Homecare System for Demented People using IoT

Santhosha Rao, Varun S Tilekar, Niranjana Sampathila

Abstract: *Internet of Things (IoT) provides many homecare systems and makes an easier life for humans. Some homecare systems are really useful for aged people. In our society, many aged people are suffering from a disease called dementia. Dementia word describes the set of symptoms that may contain memory loss and difficulty with thinking. The demented people are unable to recognize their family members. Also they have difficulty to deal with day to day activities. Taking care of such people is not a dominant task if assigned to a caretaker, but some people may not afford these much of expenses. Even if it is assigned to the caretaker, they may be burdened with the amount of care required. In this work, to reduce the burden on the caretakers, a homecare system using IoT is designed. An android camera phone installed at the door recognizes the face of the arrived person and sends an unique identifier wirelessly to an android watch wore by the demented person. The android watch alerts the user with vibration. Also, it opens the locally stored image using the unique identifier and announces the name of the arrived person. Reminder application is also used to remind the day to day activities with voice commands.*

Keywords : Internet of Things (IoT), OpenCV, LBPH, Face Recognition.

I. INTRODUCTION

The Internet of Things (IOT) has already changed the world by immensely impacting the way in which we live and work. IoT gives a major contribution to the homecare system by connecting the home appliances to the internet. This makes human life easier and better. The increasing population can be categorized into different stages of aged people, in which many people are unable to manage their day to day activities on time owing to diseases like Dementia and Alzheimer. Gradually they have to rely on caretakers. Dementia is an overall term which describes symptoms that directly impact memory, performance and communication abilities. Alzheimer is one such type of Dementia, which is a progressive disease of the brain that slowly leads to many disabilities like memory loss of a person.

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The amount of care required for the person with Dementia, includes an enormous amount of resources in terms of time, money, and manpower. There are many homecare systems already implemented for aged people, which perform assorted solutions to do the day to day activities. Saranya et.al [1] have developed device called MiWi, which is connected to the Alzheimer patient all the time. Whenever the patient is out of house, it keeps track of the patient using a GPS and sends the real-time location to the caretaker's mobile. Dawadi et.al [2] visualized new scenario of home environment to provide caretakers with a better view of the living condition of the elderly and position and state of the home objects. This new home scenario is expected to offer a secure and easy living environment for the elderly, where Internet of Things can be used to control all the frequently used home objects by the elderly. Majumder et.al [3] have implemented a homecare system intended to continuously monitor the dementia people remotely, with low cost and manpower by integrating the actuators, wearable medical sensors and other modern communication devices. Amir et.al [4] proposed healthcare system in combination with IoT based medicine box. The system integrates sensing hardware system and android application for the aged people facing cognitive problems such as Alzheimer. In this system, the physician can prescribe medicines for the patient via android application, which in turn helps the patient to organize the medicine as per the schedule prescribed by the physician. Ashfaq et.al [5] developed an android application which provides various games and quiz to boost the Alzheimer's patient brain functions and display progress report. Coppala et.al [6] conducted a study to addresses the cognitive functioning and quality of life for people diagnosed with dementia via technology. The study analyzes how specially created applications and existing assistive software can be used to decrease the symptoms and improve cognition of older adults suffering from dementia related diseases. Frank Sposaro et.al [7] have implemented an Android application called iWander which communicates with GPS and enables the caretaker to get exact location of dementia patient remotely. The ultimate goal of all these technologies is to reduce the burden on the caretakers of the demented people. In this work, additional system is developed which would further reduce the burden on the caretakers when they are temporarily not available due to some personal commitments. The proposed system contains face recognition and remainder applications. The face recognition application is helpful for the demented people to recognize the family member and friends.

Retrieval Number A4686119119/2019©BEIESP
DOI: 10.35940/ijitee.A4686.119119
Journal Website: www.ijitee.org

1043

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

The reminder application, reminds them to do the day to day activities on time such as breakfast, lunch, dinner, tablets, etc. These both applications give the text as well as voice command notification to the user.

II. SYSTEM MODEL

The homecare system as shown in Fig.1 contains two applications client and server. A client application runs in the android camera and the server application runs in the wearable android gadget. The client application captures the faces of arriving people using OpenCV library and does the face recognition using predefined dataset. The client sends the

unique ID corresponding to arriving people to the server. Server application uses this ID to open the image of the arrived person.
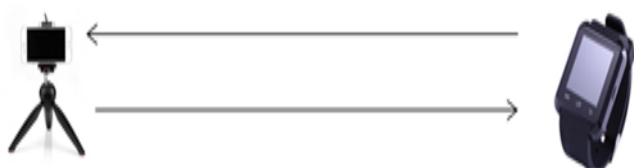

Fig. 1.Homecare system

OpenCV is the open source computer vision library. This open source library provides C, C++, Java, and Python language interfaces with multi-platform such as Windows, Linux, Mac and Android [8]. For face recognition method OpenCV provides three algorithms: Eigenfaces, Fisherfaces, and LBPH (Local Binary Pattern Histogram). The LBPH uses four parameters such as radius, Neighbor, Grid X, and Grid Y. The radius is used to construct the circular local binary pattern and shows the radius over the central pixel. It is commonly fixed to 1. Neighbor is the number of sample points to construct the CLBP (Circular Local Binary Pattern). Grid X and Grid Y show the number of cells in the horizontal and vertical direction. The neighbor, grid X, and grid Y are commonly set to 8 [9] [10]. This work uses OpenCV version 2.4 which provides the newer Face Recognizer class for Face Recognition.

III. IMPLEMENTATION

Automatic face recognition is divided into two steps: Training the algorithm and Face recognition using the predefined dataset.

A. Training the algorithm

In order to train the algorithm, the Train function is to be called by passing a slice of images and a slice of labels as parameter. The labels are used as IDs for the images. In case of more than one image of the same person, the labels should be the same. The Train function will apply the basic LBP operation by changing each pixel based on its neighbors using a default radius defined by the user. The basic LBP operation is depicted in Fig. 2 (using 8 neighbors and radius equal to 1):

After applying the LBP operation, the histograms of each image based on the number of grids (X and Y) passed by parameter are extracted as depicted in Fig. 3. The histograms

of various regions are concatenated to get the histogram that represents the image. The images, unique ID, and histograms are stored in a database.
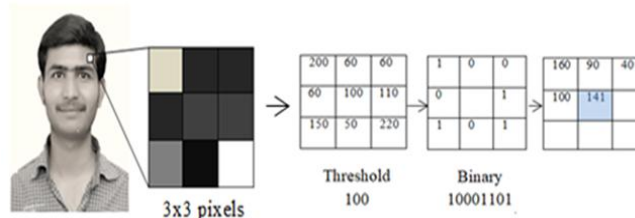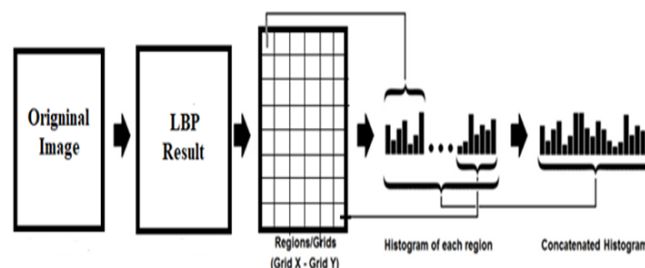

Fig. 2.Basic LBP operation

Fig. 3.Extraction of the Histogram

B. Face Recognition using Predefined Dataset

A face recognition application uses the two android applications such as Client and Server. These applications are connected to each other using TCP/IP socket connection. The server generates the static IP address and port number for making a connection to the client side and goes into the listening mode and waits for a connection. The client uses this IP address and port number and makes the connection using a private Wi-Fi network. Client continuously sends the data packet to the server to maintain the connection. This packet contains the unique ID of the person. Server continuously receives the data packet and does the remaining operation. The client application uses the IP address and port number generated by the server application to establish a connection with the server.

Whenever a person comes in front of the camera, the image is captured and the Predict function is called by passing the image as parameter. The Predict function will extract the histogram from the new image and compares it with the histograms stored in the database and returns the unique ID corresponding to the closest histogram. The Euclidean distance metric is used as the metric for the histogram comparison. The server-side database also contains the unique ID, name of the person, personal information, and image of the person. The unique ID at the server side should be same as that of the client side. It compares received ID with database ID and if it matches, it will display an image of the person as well as display and announce the name. This application also provides information about the person. If the aged people are unable to recognize the person using a name, the system will ask to the user, "Do you recognize the person? Say Yes or No". If the user says "Yes" it will go to the recognition mode, If the user says "No" it will display the information about the recognized person and announce to the user. The entire face detection process is depicted in Fig. 4.
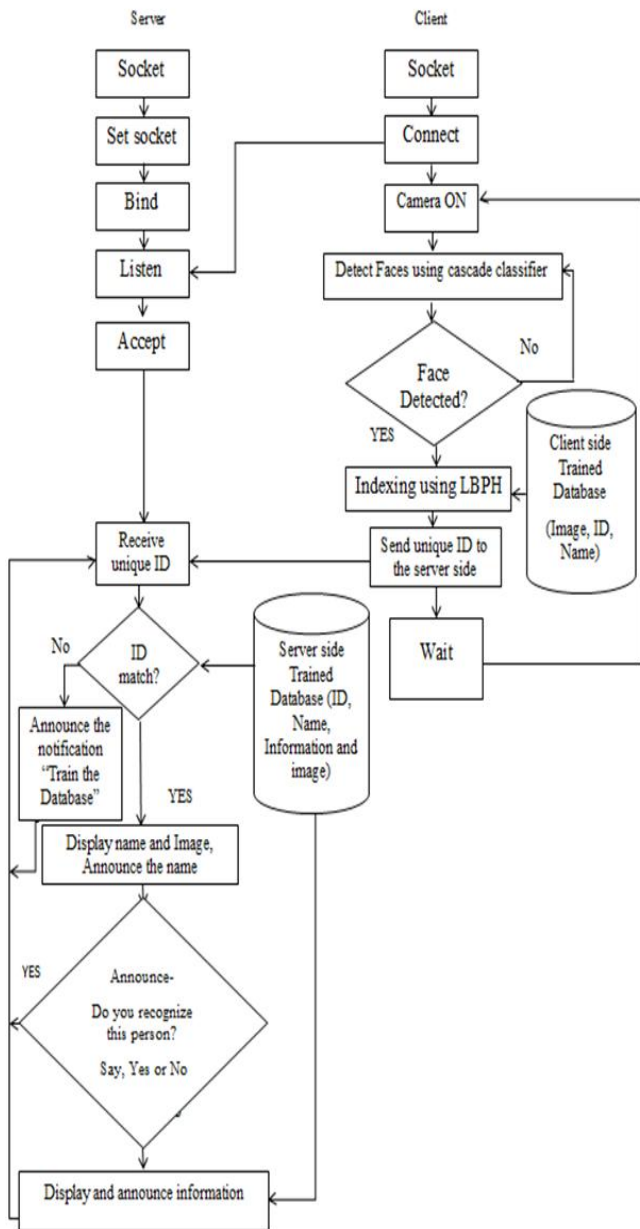
Fig. 4.Face recognition process

C. Assistive Reminder System

This application has been constructed in Java programming language and GUI in XML language with android studio 3.0.1 and the Target API level 26. This is used to remind the day to day activities to the aged people who are suffering from dementia using voice command and vibration. The reminder reminds them day to day activities such as breakfast, lunch, dinner, medicine, etc. The date and time picker is used to set the exact date and time based on the schedule. It supports configurable options for minimum and maximum value, format, interval between the predefined hours in the time view, and convention templates for the month vision of the calendar. The user can create multiple reminders in text format and store into the database. The user can even modify the reminder using three options such as edit, delete and duplicate. Fig.5 shows the screenshot of multiple operations of reminder application.

Edit: - The user can edit the reminder and modify the date, time and text message.

Delete: - The user can delete the reminders.

Duplicate: - The user can set multiple same reminders note using different time and date.
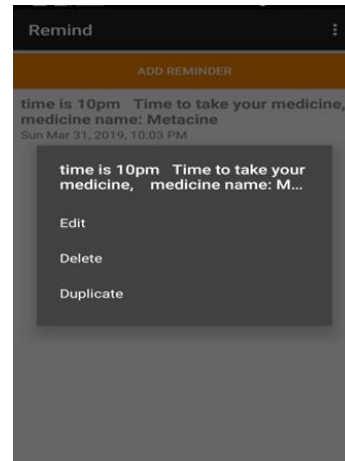

Fig. 5.Multiple operations in Reminder Application

The Fig.6 shows the various steps of the assistive remainder application. After starting the application user can create multiple reminders using note. A user can pick the exact date and time using date and time picker and save into the database. The mobile gives the voice notification with vibration, whenever the configured reminder time matches with the mobile time.
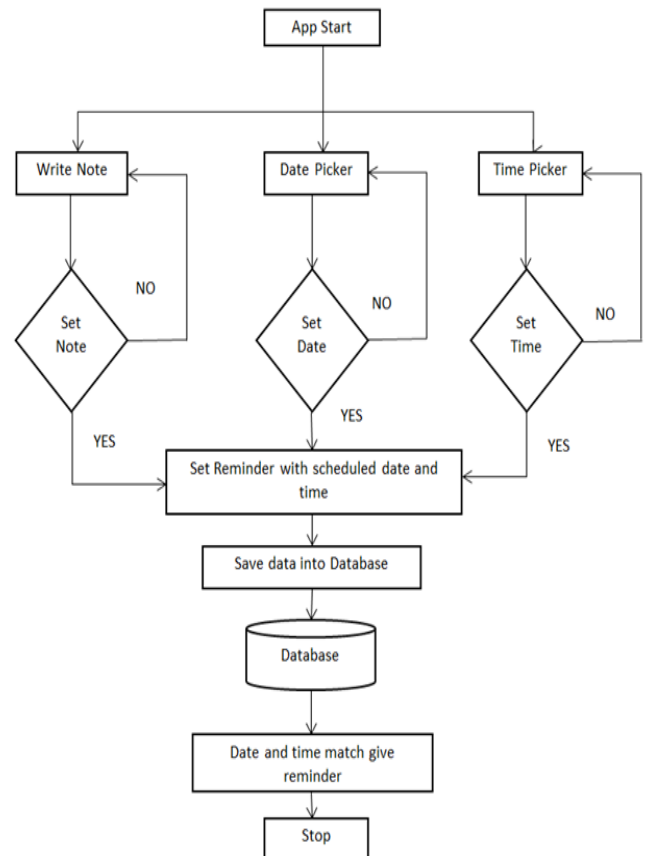

Fig. 6.Reminder process

Google text to speech converter is used to convert text note into voice form. Face recognition and reminder applications use the Google text to speech converter to announce the text output into the voice form.

The face recognition application uses both TTS and STT converter. This application announces the name and information in the voice form using Google TTS converter. The STT converter records the user response in voice and converts into the text form. The reminder is created in the text form and saved into the database. Whenever reminder broadcasts the alarm, it announces the note in the voice form using Google text to speech converter.

IV. RESULTS AND DISCUSSION

The Android camera and the Android gadget are connected to private Wi-Fi network. It is able to cover about 46 meters indoor and 92 meters outdoor. Whenever a person comes in front of the camera, the client captures the frontal face image and does the face recognition. This process is indicated by a marker around the face as depicted in Fig.7. At this point, client recognizes the image and sends unique ID associated with image which was generated during the training phase. The android wear accepts this ID and compares with its database and pops up the image and name of the person corresponding to this ID. If the user is not in a position to recognize the person using name and image, then the system will ask to the user "Do you recognize this person? Say Yes or No". The system records the user response. If the user says 'No' then the system gives them more information about that person in the form of text.
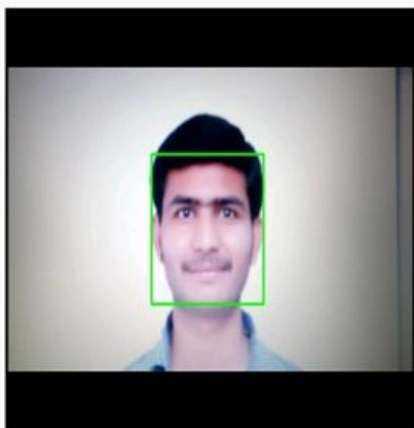

Fig. 7.Image Recognition by Client Application (Android Camera)

V. CONCLUSION

Aged people who are suffering from dementia disease are unable to recognize the family members and friends. The fact that they are unable to do their day to day activities demands a dedicated care taker. It is imperative to reduce the burden on the caretakers by designing systems which would facilitate them to attend some personal commitments. Keeping this in mind, a system is developed which comprises two applications. Automatic face recognition application helps to recognize the arrived person and reminder application helps to do day to day activities on time.

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