LA2ENEE: Finding Lost People

Dr. Osama S. Elshehry

Higher Institute of Computers and Information Technology, Computer Department. , El. Shorouk Academy, Cairo, Egypt

Email: dr.osama.elshehry@sha.edu.eg

Mohamed Khaled Essam, Abdelrahman Raafat Mohamed, Mohamed Yasser Morsy, Mahmoud Samy Mohamed, Fatma Abdelmohsen Hasan, Mariam Ehab Rezk, Mariam Abdallah Mohamed, Mohamed Aboelfotoh Abdelkhalek

Higher Institute of Computers and Information Technology, Computer Department. , El. Shorouk Academy, Cairo, Egypt

Abstract

This paper presents a mobile application that uses face recognition to help find lost or stolen people. The application is designed for two main user groups: Seekers and Finders. Seekers are people looking for a lost or missing person, while Finders are those who have found a lost person and are searching for his family. The application stores pictures of both found and lost people in its database, and uses face recognition to match them. If a match is found, the application notifies both the Seeker and the Finder about the match, and provides a chat facility between them to facilitate communication. The paper discusses the design of the application, its features, and its potential benefits in helping reunite families with their lost loved ones.

Keywords: face recognition, finding lost people, mobile application.

1. Introduction

The issue of missing and stolen people, particularly children, is a global problem that has been prevalent for decades. The problem is further compounded by the issue of child labor and human trafficking, which has become a lucrative business for criminal organizations. The United Nations estimates that there are approximately 25 million victims of human trafficking worldwide, with children accounting for a significant proportion of this number [1].

The typical scenarios for families to try and locate a lost or stolen individual. It's important to act quickly and efficiently in these situations, as time is of the essence. Social media can also be a useful tool in spreading the word and getting more people involved in the search effort. However, it's important to remember that social media platforms are not specifically designed for this purpose, so it's important to also utilize other resources such as law enforcement agencies and community organizations.

LA2ENEE is a mobile application that aims to assist in locating missing persons. It provides a convenient and efficient way for people to search for their loved ones using their smartphones in real-time. Additionally, it allows families and friends to post information about the missing person and track any updates on their whereabouts. The LA2ENEE project has several objectives, including the creation of a specialized mobile app that simplifies the process of finding missing people. By matching images from two categories (Finder and Seeker) and applying various processes, the app can recognize the same person from both categories and notify the seeker of a successful match. Moreover, it facilitates communication between seekers and finders through chatting until they meet. One significant advantage of LA2ENEE is that it can collect vast amounts of data that can be used in other applications. This feature makes it an invaluable tool for researchers studying missing persons' cases. While there are similar applications under development worldwide, we could not find any like LA2ENEE in Egypt. However, we

found "DeEye", an application with different features currently under development [2]. Table 1 shows a comparison between LA2ENEE and DeEye, highlighting the unique features of each application.

LA2ENEE application is primarily designed to match faces using advanced face recognition technology. This core feature allows users to easily identify and verify individuals by comparing their facial features with those stored in the app's database. The app uses sophisticated algorithms and machine learning techniques to analyze facial features such as the distance between the eyes, nose, and mouth, as well as other unique characteristics like skin texture and color. With this powerful tool, users can quickly and accurately identify people they know or need to interact with, making it an ideal solution for security, law enforcement, and other industries where identification is critical. Overall, the face recognition feature of LA2ENEE is unique in terms of convenience, accuracy, and efficiency.

*Table 1 Comparison between **LA2ENEE** and DeEye apps*

Features	LA2ENEE	DeEye App
Posting Missing person	✓	✓
Posting lost person	✓	✗
Real time feed	✓	✓
Live news updates	✗	✓
Chatting and contact	✓	✓
Face recognition to match	✓	✗

2. Face Matching

Facial recognition is a technology that utilizes an individual's facial features to identify or verify their identity. This technology can be used in various settings, including photos, videos, and real-time situations. It is a type of biometric security that falls under the same category as voice recognition, fingerprint recognition, and eye retina or iris recognition.

Facial recognition systems are commonly used in security and law enforcement to identify individuals who may pose a threat or have committed a crime. However, there is growing interest in other areas of use for this technology. For example, some companies are exploring the use of facial recognition for customer identification and personalization purposes. Additionally, some schools are considering using facial recognition to monitor attendance and improve campus security.

Despite its potential benefits, facial recognition technology has also raised concerns about privacy and civil liberties. Critics argue that the use of this technology could lead to mass surveillance and the violation of individuals' rights. As such, there have been calls for greater regulation and oversight of facial recognition systems to ensure that they are used responsibly and ethically.

Face recognition is a complex process that involves several steps, including face detection, face analysis, converting the face image to data, and face matching.

2.1 How does face recognition work?

Many people are familiar with face recognition technology through the FaceID used to unlock iPhones (however, this is only one application of face recognition). Typically, facial recognition does not rely on a massive database of photos to determine an individual's identity it simply identifies and recognizes one person as the sole owner of the device, while limiting access to others.

Beyond unlocking phones, facial recognition works by matching the faces of people walking past special cameras, to images of people on a watch list. The watch lists can contain pictures of anyone, including people who are not suspected of any wrongdoing, and the images can come from anywhere... even from our social media accounts. Face technology systems can vary, but in general, they tend to operate as follows.

2.1.1 Face detection

The first step in face recognition is face detection. This involves identifying the location of a human face within an image or video frame. Face detection algorithms use various techniques such as Haar cascades or deep learning models to identify facial features such as eyes, nose, and mouth. Once the face has been detected, the next step is to analyze it.

2.1.2 Face analysis

Face analysis involves extracting various features from the detected face such as the distance between eyes, nose shape, and jawline. These features are then used to create a unique representation of the individual's face.

2.1.3 Converting the image to data

The third step in face recognition is converting the facial image into data. This involves transforming the facial features extracted during analysis into a numerical representation that can be easily compared with other faces. This numerical representation is often referred to as a "face print" or "face template" .

In the same way that thumbprints are unique, each person has their own faceprint.

2.1.4 Finding a match

Facial recognition technology is a process that involves comparing a faceprint to a database of known faces. This technology is widely used by law enforcement agencies such as the FBI, which has access to over 650 million photos from various state databases [3]. Social media platforms like Facebook also use facial recognition technology by adding any photo tagged with a person's name to their database.

When your faceprint matches an image in a facial recognition database, it can lead to a determination being made about your identity. Facial recognition is considered the most natural biometric measurement because we typically recognize ourselves and others by looking at faces rather than other biometric measurements like thumbprints and irises.

It is estimated that over half of the world's population is touched by face recognition technology regularly. This means that facial recognition technology has become an integral part of our lives, whether we realize it or not. While this technology has its benefits, there are also concerns about privacy and security, especially when it comes to law enforcement agencies using this technology without proper regulations in place [4].

2.1.5 The used library

There are numerous face recognition libraries that are currently available in the market. However, for our work, we have chosen to use Dlib [5] due to its high accuracy and widespread availability. Dlib has been proven to be a reliable and efficient library for facial recognition tasks, making it an ideal choice for our project. In order to provide a more comprehensive comparison between Dlib and other face recognition libraries, we have adapted Table 1 from [6]. This table highlights the key differences between Dlib and other popular libraries, such as OpenCV and FaceNet. It provides a simple yet informative overview of the strengths and weaknesses of each library, allowing us to make an informed decision on which library is best suited for our specific needs. Overall, the availability of various face recognition libraries provides developers with a wide range of options when it comes to choosing the right tool for their project.

However, by carefully evaluating each library's features and capabilities, we can ensure that we select the most appropriate one for our particular application.

The results obtained by SVM with different kernel functions using the descriptors obtained with Dlib [7], VGG16 [8], OpenFace [9], FaceNet [10], and ArcFace [11].

Table 2. Comparison between face recognition libraries

Dataset	Kernels	Dlib	VGG16	OpenFace	FaceNet	ArcFace
LFW	Linear	4.00	12.67	5.30	13.45	6.58
	RBF	9.36	4.81	11.20	4.53	4.01
	Poly-2	19.25	4.81	21.50	14.23	6.82
	Poly-4	27.39	4.89	9.50	20.02	4.33
	Poly-6	23.56	4.54	5.30	20.02	2.78
CFPW	Linear	**48.78**	14.56	37.42	51.94	3.23
	RBF	50.94	7.82	5.00	**54.14**	2.00
	Poly-2	46.82	6.82	29.38	**49.26**	3.75
	Poly-4	31.02	3.01	10.56	22.06	2.33
	Poly-6	17.28	1.29	3.92	6.68	2.05

3. Analysis & Design

3.1 Analysis

3.1.1 Use Case diagram:

A use case diagram is a type of diagram used in software development to describe the interactions between users and a system. It shows the different ways that users can interact with the system, as well as the different types of users that may interact with it. The diagram typically includes actors, which represent the different types of users, and use cases, which represent the different actions or tasks that can be performed within the system. The use case diagram is an important tool in software development because it helps developers to understand how users will interact with the system and what features or functionality they will need. This information can then be used to design and develop a system that meets the needs of its users. Additionally, use case diagrams can help to identify potential issues or problems with a system before it is developed, allowing developers to make changes or improvements early on in the development process.

The use case diagram of our system is shown in **Error! Reference source not found.**.

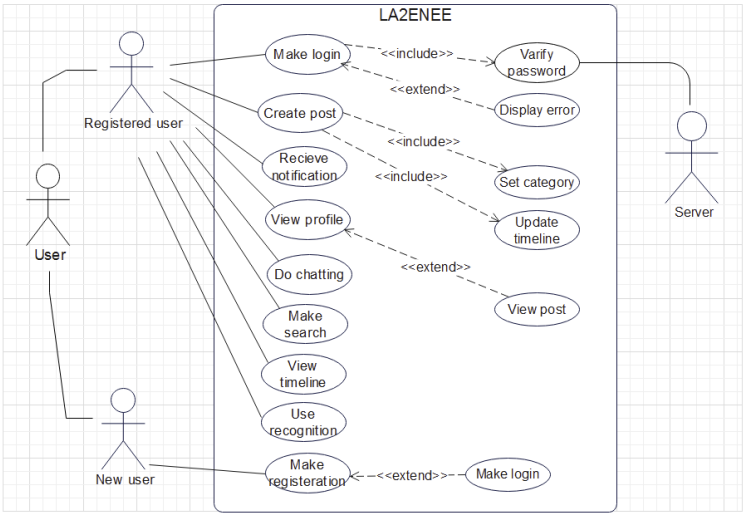

Figure 1 Use Case Diagram

3.1.2 Class Diagram

A UML class diagram is a type of diagrams used in software engineering to visually represent the structure of a system or application. It shows the classes, interfaces, attributes, and methods that make up the system, as well as the relationships between them.

The main purpose of a UML class diagram is to provide a high-level overview of the system's architecture and design. It helps developers and stakeholders understand how different components of the system interact with each other and how data flows through the system. This understanding is crucial for ensuring that the system functions as intended and for identifying potential issues or areas for improvement.

In addition to its role in design and architecture, UML class diagrams can also be used for documentation purposes. They provide a clear and concise way to communicate important information about the system's structure to other members of the development team or stakeholders.

Overall, UML class diagrams are an important tool in software development that help ensure that systems are well-designed, functional, and easy to understand.

The class diagram of our system is shown in **Error! Reference source not found.**.

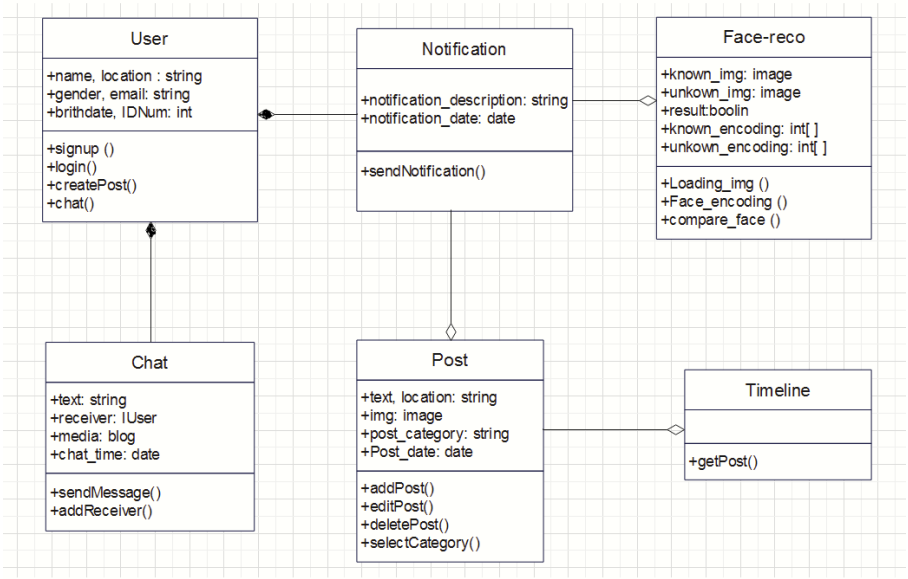

Figure 2 The Class Diagram

3.2 System design

3.2.1 System Architecture:

In software development, system architecture refers to the overall design and structure of a software system. It includes the high-level components and their interactions, as well as the principles and guidelines that govern their construction. The system architecture provides a blueprint for the development team to follow, ensuring that all components work together seamlessly and efficiently. It also helps to ensure that the software is scalable, maintainable, and adaptable to changing requirements over time. A well-designed system architecture is critical to the success of any software project, as it lays the foundation for all subsequent development efforts.. Our system architecture is shown in Figure 3.

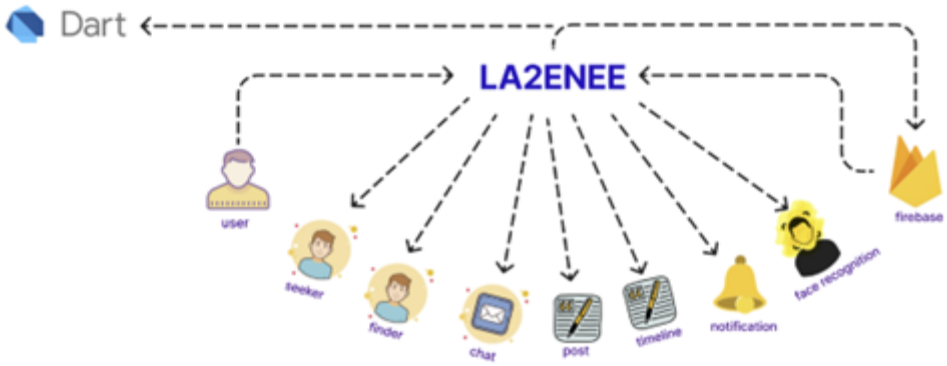

Figure 3 System Architecture

3.2.2 Database Design

Database design involves creating a blueprint for how data will be stored, organized, and accessed within a database system. This includes defining the tables that will hold the data, the relationships between those tables, and any constraints or rules that must be followed when manipulating or querying the data. A well-designed database can improve performance, reduce errors, and make it easier to maintain and update the system over time.

An entity relationship diagram (ERD) is a graphical representation of entities and their relationships to each other. It is used in database design to illustrate the relationships between tables and the attributes of

those tables. ERDs are typically created using symbols such as rectangles, diamonds, and lines to represent entities, attributes, and relationships respectively.

Our system ERD is shown in **Error! Reference source not found.**.

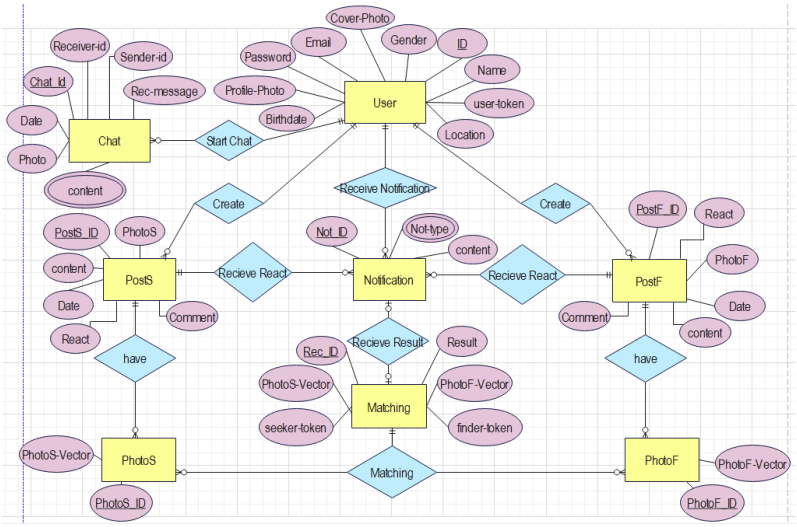

Figure 4 ERD Diagram

3.2.3 Database Schema

A database schema is a blueprint or a plan that outlines the structure of a database. It defines how data is organized and stored in tables, as well as the relationships between those tables. The schema also specifies the data types, constraints, and rules that govern the data stored in the database. In essence, a database schema provides a framework for creating and managing databases, allowing users to easily access and manipulate data in a structured and organized manner.

Our system database schema is show in Figure 5.

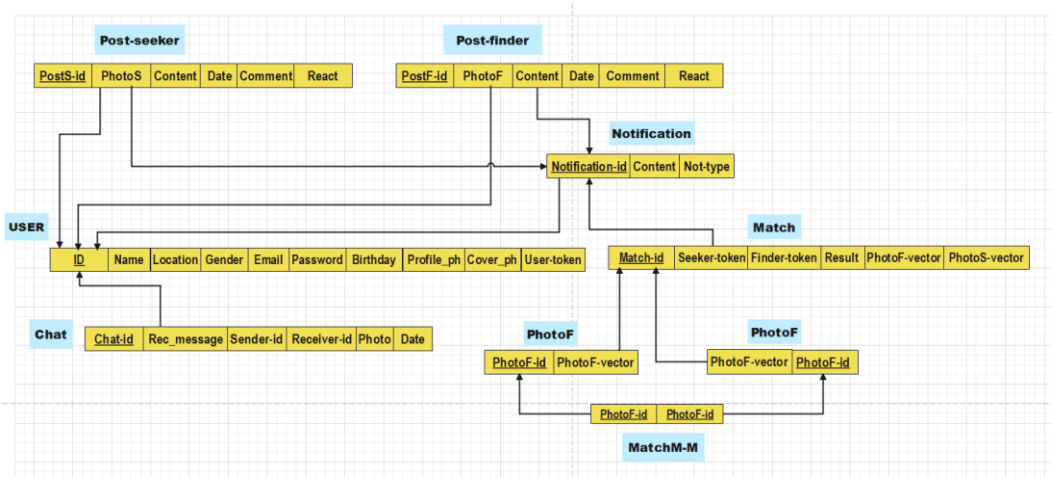

Figure 5 Database schema

3.3 User Interface design:

Firstly, let's talk about the signup screen. The signup screen is where new users can create an account with the app. It typically includes several input fields such as name, email address, and password. There are additional fields such as date of birth, and gender.

Next let's move on to the login screen. The login screen is the first point of contact for users who are already registered with the app. It typically consists of two input fields: one for the user's email or

username and another for their password. Additionally, there is a "forgot password" link or button that allows users to reset their password if they have forgotten it.

The following figures from Figure 6 to Figure 13 are some samples of LA2NEE mobile application screens.

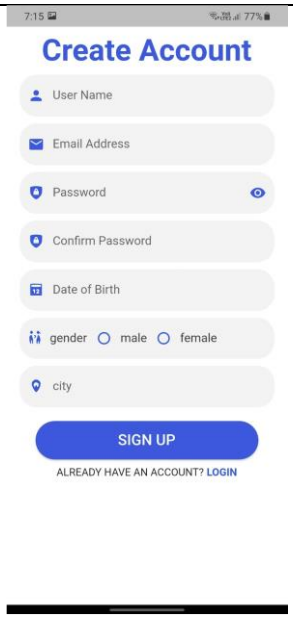

Figure 6 *Sign up Screen*

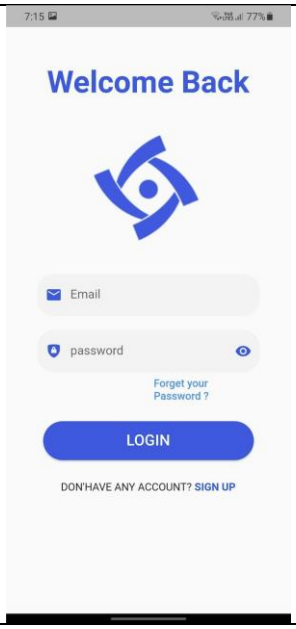

Figure 7 Login Screen

Figure 8 *Post seeker screen*

Figure 9 Finder post

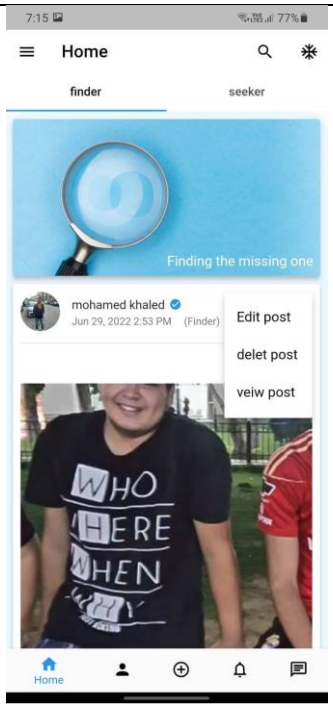

Figure 10 edit, delet and view post

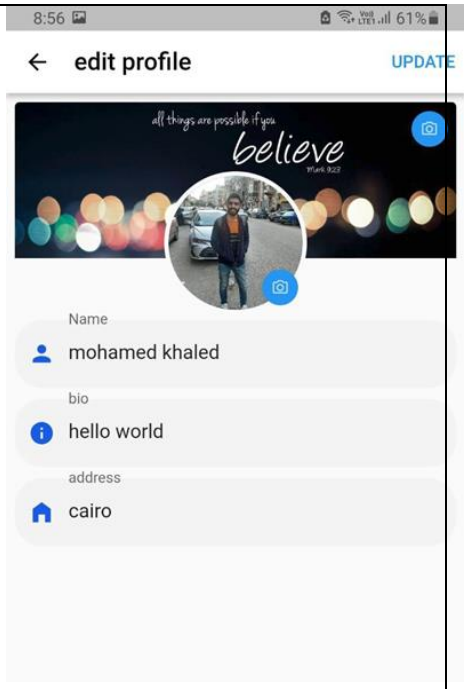

Figure 11 edit profile

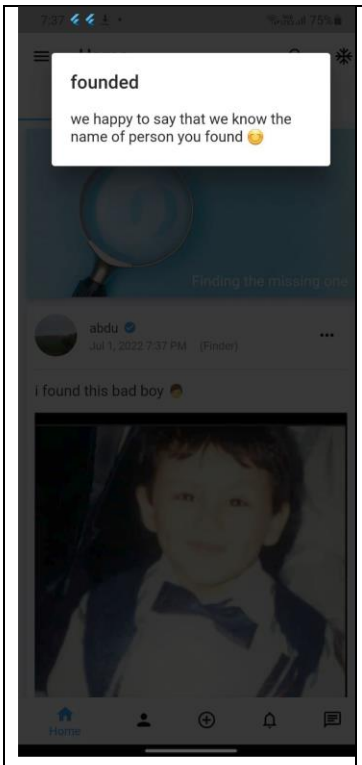

Figure 12 notification when matching is true

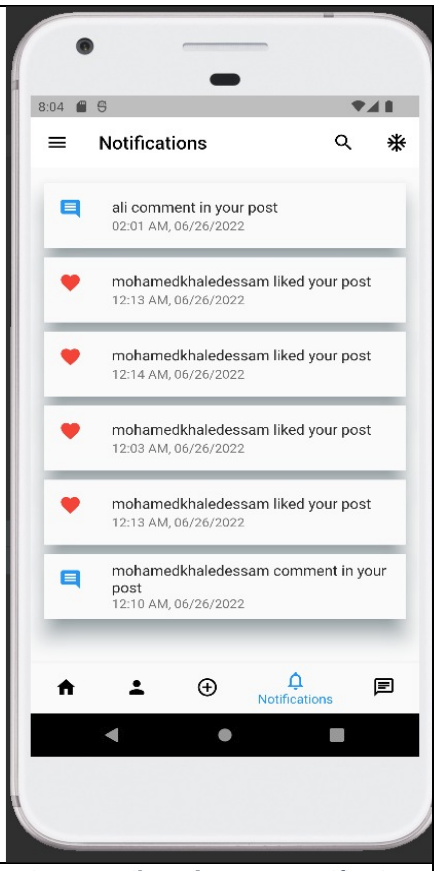

Figure 13 Like and comment notification

4. Implementation

4.1 Flutter Framework

LAENEE mobile application was developed using Flutter framework. Flutter is an open-source mobile application development framework that was developed by Google. It allows developers to create high-performance, visually attractive, and natively compiled applications for mobile, web, and desktop platforms from a single codebase. Flutter uses the Dart programming language, which is easy to learn and has features such as AOT (Ahead of Time) compilation and Just-in-Time (JIT) compilation.

Flutter's architecture is based on widgets, which are building blocks for creating user interfaces. Widgets can be combined to create complex UI elements, and they can be customized to fit the needs of the application. Flutter also provides a rich set of pre-built widgets that can be used to create common UI elements such as buttons, text fields, and lists.

One of the key benefits of using Flutter is its hot reload feature, which allows developers to see changes in their code immediately without having to restart the application. This makes it easier for developers to iterate quickly and make changes on the fly.

Overall, Flutter is a powerful framework that enables developers to create beautiful and performant applications across multiple platforms with ease.

4.2 Flask web framework

The backend of the application was developed using Flask. Flask is a popular Python web framework that allows developers to build web applications quickly and easily. It's lightweight, flexible, and easy to learn, making it a great choice for beginners and experienced developers alike. Flask provides a lot of

built-in functionality for handling HTTP requests and responses, as well as support for routing, templates, and more. Additionally, Flask is highly extensible through the use of plugins and extensions.

4.3 Firebase

LA2NEE mobile application uses Firebase as a Backend-as-a-Service (Baas Firebase is a cloud-based platform that provides developers with a variety of tools for building mobile and web applications. It includes features such as real-time database, authentication, hosting, storage, messaging, and more. Firebase is designed to be easy to use and integrate into application code with minimal setup required. It also offers robust security features to keep your data safe.

When used together, Flask and Firebase can provide a powerful combination for building modern web applications. Flask can handle the server-side logic of your application while Firebase can handle the client-side interactions with real-time data updates. This allows us to build highly responsive applications that can scale easily as our user base grows. Overall, both Flask framework and Firebase are great tools for building modern web applications quickly and easily.

5. Results & Conclusion

In conclusion, the mobile application presented in this article is a promising tool for reuniting lost or missing people with their families. By utilizing face recognition technology, the application can match pictures of both found and lost individuals in its database, and notify both Seekers and Finders about potential matches. The chat facility provided by the application also facilitates communication between these two groups, making it easier to coordinate efforts to reunite families with their loved ones. The use of Dlib face recognition library and development using Flutter and Firebase are also noteworthy aspects of this application's design. Overall, this mobile application has great potential to make a positive impact on society by helping to bring families back together.

6. References

[1] U. Nations, "UNODC report on human trafficking exposes modern form of slavery," United Nations, [Online]. Available: https://www.unodc.org/unodc/en/human-trafficking/global-report-on-trafficking-in-persons.html.

[2] Deeye, "DeEye," [Online]. Available: https://appadvice.com/app/deeye/1598235748.

[3] N. S. Guliani, "The FBI Has Access to Over 640 Million Photos of Us Through Its Facial Recognition Database," ACLU, [Online]. Available: https://www.aclu.org/news/privacy-technology/fbi-has-access-over-640-million-photos-us-through.

[4] Introna, Lucas and Nissenbaum, Helen, "Facial Recognition Technology: A Survey of Policy and Implementation Issues," *Center for Catastrophe Preparedness and Response, New York University*, 2009.

[5] D. E. King, "Dlib-ml: A Machine Learning Toolkit," *Journal of Machine Learning Research*, vol. 10, pp. 1755-1758, 2009.

[6] R. Biswas and P. Blanco, "State of the Art: Face Recognition," *arXiv e-prints*, aug 2021.

[7] S. Sharma; Shanmugasundaram Karthikeyan; Kumar Ramasamy Sathees, "FAREC – CNN based efficient face recognition technique using Dlib," in *International Conference on Advanced Communication Control and Computing Technologies (ICACCCT),*, 2016.

[8] K. Simonyan and A. Zisserman., "Very deep convolutional networks for large-scale," in *International Conference on Learning Representations*, 2015.

[9] Brandon Amos, Bartosz Ludwiczuk, and Mahadev Satyanarayanan, "OpenFace: A general-purpose face recognition library with mobile applications," 2016.

[10] Florian Schroff; Dmitry Kalenichenko; James Philbin, "FaceNet: A unified embedding for face recognition and clustering," in *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Boston, MA, USA, 2015.

[11] Jiankang Deng; Jia Guo; Niannan Xue; Stefanos Zafeiriou, "ArcFace: Additive Angular Margin Loss for Deep Face Recognition," in *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, ArcFace: Additive Angular Margin Loss for Deep Face Recognition, 2019.