AI-Based Localization and Classification of Skin Disease with Erythema

Team 175

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1. INTRODUCTION

1.1 Overview

Nearly all age groups of people experience skin diseases. Due to changing environments and lifestyles, skin disease rates have grown. It has been noted that every fifth person in the USA is infected with some form of skin disease. The hierarchical genetic group of cells, hormones, and immune system conditions are some of the internal and external elements that commonly contribute to their development. Other aspects include distinct organisms' cells, varied food, and other internal and external factors. These elements may work in concert or in succession to cause skin conditions. There are malignant diseases like malignant melanoma as well as chronic, incurable diseases like eczema and psoriasis. If these illnesses are discovered early enough, recent research has revealed that there are treatments available.

1.2 Purpose

The most prevalent kind of sickness in the world is dermatological. Despite how prevalent it is, diagnosing it requires a high level of competence. A survey found that roughly 24% of people consult their general practitioner (GP) over a skin issue each year. The curriculum for undergraduate dermatology education is unequal (and frequently constrictive), suggesting that trainees should reassess their prior skills and knowledge in this field. Currently, primary care is in charge of treating 90% of all skin issues and illnesses.

The system examines the user's supplied image of the skin condition, performing feature extraction using the CNN algorithm and diagnosing the condition using the softmax image classifier. The system reacts poorly to the user if no disease is found. As a result, a novel CNN-based dermoscopy detection and classification technique has been proposed.

2. LITERATURE SURVEY

2.1 Existing Problem

AI-based localization and classification of skin diseases with erythema have shown promise, but it faces several challenges. These include limited diversity in training data, limited generalization, interpretability and explainability, limited availability of ground truth labels, ethical and legal considerations, and integration into clinical workflow. AI algorithms rely on large datasets, but there is a lack of comprehensive datasets that accurately represent various skin types, ethnicities, and demographic characteristics. This can result in biased or inaccurate predictions, especially for underrepresented populations. Ensuring robust generalization of AI models is crucial for their effective deployment in clinical practice.

Interpretability and explainability are also challenges, as deep learning models can be complex and difficult to interpret, leading to reduced trust and acceptance among healthcare professionals and patients. Ethical and legal considerations, informed consent, data ownership, and potential biases must be carefully addressed. Integrating AI-based systems into the clinical workflow can be complex, and collaborative efforts between researchers, healthcare providers, and AI experts are necessary to overcome these challenges and develop more accurate and reliable AI systems for dermatologists in diagnosing and managing skin diseases with erythema.

2.2 Proposed Solution

There is a sizable amount of literature on the subject of skin disease detection, encompassing topics like diagnostic procedures, imaging approaches, machine learning algorithms, and technological breakthroughs. Here are a few noteworthy studies and articles that shed light on the subject:

A. Esteva et al., 2017. "Classification of skin cancer at the dermatologist level using deep neural networks." 542(7639), pp. 115–118 in Nature.

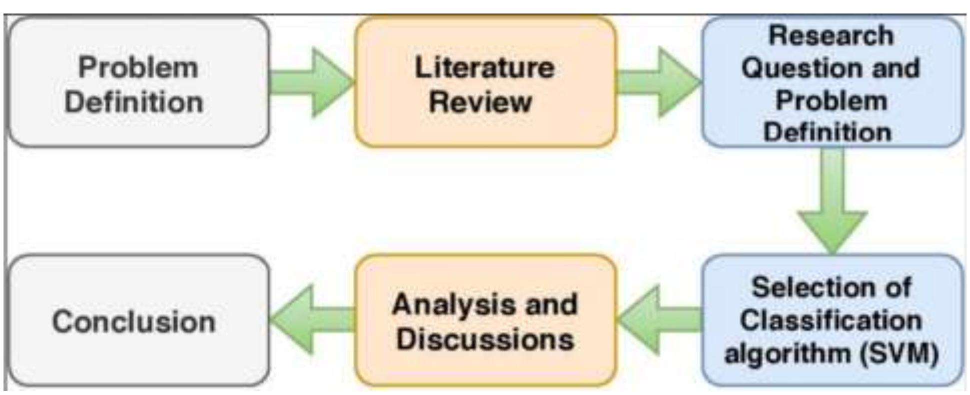
This ground-breaking study illustrates how deep learning algorithms can accurately categorize skin cancer. The performance of the convolutional neural network that the researchers trained to recognize skin lesions was on par with that of dermatologists.
P. Tschandl and colleagues (2019). An open, web-based, multinational diagnostic study comparing the precision of human readers with machine learning algorithms for the classification of pigmented skin lesions. p. 938–947 in The Lancet Oncology, 20(7).

In this work, the classification of pigmented skin lesions by dermatologists and machine learning algorithms is compared. The study showcases the potential of machine learning models in dermatological diagnostics and used a sizable worldwide dataset.

In a head-to-head comparison, the authors classified images of dermoscopic melanoma using deep learning algorithms and dermatologists. The findings suggest that deep learning models can perform better in this particular task than most dermatologists.

3. THEORETICAL ANALYSIS

3.1 Block Diagram



3.2 Hardware / Software Designing

Skin disease detection projects typically involve a combination of hardware and software components for image acquisition, analysis, and diagnosis. Here are some commonly used hardware and software tools in the field:

Hardware:

Dermatoscopes: These are specialized handheld devices used to capture magnified images of the skin. Dermatoscopes provide enhanced visualization of skin lesions and help in the diagnosis of various skin conditions.

Computational Hardware: To process large amounts of data and run complex algorithms, powerful computational hardware such as servers or high-performance GPUs (Graphics Processing Units) are often utilized.

Analysis and software:

Software used for image processing and analysis includes a variety of tools and libraries for noise reduction, contrast enhancement, and image segmentation. For further investigation, these tools assist in removing pertinent elements from skin image data.

Machine learning and deep learning algorithms: These two types of algorithms are essential for detecting skin diseases. Convolutional neural networks (CNNs) are frequently used for tasks including feature extraction, segmentation, and classification of images. To identify trends and provide precise diagnoses, these algorithms are trained on enormous datasets of labeled skin photos.

Extraction and Selection of Relevant Characteristics from Skin Images: Feature extraction techniques are employed. These characteristics of skin lesions could be their color, texture, shape, or spatial distribution. Methods for selecting traits that are most informative for classification and diagnosis are helpful.

Decision Support Systems: To incorporate machine learning algorithms and create a user-friendly platform for dermatologists or other healthcare professionals to interact with the system, software applications, and interfaces have been developed. These programs aid in the interpretation of the findings, the creation of diagnostic reports, and the facilitation of interaction between the algorithm and the medical professional.

4. EXPERIMENTAL INVESTIGATION

To achieve accurate and trustworthy results, many forms of analyses and research are carried out while developing a skin disease detection solution. Here are a few typical examinations and analyses carried out throughout the project:

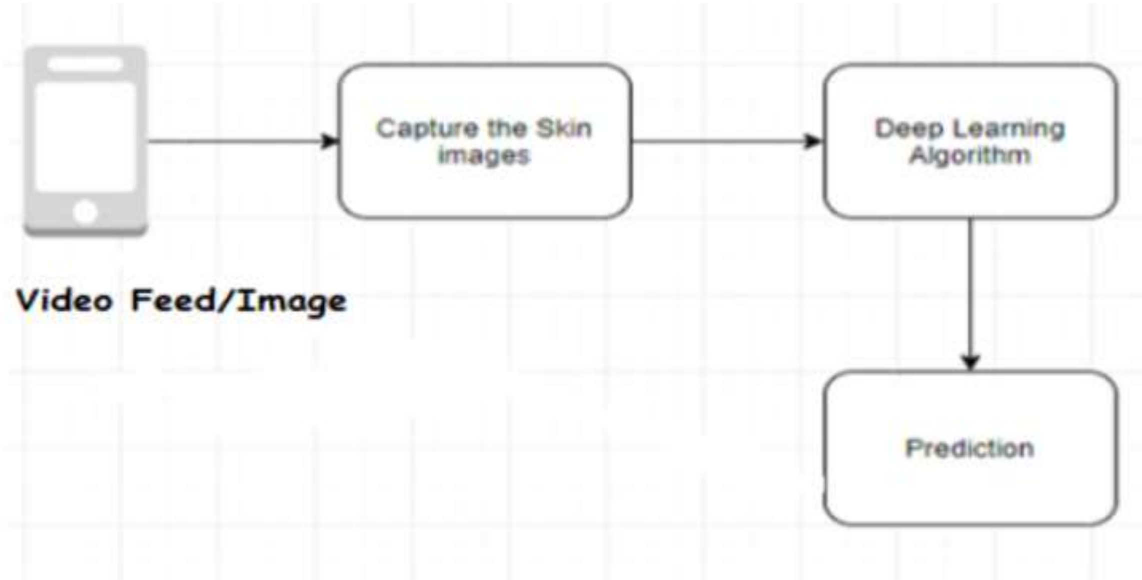
Image Preprocessing and Enhancement: Skin image preprocessing and enhancement techniques may be used before analysis. This covers image scaling, contrast correction, image normalization, and noise reduction. These procedures aid in raising the caliber and uniformity of the input photos.
Extraction of Relevant Features: Analysis involves the extraction of pertinent features from skin pictures. It is possible to use a variety of methods, such as local binary patterns (LBP) or Haralick features to extract texture characteristics, color histograms or color channel statistics to extract color features, and boundary or geometric measurements to obtain form data. These characteristics offer important information for further classification or diagnosis.

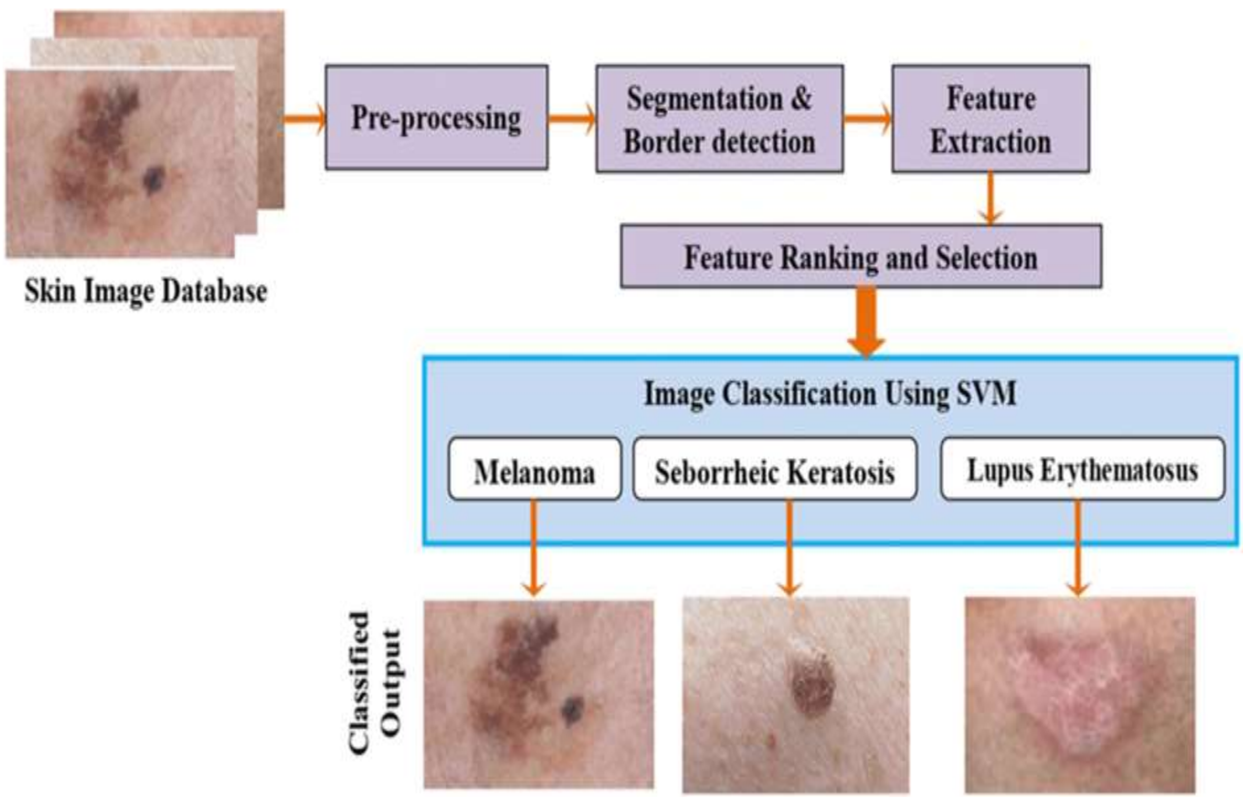
An annotated and labeled dataset must be used for the training and evaluation of supervised learning algorithms. Dermatologists or other medical professionals frequently annotate the photos by highlighting key areas or adding labels that describe the particular skin condition or disease that is present. Data annotation makes sure that the algorithms only use precisely labeled data to learn.
Algorithm Training and Validation: The annotated dataset is used to train machine learning or deep learning algorithms. A training set and a validation set are created from the dataset, and the algorithm is trained on the training set while being evaluated on the validation set. The performance of the algorithm is assessed and fine-tuned using a variety of metrics, including accuracy, precision, recall, and F1-score.

Cross-Validation and Evaluation: To evaluate the robustness and generalizability of a method, cross-validation techniques like k-fold cross-validation are frequently utilized. The dataset is split up into several subsets, and various combinations of the subsets are used to train and validate the algorithm repeatedly. By doing so, overfitting problems are reduced and the algorithm's performance on unknown data is estimated.
Comparative Analysis: Comparative analysis is carried out to assess the effectiveness of the created skin disease detection solution. This entails contrasting the algorithm's findings with dermatologists' or other diagnostic techniques' conclusions. The performance of the algorithm is evaluated using metrics like sensitivity, specificity, and accuracy, and its results are contrasted with those of human experts.

Clinical Validation and Feedback: The produced solution may occasionally go through clinical validation, which involves testing it in a real-world clinical environment. Dermatologists or other healthcare specialists assess the system's efficacy, usefulness, and practicality in diagnosing skin conditions and offer input.
Continuous analysis and inquiry are carried out throughout the project to increase the solution's precision, solve any shortcomings, and make sure it satisfies the needs for accurate and effective skin disease identification.

5. FLOW CHART


Capture the Skin images
Deep Learning Algorithm
Video Feed/Image
Prediction


Pre-processing
Segmentation & Border detection
Feature Extraction
Feature Ranking and Selection
Skin Image Database
Image Classification Using SVM
Melanoma
Seborrheic Keratosis
Lupus Erythematosus
Classified Output

6. RESULT

```
Epoch 19/30
126/126 [==============================] - 108s 862ms/step - loss: 0.5560 - accuracy: 0.8546 - val_loss: 0.5416 - val_accu
Epoch 20/30
126/126 [==============================] - 109s 863ms/step - loss: 0.5135 - accuracy: 0.8676 - val_loss: 0.4358 - val_accuracy: 0.8748
Epoch 21/30
126/126 [==============================] - 107s 849ms/step - loss: 0.4825 - accuracy: 0.8691 - val_loss: 0.3794 - val_accuracy: 0.9163
Epoch 22/30
126/126 [==============================] - 108s 860ms/step - loss: 0.4724 - accuracy: 0.8813 - val_loss: 0.4180 - val_accuracy: 0.9025
Epoch 23/30
126/126 [==============================] - 114s 910ms/step - loss: 0.4554 - accuracy: 0.8788 - val_loss: 0.3852 - val_accuracy: 0.9093
Epoch 24/30
126/126 [==============================] - 109s 864ms/step - loss: 0.4460 - accuracy: 0.8753 - val_loss: 0.3537 - val_accuracy: 0.9128
Epoch 25/30
126/126 [==============================] - 108s 862ms/step - loss: 0.4034 - accuracy: 0.8986 - val_loss: 0.3858 - val_accuracy: 0.9093
Epoch 26/30
126/126 [==============================] - 108s 858ms/step - loss: 0.4000 - accuracy: 0.8946 - val_loss: 0.3820 - val_accuracy: 0.8981
Epoch 27/30
126/126 [==============================] - 109s 866ms/step - loss: 0.3896 - accuracy: 0.9008 - val_loss: 0.3014 - val_accuracy: 0.9290
Epoch 28/30
126/126 [==============================] - 114s 911ms/step - loss: 0.3586 - accuracy: 0.9058 - val_loss: 0.3479 - val_accuracy: 0.9100
Epoch 29/30
126/126 [==============================] - 114s 909ms/step - loss: 0.4235 - accuracy: 0.8813 - val_loss: 0.3389 - val_accuracy: 0.9105
Epoch 30/30
126/126 [==============================] - 109s 869ms/step - loss: 0.3691 - accuracy: 0.9045 - val_loss: 0.3276 - val_accuracy: 0.9180
<keras.callbacks.History at 0x7f94f331fc40>
```

Accuracy after 30 epochs: 90.45%

```
img1 = image.load_img('/content/ecz.jpeg',target_size=(224,224))
img1 = image.img_to_array(img1)
img1 = np.expand_dims(img1,axis=0)
pred1 = np.argmax(model.predict(img1))
output = ['Acne and Rosacea Photos','Actinic Keratosis Basal Cell Carcinoma and other Malignant Lesions','Atopic Dermatitis Photos',
          'Bullous Disease Photos','Cellulitis Impetigo and other Bacterial Infections','Eczema Photos','Exanthems and Drug Eruptions',
          'Hair Loss Photos Alopecia and other Hair Diseases','Herpes HPV and other STDs Photos','Light Diseases and Disorders of Pigmentation',
          'Lupus and other Connective Tissue diseases','Melanoma Skin Cancer Nevi and Moles','Nail Fungus and other Nail Disease',
          'Poison Ivy Photos and other Contact Dermatitis','Psoriasis pictures Lichen Planus and related diseases',
          'Scabies Lyme Disease and other Infestations and Bites','Seborrheic Keratoses and other Benign Tumors','Systemic Disease',
          'Tinea Ringworm Candidiasis and other Fungal Infections','Urticaria Hives','Vascular Tumors','Vasculitis Photos','Warts Molluscum and other
print(output[pred1])

1/1 [==============================] - 1s 681ms/step
Eczema Photos
```

Predicted disease: Eczema

```
img2 = image.load_img('/content/ak.jpeg',target_size=(224,224))
img2 = image.img_to_array(img2)
img2 = np.expand_dims(img2,axis=0)
pred2 = np.argmax(model.predict(img2))
output = ['Acne and Rosacea Photos','Actinic Keratosis Basal Cell Carcinoma and other Malignant Lesions','Atopic Dermatitis Photos',
          'Bullous Disease Photos','Cellulitis Impetigo and other Bacterial Infections','Eczema Photos','Exanthems and Drug Eruptions',
          'Hair Loss Photos Alopecia and other Hair Diseases','Herpes HPV and other STDs Photos','Light Diseases and Disorders of Pigmentation',
          'Lupus and other Connective Tissue diseases','Melanoma Skin Cancer Nevi and Moles','Nail Fungus and other Nail Disease',
          'Poison Ivy Photos and other Contact Dermatitis','Psoriasis pictures Lichen Planus and related diseases',
          'Scabies Lyme Disease and other Infestations and Bites','Seborrheic Keratoses and other Benign Tumors','Systemic Disease',
          'Tinea Ringworm Candidiasis and other Fungal Infections','Urticaria Hives','Vascular Tumors','Vasculitis Photos','Warts Molluscum and other
print(output[pred2])

1/1 [==============================] - 1s 517ms/step
Actinic Keratosis Basal Cell Carcinoma and other Malignant Lesions
```

Predicted Disease: Actinic Keratosis Basal Cell Carcinoma and other Malignant Lesions

7. ADVANTAGES AND DISADVANTAGES

Advantages

The above skin disease prediction model offers several advantages:

- **Accurate predictions**: By training the model on a large dataset of skin disease cases, the model can learn patterns and features that are indicative of different skin diseases. This can result in accurate predictions when presented with new, unseen cases.

- **Early detection**: The model can potentially aid in the early detection of skin diseases. By analyzing symptoms or images, it can identify potential diseases at an early stage, allowing for prompt medical intervention and treatment.

- **Objective assessment**: The model provides an objective assessment of skin diseases based on input data. It can eliminate potential biases or subjective interpretations that can occur in manual assessments, leading to more reliable predictions.

- **Efficiency and scalability**: Once trained and deployed, the model can quickly analyze new cases, making it an efficient tool for dermatologists and healthcare professionals. Additionally, the model can be easily scaled to handle a large volume of cases, providing support in situations where human resources may be limited.

- **Accessible healthcare**: By deploying the model in a user-friendly interface or application, it can be accessible to a wider audience. Patients can use the model to obtain initial assessments and recommendations, potentially reducing the need for immediate in-person consultations and improving access to healthcare.

- **Continuous learning**: The model can be continually improved by incorporating new data and updates. As more cases and diagnoses become available, the model can be retrained to enhance its accuracy and broaden its knowledge base.

- **Potential support for healthcare professionals**: The model can act as a complementary tool for dermatologists and healthcare professionals, providing them with additional insights and support in their decision-making process. It can assist in triage, preliminary diagnosis, or treatment recommendation, potentially improving overall patient care.

It's important to note that the model's advantages may depend on various factors, including the quality and diversity of the training data, the performance of the underlying algorithms, and the overall implementation and integration of the model into the healthcare system. Regular monitoring, evaluation, and validation are essential to ensure the model's effectiveness and safety

Disadvantages

The skin disease prediction model described above has a number of benefits, but it also could have some drawbacks:

- **Training data limitations**: The training data's quality, variety, and representativeness have a significant impact on the model's performance. The model may demonstrate poor accuracy or fail to generalize adequately to new instances if the training dataset is inadequate, biased, or lacking key skin disease cases.

Predictions are **uncertain** since skin conditions can range in complexity and require additional testing or professional consulting for a proper diagnosis. The projections of the model could not always fully reflect the intricacy of a skin disease, which could result in false positives or false negatives.

- **Insufficient contextual awareness**: The model mainly uses patterns and characteristics taken from the input data. It could not completely comprehend the patient's situation, medical history, or unique circumstances, which might be important for an appropriate diagnosis and course of therapy.

Like with any predictive model, there is a chance that data could be misclassified or misinterpreted, which can provide inaccurate predictions or recommendations. The output of the model should be viewed as a tool for early evaluation rather than a final diagnosis, and it is crucial that users are aware of this.

- **Fairness and bias in data**: If the training data used to create the model is unfair, such as bias based on particular demographics or geographic areas, the model may show unfairness and discrepancies in its predictions. This can result in unequal access to healthcare or misdiagnosis for certain groups.
- **Skin disease** data frequently contain sensitive and personal information, raising privacy and security concerns. To maintain patient confidentiality, it is essential to take strong privacy and security precautions while collecting, keeping, and processing this type of data.
- **Dependence on technology**: The efficiency of the model depends on the functionality of the underlying technology, which includes infrastructure, software, and hardware. The performance and availability of the model may be impacted by technical issues, software flaws, or resource constraints.
- **Lack of human interaction**: The model might not have the compassion and empathy that medical personnel can offer. It should be used in conjunction with clinical judgment and knowledge, not as a replacement for them.

8. APPLICATIONS

Dermatology and healthcare fields may benefit from AI-based localization and classification of skin conditions marked by erythema. Here are a few examples of possible uses:

- **Support for dermatology diagnosis**: AI algorithms can help dermatologists identify and categorize erythematous skin conditions such as psoriasis, eczema, rosacea, and other dermatitis. AI can offer additional insights, identify potential diagnoses, and help with treatment planning by examining photos or patient data.
- **Telemedicine and Remote Consultations**: Telemedicine platforms can incorporate localization and classification methods for skin diseases powered by AI. Smartphones or other devices can be used by patients to take pictures of their skin issues, which the AI system can then analyze remotely. After reviewing the AI-generated data, dermatologists can offer suggestions or treatment strategies without requiring an in-person visit.
- **Skin Cancer Detection:** Erythema is a common symptom of melanoma and other types of skin cancer. By examining skin imaging data, AI systems can assist in locating and recognizing probable malignant tumors. AI can help dermatologists identify worrisome spots early, enabling prompt action and better patient results.
- **Personalised Treatment Plans:** AI algorithms can examine big datasets of erythematous skin disease cases and find patterns and correlations between symptoms, disease development, and treatment outcomes. Using this data, personalized treatment plans based on a patient's unique condition can be created, taking into account things like the degree of erythema and the efficacy of various medicines.
- **Public Health Monitoring:** AI algorithms can identify and monitor the spread of infectious skin disorders that show erythema by analyzing anonymized data from numerous sources, including medical records, social media, and online health forums. To efficiently manage outbreaks, this information can be used for early warning systems, public health interventions, and resource allocation.
- **Education and Training:** AI-based systems can be used as training resources for healthcare workers, residents, and medical students. These technologies can improve diagnostic abilities, simplify case-based discussions, and boost learning by accurately localizing and classifying skin conditions that cause erythema.

It is important to remember that, despite the fact that AI algorithms can be helpful assistance and aid in decision-making, they shouldn't take the place of the knowledge and clinical judgment of qualified healthcare professionals. Before deciding on a final diagnosis or course of therapy, dermatologists should always check and confirm AI-generated data.

9. CONCLUSION

The use of AI-based localization and classification of skin conditions characterized by erythema offers tremendous promise for the future of dermatology and healthcare. AI can help dermatologists more successfully diagnose and treat a variety of skin diseases by utilizing cutting-edge algorithms and image analysis techniques. Such a project offers advantages including better education and training possibilities, personalized treatment plans, improved diagnosis accuracy, and remote consultations. It is vital to understand that AI should be utilized in conjunction with medical practitioners rather than as a replacement for them. In order to guarantee the greatest level of patient care, dermatologists should always verify and authenticate AI-generated outcomes.

With more study and development, AI-based solutions may help progress dermatological treatment, improving results for people with erythematous skin conditions.

10. FUTURE SCOPE

The future scope of AI-based localization and classification of skin diseases with erythema presents promising opportunities for further development and advancements. These areas include enhanced accuracy and performance, integration of multi-modal data sources, real-time monitoring and tracking, expansion to other dermatological conditions, and incorporation of deep learning techniques. AI algorithms can improve sensitivity and specificity, reduce false positives and false negatives, and generate more accurate predictions and personalized treatment recommendations. Wearable devices, such as smartwatches and sensors, can enable real-time monitoring and tracking of skin conditions, facilitating early detection and prompt intervention. AI-based systems can be extended to encompass a broader range of dermatological conditions by training algorithms on larger datasets.

Deep learning techniques, such as convolutional neural networks, can enhance the accuracy and efficiency of AI systems in analyzing and interpreting images of skin diseases with erythema. Collaboration and data sharing among researchers, clinicians, and AI experts can facilitate the sharing of annotated datasets, methodologies, and best practices, fostering the development of standardized datasets and benchmarking metrics. Regulatory and ethical considerations are essential as AI-based systems become more integrated into healthcare. Overall, the future scope of AI-based localization and classification of skin diseases with erythema is vast, with opportunities for improved accuracy, expanding applications, and integrating advanced technologies

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8. AI-based localization and classification of skin disease with erythema. H. Son, Wooho Jeon

Source Code for the Application Building:

main.py

```
from flask import Flask, render_template, request
from tensorflow.keras.models import load_model
import numpy as np
from tensorflow.keras.preprocessing.image import load_img
from tensorflow.keras.applications.vgg16 import preprocess_input
import os
from tensorflow.keras.preprocessing import image

app = Flask(__name__)
model = load_model('skindiseases.h5')
target_img = os.path.join(os.getcwd(), 'static/images')


@app.route('/')
def index_view():
    return render_template('index.html')

ALLOWED_EXT = set(['jpg', 'jpeg', 'png'])

def allowed_file(filename):
    return '.' in filename and \
        filename.rsplit('.', 1)[1] in ALLOWED_EXT

def read_image(filename):
    img = load_img(filename, target_size=(224, 224))
    x = image.img_to_array(img)
    x = np.expand_dims(x, axis=0)
    x = preprocess_input(x)
    return x
```

```
@app.route('/predict', methods=['GET', 'POST'])
def predict():
    if request.method == 'POST':
        file = request.files['file']
        if file and allowed_file(file.filename):
            filename = file.filename
            file_path = os.path.join('static/images', filename)
            file.save(file_path)
            img = read_image(file_path)
            class_prediction = model.predict(img)
            classes_x = np.argmax(class_prediction, axis=1)
            if classes_x == 0:
                disease = 'Acne and Rosacea Photos'
            elif classes_x == 1:
                disease = 'Actinic Keratosis Basal Cell Carcinoma and other
Malignant Lesions'
            elif classes_x == 2:
                disease = 'Atopic Dermatitis Photos'
            elif classes_x == 3:
                disease = 'Bullous Disease Photos'
            elif classes_x == 4:
                disease = 'Cellulitis Impetigo and other Bacterial
Infections'
            elif classes_x == 5:
                disease = 'Eczema Photos'
            elif classes_x == 6:
                disease = 'Exanthems and Drug Eruptions'
            elif classes_x == 7:
                disease = 'Hair Loss Photos Alopecia and other Hair Diseases'
            elif classes_x == 8:
                disease = 'Herpes HPV and other STDs Photos'
            elif classes_x == 9:
                disease = 'Light Diseases and Disorders of Pigmentation'
            elif classes_x == 10:
                disease = 'Lupus and other Connective Tissue diseases'
            elif classes_x == 11:
                disease = 'Melanoma Skin Cancer Nevi and Moles'
            elif classes_x == 12:
                disease = 'Nail Fungus and other Nail Disease'
            elif classes_x == 13:
                disease = 'Poison Ivy Photos and other Contact Dermatitis'
            elif classes_x == 14:
                disease = 'Psoriasis pictures Lichen Planus and related
diseases'
            elif classes_x == 15:
                disease = 'Scabies Lyme Disease and other Infestations and
Bites'
            elif classes_x == 16:
                disease = 'Seborrheic Keratoses and other Benign Tumors'
            elif classes_x == 17:
                disease = 'Systemic Disease'
            elif classes_x == 18:
                disease = 'Tinea Ringworm Candidiasis and other Fungal
Infections'
            elif classes_x == 19:
```

```
                disease = 'Urticaria Hives'
            elif classes_x == 20:
                disease = 'Vascular Tumors'
            elif classes_x == 21:
                disease = 'Vasculitis Photos'
            elif classes_x == 22:
                disease = 'Warts Molluscum and other Viral Infections'
            else:
                disease = 'Unknown Disease'
            return render_template('predict.html', disease=disease,
prob=class_prediction, user_image=file_path)
        else:
            return "Unable to read the file. Please check file extension"


if __name__ == '__main__':
    app.run(debug=True, use_reloader=False, port=8000)
```

index.html:

```
<html>
<head>
 <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">
 <title>Skin Disease Prediction</title>
</head>
<body>
  <div class="container">
  <div class="row">
    <div class="col-lg-12">
      <center><h1 style="padding:30px;font-weight: 600 !important;font-size:
3.2em">SKIN DISEASE PREDICTION</h1></center>
    </div>
    <div>
    <div class="col-lg-12">
      <center><form  class="form-inline" action = "/predict" method = "post"
enctype="multipart/form-data">
          <input type="file" name="file"/><br>
          <input type = "submit" class="btn btn-success" value="Predict">
      </form></center>
    </div>
    </div>
</body>
</html>
```

predict.html:

```
<!DOCTYPE html>
<html>
<head>
    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1,
shrink-to-fit=no">
    <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">
    <title>Skin Disease Prediction</title>
</head>
<body>
  <div class="container">
    <div class="col-lg-12">
      <center><h1 style="padding:30px;font-weight: 600 !important;font-size:
3.2em">SKIN DISEASE PREDICTION</h1></center>
    </div>
   <div class="col-lg-12">
      <center><form  class="form-inline" action = "/predict" method = "post"
enctype="multipart/form-data">
          <input type="file" name="file"/><br>
          <input type = "submit" class="btn btn-success" value="Predict">
      </form></center>
    </div>
    <div class="col-lg-5" style="padding-top:30px">
      <span class="border border-primary">
        <img src="{{ user_image }}" alt="User Image" class="img-thumbnail"
style="width:250px;height:250px;float:right">
      </span>
    </div>
    <div class="col-lg-5" style="padding-top:30px">
      <h4>Skin Disease is <mark style="background-
color:#04aa6d;color:white;border-radius:5px">{{disease}}</mark></h4>
    </div>
  </div>
</div>
</body>
</html>
```