Face Recognition and QR-Code Application.

Table of Contents:

Abstract:

Facial recognition is a way of identifying or confirming an individual's identity using their face. Facial recognition systems can be used to identify people in photos, videos, or in real-time. Facial recognition is a category of biometric security. Other forms of biometric software include voice recognition, fingerprint recognition, and eye retina or iris recognition. The technology is mostly used for security and law enforcement, though there is increasing interest in other areas of use.

Many people are familiar with face recognition technology through the Face-ID used to unlock iPhones (however, this is only one application of face recognition). Typically, facial recognition does not rely on a massive database of photos to determine an individual's identity. It simply identifies and recognizes one person as the sole owner of the device, while limiting access to others. Beyond unlocking phones, facial recognition works by matching the faces of people walking past special cameras, to images of people on a watch list. The watch lists can contain pictures of anyone, including people who are not suspected of any wrongdoing, and the images can come from anywhere even from our social media accounts.

A QR code (abbreviated from Quick Response code) is a type of matrix barcode (or two-dimensional barcode). A QR code consists of black squares arranged in a square grid on a white background, which can be read by an imaging device such as a camera, and processed using Reed–Solomon error correction until the image can be appropriately interpreted. The required data is then extracted from patterns that are present in both horizontal and vertical components of the image.

Introduction:

What is face recognition?

Face recognition is a method of identifying or verifying the identity of an individual using their face. Face recognition systems can be used to identify people in photos, video, or in real-time. Law enforcement may also use mobile devices to identify people during police stops.

Additionally, face recognition has been used to target people engaging in protected speech. In the near future, face recognition technology will likely become more common. It may be used to track individual's movements out in the world like in India, automated license plate readers track vehicles by plate numbers. Real-time face recognition is already being used in other countries and even at sporting events in the United States.

How face recognition work?

Face detectors use computer algorithms to select specific, distinct details about a person's face. This information, such as the distance between the eyes or the shape of the chin, is then converted into statistical representation and compared with other face data collected in the face recognition database. Details about a particular face are often referred to as a face template and are different from an image because they are designed to include only certain details that can be used to distinguish the one face from another.

Some face recognition programs, instead of accurately identifying a stranger, are designed to calculate possible match points between a stranger and certain face templates stored in a database. These systems will provide several possible similarities, positioning the sequence of probable diagnostic possibilities, rather than returning a single result.

Face recognition systems vary in their ability to identify people under challenging conditions such as poor lighting, low quality image resolution, and suboptimal angle of view (such as in a photograph taken from above looking down on an unknown person).

Face detection systems differ in their ability to detect people under challenging conditions such as improper lighting, low image correction, and high viewing angle (such as in a photograph taken from above looking down on an unknown person).

When it comes to errors, there are two key concepts to understand:

- A "false negative" is when the face recognition system fails to match a person's face to an image that is, in fact, contained in a database. In other words, the system will erroneously return zero results in response to a query.
- A "false positive" is when the face recognition system does match a person's face to an image in a database, but that match is actually incorrect. This is when a police officer submits an image of "Joe," but the system erroneously tells the officer that the photo is of "Jack."

When researching a face recognition system, it is important to look closely at the "false positive" rate and the "false negative" rate, since there is almost always a trade-off. For example, if you are using face recognition to unlock your phone, it is better if the system fails to identify you a few times (false negative) than it is for the system to misidentify other people as you and lets those people unlock your phone (false positive). If the result of a misidentification is that an innocent person goes to jail (like a misidentification in a mugshot database), then the system should be designed to have as few false positives as possible.

What are QR-Codes?

A QR code is a type of barcode that can be read easily by a digital device and which stores information as a series of pixels in a square-shaped grid. QR codes are frequently used to track information about products in a supply chain and – because many smartphones have built-in QR readers – they are often used in marketing and advertising campaigns. More recently, they have played a key role in helping to trace coronavirus exposure and slow the spread of the virus.

The first QR code system was invented in 1994 by the Japanese company Denso Wave, a Toyota subsidiary. They needed a more accurate way to track vehicles and parts during the manufacturing process. To achieve this, they developed a type of barcode that could encode kanji, kana, and alphanumeric characters.

Standard barcodes can only be read in one direction – top to bottom. That means they can only store a small amount of information, usually in an alphanumeric format. But a QR code is read in two directions – top to bottom and right to left. This allows it to house significantly more data.

Literature Review:

With the tremendous increase in video and image database there is a great need of automatic understanding and examination of data by the intelligent systems as manually it is becoming out of reach. Narrowing it down to one specific domain, one of the most specific objects that can be traced in the images are people i.e., faces. Face detection is becoming a challenge by its increasing use in number of applications. It is the first step for face recognition, face analysis and detection of other features of face.

Neural networks are adaptive information processing systems that offer attractive solutions for video surveillance. This application aims at identifying particular patterns. The main goal of this presentation is to provide face detection for video surveillance using neural network-based method. After providing the corresponding architecture for face detection, the emphasize is on the detector which is trained with multilayer back propagation neural networks. Three different face representations are taken into account, i.e., pixel representation, partial profile representation and eigenface representation. Based on this, three independent sub-detectors are generated. The detection rates are measured. The circle at about 94% indicates the position where the neural network achieves the optimal performance.

A self-growing probabilistic decision-based neural network (SPDNN) is used to learn the conditional distribution for each colour classes. Pixels of a colour image are first classified into facial or non-facial regions, then pixels in the facial region are followed by eye region segmentation. The class of each pixel is determined by using the conditional distribution of the chrominance components of pixels belonging to each class.
There exists a range of feature detecting and feature matching algorithms; many of which have been included in the Open Computer Vision (OpenCV) library. However, given these different tools, which one should be used? Here, the implementation and comparison of a range of the library's feature detectors and feature matchers. It shows that the Speeded-Up Robust Features (SURF) detector found the greatest number of features in an image, and that the Brute Force (BF) matcher matched the greatest number of detected features in an image pair. The combination of the Binary Robust Invariant Scalable Key-points (BRISK) detector and BF matcher was found to be the highest ranked combination of OpenCV's feature detectors and feature matchers.

For the applications of technology of camera calibration to binocular stereo vision system, the non-linear distortion of the tangential and radial distortion aberration is considered. This gives an arithmetic of camera calibration based on OpenCV. This arithmetic makes use of the functions of the library effectively, improves precision and efficiency of computation, and has a good property for the application to multi-platform.

With the development of video surveillance gradually from the traditional security surveillance to intelligent surveillance, in order to find an intelligent surveillance model to facilitate the implementation and promotion, we present a method, performing the moving object detection by using OpenCV based on DirectShow framework, which will make intelligent surveillance come true consequently.

Positioning objects such as appliances inside rooms has become of fundamental importance in the Internet of Things (IoT) and in-home automation, as well as in augmented reality (AR). A new positioning system based on a smartphone and radio-frequency identification (RFID) tags applied to the objects to be localized is presented. The 3D positioning of the smartphone is obtained through an ultrasound system while its orientation in space is obtained with the onboard magnetometers and accelerometers. When a certain RFID tag is read through the near-field communication (NFC) interface of the smartphone, from its distance and from the orientation of the smartphone that reads it, the 3D position of the tagged object is obtained.

It is popular to use mobile phone daily in modern life. Among the numerous applications provided by mobile phone, barcode utility is one of the important branches. Many companies supply barcode tools for mobile phones. For example, Google's mobile Android operating system supports QR codes by natively including the barcode scanner in some models, and the browser supports URI redirection function which allows QR codes to send metadata to the applications on the device. After investigated the supplied applications on mobile devices, most of the products exhibit information accessible to every user.

Comparative Analysis:

Ideology:

Creating a system within professional institutions wherein each individual who is a part of that institution could automate their work at some level by using ID cards which contain a QR code, this ID card coupled with the facial recognition technology could provide a unique identity to individuals.

Problems faced (before the application of this technology):

1) Attendance of individuals needs to me marked by some invigilator and takes a bulk of time.
2) Books and other objects owned by the institutions which can be rented by individuals need to marked in a logbook or entered into a database by some invigilator which is time consuming.
3) Whereabouts of individuals cannot be tracked within these institutions giving a rise to unethical practises.
4) Invigilation in an exam hall or during tests requires an invigilator who in turn again cannot guarantee that no unethical practices are going on.

Solutions to the above-mentioned problems (after the application of this technology):

1) An attendance scanner can scan the QR code and the face of an individual decreasing the time spent in attendance drastically. Also, each individual carrying the QR code could mapped to the person who owns the QR code allowing us to check if the person is the same or not.
2) A scanner could be placed outside libraries and other rooms out of which students can rent objects owned by the college. Instead of them or some invigilator adding entries within books or database the scanner can scan the QR code and the face map them and then scan the object rented by that individual.
3) If the scanners are placed in various corridors or rooms and entry to that place within the institution is only possible by scanning the QR code and the individuals face and then mapping them, then it could be easy to locate individuals as they would have to be in a certain area of the institution. This could guarantee the safety of individuals too.
4) A movable scanner could be placed in examination halls that could scan for individuals performing unethical practices. The time spent by the invigilator is taken out of the equation with a better guarantee or chance that such unethical practices do not take place.

The QR code could store more information about a student's academics or work experience allowing institutions to keep a track of such information which could later be provided to recruiters to make the recruiting process smoother and more efficient.

It goes without saying that the data stored by the QR code would be encrypted as the data stored within the QR code needs to be secured in a way that no individual other the ones to whom access has been given and the individual to whom the data belongs could access such sensitive information.

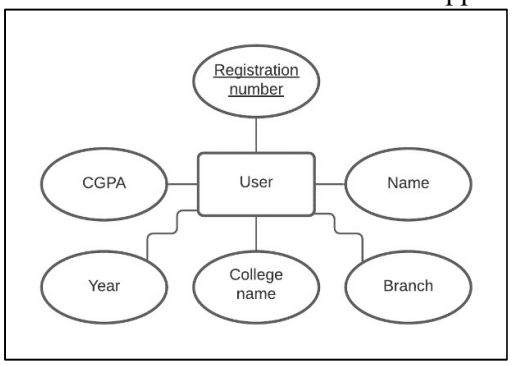
All these solutions could eliminate the above-mentioned problems and many more problems too. Not only the problems are eliminated but also the institution could keep a track of data and individuals in a more efficient and a safe way.

Local Database:

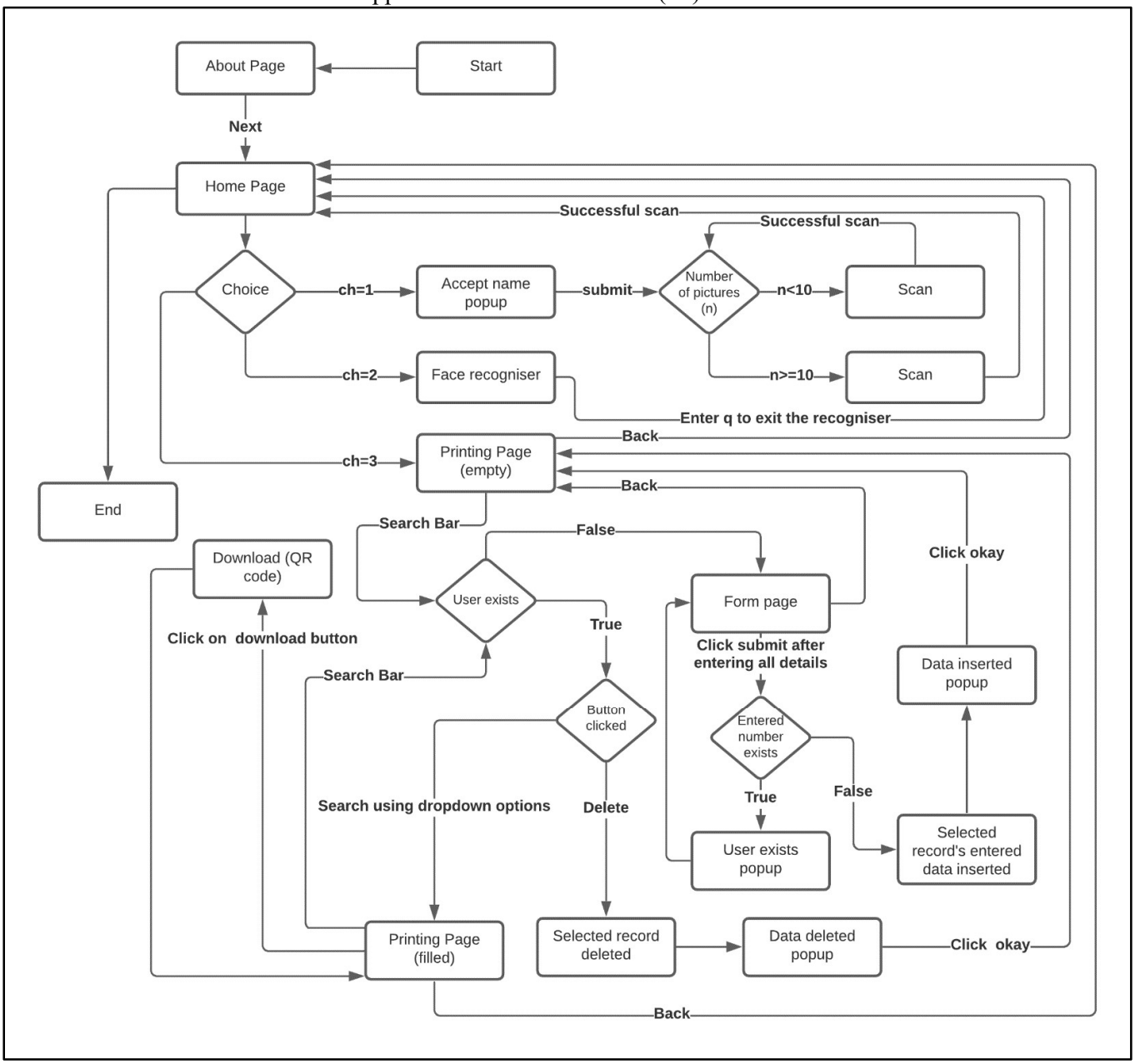
The database for this program is local and not online hence users can access and use this application without the requirement of an internet connectivity.

Design Details:

The EER diagram:
This is the backend structure of the application, the database,



The Flowchart:
This is the frontend structure of the application the user interface (UI).



Summary:

Conclusion:
Created the basic functionalities like facial recognition using OpenCV and QR-Code Application using pyqrcode. Created the functionalities using Python, frontend using Tkinter and backend using SQL. These basic functionalities form a path and allows us to implement an ID-Card generator and facial recognition software.

Future Scope:
Implementation of the basic functionalities like facial recognition using OpenCV and QR-Code Application using pyqrcode to create an ID-Card generator and facial recognition software. Using this software the institutions could involve autonomy making most of their task autonomous and more efficient while increasing the security and ensure safety of individuals.

Reference:

Kirti Dang; Shanu Sharma; Review and comparison of face detection algorithms; CSE Department, ASET Amity University; IEEE; Noida, India 2017

Zoran Bojkovic; Andreja Samcovic; Face Detection Approach in Neural Network Based Method for Video Surveillance; Faculty for Traffic and Transport Engineering, University; IEEE; Belgrade, Serbia 2006

Hsin-Chia Fu; P.S. Lai; R.S. Lou; H.-T. Pao; Face detection and eye localization by neural network based color segmentation; National Chiao Tung University; IEEE; Hsinchu, Taiwan 2000

Zhu Lingling; Chen Fucai; Gao Chao; Improvement of Face Detection Algorithm Based on Lightweight Convolutional Neural Network; National Digital Switching System Engineering & Technological R & D Center; IEEE; Zhengzhou, China 2020

Olarik Surinta; Sanya Khruahong ; Tracking People and Objects with an Autonomous Unmanned Aerial Vehicle using Face and Color Detection ; Naresuan University; Thailand 2019

Frazer K. Noble; Comparison of OpenCV's feature detectors and feature matchers; Massey University; IEEE; New Zealand 2016

Zhang Zhi; Zhou Xiang; Mao Zheng; Ma Lianyi; Design and implementation of camera calibration system based on OpenCV; China Changfeng Science and Technology Industry Group Corporation; IEEE; Beijing, China 2011

Chaoyu Lin; Yuliang Tang ; Research and design of the intelligent surveillance system based on DirectShow and OpenCV; Xiamen University; IEEE; Xiamen, China 2011

Riccardo Carotenuto; Massimo Merenda; Demetrio Iero; Francesco Giuseppe Della Corte; Indoor Object Positioning using Smartphone and RFID or QRCode; University Mediterranea of Reggio Calabria; IEEE; Reggio Calabria, Italy 2020

Wen-Pinn Fang; Offline QR Code Authorization Based on Visual Cryptography; Yuanpei University; IEEE; HsinChu, Taiwan 2011

Acknowledgement:

We would like to express our special thanks of gratitude to our mentor Ms. Jalpa Mehta and Ms. Nida Jawre, our principal Mr. Bhavesh Patel and the faculty of Shah and Anchor Kutchhi Engineering College for this wonderful project on the topic Face Recognition and QR-Code Application which also helped us in doing a lot of Research. It had been a great journey in analysing, understanding and realizing the implementation of a real time project in PYTHON and SQL. It helped us grow a lot not only academically but also in a broader and knowledgeable aspect. I as a group leader would like to express my appreciation to my group members for their valuable and constructive execution and suggestions during the planning and development of this research work and in the development of this project. The team building, managing and co-operative skills were also been imparted to us, hence making us more professional and patient.