DermAInsight Overview

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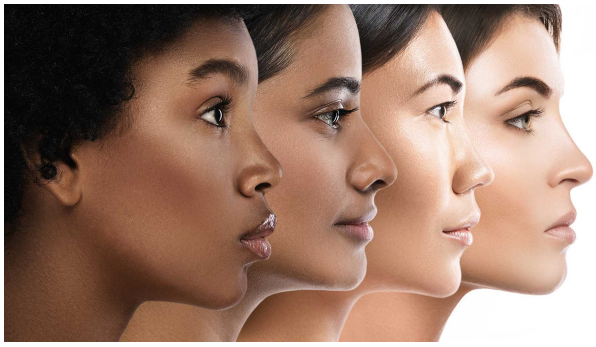
Abstract—An AI-powered tool designed to revolutionize the detection of skin diseases and cancers, with a focus on providing accurate diagnoses for people of colour. "What if we could use artificial intelligence or AI to accurately detect skin diseases and cancers in people of colour?" By leveraging advanced machine learning algorithms trained on a diverse dataset, DermAInsight aims to provide early and accurate diagnoses, improving health outcomes and ensuring equitable care.

Contents

1. Introduction

DermAInsight uses AI to bridge the gap in dermatology for the BIPOC community by addressing the lack of knowledge and proper diagnosis for darker skin tones. Using information inputted by the user (images, symptoms, location of condition), our model suggests a list of potential diagnoses.



2. Objective

DermAInsight is an AI-powered tool designed to revolutionize the detection of skin diseases and cancers, with a focus on providing accurate diagnoses for people of colour. By leveraging advanced machine learning algorithms trained on a diverse dataset, DermAInsight aims to provide early and accurate diagnoses, improving health outcomes and ensuring equitable care.

3. Why this matters

The field of dermatology has long struggled with disparities in diagnosis and treatment outcomes for people of colour. Traditional medical training and diagnostic tools have primarily focused on paler skin tones, resulting in a significant knowledge gap when it comes to understanding and managing skin conditions in BIPOC (Black, Indigenous, and People of Colour) communities. This gap has profound implications for individuals, healthcare systems, and society at large.

3.1. Impact on BIPOC Individuals

For BIPOC individuals, misdiagnosis or delayed diagnosis of skin conditions can lead to unnecessary suffering, increased health risks, and diminished quality of life. Conditions that appear differently on darker skin tones are often overlooked, resulting in ineffective treatments and prolonged discomfort. In severe cases, this can escalate to life-threatening conditions being missed entirely, exacerbating health inequities and fostering distrust in the healthcare system.

3.2. Impact on Healthcare Systems

The failure to accurately diagnose and treat skin conditions in BIPOC populations places an additional burden on healthcare systems. Misdiagnoses can lead to repeated visits, increased healthcare costs, and strained resources as patients seek second opinions or alternative treatments. This inefficiency impacts patients and clogs the system, reducing the overall quality of care.

3.3. Empowerment of Healthcare Professionals

Healthcare professionals often feel ill-equipped to diagnose and treat skin conditions in BIPOC patients due to limited training focused on paler skin tones. An international survey in 2022 revealed that 74% of dermatologists felt less confident in managing diseases in skin of colour. DermAInsight provides the resources and support needed for accurate diagnoses, enabling professionals to deliver equitable care.

3.4. Advancing Research and Systemic Change

Healthcare professionals often feel ill-equipped to diagnose and treat skin conditions in BIPOC patients due to limited training focused on

paler skin tones. An international survey in 2022 revealed that 74 of dermatologists felt less confident in managing diseases in skin of colour. DermAInsight provides the resources and support needed for accurate diagnoses, enabling professionals to deliver equitable care.

In summary, DermAInsight is more than a diagnostic tool; it is a catalyst for change. It bridges critical gaps in dermatological care, supports healthcare professionals in delivering better care, and empowers BIPOC individuals to receive the diagnoses and treatments they deserve. By doing so, it contributes to a more equitable, efficient, and compassionate healthcare landscape.

4. Our Dataset: SCIN

4.1. SCIN: A new resource for representative dermatology images

DermAInsight leverages the SCIN Dataset from Google Research. The Skin Condition Image Network (SCIN) dataset[2] provides a diverse and representative collection of skin condition images, addressing crucial gaps in AI development, medical research, and equitable healthcare. This dataset, the most diverse in skin tone among those we researched, ensures significant representation of BIPOC individuals.

4.2. Dataset Composition

The SCIN dataset, developed in collaboration with physicians at https://med.stanford.edu/, includes over 10,000 images of skin, nail, and hair conditions. Designed to reflect the diverse range of concerns people search for online, it supplements typical clinical datasets. All contributions were made voluntarily through a **Crowdsourcing Method**, with informed consent under an institutional review board-approved study in the US.

Figure 1. Sample of images of skin conditions submitted and diagnosed in the SCIN Dataset [2].

4.3. Dataset Distribution

To ensure robust analysis and fair model training, we examined the distributions in our dataset across various dimensions such as ethnicities, skin tones, Fitzpatrick skin types, skin conditions, ages, and gender. By maintaining a balanced dataset, we aim to reduce bias and improve the accuracy and equity of our AI model.

4.3.1. Age Range

The dataset covers a wide spectrum of age groups, including children, adolescents, adults, and the elderly. This helps the model understand and diagnose age-specific dermatological issues accurately, reflecting the conditions' real-world distribution across different age groups.

Fig. 13 The following graph shows the distribution of Age Ranges in the SCIN Dataset.

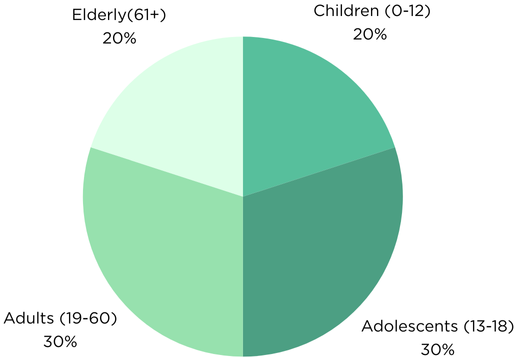


Figure 2. The The age distribution of the SCIN dataset is as follows: 20% Children (0-12 years), 30% Adolescents (13-18 years), 30% Adults (19-60 years), 20% Elderly (61+ years). [2].

4.3.2. Gender

The SCIN dataset also includes a balanced representation of genders

Fig. 13 The following graph shows the distribution of Genders in the SCIN Dataset.

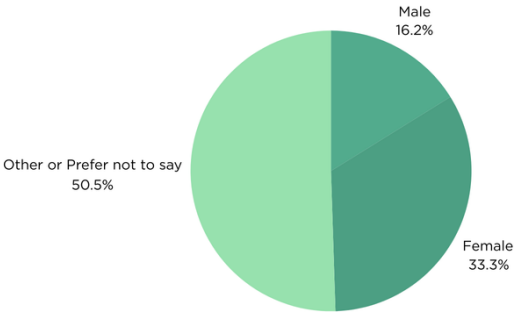


Figure 3. The gender distribution of the SCIN dataset is as follows: 16% Male, 33% Female, 50% Other or Prefer not to say. [2].

4.3.3. Ethnicities

The SCIN dataset includes a diverse range of ethnicities to ensure comprehensive representation. This diversity is critical for accurately diagnosing skin conditions across different ethnic backgrounds and reduces the risk of bias in the AI model. Ethnicity data is self-reported by the contributors, providing a wide array of demographic information that enhances the dataset's inclusivity and effectiveness.

Fig. 13 The following graph shows the distribution of Ethnicities in the SCIN Dataset.

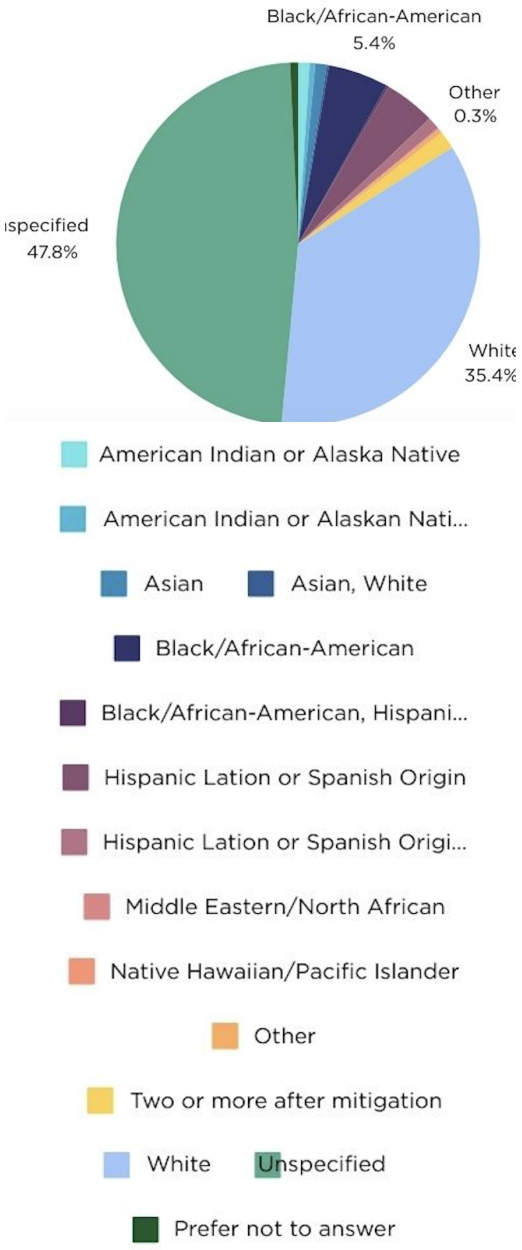


Figure 4. The ethnicity distribution of the SCIN dataset is as follows: 35% White, 5.3% Black or African American, 4.5% Hispanic Latino or Spanish Origin, 1.7% Asian, 1% American Indian or Alaskan Native, 0.1% Middle Eastern or North African, 0.1% Native Hawaiian or Pacific Islander, 4% Mixed Ethnicity, and 48.3% Other or Prefer not to answer/Unspecified. [2].

4.3.4. Monk Skin Tone

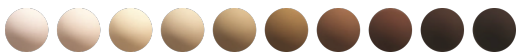


Figure 5. Monk Skin Tone Scale [1].

The dataset uses the Monk Skin Tone (MST) scale[1] to categorize skin tones accurately. The MST scale, developed by Dr. Ellis Monk, offers a more granular classification of skin tones ranging from light to dark. This scale is essential for developing an AI model that recognizes and diagnoses conditions across a wide range of skin tones.

Fig. 13 The following graph shows the distribution of Skin Tones in the SCIN Dataset.

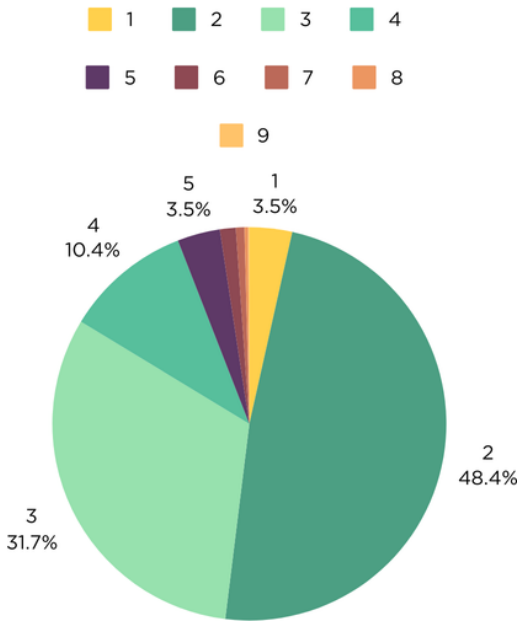
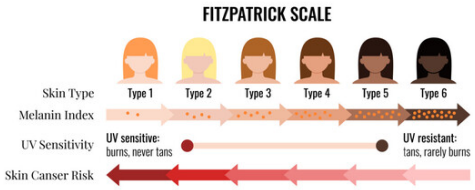


Figure 6. The Monk Skin Tone distribution of the SCIN dataset is as follows: 48.4% label 2, 31.7% label 3, 10.4% label 4, 3.7% label 1, 3.5% label 5, 1.3% label 6, 0.7% label 7, 0.3% label 8, 0.1% label 9. [2].

4.3.5. Fitzpatrick Skin Type



The Fitzpatrick Skin Type classification is also employed in the SCIN dataset. This system categorizes skin types based on their response to ultraviolet (UV) light, ranging from Type I (very fair skin, always burns, never tans) to Type VI (very dark skin, never burns, tans very easily). This classification is crucial for understanding how skin conditions present differently across various skin types. Contributors self-reported their Fitzpatrick Skin Type during data collection. Additionally, dermatologists assigned a Fitzpatrick Skin Type to each submission based on the submitted images, and we took the average of the self-reported and dermatologist-assigned Fitzpatrick Skin Types to ensure accurate representation and enhance the AI model's diagnostic capabilities

Fig. 13 The following graph shows the distribution of Skin Tones in the SCIN Dataset.

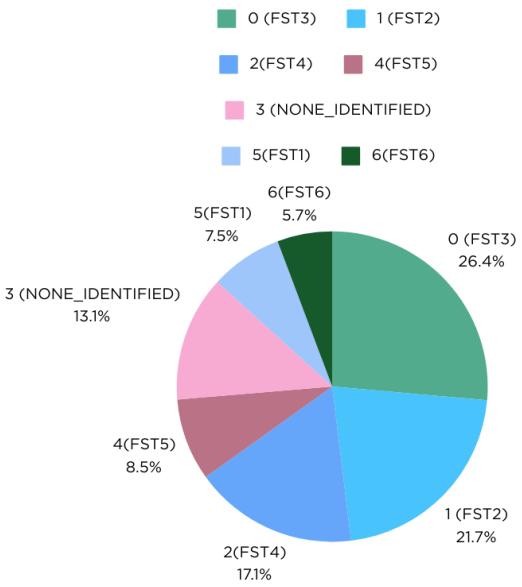


Figure 7. The Fitzpatrick Skin Type distribution of the SCIN dataset is as follows: 26.4% label 3, 21.7% label 2, 17.1% label 4, 8.5% label 5, 7.5% label 1, 5.7% label 6, 13.1% None Identified. [2].

4.4. Ethical Considerations

Our team collaborated with Responsible AI consultants from Mila to address crucial ethical considerations for our solution. Here are the key points we focused on:

1. **Partnering with Healthcare Institutions:** Partnering with healthcare institutions and professionals to ensure that the dataset annotations and diagnoses are dermatologist-approved. Continuously validating and overseeing by qualified medical experts to maintain the highest standards of accuracy and reliability in our data and model training processes, to avoid misdiagnosis.

2. **Transparency:** Communicating to users the data being collected, its purpose, and how it will be used to build trust and ensure ethical data use.

3. **Data Privacy and Protection:**Protecting user data through advanced encryption methods to safeguard submitted information. Given the sensitive nature of medical data, which is often highly confidential, we are taking extra precautions to ensure its security and privacy. Developing transparent privacy policies aligned with Canada's privacy guidelines, making them accessible and understandable, while clearly communicating the company's data protection practices and limitations.

4. **Data Quality:** Implementing rigorous data cleaning protocols and ensuring that all data used for training is accurate and validated by healthcare professionals. Maintaining a balanced and representative distribution of skin tones, skin types, and ethnicities to facilitate comprehensive analysis and training. Collecting only essential data, clearly communicating each data point's necessity to users, and preventing unnecessary data accumulation while respecting user privacy.

5. **Bias Mitigation and Fairness:** Mitigating bias by evaluating the dataset for potential biases, particularly concerning skin tone and demographic representation. Implementing fairness algorithms to reduce bias in data collection and model training. Designing segregated evaluations to assess model performance across different groups.

6. **Engaging and Impacting the Community:** Prioritizing the inclusion of marginalized groups in our dataset to ensure equitable healthcare outcomes. Utilizing surveys and focus groups during the development process to gather insights and address user needs effectively, ensuring our solution is both valuable and impactful.

7. **Maintaining Ethical AI Practices:** Committing to ethical AI practices by responsibly developing and deploying the AI model, with ongoing monitoring for biases and inaccuracies. Regularly updating the dataset and the model to reflect new medical knowledge and societal changes. Strictly maintaining compliance with all relevant regulations and ethical guidelines in AI and healthcare.

By adhering to these detailed ethical considerations, we are developing a responsible and effective AI solution that serves diverse populations and promotes equitable healthcare. For further details on ethical AI practices and privacy policies in Canada, please refer to the. Privacy Policy of Canada

5. Our Solution

5.1. DermAInsight:

Revolutionizing Dermatological Care, DermAInsight is an AI-powered tool designed to revolutionize the detection and diagnosis of skin diseases and conditions, with a particular focus on providing accurate diagnoses for people of color. Leveraging advanced machine learning algorithms, DermAInsight is trained on a diverse dataset that includes a wide range of skin tones and types, ensuring inclusivity and accuracy.

5.2. User Interaction and Experience:

DermAInsight features an intuitive and easy-to-navigate interface, making it accessible for users of all ages and technical backgrounds. Upon accessing the platform, users are guided through a simple process to submit their queries and images.

5.3. Step-by-Step Guidance:

The platform prompts users to upload clear images of the affected area, which are crucial for accurate analysis. Users are also able to enter basic information about their skin condition, including any relevant symptoms and the duration of the condition.

5.4. Image Classification and Analysis:

Once the images and information are submitted, DermAInsight employs advanced image classification algorithms to analyze the uploaded images. The AI model, trained on a comprehensive and diverse dataset, identifies potential skin conditions by comparing the input images with known conditions in the database.

5.5. Condition List and Recommendations:

Based on the analysis, DermAInsight generates a list of possible skin conditions that match the submitted images and symptoms. Each suggested condition comes with a detailed description, including common symptoms, potential causes, and recommended next steps. Users receive a clear, concise report that outlines these possibilities, helping them understand their condition better.

5.6. Symptom Integration:

In addition to image analysis, DermAInsight considers the symptoms inputted by the user. The AI model integrates this information to refine the list of potential conditions, ensuring a more accurate and tailored diagnosis.

Figure 8. Scan this QR Code for Figma Demo.

6. Our Model

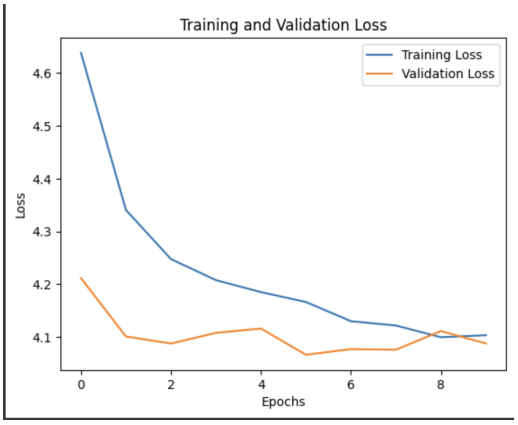
6.1. Model Architecture

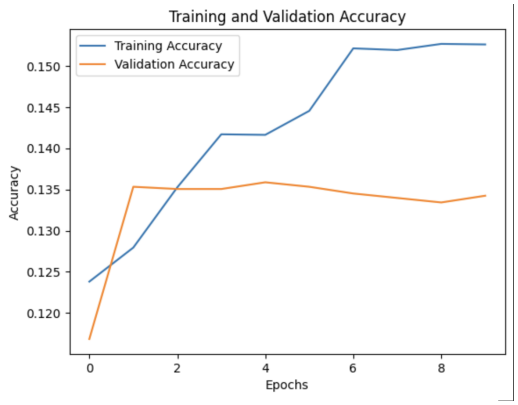
ResNet-50 model with deep conditional neural network using Tensorflow and Keras Libraries. Pre-trained on a dataset of large-skin lesion images. Using Adam optimizer, Categorical Cross Entropy Loss, Learning rate = 1e-4.

6.2. Fine Tuning

Fine-tuning some of the top layers of the ResNet-50 model allows the network to adapt pre-trained features more specifically to our dataset.

Utilizes the ImageDataGenerator for data augmentation and loading. Trained on 10 epochs with batch size 32.





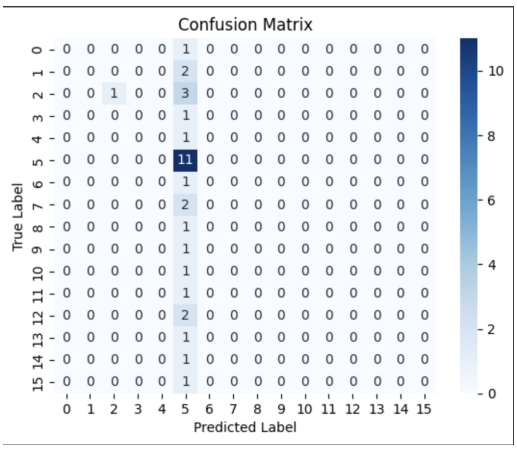
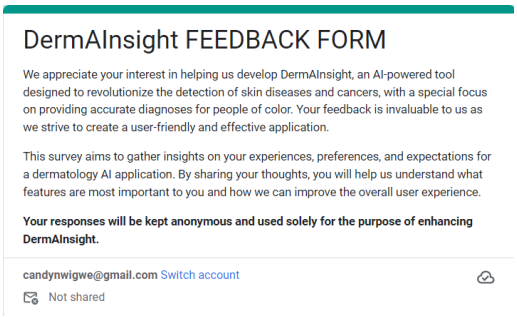


Figure 9. Confusion matrix after evaluation.

7. User Feedback and Insights

We conducted a survey to gather user feedback on our DermAInsight prototype and to understand user experiences with dermatology. The survey can be accessed here. Below is a general summary and insights from the survey responses.



7.1. General Summary

The survey aimed to capture users' interactions with the DermAInsight prototype and their overall experience with dermatological care. We received a diverse range of responses from individuals of varying age groups, ethnic backgrounds, and skin types. The feedback provided valuable insights into user expectations, challenges faced in dermatological care, and suggestions for improving the prototype.

7.2. User Feedback Demographics:

7.2.1. Age Group Distribution

Fig. 10, The following graph shows the distribution of the Ages of our survey participants.

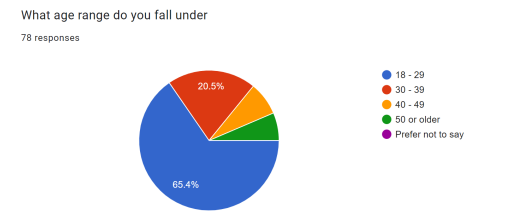


Figure 10. The survey responses included a wide range of age groups, with the majority being between 25-40 years old.[3].

7.2.2. Ethnicity Distribution

Fig. 11, The following graph shows the distribution of the respondents' ethnicities.

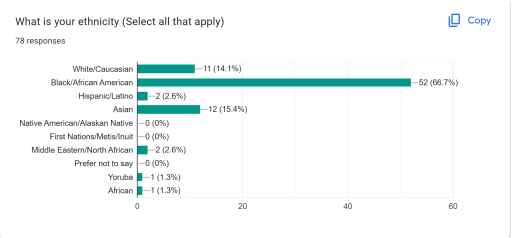


Figure 11. The respondents represented a diverse set of ethnic backgrounds, with significant representation from African American, Caucasian, and Asian communities. [3].

7.2.3. Skin Tone Distribution (based on Monk Skin Tone Scale)

Fig. 12, The following graph shows the distribution of the respondents' skin tones based on the Monk Skin Tone Scale.

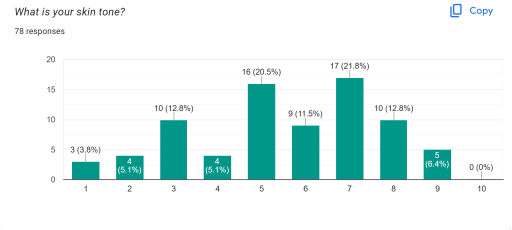


Figure 12. The most represented skin tones in the survey were medium and dark tones. This aligns with our objective to provide accurate dermatological care for people of color, who are often underrepresented in traditional dermatological datasets. [3].

Observations from Skin Tone demographics : Users with dark skin tones shared their experiences with misdiagnoses in traditional dermatological care. They appreciated DermAInsight's focus on inclusivity and the accurate representation of their skin conditions.Although fewer in number, respondents with light skin tones also contributed valuable feedback. Their insights helped ensure that DermAInsight maintains high accuracy and relevance across different skin types.

7.3. Key Insights

7.3.1. Access to Care:

Many users highlighted difficulties in accessing dermatologists, especially in remote or underserved areas. This feedback underscores the importance of making dermatological care more accessible through technology.

Fig. 13, The following graph shows the distribution of the responses to the survey question: "Do you feel you had adequate resources and support for managing your skin condition?".

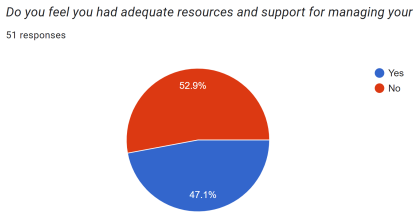


Figure 13. The survey responses included an almost 50/50 split between those who feel they had adequate resources and support for managing their skin condition and those who do not. This is an alarming distribution as something as critical in healthcare needs to be able to adequately support the masses at a much higher percentage than this.[3].

7.3.2. Skin Tone Representation:

Users of color expressed concerns about misdiagnosis due to inadequate representation of diverse skin tones in traditional dermatological resources. This feedback validates our focus on inclusivity in the DermAInsight dataset.

7.3.3. Wait Times and Availability:

Real-life experiences shared by users revealed long wait times and limited availability of dermatologists, leading to delays in diagnosis and treatment. This highlights the need for more efficient and accessible dermatological services.

7.3.4. Ease of Use:

Most users found the DermAInsight prototype easy to navigate and user-friendly. However, a few users suggested enhancements and adding more interactive features, such as live chat with dermatologists and a comprehensive FAQ section.

7.3.5. Privacy and Security:

Ensuring data privacy and security was a major concern for users, particularly due to the sensitive nature of medical data. Users appreciated our commitment to protecting their data through advanced encryption and transparent privacy policies.

The survey responses provided valuable insights that will guide the refinement of the DermAInsight prototype. By addressing user feedback and incorporating their suggestions, we aim to enhance the user experience, ensure inclusivity, and improve accessibility to dermatological care. The commitment to data privacy and security remains a top priority as we continue to develop and improve the DermAInsight tool.

7.4. Our Conclusion

DermAInsight represents a significant advancement in dermatological care, leveraging AI to provide accurate and inclusive diagnoses for diverse skin tones and conditions.

Insights from our user survey have been crucial in refining DermAInsight. Feedback highlighted the need for accurate representation of different skin tones and improved access to quality dermatological services. Users emphasized the importance of inclusivity, accessibility, and detailed information in dermatological care.

DermAInsight's user-friendly interface, combined with advanced image classification algorithms, allows for accurate analysis of skin conditions. By integrating user-reported symptoms and providing detailed condition reports, DermAInsight empowers users to manage their skin health effectively. Our commitment to data privacy and security ensures users can trust the platform with their sensitive medical information.

Our dedication to continuous improvement and community engagement drives us to incorporate user feedback into future updates, ensuring DermAInsight evolves to meet user needs. By prioritizing the inclusion of marginalized groups and maintaining ethical AI practices, we aim to create a solution that is technologically advanced and socially responsible.

In conclusion, DermAInsight stands as a testament to the potential of AI in transforming healthcare. By providing equitable, accessible, and accurate dermatological care, we strive to improve health outcomes for all individuals, regardless of skin tone or location. Moving forward, we remain committed to ethical AI development and user-centered design, ensuring DermAInsight continues to be a trusted tool in dermatological care.

8. Contact Us

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