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Rescue-Net: AI-based Urban Search System

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***Abstract*— Alzheimer's disease is a progressive neurological disorder that affects cognitive abilities, particularly the ability to do intricate mental tasks. The central nervous system is impacted. As the condition worsens, the incapacity to perform intricate mental duties will also worsen. A person suffering from this condition will experience severe cognitive impairment as a result of losing their capacity for clear thought and information processing. Research has shown that genetic predispositions, dietary practices, and psychological stress all contribute significantly to the development of this illness. Memory loss is a chronic neurological illness that is related to Alzheimer's disease. By causing a permanent degeneration of brain tissue, this is accomplished. Memory loss is linked to a wide range of symptoms, including trouble speaking, cognitive impairment, sense of disorientation emotional instability, difficulty carrying out everyday tasks, and difficulties with language. As a disease progresses, people typically become less self-sufficient and need round-the-clock care. Even with these dynamic elements, face recognition in recordings taken in a crowded, large-scale situation remains difficult to use for Alzheimer's patient identification. In this study, we present a novel tracking system designed specifically for individuals suffering from Alzheimer's disease. Using face recognition software, we are able to identify them from a profile photo that caregivers or family members have submitted. The findings of our proposed intelligent tracking system show good performance, which makes it a valuable tool for identifying individuals who may wander due to cognitive impairment.**

***Index Terms*— Alzheimer's, Neurological disorder, Genetic Predisposition, Tracking system, Cognitive Impairment.**

I. INTRODUCTION

Alzheimer's disease (AD) is an ailment that arises from the irreversible damage of memory cells, commonly termed dementia. It leads to the destruction of nerve cells and the deterioration of tissues throughout the brain, culminating in memory loss. This condition adversely affects the ability to perform daily activities. An alarming number of individuals are afflicted by this disorder annually; recent estimates suggest that one in 85 individuals will experience AD by 2050. This condition is recognized as the world's second most critical neurological disorder. Symptoms of dementia manifest in approximately 60%–80% of the population diagnosed with Alzheimer's disease. This paper presents Rescue-Net, a Flutter-created mobile application to assist missing Alzheimer's sufferers in finding their way home. Rescue-Net's powerful facial recognition technology provides fast and accurate identification by matching provided photographs with approved database profiles. Law enforcement officers can handle missing persons situations more effectively when missing persons are promptly reunited with their families through the service.

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Rescue-Net's intuitive interface makes it easy for law enforcement and concerned citizens to report and track missing persons. Together with expediting the prompt reunion of lost persons with their families, the initiative increases the effectiveness of law enforcement in managing similar instances. With Rescue-Net's user-friendly interface, both law enforcement officers and concerned civilians may quickly report and locate missing persons. Using geolocation technologies, the app provides real-time information on the closest police stations, allowing for quick action. Rescue- Networks with law enforcement organizations to enhance its effectiveness in addressing this intricate societal issue.

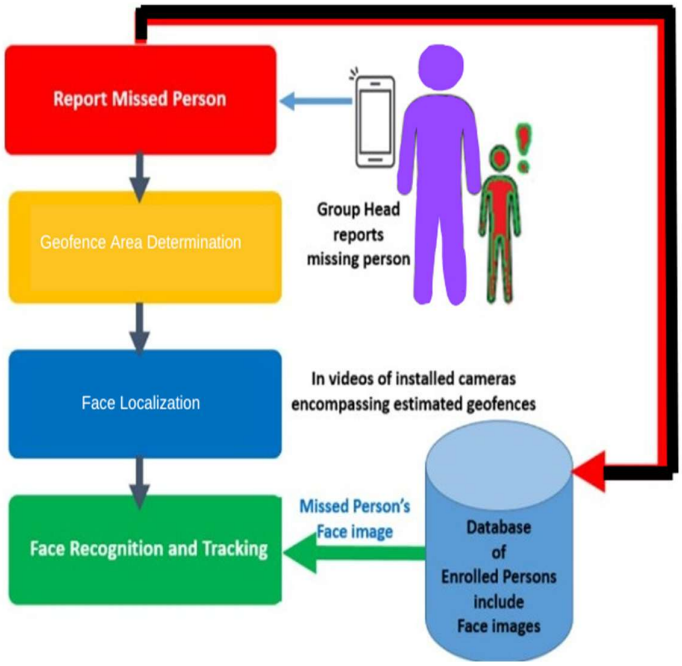

Figure 1. Overall System Process

II. Literature Survey

Several recent studies have explored innovative approaches to address Alzheimer's issue of finding missing persons, with a particular emphasis on leveraging advanced technologies such as face recognition and iris recognition systems.

Mehboob, K., Shaikh, M. K., Khan, M. A., Umm-E-Laila, Bin Mazhar, S. A. [4] This paper studies an appealing methodology that can help individuals with Alzheimer's disease or related disorders in detecting faces they are familiar with. The camera module, ESP32-CAM, analyzes faces in the system, while the Raspberry Pi's processor is in charge of data handling and storing. Providing patients with the names and associations of significant people helps them recall those names. Those who have been witnessing diminished memory might uncover that their quality of life has been improved by this affordable electronic equipment to be utilized at home.

Adnan Nadeem, Mu Hammad Ashraf, Naum, and Qadeer [3] In this paper tested tracking of a missing person in low-resolution images of a large gathering scenario. Face detection using the fusion of Viola-Jones cascades LBP, CART, and HAAR to optimize the results of the localization of face regions. The overall results of the proposed intelligent tracking mechanism suggest good performance when tested on a challenging dataset of 2208 low-resolution images of large crowd-gathering.

Mr. E. Murali et.al [2] This demonstrates the Histogram Of Oriented Gradients (HOG) algorithm in this system will encode the frame and find the faces present in every individual frame and Support Vector Machine (SVM) will compare it with the previously existing images in our database. If there is a match it will send the alert. Enabling the access to normal users to upload pictures of suspicious persons. The proposed project will reduce the efforts of policemen in searching for missing people and will make the search process smoother and more effective.

Deep and Kaushik [1] introduced "Khoj," a system designed for locating missing persons through face recognition. Utilizing 2D arrays to save coordinate points of faces, their system achieved an impressive accuracy rate of 96%. The model gives accurate results for both the detection and recognition of faces. Works by saving the coordinate points of faces in two-dimensional arrays and then match these points with the face points of the searched person.

III. Proposed Methodology

The Rescue-Net program uses state-of-the-art technology in conjunction with procedural frameworks to provide a comprehensive and methodical diagnosis of Alzheimer's patients. Users register on the portal and then send in a detailed report that includes all relevant information regarding the missing Alzheimer's patient. This report data is carefully regulated within the database and then goes through a stringent email verification process to ensure authenticity and data integrity. The images from the databases of the complainant and the finding person are carefully processed using a TensorFlow Lite model after the report facts have been verified. This allows the system to generate similarity matrices for comparison through sophisticated pattern recognition and feature extraction. The user receives instant notifications through the application if a likely match is discovered, ensuring quick updates and action. Geolocation services are used to determine the closest police station and direct users on the next steps for collaborating with law enforcement, further streamlining the search process and increasing user involvement. Simultaneously, any newly captured images of Alzheimer's patients who might have wandered are simply uploaded to the present database, improving the system's ability to be used and examined at a later time. Additionally, due to the platform's user-friendly smartphone interface, users may monitor the status of their reports in real-time. The Rescue-Net platform needs to improve the effectiveness, efficiency, and precision of its search for Alzheimer's patients during this drawn-out procedure. Modern technology is essential for doing this, including deep learning algorithms and GPS integration.

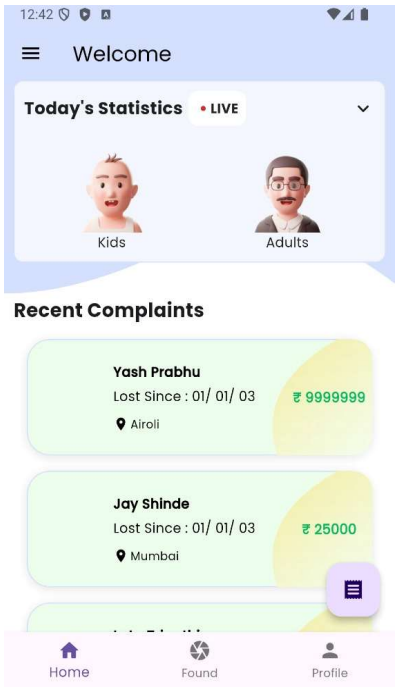

Figure 2. Home page of the App

Figure 3. Logo of the app

A. Convoluted Neural Network

Convolutional neural networks are the predominant technology used in the [2]. It's ambition is to locate the missing person by using facial recognition technology. Because CNNs are very good at sort out facial idiosyncrasy(traits) from raw images, they are perfect for handling challenging remembrance(recognition) jobs in real world scenarios. The procedure begins with convolutional layers, where filters are applied to recognize different aspects of the face. These layers generate feature maps that highlight specific facial characteristics, such

as the eyes, nose, and mouth. The spatial dimensions of these feature maps are then minimized by pooling layers, maintaining important characteristics and lowering the processing demands of the model. Finally, the extracted features are processed by fully connected layers, which enable the system to classify and match the input images to those in a database of missing persons. One significant feature of CNN IN [2] is its ability to handle real-world variances in input photos, including variations in occlusion, lighting, and facial position. This enables [2] to perform flawless face recognition even in challenging scenarios, such as images with poor quality or partial obscurity. By employing CNN, [2] efficiently matches faces from CCTV or other sources with large databases, providing a very trustworthy real-time method for identifying missing persons.

B. YOLO

Nadeem et al. [3] developed the You Only Look Once (YOLO) model, which utilize Convolutional Neural Networks for real-time object detection and human locating in the field of missing person recognition in huge crowds. Because of its special architecture, YOLO can handle object detection as a single regression problem and process the entire image in a single run. YOLO produces bounding boxes and score of trust for the presence of persons or object in each grid cell by diving the picture being used into a S x S grid. It is useful in packed spaces like public gathering as it permits swift and precise recognition. The authors' method involves augmenting YOLO's object detection capabilities with motion tracking strategies, such as Kalman filters, to follow recognized subjects over a series of video frames. This guarantees consistent and trustworthy tracking of individuals who go missing while navigating dense crowds. In order to ensure thorough coverage in heavily packed locations, the system also includes multi-camera integration, which enables smooth tracking across many angles. By leveraging YOLO's capability to detect and classify objects in real-time, Nadeem et al.'s system provides a robust solution for large-scale video surveillance and missing person identification. The combination of CNN-based feature extraction, efficient grid-based detection, and multi-camera tracking facilitates person re-identification, ensuring effective monitoring even in dynamic and crowded settings.

C. Support Vector Machine (SVM)

Murali et al. (2020) [2] in their work on missing person identification utilized Support Vector Machines as a fundamental classifier for identifying faces. Due to it's strong ability to conclude and handle high-dimensional feature spaces advantageously SVM technique is widely used in machine learning algorithm in face recognition. The primary goal of SVM is to identify the optimal hyperplane that best separates the data into distinct categories—in this case, separating images of identified persons from those of missing individuals. Murali et al. incorporated SVM into their system after performing image preprocessing to enhance facial image quality. Histogram equalization is one preprocessing technique that helps normalize light variations in face photographs. Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) are two methods used in feature extraction that decrease the dimensionality of facial data while maintaining important discriminative features. These reduced features are then passed into the SVM classifier for final identification.

The algorithm of Support Vector Machines (SVM) can effectively separate non-linear data patterns by projecting data into higher-dimensional spaces through the use of kernel functions like the Radial Basis Function (RBF). For different aspects of the face recognition, like lighting, expression, and posture, might complicate classification this capacity is essential. By applying SVM in this way, Murali et al.'s approach enhances the overall performance and reliability of the face recognition model by correctly identifying missing people from photos in a variety of real-world scenarios.

D. Histogram of Oriented Gradients (HOG)

Murali et al., in an attempt to develop a facial recognition model that can help with identifying missing persons, mean imputed columns of their dataset. The work in (2020) [2] utilized as a sample extraction method-Histogram of Oriented Gradients (HOG). HOG is effective for facial feature detection in photos as it locates edge and gradient structures which prove to be uniquely accurate.

The input image is divided into tiny, interconnected areas called cells using HOG, which then gives each cell a gradient or edge orientation. These gradients are then combined to create a histogram of the distribution of intensity change directions for each cell. For instance, a linear filter could be used to detect edges of any orientation in an image of the face. This solves for there is no change in intensity with regard to light sources applied. In Murali et al. The HOG used was in terms of preprocessing and feature extraction pipeline prior to using Support Vector Machines (SVMs) for classification. This method of facial recognition consists in using HOG to extract most important features on the face, which results more accurate and reliable result. The key reason for why we applied this new technique is that hogs feature descriptors are able to construct really

powerful representation from a faces. The SVMs classify the HOG features of a face cropped from large datasets to determine if it was in that dataset.

E. Tensor Flow Lite

TensorFlow is widely quoted in many research as an important weapon to achieve high efficiency computing for biometric and face recognition systems. For Instance, [1] has developed a TensorFlow-based real-time face recognition system that can eliminate missing criminals from enormous surveillance videos at unusually high identification rates based on Convolutional Neural Networks. The fluidity of data preparation, model training and evaluation was also a strong synergy point in their system performance. An approach is taken by Murali et al. To build/boost face recognition algorithms with TensorFlow, support vector machines (SVMs) were integrated and also the Histogram of Oriented Gradients algorithm was used for feature extraction [2]. TensorFlow's handling of big data and optimization with its automatic differentiation made it possible for the authors to obtain better identification rates in various scenarios.

F. Long- Short Term Memory (LSTM)

One type of recurrent neural network designed to capture temporal dependencies and reflect sequential input is the long short-term memory network. In contrast to traditional RNNs, which struggle to deal with fading gradients and learn long-term connections, LSTMs employ a unique architecture that includes memory cells and gating mechanisms. These gates are especially useful for jobs involving time-series data since they control the flow of input, which may gradually educate the network to remember what to keep and what to discard. LSTMs can be employed in the Rescue-Net architecture to study how Alzheimer's patients travel by using GPS data. By learning from previous location data, LSTMs can predict likely wandering behaviors and identify patterns that indicate when a patient is in danger of leaving a safe place.

G. Google ML Kit

ML Kit is a mobile SDK that brings Google's machine learning expertise to Android and iOS apps in a powerful way, allowing developers who wish to harness the power of Machine Learning easily. In addition to this, it has pre-trained models that can be used for other common use cases such as face detection & recognition tasks and text or barcode scanning which makes it excellent library when creating a facial related apps & biometric system. In [1] Google ML Kit could improve the performance of their system while authors were concentrating mostly on CNN for real-time face recognition. Between the use of face detection APIs from ML Kit and additional support vector machines (not just for improved accuracy, but still useful), they were able to increase their ability to recognize faces between different lighting conditions and environmental situations. The work [3] implemented the You Only Look Once (YOLO) algorithm to detect objects in crowded environments. To supplement their strategy, Google ML Kit might offer a real-time face detection functionality that can be easily incorporated with mobile or web apps. The speed-up would make their system more responsive, reduce processing time for incoming video feeds and better track identified individuals in real-time.

TABLE I

Algorithm	**Description**	**Potential Applications**
Convolutional Neural Networks	A deep learning algorithm designed for processing structured grid data, such as images, by automatically learning spatial hierarchies of features. Ideal for image classification and object detection.	Used in facial recognition systems, autonomous vehicles for object detection, and medical image analysis.
Histogram of Oriented Gradients	A feature descriptor that captures the distribution of intensity gradients or edge orientations in an image, making it effective for object and face detection.	Commonly applied in human detection for surveillance systems and robotics, as well as in image classification tasks
TensorFlow Lite	For mobile and embedded devices, a lightweight TensorFlow variant that enables effective on-device inference using optimized models.	Suitable for mobile apps, Internet of Things (IoT) devices, and real-time analytics in various applications, including healthcare and retail.
Support Vector Machines (SVM)	With an emphasis on the support vectors that define the margin, this supervised learning approach for classification tasks determines the best hyperplane to divide classes.	Applied in text classification, image classification, and bioinformatics for gene classification.
Long Short-Term Memory Networks (LSTMs	a kind of recurrent neural network that uses memory cells and gating mechanisms to learn long-term dependencies and is intended to mimic sequential input.	Used in natural language processing, speech recognition, and time-series forecasting, such as stock price prediction.

H. Geolocation Service

Rescue-Net uses geolocation services to support its device to find missing persons This is achieved through GPS (The app integrates with GPS to locate nearest itineraries at the places. The news will be posted to a police station in the user nearest place. For this capability to function, Seek Reunite makes use of Map APIs like Google Maps, offering a full geolocation services and mapping functionalities. Seek Reunite uses these technologies to quick and accurate detection of the nearest law. Prompt response to action enforcement authorities or for other purposes; missing person reports.

IV. CONCLUSION AND FUTURE SCOPE

As part of its plans, the Rescue-Net AI-Based Urban Search System will work with law enforcement and non-governmental organizations to improve machine learning algorithms for increased precision, add more features for real-time tracking, connect on social media to reach a wider audience, implement predictive analytics for proactive identification, and prioritize user support features. These advancements ensure that missing Alzheimer's patients will receive state-of-the-art identification and support. In conclusion, the Rescue-Net flutter application's ongoing technological advancements ensure its continued influence in the field by reinforcing its position as a premier solution for both missing person detection and support.

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