**Data science Project**

1. ***Introduction***
   1. ***Problem definition***

Biometric identification systems, particularly those relying on fingerprint recognition, face vulnerabilities when individuals experience physical damage to their fingers due to burns, cuts, or presence of a pathological skin conditions such as eczema (Figures 1 - 3).

Top of Form

Figure 1: Fingertip deep cut

Figure 3: Fingertip eczema

Figure 2: Fingertip burn blister

* 1. ***Testimonials from Real-World Cases***

While some may perceive it as insignificant, some real-world complaints are showcased in the following as testimonials to the severity of the problem at hand.



Figure 4: Some examples of people complains concerning the efficiency of biometric recognition systems after accidents

* 1. ***Research questions and Sub questions:***

Therefore, it would be interesting to comprehensively understand the impact of such damage on recognition algorithms' performance to strengthen the reliability and efficiency of biometric systems in real-world scenarios. Thus, the present project follows two main goals:

* Firstly, quantifying the impact of pathological conditions on fingerprint recognition algorithms
* Secondly, investigating whether damaged portions of fingerprints can be effectively regenerated using data from healthy regions, thereby enhancing the precision of biometric identification systems from a biological perspective.Top of Form

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Two sub questions can also be defined as following:Top of Form

* Are there any discernible differences in fingerprint characteristics, such as ridge density, ridge patterns, and ridge minutiae between males and females? (we can use segmentation maybe to answer this)
* If yes, can they be utilized to refine the accuracy of gender-specific biometric identification systems?

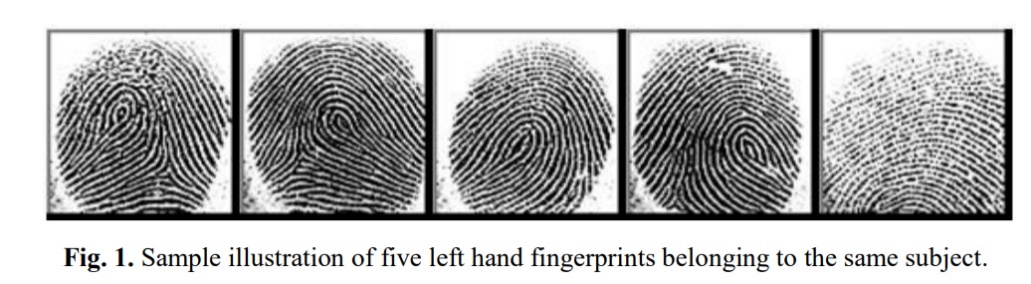
I would put those two questions, comparing recognitions techniques for unhealthy fingerprints and identifying what kind of disease threaten identification the most (if we don’t find true disease datasets we can find which artificial damage implies the most dramatic results for each technique.

* How could damage be quantified using one recognition technique or another? Pattern recognition might enable to define a characteristic data quantity above which recognition dramatically falls down. On the other hand, if simple machine learning programs proved more efficient for healthy recognition, their ability to bypass injuries should be investigated. If we manage to do only one technique, we can still quantify the damage.
* To what extent a damaged fingerprint can be used as an identifier? Up to which point is it safe and for which disease/injury/damage? We can still do that question if we manage to do only one recognition technique.

1. ***Materials and Methods***
   1. **Dataset**

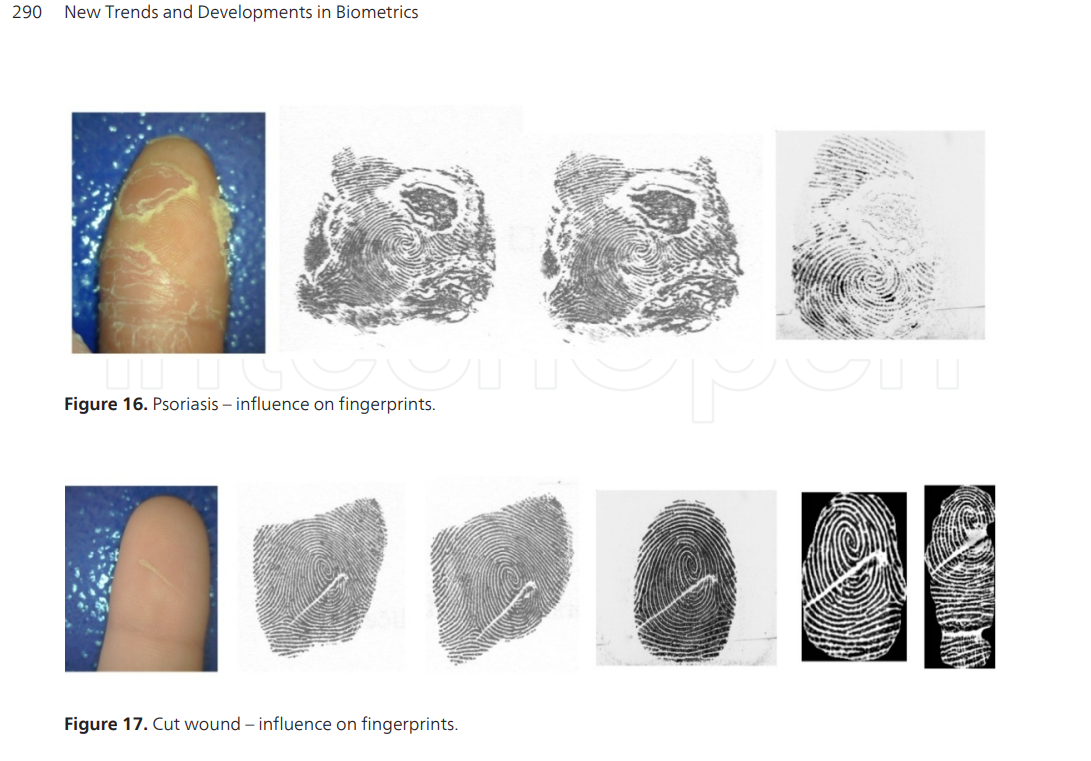
The SOCOFing dataset contains 6,000 fingerprints from 600 African individuals (aged 18 or older), with each person providing 10 fingerprints. This dataset includes unique attributes like gender, hand, and finger names. Figure below shows some samples of the original fingerprints. Top of Form

The original images were captured with Hamster plus (HSDU03PTM) and SecuGen SDU03PTM sensor scanners, totaling 55,273 fingerprint images in the dataset. All images have a resolution of 1 × 96 × 103 (gray × width × height).



**2.2 Methods**

Studying the fingerprint pattern disruption induced by pathology (In an article several pathologies are presented along with their disruption effects)



https://www.youtube.com/watch?v=dnd8IH1Pars&t=897s

* **References:**

1. Michal Dolezel, Martin Drahansky, Jaroslav Urbanek, Eva Brezinova and Tai-hoon Kim, “Influence of Skin Diseases on Fingerprint Quality and Recognition” <http://dx.doi.org/10.5772/51992>
2. Shehu, Yahaya Isah, et al. "Sokoto coventry fingerprint dataset." arXiv preprint arXiv:1807.10609 (2018).