Melanoma Screening With Smartphone Spectroscopy

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Motivation

Melanoma accounts for 1% of all skin cancer diagnoses in the US yet it results in the most deaths with an estimated 7,180 fatalities each year[1]. This situation is made more dramatic by the higher incidence of melanoma cases in rural or remote places with less access to state-of-the-art medical care[2]. Earlier diagnosis could be effective in increasing the survival rate and ease of treatment. Localized melanoma has a 99% five-year survival rate, while distant melanoma which has spread to other areas of the body has only a 27% five-year survival rate[1].

Objective

Develop a low cost, easy to use, in vivo diagnosis tool to increase accessibility and ease of melanoma screening.

Figure 1: Smartphone Spectrometer System[3]

Proposed Solution

- A smartphone spectrometer attachment that couples to the phone's camera.
- A corresponding application which provides spectral analysis to catch signatures of melanoma such as those documented in figure 2[4].

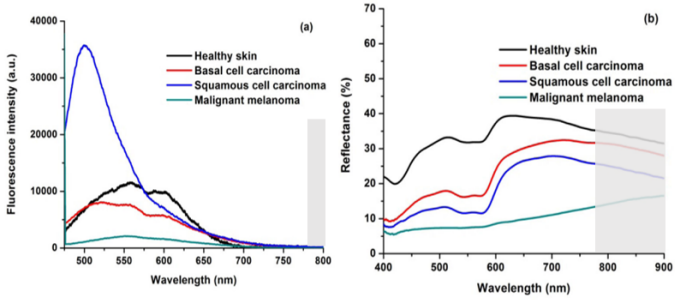

Figure 2: Skin Spectrum Profiles with Range of Smartphone System Noted[4]

Methods

- Light is collected via a fiber optic cable[3].
- The beam is then collimated and diffracted into a spectrum[3].
- The spectrum is imaged via smart phone camera to be processed via smartphone application[3].
- A benchtop system model has been developed to explore the limitations of this data collection method.

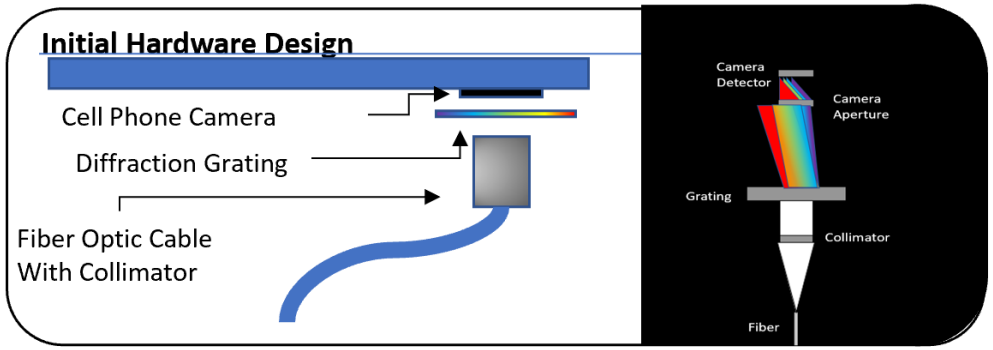

Figure 3: Hardware and Optical Design of Spectrometer

Results

Initial measurements made with the benchtop model show promise for key feature identification.

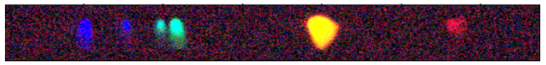

Figure 4: Helium gas spectrum tube measured with the smartphone

Spectrum can then be extracted from the image pixelwise into the individual color channels.

Figure 5: Relative Spectrum for Red, Green and Blue Bayer Channels

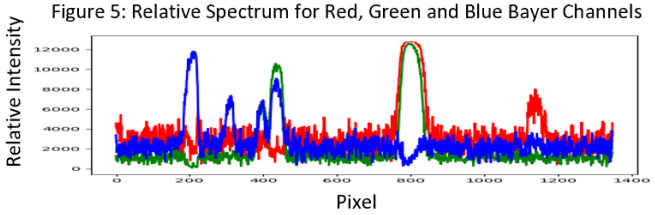

Figure 6: Helium Spectrum Tube Measured with Vernier Spectrometer for Reference

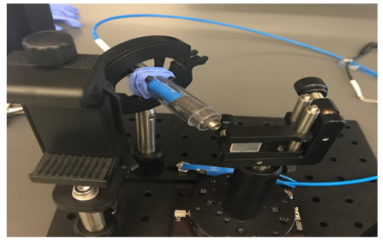

Figure 7: Benchtop System Model

Next Steps

- Spectrum will be calibrated to wavelength.
- Spectrometer model will be fine tuned to maximize spectral resolution.
- Case to hold spectrometer directly to the phone will be developed.
- Biorepository melanoma samples will be measured and analyzed against healthy samples.
- Melanoma identifying algorithms will be developed for the cell phone application.

Figure 8 : Healthy Skin vs. Melanoma[5]

Normal Mole Melanoma

Conclusions

- This method shows promise for detecting melanoma.
- When fully implemented this method would allow for low-cost point-of-care diagnosis.

Acknowledgements-
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