Haem: Deep Learning to Detect Anaemia Using Smartphones

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Anemia is the most common blood disorder in the world, affecting more than 2 billion people. Iron deficiency anemia, in particular, affects more than 1 billion people across the globe with a greater prevalence in women and children. Current systems of detection and diagnosis of anemia involve measuring the hemoglobin (Hb) levels using hematology analyzers, biochemical reagents, and lab experts in addition to venipuncture systems to extract blood for testing. Due to the high cost and impracticality of such equipment in a rural setting, a large proportion of anemics remain undiagnosed. To solve this problem, we harness the diagnostic power of smartphone imaging to create a solution: Haem. Pallor in the conjunctive, nail beds, face, palms, skin, and palmar creases have been observed to reflect the level of hemoglobin in the body. Using images of nail-beds taken from a standard smartphone, image processing, and deep learning algorithms are used to detect pallor in the image and the extent of pallor is used to predict the presence of anemia in individuals by determining Hb levels. On training and testing with a dataset of 102 participants, this system has shown to provide very positive results. Using Haem, the viability and capability of deep learning and image-processing models to predict the presence of anemia using a photograph from a smartphone are demonstrated. Such a system has great potential in non-invasive anemia screening in rural and urban settings in developing regions around the world.