Analysis of Mini Video images from Cellphone camera for Hemoglobin Level Assessment

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Introduction

- Hemoglobin level detection is important for several medical diagnosis and triage for patient-care
- It is generally performed in following way
  - Blood sample is taken from patient
  - A solution created from that sample
  - Shining light through the sample to measure how much light absorbs
- Usually require lab environment, cost and time
- Few portable solutions but very costly and intrusive
- A non-intrusive solution with easy to use technology will help a lot for clinical triage and proper healthcare

Motivation

- For several medical diagnosis require hemoglobin level detection
  - Anemia
  - Sickle Cell Disease (SCD)
- Hemoglobin level detection can be useful for clinical triage for SCD patients
- SCD affects 90,000 to 100,000 Americans.
- SCD occurs
  - 1 out of every 500 Black or African-American births
  - 1 out of every 36,000 Hispanic-American birthsPeople with SCD have less access to comprehensive team care than people with genetic disorders
- An average adult suffering from SCD is admitted to emergency department (ED) about four times a year
- About 10 percent of the patients are admitted to the ED once per month

Priliminary Data Collection

- Hemoglobin and related data collected from 17 subjects from the emergency department of Froedtert Hospital, Milwaukee, Wisconsin.
- Hemoglobin levels in three different groups: <9 g/dl (N=3), 9-13 g/dl (N=6), 13-16 g/dl (N=8)
- A single 30 second video was taken for each participants using a cell phone camera (with the flash on)
- Hemoglobin level were measured using specialized device at the same time

Research Hypothesis

1. The red pixel intensity of finger tip video image is positively correlated with hemoglobin level
2. The green pixel intensity of finger tip video image is negatively correlated with hemoglobin level
3. The red pixel intensity of finger tip video is positively correlated with oxygenation
4. The red pixel intensity of finger tip video is negatively correlated with skin thickness

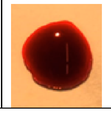
	Color	Red Pixels	Green Pixels
More hemoglobin	Bright Red 	↑	↓
Less Hemoglobin	Dark Red 	↓	↑

Fig: Redness of blood with respect to Red and Green pixel intensities

Analysis

- Each video image of the finger-tip with the flash of the camera on was converted into three time series data: average of the red, green and blue pixels for each frame over 30 seconds
- For analysis Red and Green pixel data was taken as Blue pixel data appeared to be nearly constant for the data

Proposed Model

Hb = f(RPI, GPI, Oxy, ST)

Where

Hb = Hemoglobin Level
RPI = Red Pixel Intensity
GPI = Green Pixel Intensity
Oxy = Oxygenation
ST = Skin Thickness

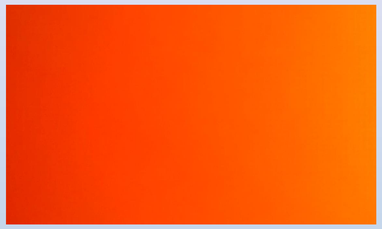


Fig: Fingertip images taken by smartphone with flash on

Initial Result

HB Level	Subject	Red	Green	Red	Green
HB_13-16	S4	-0.3341	-0.1452		
	S5				
	S10				
	S11				
	S12				
	S13				
	S16				
	S15				
	S17			0.5982	-0.5603
HB_9-13	S1	0.4782	-0.1008		
	S2				
	S3				
	S6				
	S7				
	S14				
HB_<9	S8	-1	1		
	S9				

Future work

- A large sample validation study needed
- Data cleanup
  - Analyze the stable portion of the data
  - Crop frames to reduce edge errors
- Oxygenation level and skin thickness needs to be acquired

References

1. Data and Statistics, Center for Disease Control and Prevention
http://www.cdc.gov/ncbddd/sicklecell/data.html