ProteCount: An AI-Based Reader for Rapid Protein Quantification

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Blood testing for target protein concentrations remains the number one way to diagnose and monitor chronic diseases like arthritis, heart failure, and thyroid-related conditions. However, blood tests cost $100-$3,000 and can only be done in professional settings (lab, hospital, etc.), causing them to be unavailable to individuals in rural, low-income communities. In fact, an estimated 60% of Americans living with thyroid disease and 50% who have experienced a heart attack are unaware of their condition, and in low-income and rural communities, the false diagnostic rate is as high as 35%. The goal of this project was to develop a low-cost, portable device that employs lateral flow assays (LFAs) and image recognition to predict protein concentration using the variable line's color saturation. The device uses a Raspberry Pi computing unit with a camera sensor and macro lens that is held by a 3D printed, adjustable stand to capture images of the LFA strips. The model then converts the images into the HLS color space. This data is fed into a categorical classification neural network, which outputs a 25 mIU/mL interval that the sample falls in. The model was trained and tested using images of LFA strips that were dipped in hCG concentrations from 100-200 mIU/mL. The model predicts the correct concentration range with an accuracy of 95%, a sensitivity of 93%, and a recall of 89%. In conclusion, this device provides a novel, inexpensive, and highly accessible method of measuring a target protein's concentration in the blood, allowing individuals in rural and/or low-income communities to have their chronic diseases diagnosed and tracked easily.