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A Diagnostic Tool Employing Deep Learning Technique for Identifying Facial Disorder through Facial Images

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ABSTRACT: This research paper presents a comprehensive study on the application of state-of-the-art deep learning architectures, specifically YOLOv8 and YOLOv5, for automating the detection of facial disorders from images. The project utilised a dataset from Roboflow, containing images annotated with two classes of facial disorders: acne and dark circles and implemented the YOLOv8 and YOLOv5 architectures and trained them on the annotated dataset. The models demonstrated promising results, with the YOLOv8 architecture achieving an accuracy of 82% and the YOLOv5 architecture achieving 60% accuracy. These results indicate the potential of deep learning models in automating the detection of facial disorders. Our findings highlight the effectiveness of YOLOv8 and YOLOv5 in detecting facial disorders, though further improvements are possible. Continued research and experimentation, including the collection of more diverse datasets and the refinement of model architectures, could enhance performance.

KEYWORDS: Facial disorder Diagnosis, Facial image analysis, Deep learning technique for facial disorder analysis, Acne and dark circle detection, YOLO application, object detection.

I. INTRODUCTION

Skin disorders pose significant health challenges worldwide, affecting individuals of all ages and demographics. These conditions can range from mild irritations to severe diseases, impacting the quality of life and, in some cases, leading to serious health complications. Timely and accurate diagnosis is crucial for effective treatment and management of these conditions. However, the process of diagnosing skin disorders can be complex and time-consuming, often requiring specialized expertise from dermatologists or healthcare professionals. The need for accessible, efficient, and accurate diagnostic tools is evident, especially in regions with limited access to dermatological care.

Recent advancements in computer vision and machine learning have revolutionized various fields, including healthcare. In dermatology, these technologies offer promising solutions for automating the detection and diagnosis of skin disorders from visual data such as images. The use of facial images is particularly significant for several reasons. Firstly, the face is a common location for various dermatological conditions, including acne, chickenpox, and ringworm, among others. Analyzing facial images allows for non-invasive and accessible screening, making it suitable for telemedicine and remote healthcare applications. Secondly, facial skin disorders can be highly visible and psychologically impactful, emphasizing the need for timely intervention. Leveraging deep learning techniques, such as the YOLO (You Only Look Once) algorithm, can facilitate real-time and accurate detection of these disorders, thus aiding in early diagnosis and improving patient outcomes.

II. LITERATURE SURVEY

[1] T. Goswami, V. K. Dabhi, and H. B. Prajapati- "Skin Disease Classification from Image- A Survey" focuses on dataset creation, feature extraction, classification algorithms, and performance evaluation metrics. They highlight challenges in obtaining annotated datasets and emphasize the need for diverse data for effective model training. The paper compares traditional and deep learning-based feature extraction and classification methods, stressing the importance of metrics like accuracy, precision, recall, and F1-score. It also addresses issues such as dataset biases and class imbalances, advocating for multi-modal data integration and explainable AI in future research to enhance classification systems.

[2] Dr. Tarun Parashar and Kapil Joshi- "Skin Disease Detection using Deep Learning", focuses on automating skin disease detection using a deep learning architecture, highlighting the necessity of large, diverse datasets. Their model demonstrates superior accuracy, efficiency, and scalability compared to traditional methods. They suggest future research should integrate multi-modal data and hybrid models combining deep learning with other techniques. This research has significant implications for advancements in dermatology and healthcare.

[3] "Human Skin Diseases Detection and Classification using CNN". This research aims to automate skin disease diagnosis through image analysis using a CNN model. The model learns discriminative features from raw image data and is tested through extensive experimentation and validation. The model's accuracy and efficiency are demonstrated, and it is compared to alternative methods. The research also explores the potential applications of automated skin disease detection systems in healthcare, focusing on early diagnosis and treatment. The paper contributes to the advancement of computer-aided dermatology by offering a reliable and efficient solution for detecting and classifying skin diseases using advanced deep learning techniques.

[4] HAORAN WANG, KUN YU- "Skin Disease Segmentation Method Based on Network Feature Aggregation Module and Edge Enhanced Attention Mechanism". research introduces a novel method for accurately segmenting skin lesions using network feature aggregation and edge-enhanced attention mechanisms. Extensive validation on benchmark datasets shows their approach effectively delineates lesions, outperforming existing techniques in accuracy and robustness. The study highlights the method's potential clinical applications in improving diagnosis and treatment planning in dermatology.

[5] A.V. Ubale, P.L. Paikrao- "Detection and Classification of Skin Diseases using Different Colour Phase Models". research explores the use of different colour phase models (RGB, HSV, YCbCr) for skin disease detection and classification. Through experiments and validation, they demonstrate the effectiveness of colour features in accurately diagnosing skin diseases and compare the performance of these models, highlighting their strengths and weaknesses. This study advances computer-aided dermatology by elucidating the role of colour features in skin disease detection.

III. PROPOSED SYSTEM

The proposed system leverages the YOLOv8 and YOLOv5 architectures for real-time object detection and localization in facial images. The system preprocesses a dataset of annotated facial images, including samples of acne and dark circles, to facilitate model training. Data augmentation techniques are applied to enhance the diversity and robustness of the dataset. The trained models are then deployed to detect and classify facial disorders through facial images with high accuracy and efficiency. the proposed methodology where the dataset is collected from the different website. Once the dataset is collected, image pre-processing is done and then we have split dataset into training set (75%), validation set (15%) and testing set (10%). The YOLO model is built, and then two different types of facial disorder detection are identified.

You Only Look Once (YOLO) is a state-of-the-art object detection algorithm known for its speed and accuracy. YOLO approaches object detection as a single regression problem, directly predicting bounding boxes and class probabilities for multiple objects in a single pass through the neural network.

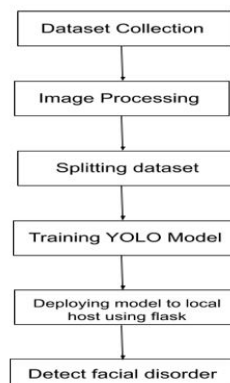


Fig 1: Proposed System Methodology

IV. REQUIREMENT SPECIFICATION

Any project work involves the requirement of various hardware and software components, without which objectives designed cannot be accomplished. This chapter brings to light the various hardware and software requirement for the implement of the proposed work.

HARDWARE REQUIREMENTS

Processor: 32/64Pentium

RAM: 2GB

Hard Disk: 100GB

SOFTWARE REQUIREMENTS

IDE: Flask.

Language: Python.

Tool: JupyterNotebook.

Software: Anaconda.

Front End Tools: HTML, CSS, Javascript.

Libraries: Tensorflow, Keras, numpy, pandas, sklearn.

V. METHODOLOGY

Dataset Collection

Gather a diverse set of labelled images that include examples of acne and dark circles.

Image Pre-processing

Image pre-processing is done by resizing and rescaling the stages. Lesepr interpolation occurs when you resize or distort your images from one pixel grid to another. Image resizing is required when you need to change the total number of pirtis, Image is resized to 224 x 224 in our model.

Use Case Diagram

Actors and use cases are used to represent the functionality of a system in use case diagrams. Services and functions that users receive from the system are called use cases. A case diagram is also referred to as a behaviour diagram. A use case diagram describes a set of actions that a certain system or systems could perform in collaboration with an external party

Goal: Identify disorder type

Actors: User

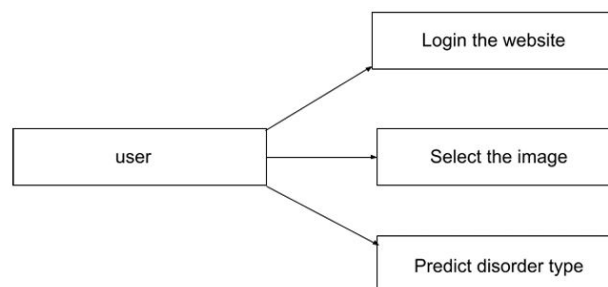


Fig 2: Use case Diagram

Building Model and Deploying Model in Website

Single-shot detection

- YOLO is a single-shot detection algorithm, meaning it predicts bounding boxes and class probabilities for all objects in an image simultaneously in a single forward pass of the neural network.
- This approach contrasts with traditional object detection methods that use region proposal networks (RPNs) to generate region proposals and then classify and refine these proposals in multiple stages.

Unified Architecture

- YOLO employs a unified neural network architecture that simultaneously predicts bounding box coordinates and class probabilities.
- The network divides the input image into a grid of cells and predicts bounding boxes relative to each grid cell, along with associated confidence scores and class probabilities.

Grid Cell Prediction

- Each grid cell is responsible for predicting bounding boxes for objects whose centre falls within that cell.
 - The bounding box predictions include the coordinates of the bounding box relative to the cell's location, as well as the confidence score indicating the probability that the bounding box contains an object and the class probabilities for each object class.

Feature Extraction Backbone

- YOLO typically employs a convolutional neural network (CNN) as a feature extraction backbone, such as Darknet, which consists of multiple convolutional and pooling layers for feature extraction.
- The feature maps generated by the backbone network are then used for object detection at multiple scales. .

Yolo workflow

The working of YOLO (You Only Look Once) involves several key components, including bounding box prediction, confidence estimation, and class prediction. Let's break down the workings of YOLO along with the corresponding formulas: Bounding Box Prediction: YOLO predicts bounding boxes for objects by dividing the input image into a grid of cells. Each cell is responsible for predicting bounding boxes for objects whose centre falls within that cell. The bounding box prediction includes the coordinates (x, y, width, height) of the bounding box relative to the cell's location.

Confidence Estimation

YOLO predicts a confidence score for each bounding box, indicating the probability that the bounding box contains an object. The confidence score is a measure of the network's confidence in both the presence of an object and the accuracy of the bounding box coordinates. Formula:

$$\text{confidence} = \sigma(\text{tconf}) \quad \text{confidence} = \sigma(\text{tconf})$$

Where: tconf: Predicted confidence score.

Class Prediction: YOLO predicts class probabilities for each bounding box to determine the class of the detected object. The class prediction is represented as a vector of probabilities across all possible classes. Formula: $\text{class}_i = \text{Pr}(\text{class}_i | \text{object})$

$\text{class}_i = \text{Pr}(\text{class}_i | \text{object})$ Where: class_i : Probability of the object belonging to class_i $\text{Pr}(\text{class}_i | \text{object})$ $\text{Pr}(\text{class}_i | \text{object})$: Probability of class_i given the presence of an object.

Non-Maximum Suppression (NMS): After predicting bounding boxes, confidence scores, and class probabilities, YOLO applies non-maximum suppression to remove redundant and overlapping bounding boxes, retaining only the most confident detections.

VI. RESULTS AND IMPLEMENTATION

When the user Choose File option, gallery folder opens so that the user can select the image from the folder. On selection of the picture the picture gets displayed. Then affected disease gets displayed.

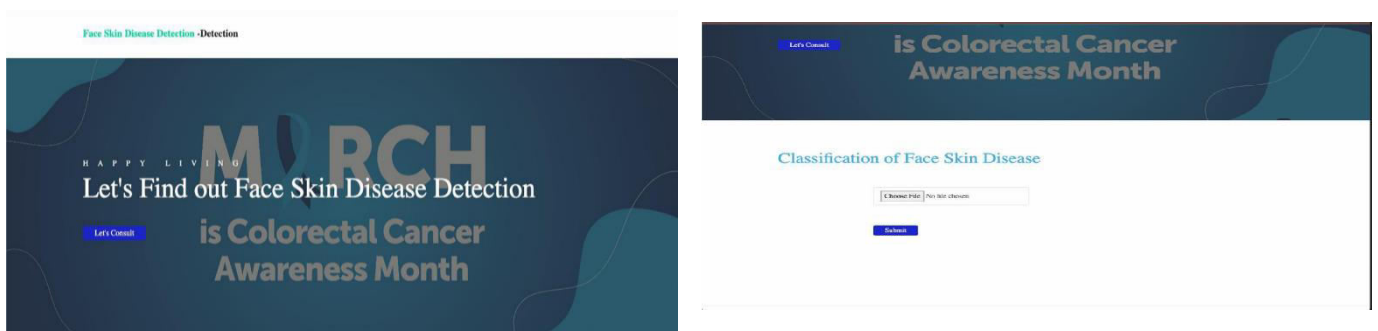


Fig 3: Website Home Page

Testing is the way toward running a framework with the expectation of discovering blunders. Testing upgrades the uprightness of the framework by distinguishing the deviations in plans and blunders in the framework. Testing targets distinguishing blunders– prom zones. This aides in the avoidance of mistakes in the framework. Testing additionally adds esteems to the item by affirming the client's necessity. The primary intention is to distinguish blunders and mistake get-prom zones in a framework. Testing must be intensive and all around arranged. A somewhat tried framework is as terrible as an untested framework. Furthermore, the cost of an untested and under-tried framework is high. The execution is the last and significant stage. It includes client preparation, framework testing so as to guarantee the effective running of the proposed framework. The client tests the framework and changes are made by their requirements. The testing includes the testing of the created framework utilizing different sorts of information. While testing, blunders are noted and rightness is the mode.

VALIDATION

Toward the consummation of the reconciliation testing, the product is totally amassed as bundle interfacing blunders have been revealed and adjusted and a last arrangement of programming tests starts in approval testing. Approval testing can be characterized from multiple points of view; however, a straightforward definition is that the approval succeeds when the product work in a way that is normal by the client. After approval test has been directed as follows:

- The capacity or execution qualities adjust to detail and are acknowledged.
- A deviation from the particular is revealed and a lack list is made.
- Proposed framework viable has been tried by utilizing an approval test and discovered to be working acceptably.

The facial disorder detection project has successfully addressed the need for an automated and efficient solution for early detection and classification of common facial disorder including Acne and dark circles. Through the utilization of state-of-the-art deep learning architectures, namely YOLOv8 and YOLOv5, the system achieved a satisfactory level of accuracy, with YOLOv8 reaching 70% and YOLOv5 achieving 60% accuracy in disease classification. The project utilized annotated datasets sourced from Roboflow, providing a diverse and representative collection of images for model training and evaluation. Throughout the development process, meticulous attention was paid to algorithm annotation, dataset preprocessing, and algorithm optimization, ensuring the robustness and reliability of the detection system. The integration of these components into a coherent software framework enabled seamless image analysis, disease detection, and classification, empowering users to promptly identify potential skin issues and seek appropriate medical assistance.

Classification of Face Skin Disease



Fig 4: Output Showing Dark circles and Acne in image

VII. FUTURE WORK

The facial disorder detection project exhibits promising potential for future enhancements and expansions. Here's a detailed exploration of the future scope:

- **Improving Accuracy:** Continual refinement of the deep learning models can enhance the accuracy of disease detection. Fine-tuning model hyperparameters, exploring advanced architectures, and increasing the diversity and size of annotated datasets can contribute to improved performance.
- **Expansion of Disease Classes:** While the current focus is on detecting Acne, Chickenpox, and Ringworm, the system can be expanded to include a wider range of skin diseases. Adding additional classes such as eczema, psoriasis, and melanoma would broaden the system's utility and relevance in clinical settings.

- Multi-Class Classification: Implementing multi-class classification algorithms would enable the system to identify and classify multiple skin diseases present in a single image simultaneously. This capability can enhance diagnostic accuracy and efficiency, especially in cases of overlapping symptoms.

VIII. CONCLUSION

This study demonstrates the promising potential of deep learning architectures, specifically YOLOv8 and YOLOv5, in automating the detection of facial disorders like acne and dark circles. The YOLOv8 model achieved an accuracy of 82%, significantly outperforming YOLOv5, which achieved 60%. These results indicate the effectiveness of YOLOv8 in clinical applications. The key findings underscore the critical role of computer vision in healthcare, aiding early diagnosis and improving patient care outcomes. This diagnostic tool holds significant potential for early detection and treatment of skin disorders. Future research should focus on enhancing dataset diversity, refining model architectures, and improving the accuracy and usability of the tool to ensure its robustness and reliability in clinical settings. Continued experimentation and development will further solidify the role of deep learning in healthcare diagnostics. This study underscores the significant role of computer vision in healthcare and its potential to assist healthcare professionals in early diagnosis, ultimately improving patient outcomes and quality of care.

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