2020

British Association of Dermatologists

healthy skin for all

BAD Project Grant Report Summer 2020

Application of machine learning algorithms for atopic eczema severity classification to develop a disease flare prediction App for eczema sufferers and a study protocol.

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Foreword

I had the privilege of receiving a project grant from the British Association of Dermatologists (BAD) to carry out my research project over the summer period to investigate the use of machine learning algorithms for atopic eczema management. The project was conducted at the Unit for Population-Based Dermatology Research, St John's Institute of Dermatology under Professor Carsten Flohr and Professor Magnus Lynch

Working remotely from home - adapting to the 'New Normal'

Need for AI in Eczema

Eczema is a chronic, inflammatory skin condition characterised by periods of flares and remissions. The global burden of eczema is immense, with severe cases having marked impairments of their quality of life and association with psychological co-morbidities, such as anxiety and depression. A 2019 pan-European study found an additional out-of-pocket expenditure due to eczema of £844 per patient (Zink et al., 2019). According to Allergy UK (2017), 1 in 4 patients in the UK have missed more than 6 days of work due to eczema.

As the Topol Review (2019) outlined, "New digital technologies have the potential to transform how the NHS delivers care for decades to come". This statement has only

become more profound with COVID-19 and the rise in potential for increased teledermatology. If patients can self-assess their eczema flares accurately, treatments can be stepped up, leading to better disease control. The integration of accurate machine learning models into mobile applications can ensure patients are avoiding exposures to triggers at high-risk times and can access clinical treatments at the early stage to prevent exacerbations. This enables equity of access and can deliver cost savings to the NHS.

Project Overview

The goal of the summer research project was to build a proof-of-concept algorithm to detect eczema and differentiate from healthy skin and skin conditions with similar presentations, such as psoriasis. The role of convolutional neural networks (CNNs) has shown considerable potential in its analysis of clinical images. Researchers have identified and implemented a myriad of image processing techniques for the detection of dermatological conditions and the classification of their severity.

However, existing algorithms for eczema all suffer from limitations in quality and quantity of images in training databases, which is invariably detrimental to the accuracy of the algorithm.

I obtained a dataset using only publicly available data sources. This subset was then used to train a constitutional neural net using a machine-learning library using 27 images of real eczema and approximately 120 images of not eczema. Data augmentation techniques were used to create extra data points using existing ones. Finally, I downloaded the model locally and ran tests using a completely unseen dataset of all positive cases of eczema. As a binary classifier, the model achieves a 60% accuracy.

```
types-of-eczema-01-atopic-722x406.jpg
eczema:0.00017635693
NOT_eczema:0.99982363
```

```
num_predicted_correct = sum(map(lambda x: 1 if x>0.5 else 0, results))
total = len(results)
print("%s / %s = %s" % (num_predicted_correct, total, num_predicted_correct/total))
```

```
16 / 27 = 0.5925925925925926
```

This depicts the outcome from the model when inputting a new image. The output percentage shows the model's accuracy when given unseen data.

Future Scope and Reflection

The project acted as a proof-of-concept for the potential of a full research project to gather a large-scale dataset that will be representative of different skin types. To build on this model, additional images can be scraped from the public domain and new image models can be created using the existing models. The challenges posed by COVID in remote working also demonstrates the need of implementing digital technologies in healthcare. The project was a fantastic way to get acquainted with image processing techniques and delve into the possibilities of teledermatology.

I would like to express my gratitude to Professor Carsten Flohr, Professor Magnus Lynch and the team at St John's Institute of Dermatology for the continued support mentoring and support, as well as the British Association of Dermatologists for facilitating this project.

Allergy UK (2017) *SEEiNg rEd*. [Online]. Available from: https://www.allergyuk.org/assets/000/001/411/Seeing_Red_Report_FINAL_25.04.17_original.pdf?1508228476.

Health Education England (2018) *The Topol Review*. [Online]. 21 February 2018. Available from: https://www.hee.nhs.uk/our-work/topol-review [Accessed: 18 October 2020].

Zink, A., Arents, B., Seitz, I., Mensing, U., et al. (2019) Out-of-pocket Costs for Individuals with Atopic Eczema: A Cross-sectional Study in Nine European Countries. *Acta Dermato Venereologica*. [Online] Available from: doi:10.2340/00015555-3102.