PROJECT REPORT

Project Name: Early Diagnosis of Diseases Using Image Processing of Human Nails

Team Id: Team-592681

Team Members

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1. INTRODUCTION

1.1 Project Overview

In the healthcare domain, the early diagnosis of diseases is a crucial aspect for effective treatment. This project focuses on leveraging image processing techniques for the early detection of diseases by analyzing human nails. Many diseases manifest specific indicators in the color and shape of nails, making them a valuable source of information for healthcare professionals. By developing a model capable of interpreting these visual cues, we aim to provide a non-invasive and accessible method for disease prediction.

1.2 Purpose

The primary purpose of this project is to create a system that aids in the early diagnosis of diseases through the analysis of human nails. Traditional methods of disease identification often involve subjective visual examination, which can be limited by the human eye's sensitivity to color changes and resolution constraints. This project addresses these limitations by employing image processing techniques to detect subtle changes in the color, shape, and texture of nails that may indicate an underlying health condition.

2. LITERATURE SURVEY

2.1 Existing Problem

In the existing healthcare landscape, traditional methods of disease diagnosis often rely on visual inspection by healthcare professionals. However, this subjective approach has limitations, particularly when it comes to the early detection of diseases through the analysis of human nails. The human eye may not effectively capture subtle changes in color and shape that could serve as early indicators of various health conditions. To address these challenges, the literature survey delves into existing problems and gaps in the current methods of nail disease diagnosis.

Challenges in Traditional Diagnosis

- Subjectivity in visual inspection.
- Limited sensitivity to subtle color changes.
- Resolution constraints impacting accurate detection.
- Delayed diagnosis due to reliance on observable symptoms.

2.2 References

- Nail Disease Diagnosis: A Review of the Literature by A. Gupta, D.K. Garg, and R.K. Mahajan (2016) in the Journal of the Indian Academy of Dermatology, Venereology, and Leprosy
- Dermatologic Manifestations of Systemic Diseases: A Review by G. Singh (2011) in the Indian Journal of Dermatology, Venereology, and Leprosy
- Nail Color Analysis for Early Detection of Diseases by N. Bajpai, R. Alawadhi, A. Thakare, S. Avhad, and S. Gandhat (2015) in the International Journal of Scientific Engineering and Research
- Disease Detection Based on Nail Color Analysis Using Image Processing by P. Hardik and D.M. Shah (2013) in the 2013 International Conference on Intelligent Systems and Signal Processing
- Early Stage Disease Diagnosis System Using Human Nail Image Processing by T.S. Indi and Y.A. Gunge (2016) in the International Journal of Information Technology and Computer Science
- Nail Disease Detection Using Machine Learning by K. Nirmala and D.S. Reddy (2017) in the International Journal of Engineering and Technology

2.3 Problem Statement Definition

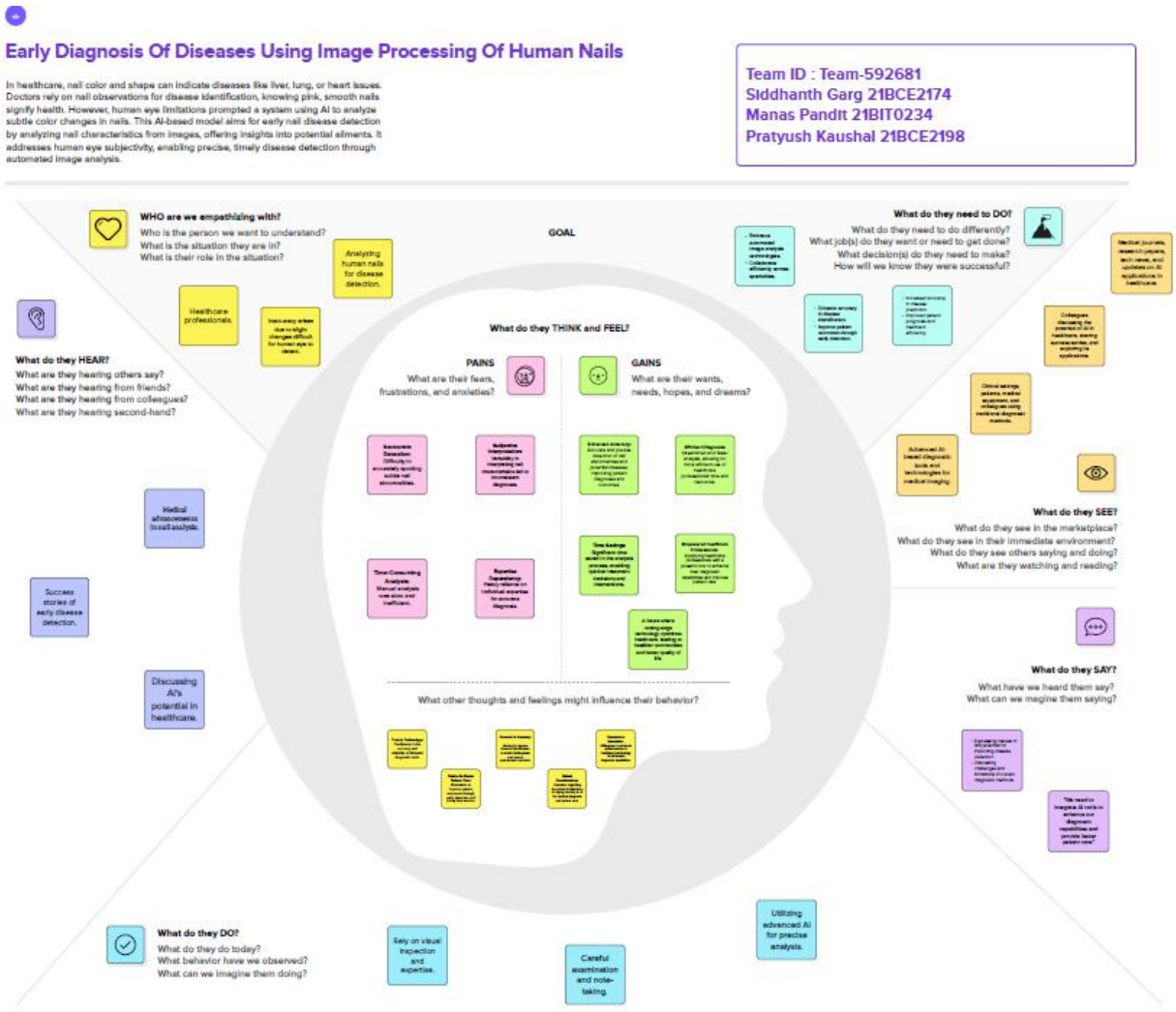
The identified challenges in traditional nail disease diagnosis form the basis for defining the problem statement of this project. The need for a more objective, automated, and early detection system becomes apparent. The problem statement is framed to address the limitations in current methodologies and proposes the development of an image processing model for accurate and timely diagnosis of nail diseases.

Problem Statement

The existing methods of nail disease diagnosis suffer from subjectivity and limited sensitivity, leading to delayed detection. This project aims to design and implement an image processing model that can analyze human nails to provide a more objective and early diagnosis of diseases. The system will overcome the drawbacks of traditional visual inspection, contributing to improved healthcare outcomes.

3. Ideation and Proposed solution

3.1 Empathy Map Canvas



3.2 Ideation and Brainstorming

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM

Develop a web application that analyse photos of human nails and identify the illnesses

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

Siddhanth

- Collect diverse nail image dataset.
- Develop CNN model for disease analysis.
- Use Transfer Learning and use Pre trained models like vgg16

Manas

- Implement image preprocessing and user-friendly web app.
- Enable real-time nail analysis and disease classification.

Pratyush

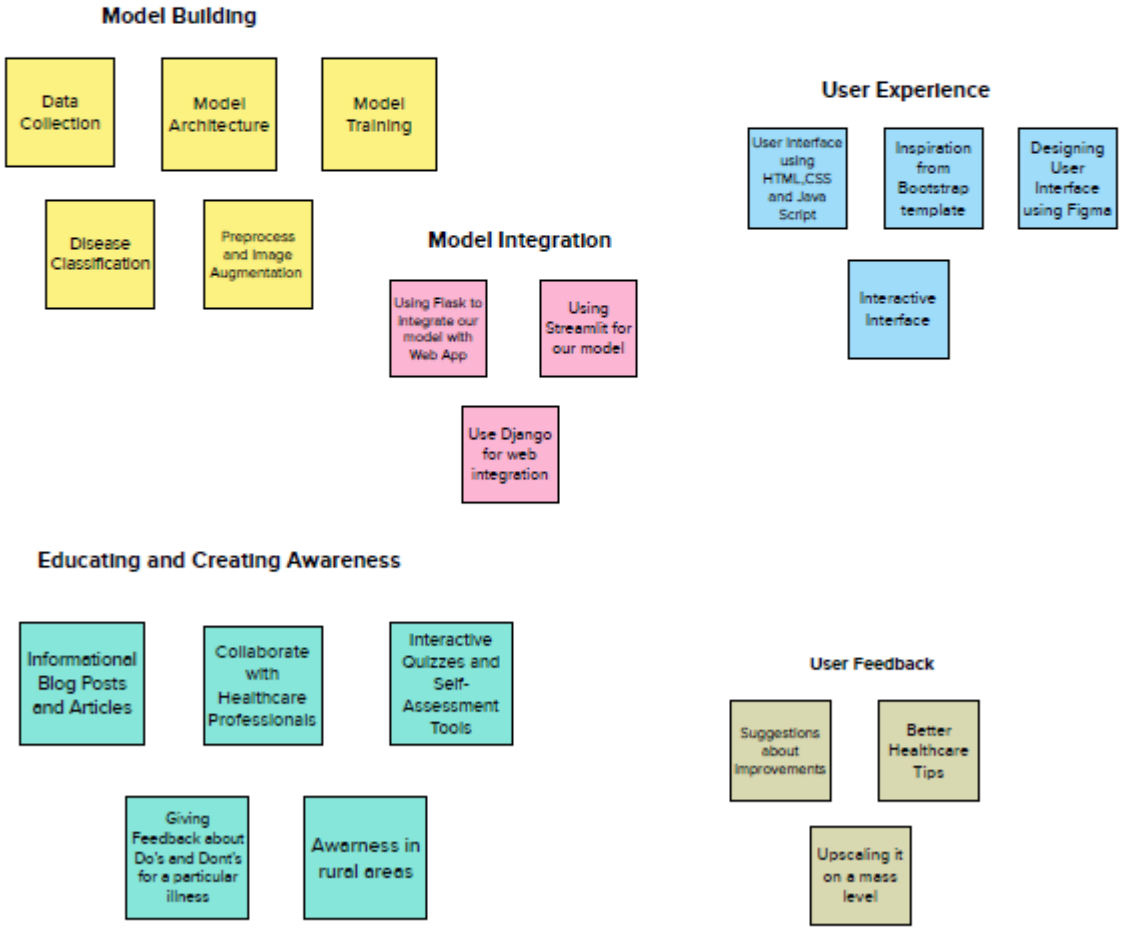
- Ensure transparency, data security, and medical collaboration.
- Educate users on symptoms indicated through nails

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

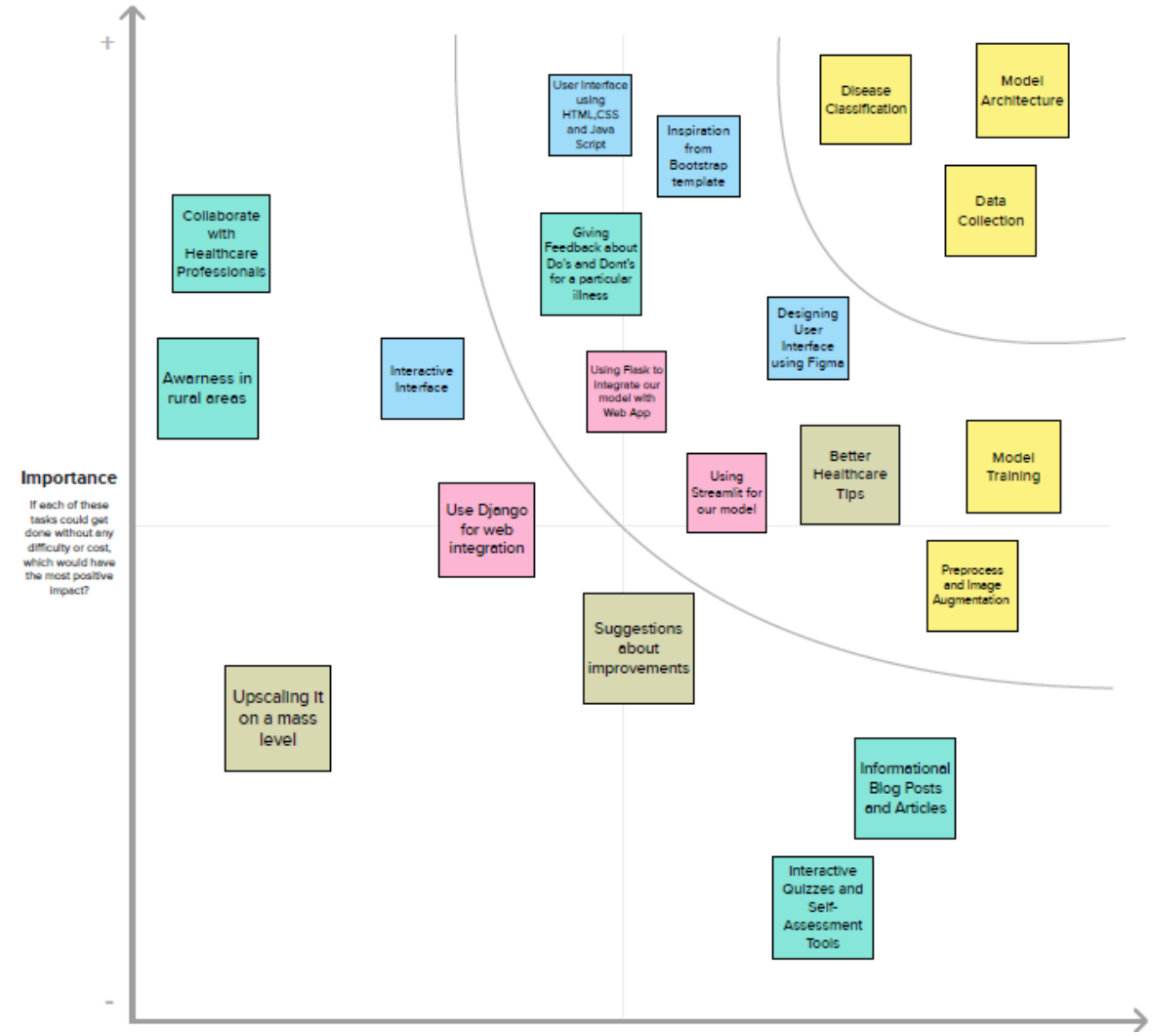


4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



4. REQUIREMENT ANALYSIS

4.1 Functional Requirements

4.1.1 Image Capture

- The system should allow users to capture images of their nails for analysis.
- Images should be clear, high-resolution, and suitable for processing.

4.1.2 Image Processing

- The system should employ image processing techniques to analyze nail characteristics.
- Analysis should include color, shape, and texture features for disease prediction.
- The model should be capable of detecting subtle changes indicative of various nail diseases.

4.1.3 Disease Classification

- The system should classify the detected nail conditions into specific diseases.
- The classification model should be trained on a diverse dataset of nail images.

4.1.4 User Interface

- The user interface should be user-friendly and intuitive.
- Users should have the ability to easily capture and submit nail images for analysis.
- The results of the analysis should be presented in a clear and understandable format.

4.1.5 Database Management

- The system should maintain a database of labeled nail images for training and testing.
- It should support efficient storage, retrieval, and management of image data.

4.2 Non-Functional Requirements

4.2.1 Performance

- The system should provide timely responses for image processing and disease prediction.

- Response times should be optimized for user experience.

4.2.2 Accuracy

- The image processing model should achieve a high level of accuracy in disease prediction.

- The classification accuracy should be continually monitored and improved.

4.2.3 Security

- User data, especially images containing sensitive health information, should be securely stored.

- Access to the system should be restricted, and user privacy should be prioritized.

4.2.4 Scalability

- The system should be scalable to accommodate a growing database of nail images.

- It should handle increased user activity without significant performance degradation.

4.2.5 Compatibility

- The system should be compatible with a variety of devices and browsers for broad accessibility.

- It should adhere to web standards to ensure compatibility across platforms.

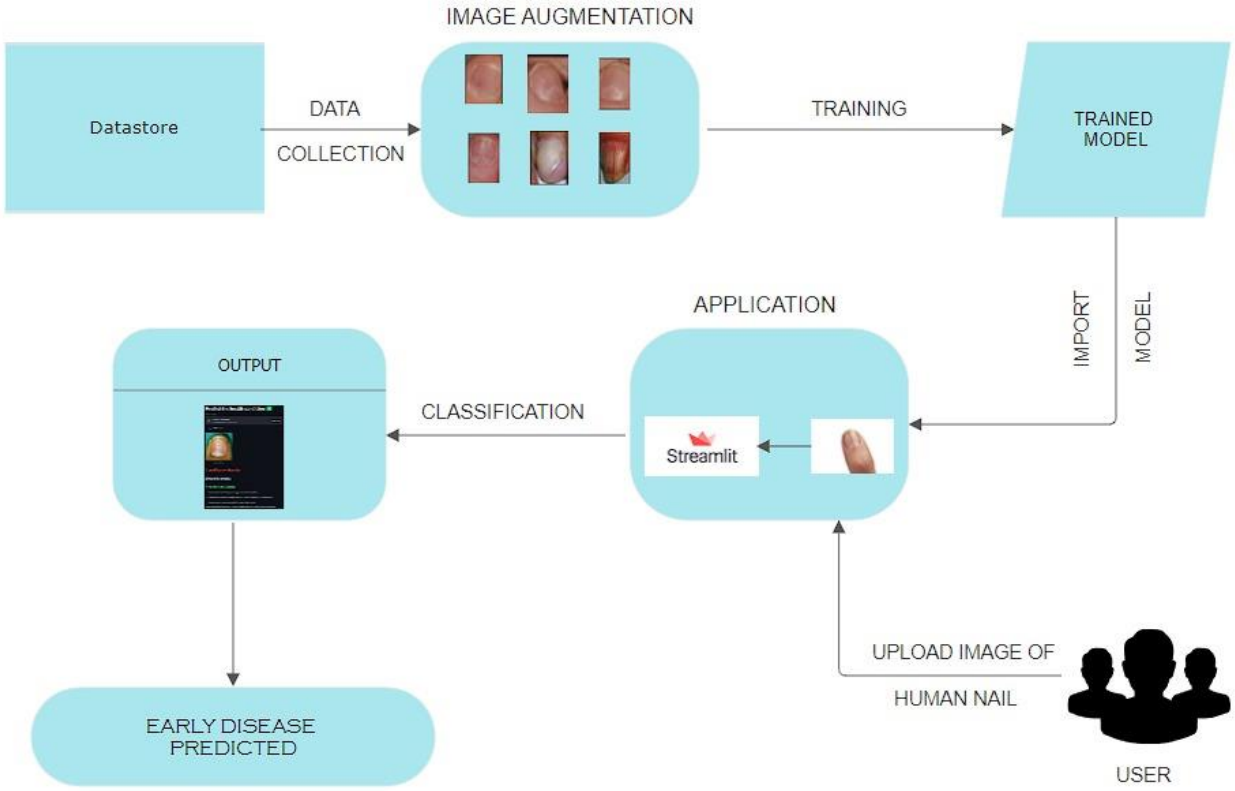
4.2.6 Usability

- The user interface should be designed for ease of use, catering to users with varying levels of technical proficiency.

- User feedback should be considered for continuous improvement.

5. Project Design

5.1 Data Flow Diagrams & User Stories



USER STORIES –

USER TYPE	Functional Requirement	User Story No.	User Story / Task	Acceptance Criteria	Priority	Release
Health Care Professionals	Data Collection and Diagnosis	USH-1	Upload Patient Nail Images	Healthcare professionals can upload nail images of patients, attaching relevant medical history and patient information.	High	Sprint 1
		USH-2	View Patient Diagnosis Results	Healthcare professionals can access diagnosis results for their patients, including disease classifications and recommended actions.	High	Sprint 1
		USH-3	Schedule Teleconsultations	Healthcare professionals can schedule teleconsultations with patients for further guidance based on diagnosis results.	Medium	Sprint 1
End Users (Patients)	User-Friendly Interface	USE-1	Upload Nail Images for Analysis	Users can easily upload nail images for analysis through a user-friendly web interface.	High	Sprint 2
		USE-2	Receive Personalized Recommendations	Users can receive personalized recommendations based on diagnosis results to manage their health effectively.	High	Sprint 2
		USE-3	View Diagnostic History	Users can view their diagnostic history and track changes over time to monitor health progress.	Medium	Sprint 2
Administrators	System Monitoring	USA-1	Monitor System Performance	Administrators can monitor system performance, user activity, and ensure smooth and secure system operations.	Medium	Sprint 2

5.2 Solution Architecture

Our system optimizes the early disease diagnosis process through CNNs for real-time image-based classification. It enhances diagnostic accuracy and improves healthcare management while empowering individuals to take control of their well-being. The architecture consists of the following key components:

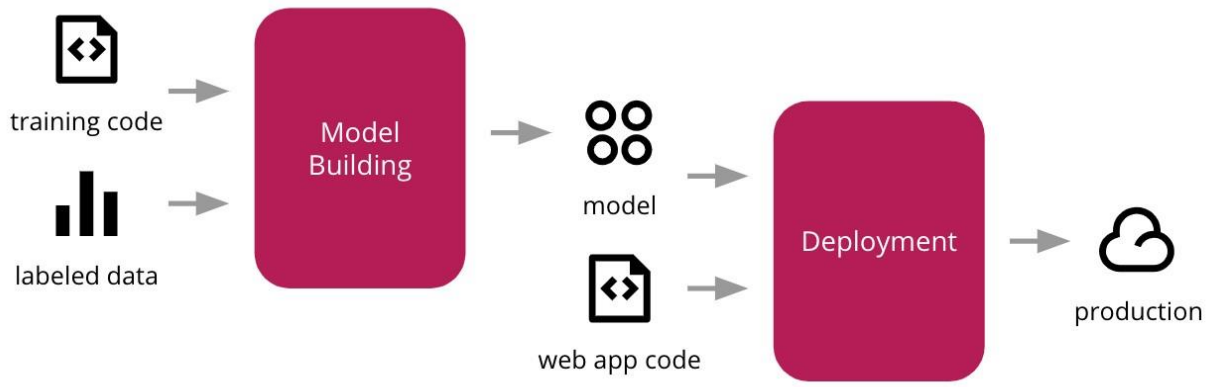
1. **Data Collection**: Provided nail images are used for analysis.

2. **Image Preprocessing**: Uploaded images undergo preprocessing to enhance quality and consistency.

3. **Model Building**: The system leverages the VGG16 model and transfer learning techniques to extract features from nail images.

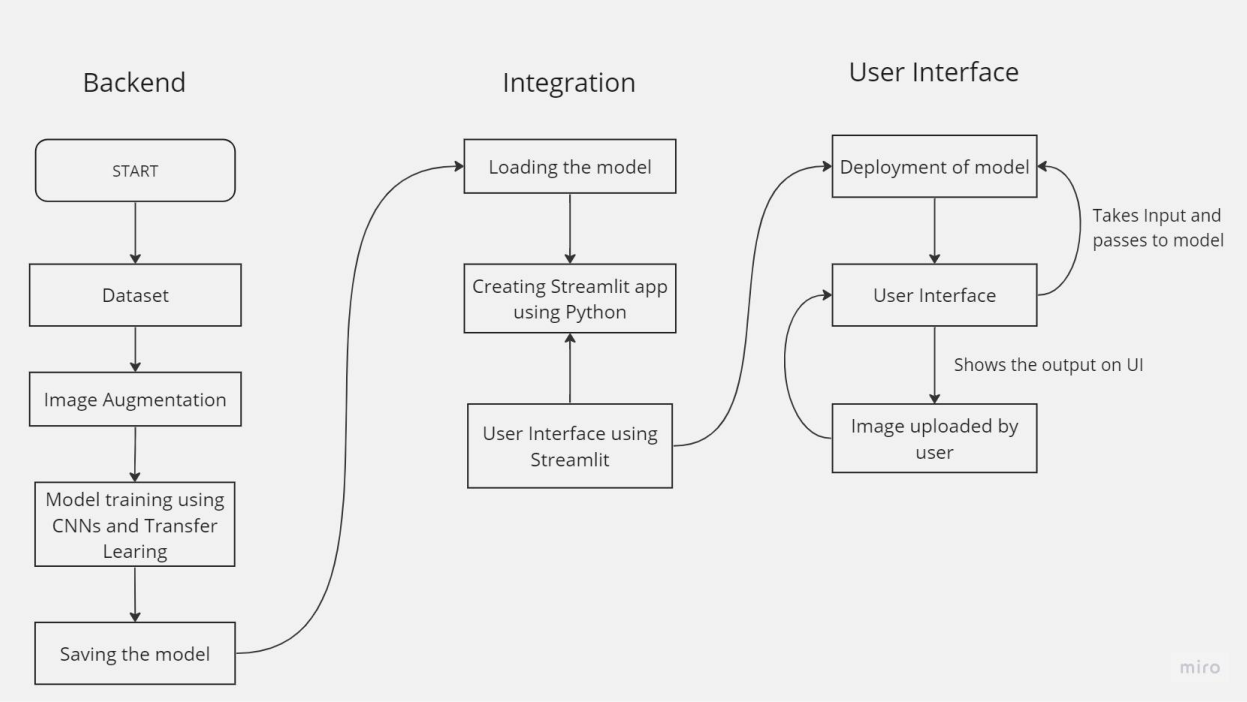
4. **Disease Classification**: Extracted features are used to classify nail images into various disease categories.

5. **Recommendations**: Based on the classification results, personalized recommendations and next steps are provided to users for proactive healthcare management.



6. Project Planning & scheduling

6.1 Technical Architecture

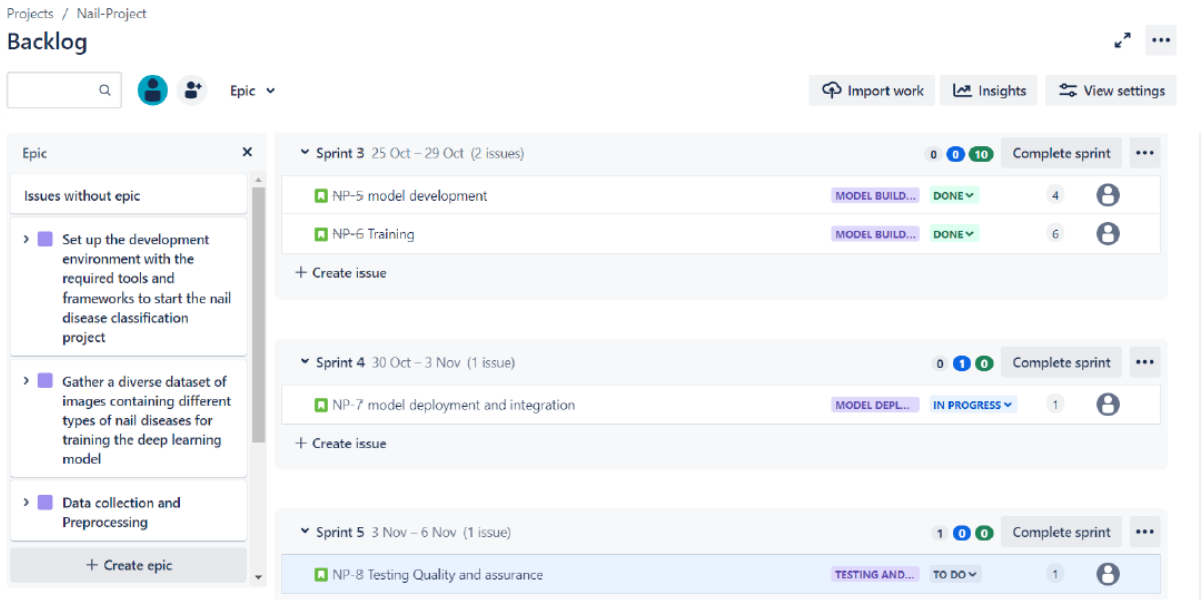


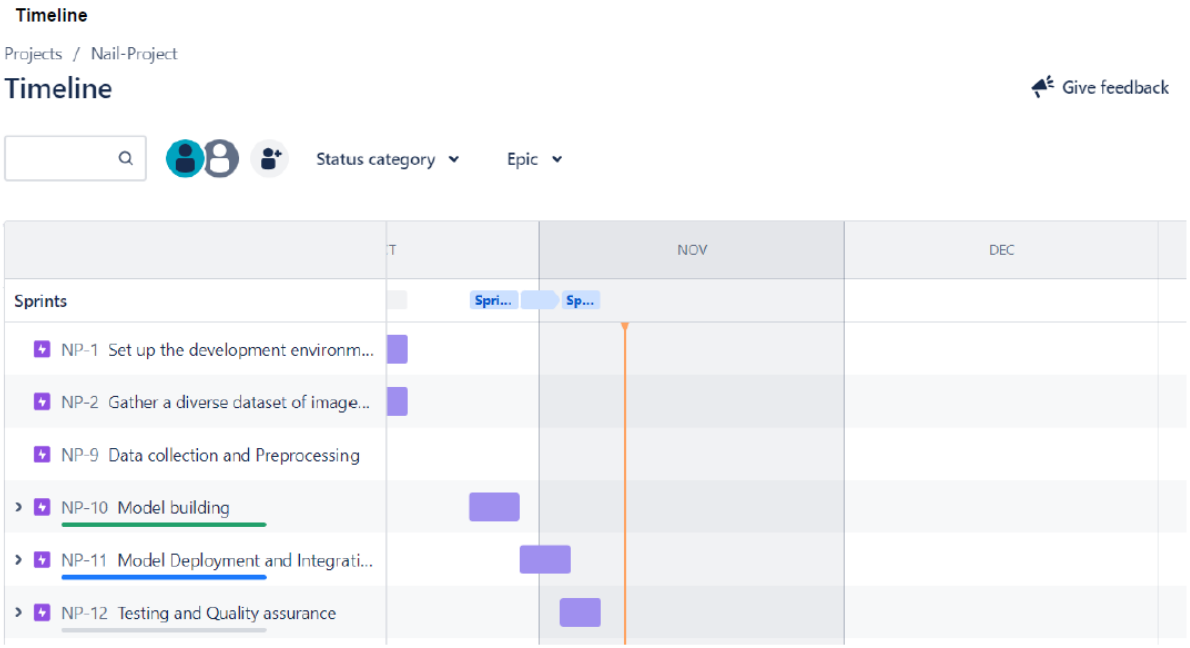
6.2 Sprint Planning & Estimation

Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	3	3 Days	16 Oct 2023	18 Oct 2023	3	18 Oct 2023
Sprint-2	5	6 Days	19 Oct 2023	24 Oct 2023	5	22 Oct 2023
Sprint-3	10	4 Days	25 Oct 2023	29 Oct 2023	10	29 Oct 2023
Sprint-4	1	5 Days	30 Oct 2023	3 Nov 2023	1	3 Nov 2023
Sprint-5	1	3 Days	4 Nov 2023	6 Nov 2023	1	6 Nov 2023

6.3 Sprint Delivery Schedule





7. CODING & SOLUTIONING

7.1 Feature 1: Image Capture and Submission

The Image Capture and Submission feature enables users to capture images of their nails using the system's interface. Once captured, users can submit the images for analysis.

```python
if uploaded_file is not None:
    # Perform image classification using your classification model
    image = Image.open(uploaded_file)
    image = image.resize((224, 224))  # Resize the image to match the input size of your model
    image = image.convert("RGB")
    # Convert the image to a NumPy array and normalize it
    image = np.array(image) / 255.0

    # Reshape the image to match the input shape expected by your model
    image = np.expand_dims(image, axis=0)

    classification_result = model.predict([image])
    result = label_dict[np.argmax(classification_result)]
    # Display the uploaded image
    st.image(image, caption="Uploaded Image", width=250)

    # Display classification result
    st.header(":red[Classification Result:]")
    st.header(result)

    # Display prevention steps
    if result in disease_info:
        st.header(":green[Prevention Steps:]")
        for step in disease_info[result]['prevention']:
            st.write(step)
    else:
        st.warning("Prevention steps information not available for this disease.")

    st.markdown("It is recommended to consult with a healthcare professional for further evaluation and diagnosis.")
```

7.2 Feature 2: Disease Classification and Results Presentation

The Disease Classification feature utilizes a trained model to classify the nail condition and presents the analysis results in an easily understandable format along with some recommended steps

```python
# Display prevention steps
if result in disease_info:
    st.header(":green[Prevention Steps:]")
    for step in disease_info[result]['prevention']:
        st.write(step)
else:
    st.warning("Prevention steps information not available for this disease.")

st.markdown("It is recommended to consult with a healthcare professional for further evaluation and diagnosis.")
```

8. PERFORMANCE TESTING

8.1 Performance Metrics

Accuracy after 100 epochs

```
Epoch 1/100
C:\Users\Siddhanth\AppData\Local\Temp\ipykernel_10036\1681972780.py:1: UserWarning: `Model.fit_generator`
l be removed in a future version. Please use `Model.fit`, which supports generators.
  model.fit_generator(train_data,steps_per_epoch=len(train_data),epochs=100)
82/82 [==============================] - 10s 77ms/step - loss: 3.5104 - accuracy: 0.1099
Epoch 2/100
82/82 [==============================] - 5s 60ms/step - loss: 2.7147 - accuracy: 0.2519
Epoch 3/100
82/82 [==============================] - 5s 60ms/step - loss: 2.3635 - accuracy: 0.3542
Epoch 4/100
82/82 [==============================] - 5s 62ms/step - loss: 2.2131 - accuracy: 0.4198
Epoch 5/100
82/82 [==============================] - 5s 61ms/step - loss: 1.8821 - accuracy: 0.4809
Epoch 6/100
82/82 [==============================] - 5s 61ms/step - loss: 1.4647 - accuracy: 0.5527
Epoch 7/100
82/82 [==============================] - 5s 65ms/step - loss: 1.3930 - accuracy: 0.5771
Epoch 8/100
82/82 [==============================] - 5s 64ms/step - loss: 1.4348 - accuracy: 0.5756
Epoch 9/100
82/82 [==============================] - 5s 60ms/step - loss: 1.1756 - accuracy: 0.6580
Epoch 10/100
82/82 [==============================] - 5s 62ms/step - loss: 1.0305 - accuracy: 0.6824
```

```
Epoch 90/100
82/82 [==============================] - 6s 68ms/step - loss: 0.4241 - accuracy: 0.8840
Epoch 91/100
82/82 [==============================] - 6s 67ms/step - loss: 0.1724 - accuracy: 0.9389
Epoch 92/100
82/82 [==============================] - 6s 70ms/step - loss: 0.1559 - accuracy: 0.9527
Epoch 93/100
82/82 [==============================] - 6s 67ms/step - loss: 0.1145 - accuracy: 0.9664
Epoch 94/100
82/82 [==============================] - 5s 66ms/step - loss: 0.2045 - accuracy: 0.9466
Epoch 95/100
82/82 [==============================] - 6s 67ms/step - loss: 0.3152 - accuracy: 0.9084
Epoch 96/100
82/82 [==============================] - 6s 69ms/step - loss: 0.2317 - accuracy: 0.9298
Epoch 97/100
82/82 [==============================] - 6s 71ms/step - loss: 0.1392 - accuracy: 0.9573
Epoch 98/100
82/82 [==============================] - 7s 85ms/step - loss: 0.1516 - accuracy: 0.9542
Epoch 99/100
82/82 [==============================] - 7s 85ms/step - loss: 0.2344 - accuracy: 0.9344
Epoch 100/100
82/82 [==============================] - 7s 84ms/step - loss: 0.1589 - accuracy: 0.9603

<keras.callbacks.History at 0x257bfd1e3e0>
```

It yielded an accuracy of 96.03%

Testing model performance on Testset

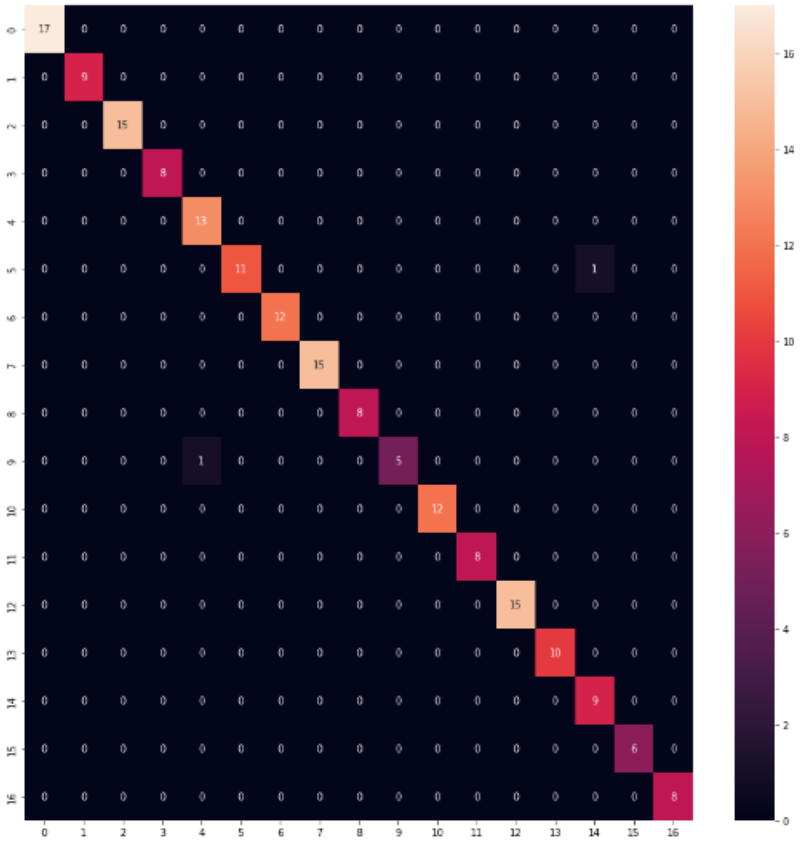
```
In [18]: model.evaluate(test_data)
         23/23 [==============================] - 1s 41ms/step - loss: 0.0275 - accuracy: 0.9891
Out[18]: [0.02747969515621662, 0.9890710115432739]
```

Confusion Matrix:

```
In [19]: pred=model.predict(test_data)
         pred=[np.argmax(i) for i in pred]
```

```
23/23 [==============================] - 1s 43ms/step
```

```
In [20]: cm=confusion_matrix(test_data.classes,pred)
         plt.figure(figsize=(15,15))
         sns.heatmap(cm,annot=True)
         plt.show()
```



Classification Report:

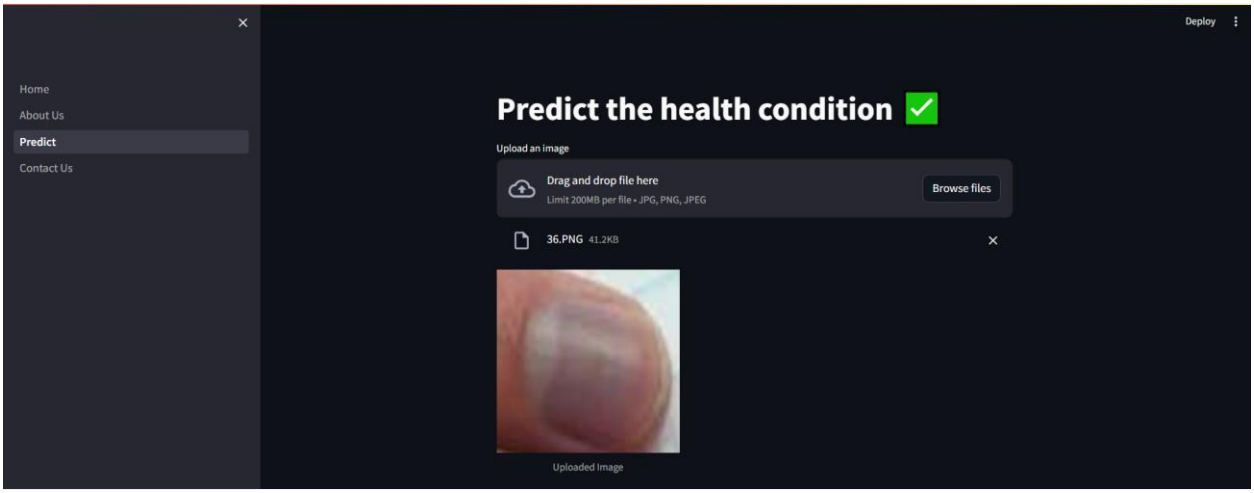
```
In [21]: print(classification_report(test_data.classes,pred))
```

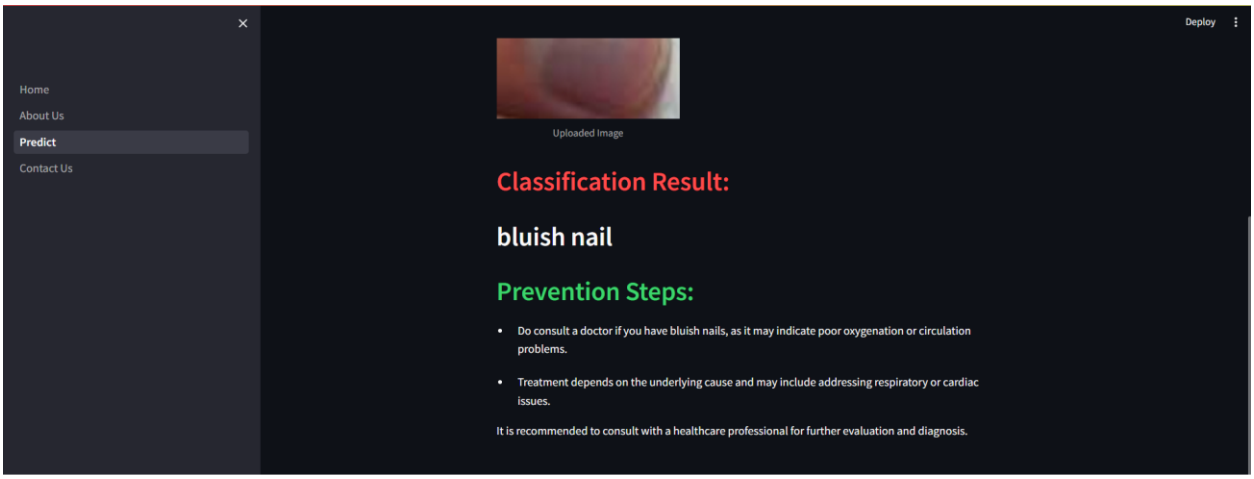
	precision	recall	f1-score	support
0	1.00	1.00	1.00	17
1	1.00	1.00	1.00	9
2	1.00	1.00	1.00	15
3	1.00	1.00	1.00	8
4	0.93	1.00	0.96	13
5	1.00	0.92	0.96	12
6	1.00	1.00	1.00	12
7	1.00	1.00	1.00	15
8	1.00	1.00	1.00	8
9	1.00	0.83	0.91	6
10	1.00	1.00	1.00	12
11	1.00	1.00	1.00	8
12	1.00	1.00	1.00	15
13	1.00	1.00	1.00	10
14	0.90	1.00	0.95	9
15	1.00	1.00	1.00	6
16	1.00	1.00	1.00	8
accuracy			0.99	183
macro avg	0.99	0.99	0.99	183
weighted avg	0.99	0.99	0.99	183

9. RESULTS

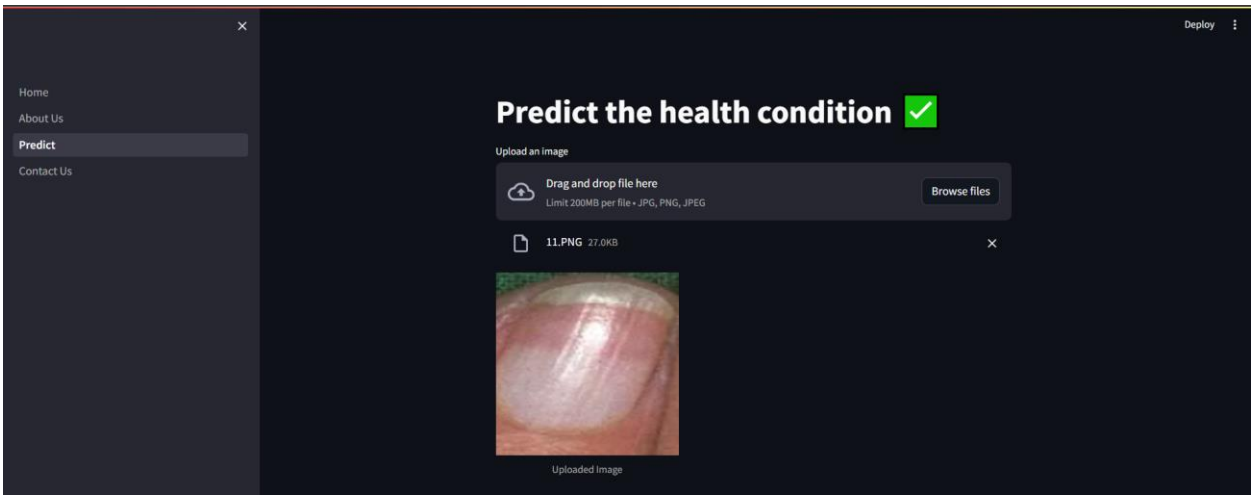
9.1 Output Screenshots

Output 1




Deploy
Home
About Us
Predict
Contact Us
Uploaded Image
Classification Result:
bluish nail
Prevention Steps:
Do consult a doctor if you have bluish nails, as it may indicate poor oxygenation or circulation problems.
Treatment depends on the underlying cause and may include addressing respiratory or cardiac issues.
It is recommended to consult with a healthcare professional for further evaluation and diagnosis.

Output 2


Deploy
Home
About Us
Predict
Contact Us
Predict the health condition
Upload an image
Drag and drop file here
Limit 200MB per file • JPG, PNG, JPEG
Browse files
11.PNG 27.0KB
Uploaded Image


Deploy
Home
About Us
Predict
Contact Us
Uploaded Image
Classification Result:
half and half nailes (Lindsay_s nails)
Prevention Steps:
Do consult with a healthcare professional for proper evaluation and diagnosis.
The cause of the nail discoloration should be determined to guide treatment.
It is recommended to consult with a healthcare professional for further evaluation and diagnosis.

10. Advantages and Disadvantages

10.1 Advantages

10.1.1 Early Disease Detection

- The system enables early detection of nail diseases, contributing to timely medical intervention and improved treatment outcomes.

10.1.2 Non-Invasive

- Unlike traditional diagnostic methods, the system provides a non-invasive way to assess and predict diseases by analyzing visual cues in human nails.

10.1.3 Accessibility

- Users can easily capture and submit nail images through the user-friendly interface, making the system accessible to a broad audience.

10.1.4 Objective Analysis

- The use of image processing techniques reduces subjectivity, providing a more objective analysis of nail characteristics for disease prediction.

10.2 Disadvantages

10.2.1 Dependency on Image Quality

- The accuracy of disease prediction may be influenced by the quality of the uploaded nail images. Low-quality images may result in less accurate analyses.

10.2.2 Limited to Visual Indicators

- The system relies on visual indicators in human nails, and certain diseases without visible manifestations in nails may not be detected.

10.2.3 Training Dataset Bias

- The accuracy of disease classification depends on the diversity and representativeness of the training dataset. Bias in the dataset may impact the model's generalization.

10.2.4 Privacy Concerns

- The system deals with sensitive health information. Adequate measures must be in place to address privacy concerns and protect user data.

10.2.5 Technological Dependency

- Users need access to devices with image capture capabilities and an internet connection. This technological dependency may limit accessibility in certain scenarios.

11. CONCLUSION

In conclusion, the development and implementation of the Nail Disease Diagnosis System represent a significant advancement in healthcare technology. By leveraging image processing techniques, the system offers a non-invasive and accessible method for the early detection of diseases through the analysis of human nails.

Key Achievements

1. Early Disease Identification

The system provides a means for the early identification of nail diseases, allowing for prompt medical intervention and enhancing the overall healthcare experience for users.

2. Objective Analysis

By utilizing image processing, the system minimizes subjectivity in disease diagnosis, offering a more objective and consistent analysis of nail characteristics.

3. User-Friendly Interface

The user interface is designed to be intuitive and accessible, allowing users to easily capture and submit nail images for analysis without the need for specialized technical skills.

Future Enhancements

While the Nail Disease Diagnosis System has demonstrated valuable features, there are opportunities for further enhancements and refinements:

-Improved Image Quality Handling: Addressing challenges related to the dependency on image quality, enhancing the system's ability to process a wide range of image qualities.

- Expanded Disease Detection: Exploring additional visual indicators and collaborating with healthcare professionals to expand the system's capabilities to detect a broader range of diseases.

- Enhanced Privacy Measures: Implementing robust privacy measures to address concerns related to the handling of sensitive health information and ensuring compliance with data protection regulations.

In summary, the Nail Disease Diagnosis System represents a promising step towards revolutionizing early disease detection using innovative technology. Continuous collaboration with healthcare professionals, ongoing refinement of algorithms, and a focus on user feedback will contribute to the system's continual improvement and positive impact on healthcare outcomes.

12. FUTURE SCOPE

The Nail Disease Diagnosis System lays the foundation for future advancements and expansions in the field of healthcare technology. The project's success opens doors to various avenues for growth and improvement:

12.1 Integration with Wearable Devices

Exploring integration with wearable devices equipped with advanced sensors could enhance the system's capabilities. Continuous monitoring of nail health through wearables may provide real-time data for disease detection.

12.2 Collaboration with Healthcare Professionals

Further collaboration with healthcare professionals, dermatologists, and medical researchers can lead to the development of a more comprehensive and specialized system. Input from experts in the field can contribute to refining algorithms and expanding the system's disease detection capabilities.

12.3 Mobile Application Development

Expanding the system into a mobile application could increase accessibility and user engagement. A dedicated app could facilitate easy image capture, analysis, and result presentation, providing users with a convenient tool for monitoring their nail health.

12.4 Machine Learning Model Enhancement

Continued research and development in machine learning can lead to the refinement and enhancement of the disease classification model. Incorporating more diverse datasets and advanced algorithms may improve the accuracy and reliability of disease predictions.

12.5 Global Outreach and Awareness

Promoting the system on a global scale and raising awareness about the importance of nail health in disease diagnosis can contribute to widespread adoption. Partnerships with healthcare organizations and community outreach programs can facilitate the dissemination of knowledge.

12.6 Telemedicine Integration

Integrating the Nail Disease Diagnosis System into telemedicine platforms could extend its reach to remote areas. This integration can support healthcare professionals in making informed decisions based on the analysis of nail images captured by users.

In summary, the future scope of the project is promising, with opportunities for technological advancements, collaborations, and a broader impact on global healthcare. By staying adaptive to emerging technologies and embracing continuous improvement, the Nail Disease Diagnosis System can evolve into a versatile and indispensable tool for early disease detection.

13. APPENDIX

Source Code:

You can find all code files in the GitHub repository.

GitHub & Project Demo Link

https://github.com/smartinternz02/SI-GuidedProject-594299-1697642990

https://drive.google.com/drive/folders/1Dqv4hAUHDTpx4uEr2fo1QSSN7uSKir3K?usp=sharing