健康快拍

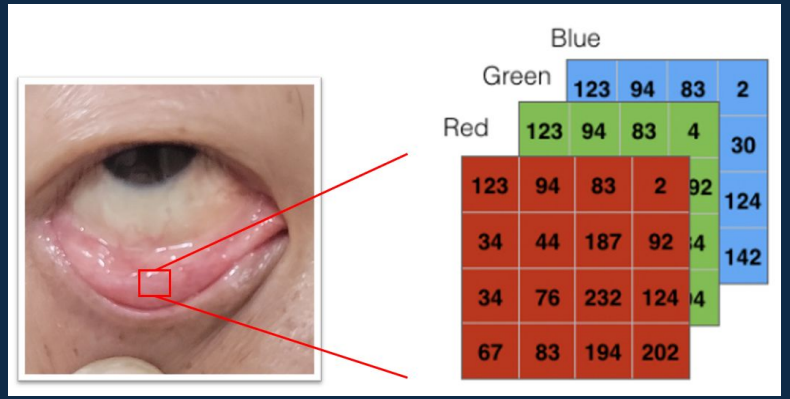
Health Gather

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

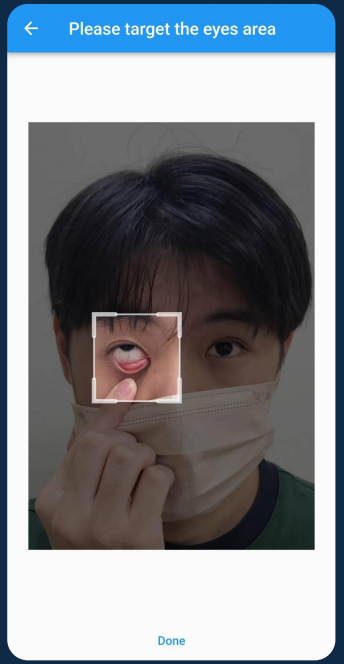
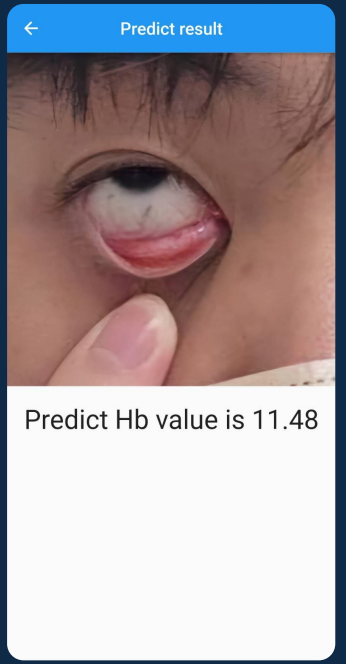


Image-based symptom detection



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

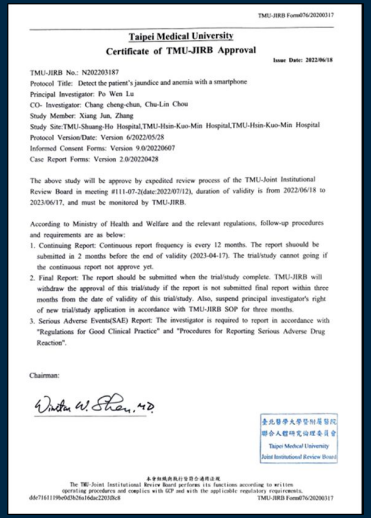
In deep learning classification, a deep learning model is employed to classify anemia images, using a hemoglobin (Hb) concentration threshold of 12 g/dL to determine anemia presence. The model leverages multi-level feature extraction to automatically identify anemia-related features, such as color variations 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-JIRB Form076/20200317

Taipei Medical University

Certificate of TMU-JIRB Approval

Issue Date: 2022/06/18

TMU-JIRB No.: N202203187
Protocol Title: Detect the patient's jaundice and anemia with a smartphone
Principal Investigator: Po Wen Lu
CO- Investigator: Chang cheng-chun, Chu-Lin 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 6/2022/05/28
Informed Consent Forms: Version 9.0/20220607
Case Report Forms: Version 2.0/20220428

The above study will be approve by expedited review process of the TMU-Joint Institutional Review Board in meeting #111-07-2(date:2022/07/12), duration of validity is from 2022/06/18 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:

1. Continuing Report: Continuous report frequency is every 12 months. The report shuould be submitted in 2 months before the end of validity (2023-04-17). The trial/study cannot going if the continuous report not approve yet.
2. 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, suspend principal investigator's right of new trial/study application in accordance with TMU-JIRB SOP for three months.
3. 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".

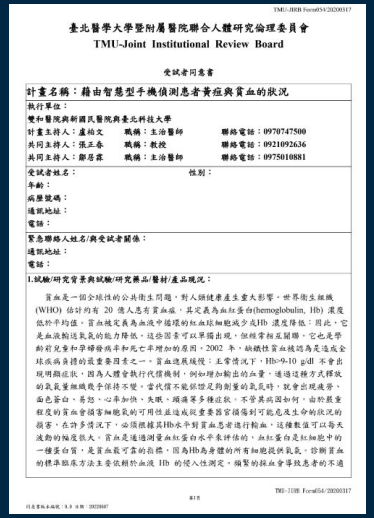
Chairman:

Wintu W. Shen, MD

臺北醫學大學暨附屬醫院聯合人體研究倫理委員會
Taipei Medical University
Joint Institutional Review Board

本會組織與執行皆符合適用法規
The TMU-Joint Institutional Review Board performs its functions according to written operating procedures and complies with SOP and with the applicable regulatory requirements.

ddc7161199e0d3b26a16dac22030c8 TMU-JIRB Form076/20200317



TMU-JIRB Form054/20200317

臺北醫學大學暨附屬醫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黃疸與貧血的狀況

執行單位：
雙和醫院與新國民醫院與臺北科技大學
計畫主持人：盧柏文　職稱：主治醫師　聯絡電話：0970747500
共同主持人：張正春　職稱：教授　聯絡電話：0921092636
共同主持人：鄒居霖　職稱：主治醫師　聯絡電話：0975010881

受試者姓名：　性別：
年齡：
病歷號碼：
通訊地址：
電話：

緊急聯絡人姓名/與受試者關係：
通訊地址：
電話：

1.試驗/研究背景與試驗/研究藥品/醫材/產品現況：

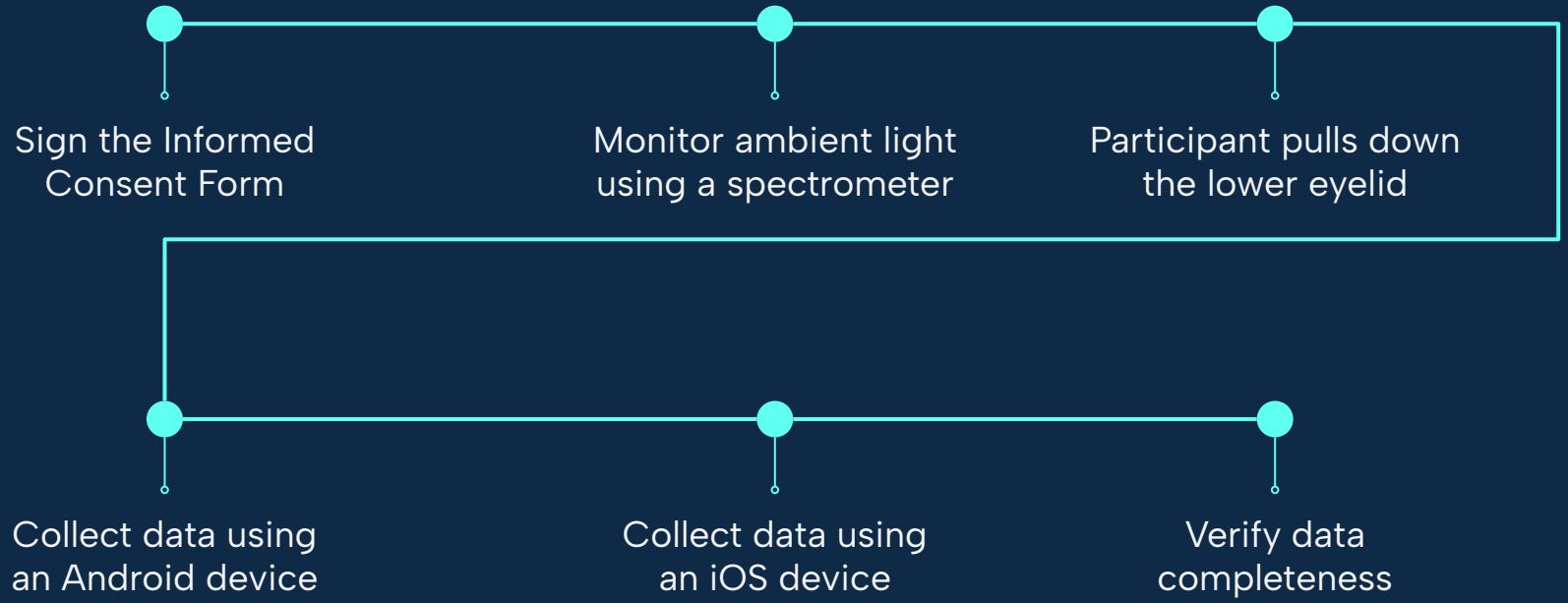
貧血是一個全球性的公共衛生問題，對人類健康產生重大影響，世界衛生組織(WHO) 估計約有 20 億人患有貧血症，其定義為血紅蛋白(hemoglobulin, Hb) 濃度低於平均值，貧血被定義為血液中循環的紅血球細胞減少或Hb 濃度降低；因此，它是血液輸送氧氣的能力降低，這些因素可以單獨出現，但經常相互關聯，它也是學齡前兒童和孕婦發病率和死亡率增加的原因。2002 年，缺鐵性貧血被認為是造成全球疾病負擔的最重要因素之一。貧血進展緩慢：正常情況下，Hb>9-10 g/dl 不會出現明顯症狀，因為人體會執行代償機制，例如增加輸出的血量，通過這種方式釋放的氧氣量細胞數手保持不變，當代償不能保證足夠劑量的氧氣時，就會出現疲勞、面色蒼白、易怒、心率加快、失眠、頭痛等多種症狀。不管其病因如何，由於嚴重程度的貧血會損害細胞氧的可用性並造成從重要器官損傷到可能危及生命的狀況的損害，在許多情況下，必須根據其Hb水平對貧血患者進行輸血，這種數值可以每天波動的幅度很大，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。診斷貧血的標準臨床方法主要依賴於血液 Hb 的侵入性測定，頻繁的採血會導致患者的不適

TMU-JIRB Form054/20200317

第1頁

同意書版本編號：8.0 日期：20220607

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%.

Activity

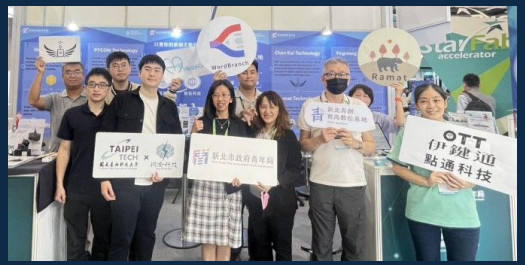
2023/07 FITI

2024/03 Smart city

2023/05 中科新創生醫學研團隊技術發表

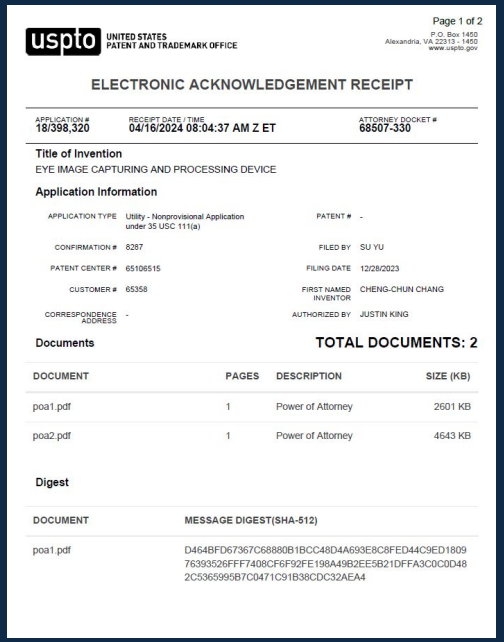
2023/10 諾薩克百萬美金挑戰 新創 Demo Day

2024/06 Innovex



Call for support our projects

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

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/398,320	04/16/2024 08:04:37 AM Z ET	68507-330

Title of Invention

EYE IMAGE CAPTURING AND PROCESSING DEVICE

Application Information

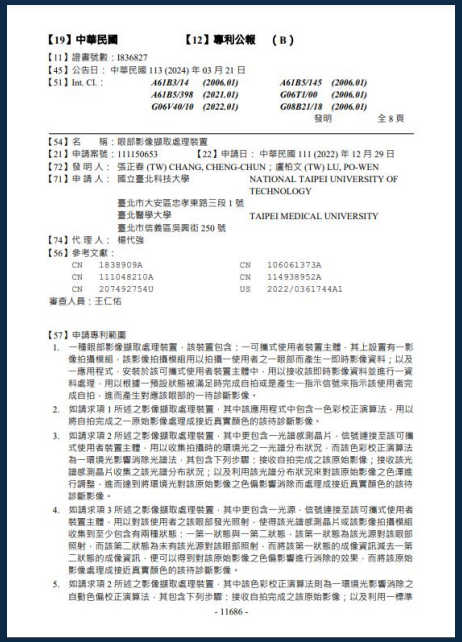
APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8287	FILED BY	SU YU
PATENT CENTER #	65106515	FILING DATE	12/28/2023
CUSTOMER #	65358	FIRST NAMED INVENTOR	CHENG-CHUN CHANG
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	JUSTIN KING

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)
poa1.pdf	D464BFD67367C68880B1BCC48D4A693E8C8FED44C9ED1809 76393526FFF7408CF6F92FE198A49B2EE5B21DFFA3C0C0D48 2C5365995B7C0471C91B38CDC32AEA4



【19】中華民國 【12】專利公報 （B）

【11】證書號數：I836827

【45】公告日：中華民國 113 (2024) 年 03 月 21 日

【51】Int. Cl.： *A61B3/14 (2006.01)* *A61B5/145 (2006.01)* *A61B5/398 (2021.01)* *G06T1/00 (2006.01)* *G06V40/10 (2022.01)* *G08B21/18 (2006.01)*

發明 全 8 頁

【54】名 稱：眼部影像擷取處理裝置

【21】申請案號：111150653 【22】申請日：中華民國 111 (2022) 年 12 月 29 日

【72】發 明 人：張正春 (TW) CHANG, CHENG-CHUN；盧柏文 (TW) LU, PO-WEN

【71】申 請 人：國立臺北科技大學 NATIONAL TAIPEI UNIVERSITY OF TECHNOLOGY
臺北市大安區忠孝東路三段 1 號
臺北醫學大學 TAIPEI MEDICAL UNIVERSITY
臺北市信義區吳興街 250 號

【74】代 理 人：楊代強

【56】參考文獻：

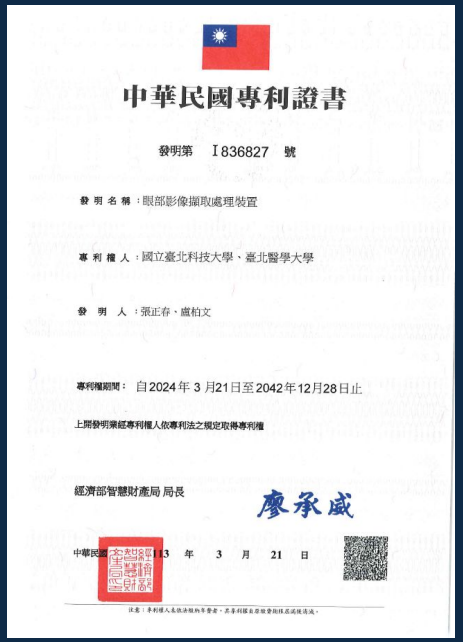
CN	1838909A	CN	106061373A
CN	111048210A	CN	114938952A
CN	207492754U	US	2022/0361744A1

審查人員：王仁佑

【57】申請專利範圍

1. 一種眼部影像擷取處理裝置，該裝置包含：一可攜式使用者裝置主體，其上設置有一影像拍攝模組，該影像拍攝模組用以拍攝一使用者之一眼部而產生一即時影像資料；以及一應用程式，安裝於該可攜式使用者裝置主體中，用以接收該即時影像資料並進行一資料處理，用以根據一預設狀態被滿足時完成自拍或是產生一指示信號來指示該使用者完成自拍，進而產生對應該眼部的一待診斷影像。
2. 如請求項 1 所述之影像擷取處理裝置，其中該應用程式中包含一色彩校正演算法，用以將自拍完成之一原始影像處理成接近真實顏色的該待診斷影像。
3. 如請求項 2 所述之影像擷取處理裝置，其中更包含一光譜感測晶片，信號連接至該可攜式使用者裝置主體，用以收集拍攝時的環境光之一光譜分布狀況，而該色彩校正演算法為一環境光影響消除光譜法，其包含下列步驟：接收自拍完成之該原始影像；接收該光譜感測晶片收集之該光譜分布狀況；以及利用該光譜分布狀況來對該原始影像之色澤進行調整，進而達到將環境光對該原始影像之色偏影響消除而處理成接近真實顏色的該待診斷影像。
4. 如請求項 3 所述之影像擷取處理裝置，其中更包含一光源，信號連接至該可攜式使用者裝置主體，用以對該使用者之該眼部發光照射，使得該光譜感測晶片或該影像拍攝模組收集到至少包含有兩種狀態：一第一狀態與一第二狀態，該第一狀態為該光源對該眼部照射，而該第二狀態為未有該光源對該眼部照射，而將該第一狀態的成像資訊減去一第二狀態的成像資訊，便可以得到對該原始影像之色偏影響進行消除的效果，而將該原始影像處理成接近真實顏色的該待診斷影像。
5. 如請求項 2 所述之影像擷取處理裝置，其中該色彩校正演算法則為一環境光影響消除之自動色偏校正演算法，其包含下列步驟：接收自拍完成之該原始影像；以及利用一標準

- 11686 -



中華民國專利證書

發明第 I836827 號

發 明 名 稱：眼部影像擷取處理裝置

專 利 權 人：國立臺北科技大學、臺北醫學大學

發 明 人：張正春、盧柏文

專利權期間：自2024年3月21日至2042年12月28日止

上開發明業經專利權人依專利法之規定取得專利權

經濟部智慧財產局 局長 廖承威

中華民國 113 年 3 月 21 日

注意：專利權人在法律規約年費者，其專利權在應繳費期限屆滿後滿六。