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Emotion Recognition of Elderly People Using Deep Learning

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Abstract: Currently, many countries around the world are moving towards becoming an aging society. The mental health of the elderly is one of the key challenges in an aging society. An elderly population is a special group that needs to be taken care of closely. A key area of concern for the elderly is that of mental health and many technologies can be applied in this area. One possible tool is facial expression recognition (FER) that can be used to detect emotions of the elderly for the purpose of mental health care. Emotion recognition in the field of human-computer interaction refers to that the computer has the corresponding perceptual ability to predict the emotional state of human beings in advance by observing human expressions, behaviours and emotions, so as to ensure that computers can communicate emotionally with humans. This project proposes a reminder system to help patients or old people to take medication. It also helps the users to take appointment from the needy doctor and send notification about the appointment confirmation and notify the care taker about the appointment date and time well in advance. This project recognizes the emotions of elder people using deep learning technique and send the notification to care taker so that care taker can respond to elder people very quickly. This project uses Django framework to build backend of the system and uses MySQL for persistent data storage. Android application enables a graphical user interface were end user will interact with application.

Keywords: Mental health, facial expression recognition, emotions, human expressions, detect emotions.

I. INTRODUCTION

According to the WHO, the number of people aged 60 years or more in the population is gradually increasing, where in 2030 projections indicate that there will be 1.4 billion elderly people and in 2050, it will reach 2.1 billion. There are those who see this milestone from two perspectives. The first of them we can understand that being able to achieve this longevity is a success for humanity since the elderly can contribute to society through knowledge, skills and experiences. On the other hand, the second perspective states that population aging is the most important medical and social demographic problem in the world. The WHO emphasizes that it is necessary to deconstruct these ideas and attitudes related to age, as it can lead to discrimination and directly affect the way the elderly and society face aging.

Population aging is a global phenomenon that has been growing steadily in recent years. About half of the current population of elderly people over 75 years old suffers from physical and/or mental disabilities, with dementia being one of the major challenges affecting the quality of life of the elderly and also of their caregivers. It is important to clarify that along with the aging process, changes in perception can damage the recognition of facial emotions. Basic emotions can be understood as involuntary physiological responses shared by human beings, visually distinguishable and shaped by lifelong experiences. Therefore, the ability to express and recognize emotions through facial expressions is considered a fundamental stage of basic communication and an essential skill to get along in society. Not being able to express emotions such as anger, sadness or disgust can result in social isolation or negatively affect non-verbal communication. In this sense, by decreasing the ability to express emotions, older people may have difficulty communicating important messages such as discomfort associated with treatments and others complications.

With this problem, technology has become a strongly to increase the quality of life of the elderly whether they have any cognitive impairment or not. Although the technological barrier is still a very present point in older generations, current devices and software have broken paradigms and have been adapted to achieve this audience. Basically, what we have is a context in which the increase in life expectancy generates more demands for assistance, care and trained professionals, which are required for longer and longer periods of time. These very specific health resources become unfeasible when we talk about large-scale policies. Assistive technologies are the only solution for this problem. In addition to supporting possible responses to health, assistive technologies seek to integrate these elderly people in a society that is sometimes distant and in which isolation has become not only social but digital.

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II. PROBLEM STATEMENT

The development of emotion recognition detection technology within the artificial intelligence field has garnered significant attention, with a primary focus on leveraging facial expressions to extract rich emotional information. This not only holds substantial promise for enhancing human-computer interaction but also plays a pivotal role in advancing pattern recognition capabilities. In line with this, our goal is to create an Android application that harnesses the power of deep learning models to accurately identify and classify the emotions of elderly individuals. This involves uploading facial images of the elderly to our server, where a deep learning model, specifically constructed using Convolutional Neural Networks (CNN), processes the images after pre-processing a diverse emotion dataset. The application goes beyond emotion recognition and extends its functionality to assist in healthcare management for the elderly. The system efficiently manages the intake of medicines by monitoring and providing timely reminders to the users. Additionally, it helps in organizing and scheduling patient appointments with healthcare professionals, ensuring that elderly individuals receive the necessary medical attention. The notification feature alerts designated caregivers about the medicine intake schedule and upcoming doctor appointments, facilitating a proactive and supportive caregiving approach. This integrated system, encompassing emotion recognition and healthcare management, strives to enhance the overall well-being of elderly individuals while providing valuable support to their caregivers. It exemplifies the transformative potential of artificial intelligence in addressing crucial aspects of healthcare and human interaction.

III. OBJECTIVES AND EXPECTED OUTCOMES

Objectives outline goals to be achieved, while expected outcomes depict anticipated results. They provide direction and clarity, guiding efforts towards desired achievements, fostering accountability, and measuring success effectively.

A. Objectives

The main objectives of this project as follows:

- To develop an Android application to recognize elder people's facial expression using deep learning methodology.
- To develop a system that process people's medicine data and to send notification to care taker about medicine intake.
- To develop a system that process patients appointment data and send notification to caretaker regarding the upcoming doctor appointment.
- To assist the care taker in managing the older people by providing current patients mental status and by providing useful notification regarding medicine intake and appointment.

B. Expected Outcomes

Expected outcome of this project is as follows:

- This application should create a deep learning model using Keras framework to classify dataset images.
- This application should have a graphical user interface to help end user to use the system easily.
- This application should classify input facial images into different emotion classes.
- This application should manage appointment and System should pre-process individual images to clean the facial emotion dataset.
- This application should manage appointment and medicine data to provide timely notification to care taker.

IV. SYSTEM DESIGN

System Design is defined as a process of creating an architecture for different components, interfaces, and modules of the system and providing corresponding data helpful in implementing such elements in systems. System Design is the core concept behind the design of any distributed systems. System Design involves identifying sources of data, it is an intuition towards characterizing, creating, and planning a framework to fulfil the necessity and indeed the prerequisites of particular businesses.

A. Data Flow Diagram

The Fig 1 initiates with a start symbol, indicating the initiation of the image upload. The next step involves inputting credentials. This could involve a username, password, or other access control mechanism to ensure only authorized users can upload images to the database. The flowchart then checks if the entered credentials are correct. If not, the process likely terminates or directs the user to try again. If the credentials are correct, the next step involves uploading the appointment data associated with the image. This could include information such as the patient's name, date of birth, appointment date, and doctor's name. Next, the medical image itself is uploaded to the database.

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The flowchart doesn't specify the image format (e.g., DICOM, JPEG), but medical databases typically use standardized formats to ensure compatibility and image integrity.

Depending on the specific database, this step might involve classifying the image into different categories based on its content. For instance, the image could be classified by body part (e.g., X-ray of the chest, MRI of the brain), medical condition (e.g., fracture, tumor), or imaging modality (e.g., CT scan, ultrasound). This step, also potentially specific to certain databases, could involve analysing the image to detect emotions related to the patient's condition. For example, an algorithm might analyse facial expressions in an ultrasound image to detect fetal distress. Finally, any relevant medication data associated with the patient or appointment is uploaded to the database. This could include medication names, dosages, and administration times. Once all data is uploaded, the system might generate a notification to inform relevant personnel (e.g., doctors, radiologists) that the image and associated data are now available in the database. The process ends with an end symbol, signifying the successful upload of the medical image and associated data to the database.

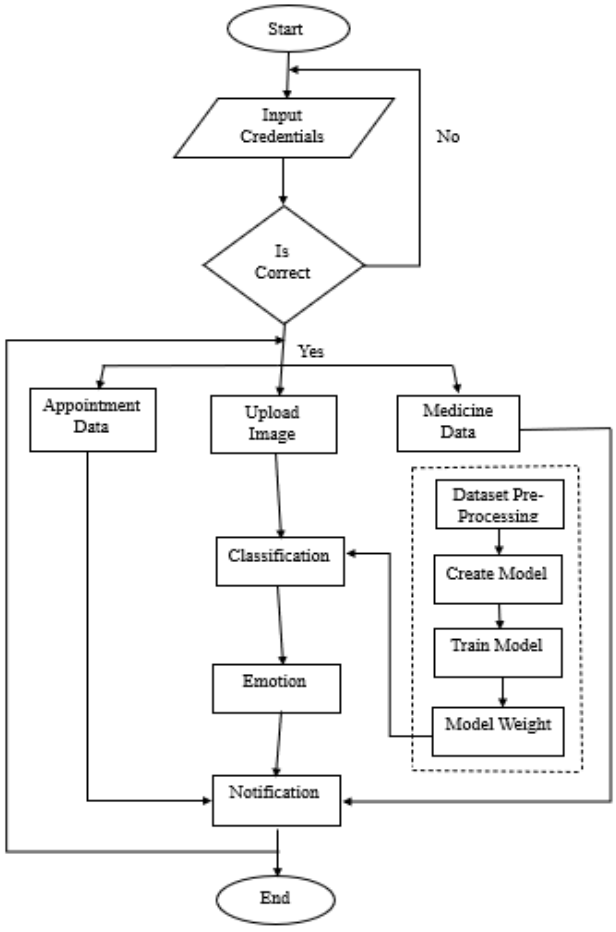

Fig 1: Flow diagram

Overall, this flowchart outlines a fairly standard process for uploading medical images to a database, ensuring secure access, proper data association, and potential for further analysis or notifications. However, it's important to remember that specific details and functionalities might vary depending on the specific database and its intended use.

B. System Architecture

System architecture is the conceptual structure and design of a computer system, which includes hardware components, software components, networks, and how they interact to achieve specified capabilities and goals. It provides a framework for effectively designing, integrating, and managing complex systems. System architecture is fundamentally concerned with establishing the system's components, their responsibilities and linkages, as well as the means for communication and data exchange between them.

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It tries to guarantee that the system satisfies its performance, scalability, reliability, security, and other quality standards. The design often begins with a requirements study, which identifies stakeholders' demands and limitations. This knowledge directs the design process, which may include selecting acceptable hardware platforms, deciding software frameworks and programming languages, and creating protocols for communication between various components.

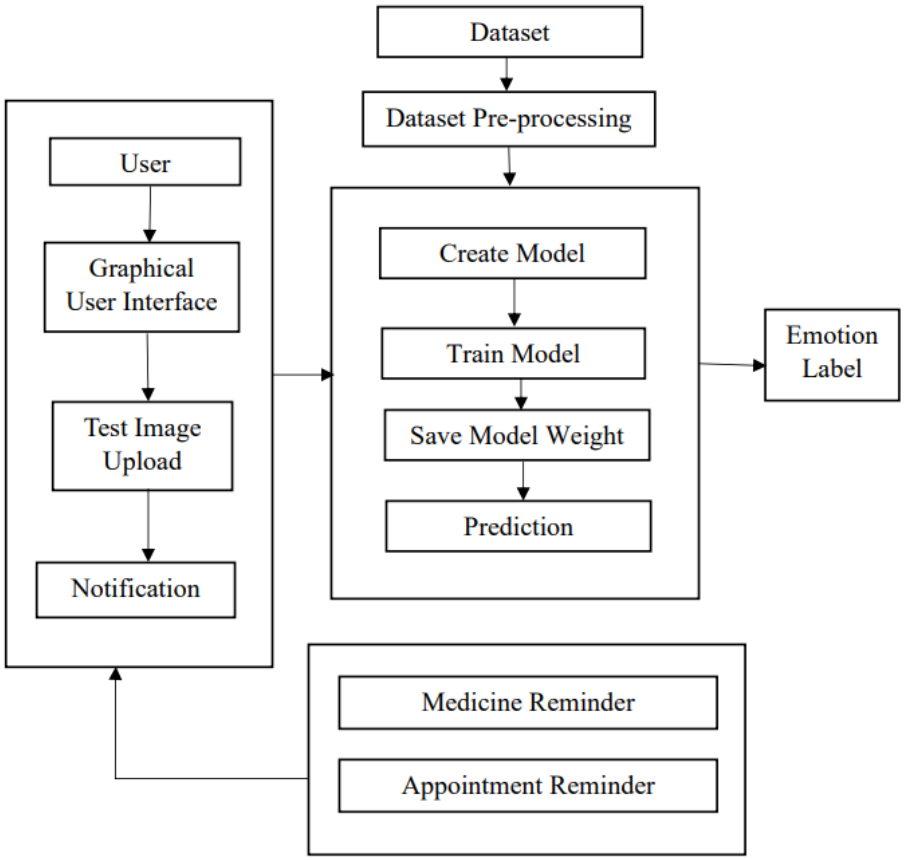

Fig 2: System Architecture

As shown in the Fig 2 the architecture of proposed system. User will communicate with the system using web application. Every uploaded test image will be processed by the deep learning model and predict its class. Deep learning module has Four main functionalities such as create model, train model, saving the model weight and classification.

Dataset needed for the proposed system is obtained from the Internet and augmented to create more copies using different augmentation methods such as scaling, zooming and rotation. A CNN model is built to train the system by extracting image features. DL model predicts the type of user emotion from input image. System also provide notification to elder people regarding medicine intake and doctor appointments.

V. SYSTEM IMPLEMENTATION

A crucial phase in the system development life cycle is successful implementation of new system design. Implementations simply mean converting new system design into operation. The term implementation has different meanings, ranging from the conversion of a basic application to a complete replacement of computer system.

Implementation is used here to mean the process of converting a new or revised system design into an operational one.

A. Model Used

The model used in this project is Customized Convolution Neural Network (CNN).

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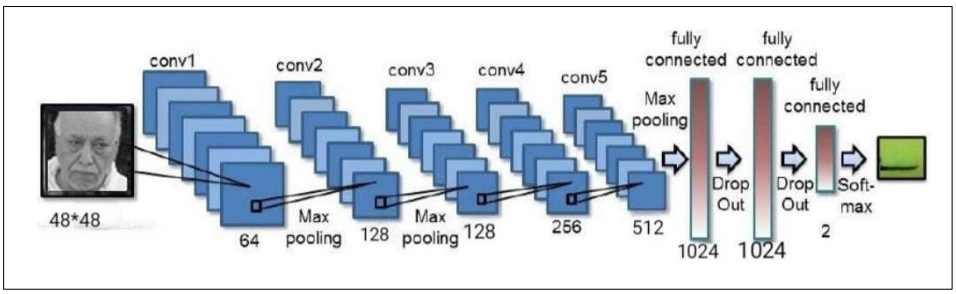

Fig 3: Customized Convolution Neural Network

The Fig 3 convolutional neural network (CNN) architecture is meticulously crafted for image classification, adept at translating 48x48 pixel grayscale input images into meaningful representations for accurate categorization. Beginning with an input layer, it sequentially employs convolutional layers (conv1-conv5) to extract features, escalating from rudimentary to intricate representations using progressively increasing filter counts (64 to 256). Max pooling layers interspersed within the network compress spatial dimensions, fortifying robustness by spotlighting essential features while discarding redundancies. Strategically placed dropout layers combat overfitting by randomly deactivating neurons during training, enhancing generalization. Fully connected layers consolidate high-level features for classification, culminating in a SoftMax layer with two output neurons for binary classification tasks. This architecture, adhering to conventional CNN paradigms, melds convolutional and pooling layers for feature refinement, supplemented by fully connected layers for classification. Its adaptability permits customization to suit diverse task complexities and computational constraints, ensuring efficacy in discerning intricate patterns within image data.

B. Data Used

All photos have been registered and resized to 48*48 pixels. This dataset contains 35,685 images, 48x48-pixel dimension of faces displaying a range of emotions 7 emotions.

Emotion labels in the dataset are as follows:

0: 4593 images- Angry
1: 705 images- Disgust
2: 5121 images- Fear
3: 8989 images- Happy
4: 6077 images- Sad
5: 4002 images- Surprise
6: 6198 images- Neutral

Fig 4: Dataset

Face Expression Recognition (FER) dataset comprises images depicting various emotions such as happiness, sadness, disgust, fear, surprise, anger, and neutrality. These datasets are vital for training Convolutional Neural Network (CNN) models to recognize human emotions from static images.

They encompass diverse attributes including gender, ethnicity, and age, facilitating the development of robust emotion recognition models. By leveraging CNN architectures, one can analyse these datasets to accurately classify emotions.

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VI. RESULT AND DISCUSSION

Result and discussion are the process of examining the outcomes of a particular activity, project, or situation to understand its performance, effectiveness, and impact.

A. Screenshots

Fig 5 showcases a login interface with email and password fields against a futuristic backdrop, inviting contemplation on human-machine interaction's future. Admin-exclusive access allows data management, with login redirecting to the admin dashboard.

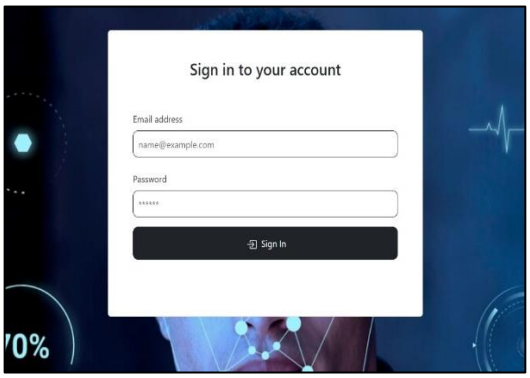

Fig 5: Admin login

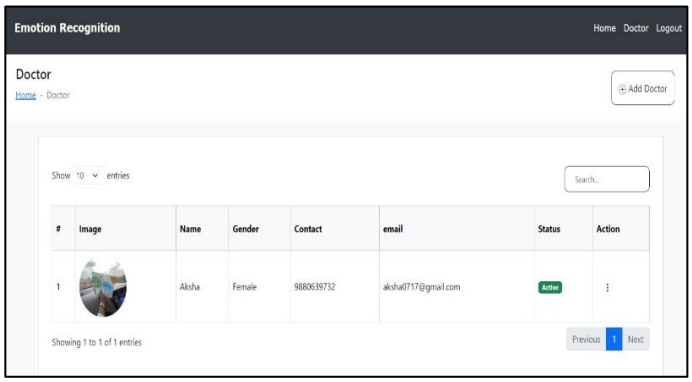

Fig 6: Add Doctor (Admin)

Fig 6 displays admin panel for an "Emotion Recognition" system, facilitating healthcare professional management. User-friendly controls and an "Add Doctor" option ensure streamlined database expansion. The interface efficiently maintains a directory of healthcare professionals within the emotion recognition framework.

Fig 7: User Login

Fig 8: User Profile

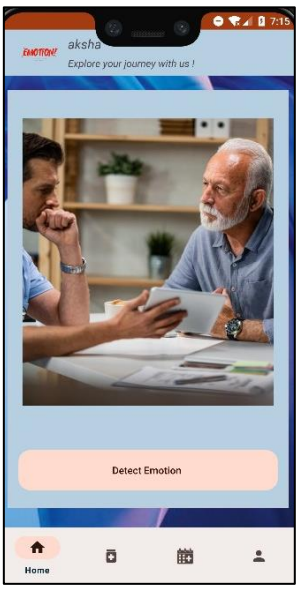

Fig 9: Detect emotion page (user)

Fig 7 portrays a login screen for a mobile app or website, featuring a background image of an elderly woman embraced warmly. Input fields for email and password are displayed below. Fig 8 reveals the user profile/dashboard of "EMOTION!" app, indicating its focus on emotion recognition. Personalized details like name, gender, contact, and location are provided below. Fig 9 unveils "EMOTION!", a mobile app centred on analysing emotions through image processing. The top bar displays a username alongside the tagline "Explore your journey with us!", promising a personalized experience.

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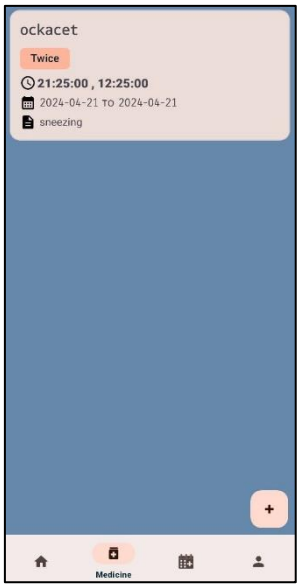

Fig 10: Medicine Reminder Added

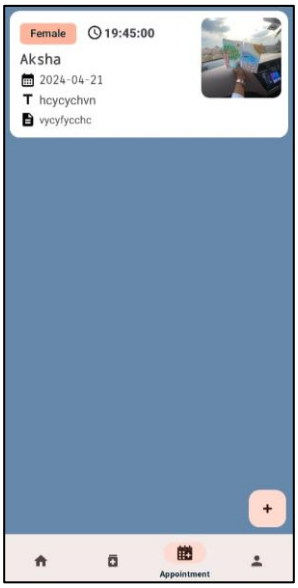

Fig 11: Doctor Appointment Added

Fig 12: Emotion Detection (fearful)

In Fig 10, a medicine reminder app facilitates setting medication reminders by allowing users to input date, time, dosage, and medication details. Notifications are sent two hours prior to intake, including tablet name and dosage instructions, aiding in timely medication and reducing missed doses. Fig 11 depicts an appointment reminder app enabling efficient schedule management by inputting appointment details like date, time, and doctor's information. Notifications, sent two hours before appointments, ensure users are prepared, enhancing organization and punctuality in healthcare commitments. In Fig 12 the app enables users to detect emotions via facial analysis from photos or live camera feeds. It accurately identifies emotions like "Fearful" based on facial expressions. The presence of a "Detect Emotion" button suggests real-time analysis or image uploads. This feature promotes self-awareness and emotional exploration through facial emotion detection.

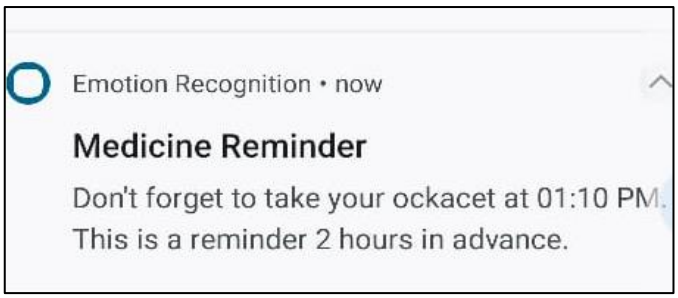

Fig 13: Medicine Reminder Notification

Fig 14: When negative emotion detected SMS sent

Fig 13 displays a medicine reminder notification from the "Emotion Recognition" app, prompting the user to take their "ockacet" medication at 01:10 PM, two hours in advance. This feature integrates with the user's medication schedule, aiding in timely dosage adherence. Fig 14 showcases a messaging app screenshot featuring a conversation with "Mom." Automated messages inform the user about their parent's emotional states, indicating "Sad" on Sunday and "Fearful" today at 8:15 AM, potentially providing updates on the well-being of an elderly or vulnerable parent.

VII. CONCLUSION

The deep learning approach for automatic recognition of facial expressions in older individuals shows its potential to significantly decrease caretaker strain while improving the quality of care for the elderly. The system efficiently handles facial emotion datasets using Convolutional Neural Networks (CNNs), allowing the extraction of complex emotional clues from photos of elderly people. The dataset is thoroughly pre-processed before it is processed to optimize it for further deep learning model training. This algorithm, trained on pre-processed data, improves its accuracy in recognizing facial expressions, offering caretakers with real-time insights into the mental states of the elderly under their care.

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Furthermore, the system's capability goes beyond emotion recognition, including features for continuous caretaker assistance. By including reminders for upcoming medical appointments and medication schedules, the system assures immediate action and commitment to medications. This thorough approach to elder care management addresses not just the urgent need for emotional support and monitoring, but also the broader range of healthcare requirements necessary for the well-being of older people. By providing timely notifications and complete understanding of the emotional well-being of the elderly, the proposed system provides a supportive and caring environment. It provides caretakers with the information they need to better predict and meet the needs of older adults, eventually improving the quality of care given.

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