

# Face Recognition Using Raspberry Pi for Mentally Retarded Person

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**Abstract:** The face recognition system described in this paper focuses on addressing the needs of individuals with intellectual disabilities. Intellectual disabilities often affect an individual's cognitive and adaptive functioning, making it challenging for them to perform everyday tasks independently. This system utilizes the capabilities of Raspberry Pi, a low cost single-board computer, to create an accessible and user-friendly solution for face recognition. The main objective of this system is to assist mentally challenged individuals in recognizing and identifying familiar faces. By utilizing face recognition technology, the system aims to enhance their independence, social interactions, and overall quality of life. The Raspberry Pi platform provides a flexible and affordable hardware foundation for implementing this system. The system leverages a pre-trained deep learning model for face recognition, such as OpenCV or dlib, to perform face detection and identification tasks. The model is trained on a dataset containing facial images of familiar individuals to ensure accurate recognition. Raspberry Pi's computational capabilities enable real-time processing of the captured video feed, facilitating prompt recognition and response.

**Keywords:** Face recognition, Raspberry Pi.

## 1. INTRODUCTION

In today's world, advancements in technology have opened up new possibilities for enhancing the lives of individuals facing cognitive challenges [1], such as those with mental retardation. One such breakthrough is the utilization of face recognition technology, integrated with the Raspberry Pi, to provide a supportive and inclusive environment for these individuals. Face recognition using Raspberry Pi offers a promising solution that can empower mentally challenged individuals [2], enabling them to navigate their daily lives more independently while fostering a sense of belonging within their communities. One of the challenging issues is to endow a machine with an emotional intelligence. Emotionally intelligent systems must be able to create an affective interaction with users: they must be endowed with the ability to perceive, interpret, express and regulate emotions [1]. The recent research suggests that there are two approaches which are particularly applicable to the study of mental retardation. Studies from the psychology show the need to consider the integration of different non-verbal behavior modalities in the human communication. In this paper, a comparative study of mentally retarded person's expressions with normal persons and a multimodal approach has been attempted to recognize emotions of mentally challenged person's from their facial expressions, speech and body gestures. The model proposed in this approach is using a Bayesian classifier, using a multimodal corpus with four emotions. In face feature extraction method, feature extraction is performed for eyes, eyebrows, mouths and nose using multi-cue approach. Feature masks generated for each facial feature are fused together to produce a final mask along with confidence level estimation. In speech feature extraction method, the set of features that contains features based on intensity, pitch, MFCC, Bark spectral bands, voiced segment characteristics and pause length. Mental retardation [3], also known as intellectual disability, refers to a condition characterized by limitations in cognitive functioning and adaptive behaviors. Individuals with mental retardation often face obstacles in recognizing and interacting with others, making it challenging for them to establish meaningful connections and engage in society confidently.

Here is where the amalgamation of face recognition technology and Raspberry Pi presents a compelling opportunity. Raspberry Pi [4], a credit card-sized computer, is highly versatile and cost-effective. It provides an ideal platform for implementing face recognition systems due to its portability, computational capabilities, and ease of integration with various sensors and peripherals. [5] By combining the power of Raspberry Pi with sophisticated face recognition algorithms, we can create a solution tailored to the specific needs of mentally challenged individuals. The concept of face recognition revolves around the ability to identify and verify individuals based on their unique facial features [6]. By capturing an image or video input, the system can analyze the facial characteristics, compare them against a pre-existing database, and determine the identity of the person in real-time [7]. This technology has widespread applications, including security systems, access control, and personal identification [8]. To improve usability [9], the system incorporates a user-friendly interface that utilizes visual cues, simplified commands, and audio feedback. This interface is designed to accommodate the specific cognitive and sensory needs of individuals with intellectual disabilities. Additionally, the system allows customization options to adapt to varying levels of disability [10], including adjustable sensitivity settings and personalized profiles. [11] describes about Esophageal Peristaltic Control of a Soft-Bodied Swallowing Robot by the Central Pattern Generator. This paper presents the design, implementation, and evaluation of the face recognition system using Raspberry Pi for individuals with intellectual disabilities. The system's effectiveness and usability are assessed through user studies and feedback from caregivers, therapists, and individuals with disabilities.

## II. WORKING

The design process of the proposed system consists of three major divisions: Mechanical, electrical and electronics.  $\lambda$  **MECHANICAL DESIGN:** This involves a movable mechanism. The mechanical design of the robot is a box shape. The box weighs around 60Kg. The height is 3ft, breadth and width is 1.5 ft. There are 3 compartments for keeping the power supply, electronics board and storage container. The robot has the adjustable neck which holds an Android mobile. And the robot is fitted with rubber hand to hold the patient's hand. The motorized wheels are fitted on the robot for mobility purpose.  $\lambda$  **ELECTRICAL DESIGN:** This involves the design of drivers for the system. The robot is fitted with wheels front and back on 4 wheels. The wheels are connected to the 2DC encoder motors to control the front and back wheels. The system will also have containers for food and water, which will be brought out automatically based on the inputs from the patient. This container door is controlled by the stepper motor. The power supply for the whole system is given by a car/bike battery. **ELECTRONICS DESIGN:** The electronics division provides the smartness to the total system. The electronics module has the 2 sub modules, which are processor module and controller module. Processor uses the Android Technology and Controller uses the Raspberry pi board. The system provides water, snacks and food to the patient automatically. In-built storage container holds food, water, and snacks which are served at the patient's discretion.  $\lambda$  **ANDROID TECHNOLOGY:** With behavior: Their feel of thirst and hunger are decoded dynamically by employing facial and voice recognition algorithms and based on the inference.

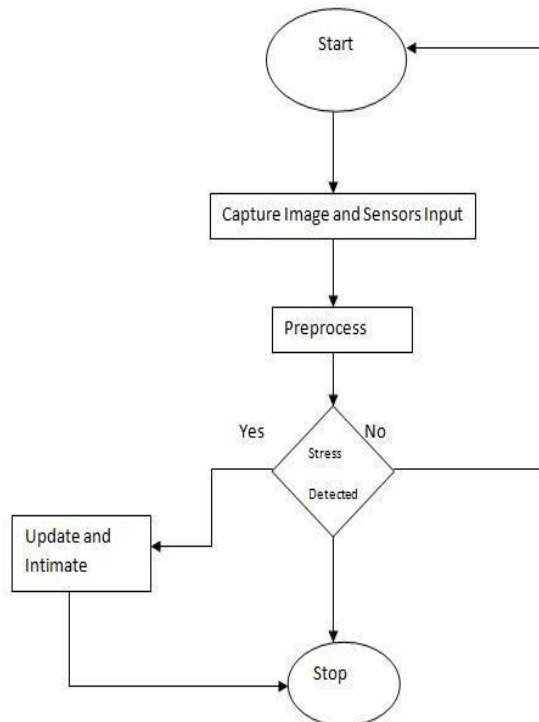


Fig. I Flow chart of proposed model

### III. PROPOSED MODEL

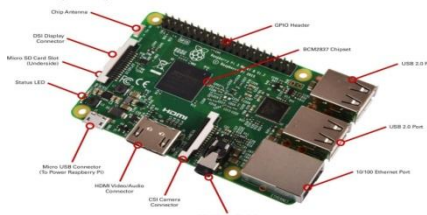
The figure shows the flowchart for the pre-processing of the images received from the output of the previous step. This involves converting the image from the RGB format to grey scale to ease processing, the use of an averaging filter to filter out the noise, global basic thresholding to remove the background and consider only the image and a high-pass filter to sharpen the image by amplifying the finer details.

#### HARDWARE

##### Raspberry Pi

##### ARM11 Raspberry Pi 3 board

Pi is a credit-card sized computer that connects to a computer monitor or TV and uses input devices like keyboard and mouse. It is capable of performing various functionalities such as surveillance system, military applications, surfing internet, playing high definition videos, live games and to make data bases. The device is implemented using a Raspberry pi 3B board and their specifications are as follows.



#### a. Processor / SoC (System on Chip):

The Raspberry Pi has a Broadcom BCM2835 System on Chip module. It has a ARM1176JZF-S processor. The Broadcom SoC used in the Raspberry Pi is equivalent to a chip used in an old Smartphone (Android or iPhone). While operating at 700 MHz by default, the Raspberry Pi provides a real world performance roughly equivalent to the 0.041 GFLOPS. On the CPU level the performance is similar to a 300 MHz Pentium II of 1997- 1999, but the GPU, however, provides 1 G pixel/s, 1.5 Gtexel/s or 24 GFLOPS of general purpose compute and the graphics capabilities of the Raspberry Pi are roughly equivalent to the level of performance of the Xbox of 2001.

#### b. Power source:

The Pi is a device which consumes 700mA or 3W or power. It is powered by a Micro USB charger or the GPIO header. Any good smart phone charger will do the work of powering the Pi.

#### c. SD Card:

The Raspberry Pi does not have any onboard storage available. The operating system is loaded on a SD card which is inserted on the SD card slot on the Raspberry Pi. The operating system can be loaded on the card using a card reader on any computer. General-purpose input/output (GPIO) is a generic pin on an integrated circuit whose behavior, including whether it is an input or output pin, can be controlled by the user at run time. GPIO pins have no special purpose defined, and go unused by default. The idea is that sometimes the system designer building a full system that uses the chip might find it useful to have a handful of additional digital control lines, and having these available from the chip can save the hassle of having to arrange additional circuitry to provide them.

#### Audio Jack:

A standard 3.5 mm TRS connector is available on the RPi for stereo audio output. Any headphone or 3.5mm audio cable can be connected directly. Although this jack cannot be used for taking audio input, USB mics or USB sound cards can be used.



## 2. SOFTWARE

### Raspbian OS

Although the Raspberry Pi's operating system is closer to the Mac than Windows, it's the latter that the desktop most closely resembles. It might seem a little alien at first glance, but using Raspbian is hardly any different to using Windows (barring Windows 8 of course). There's a menu bar, a web browser, a file manager and no shortage of desktop shortcuts or pre-installed applications. Raspbian is an unofficial port of Debian Wheezy arm hf with compilation settings adjusted to produce optimized "hard float" code that will run on the Raspberry Pi. This provides significantly faster performance for applications that make heavy use of floating point arithmetic operations. All other applications will also gain some performance through the use of advanced instructions of the ARMv6 CPU in Raspberry Pi. Although Raspbian is primarily the efforts of Mike Thompson (mptompson) and Peter Green (plug wash), it has also benefited greatly from the enthusiastic support of Raspberry Pi community members who wish to get the maximum performance from their device.

### Open CV

It is a library of programming functions mainly aimed at real-time computer vision. It is developed by Intel research center and subsequently supported by Willow Garage and now maintained by it seez. It is written in C++ and its primary interface is also in C++. Its binding is in Python, Java, and Mat lab. OpenCV runs on a variety of platform. Windows, Linux, and MacOS, open BSD in desktop and Android, IOS and Blackberry in mobile. It is used in diverse purpose for facial recognition, gesture recognition, object identification, mobile robotics, segmentation etc. It is a combination of OpenCV C++ API and Python language. In our project we are using OpenCV version 2 OpenCV is used to gesture control to open a camera and capture the image. It is also used in the image to text and voice conversion technique.

## III. RESULT

A system device which looks similar to a human assisting robot but with less complications (from a usual robot) in the design with listed features such as guiding patients to walk in predetermined path in and around the house. Monitoring and keeping track on the heart rate and physical activities of patients. System enables to detect the mood swings as well as their physical health constantly. Acts as support system during unavailability of care takers.

## IV. CONCLUSION

In conclusion, using a Raspberry Pi-based system for face recognition can be a valuable tool for assisting mentally retarded people in recognizing and identifying familiar faces. The system can be designed to capture images of individuals and store them in a database, which can then be used for face recognition purposes. The Raspberry Pi's small size, low power consumption, and relatively low cost make it an ideal platform for this type of application. Implementing face recognition on a Raspberry Pi involves several key components, including the image acquisition module, the face detection and recognition algorithms, and the database management system. These components can be implemented using various software libraries and tools, such as OpenCV, dlib, and TensorFlow. The system can be further enhanced by incorporating additional features, such as voice commands, text-to-speech conversion, and real-time video streaming. This would enable mentally retarded individuals to interact with the system and receive feedback in a more intuitive and natural way. Overall, a face recognition system based on a Raspberry Pi can have a significant positive impact on the daily lives of mentally retarded individuals, by providing them with a means of recognizing familiar faces and improving their social interactions and communication skills.

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