Skin Cancer Detection and Classification

University of Wisconsin - Madison

Computer Science 539

1. Overview

This project aims to use a convolutional neural network for the classification of images of skin lesions. The images in the set will fall under and will be sorted into 10 categories: actinic keratosis, basal cell carcinoma, dermatofibroma, melanoma, nevus, pigmented benign keratosis (seborrheic keratosis), squamous cell carcinoma, and a control group of noncancerous lesions.

2. Background

Skin cancer affects 20% of the US population - by the age of 70, 1 in 5 Americans will suffer it [1]. Patients often visit a dermatologist with a skin lesion like a lump, spot, or mole. It is then up to the dermatologist's clinical expertise [2] to decide whether further testing like a biopsy is needed. While a human in the loop (in the best case, an experienced dermatologist) is vital, the use of an algorithm to diagnose skin cancers can not only improve patient outcomes, but democratize healthcare for those without access to specialized care.

The current process for skin cancer diagnosis starts with a clinical examination of the skin. Then, part of the skin is removed for a biopsy and sent to a lab for testing. Depending on the type of skin cancer diagnosed, the doctor may order additional tests for staging, or figuring out if the cancer has spread [3]. While not all skin cancers spread, many do - including melanoma, the deadliest type of skin cancer.

Backing up a clinical diagnosis with algorithmic classification can increase the accuracy of skin cancer detection, and perhaps even catch cancers earlier, which makes a tremendous difference in treatment. In rural, underdeveloped, or underprivileged settings, an algorithmic classifier could make an enormous difference, perhaps even between life and death [2]. While a specialist is hard to come by for these communities, all a classifier would need is a device and an image of the concerning skin sample.

3. Statement of Work

3.1 Datasets

Our dataset will be a combination of the two following datasets for the model to get a better understanding of skin cancer. Vascular lesion images from dataset 2 are excluded from our combined dataset and model because it can either be malignant or benign which is not labeled in the images.

Dataset 1: Malignant vs. Benign

This dataset contains data from the ISIC(The International Skin Imaging Collaboration) archive. It consists of two folders of 1800 images each, respectively featuring either malignant or benign skin moles.

Dataset 2: Skin Cancer ISIC

This dataset contains data from the ISIC(The International Skin Imaging Collaboration) archive. It consists of 2357 images of malignant and benign skin diseases as follows:

- actinic keratosis(benign)
- basal cell carcinoma(malignant)
- dermatofibroma(benign)
- melanoma(malignant)
- nevus(benign)
- seborrheic keratosis(benign)
    - also known as pigmented benign keratosis
- squamous cell carcinoma(malignant)
- vascular lesion(mixed)

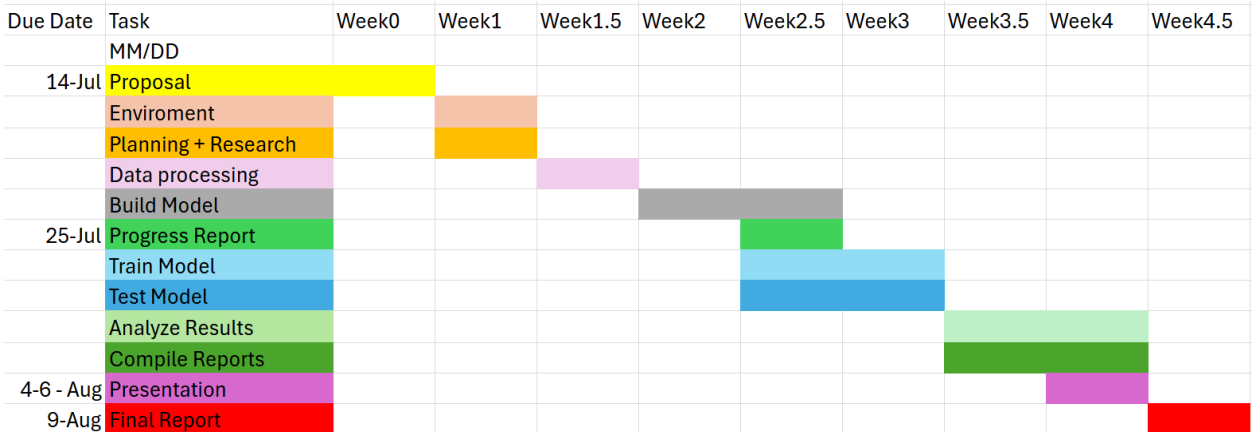
3-2. Method

It seems that our approach has the same steps from acquisition and data processing to testing results [6]. A lot of work on these datasets and in real work spaces have reached a very solid level of detection and classification for skin cancer. It seems as though CNN which is common for images is used efficiently for skin cancer as well as a few other architectures. These include AlexNet, VGG, ResNet and a few others. Overall they give around 95% accuracy based on the datasets they used on these models. As for computation itself, a lot of GPUs off linux machines and general computers are used to quickly use and make these models. We have a lot of options for CNN, KNN and the other listed architectures in modeling this data. Given that CNN is the best entrance to classification on skin we have a good base to start on. There is more research to be done for the coming weeks but a lot of development and learning will overlap over time. But with the time crunch it will be a quick start to development and continuing till the very end.

3-3. Outcome and Performance evaluation

We hope to have a confident model that classifies and detects. What defines this will be how accurate it is. To know these thresholds we can look at other examples and see how we compare. Pubmed and few other medical institutions show that dermatologists usually work with around 95% sensitivity rate for their detection models [4]. So our goal will be above 90% sensitivity preferably for detection and classification. So to really gauge if this project will be successful is if we minimize enough false negatives and have a confident model such that it could be used for the medical field. Performance should be fast, it is recommended to check for skin cancer every month and do a self screening for it [5]. If we have dermatologists, doctors and citizens all trying to queue for an open source model, it can really eat it up. So managing to be quick is important. Overall we would like this project to be completed in a way where it is accurate, fast and able to learn.

4. Project Plan



GitHub Repository:

https://github.com/jkira1/ece539_project

5. References

1. "Skin Cancer Facts & Statistics." *The Skin Cancer Foundation*, The Skin Cancer Foundation, 27 Jan. 2025, www.skincancer.org/skin-cancer-information/skin-cancer-facts/.
2. Musthafa, M Mohamed, et al. "Enhanced Skin Cancer Diagnosis Using Optimized CNN Architecture and Checkpoints for Automated Dermatological Lesion Classification - BMC Medical Imaging." *BioMed Central*, BioMed Central, 2 Aug. 2024, bmcmedimaging.biomedcentral.com/articles/10.1186/s12880-024-01356-8.
3. Mayo Clinic Staff. "Skin Cancer." *Mayo Clinic*, Mayo Foundation for Medical Education and Research, 8 Apr. 2025, www.mayoclinic.org/diseases-conditions/skin-cancer/diagnosis-treatment/drc-20377608.
4. Screening for skin cancer in Adults: An Updated Systematic Evidence Review for the U.S. Preventive Services Task Force [Internet]. (2016, July 1). PubMed. https://pubmed.ncbi.nlm.nih.gov/27583318/
5. How to do a skin Self-Exam | Examine your skin. (n.d.). American Cancer Society. https://www.cancer.org/cancer/risk-prevention/sun-and-uv/skin-exams.html?

6. Naqvi, M., Gilani, S. Q., Syed, T., Marques, O., & Kim, H. (2023). Skin Cancer Detection Using Deep Learning—A Review. Diagnostics, 13(11), 1911. https://doi.org/10.3390/diagnostics13111911

6. Contributions (50 words each)

Shivani - I came up with ideas and found datasets to back them up, although we did not end up choosing my idea. I also researched existing studies on skin cancer classification, skin cancers themselves, and wrote the overview and background.

Michael - Researched project ideas and their datasets. Analyzed the two datasets provided by Jay and Shivani to write the datasets part of section 3. Researched skin diseases in dataset 2 to categorize them as benign, malignant, or mixed. Filled out the gantt chart for section 4.

Jay - Created and organized the github and gantt chart. Researched datasets for skin cancer classification and detection. Filled in information for section 3. Reviewed topics on how CNN is used for skin cancer and how well we will do based on medical standards.