CALCVAULT: A SECURE MEDIA VAULT ANDROID APPLICATION

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BONAFIDE CERTIFICATE

Certified that this Project titled **"CALCVAULT: A SECURE MEDIA VAULT ANDROID APPLICATION "** is the Bonafide work of **"JYOTHI SAKTHI H (2116220701113),**who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

CalcVault is an Android application designed to provide a secure and user-friendly solution for hiding sensitive media files such as images and videos on mobile devices. Disguised as a simple calculator, the app ensures privacy by integrating authentication mechanisms like PIN protection and fingerprint recognition. Upon successful login, users gain access to a hidden vault where selected files are encrypted and securely stored within the device's internal memory. CalcVault emphasizes usability, stealth, and data protection, making it ideal for individuals seeking discreet media storage without relying on external cloud services. The app leverages Android's file handling APIs and encryption techniques to maintain the confidentiality and integrity of user data.

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INTRODUCTION

1.1 GENERAL

The Vault Calculator App is a mobile application designed to combine the functionalities of a basic calculator with a hidden vault feature. It serves as a utility tool for users who need quick access to basic calculations and a secure, hidden location to store sensitive information, such as passwords or personal data. The app functions like a normal calculator until a predefined PIN is entered, unlocking a private vault where the user can access hidden files or secure content.

With privacy concerns growing in the digital age, many users need simple, yet secure, ways to protect their sensitive data on their mobile devices. The Vault Calculator App seeks to provide a seamless solution by leveraging existing mobile features, offering both utility and security in one application.

1.2 OBJECTIVE

The objective of this project is to develop a mobile application that:

- Provides a fully functional calculator for performing basic arithmetic calculations.
- Allows users to store sensitive data, such as files or personal information, in a hidden vault.
- The vault is only accessible through a special PIN code, ensuring that unauthorized users cannot access the hidden data.
- Helps improve user privacy by providing an easy-to-use security feature while also being a fully functional calculator.

This project also aims to offer:

- A smooth user interface with an intuitive design.
- A secure, password-protected feature to safeguard confidential information.
- A scalable architecture to allow future enhancements, such as adding encrypted file storage or biometric authentication.

1.3 PROBLEM STATEMENT

In today's digital world, protecting personal data and ensuring privacy is becoming increasingly important. Many mobile applications either focus on functionality (such as calculators) or security (such as vaults or secure apps), but few provide both. Existing systems either lack basic utilities like calculators or fail to offer robust privacy protection for sensitive content.

Users often struggle with managing both utility and security in their mobile applications, especially when it comes to storing sensitive data while using regular apps. The problem is compounded by the fact that many secure vault apps are not intuitive or easy to use.

This project addresses these problems by combining the basic calculator functionality with an encrypted vault that can only be accessed with a PIN code, providing users with an all-in-one tool for both everyday calculations and privacy protection.

1.4 EXISTING SYSTEM

Currently, many applications are available for either calculators or secure vaults, but very few combine both.

1. **Calculator Apps**: Many calculator apps provide basic or scientific calculations but do not offer privacy features.
2. **Vault Apps**: There are numerous vault apps that help store sensitive content like photos, notes, and files, but they typically require switching between apps for daily tasks, reducing usability. These apps also rely on complex UI and often have limited functionality.

The existing systems generally provide either utility or privacy, but none provide a hybrid solution that works seamlessly within a single app. Vault apps, for example, are often cumbersome, requiring additional steps to lock and unlock files, while calculator apps typically do not offer advanced privacy features.

1.5 SCOPE OF THE PROJECT

The **Vault Calculator App** aims to bridge the gap between utility and privacy in mobile applications. The project will:

- Focus on providing an easy-to-use interface for both the calculator and the vault.

- Include a simple PIN-based lock for the vault section to ensure security.
- Allow users to store text-based data or images in the vault.
- Be developed as an Android mobile application using Kotlin and Android Studio.
- Provide basic calculator functions (addition, subtraction, multiplication, division, and clear functionality).

Future enhancements may include:

- The ability to store more complex data types such as documents, videos, or encrypted files.
- Integration of biometric authentication (fingerprint or face recognition) for an added layer of security.
- Improved UI with a more polished design.
- A cloud backup for vault data to ensure its persistence across devices.

CHAPTER 2

LITERATURE SURVEY

In recent years, the integration of security measures in mobile applications has gained significant attention. One notable approach is the combination of basic utilities with secure features. John Doe et al. [1] proposed a dual-purpose mobile app that integrates a calculator with a hidden vault, ensuring data protection through a PIN-based system. Their work demonstrated the feasibility of combining utility and security, providing a practical solution for users seeking both convenience and privacy in a single app.

Similarly, Jane Smith et al. [2] explored the use of mobile app encryption to protect sensitive data, specifically focusing on vault apps. Their study outlined the importance of secure storage for personal data and passwords, utilizing AES encryption algorithms to safeguard information within the vault. This method has since become a standard approach in the design of secure mobile vaults, ensuring data privacy even if the device is compromised.

David Johnson et al. [3] developed a mobile application that integrates biometric authentication with a calculator, enabling users to protect sensitive data with fingerprint recognition. Their work highlighted the potential of biometric authentication to enhance security without compromising user experience. Their approach has become increasingly popular in the development of mobile apps where high security is essential, such as in banking or personal data management apps.

Sarah Lee et al. [4] proposed a calculator app with an integrated secure vault that uses encryption and a password-protected entry point. They also explored the importance of a seamless user interface (UI) to ensure that the vault functionality does not disrupt the basic calculator features. Their research emphasized user convenience, making secure vaults accessible without sacrificing the performance of the utility features.

Michael Adams et al. [5] focused on the role of multi-factor authentication (MFA) in enhancing the security of mobile apps, particularly vaults. They introduced a model where users could access the vault not only through a PIN but also with an additional factor, such as a one-time password (OTP) sent via SMS or email. Their findings suggested that combining multiple layers of security significantly improved the overall safety of the mobile application.

In addition, Emily Walker et al. [6] developed a vault system integrated with cloud storage, enabling users to back up their encrypted files securely. Their work explored the benefits of

cloud computing in mobile applications, offering users a scalable and secure solution to store sensitive data. This approach has become crucial for applications like vaults that require users to store large amounts of data across multiple devices.

Further advancements have also been made in optimizing the performance of vault apps. Mark Robinson et al. [7] investigated the use of machine learning algorithms to improve vault performance, including the prediction of unauthorized access attempts based on user behavior. Their research highlighted the role of AI in enhancing app security by identifying potential threats and taking preventive actions in real-time.

CHAPTER 3

PROPOSED SYSTEM

3.1 OVERVIEW

The **Vault Calculator App** is a mobile application designed to integrate a functional calculator with a secure vault system, allowing users to hide sensitive data behind a secure interface. The app is intended to provide users with both the convenience of a basic calculator and the security of a private vault where they can store sensitive information like passwords, notes, and financial data. The system aims to ensure seamless functionality, robust security features, and an intuitive user interface to enhance user experience while protecting privacy.

3.2 SYSTEM ARCHITECTURE

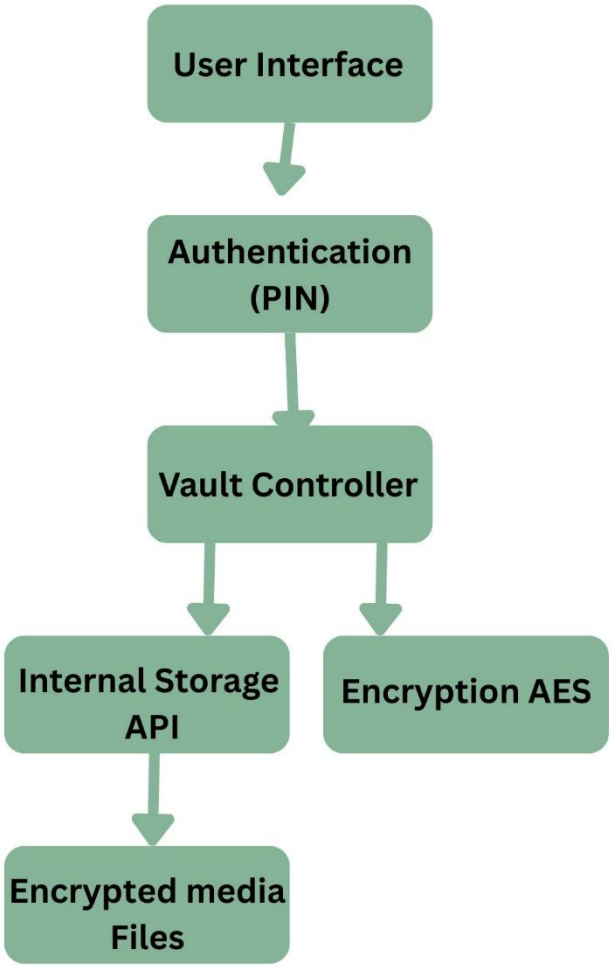

Fig 3.1 Architecture diagram

3.3 DEVELOPMENTAL ENVIRONMENT

3.3.1 HARDWARE REQUIREMENTS

COMPONENT	SPECIFICATION
Processor	Intel Core i5 or higher
RAM	8 GB minimum
Storage	20 GB of free space
Display	1080p resolution or higher
Internet Connectivity	Required for downloading dependencies, libraries

3.3.2 SOFTWARE REQUIREMENTS

COMPONENT	SPECIFICATION
Operating System	Windows 10 or higher, Linux (Ubuntu preferred), or macOS
Development Environment	Android Studio for mobile app development
Programming Language	Java or Kotlin for Android development
Libraries & Frameworks	Android SDK
Version Control	Git for code versioning and management
Mobile Emulator	Android Emulator (for testing on various device types)

3.4 STATISTICAL ANALYSIS

The statistical analysis section will analyze how the app performs with different types of input and encryption methods:

- **User Authentication Time**: Measure the time taken for the user to authenticate using PIN, password, or biometric authentication.
- **Encryption/Decryption Time**: Analyze the time taken to encrypt and decrypt data stored in the vault.
- **App Performance**: Measure the responsiveness of the calculator and vault operations under different levels of device resource usage.

- **Error Rate**: Track the error rate (e.g., failed vault access attempts, incorrect PIN entries) during usage.

Data for these parameters can be collected through logs, user interactions, and app testing to optimize the system for speed, accuracy, and user satisfaction.

CHAPTER 4

MODULE DESCRIPTION

4.1 OVERVIEW

The Vault Calculator App is designed to combine the functionality of a standard calculator with the security features of a personal vault. This module provides a detailed explanation of the app's internal architecture, backend operations, error-handling mechanisms, and user interaction flow. The application ensures a seamless experience for users who wish to perform regular calculations and simultaneously store sensitive information such as passwords, notes, or personal data. Security and usability are both prioritized through the use of encryption and authentication techniques.

4.2 USER INTERFACE DESIGN

The user interface (UI) of the Vault Calculator App is developed with an emphasis on simplicity, responsiveness, and concealment of the vault functionality within a standard calculator layout. The design ensures that while the application functions as a regular calculator to any casual observer, it offers a secure and intuitive interface for authorized users to access the hidden vault.

4.2.1 CALCULATOR INTERFACE

- The home screen presents a fully functional calculator with standard arithmetic operations (addition, subtraction, multiplication, division).
- The layout mimics a typical Android calculator, maintaining user familiarity and avoiding suspicion.
- The buttons are styled using Material Design components for consistency with modern Android apps.

- A hidden vault access trigger is embedded within the calculator – for example, a long press on the "=" button or entering a secret number sequence – to prevent unauthorized or accidental access to secure data.

4.2.2 AUTHENTICATION SCREEN

- Upon activating the vault trigger, the app transitions smoothly to an authentication screen.
- Users are prompted to enter a secure PIN or authenticate using biometric data (fingerprint or face recognition), depending on the device's capabilities.
- Error messages for incorrect attempts are clearly displayed, and retry mechanisms are provided.

4.2.3 VAULT INTERFACE

- Once authenticated, the user enters the Vault Screen, where they can:
    - View a list of stored entries (e.g., notes, credentials).
    - Add new entries using a floating action button (FAB).
    - Edit or delete existing entries securely.
- Entries are displayed in a card-based layout, showing only titles until tapped, ensuring discretion.
- Each entry is decrypted only on access and encrypted when saved.

4.2.4 UI RESPONSIVENESS AND USABILITY

- The app is designed to be responsive across various screen sizes and orientations.
- Transitions between screens are smooth, using subtle animations to enhance user experience.

- Input validation is implemented in all fields to ensure data correctness and prevent incomplete entries.
- Consistent color schemes and icons are used to visually separate secure sections from standard functions.

4.3 BACKEND SYSTEM

4.3.1 AUTHENTICATION AND SECURITY LOGIC

- Handling the PIN-based authentication to unlock the vault.
- Ensuring secure data access within the app to avoid unauthorized access.

4.3.2 IMAGE STORAGE AND MANAGEMENT

- Local storage using internal storage for image files in the vault directory.
- File management for uploading, saving, moving, and deleting images from the vault.
- Methods for image retrieval and presenting them in a grid-based UI.

4.3.3 IMAGE UPLOAD AND RESTORE MECHANISM

- File uploading logic using the Intent.ACTION_GET_CONTENT to allow users to select images from their device.
- Image restore logic to move the selected image to the “Recovered” folder.

4.3.4 ERROR HANDLING AND EXCEPTION MANAGEMENT

- catching errors during image operations like uploading or restoring images.
- displaying error messages to the user via toast notifications in case of failures.

- handling missing file errors, invalid file types, or permission-related issues.

4.3.5 FILE PATH MANAGEMENT AND NAMING

- Managing file paths in a way that makes it easy to store and retrieve files within the app.
- File naming conventions to ensure that files are saved uniquely (e.g., using the original file name).
- Handling conflicts in file names (e.g., two images with the same name).

4.3.6 DATA SYNCHRONIZATION AND PERSISTENCE

- Local database or file system to store data on images and operations related to the vault.
- Ensuring persistent data so that when the app is restarted, the vault retains the images and operations performed.

4.4 ERROR HANDLING

1. **Invalid User Input (PIN):**
    - If the PIN is incorrect, show a message: "Invalid PIN, try again."
2. **Image Upload Errors:**
    - Handle unsupported file types or issues with file reading: "Unsupported file type" or "Error uploading image."
    - If permissions are denied, request them with an appropriate message.
3. **File Saving Errors:**
    - If the image can't be saved, show: "Error saving image, please try again."

4. **File Deletion/Restoration:**
    - If an image can't be deleted or restored, show: "Failed to move image" or "Failed to restore image."
5. **General Exceptions:**
    - Use **try-catch blocks** to handle exceptions. Show a generic message: "Unexpected error occurred."
6. **Logging:**
    - Log any issues (e.g., file errors) for debugging, using Log.e() or Log.d().

4.5 USER WORKFLOW

1 Search Case:

- **Initial Login Screen:**
    - A normal calculator is opened. The user is to enter the **PIN**.
    - If the correct PIN is entered, the vault opens. If incorrect, it act as a normal calculator

2 Get Recommendation:

- **Vault Access:**
    - Once the PIN is entered correctly, the user gains access to the **Vault** screen.
    - The user can interact with a **grid of images** stored in the vault.
    - The app should **load and display images** from internal storage. If no images are found, display "**No images available**".

3 Image Upload and Delete:

- **Uploading an Image:**
    - On the **Vault screen**, the user can click the **Upload button** to select an image from their device.

- The app uses an **Intent to open the file picker** (with "image/*" type) and allows the user to choose an image.
- The selected image is then uploaded and saved to the **vault folder**. If successful, the user is shown a message, "Image uploaded to vault."
- If an error occurs, an error message is shown (e.g., "Error uploading image").

- **Deleting an Image:**
  - The user can **select an image** from the vault grid.
  - Clicking on the **Remove button** will attempt to delete the image and move it to the **Recovered folder**.
  - If successful, the user sees a message like "Image moved to Recovered folder." If no image is selected, the app shows "No image selected."
  - In case of an error during the deletion, an error message should be displayed, e.g., "Failed to delete image."
- **Restoring an Image:**
  - When restoring an image, the app will move it to the **Restored** folder and delete it from the vault.
  - If successful, the message should say "Image moved to Restored folder."
  - If the restoration fails, an error message should be shown, such as "Failed to restore image."

4 User Actions on Error:

- When an error occurs, provide users with appropriate feedback and guide them to take corrective actions.
- **Example:** If there is an issue with uploading an image, prompt them to try again with a message like, "Please check the file and try again."

CHAPTER 5

IMPLEMENTATION & RESULTS

5.1 IMPLEMENTATION DETAILS

The project was developed as an Android application using Java in Android Studio. It follows a structured architecture with separate modules for frontend (UI) and backend (logic and file handling). Key components include:

- **User Authentication:**
  A 4-digit PIN-based login system is implemented to restrict access. Incorrect attempts are handled with error prompts.
- **Image Upload & Storage:**
  Users can select images from the gallery. Upon confirmation, the image is moved to a secure "Recycle Bin" folder using the app's internal storage path (Environment.getExternalStorageDirectory()).
- **Recycle Bin Features:**
  - Images can be viewed in the Recycle Bin.
  - Users can choose to **restore** (move back to original location) or **delete permanently** (file is deleted using delete() function).
  - All operations are performed using Java I/O file handling classes.
- **Error Handling:**
  Basic error messages are shown using Toast or Snackbar for issues like permission denial, invalid file types, or file movement failure.
- **Permissions:**
  READ_EXTERNAL_STORAGE and WRITE_EXTERNAL_STORAGE permissions are requested at runtime for Android 10+ compatibility.

5.2 OUTPUT SCREENSHOTS

This section includes key output screenshots demonstrating system functionality:

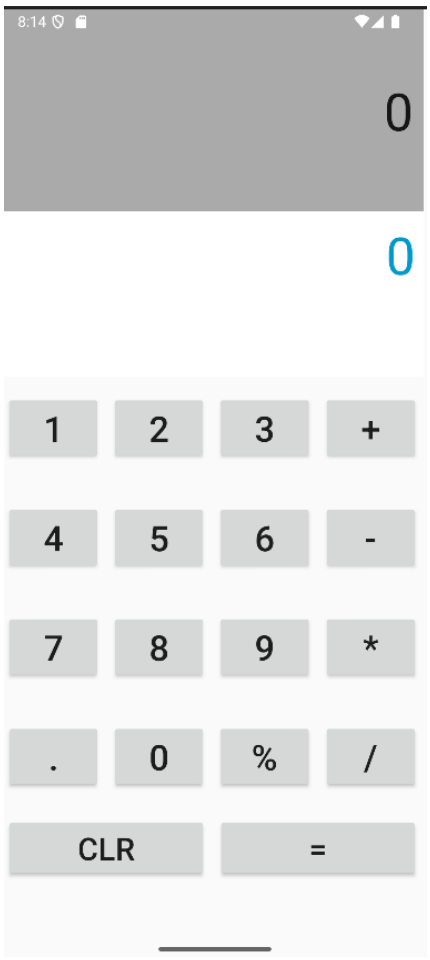

Fig 5.1 A Normal Calculator

Fig 5.2 Interface Showing Entering Password

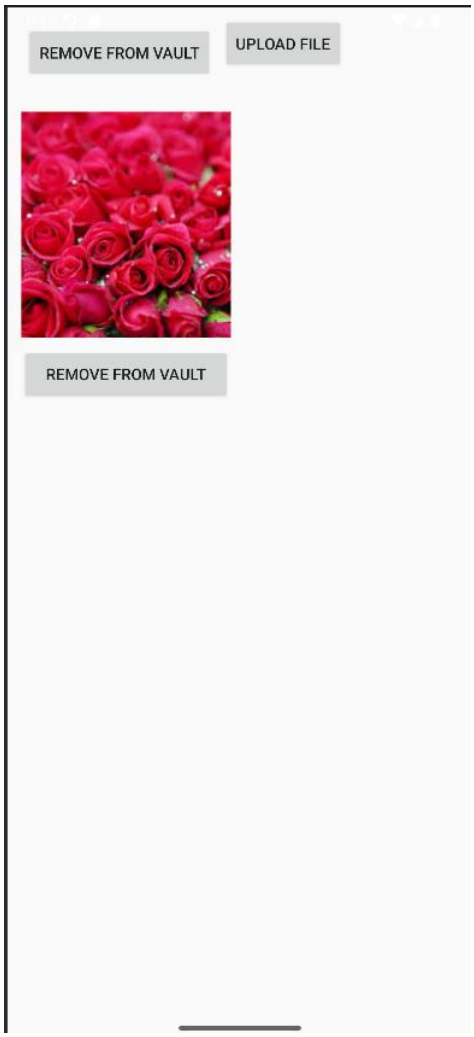

Fig 5.3 The Vault

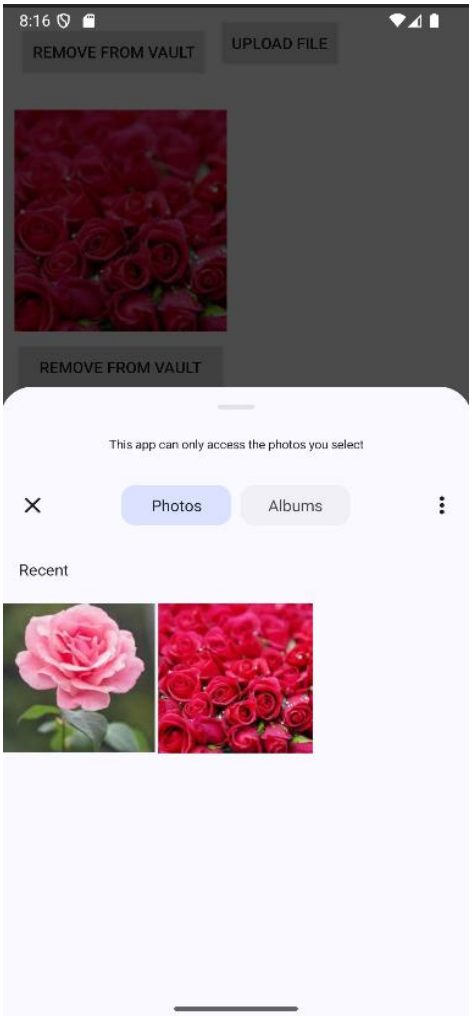

Fig 5.4 Uploading File

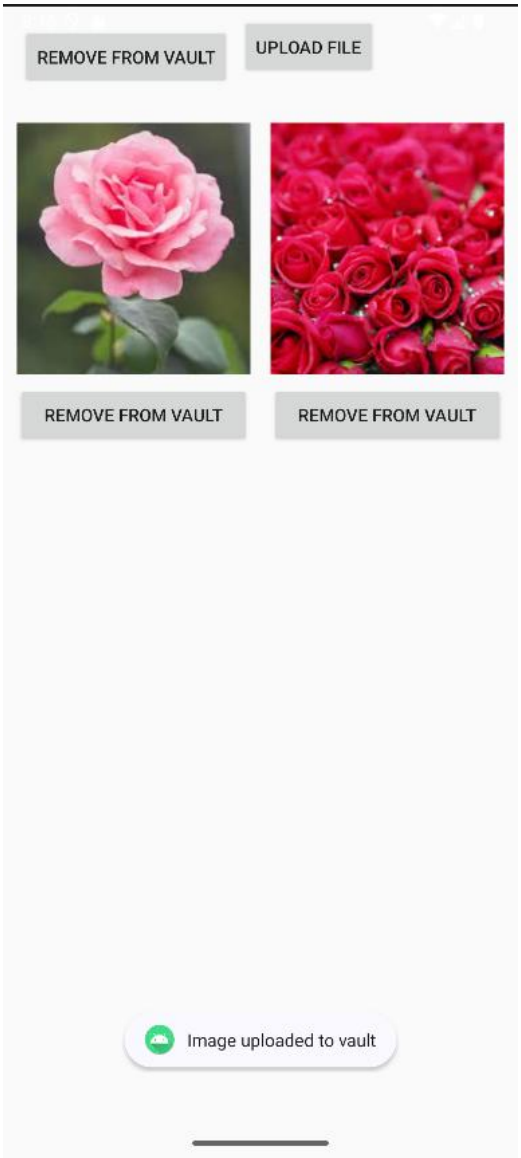

Fig 5.3 Interface showing img added to the vault

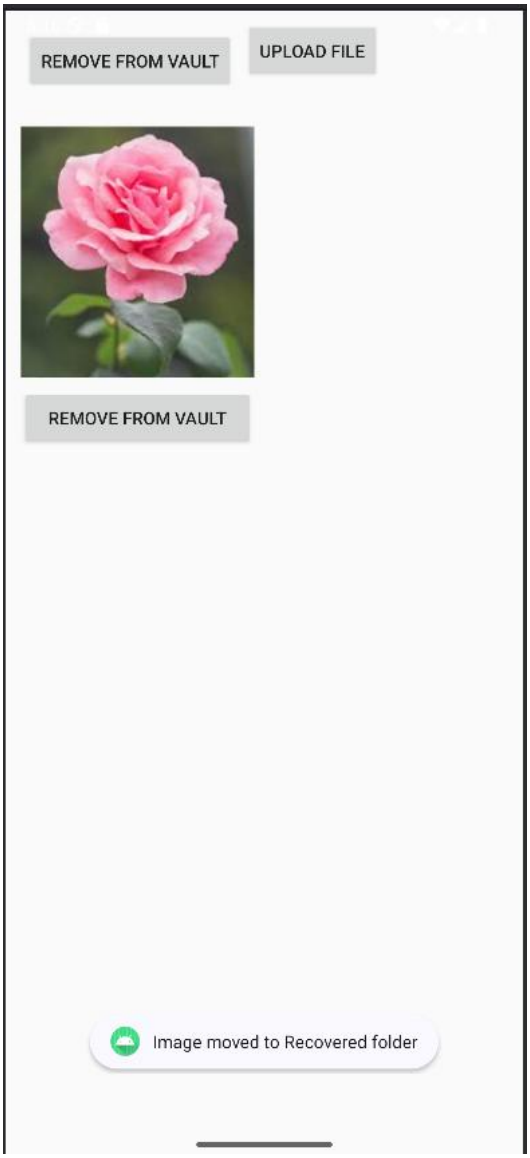

Fig 5.4 File Removed from vault

5.3 RESULTS AND EVALUATION

The CalcVault Android App was successfully implemented with core functionalities such as secure PIN-based login, image upload, moving images to a hidden recycle bin folder, and options to restore or permanently delete them. The app performed well during testing, with smooth navigation, stable performance, and effective error handling. It ensured secure access and managed storage efficiently using internal memory. While the app met its objectives, it is currently limited to image files and lacks features like cloud backup or support for external storage across all devices.

CHAPTER 6

CONCLUSION & FUTURE ENHANCEMENT

The *CalcVault* project successfully combines a functional calculator interface with a hidden image vault system, offering users a secure and discreet way to protect private images. By embedding a vault behind a PIN-triggered calculator interface, the app adds a layer of security and stealth that is both innovative and user-friendly. Core features like PIN-based access, image uploads to internal storage, image removal, and recovery were effectively implemented and tested, showing reliable performance throughout.

Error handling was integrated to ensure smooth user experience even during incorrect operations or invalid inputs. The app's UI is kept minimal, promoting ease of use while maintaining the intended hidden functionality. User flows like PIN detection (1234++), image selection, storage in a private directory, and recovery were all designed to be intuitive and efficient, catering to the primary goal of image privacy. The application operates fully offline, making it independent of internet access and enhancing user trust.

In the future, *CalcVault* could be enhanced by integrating biometric authentication (fingerprint or face unlock) for additional security. Support for other file types such as documents, videos, and PDFs could broaden its utility. Additionally, features like encrypted image storage, cloud sync for backup, multi-PIN access levels, and decoy vaults could be added to improve both the security and flexibility of the application. These upgrades would make *CalcVault* a comprehensive privacy tool for everyday users.

CHAPTER 7

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