

Face Recognition Technology: Better security; empowered by Raspberry Pi

Mrinmoy Sarkar¹, Sarmista Malakar², K Sai Prashanth³, Nikkondi Dheeraj⁴,
Gurpreet Singh Shahi⁵

¹ Persuing B-tech, CSE, Lovely Professional University, Phagwara, Punjab
mst3084@gmail.com

² Persuing B-tech, IT, Lovely Professional University, Phagwara, Punjab
mithi8856@gmail.com

³ Persuing B-tech, CSE, Lovely Professional University, Phagwara, Punjab
kummarisaiprashanth@gmail.com

⁴ Persuing B-tech, CSE, Lovely Professional University, Phagwara, Punjab
Sivaji1070@gmail.com

⁵ Professor, Lovely Professional University, Phagwara, Punjab
gurpreet.17671@lpu.co.in

Abstract—Face recognition is a powerful tool for ensuring privacy as well as security. It exhibits very less hassles compared to conventional security systems. Face detection using various advanced tools and methods, face analysis, facial data storage and facial data comparison are the typical phases of various face recognition technologies. A mini gadget, Raspberry Pi enables to recognize faces with the help of a camera module, installed dependencies, installed libraries, sample images and appropriate training. Apart from being highly efficiency, the face recognition is not sparred from limitations such as intra class variations, inter class similarities, extensive storage requirements, etc.

I. INTRODUCTION

Either physical asset or digital data, for both, security is the utmost need of the hour. The question might be where these assets or data lie? The answer is not restricted to a single location, but can stretch almost up to every dimension of our living. Smart phones need security. So as residential buildings, Offices, Data centers, Laboratories, Locker systems. Conventional security systems are not hassle free and possess less protective capacity against today's vulnerabilities and threats. Days are gone when password protected mobile phones were considered safeguarded, When gatekeeper of a home was the savior from outside enemies and the keys were the only means of unlatching the lockers

Technology and security systems are evolving parallelly. The most recent developments in this field are assumed to be the biometric technologies. What is biometrics? Biometrics are the measurements and computations of physical and/or behavioral characteristics of human beings. The biometric technologies recognize, retrieve and store the biometrics of human beings and compare the given input with the stored data to grant or disallow access to the system, place or data. The advantages of biometric systems are many against the conventional security systems. As biometrics are nothing but the unique human features, these are not transferable, neither any matter of being forgotten, as in case of passwords. Even cannot be lost or be in undesirable hands just like the locker keys.

In this paper we talk about one of the biometric technologies: facial recognition technology. In 1994-1995, Woody Bledsoe, alongside Helen Chan Wolf and Charles

Bisson started the work utilizing the PC frameworks to perceive human facial highlights, denoting the beginning of the facial acknowledgment innovation, albeit the underlying work just elaborate the manual stamping of the different milestones of the face. The applications embedded with this technology are made capable of comparing the human face with the stored data and take action accordingly in response to the result. Singapore became the first country in the world to bind facial verification in the National Identification Database. Named the process as "SingPass Face Verification".

II. BASIC WORKING

The technology used in the facial recognition system often does vary, but the general procedures tend to be similar. These are describes below:

A. Face Detection

The very initial and crucial step in face recognition process is the face detection. The basis of this process is the object detection, one of the computer technologies, that is linked with image processing and computer vision and works to detect instances of an object such as human faces, vehicles, trees etc. The face detection techniques are used to detect faces in real times, even from video clips. It is widely used in surveillance cameras and can identify even multiple appearances in the frame.

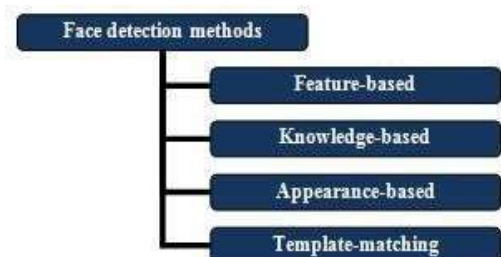


Fig: 2.1 various methods for face detection

Firstly, the image is captured or imported, and then the image is converted from RGB to grayscale as it becomes easy to detect face in grayscale. Image manipulation is done in case if it is needed, such as cropping, sharpening, resizing etc. In next step image segmentation is done which makes it easier for the classifier to detect the other

objects and human faces in the picture. In next step algorithms are used such as Haar-Like features algorithm, which was proposed by Viola and Jones for face detection. This algorithm finds out the location of human face/faces in an image. Universal properties of human faces are common among all human beings. This specific algorithm is also useful in feature extraction of any object in an image. Haar highlights are made of at least two square shapes and do encode power contrasts between adjoining regions.

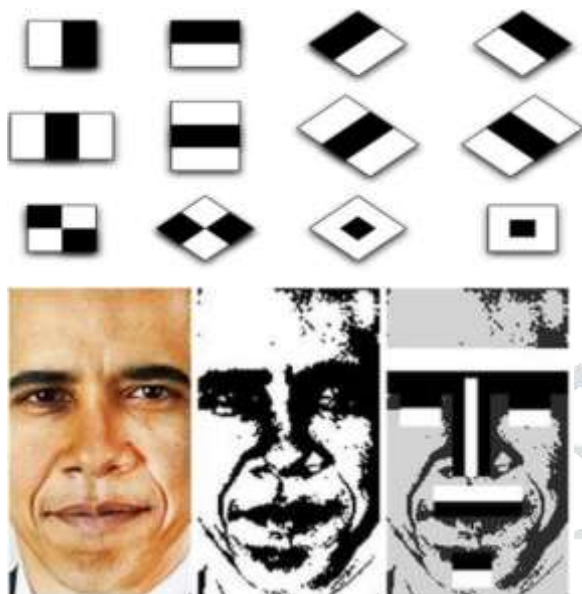


Fig: 2.2 haar features

- *Feature based face detection*

The process of extracting facial features such as eyes, nose, eyebrows, and mouth is done using multi-resolution filters, edge detectors, morphological operations, and other tools and techniques. Different Statistical models, neural organizations and chart coordinating with used to follow connections between highlights. Fundamentally gathers highlights of the face which are invariant to appearance varieties.

- *Knowledge-based face detection*

It characterizes a few arrangements of rules to address the face and use them for distinguishing the face, here are some substantial models, for example, "Center face part has uniform power", "Face has two eyes, a nose and a mouth". It has embraced progressive methodology inspecting the face at various goal levels with the end goal that the lower level: discovers conceivable face up-and-comers dependent on picture power; the mid level: identifies edges; the more significant level: extricates facial highlights (mouth, eyes). Arranges the picture area as face or non-face. Worth to make reference to here, it difficult to make an interpretation of information into rules or stretch out rules to various postures

- *Appearance based face detection*

The appearance-based face recognition method shows a face regarding several images. A picture is taken into account to be a high dimensional vector. This framework

is utilized to accomplish highlight space from the picture division. The example picture contrasted with the preparation set. The appearance-based methods are generally classify as linear or nonlinear. Ex- PCA, LDA, IDA used in linear approach whereas Kernel PCA used in nonlinear approach. It is perceived as most successful approach, fast as well as robust. Recognition rates almost 80-90% at a bogus positive rate almost 10%. One downside is that, it needs to look over scale and space and in particular requires enormous arrangement of preparing models.

- *Template based face detection*

Machine recognition of faces from still and moving images is emerging as a vigorous research area spanning several research fields like image processing, pattern recognition, computer vision and communication. Additionally, face detection, recognition and identification techniques have numerous applications like human interface based systems and real-time video systems for surveillance and security, etc. Template based face detection, also referred to as template matching. Template based face recognition problems assume that both probe and gallery items are potentially represented using multiple visual items instead of only one.

The template setting was designed to reflect many real-world biometric scenarios, where capturing a subject's facial appearance is feasible over once and using different acquisition methods. Ostensibly, having many images rather than one provides more appearance information which successively should result in more accurate recognition. The challenges within the template matching task are: occlusion, detection of non-rigid transformations, illumination and background changes, background clutter and scale changes. For templates without strong features, or for when the majority of the template image constitutes the matching image, a template-based approach could also be effective.

B. Face Analysis

The face recognition softwares use such algorithms which are able to recognize a human face in an image. The algorithms then measures various features out of the face. The human faces have numerous, discernible landmarks that make up the face. In technical terms these landmarks are recognized as nodal points. Every human face has nearly 80 nodal points. These nodal points are analyzed by the softwares to capture the distinguishable feature of each face such as shape of the cheekbone, width and length of the nose, shape of the eyes and distance between them, so on.

The proceeds from the facial analysis act as the boon for the recognition of the faces as these proceeds are the basis of the identification and authentication process.

C. Converting Into Data

The facial analysis is turned into mathematical formula and thus represented as numbers in a code. Basically this is called a faceprint and stored in the database.

These data can be compared in real time with the input data such as a face and the action such as identification, authentication is done in accordance with the result of the comparison.

III. STRUCTURAL MATCHING USING ASM, AAM

ASM represents Active Shape Model. Dynamic shape models (ASMs) are the measurable models of the type of the things which iteratively distort to suit to an illustration of the item in a really new picture. It is created by Tim Cootes and Chris Taylor inside the year 1995. The type of an item is introduced by a gathering of focuses which are constrained by the shape model. The ASM calculation centers to coordinate with the model to a pristine picture. Creates a proposed shape by checking out each point on the picture to recover a more powerful situation for the point. This is ideally done utilizing what is known as a "profile model", which fundamentally searches for solid edges, utilizes the Mahalanobis distance to coordinate with a model layout for the point. Adjusts the recommended shape to the point dissemination model, called a "shape model" in this unique situation. Simply put, it makes use of a prior model of whatever is expected in the image, and generally attempts to find out the best match position between the model and the data present in a new image.

AAM is the abbreviation of Active Appearance Model. An active appearance model (AAM) basically refers to a computer vision algorithm used for matching a statistical model of object shape as well as appearance to a new image. Can be said it is a single statistical model combining shape and texture. Connections between the shape and surface normally figured out how to create the joined appearance model.

IV. EMERGING MODES OF FACERECOGNITION TECHNOLOGY

Undoubtedly, the face recognition has been interesting area for researcher's since very long time. As a result there is a continuous shift and advancement in the face recognition technologies. Most of the facial recognition technologies depend upon 2D images rather than 3D images as it is much more convenient to match a 2D photo with public images or the images in the database. The emergence of 3D face recognition is quite recent, though more useful. 3D pictures present the 3D construction of a face. It gives rich or can say huge wellspring of data which isn't caught in 2D pictures. The 3D face acknowledgment is better at catching surface calculation. Additionally, it isn't influenced by light varieties, even by utilization of beauty care products. Less affectability to appearance varieties makes it all the more impressive and is simpler to deal with present varieties. Great to note here, the projective idea of 2D pictures simplifies face and facial element recognition, present assessment and posture remuneration. We wouldn't be in an ideal situation by choosing just one from these two. 2D and 3D pictures give corresponding data about the face and surface is pretty much as significant as calculation of the face. The best way is a multimodal approach; which recommends utilizing both 2D and 3D facial data in all stages.

3D facial data representations:

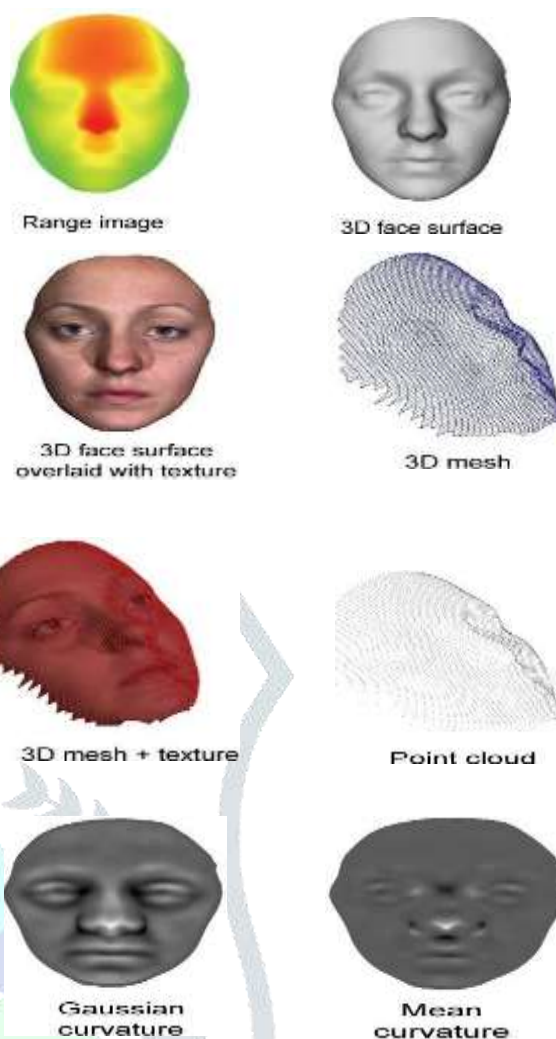


Fig: 4.1 facial data representations for 3D face recognition

V. WHAT IS RASPBERRY PI?

The Raspberry Pi is an easy to use, Visa measured PC that connects to a PC screen or TV, and utilizes a customary console and mouse. It's a proficient little gadget that empowers individuals, everything being equal, to research figuring, and to work out the way to program in dialects like Scratch and Python. It can do all that you'd anticipate that a personal computer should do, from perusing the internet and playing high quality video, to creating accounting pages, word-preparing, and messing around.

VI. HOW DOES THE RASPBERRY PI WORK?

A SD card embedded into the space on the board goes about because the hard drive for the Raspberry Pi. It's fueled by USB and therefore the video yield are snared to a customary receiver, a more present day screen, or maybe a TV utilizing the HDMI port. This offers you the whole lot of the elemental capacities of a normal PC. It additionally features a very low force utilization of around 3 watts. To position this force utilization in context, you may run quite 30 Raspberry Pi's rather than a typical light!

VII. APPLICATIONS OF RASPBERRY PI

- Add AirPrint Support to Your Pi PrintServer.
- Build a Minecraft Game Server.
- Control a Robot.
- Broadcast a Pirate FM Station.
- Build a Raspberry Pi Web Server.
- Build a Motion Capture Security System.
- Build a Network Monitoring Tool.
- Control a Model Railroad, All using the Raspberry Pi.

VIII. HOW WILL WE USE FACIAL RECOGNITION ON RASPBERRY PI?

- *Connection*
 1. Connect Ribbon cable from Display to Raspberry Pi.
 2. Connect SDA to Raspberry Pi SDA pin and connect SCL from Display to Raspberry Pi SCL pin.
 3. Connect Ribbon cable from camera to Raspberry Pi.
 4. Connect GND from Display to Raspberry Pi GND.
 5. Connect 5V from Display to Raspberry Pi 5V.
- *Procedure for installing OpenCV biometric identification libraries*
 1. Expand filing system.
 2. Install dependencies.
 3. Download the OpenCV ASCII text file.
 4. Install Pip.
 5. Installing NumPy on your Raspberry Pi.
 6. Compile and Install OpenCV.
 7. Configure disc space size before compiling.
 8. Build and install OpenCV.
 9. Testing your OpenCV install.
 10. Change disc size back.
 11. Installing libraries required for face recognition.

IX. CONCLUSION

Face acknowledgment advances have seen enormous acknowledgment and demonstrated very effective for security just as protection. Other than every one of the benefits, face acknowledgment isn't liberated from impediments. There can be intrapersonal variations. Intrapersonal or intra-class varieties are alluded as varieties in the presence of an equivalent face, brought about by various Illumination, Pose varieties, Use of beauty care products and extras, changes in haircut, maturing, and so forth. Interclass similarity, means various individuals may have very much like appearance like twins, close family members and even outsiders may resemble the other the same. It prompts higher bogus acknowledgment rate.

Enlightenment varieties mean varieties of lights which may altogether alter the presence of a face in 2D pictures. Acknowledgment execution may drop more than 40% if there should arise an occurrence of pictures which are taken outside! Indeed, even people face troubles in perceiving natural appearances when light course changes.

Distinction between two pictures of a similar individual under various view points, also referred as pose variations is a particularly matter which can lead the face acknowledgment framework fall flat. Facial expressions are additionally among the components which can influence the face acknowledgment frameworks essentially. Individuals may even camouflage about their appearances to try not to be perceived. Individuals may even camouflage about their appearances to try not to be perceived. Amazingly high stockpiling prerequisites are another downside.

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