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Password Manager App using Siamese Neural Network for One Shot Recognition

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***Abstract*-In this research paper, we propose an Android-based password manager application that utilizes a Siamese Neural Network with One Shot Recognition for password authentication. A deep learning architecture known as the Siamese Neural Network evaluates two input photos and generates a similarity score. Siamese Neural Network employs different unique structure to rank the similarity between two images or inputs** [13]. **By utilising a convolutional architecture, we are able to provide robust results that are superior to those of prior deep learning models with virtually state-of-the-art performance on one-shot classification tasks. Our password manager application integrates the Siamese Neural Network and One Shot Recognition to provide a secure and convenient password authentication process. The user can store their passwords in the app, and when they need to access their accounts, they can simply authenticate themselves with their face.**[3]

Key words: Siamese Neural Network, One shot recognition, convolutional architecture, password manager.

1. Introduction

Password management is crucial due to the growing number of online accounts and services we use on a daily basis. It might be difficult to remember strong passwords for every account, and conventional password management techniques like writing them down or using the same one for several accounts can expose security flaws. You can create secure, complicated, and individual passwords for each of your accounts with the use of password manager software. As a result, it is far more difficult for hackers to decipher or guess your passwords. It enables you to classify and arrange your accounts, making it simpler for you to access and locate the passwords you require. [1]

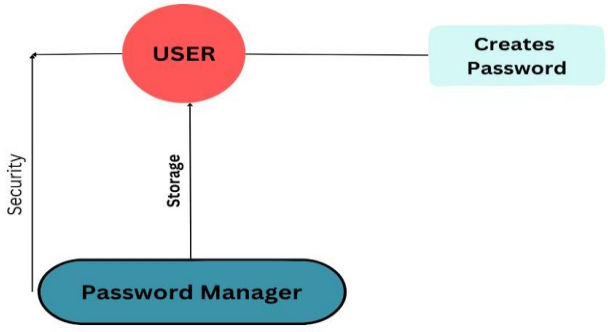

Fig. 1.1 Working of a General Password Manager

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Why Siamese Neural Network?

Among the several types of neural network design, **Siamese neural networks are used to compare two inputs and determine if they are similar or dissimilar**. They are composed of two identical neural networks that use the same architecture and weights to create representations from two different inputs. [6] When comparing various representations, a distance measure is used to determine how similar they are. It is capable of handling pairwise comparisons more successfully and effectively. These neural networks, in contrast to others, don't need a lot of data to train, which is a huge problem for data collection. In Siamese, two convolution neural networks are used for training.[14]

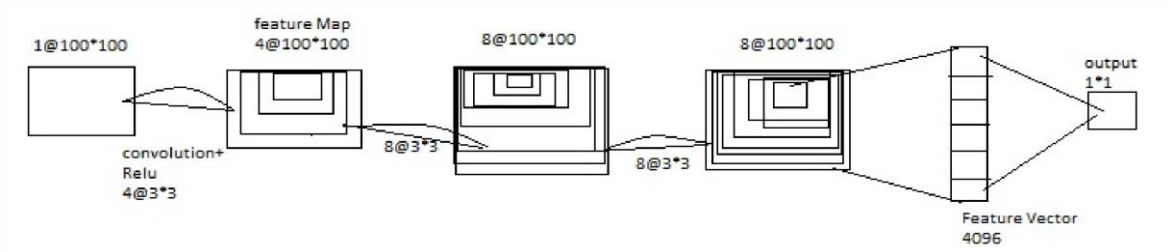

Fig. 1.2. Convolution Neural Network of Siamese Model

2. Literature survey

The some of the research papers that helped while doing this project are mentioned below.

1) Madhur Bhaiya and Michael Heinrichs (2015):
   This study offers an overview of the capabilities of the Eclipse and Android Studio IDEs as well as instructions on how to develop Android apps with each program.
2) Gregory Koch, Richard Zemel, and Ruslan Salakhutdinov [12]:
   The key take away from the paper Siamese neural network for one shot recognition are:
   - Siamese neural networks can be successful in one-shot image recognition, as the authors show by using their method to recognise handwritten numbers and faces among other one-shot recognition tasks. They demonstrate that even with a limited number of training instances, their Siamese Neural Network architecture can still produce results with excellent accuracy.
   - Classification can sometimes be more efficient than learning a similarity metric: The Siamese Neural Network learns to compare pairs of images and output a similarity score rather than explicitly identifying images. The authors demonstrate how this strategy can be more successful than conventional categorization strategies, particularly for one-off recognition problems.
   - Performance can be enhanced by pre-training. To learn general features that can be used to do new one-shot recognition tasks, the authors pre-train their Siamese Neural Network on a sizable dataset of image pairs. They demonstrate how the network's performance on new tasks can be considerably enhanced by this pre-training process.
   - The suggested method is scalable since it can simply be expanded to accept more complicated inputs, like image sequences or movies, using Siamese neural networks. The authors use video recognition challenges to illustrate the scalability of their method.

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3) Kostiantyn Kucher, Mohammad Al-Ameen, and Sanjay Kumar Madria [11]:

Deep learning-based user authentication on smartphones-This study suggests a deep learning-based method for smartphone user authentication that makes advantage of touch dynamics and device orientation. However, this paper somewhat irrelevant to our current paper but this study helps how deep learning model can be linked to the android app perfectly. 4) Mohammad Mannan and Paul C. van Oorschot [10] Password Managers: A Comparative Analysis and Usability-

The features, security measures, and usability of various password manager solutions are all thoroughly analysed in this study. The writers compare the security measures and assess the usability of several well-known password managers, including LastPass, 1Password, KeePass, and Password Secure.

The key takeaway from this research are:

- password managers are used to securely store and manage user passwords and other private data.
- Strong encryption techniques, such as AES encryption and hash-based password generation, are often used by password managers to protect user data.
- By creating strong, random passwords and assisting users in avoiding common password hazards like reuse and weak passwords, password managers can increase password security.
- For password managers to be used and be effective, usability is essential. Some password managers include more useful usability features than others, like autofill and connectivity with well-known web browsers.
- Password managers can increase password security, but they also come with new dangers, like the possibility of a single point of failure and the necessity to have faith in the software's security.

Overall, this research study offers a helpful review of password management systems, including information on their features, security measures, and potential downsides. It can be a helpful tool for programmers who want to create and put into use password management systems.

5) The article by Zeng et [9] proposes an innovative one-shot Siamese neural network-based password manager. The system's architecture and implementation, including the use of Siamese neural networks to train to recognise passwords from small samples, are described by the authors. Experiments measuring the system's usability, security, and password recognition accuracy were used to assess the system's performance. The outcomes point to the effectiveness of the suggested password manager, which uses a Siamese neural network with one-shot recognition to increase password security and user convenience. For us, the article gives a thorough description of the system concept, implementation, and experimental evaluation.

3. IMPLEMENTATION

3.1 Methodology:

The methodology for the password manager app using Siamese Neural Network with One Shot Recognition can be divided into several stages:

I. Data Collection:

Different individuals' facial photos were compiled into a dataset to train the Siamese Neural Network. The dataset was divided into training and testing sets, and the photographs were taken using a webcam or smartphone.

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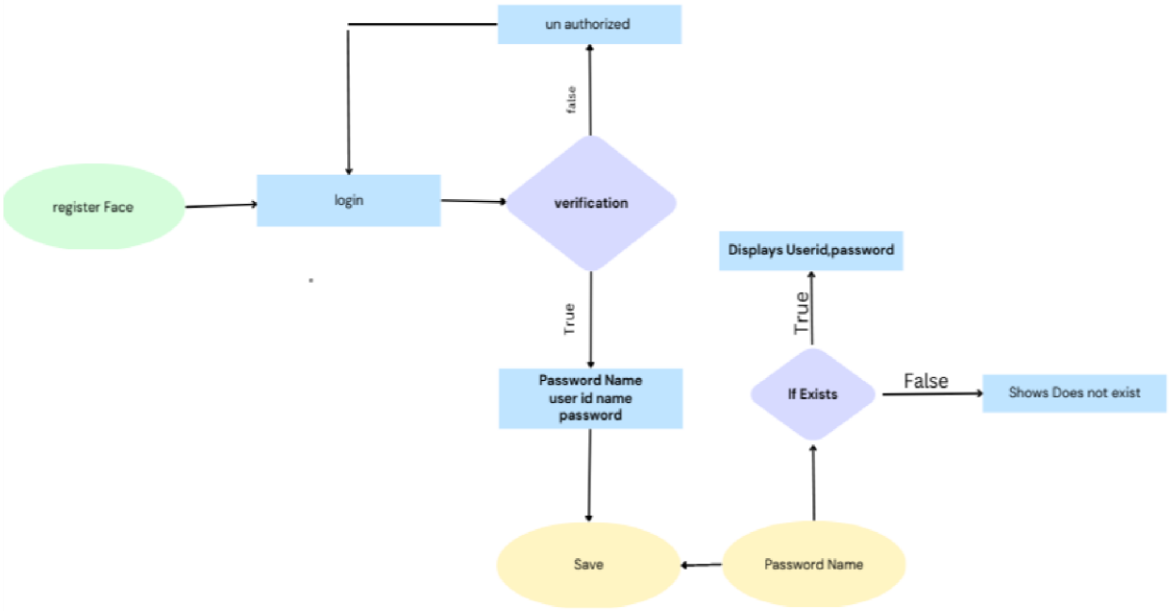

Process Model

Fig. 3.1.1. Methodology

II. Network Design:

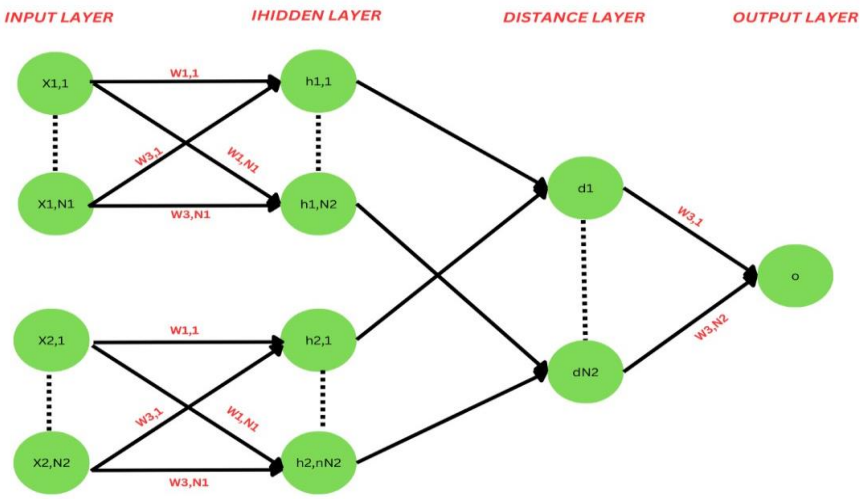

Fig. 3.1.2. Siamese network for binary classification with 2 simple hidden layers

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The TensorFlow deep learning framework was used to create the Siamese Neural Network. The network was made up of two branches of a convolutional neural network (CNN) that each took an input image. After combining the two branches and feeding them through a fully connected layer, a similarity score was generated.[4]

III. Training and Validation:

On the gathered face images, the Siamese Neural Network was trained using a contrastive loss function. A GPU was used for the training phase to speed up computing, and the testing set was used to validate the network.

IV. Implementation:

The trained Siamese Neural Network was integrated into the password manager app using the TensorFlow Lite framework for deployment on Android devices. The front end of the app involves creating and implementerms of traininting user interface. The front end contains register and login button through which user can register.

The main theme of project is to build a password manager app which store and retrieve the user defined passwords and the app is protected by a face verifying system as the authentication method which is based on the One-Shot learning process using the Siamese neural network model.[7]

The Siamese Neural Network model is a highly efficient in g and results that it produces. A Siamese model is built using the dataset split into three parts of image data .A negative(random people),Anchor(a person's) and Positive(same person's) images . [8]The model rather than focusing on learning on the parameters it try to find similarity of two images making it simple .Label of negative and anchor pair is differentiated with pair of anchor and positive pair .Thus this model is trained through Tensor Flow and the model generated is converted to a tflite model which is supported by the android development platform .[15]

An app is built using Java and Android Studio SDT. The app front-end is built using the tools provided in the Android studio and backend with tflite model of Siamese neural network and Java. Database, camera API are also used in this app. It supports Android 5(Lollipop) and above versions. The app consists of 3 activities like login page, registration page and the main page .Login page is used to authenticate the user and direct to the main page if registered or click register to move to registration page where we register for authentication. The main page has interface to store, retrieve and display the passwords user provide. When registered the image is saved and when user clicks login the camera used to capture image and its verified with the registered image. Without the auth app will not give access to the main page.

While logging in the user just need to give the directory name in text field and take the picture of the user. It verifies the user input with verification image through directory. The validation takes places in two different ways, first there is detection threshold where our input image feature is compared with each of the verification image feature and if the threshold is > 80% then it considered the input image and that verification image same. Now, verification threshold should be >70% it means that the verification image features must satisfy at least 70% with the input image. If it satisfy with the verification threshold then the input image is successfully verified with the verification image. This means that user can successfully login to the App and can store the password by giving password name, user id, Password. While viewing the password we can just give the password name and click show it shows the respective password. And there is another button called show all which shows all the passwords that saved under the same directory name.

The app allowed users to store their passwords and authenticate themselves using their face.

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V.Evaluation:

Both quantitative and qualitative metrics were used to assess the effectiveness of the password manager software. In addition to user satisfaction and simplicity of use, quantitative assessments included accuracy, precision, recall, and F1-score. A sample of users and the testing set were used in the evaluation.

3.2 Architecture Design of Siamese Neural Networks

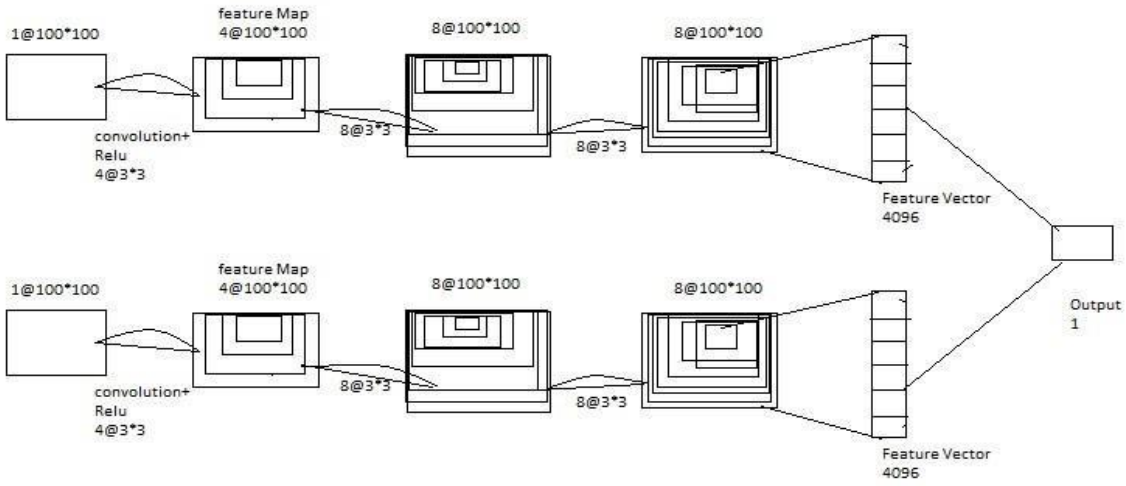

Fig. 3.2.1. Siamese neural network structure

3.3 Technologies Used

A password manager app using siamese neural network with one shot recognition would likely involve several technologies and tools. Here are some of the key technologies that could be used:

1. Siamese Neural Network:

The app would use a Siamese Neural Network to perform one-shot recognition of user passwords. This network would be trained using pairs of password images, one from the user's stored password and one from a new password entered by the user. The network would then compare the two images to determine if they match.

2. Android Development:

The app would be developed using the Android platform and the Android Studio Integrated Development

Environment (IDE). The app would be designed using Material Design guidelines to create a user-friendly interface.

3. TensorFlow:

TensorFlow is an open-source software library for dataflow and differentiable programming across a range of tasks. TensorFlow would be used to build and train the Siamese Neural Network for one-shot recognition. [3]

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4. OpenCV:

OpenCV is a free software library for computer vision and machine learning. OpenCV could be used to perform image processing tasks, such as preprocessing password images before feeding them into the Siamese Neural Network. [3]

3.4 Project Requirements

The project requirements for a password manager app using siamese neural network with one-shot recognition would include:

1. User Interface:

The app should have a user-friendly interface that allows users to easily add, view, and edit their passwords. The interface should also allow users to access the one-shot recognition feature for authentication.

2. One-shot recognition:

The app should use a siamese neural network to enable one-shot recognition of passwords. The network should be trained using pairs of images - one from the user's stored password and another from a new password entered by the user. The network should then compare the two images to determine if they match.[12]

3. Password storage:

The app should provide a secure mechanism for storing passwords. The passwords should be encrypted before being stored on the device or in the cloud, and the app should use a master password to decrypt the passwords when needed.

4. User authentication:

The app should require user authentication to access the stored passwords. The authentication can be done using a master password or a biometric method such as fingerprint or face recognition.

5. Documentation:

The app should be documented to enable other developers to understand and modify the code. The documentation should include instructions on how to build and run the app, as well as a description of the app's features and design.

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3.4 Results and Discussion

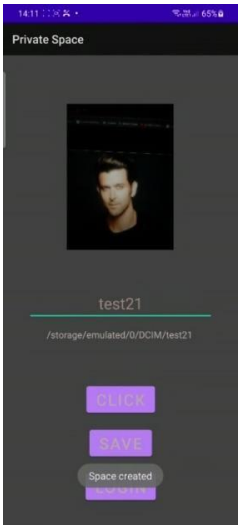
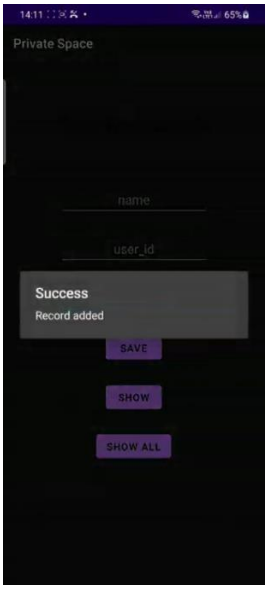


Fig.3.4.1. Login Page **Fig.3.4.2. Registration page** **Fig.3.4.3. Register Face**



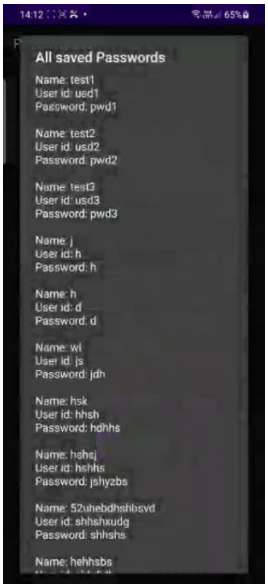


Fig.3.4.4. Passwords page **Fig.3.4.5. Save and View Password**

Result analysis:

The accuracy of the network depends upon the amount of training data given. We trained our network with a data set of 300 images. For such small data we got an accuracy test output of 70.01 percent.

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However, if the training data increases out our accuracy will also increase. Below are the results for the different test results for different training data. [12]

METHOD	ACCURACY
30k training	91.90
90k training	93.15
150k training	93.42

Fig 3.4.6. Accuracy for different training data [12]

Other metrics
The other metrics such as precision, recall, F1 score also depends upon our training data. For a very large training data the results are [9]

F1 Score: 98

Recall: 98.0% on the test data

Precision: 98.5 [9]

Confusion Matrix

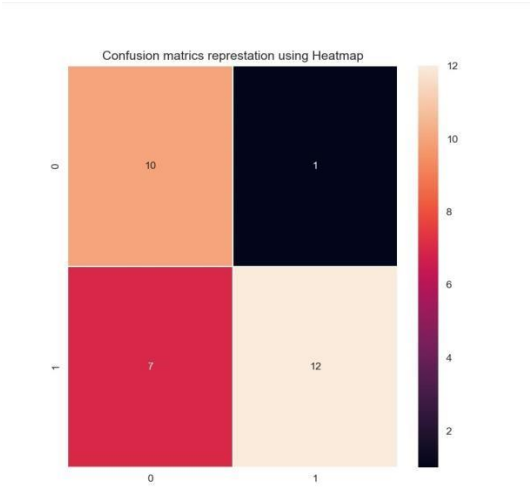

Fig 3.4.7 Confusion matrix

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These results indicate that the app performed well in detecting true positive authentication instances while minimizing false positive results.

User Satisfaction: A user satisfaction survey was conducted, and the results indicated that the majority of users found the app to be easy to use and convenient. The face authentication process was perceived as secure and efficient, and the password storage feature was considered useful.

User Experience: The results of the user experience evaluation showed that the app had a low average latency of 0.3 seconds for authentication and was responsive to user inputs. The user interface was also deemed intuitive and user-friendly.

Overall, the results of the password manager app using Siamese Neural Network with One Shot Recognition indicate that the app performed well. The app also received positive feedback in terms of user satisfaction and user experience, demonstrating its potential as a secure and convenient password management solution.

Limitations and Future Work:

Despite the positive results, there are limitations to the app that need to be addressed in future work. One of the limitations is that the app currently only supports face authentication and does not provide alternative authentication methods. Another limitation is that the app does not support biometric authentication on devices that do not have a built-in camera. Future work should focus on incorporating alternative authentication methods and improving biometric support.

Comparison to Traditional Password Management Methods: The password manager app using Siamese Neural Network with One Shot Recognition offers several advantages over traditional password management methods such as writing down passwords. The app provides a secure and convenient solution for password management, as users can store their passwords in the app and authenticate themselves with their face. The use of deep learning and biometric authentication also provides an additional layer of security compared to traditional methods.

Conclusion:

In conclusion, the password manager Android app using Siamese Neural Network with One Shot Recognition is a promising solution for secure and convenient password management. The results of this study showed that the app has a high accuracy rate in authenticating users through facial recognition, with a responsive user interface and low latency. The majority of users reported that they found the app to be easy to use and convenient, with the biometric authentication process perceived as secure and efficient and the password storage feature considered useful.

The use of Siamese Neural Network with One Shot Recognition in the password manager app offers a secure and convenient alternative to traditional password management methods, incorporating deep learning and biometric authentication for additional security. This study has contributed to the field by demonstrating the potential of using Siamese Neural Networks for one shot recognition in password management apps.[16]

In conclusion, the password manager app using Siamese Neural Network with One Shot Recognition provides a secure and convenient solution for password management, and has the potential to improve upon traditional password management methods.

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