Automated Evaluation of Representation in Dermatology Educational Materials

IBM Research | Africa

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1. Introduction

- Dermatology materials lack adequate skin color representation [1,2]
- The lack of representation in educational materials may translate to the clinical realm, leading to increased morbidity and mortality [3]
- Manual skin tone annotation is not feasible for a large corpus of dermatology education materials due to its subjectivity and labor-intensive nature
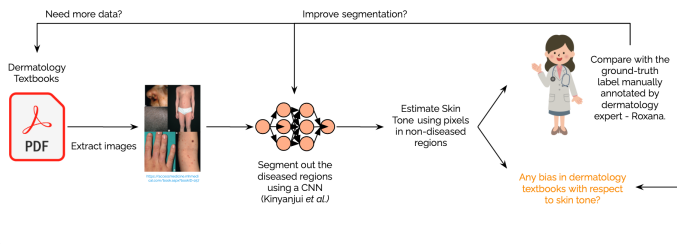

2. Proposed framework

- We propose a unified framework, where academic materials (e.g., in pdf format) are fed as input to be parsed using a corpus conversion service (CCS) [4]
- Images are then cropped out using the annotations from CCS, and skin images are selected.
- Segmentation of non-diseased skin regions followed by skin tone estimation is applied.
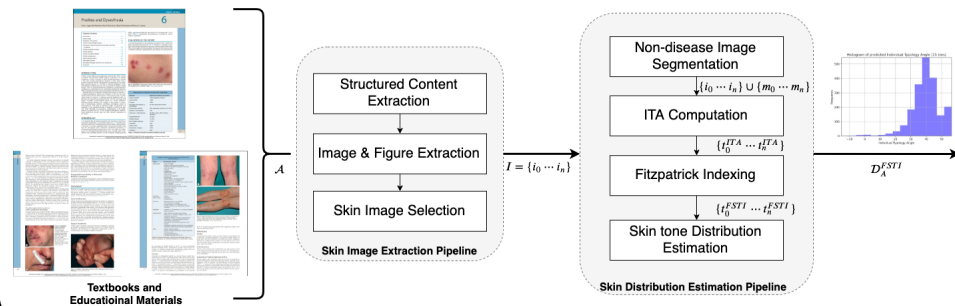
3. Experiments

- Three dermatology textbooks used for validation

Bologna 4e   Atlas 8e   General Med 9e
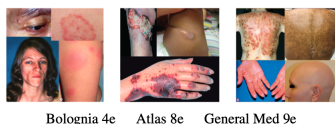
- Non-disease regions are segmented using Mask R- CNN [5] and Individual Typology Angle (ITA) values are computed and mapped to Fitzpatrick skin type indices (FSTI)

| ITA Range	FSTI
$ITA > 41°$	I
$34.5° < ITA \leq 41°$	II
$28° < ITA \leq 34.5°$	III
$19° < ITA \leq 28°$	IV
$10° < ITA \leq 19°$	V
$ITA \leq 10°$	VI

- Performance metrics: sum of absolute difference (SAD), mean absolute error (MAE), mean squared error (MSE), and root mean squared error (rMSE)
- Segmentation examples:

- Lack of dark skin images in all textbooks

	Bologna	Atlas	General Med
GT	11.92%	9.56%	11.78%
Proposed	17.42%	6.82%	7.84%

- More results

SAD	MAE	MSE	rMSE
61.0	0.6559	0.8710	0.9333
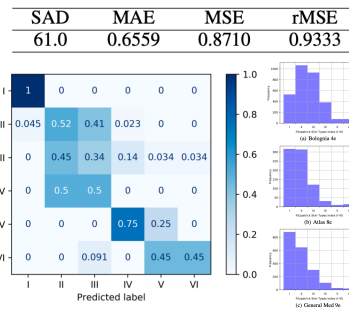
4. Conclusions

- We proposed a framework that automatically assesses bias in representation of darker skin tones
- Main steps include *Automated ingestion academic documents, extracting image contents and quantifying representation across skin tones*
- We validated the framework using three dermatology textbooks and encouraging performance is achieved
- This work has a potential to facilitate the development of trustworthy AI systems in field of dermatology and beyond.

References

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