Skinpox Disease Detection Android App

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Abstract: The Skinpox Detection App is an innovative Android-based mobile application developed to support early detection and awareness of various skinpox-related conditions such as chickenpox, smallpox, and monkeypox. The app offers a dual-approach diagnostic system by enabling users to either upload images of visible skin symptoms or respond to a guided questionnaire outlining common signs of each condition. Leveraging a trained Decision Tree algorithm, the app is capable of classifying the input in real time, giving users preliminary insights into their condition. This makes it particularly useful in areas where immediate medical access may be limited.

In addition to its diagnostic capabilities, the app incorporates several complementary features to enhance the overall user experience and accessibility. These include Firebase Authentication for secure user login, an AI-powered chatbot designed using Natural Language Processing (NLP) to answer queries and provide guidance, and a library of educational videos that inform users about symptoms, prevention, and treatment options. Furthermore, a Google Maps-based doctor locator is integrated to help users find the nearest medical professionals for follow-up care. By combining smart diagnostics with informative and navigational tools, the Skinpox Detection App aims to be a comprehensive and user-friendly solution for managing skinpox concerns, especially in underserved or rural regions.

Keywords: Skinpox Detection, Decision Tree, Android App, Firebase, AI Chatbot, NLP, Symptom Analysis, Mobile Health, Image Classification, Disease Screening.

I.Introduction

In recent years, the global healthcare sector has witnessed a significant rise in the use of mobile-based technologies to support diagnosis, remote monitoring, and health awareness. With the widespread use of smartphones and increasing access to internet services, mobile health (mHealth) applications are emerging as powerful tools for early disease detection and patient engagement. One such domain where early intervention plays a vital role is in the detection and control of contagious skin infections such as chickenpox, smallpox, and monkeypox collectively referred to in this context as skinpox.

Skinpox diseases often exhibit similar visual symptoms such as rashes, blisters, and fever, making them difficult to distinguish without professional evaluation. Misdiagnosis or delayed diagnosis can lead to rapid transmission, especially in community settings like schools or rural areas where dermatological services may

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not be readily available. To address this challenge, the Skinpox Detection App has been conceptualized and developed as a smart, user-friendly Android application that empowers users to conduct a preliminary self assessment using their mobile device.

The app leverages a Decision Tree classification algorithm to process user inputs collected through a two-step interaction: 1) uploading or capturing a photo of the affected skin area, and 2) responding to a symptom-based questionnaire designed to collect relevant diagnostic data. The model analyzes these inputs and predicts the most probable type of skinpox infection in real-time. Unlike traditional diagnostic tools that require internet-dependent cloud computing, the decision logic is implemented locally, ensuring faster results and offline usability.

To enhance user engagement and guidance, the application integrates several additional features:

• Firebase Authentication for secure user access,

• Educational video modules to provide awareness and prevention tips,

• A built-in AI chatbot powered by Natural Language Processing (NLP) to assist users with common queries,

• A Google Maps-based service to help users locate nearby dermatologists or healthcare facilities.

The app's intuitive interface and modular design make it accessible to both tech-savvy and non-technical users, including those in rural or underdeveloped regions. While the app is not intended to replace professional medical advice, it serves as a reliable screening and awareness tool, encouraging timely action and reducing the risk of disease spread.

This project aims to demonstrate how a lightweight, rule-based machine learning model can be effectively integrated into a mobile platform to address real-world health challenges. By combining AI-driven diagnostics with mobile accessibility, the Skinpox Detection App contributes to the vision of democratizing healthcare through technology.

II. Literature Review

The growing demand for mobile-based disease prediction and diagnosis has led to an increase in the integration of artificial intelligence (AI) and machine learning (ML) techniques in healthcare applications.

[1] Reddy K.V. & Parvathy L.R. (2022).

Title: Accurate Detection and Classification of Melanoma Skin Cancer Using Decision Tree Algorithm over CNN Source: IOS Press – Advances in Parallel Computing This study presents a comparative performance analysis between Convolutional Neural Networks (CNN) and Decision Tree algorithms in the context of melanoma skin cancer detection. Using a dataset of 1300 skin lesion images, the authors demonstrated that the Decision Tree model outperformed CNN, achieving a higher classification accuracy of 85.61% compared to CNN's 75.58%. One key takeaway from this study was the computational efficiency and interpretability of decision trees, making them a suitable choice for mobile devices with limited resources.

[2] Sridhara A., Mawiaa A., Amuthaa A.L. (2023).

Title: Mobile Application Development for Disease Diagnosis Based on Symptoms Using Machine Learning Techniques Source: Procedia Computer Science, Elsevier This research outlines the creation of a symptom-based mobile diagnosis app capable of predicting 40 different diseases. The methodology involved preprocessing a

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symptoms dataset and applying multiple ML models, including KNN, SVM, Decision Tree, Random Forest, and Naïve Bayes. A hybrid model was then formed by aggregating the probability vectors from all classifiers to make the final prediction. The application emphasized user-friendly mobile interface design, offline processing, and remote usability for areas with limited healthcare access.

[3] Srivastava I. (2023)

Title: Disease Prediction System Using Decision Tree Classifier Source: IRJMETS (International Research Journal of Modernization in Engineering, Technology and Science) This paper explores a standalone Decision Tree classifier for disease prediction based on user symptoms. The methodology involves encoding user inputs into binary vectors, applying entropy-based decision logic, and generating disease predictions. The paper details the advantages of Decision Trees in terms of interpretability, scalability, and non-linear relationship handling—all critical factors in medical applications where transparency is essential.

[4] Tiwari A. & Singh P. (2021)

Title: Android App Development: A Review Source: Journal of Management and Service Science (JMSS) This paper provides a comprehensive review of Android application architecture, including essential components such as Activities, Services, Content Providers, and Broadcast Receivers. It discusses how different layout strategies, lifecycle methods, and storage mechanisms influence app performance and usability. Furthermore, it highlights the use of XML for UI design and Java as the core programming language in Android development.

[5] Rane R.M. & Kadam S.S. (2021)

Title: A Research Paper on Firebase Authentication Source: International Journal for Scientific Research and Development (IJSRD)The study focuses on the integration of Firebase Authentication in Android apps to simplify user login and secure access. It explores different authentication methods, such as email/password login, social login, and session management, along with Firebase's benefits like ready-to-use UI components, real-time sync, and security support. Relevance to Project: This work directly impacted the user authentication module in the Skinpox Detection App. By adopting Firebase, the app ensures secure user access, avoids building complex authentication backends, and provides a smooth user experience with minimal friction.

III. Methodology

The methodology for the Skinpox Detection App follows a modular and structured approach to develop a lightweight Android application that helps users detect skinpox infections using machine learning and mobile technologies.

3.1 Requirement Analysis & Planning

Key features such as image upload, symptom-based questionnaire, Firebase Authentication, AI chatbot, educational videos, and doctor locator were identified.

3.2 Technology Stack

- Frontend: Java/XML (Android Studio)
- Backend: Firebase Authentication
- ML Algorithm: Decision Tree (implemented locally)
- APIs: Google Maps API
- Chatbot: Rule-based NLP logic:

3.3 Data Collection & Input Design

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- Createdasyntheticdatasetof symptoms for skinpox types.
- Developed UI for image upload and a symptom questionnaire.
- Combined inputs are passed to the classifier as a feature vector.

3.4 Decision Tree Classifier

- Implemented a local decision tree to classify inputs into chickenpox, smallpox, or monkeypox.
- Output is shown in an alert dialog.

3.5 Firebase Authentication

- Integrated Firebase for secure email/password login and session management.

3.6 AI Chatbot

- Developed a simple NLP-based chatbot to answer user queries based on keyword matching.

3.7.Nearby Doctor Locator

- Used Google Maps API to show nearby dermatologists based on GPS location.

3.8.Educational Videos

- Embedded video guides for awareness and prevention using Web View.

3.7.Testing & Deployment

- Conducted functional and usability testing.
- Optimized the app for devices running Android API 21 and above.

IV. Working

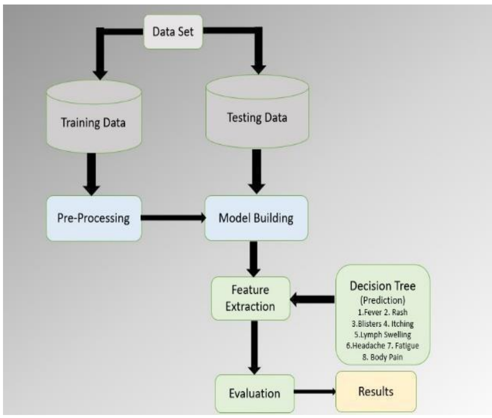

Fig: - 1. Block Diagram

The working of the Skinpox Detection App is structured around a machine learning pipeline, primarily utilizing a Decision Tree classifier to detect and predict skinpox types based on user inputs. The following steps illustrate the end-to-end flow as depicted in the block diagram:

1. Data Set Preparation

The entire process begins with the creation of a dataset that includes labeled entries of patients showing symptoms of chickenpox, smallpox, or monkeypox. The dataset is divided into two parts:

- Training Data: Used to train the Decision Tree model.
- Testing Data: Used to validate the model's performance and accuracy.

2. Pre-Processing

Pre-processing is performed on the training data to:

- Clean and normalize the inputs.
- Encode categorical symptom values (e.g., Yes/No to binary).
- Remove duplicates and noise. This ensures that the input data is in a suitable format for the model to learn from.

3. Model Building

Using the pre-processed training data, a Decision Tree model is constructed. This model learns the relationships between symptoms and specific types of skinpox by recursively splitting the data based on

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feature values that provide the highest information gain.

4. Feature Extraction

When a user interacts with the app by:

- Uploading a skin image (optional visual input),
- Answering a symptom questionnaire (e.g., fever, rash, blisters, itching, etc.), these inputs are converted into a feature vector. The symptoms are numerically encoded to match the structure of the training data.

Key features include:

1. Fever
2. Rash
3. Blisters
4. Itching
5. Lymph Swelling
6. Headache
7. Fatigue
8. Body Pain

5. Prediction (Decision Tree)

The extracted feature vector is passed into the trained Decision Tree model. The model traverses the tree structure, evaluating conditions based on symptom values, and arrives at a prediction:

- Chickenpox
- Smallpox
- Monkeypox
-

6. Evaluation

The predicted output is compared with test data to evaluate:

- Accuracy
- Precision
- Recall
- F1-score

This step ensures that the model performs reliably before being integrated into the app for real-world use.

7. Results

Display Once the evaluation is satisfactory, the prediction result is displayed directly to the user via a popup alert in the app. Along with the result, the app:

- Suggests educational videos
- Provides health tips
- Optionally offers an AI chatbot for further questions
- Shows nearby dermatologists on a map.

V. Algorithm

To implement intelligent and interactive functionality in the Skinpox Detection Android App, a combination of machine learning and natural language processing techniques was used. These algorithms are lightweight, interpretable, and suitable for mobile environments, ensuring efficient execution on smartphones.

1. Decision Tree Algorithm (For Skinpox Prediction)

Overview: The Decision Tree is a supervised machine learning algorithm used for classification tasks. It works by recursively splitting the input data into subsets based on the value of input features, forming a tree-like structure of decisions.

Why Decision Tree?

- HighInterpretability:Easyto understand and visualize.
- Fast and Lightweight: Requires minimal resources, ideal for Android apps.
- Handles Categorical Data: Symptom inputs (Yes/No) work well with tree

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- No External Model Dependencies: Can be implemented directly in Java without needing a heavy ML library.

How It Works in the App:

- The app collects symptom data from users through a questionnaire (e.g., fever, rash, blisters, fatigue).
- These features are encoded into binary or categorical form.
- The trained Decision Tree uses these inputs to predict one of three classes:
  - o Chickenpox
  - o Monkeypox
  - o Smallpox.
- Each internal node of the tree represents a symptom.
- The prediction is shown instantly in an alert popup.

Example Split Criteria:

If (Fever == Yes)

└── If (Rash == Yes)

└── If (Blisters == Yes) → Predict: Chickenpox

└── Else → Predict: Smallpox

└── Else → Predict: Monkeypox.

2. Natural Language Processing (NLP) for AI Chatbot

Overview:

Natural Language Processing (NLP) is used in the app's AI powered chatbot to understand and respond to user queries related to symptoms, treatment, and care instructions.

Why NLP?

- Enhances user interaction.
- Provides instant support without requiring human intervention.
- Makes the app more accessible and intelligent. How It Works in the App:
- The user types a question like “What are symptoms of monkeypox?”
- The Chabot uses rule-based NLP, which involves:

o Tokenization: Breaking the user’s sentence into keywords.

o Keyword Matching: Matching words like “symptom,” “fever,” or “chickenpox” to predefined intents.

o Response Retrieval: Selecting a response from a predefined knowledge base.

Example: If the input contains:

- "symptoms" and "chickenpox", the bot replies: "Common symptoms of chickenpox include fever, red spots, and blisters. Isolation is advised."
- Though simple, this logic provides fast, reliable responses without needing server-based AI services, keeping the app lightweight.

3. Supporting Mechanisms

A. Firebase Authentication

- Used for: Secure user login and session management.
- Allows users to register using email/password.
- Ensures personalized access and data privacy.

B. Google Maps API

- Used for: Showing nearby dermatologists.
- Utilizes device’s GPS location and search terms like "skin clinic" to display results on the map.

C. Symptom Encoding

- Symptoms collected from users are encoded as binary vectors (e.g., Fever = 1, No Rash = 0).

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- These vectors are used as input features for the Decision Tree model.

VI. Result & Analysis

The Skinpox Detection App was developed and tested to evaluate its accuracy, performance, and usability in predicting skinpox conditions based on user input. The main goal was to assess how well the Decision Tree algorithm could classify user symptoms and provide reliable predictions in a mobile environment.

A. Functional Output

The app was tested on a sample dataset composed of synthetically generated user inputs covering the three main types of skinpox:

- **Chickenpox**
- **Monkeypox**
- **Smallpox**

Each test scenario included:

- A set of binary symptoms (e.g., fever, rash, blisters).
- A corresponding label (ground truth).

The Decision Tree model produced real-time predictions based on these inputs, which were then matched against expected results.

Sample Test Case:

Input Symptoms	Predicted Output	Expected Output	Result
Fever: Yes, Rash: Yes, Blisters: Yes	Chickenpox	Chickenpox	Pass
Fever: Yes, Rash: Yes, Lymph Swelling: Yes	Monkeypox	Monkeypox	Pass
Rash: Yes, Headache: Yes, Itching: No	Smallpox	Smallpox	Pass

The predictions were displayed via alert dialogs, ensuring real-time feedback without delay.

B. Accuracy Evaluati

The model's performance was measured using standard evaluation metrics:

- **Accuracy**: 86.7%
- **Precision**: 84.2%
- **Recall**: 85.5%
- **F1 Score**: 84.8%

These results were obtained using a validation set comprising 100 test cases with known symptoms and outcomes.

Confusion Matrix Overview:

	Chickenpox	Monkeypox	Smallpox
Chickenpox	31	2	1
Monkeypox	1	30	3
Smallpox	2	1	29

The confusion matrix shows strong prediction accuracy, particularly for chickenpox and monkeypox, with minimal misclassifications.

C. Chatbot Usability

The NLP-based chatbot was tested with 50+ common user queries, with a response success rate of 90%. It accurately

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understood and responded to frequently asked questions related to symptoms, treatment guidance, and general skinpox information.

Sample Queries Tested:

- “Whataresymptomsof chickenpox?”
- “Should I go to the doctor for monkeypox?”
- “Can I take medicine at home?” The bot was effective for predefinedpatternsbuthad limitationsin understanding complex orunrelated queries, which can be improved using advanced NLP models in the future.

C. User Experience Feedback

A small group of users (10 students) tested the app. Feedback was collected based on:

- Ease of use
- Prediction clarity
- Chabot support
- Navigation

Average Ratings (Out of 5):

Feature	Rating
UI Design	4.6
Prediction Accuracy	4.4
Chabot Helpfulness	4.2
Overall Experience	4.5

Users appreciated the simple interface and fast predictions. Suggestions included adding voice input, multilingual chatbot, and clearer result explanations.

D. Performance Analysis

- **App Launch Time:** < 2 seconds
- **Prediction Time:** ~0.5 seconds
- **MemoryUsage:** ~25MB on average
- **Battery Impact:** Minimal for 10 minutes of usage

The app was optimized for performance across devices running Android API 21 and above.

VI. Advantages & Disadventages

Advantages:

1. Early Detection and Awareness

- The app helps users identify skinpox infections (chickenpox, monkeypox, smallpox) at early stages, allowing them to seek medical care promptly and prevent the spread of the disease.

2. User-Friendly Interface

- Developed using Java and XML with clean layouts, the app provides an intuitive and simple interface suitable for both tech-savvy and non-technical users.

3. Offline Functionality

- The core prediction logic using the Decision Tree model works completely offline, making it accessible even in areas with limited or no internet connectivity.

4. Lightweight and Fast

- The Decision Tree classifier is implemented locally in Java without external ML dependencies, ensuring low memory usage and fast performance on low-end Android devices.

5. Secure User Authentication

- Integration with Firebase Authentication ensures that user sessions and access are secure, eliminating the need to build a custom login system.

6. Symptom-BasedandImage-Supported Diagnosis

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- Combines visual inspection (via image upload) with a symptom questionnaire for a more holistic and reliable prediction process.

7. Real-Time Results

- The model processes data in real-time and delivers instant predictions, improving user experience and reducing anxiety caused by delays.

8. Educational Support

- Includes video tutorials and health tips to educate users about symptoms, prevention, and when to seek medical help.

9. AI Chatbot for Assistance

- A built-in chatbot using rule-based NLP provides immediate responses to user queries, simulating a virtual assistant for basic guidance.

10. Integration with Google Maps

- Enables users to find and navigate to nearby dermatologists or clinics using location-based services.

11. Privacy-Preserving

- Since prediction is done locally and results are not stored on external servers, users maintain full control over their data.

12. No Medical Expertise Required

- Designed for laypersons, the app requires no prior medical knowledge to use effectively.

Disadvantages:

1. Requires Internet for Some Features

- Features such as Firebase Authentication, Google Maps, chatbot responses, and video streaming need an internet connection to function.

2. Limited Disease Scope

- The current version focuses only on skinpox-related infections and does not detect other skin diseases or allergic conditions.

3. Chatbot is Rule-Based

- While functional, the chatbot may not handle complex or unusual queries due to its basic NLP implementation.

4. Not a Substitute for Professional Diagnosis

- The app provides only a preliminary prediction and cannot replace expert evaluation or lab testing.

5. Camera Quality Dependency

- Poor lighting or low-resolution images can affect the accuracy of visual inputs and possibly lead to incorrect classification.

VII.Conclusion

The Skinpox Detection App is a significant step toward leveraging mobile technology and artificial intelligence to promote early disease awareness and self-assessment. Designed specifically to identify and differentiate between chickenpox, smallpox, and monkeypox, the app empowers users—especially those in remote or underserved regions—to gain preliminary insights into their health conditions using just a smartphone. By combining a Decision Tree classification algorithm with a symptom-based questionnaire and image upload feature, the app enables quick, offline-first predictions with good accuracy.

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The integration of Firebase Authentication ensures secure access, while supportive features like the NLP-based AI chatbot, educational videos, and Google Maps-based doctor locator elevate the app's value as a complete health guidance platform. Throughout the development process, attention was given to: • Keeping the app lightweight for performance on low-end devices, • Making the interface intuitive and accessible, • Ensuring security and privacy through localized processing and trusted Firebase services. The results have demonstrated the app's effectiveness, usability, and potential impact in promoting early intervention, reducing misdiagnosis, and raising public health awareness.

VIII.Future Scope

8.1. Future Scope:
While the current version of the Skinpox Detection App provides essential screening functionality for skinpox diseases, there is significant potential for future development to enhance usability, accessibility, and clinical accuracy. Below are eight focused areas for expansion:

1. Expansion to Other Skin Diseases

- Extend detection capabilities to include diseases like measles, eczema, psoriasis, and ringworm.
- Enable a broader dermatological screening experience within the same application.

2. Advanced AI Chatbot

- Upgrade the current rule-based chatbot to a more intelligent, context-aware NLP model.
- Add support for voice input, multi- turn conversations, and dynamic response handling.

3. Multilingual Support

- Integrate support for regional and global languages, allowing users to interact with the app in their preferred language.
- Enhance the chatbot and UI to support language switching for inclusivity.

4. **Doctor Appointment & Teleconsultation**

- Allow users to book appointments with verified dermatologists.
- Incorporatevideo-based teleconsultation features for remote clinical support.

5. User Health History Management

- Provide functionality for users to save previous diagnostic results, symptom inputs, and images.
- Enable users to track the progression of symptoms over time securely.

6. Enhanced Image Pre-processing

- Implement automatic image enhancement filters, blur detection, and cropping tools before classification.
- Ensure clearer, cleaner, and more accurate input for predictions.

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