's academic significance and practical potential.

## 專題研究計畫執行同意書

此同意書由本研究計畫主持人：張正春；依國家科學及技術委員會補助專題研究計畫作業要點，在行政院國家科學技術發展基金項下接受補助之「專題研究計畫」：(國家科學及技術委員會第 74 次行政會議通過，通知文號：1130042595(113.06.28))

計畫名稱：全波段 PPG 感測：光學非侵入式血液質量監測模組開發研究計畫(II)

計畫編號：NSTC 113/- 2221 - E - 027 - 039 - MY2

補助經費：新台幣(大寫) 貳 佰 陸 拾 貳 萬 陸 仟 元 整

茲願依國家科學及技術委員會有關規定執行本計畫，並同意遵守下列規定：

- 一、本計畫執行期間自民國 113 年 08 月 01 日起至 115 年 07 月 31 日止，補助項目以國家科學及技術委員會審查通過之專題研究計畫經費核定範圍所列為準。
- 二、本計畫之補助經費，依政府有關法令規定支領動支，不得移作他用，執行期滿後三個月內，依國家科學及技術委員會補助專題研究計畫作業要點規定，辦理經費結報，如有結餘，應全數繳還。但已實施校務基金制度之學校、國立社教機構作業基金之機構及中央研究院，得不繳回。
- 三、本計畫(含多年期計畫全程計畫)執行期滿三個月內，依國家科學及技術委員會補助專題研究計畫經費核定清單及有關規定撰寫可供發表之研究成果報告，送國家科學及技術委員會辦理結案。如係以調查法(如面訪、電話訪問、郵寄問卷等)進行之計畫，執行機構應將研究成果報告、資料讀取檔、空白問卷、追蹤號碼簿(CODEBOOK)、電腦資料數據檔、資料欄位定義檔及(SAS、SPSS 或其他統計程式)等及調查資料檔案利用授權書各一份送送中央研究院人文社會科學研究中心調查研究專職中心。
- 四、本計畫有關之執行期間、經費分配、支用、結報、變更、追加、減項及延期等，應依國家科學及技術委員會補助專題研究計畫作業要點、國家科學及技術委員會補助專題研究計畫經費處理原則及其他相關法令規定辦理。
- 五、本計畫之研究成果及其智慧財產權，除經認定歸屬國家科學及技術委員會所有者外，全部歸屬執行機構所有(詳見經費核定清單之研究成果歸屬欄)，其專利申請、技術轉移、著作授權及權益分配等相關事宜，由執行機構依科學技術發展基金法、政府科學技術研究成果歸屬及運用辦法、國家科學及技術委員會科學技術研究發展成果歸屬及運用辦法及其他相關法令規定辦理。
- 六、計畫主持人隨時配合國家科學及技術委員會需要，提供說明及參考資料；如屬列管計畫，應依管理考核相關規定，填送學者表獎資料。
- 七、計畫執行中如涉及人體試驗或採集人體檢體，計畫主持人應依有關法令規定辦理並檢具受試者或檢體提供者之知情同意書，受試者(檢體)如為未成年行為人，受試者項目之人或受試者之家人，則應取得其本人、法定代理人、監護人或輔助人之書面同意書，並經執行機構核准，始得進行人體實驗或採集檢體。實驗過程應顧及人道並尊重受試(檢)者個人權益與安全措施，如發生人體實驗或採集檢體之法律問題，均由計畫主持人自負完全責任；如涉及人類胚胎或人類胚胎幹細胞實驗，應遵守有關法令並依規定經醫學倫理委員會或人體試驗倫理委員會審查同意始得執行；如動物實驗，具危害性生物或病毒之實驗，應遵守相關法令規定並確實做好安全防护措施。動物轉殖田間試驗、具危害性生物或病毒之實驗，應遵守相關法令規定並確實做好安全防护措施。
- 八、計畫主持人對於計畫內容及研究成果涉及專利或其他智慧財產權者，應保護絕無侵害他人權利、違反醫療衛生規範及影響公共秩序或善良風俗。其因而造成國家科學及技術委員會之權利或名譽受損者，國家科學及技術委員會得依法主張權利或追究其法律責任，並得請求損害賠償。
- 九、計畫主持人未經國家科學及技術委員會同意，擅自對外公開關於屬國家科學及技術委員會所有之研發成果者，國家科學及技術委員會得依法主張權利或追究法律責任，並得請求損害賠償。歸屬於執行機構之研發成果，其公開有關民生福祉、國家安全、社會秩序或善良風俗之虞者，不宜公開。計畫主持人未經執行機構同意，擅自公開該研發成果，相關責任由計畫主持人自行負責。
- 十、計畫主持人有違反第一項或第二項情事者，國家科學及技術委員會得拒絕計畫主持人於日後向國家科學及技術委員會申請各項獎補助計畫。
- 十一、計畫主持人如未依規定辦理經費結報及繳交研究成果報告時，國家科學及技術委員會不再核給專題研究計畫之補助。
- 十二、計畫主持人及參與人員於研究計畫之構思、執行或成果呈現階段，如有違反學術倫理之情事，國家科學及技術委員會將依國家科學及技術委員會學術倫理案件處理及審議要點規定處理。
- 十三、計畫主持人已於申請書詳實揭露近三年執行其他補助計畫資訊(含國內外、大陸地區及港澳)，並應隨時配合國家科學及技術委員會需要提供相關資料，如未依規定辦理，國家科學及技術委員會得追回本計畫之補助經費；執行研究計畫依科技資料保密要點及其他相關法令規定與國家科學及技術委員會之相關要求處理。
- 十四、本同意書一式三份，分由國家科學及技術委員會、執行機構及計畫主持人收執，以資信守。

此 致  
國家科學及技術委員會

計畫主持人：張正春 (簽名或蓋章)

# Patent Applications

We have secured for multiple patents for the relevant technologies to further ensure the legality and commercial applicability of our research findings, while protecting our intellectual property rights under the law.

Page 1 of 2  
P.O. Box 1450  
Alexandria, VA 22313-1450  
www.uspto.gov

**uspto** UNITED STATES  
PATENT AND TRADEMARK OFFICE

**ELECTRONIC ACKNOWLEDGEMENT RECEIPT**

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APPLICATION # <b>18/398,320</b>	RECEIPT DATE / TIME <b>04/16/2024 08:04:37 AM Z ET</b>	ATTORNEY DOCKET # <b>68507-330</b>
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**Title of Invention**  
EYE IMAGE CAPTURING AND PROCESSING DEVICE

**Application Information**

APPLICATION TYPE Utility - Nonprovisional Application under 35 USC 111(a)	PATENT # -
CONFIRMATION # 8287	FILED BY SU YU
PATENT CENTER # 65106515	FILING DATE 12/28/2023
CUSTOMER # 65358	FIRST NAMED INVENTOR CHENG-CHUN CHANG
CORRESPONDENCE ADDRESS -	AUTHORIZED BY JUSTIN KING

**Documents** **TOTAL DOCUMENTS: 2**

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
poa1.pdf	1	Power of Attorney	2601 KB
poa2.pdf	1	Power of Attorney	4643 KB

**Digest**

DOCUMENT	MESSAGE DIGEST(SHA-512)
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MATTER.

THANK  
YOU



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Taipei Medical University  
Shuang Ho Hospital



臺北醫學大學  
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新國民醫院