Smart Gate Using Facial Recognition and RFID

Made By:

Lina Samer Saied Youssef - 18060

Mohamed Khaled Khalil Ahmed - 19005

Omar Hossam Elden Sayed - 19001

Eslam Adel Abdelhalem Zaki - 19041

Supervised By:

Prof. Amr El Sayed Mohamed

This thesis submitted in partial fulfillment of the requirements for

B.S. Degree in Communication & IT Engineering at Helwan University, Cairo, Egypt

July 2022

Acknowledgment

First and foremost, we are grateful to our great creator Almighty Allah for the good health and wellbeing that were necessary to complete this project.
This venture would not have been possible without the generosity of many people who contributed their time and talents to the various phases of this work.

It's our proud privilege to release the feelings of our gratitude for the immense contribution of these people who directly or indirectly made this project a success.

We would like to express our hearts full indebtedness and owe a deep sense of gratitude to our graduation project supervisor Prof. Amr El Sayed Mohamed for the advice and knowledge and the insightful discussions and suggestions throughout the whole venture, and patiently guiding us through its processes. You made us believe that we have what it takes, and we have the potential to reach greater heights in our graduation project.

We also would like to place on record, our sense of gratitude to one and all Doctors who rendered continuous aid over the period of study. Thanks for all the efforts they did to provide us with all useful information and for making the path clear for the students to implement all the education periods in real-time project design and analysis.

Most importantly, this is not only a result of hard work and the wonderful people who supported us a good as they could, it shows that even people like us who are constantly self-doubting themselves, are able to achieve something valuable and great. We dedicated this to our parents because without them we would not be who we are today. Thanks for all the way of the constant support, advises, and unconditional love.

Abstract

As we face Problems every day in the university, we “as engineers” have to think about how to improve the way we deal with university that have become one of the Major difficulties in our daily lives. These difficulties occur due to many reasons, Since the start of the Helwan university faulty of engineering there hasn’t been a gate that can secure our university not only no security guard asking for identification of the people entering the university making sure that nobody outside the university enter the university which leads to many security issues but also the is no system that keep track of the attendance

That’s why our Project is Smart gate using 2 way authentication facial recognition and RFID so that not anyone can just enter the university but also making sure that he is holding his/her ID and compere the data with the data by using facial recognition not only that but also we keep track of the people entering the university and the security guard at the gate can see the data of the students entering the university , that’s why our Project a new creation for a whole system in which we are trying to reach the highest possible efficiency with the least effort

Table of Contents

Table of figure

Chapter 1: Introduction

1.1 History:

One of the most significant universal rights is the right to privacy and security. Numerous studies are being conducted to find ways to make technology more secure in our daily lives. One of them is facial recognition, which is a well-liked and proven technique. Faces are recognized and identified from photographs using this technology, which is made even more beneficial and accurate by the Internet of Things (IoT). We want to develop a smart door that secures the gateway based on who we are using face recognition and the Internet of Things. We employed the Eigenfaces approach to identify people and the Viola-Jones method to detect faces in our proof of concept for such a smart security system. For low-cost processing, a Raspberry Pi has been employed as the microprocessor. And the system's compact size. Upon receiving an instruction from the processor, the door will automatically open for the known person. While an email with a link to the photograph is sent to the property owner, a picture of the unknown will be posted to a web server. The owner can then allow/block admission and sound an alert from anywhere in the world via the system's website.

Costlier access control system security is available. Small businesses are sometimes unable to afford the cost, leaving them vulnerable to unreliable, unsecure systems. The alternative access control strategy we present in this work enhances access control security while reducing the price. The suggested model uses passive RFID. Near a turnstile or smart door, tags are attached. Tag Reading and programming are done directly on the NFC chip., we ask the user to upload a photo of himself before passing through a secure gate. The image is then shown alongside the registration image on a monitoring dashboard so that the two may be compared. compared to one another An administration system for configuring gate access policies and monitoring entrances with filters by access time, user, and gate is provided by the client-server programmed that has been built. We also suggest a smartphone app that enables gate registration and works as

a door unlock key. The suggested access control model requires less money to install while yet providing high security.

The system is entirely wireless, and its primary component is a set of inexpensive autonomous RFID tags. We anticipate that the small- to medium-sized businesses will use the suggested system design.

1.2 Motivation

We wanted to create Smart gate using facial recognition and RFID improvement the security of our university for students and doctors.

1.3 Problem Statement

Our university major problem does not have security not even a security guard checking students Identification before entering the university any one can enter the university without any security.

1.4 Objective

We want to build a smart gate using 2-way authentication not only by their ID by RFID reader but also using facial recognition compere the image store in the database and the image capture by the camera implemented in the gate itself.

Chapter 2: Component Used

2.1 introduction

Amazing modern technologies include the Arduino and Raspberry Pi. They are inexpensive, nearly the same size, and have a similar appearance, yet they are unique and focused on various ideas. While Arduino is an open-source single-board microcontroller that runs a Linux operating system, Raspberry Pi is a single-board computer with an applications processor. Arduino lacks the conventional operating system design that some people are accustomed to. It is advised for a newcomer in embedded systems to start with the Arduino in order to understand embedded systems before moving on to the Raspberry Pi. Figure 1 displays a sample image of an Arduino (on the left) and a Raspberry Pi (right).

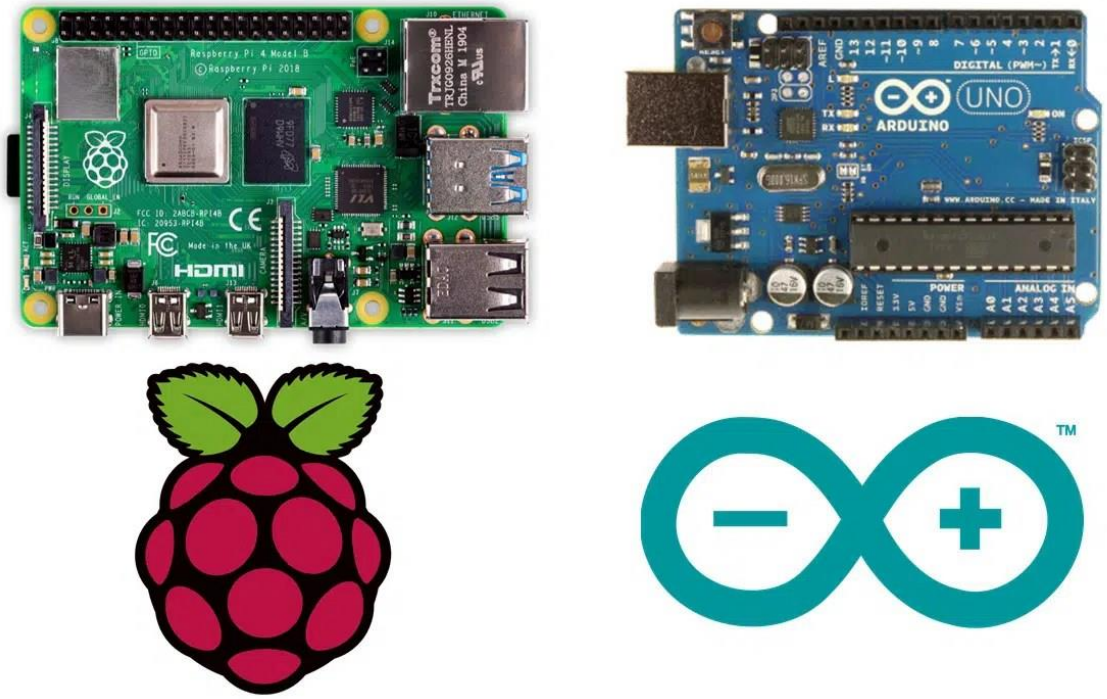


Figure 1Arduino vs Raspberry pi

2.2 Arduino

The Arduino microcontroller is programmable and can only do what you tell it to do. This microcontroller can gather data from sensors, process it, and then output it on LEDs or LCD panels that you have programmed or attached to a PC (or Raspberry Pi). You can control high-powered components, such as motors, by controlling relays. We can create a wide range of projects using Arduino, including robotics, interactive art exhibits, game devices, and music software. Various projects call for various sorts of boards.

2.3 Raspberry Pi

The Raspberry Pi is a unique device that allows users to browse the internet, play games, and more thanks to its capabilities, which include a fully featured operating system installed on an SD card and attached with audio out, Ethernet connector, HDMI, and RCA video output. Simply plug in your keyboard, mouse, and monitor to utilize it. More than hardware, the Raspberry Pi projects rely on software. Although media centers, software hacks, graphics/sound, and multimedia are the focus of the majority of Linux computer projects, the operating system can also do some basic hardware control using the GPIO pins.

2.4 Arduino vs. Raspberry Pi

You can select a suitable device to utilize, such as an Arduino or a Raspberry Pi, depending on your level of programming knowledge and the nature of your project. When compared to the Raspberry Pi, Arduino is better suited for beginners with little to no background in electronics and programming but at least a working knowledge of HTML, C, and C++. Since Arduino is a hardware-based platform, users can experiment with LEDs, LCDs, resistors, motors, and more, depending on the project. It also contains a ton of online tutorials and resources that can be utilized as a guide. The Pi is not naturally capable of a wide range of compatibility thanks to the analogue inputs and

PWM outputs. Additionally, you may connect numerous sensors and feedback components thanks to the high number of I/O pins.

However, due to a lack of good audio, video, and internet capabilities, Arduino is not as powerful as Raspberry. However, the Raspberry Pi or PC may receive data from the Arduino and utilize it to run programs that read data and perform actions. The Raspberry Pi has a stronger emphasis on software projects that include audio, video, and internet capabilities and are plug-and-play. If you are not interested in electronics, there is no longer a need to attach extra components. However, some applications call for the usage of extraneous parts like sensors.

Arduino	Raspberry Pi
Extremely simple to get working.	Less simple to get working.
A typical embedded system with easy-to-develop software.	Fully fledged computer running Linux.
Support is available virtually everywhere.	Limited support is available at present but should increase over time.
Perfect for controlling hardware (robotics).	Features an extremely powerful GPU and can handle HD content.
Umpteen, different kits and shields are available.	Very few kits are available presently.
Low power consumption (<0.5 W), capable of even running micro amps with very low clock.	Power consumption (~3.5 W) is comparatively higher than Arduino.

2.5 Results

In summary, the Raspberry Pi is the greatest choice for hardware projects due to its fantastic high-performance option, while Arduino is a solid general-purpose board. However, it is a good idea to employ Raspberry Pi in our projects to get the variety of functions supplied by boards.

2.6 introduction python

The use of coding is growing in the area of technology and sophisticated development. Almost everyone is proficient at coding. Coding skills are now needed of employees because there is a shortage of qualified coders in the IT industry. Online coding courses are available.

You may study a variety of programming languages right now. Python is now the most popular programming language utilized in a variety of fields, including data science, back-end development, and software development.

Python is a high-level programming language with a straightforward syntax. The learning process is simple. This language was developed in 1985 by Guido van Rossum. This website is particularly well-liked since the coding is readable.

2.7Why Should You Learn Python Language?

There are many reasons to learn python codes, as follows:

- This language's straightforward syntax and readable code make it easy to learn. You omit the punctuation and instead use English words. There is no need for you to write any more code. Its clear language makes it simple to update and modify the code.

- Python is an operating system-compatible programming language. During execution, it is compiled at compile time and interpreted at runtime. It enables us to run the exact same Python code on numerous additional platforms without making any changes. The code does not require recompilation. It aids in swiftly updating the code.

- It supports functional and object programming techniques, so you may utilise them to create intricate and expansive software programs.

- When compared to other programming languages, it is much more productive and expressive and requires a lot less time and code to do the same tasks. Due to its short line of codes, this language is the best for novices and newcomers.

- This language already includes many of the libraries and frameworks from the Rich set. As a result, learning the language is relatively simple.

- It features dictionary data structures and built-in libraries, which make the data structure simpler and more approachable.

- Python's code is shorter than other programming languages because of dynamic high-level typing, making it simpler for students to learn and understand. You can pick up this language quickly and easily.

- Python programmers are compensated well in the IT sector, and their income has been rising recently.

These are the explanations for Python's fame. Python-based applications and projects are less complicated and simpler to comprehend. Today, Python is used to create the majority of software. Python projects can be developed more quickly than those in other programming languages like C, C++, Java, etc.

The ideal course of action for a job applicant in the IT sectors would be to learn Python. Python may be learned anywhere. You can either learn from online classes that are available or from coaching centers close to your home.

If you're a newbie, you should take an online course on Python fundamentals to grasp the language's foundations before enrolling in a comprehensive course for Python developers to learn the language completely. The most effective way to learn Python and use it to make projects is through online courses. Try it out if you want to learn this amazing and practical skill.

2.8 What is Python used for?

Python is frequently used for creating websites and applications, automating repetitive tasks, and analyzing and displaying data. Python has been used by many non-programmers, including accountants and scientists, for a variety of routine activities including managing finances since it is very simple to learn.

According to Charles R. Severance of the University of Michigan and Coursera lecturer, "writing programs is a really creative and fulfilling endeavor." You can build programs for a variety of purposes, such as earning a living, solving a challenging data analysis challenge, having fun, or assisting someone else in addressing a problem.

2.9 What can you do with python?

- Data analysis and machine learning
- Web development
- Automation or scripting
- Software testing and prototyping
- Everyday tasks

2.10 Raspberry pi Model B+

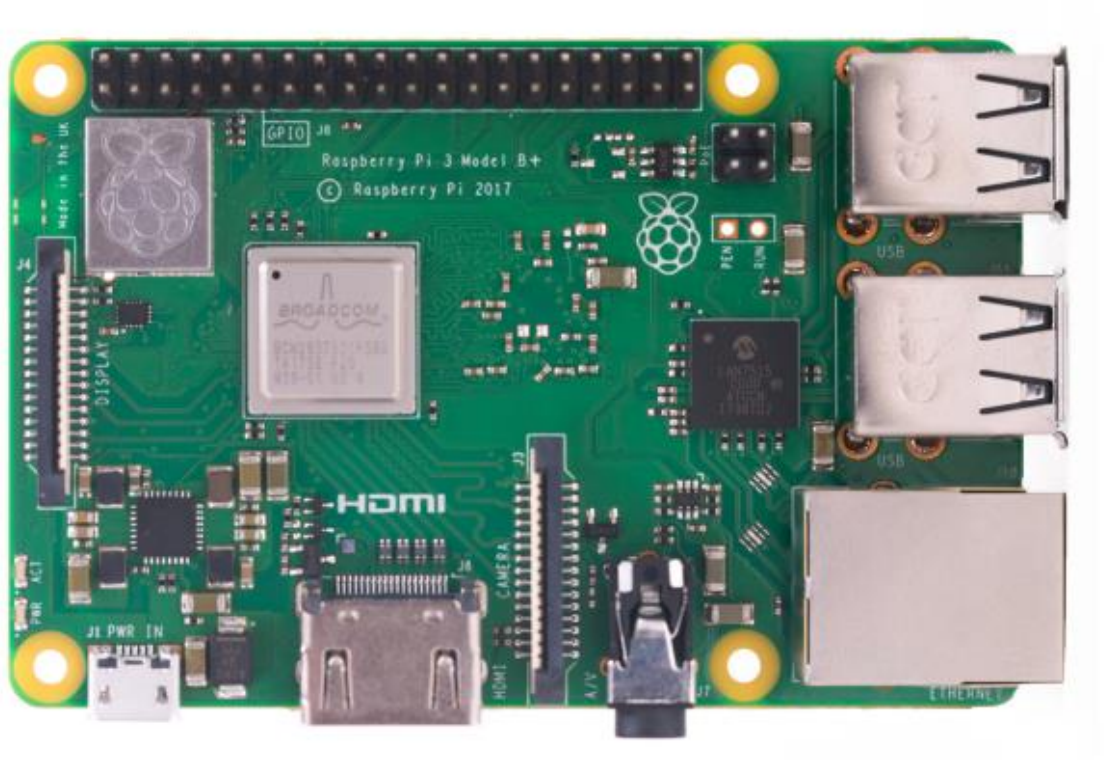


Figure 2 Raspberry pi 3

The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, boasting a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT

The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market.

The Raspberry Pi 3 Model B+ maintains the same mechanical footprint as both the Raspberry Pi 2 Model B and the Raspberry Pi 3 Model B.

Specifications:

Processor	Broadcom BCM2837B0, Cortex-A53 64-bit SoC @ 1.4GHz
Memory	1GB LPDDR2 SDRAM
Connectivity	2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE Gigabit Ethernet over USB 2.0 (maximum throughput 300Mbps) 4 × USB 2.0 ports
Access	Extended 40-pin GPIO header
Video & sound	1 × full size HDMI MIPI DSI display port MIPI CSI camera port 4 pole stereo output
Multimedia	H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics
SD card support	Micro SD format for loading operating system and data storage
Input power	5V/2.5A DC via micro-USB connector 5V DC via GPIO header Power over Ethernet (PoE)–enabled (requires separate PoE HAT)
Environment	Operating temperature, 0–50°C
Compliance	For a full list of local and regional product approvals, please visit www.raspberrypi.org/products/raspberry - pi-3-model-b+
Production lifetime	The Raspberry Pi 3 Model B+

2.12 Camera pi:

Figure 3 Camera pi

Specifications:

Product Name	Raspberry Pi Camera Module
Product Description	High-definition camera module compatible with the Raspberry Pi model A and model B. Provides high sensitivity, low crosstalk, and low noise image capture in an ultra-small and lightweight design. The camera module connects to the Raspberry Pi board via the CSI connector designed specifically for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the BCM2835 processor.
RS Part Number	775-7731
Image Sensor	Omni Vision 5647 CMOS image sensor in a fixed-focus module with integral IR filter
Resolution	5-megapixel
Still picture resolution	2592 x 1944
Max image transfer rate	1080p: 30fps (encode and decode) 720p: 60fps
Connection to Raspberry Pi	15 Pin ribbon cable, to the dedicated 15-pin MIPI Camera Serial Interface (CSI-2)
Image control functions	Automatic exposure control Automatic white balance Automatic band filter Automatic 50/60 Hz luminance detection Automatic black level calibration
Temp range	Operating: -30° to 70° Stable image: 0° to 50°
Lens size	1/4”

2.13 RFID

Radio Frequency Identification (RFID) is a method that is used to track or identify an object by radio transmission uses over the web. Data digitally encoded in an RFID tag which might be read by the reader. This is device work as a tag or label during which data read from tags that are stored in the database through the reader as compared to traditional barcodes and QR codes. It is often read outside the road of sight either passive or active RFID.

An RFID system consists of a tiny radio transponder, a radio receiver and transmitter. When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader. This number can be used to track inventory goods.

Unlike a barcode, the tag does not need to be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method of automatic identification and data capture (AIDC).

Since RFID tags can be attached to physical money, clothing, and possessions, or implanted in animals and people, the possibility of reading personally linked information without consent has raised serious privacy concerns. These concerns resulted in standard specifications development addressing privacy and security

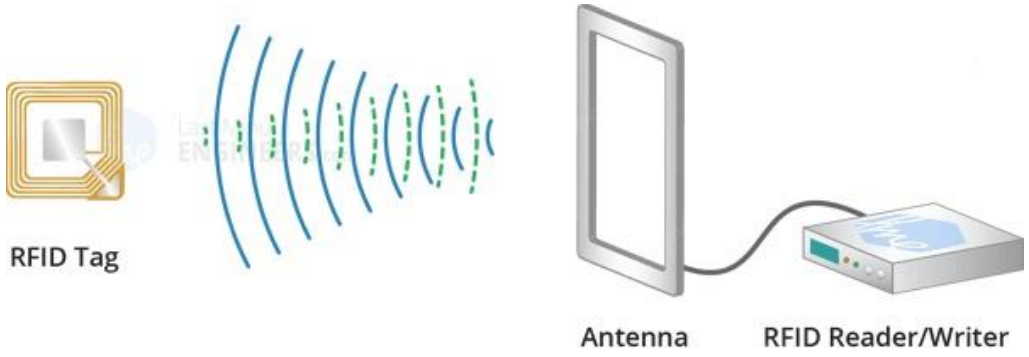


Figure 4 RFID Works

2.13.1Why RFID?

1. It Increases Operational Efficiency

One of the best benefits of RFID is that it requires less monitoring, which frees up employees to handle other tasks and focus on more productive efforts. Additionally, it doesn't require any direct line of sight to read tags, meaning multiple tags can be read at one time. You can even set up the RFID reader to automatically read tag data when you need it to.

2. It Eliminates Human Error

Manual labor always involves some level of risk for human error. With RFID, no human intervention is necessary to read data. It can all be automatically carried out by the reader. The benefits of RFID easily outweigh the costs. Not only does RFID save on labor, but it increases accuracy by eliminating the errors that come with manual data logging and product replenishment.

3. It Reduces Capital Costs

The easiest way to keep costs low is to maintain tight control of your stock or assets, especially expensive business assets like test equipment, transport packing, computer tech, field vehicles, and more. If any of these suddenly disappear, replacing them could cost you significantly. RFID provides an easy and relatively inexpensive way to keep track of these assets

4. It Grants Access to Real-Time Data

The benefits of RFID go beyond freeing up employees. RFID offers reliable track-and-trace in tough environments. This technology can easily track and provide real-time data about inventory and product location. Whether you are tracking large asset inventory, individual products, or batches, you can benefit from automatic real-time data collections.

RFID can also withstand tough conditions that standard barcode labels often can't, like high humidity, drastic temperature fluctuations, exposure to chemicals and sunlight, extremely high temperatures, and rough handling.

5. Offers Insights for Better Decision Making

Real-time data can be analyzed to give you more insight for better decisions. RFID allows you to stay informed at all times, which comes in handy when it's time to make planning and operational management decisions that can improve your profits.

2.13.2 RFID Design

A radio-frequency identification system uses tags, or labels attached to the objects to be identified. Two-way radio transmitter-receivers called interrogators or readers send a signal to the tag and read its response.

- **Tags**

RFID tags are made of three pieces:

Figure 5 RFID Tags

- A microchip (an integrated circuit which stores and processes information and modulates and demodulates radiofrequency (RF) signals).
- An antenna for receiving and transmitting the signal.
- A substrate.

There are a variety of RFID tags on the market today, differentiated by frequency range (low, high and ultra-high).

Types of RFID tags			
Types	Low-Frequency (RFID)	High-Frequency (RFID)	Ultra-High-Frequency (RFID)
Frequency Range	30 to 300 kHz	3 to 30 MHz	300 MHz to 3 GHZ
Read Range	<=10 cm	<=30 cm	<=100 m
Benefits	More resistant to interference by liquids and metals.	Higher memory capabilities.	Lower cost, with good read range and rates.

- **Readers**

Figure 6 RFID Reader

RFID systems can be classified by the type of tag and reader.

There are 3 types:

- A **Passive Reader Active Tag (PRAT)** system has a passive reader which only receives radio signals from active tags (battery operated, transmit only).
- An **Active Reader Passive Tag (ARPT)** system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags.
- An **Active Reader Active Tag (ARAT)** system uses active tags activated with an interrogator signal from the active reader.

- **Signaling**

Signaling between the reader and the tag is done in several different incompatible ways, depending on the frequency band used by the tag. Tags operating on LF and HF bands are, in terms of radio wavelength, very close to the reader antenna because they are only a small percentage of a wavelength away. In this near field region, the tag is closely coupled electrically with the transmitter in the reader. The tag can modulate the field produced by the reader by changing the electrical loading the tag represents. By switching between lower and higher relative loads, the tag produces a change that the reader can detect. At UHF and higher frequencies, the tag is more than one radio wavelength away from the reader, requiring a different approach. The tag can backscatter a signal. Active tags may contain functionally separated transmitters and receivers, and the tag need not respond on a frequency related to the reader's interrogation signal.

An Electronic Product Code (EPC) is one common type of data stored in a tag. When written into the tag by an RFID printer, the tag contains a 96-bit string of data. The first eight bits are a header which identifies the version of the protocol. The next 28 bits

identify the organization that manages the data for this tag; the organization number is assigned by the EPCGlobal consortium. The next 24 bits are an object class, identifying the kind of product. The last 36 bits are a unique serial number for a particular tag. These last two fields are set by the organization that issued the tag. Rather like a URL, the total electronic product code number can be used as a key into a global database to uniquely identify a particular product.

2.13.3 MFRC522 RFID reader

- **What is MFRC522 RFID reader?**

RC522 is the highly integrated RFID card reader which works on non-contact 13.56 mhz communication, is designed by NXP as low power consumption, low cost and compact size read and write chip, is the best choice in the development of smart meters and portable hand-held devices.

The MFRC522 uses advanced modulation and demodulation concept which fully presented in all types of 13.56MHz passive contactless communication methods and protocols. In addition, it supports rapid CRYPTO1 encryption algorithm to verify MIFARE products. MFRC522 also supports MIFARE series of high-speed non-contact communication, with a two-way data transmission rate of up to 424kbit/s. As a new member of the 13.56MHz highly integrated reader card series, MF RC522 is much similar to the existing MFRC500 and MFRC530 when there are also great differences.

- **MFRC522 complete specifications**
- Frequency Range: 13.56 MHz ISM Band
- Host Interface: SPI / I2C / UART
- Operating Supply Voltage: 2.5 V to 3.3 V
- Max. Operating Current: 13-26mA
- Min. Current (Power down): 10µA
- Logic Inputs: 5V Tolerant
- Read Range: 5 cm

- **MRC522 RFID Module Pin-out**

The RC522 module has total 8 pins that interface it to the outside world. The connections are as follows:

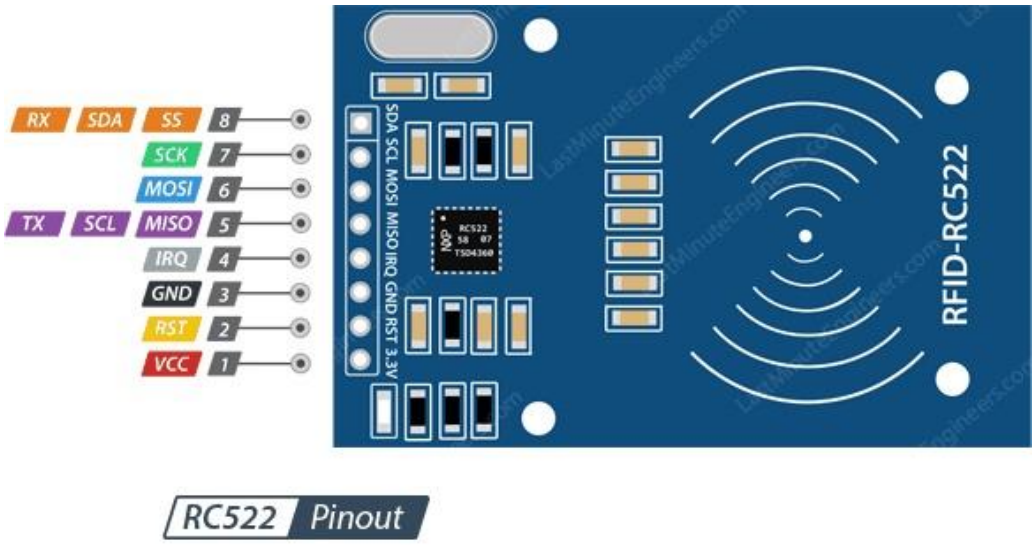


Figure 7 MRC522 RFID

- **VCC:** supplies power for the module. This can be anywhere from 2.5 to 3.3 volts. You can connect it to 3.3V output from your Raspberry pi.

- **RST:** is an input for Reset and power-down. When this pin goes low, hard power-down is enabled. This turns off all internal current sinks including the oscillator and the input pins are disconnected from the outside world. On the rising edge, the module is reset.
- **GND:** is the Ground Pin and needs to be connected to GND pin on the Raspberry pi.

- **IRQ:** is an interrupt pin that can alert the microcontroller when RFID tag comes into its vicinity.

- **MISO/SCL/TX:** pin acts as Master-In-Slave-Out when SPI interface is enabled, acts as serial clock when I2C interface is enabled and acts as serial data output when UART interface is enabled.
- **MOSI (Master Out Slave In):** is SPI input to the RC522 module.

- **SCK (Serial Clock):** accepts clock pulses provided by the SPI bus Master.

- **SS/SDA/Rx:** pin acts as Signal input when SPI interface is enabled, acts as serial data when I2C interface is enabled and acts as serial data input when UART interface is enabled. This pin is usually marked by encasing the pin in a square so it can be used as a reference for identifying the other pins.

- **MFRC522 library for Raspberry pi**
  mfrc522 is a python library to read/write RFID tags via the budget MFRC522 RFID module.

```
import MFRC522
```

2.14 Solenoid Lock

Figure 8 Solenoid Lock

In conventional door lock, there is a key to pull or push the latch, and we have to operate it manually, but in solenoid lock, the latch can be operated automatically by applying a voltage. Solenoid lock has a low-voltage solenoid that pulls the latch back into the door when an interrupt (Pushbutton, Relay, etc.) is activated. The latch will retain its position until the interrupt is enabled. The operating voltage for the solenoid lock is 12V. You can also use 9V, but it results in slower operation. Solenoid door locks are mainly used in remote areas to automate operations without involving any human effort.

Figure 9 Relay

DC Relay Switch. Share. A Electromechanical switch is called as Relay. It reacts as Automatic switch to control (just ON/OFF) large voltage load by using low voltage signal. We use DC (Direct Current) supply to Energize electromagnetic coil placed in relay so, it is referred as DC relay switch.

The circuit diagram for Raspberry Pi Solenoid Door Lock is very simple as you only need to connect the solenoid door lock to Raspberry Pi. Solenoid Lock needs 9V-12V to operate and Raspberry Pi GPIO pins can supply only 3.3V, so a 12V external power source is used to trigger the lock with the help of a relay.

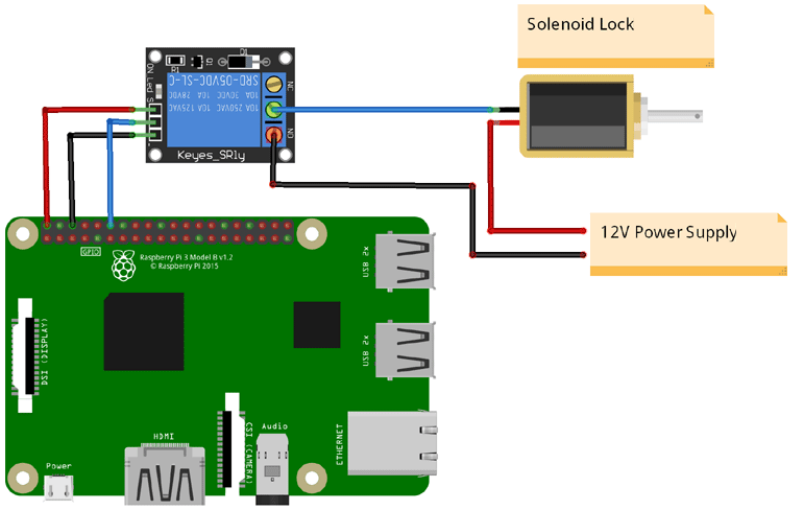


Figure 10 Circuit Diagram Solenoid

Here the input pin of the relay module is connected to GPIO 18 pin of Raspberry Pi while VCC and GND pins of the Relay module are connected to 5V and GND pin of Raspberry Pi. On the other side, the GND pin of solenoid lock is connected to COM of relay module and a Positive pin is connected to Positive of 12V power supply. The negative pin of the 12V power supply is connected to the NO pin of the relay module.

2.15 16x2 LCD display module & I2C

Figure 11 LCD display module & I2C

This 16x2 LCD display module has an I2C communication interface and is a premium 2-line, 16-character LCD module with on-board contrast control adjustment, backlight, and I2C interface. There is no longer a need for a difficult LCD driver circuit connection for raspberry pi beginners. The I2C Serial LCD module's true benefits include simplifying circuit connections, saving some I/O pins on the raspberry pi board, and simplifying firmware development with a readily available LCD driver library.

Connecting for display:

Connect the display to the pins of your Raspberry Pi like shown in the picture or rather in the chart.

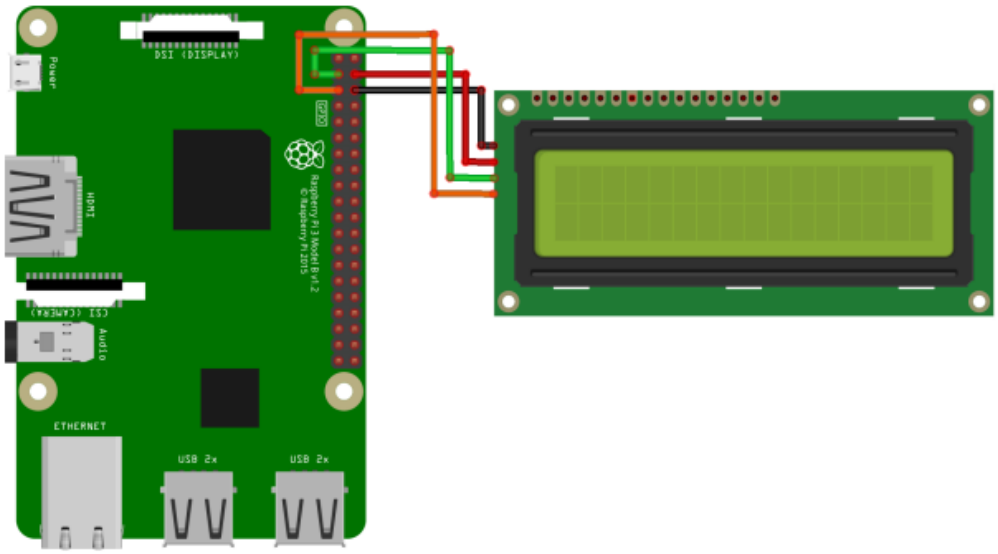


Figure 12 Connecting LCD to raspberry pi

Raspberry Pi	16 x 2 LCD
Pin 6 (Ground)	GND
Pin 4 (5 V)	VCC
Pin 3 (BCM 2 / SDA)	SDA
Pin 5 (BCM 3 / SCL)	SCL

Installation of the libraries:

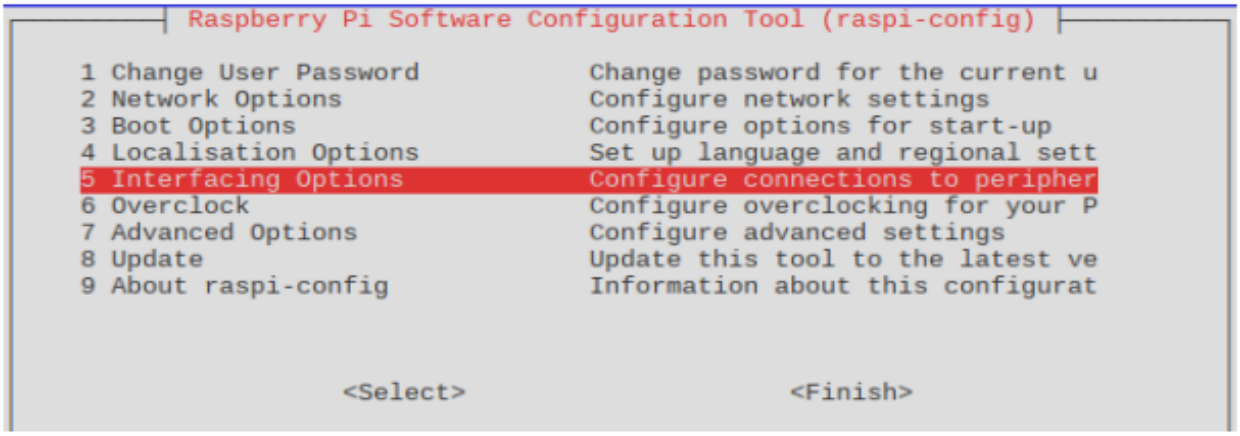
- As soon as the installation is finished and the system is restarted, open the terminal and perform the following commands:

```
sudo apt-get install python-pip python-dev build-essential
sudo pip install RPi.GPIO
sudo apt-get install python-imaging sudo apt-get
install python-smbus i2c-tools
```

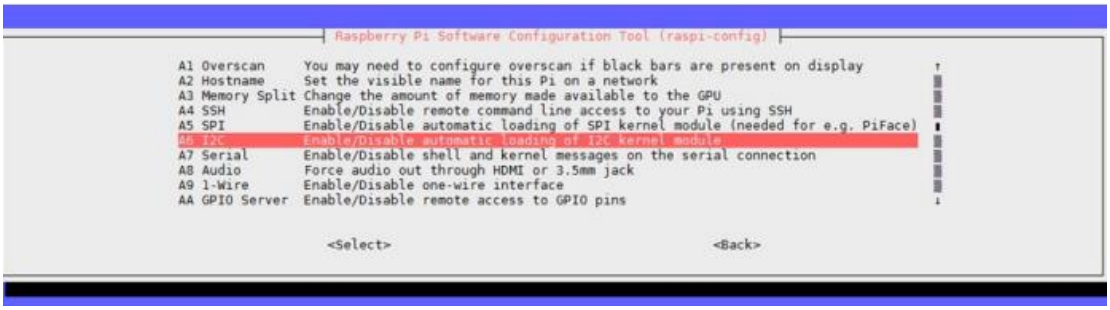
- If the I2C function is not activated on your Raspberry Pi, you must catch up on this in the settings. Therefore, open the settings with the following command:

```
sudo raspi-config
```

- In the window just opened choose the option Interfacing Options:



- Choose and activate I2C here:



Chapter 3: Facial Recognition

3.1 Introduction:

Human identification is the process of identifying a person based on one or more distinguishing characteristics. In the business and law enforcement fields, there are many different types of personal verification procedures. Password identification number (PIN) or password system is the most prevalent way of personal verification. However, these approaches are vulnerable to fraud, theft, and memory lapses. As a result, we are concentrating on confirming a person utilizing his or her unique biometric features. If we want to identify a person based on his unique biological structure, we can use fingerprint, palm, iris, retina, and face detection.

Human activity is a crucial concern in a wide range of activities, including human surveillance, human-computer interfaces, and database management using facial recognition. Face recognition was once thought to be one of the most difficult artificial intelligence techniques. However, thanks to a succession of recent accomplishments, it is now not only technically conceivable but also economically feasible. To summaries, face recognition is a popular identification technology that has a wide range of commercial and law enforcement uses.

The use of image recognition in various aspects of our lives has expanded dramatically in recent years. In their study "Face Recognition in Poor-Quality Video: Evidence from Security Surveillance," A. Mike et al. built a flawless security system solution that incorporates subsystems such as surveillance CCTV, video management, and wireless backbone. Within a confined region covered by CCTV cameras, the system is capable of identifying an intruder. To inspect the intrusion, we usually need to watch the video for a long time. Face recognition in the security system, on the other hand, will show us the areas of the video where the breach occurred. When face recognition is utilized in ATM booths, they become more secure. In the most realistic scenario, face recognizing evaluation with exceptional occlusion handling (EOH) is possible. Furthermore, utilizing

the frame difference to detect the rough edges of moving people and then using the chromatic feature to locate the people's faces, the Face Recognition technique may be used to count the number of people in a location. When educational institutes utilize face.

recognition to take attendance, the system becomes more efficient and convenient. Personal component analysis (PCA). Personal component analysis in face recognition makes it considerably easier to keep track of a student's attendance. It also allows staff to readily access information regarding student attendance by keeping track of clock-in and clock-out times. The use of a face recognition technology in hospitals and medical institutions can be quite beneficial. Patients who are unconscious are frequently admitted to hospitals. Facial recognition allows doctors to access patients' medical records more quickly, which speeds up the process of giving quick medical care. Face recognition can even be used to keep track of newborn newborns. Goods stored in the inventory of an industry with an image recognition inventory management system are safer than those held in traditional inventory management systems.

The information era is rapidly changing the way people conduct business. There is a need for a technique of user identification and authentication that is both quick and accurate. Face recognition has become one of the most widely used means of identifying users. Face recognition research is in a growing era, according to literature survey figures, and research in this field has expanded tremendously in the last forty years.

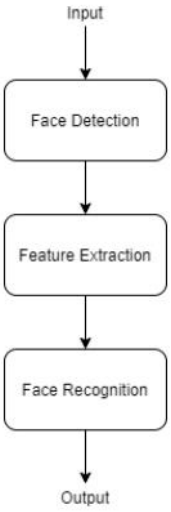


Figure 13 Face recognition Flow Chart

Face recognition is a method of recognizing a person from a photograph or video stream. It can imitate a human eye's ability to detect people. Face recognition offers a wide range of practical applications. There are a variety of ways to put this technology into practice. The detection of the face is the first stage in any face recognition system (from the source). Following the detection of a face, specific data is retrieved from the detected face and compared to a known database in order to identify the person. A Raspberry Pi 3 Model B was used in the system, along with a camera module attached to it. The Haar cascade was used to detect faces, and the Local Binary Pattern Histogram (LBPH) technique was used to recognize them. The goal is to develop a low-cost, dependable system that may be used for a wide range of applications

3.2 What is Facial recognition?

Face recognition is a technique in which images and patterns are analyzed and recognized. Face detection is known as the identification of face from a video or an image. Many improved techniques are implemented in face recognition in past ten years. Some well-known methods in each category are overviewed and then benefits and drawbacks are mentioned and analyzed in this paper. For the purpose of recognizing the face, the most recent algorithms and the approaching technology methods are analyzed.

In this modern world security has become a major concern in securing a particular area such as banks, institution, temple premises etc. The existing system can be easily broken either by hacking the password or by duplicating entry cards. There are some security systems which are very difficult to break but they are neither cost efficient nor easily affordable. We proposed a strong secure and affordable system using RFID, PIN lock and face recognition using raspberry pi3.

Face recognition can be divided into a few simple stages and those stages can be further divided into more sophisticated stages. At first, images are captured with the help of a camera and then the images are taken as inputs. Faces are differentiated from the images and only the important features of a face are kept in the database which reduces space complexity and in turn the overall computational complexity. After that, the machine is trained with these features for further evaluation. A simple face recognition procedure is shown in the flowchart

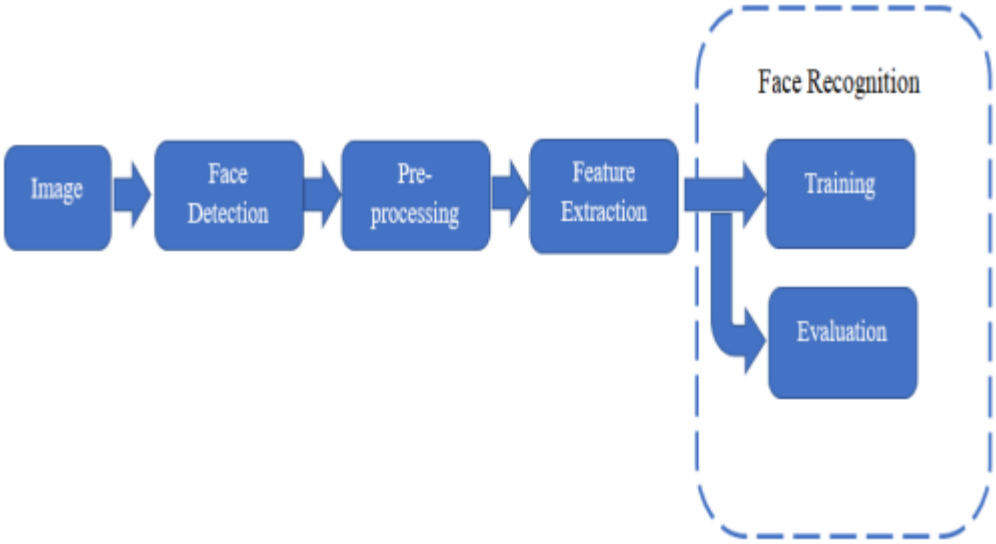


Figure 14 Face recognition Works

3.3 What is Image Processing?

Image Processing is a method to convert an image into digital form and perform some operation on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually, image processing system includes treating images as two-dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. It includes basically three steps as importing the image with optical scanner or by digital photography, analyzing and manipulating the image which includes data compression and image Enhancement and spotting patterns that are not to human eyes like satellite photographs and output is the last stage in which result can be altered image or report that is based on image analysis. Computer vision (CV)is computer imaging where the

application does not involve a human being in visual loop. One of the major topics within this field of computer vision is image analysis. First image analysis involves the examination of the image data to facilitate solving vision problem. Second analysis includes two other topics as feature extraction which is the process of acquiring higher level image information, such as shape or color information and next is Pattern Classification which is the act of taking this higher-level information and identifying objects within the image. Face recognition has repeatedly shown its importance over the last years and so not only it is a vividly research area of image analysis, pattern recognition in more precisely biometrics, but also it has become an important part of our everyday lives since it was introduced as one of the identification methods to be used in passports. Our topic on image processing is a technique of identifying the persons by a Robot on a real time basis. We are using Image Processing Technique that can detect multiple faces. It effectively tracks the human faces and detects it [6]. It is a system that works by recognizing human faces and then giving a relay on the basis of its result or conclusion. Software along with hardware is created which will recognize the human face by various algorithms used. The algorithm used will compare the different images with the pre-defined or the learned images with the real video images. The final aim is to bring about a change in the current face recognition system thus making it more efficient and robust.

3.4 System Model

A. Face detection:

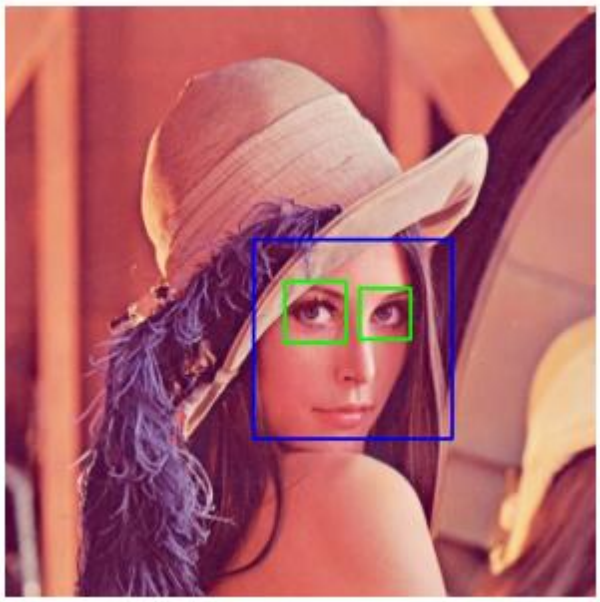


Figure 15 Face detection

is the most fundamental step for automated face analysis. The step can be considered as a sub-system input the images from camera and output the location and size of faces. The face detection system output can be an input of face recognition, face tracking, face authentication, facial expression recognition and facial gesture recognition system. If the face image is given with its size and location of frame, we can normalize the scale, illumination or orientation to continue our face analysis. However, human face belongs to a dynamic object, so many classes of approach proposed to solve this problem. The three main classes are skin color-based, shape-based and feature-based.

The skin color-based approach uses the property of skin color distribution in a color space. If we have the skin color model in a color space, we can build a skin color filter to remain the pixels in the range of the skin color domain.

The second class, shape-based approach uses shape model to detect face. For example, try to match an ellipse shape with the edge of image. It assumes face edge is similar with ellipse shape. Our face detection system adopts the Haar Classifier approach to detect human face. The Haar Classifier uses a form of AdaBoost and belongs to feature-based class. It uses Haar-like feature which consists of adding and subtracting image regions, and integral image technique enables rapid computation.

This generation of our face detection system, called Parallel Haar-like Face Detection System (PHFDS), which consists of the several processes involves the search region of interest (ROI) determination by motion predictor, adaptive skin detection, condensation filter with parallel Computing confidence of particles, Parallel Haar like wavelets classifying based on AdaBoost finished by OpenCV, and predicting the motion for next time.

B. Determine the Region of Interest (ROI) of Image:

ROI is a region of image which is interesting and allowed to process only on it. The concept about ROI is a kind of local search and a very useful tool to reduce computation and increase object hit rate. The first advantage is easy to understand, and the second one is an important basis of our motion tracking. Given a video or sequence of images, we can assume the motions of the human or object is continuous. It means that the human or object cannot disappear or appear suddenly. It is easy to combine the concept about ROI, in other words, we can set a bit bigger ROI than last region which detected the human or object. If a disturbance does not appear in the ROI, it will not be detected and increase the robustness. In real word, because webcam has the maximum frame rate (30 fps.) constraint, the human or object sometimes move too fast to track. In the situation, we can initialize our motion tracker back to the global search mode. The meaning is that we will have very low miss-rate with high performance.

3.5 Related Work

Software working includes the installation of OpenCV with the algorithm which will first detect the images and learn them. The database will be created containing different images. The recognition will be done in three steps:

A. Face detection:

Figure 16 Face detection image

This generation of our face detection system called parallel Haar-like face detection system, which consist of several process involves the search region of interest (ROI) determination by motion predictor, adaptive skin detection, parallel Haar like wavelets classifying based on AdaBoost finished by OpenCV and predicting the motion for the next time.

B. Facial skin:

Color model:HSV stands for hue, saturation and value (or brightness), and is particularly common in color analysis intuitively corresponds to the color system of human. We adopt an adaptive skin color detector proposed by Dadgostar and Sarrafzadeh. The algorithm

based on adaptive hue thresholding and hue histogram of skin pixels. To avoid undefined mapping, we set H, S, and V to be zero when R, G and B are all equal to zero.

C. Determine the region of interest (ROI) of image:

ROI is the region of image which is interesting and allowed to process only on it. The concept about ROI is a kind of local search and a very useful tool to reduce computation and increase object hit rate. The advantage is easy to understand and the second one is an important basis on our motion tracking. Given a video or sequence of images we can assume the motions of the human or object is continuous.it means that the human or object cannot disappear or appear suddenly. It is easy to combine the concept about ROI.in other words, we can set bigger ROI than last region which is detected the human or object. If a disturbance does not appear in the ROI, it will not be detected and increase the robustness.in real word, because webcam has the maximum frame rate (30fbs) constraint, the human or object cannot disappear or appear suddenly.it is easy to combine the concept about ROI in other words we can set a bit bigger ROI than last region which detected the human or object. If disturbance does not appear in the ROI, it will not be detected and increase the robustness. In real word because webcam has the maximum frame rate (30fps.) constraint the human or object sometimes move to fast to track. In the situation we can initialize our motion tracker back to the global search more. The meaning is that we will have very low miss rate with high performance.

D. Creation of a database:

After extracting the features of face, it is stored in the database with its id using OpenCV library.

E. Face Recognition:

The recognition process involves a robot which detect the face using algorithms PCA, LDA, LBPH which is an inbuilt algorithm in OpenCV library for face recognition. The robot will move a capture the images on a real time basis and again perform the face detection process. The robot is a wheeled robot with a ruster wheel of a 10 rpm. The speed should be slow in order to detect the faces by the camera and its proper resolution.

3.6 Libraries

There are several Python libraries related to Image processing and Computer vision. The ones that will be presented in this paper are:

PIL/Pillow:

This package is mostly used for elementary picture analysis and simple image transformations (rotation, resizing, etc.). (Histogram for example)

OpenCV:

It's a huge open-source library for image processing, machine learning, and computer vision. Python, C++, and Java are just a few of the programming languages that OpenCV supports. It can distinguish artefacts, people, and even human handwriting in photos and movies. When used in conjunction with other libraries, such as NumPy, a high-performance library for turning machines, OpenCV achieves good results; that is, all services that Numpy can perform may also be performed with OpenCV. It is written in C++ and has a C++ interface as its main interface, but it also includes an older Language training that is less robust but nonetheless thorough. In the C++ GUI, you may see the most up-to-date technologies and techniques. Bindings for Python, Java, and MATLAB/OCTAVE are provided. To promote broader acceptance, wrappers in a variety of programming languages have been built. In version 3.4, JavaScript plugins for a subset of OpenCV functions are released as OpenCV.js, which can be utilized on web platforms. The OpenCV project was born out of Intel's research initiative to assist CPU-intensive applications, which was first announced in 1999. Face detection and recognition methods are commonly implemented using OpenCV.

Python Imaging Library (PIL)

The Python Imaging Library (PIL) was created by Fredrik Lundh in the beginning. The most recent release of PIL was in 2009, therefore it is somewhat out of date. Pillow is its replacement, which also supports Python 3. As a result, they cannot both be installed at the same time. The most recent version of Pillow at the time the paper was being written was 5.1.0. The simplest program (which displays an image) can be created as follows:

```
from PIL import Image
im=Image.open('/path/to/the/image/')
im.show()
```

Pillow allows the execution of several common image editing techniques and can extract a lot of information from an image, including:

• per-pixel manipulations

• masking and transparency handling

• image filtering, such as blurring, contouring, smoothing, or edge finding

• image enhancing, such as sharpening, adjusting brightness, contrast or color

A few of them will be shown. For instance, with the following code, an image can be quickly rotated to a particular angle (in this case, 45 degrees)

Additionally, a color image can be divided into various parts (red, green and blue).

Additionally, blurring or sharpening an image is simple. However, it's crucial in this situation that we additionally import the Image Filter library.

Image can for example also be easily cropped with the following command

It was demonstrated that PIL/Pillow is very easy if only basic image processing task are needed. For more detailed analysis and computer vision OpenCV are more appropriate.

Face recognition:

The study of face recognition can be summed up as the collection of face photographs into sets that all belong to the same individual. Perhaps if we use Facebook as an example, it will be simpler to understand. Facebook could previously recognize faces (see previous section), but users had to tag the individual by clicking on the image and entering their name. Facebook can now automatically tag every individual in a photograph. Face recognition techniques enable this. Convolutional neural networks that have already been trained and OpenCV can be used in Python to complete this assignment.

The software as a whole largely depends on many libraries. The Python project must import the modules paths, face recognition, argparse, picle, and OS. We must first gather several photographs of the individual we want to identify. Either manually entering the information or using Microsoft's Bing API can accomplish this. The dataset should ideally include at least 30 photos of each individual. The training photographs should be free of any other people. Two illustrations (one for each person)

ResNet-34 neural network is the foundation for facial recognition. However, the Python facial recognition package uses half as many filters and has fewer layers. A dataset of over 3 million photos was used to train the network, primarily the VGG dataset and the scrubs dataset.

The four steps of the algorithm are as follows:

1-Finding face

The face detection method, which is the one that is most frequently used, might be used as the initial step. The Histogram of Oriented Gradients (HOG) approach, however, is more sophisticated and is used by the face recognition library. Grayscale images must first be created from color ones. Next, we examine which direction the image is getting darker for each individual pixel. As a result, we obtain a gradient matrix (see Fig. The brightness differences in the original image are largely unrelated to this matrix. However, it is too large to be bent.

Figure 17 brightness differences

2. Posing and Projecting Faces

This phase addresses the issue that faces in an image might be gazing away from the camera and not directly at it. There are numerous approaches to this issue. The technique with 68 landmarks that are present on every face is used by the Python library. An illustration of such a photo can be found in

3. Encoding Faces

For each face, the Deep Convolutional Neural Network is trained to produce 128 measures. Three images are used at a time during the training process: one of a familiar persons, a second image of that person, and a third image of a different individual. A sizable dataset and a lot of computing power are needed for this stage. However, it only needs to be done once. There are also some pre-trained neural networks online.

4. Finding the person's name from the encoding

The final step is rather simple. The faces in our database are contrasted with the face under analysis. Support vector machine (SVM) is used in Python's library to accomplish it. Any other categorization algorithm may theoretically be employed.

Chapter 4: Database

4.1 Introduction

A database management system (DBMS) refers to the technology for creating and managing databases. Basically, DBMS is a software tool to organize (create, retrieve, update and manage) data in a database.

The main aim of a DBMS is to supply a way to store up and retrieve database information that is both convenient and efficient. By data, we mean known facts that can be recorded and that have embedded meaning. Normally people use software such as DBASE IV or V, Microsoft ACCESS, or EXCEL to store data in the form of database.

Database systems are meant to handle large collection of information. Management of data involves both defining structures for storage of information and providing mechanisms that can do the manipulation of those stored information. Moreover, the database system must ensure the safety of the information stored, despite system crashes or attempts at unauthorized access.

This project aim is computerizing the manual process of university entrance system.

4.2 Relational databases

Relational databases became dominant in the 1980s. Items in a relational database are organized as a set of tables with columns and rows. Relational database technology provides the most efficient and flexible way to access structured information.

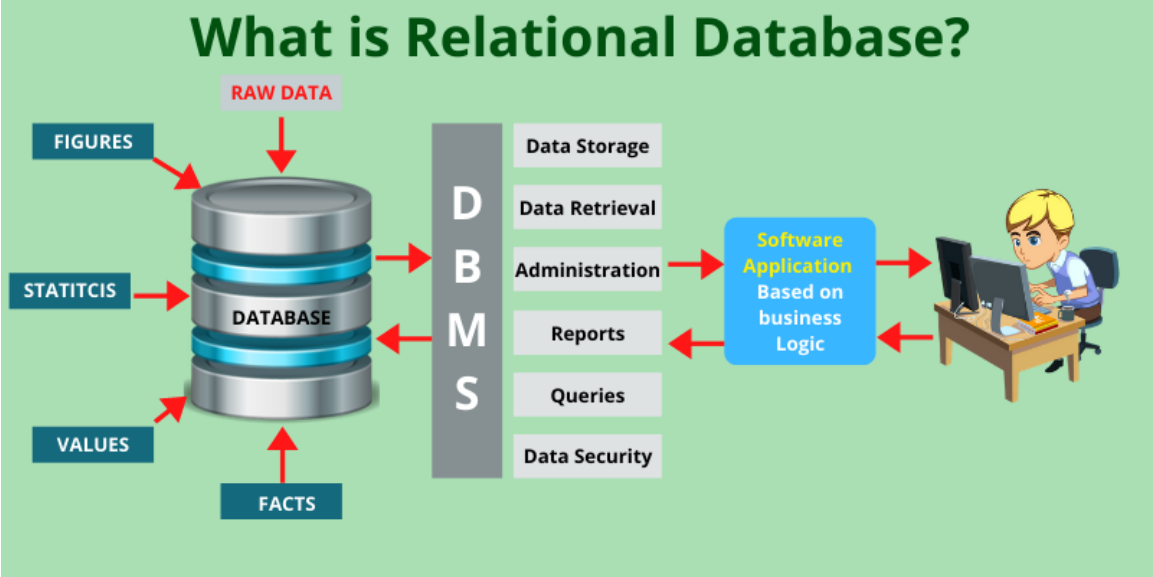


Figure 18Relational Database

Features of a relational database

Relational databases need ACID characteristics.

ACID refers to four essential properties: Atomicity, Consistency, Isolation, and Durability.

These features are the key difference between a relational database and a non-relational database.

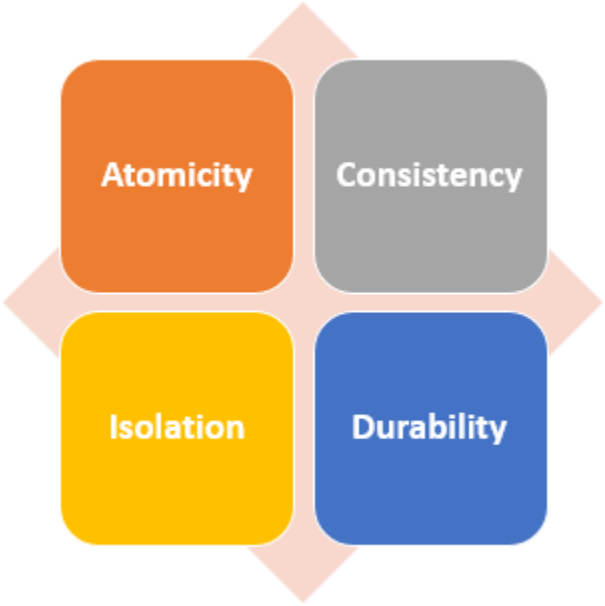


Figure 19 ACID

1. **Atomicity**

Atomicity keeps data accurate. It makes sure all data is compliant with the rules, regulations, and policies of the business.

It also requires all tasks to succeed, or the transaction will roll back.

Atomicity defines all the elements in a complete database transaction.

2. **Consistency**

Relational databases have data consistency because the information is updated across applications and database copies. This means multiple instances always have the same data.

3. **Isolation**

With a relational database, each transaction is separate and not dependent on others. This is made possible by isolation.

Isolation keeps the effect of a transaction invisible until it is committed. This reduces the risk

of confusion

4. **Durability**

Durability means that you can recover data from a failed transaction.

It also ensures that data changes are permanent.

4.3 Uses and benefits of a relational database

Some of the main advantages of a relational database are:

1. **Data consistency**

As mentioned, when we outlined ACID, a core part of a relational database is consistency.

A relational database model ensures that all users always see the same data.

This improves understanding across a business because everyone sees the same information. This ensures that nobody makes business decisions based on out-of-date information.

2. **Data working together**

All the data in a relational database has a ‘relationship’ with other data. Columns are built in a way that makes it easy to establish relationships among data points.

3. Data flexibility

Relational databases allow for flexibility. Users can change what they see. And it's easy to add additional data at a later time.

A relational database also allows for a subset of data to be viewed. This means you can hide certain data if some users only need access to a specific set of columns or rows.

4.4 What is SQLite

SQLite is a software library that provides a relational database management system. The lite in SQLite means lightweight in terms of setup, database administration, and required resources.

4.5 Why SQLite:

1. Serverless

Normally, an RDBMS such as MySQL, PostgreSQL, etc., requires a separate server process to operate. The applications that want to access the database server use TCP/IP protocol to send and receive requests. This is called client/server architecture.

The following diagram illustrates the RDBMS client/server architecture:

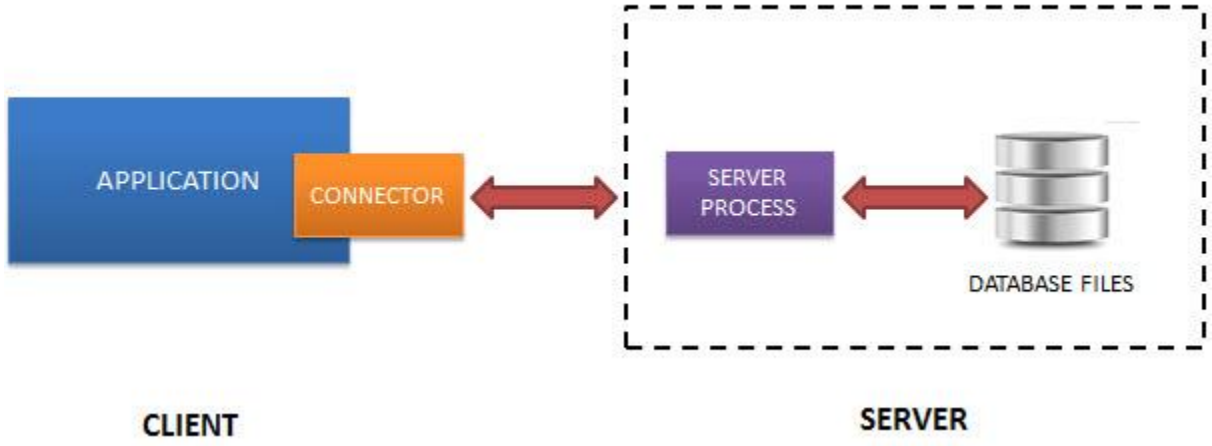


Figure 20 RDBMS

SQLite does NOT work this way.

SQLite does NOT require a server to run.

SQLite database is integrated with the application that accesses the database. The applications interact with the SQLite database read and write directly from the database files stored on disk.

The following diagram illustrates the SQLite server-less architecture:

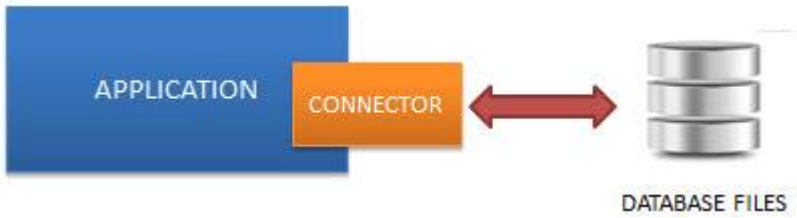


Figure 21 the SQLite server-less

2. Self-Contained

SQLite is self-contained means it requires minimal support from the operating system or external library. This makes SQLite usable in any environment especially in embedded devices like iPhones, Android phones, game consoles, handheld media players, etc.

SQLite is developed using ANSI-C. The source code is available as a big sqlite3.c and its header file sqlite3.h. If you want to develop an application that uses SQLite, you just need to drop these files into your project and compile it with your code

3. Zero-configuration

Because of the serverless architecture, you don't need to "install" SQLite before using it. There is no server process that needs to be configured, started, and stopped.

In addition, SQLite does not use any configuration files.

4. Transactional

All transactions in SQLite are fully ACID-compliant. It means all queries and changes are Atomic, Consistent, Isolated, and Durable.

In other words, all changes within a transaction take place completely or not at all even when an unexpected situation like application crash, power failure, or operating system crash occurs.

SQLite allows a single database connection to access multiple database files simultaneously. This brings many nice features like joining tables in different databases or copying data between databases in a single command.

SQLite is capable of creating in-memory databases that are very fast to work with

4.6 Smart Gate Database

We used in this project sqlite3 as our database our database consist of one table for the student have the following information:

1. Student name
2. Student ID
3. Date of birth
4. Vaccine status
5. Student picture

Database Structure | Browse Data | Edit Pragmas | Execute SQL

Table: students | New Record | Delete Reco

	Full_Name	ID	DateOfBirth	Vaccisnated	Photo
	Filter	Filter	Filter	Filter	Filter
1	Lina Samer	18060	2000-9-4	Yes	BLOB
2	Omar ...	19001	2000-10-29	Yes	BLOB
3	Mohamed ...	19005	1999-12-10	Yes	BLOB
4	Eslam Adel	19041	1998-1-25	Yes	BLOB

Figure 22 Smart Gate Database

4.7 Database GUI

We can add student details to the database by python code but it won't be convenient to use by the normal user so we made GUI to make it easier to

add and edit.

Login

the admin is the only one who can edit this table and add students to the database, so to make it secure and to prevent anyone that doesn't not have permission to access it the admin have to login first

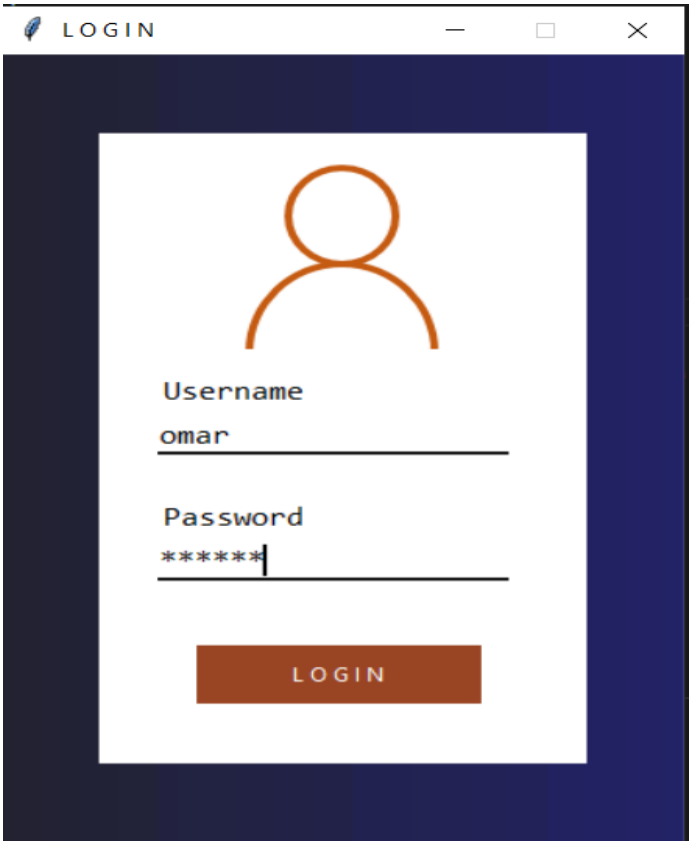


Figure 23 Login Page

Add Student records

- The admin has the ability to add student records to the database by using our GUI.

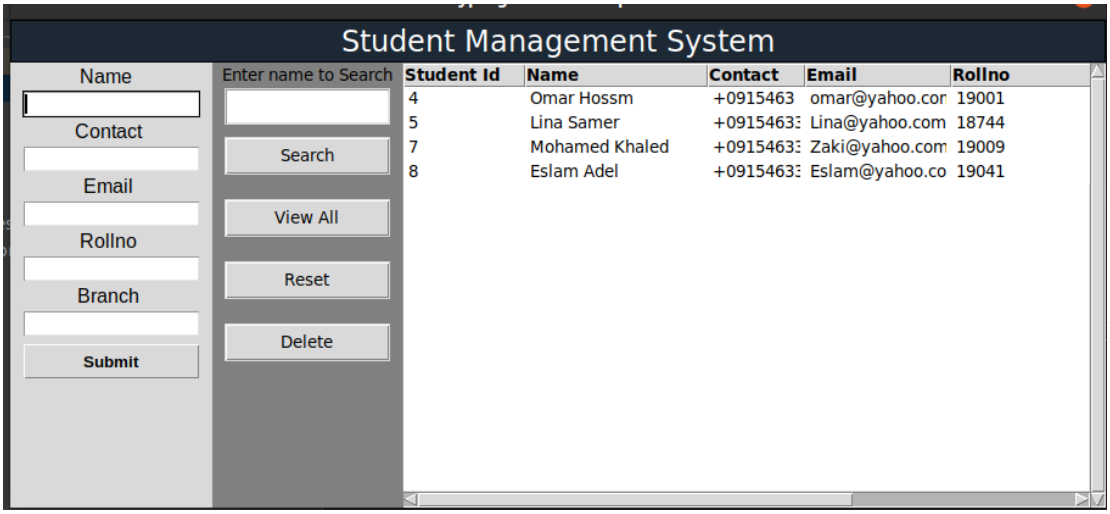


Figure 25 Student Management system

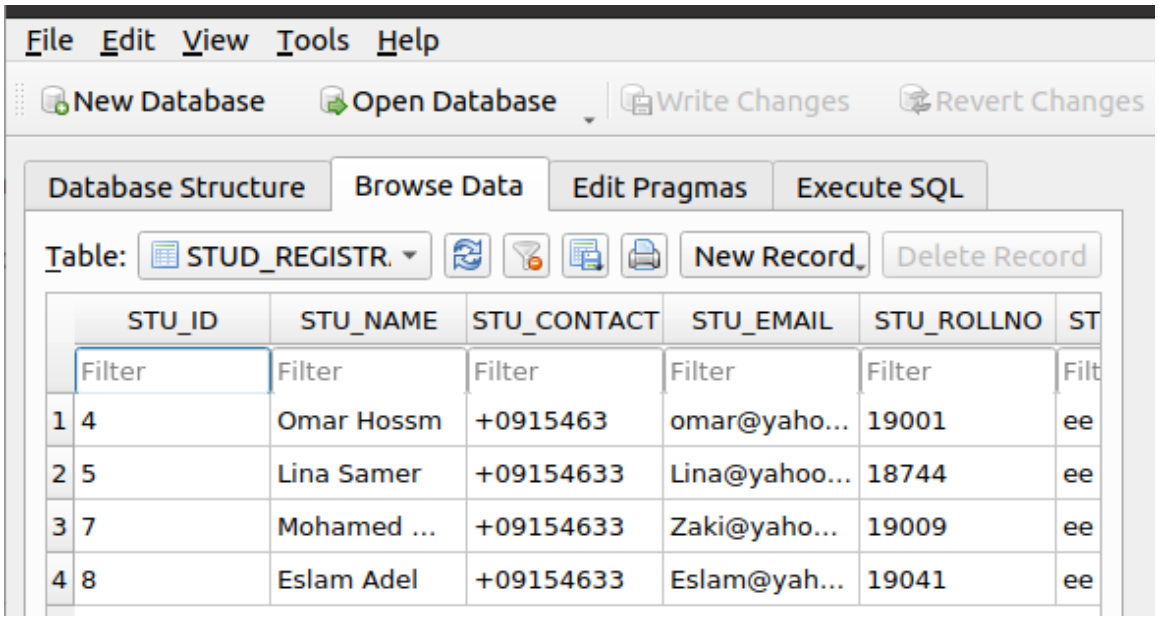


Figure 24 Database Add

- Here we find that the student records are stored to our database successful

Delete Student records

- The admin has the ability to delete student records to the database by using our GUI.

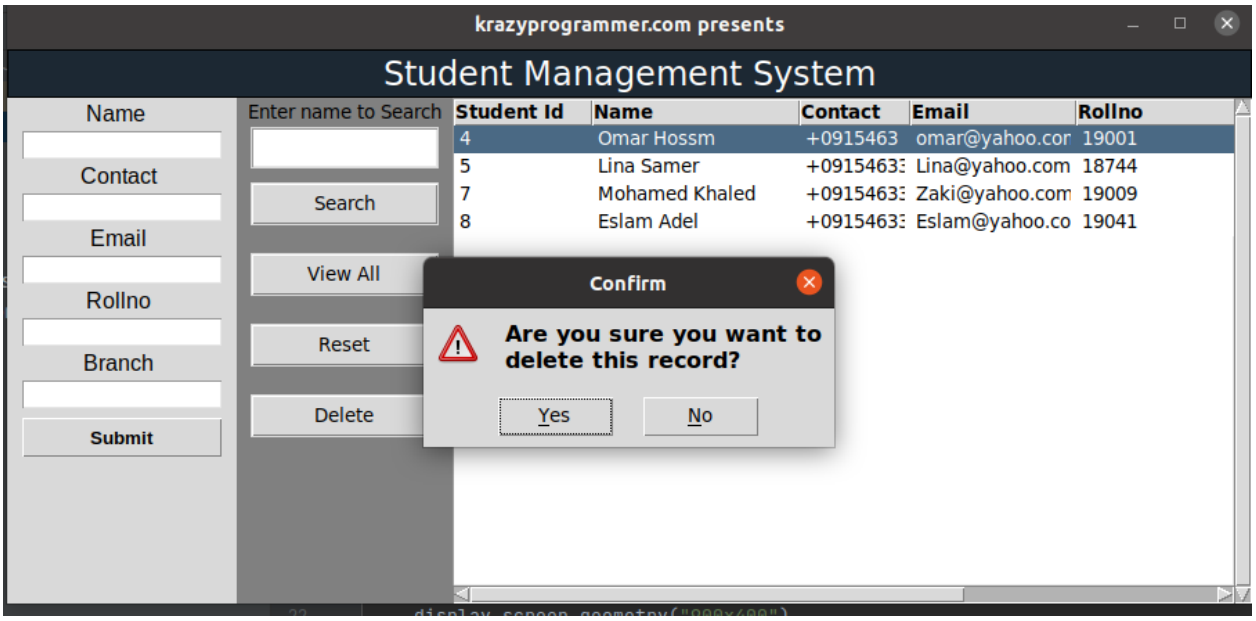


Figure 26 Delete Student

- The record has been deleted successfully.

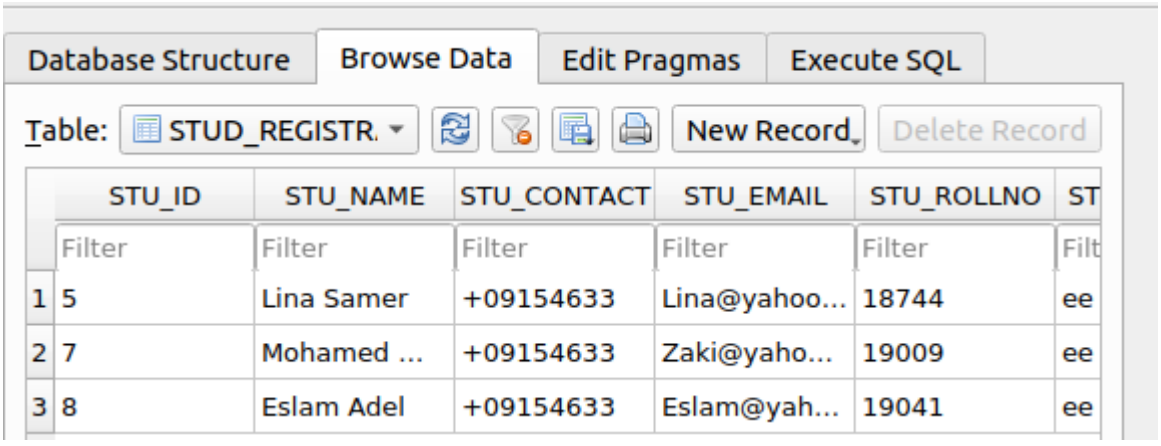


Figure 27 Database Delete

Search the records

Having a thousand of student records will be very difficult to scroll the entire database to find

the desired student record so our GUI gives the ability to search for the student record by his name

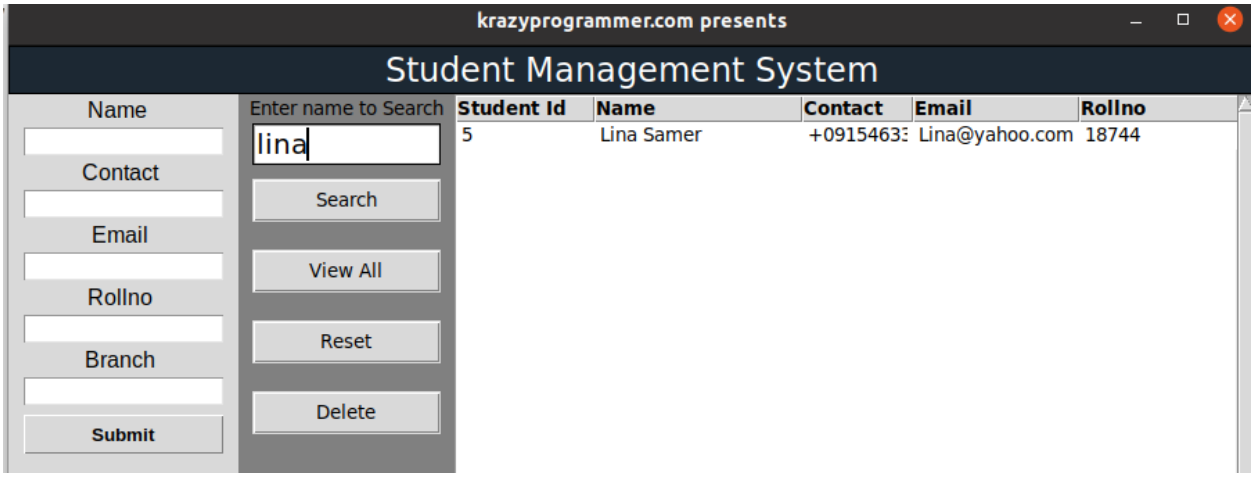


Figure 28 Search for Students

Every time student put his card on the gate the student information will be shown on the security monitor, in case any error happens with the gate and the gate didn't open the security can check the student details and can let him enter.

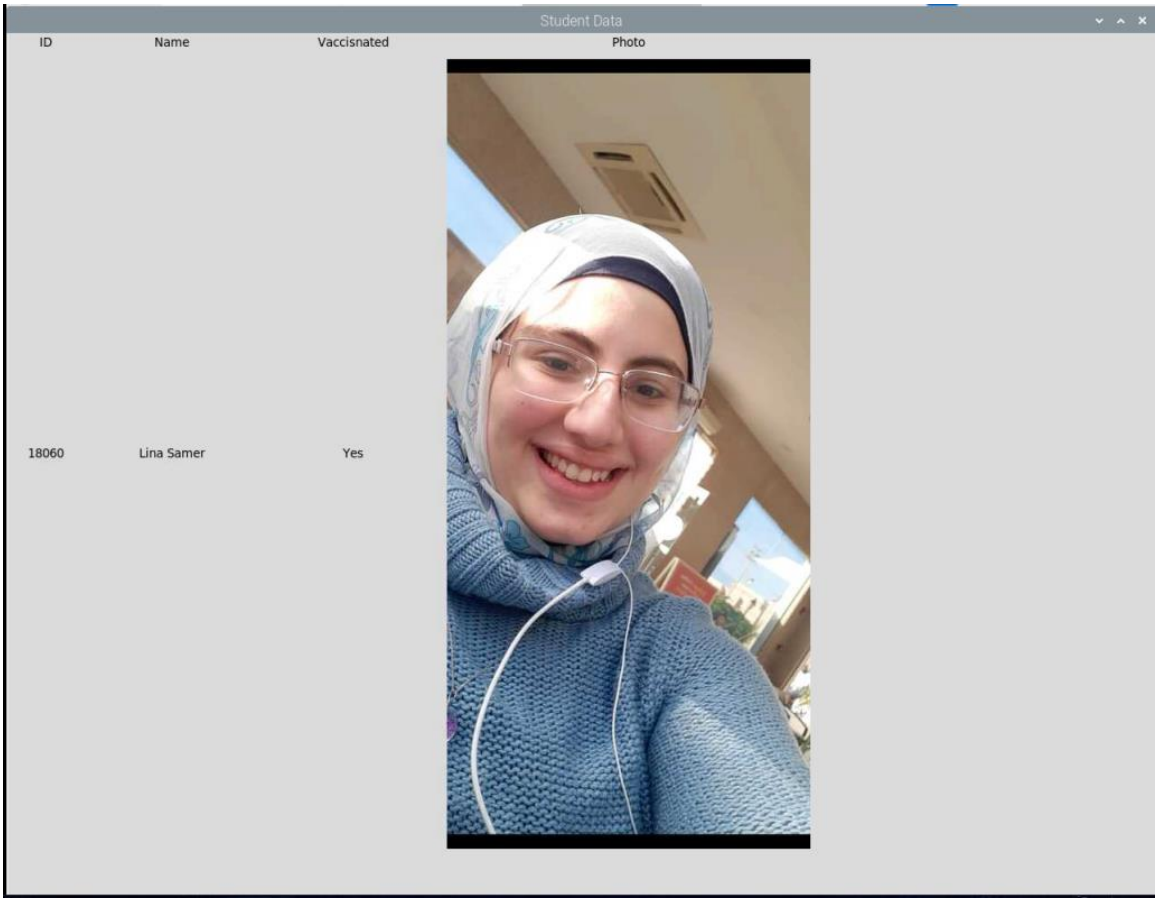
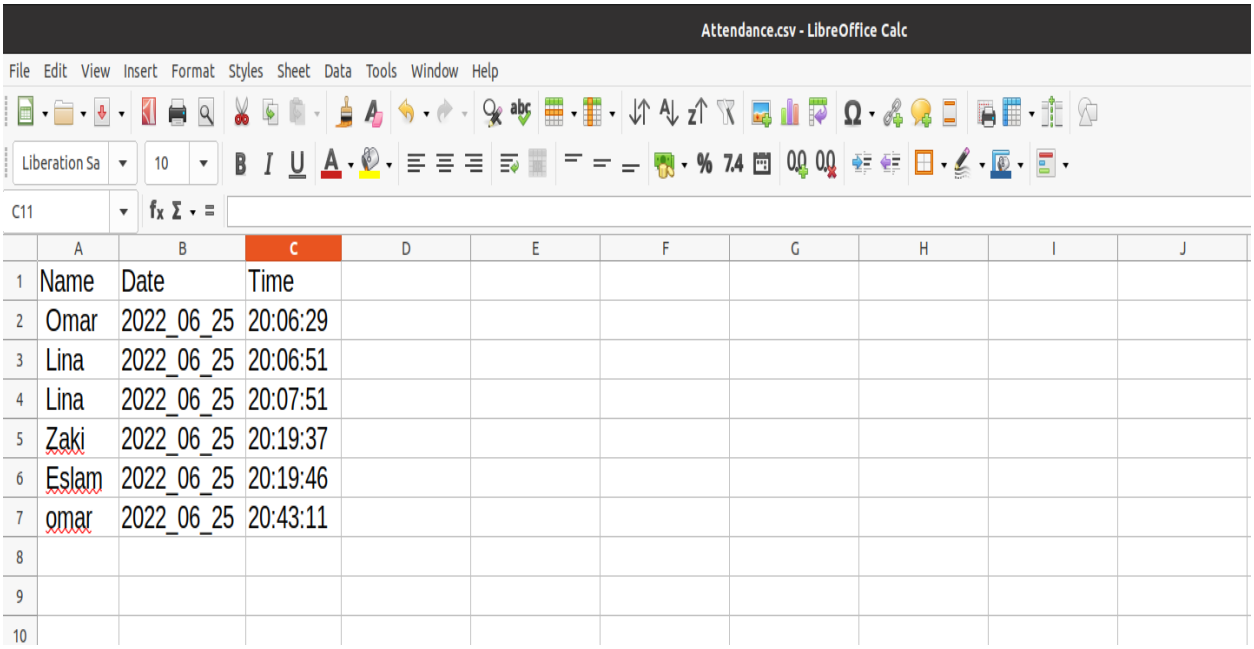


Figure 29 Photo on database

Student attendance

In the existing system we can't know who entered the university or when we don't have any kind of information. In our project we can follow this process and we can know who accessed the gate and in which time every day and we can print daily report have this information.



	A	B	C	D	E	F	G	H	I	J
1	Name	Date	Time							
2	Omar	2022_06_25	20:06:29							
3	Lina	2022_06_25	20:06:51							
4	Lina	2022_06_25	20:07:51							
5	Zaki	2022_06_25	20:19:37							
6	Eslam	2022_06_25	20:19:46							
7	omar	2022_06_25	20:43:11							
8										
9										
10										

Figure 30 Student attendance

4.8 Libraries

Tkinter

Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit.

```
import tkinter  as tk
```

Figure 31 Tkinter

Tcl

Tcl is a dynamic interpreted programming language, just like Python. Though it can be used on its own as a general-purpose programming language, it is most commonly embedded into C applications as a scripting engine or an interface to the Tk toolkit. The Tcl library has a C interface to create and manage one or more instances of a Tcl interpreter, run Tcl commands and scripts in those instances, and add custom commands implemented in either Tcl or C. Each interpreter has an event queue, and there are facilities to send events to it and process them. Unlike Python, Tcl's execution model is designed around cooperative multitasking,

Tk

Tk is a Tcl package implemented in C that adds custom commands to create and manipulate GUI widgets. Each Tk object embeds its own Tcl interpreter instance with Tk loaded into it. Tk's widgets are very customizable, though at the cost of a dated appearance. Tk uses Tcl's event queue to generate and process GUI events.

IO

The io module provides Python's main facilities for dealing with various types of I/O. There are three main types of I/O: *text I/O, binary I/O* and *raw I/O*. These are generic categories, and various backing stores can be used for each of them. A concrete object

belonging to any of these categories is called a file object. Other common terms are *stream* and *file-like object*.

independent of its category, each concrete stream object will also have various capabilities: it can be read-only, write-only, or read-write. It can also allow arbitrary random access (seeking forwards or backwards to any location), or only sequential access (for example in the case of a socket or pipe).

All streams are careful about the type of data you give to them. For example giving a str object to the write() method of a binary stream will raise a Type Error. So will giving a bytes object to the write() method of a text stream.

```
import io
```

Figure 32 IO

Text I/O

Text I/O expects and produces str objects. This means that whenever the backing store is natively made of bytes (such as in the case of a file), encoding and decoding of data is made transparently as well as optional translation of platform-specific newline characters.

Binary I/O

Binary I/O (also called *buffered I/O*) expects bytes-like objects and produces bytes objects. No encoding, decoding, or newline translation is performed. This category of streams can be used for all kinds of non-text data, and also when manual control over the handling of text data is desired.

Raw I/O

Raw I/O (also called *unbuffered I/O*) is generally used as a low-level building-block for binary and text streams; it is rarely useful to directly manipulate a raw stream from user code. Nevertheless, you can create a raw stream by opening a file in binary mode.

PIL

Python Imaging Library is the image processing package for Python language. It incorporates lightweight image processing tools that aids in editing, creating, and saving images.

```
from PIL import Image, ImageTk
```

Figure 33 PIL

SQLite3

SQLite is a C library that provides a lightweight disk-based database that doesn't require a separate server process and allows accessing the database using a nonstandard variant of the SQL query language. Some applications can use SQLite for internal data storage.

```
import sqlite3
```

Figure 34 SQLite3

Chapter 5: Implementation of gate

5.1 Introduction:

A turnstile (also called a turnpike, gateline, baffle gate, automated gate, and turn gate in some regions) is a form of gate which allows one person to pass at a time. A turnstile can be configured to enforce one-way human traffic.

A turnstile can restrict passage only to people who insert a coin, ticket, pass, or other method of payment.

Only those who input a coin, ticket, pass, or other form of payment can pass through a turnstile.

Modern turnstiles incorporate biometrics, including retina scanning, fingerprints, ID cards, face ID, and other individual human characteristics which can be scanned.

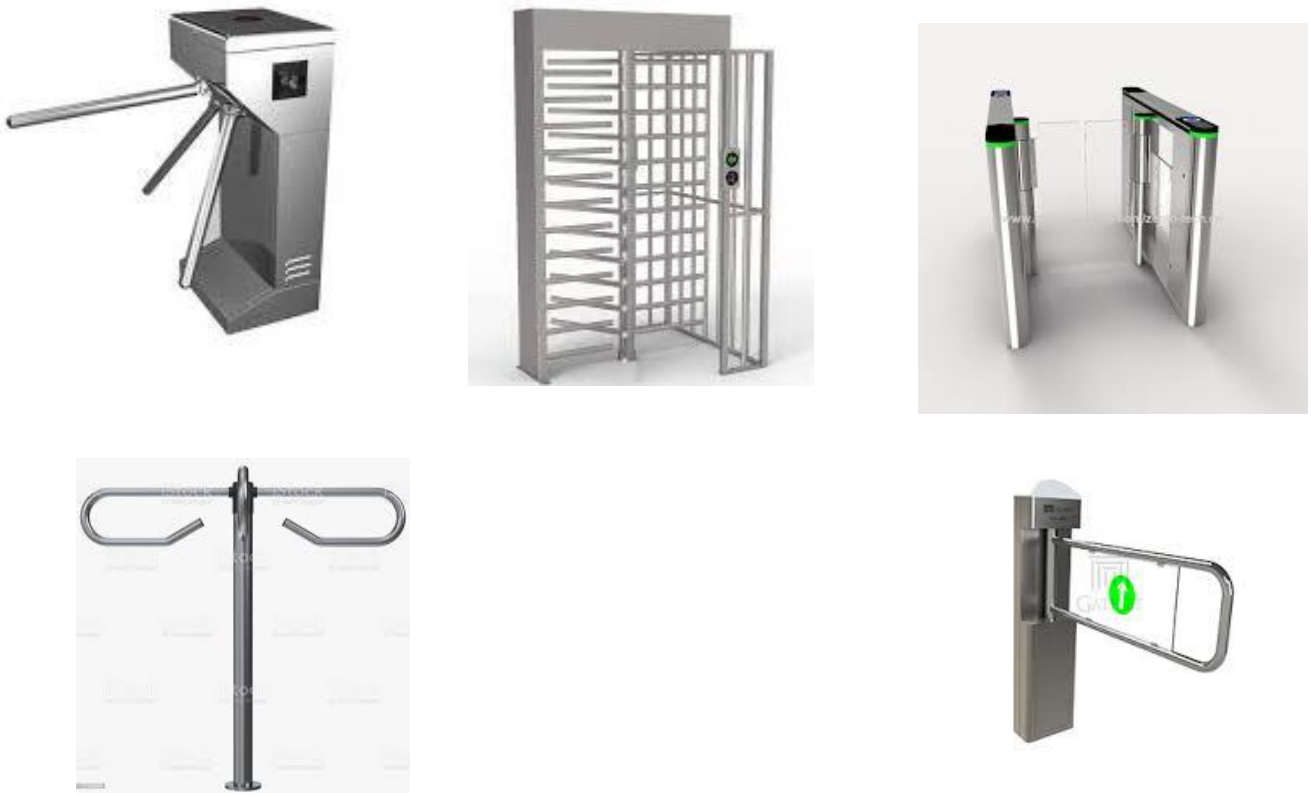


Figure 35 Example of gate

5.2 How does a turnstile gate work?

Optical pedestrian turnstiles: Capable of regulating access without any kind of physical barrier, optical turnstiles work by monitoring people who pass through with RFID cards and face ID using infrared light beams. If an optical turnstile detects an unauthorized entry, the system raises an alarm or signal.

Turnstiles often use ratchet mechanisms that only allow the stiles to rotate in one direction and not in the other.

5.3 Which type of control is the turnstile?

One person can pass through a security checkpoint at a time using a turnstile access control system. These access control systems, which are widely used to keep prying eyes away and personnel secure, are ideal for any business.

5.4 What are security turnstiles?

Tripod security turnstiles, also known as waist-high turnstiles, are a method of managing the movement of persons into and out of specific locations. Although they discourage tailgating, a determined intruder will still be able to crawl under or jump over when no one is looking. At all times, guard monitoring is required.

5.5 Turnstile Implementation

Design Used

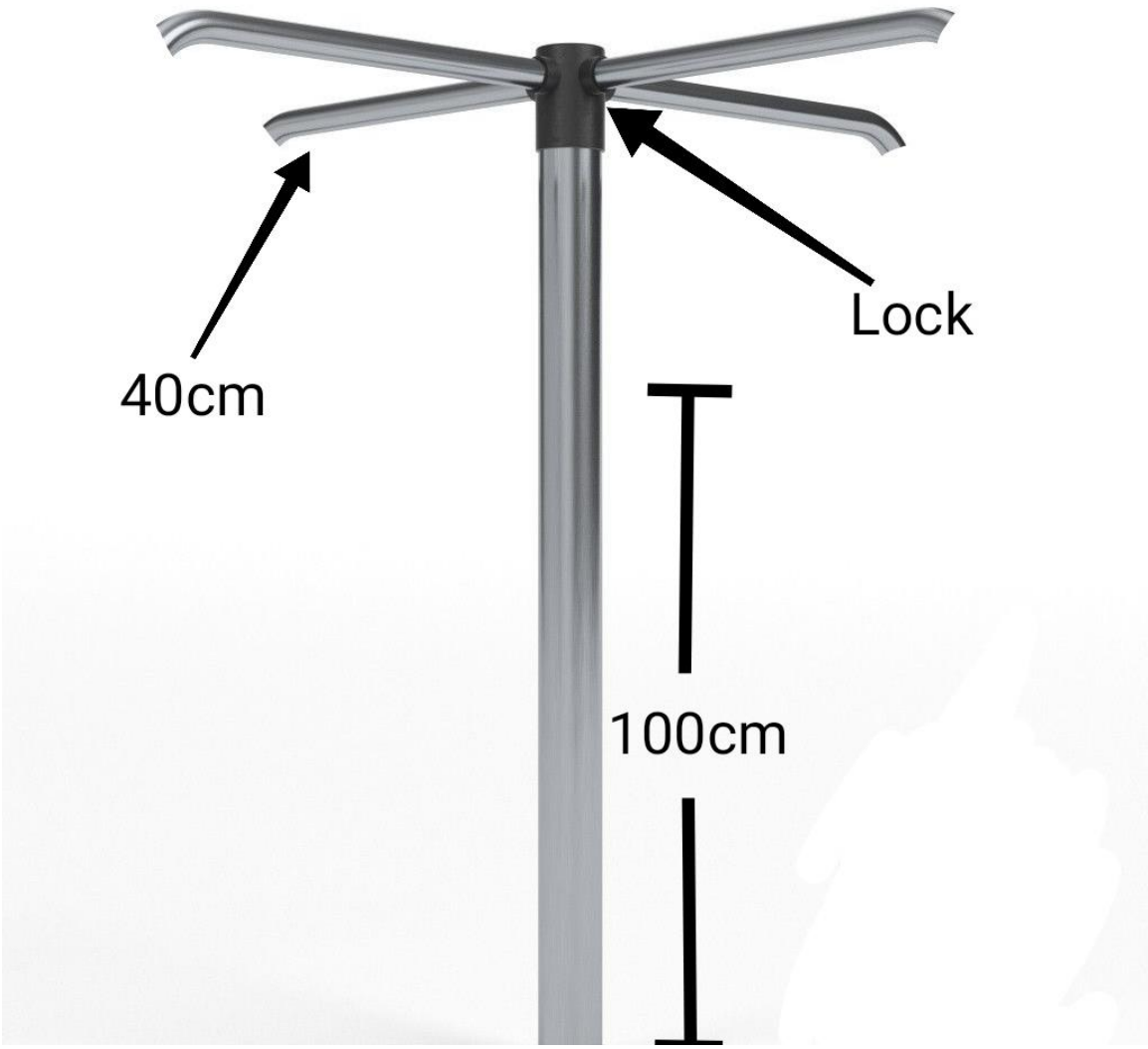


Figure 36 Our Design

Material Used

Material used is all of stainless steel, why?

- **Corrosion resistance**

  The resistance to corrosion is very good in all stainless steels. While highly alloyed grades may withstand corrosion in the majority of acids, alkaline solutions, and chloride-bearing environments, even at high temperatures and pressures, low alloyed grades are resistant to corrosion under air circumstances.

- **High and low temperature resistance**

  Some grades exhibit great toughness at normal temperatures while others exhibit exceptional scaling resistance and strong strength at very high temperatures.

- **Ease of fabrication**

  The majority of stainless steels can be cut, welded, formed, machined and fabricated readily.

- **Strength**

  Many stainless steels' ability to cold work harden can be employed in design to thin out materials, lighten them up, and cut costs. To create components with a very high strength, other stainless steels may be heat treated.

- **Life cycle characteristics**

  Stainless steel is a durable, low maintenance material and is often the least expensive choice in a life cycle cost comparison.

  100% recyclable

  Stainless steel is an excellent environmental performer and can deliver an almost endless life cycle with its 100% recyclability.

Parts Used

- **Hollow Bar**

  A 100 cm stainless hollow bar, the bar is hollowed so we can connect the solenoid lock with the tripod arm.

- **Tripod Arm**

  A 40 cm stainless tripod arms, used in the passing process for each passenger.

- **Solenoid Lock**

  The solenoid lock prevents the rotation of the 3 poles, when the lock is opened the poles can rotate freely and the person can pass through the gate after the person passes, the solenoid lock closes again and prevents the poles from moving ,so no one can pass.

Figure 37 Solenoid Lock

- **Ball bearings**

  At the top of our pole we have 2 ball bearing to provide a free rotation around the y axis and to reduce the friction between the moving parts.

Figure 38 Ball bearings

Chapter 6: Our Solution

6.1 Introduction:

Smart security systems are now essential in today's world. With less power consumption and a more dependable independent security device for both intruder detection and door security, the suggested security system has been developed to prevent theft in highly secure environments like the home environment. Face recognition technology is used to create door access control, allowing only persons with permission to enter that area. Instead of using sensor devices, intruder detection is accomplished by performing image processing on captured image frames of data and calculating the difference between the previously captured frame and the running frames in terms of pixels in the captured frames. The face recognition and detection process are implemented using the principal component analysis (PCA) approach.

This standalone security gadget was created using the Raspberry Pi electronic development board and is powered by batteries. It connects to the internet wirelessly using a USB modem. By sending security breach alert emails to the local police station's email address, auto police e-Complaint registration has been made possible. In comparison to other existing systems, this one is more efficient, dependable, and uses a lot of less data and power.

We "as engineers" must consider how to enhance the way we approach university because it has become one of the major challenges in our everyday life as a result of the problems, we encounter there every day. These issues arise for a variety of reasons, including the lack of a gate that can secure our campus since the founding of Helwan University due to engineering flaws. not only no security guard asking for identification of the individuals entering the institution making sure that nobody outside the university enter the university which leads to several security issues but also the is no system to maintain track of the attendance

That's why our project is a smart gate using two-way authentication facial recognition and RFID to ensure that not just anyone can enter the university but also making sure that he or she is holding their/her ID and comparing the data with the data by using facial recognition. In addition to all of these features, we also keep track of the people entering the university and the security guard at the gate can see the data of the students entering the university.

6.2 Frist step Facial Recognition:

What You'll Need for Raspberry Pi Facial Recognition

- Raspberry Pi 3 Module B+
- Power supply/microSD/Keyboard/Mouse/Monitor/HDMI Cable (for your Raspberry Pi)
- Camera Pi

Prepare your Raspberry Pi

We require some processing power for facial recognition to function properly, thus we advise using a Raspberry Pi 3B+ or better. The additional memory will be crucial. We chose a Raspberry Pi OS Lite installation without a desktop to retain as many resources as feasible available for our project.

Make sure you're connected to the network, have updated everything using `sudo apt -y update && sudo apt -y full-upgrade`, have chosen a new password, and have enabled SSH if necessary. Finally, open the settings by typing `sudo raspi-config`, then turn on the camera's functionality under "Interfacing Options."

Attach the camera

The original Raspberry Pi Camera will work well for this project, but the new official HQ Camera will produce far better results. Make care to turn off your Raspberry Pi 3 before connecting the camera to it. According to the instructions, connect the ribbon cable. Launch your Raspberry Pi 3 after installation to check the camera's functionality. Run the following commands from the command line:

```
raspistill -o testshot.jpg
```

Your microSD card will store image as a result. You can view what the camera can see in real-time if you have an HDMI connection hooked in. Before moving further, take some time to confirm that the focus is appropriate.

Install Dependencies

We are utilizing a facial recognition library that Adam Geitgey has been maintaining for a long time. It offers a ton of examples, including Python 3 bindings that make creating your own facial recognition apps really straightforward. The quantity of dependencies that must be installed first is what makes things difficult. There are far too many to put here, and you won't want to type them all out, so go to hsmag.cc/FacialRec to copy and paste the commands instead. On a Raspberry Pi 4, this phase will take some time to complete; on a Model 3 or an earlier model, it will take considerably longer.

Install Libraries

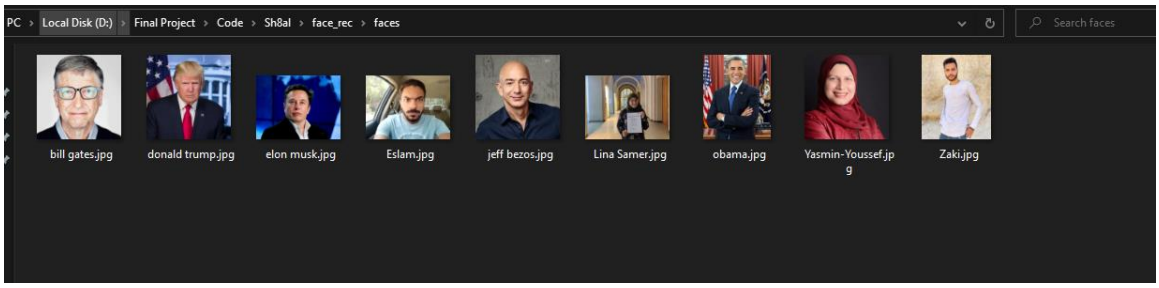
Now that we have everything in place, we can install Adam's applications and Python bindings with a simple, single command:

```
sudo pip3 install face_recognition
```

Once installed, there are some examples we can download to try everything out.

Example images

Creating the database



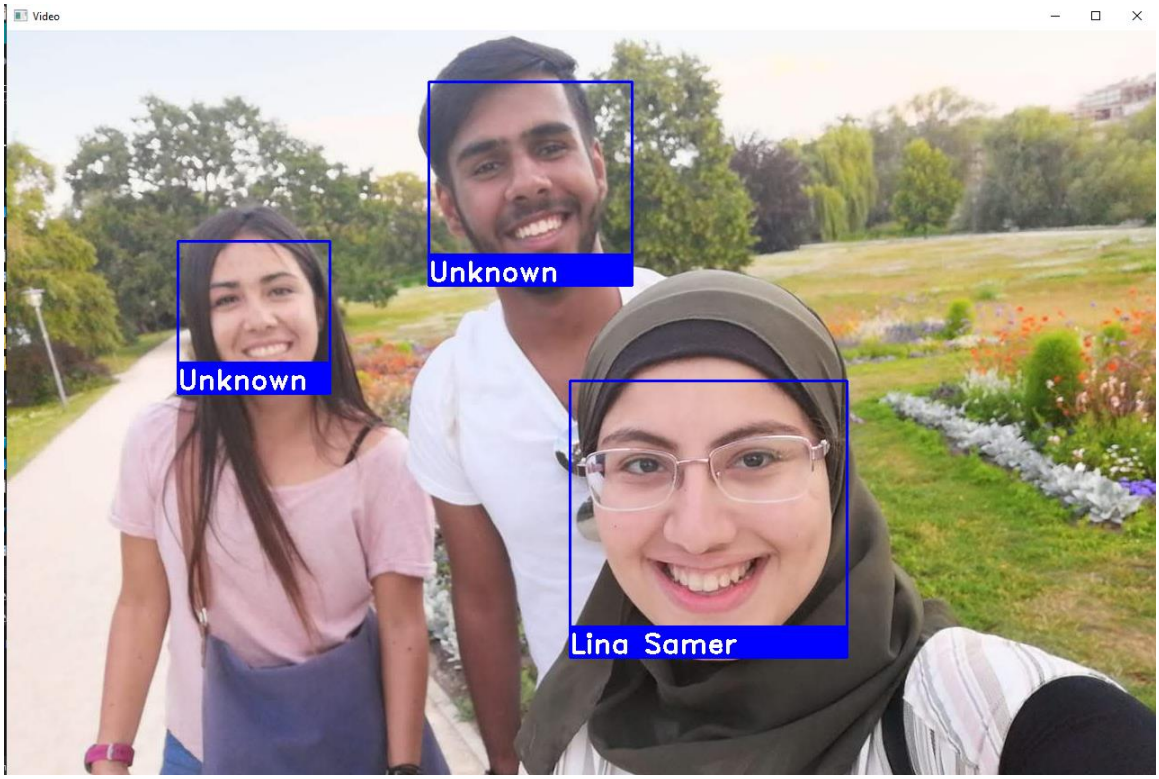
Example to test raspberry pi

face_rec.py

D: > Final Project > Code > Shbal > face_rec > face_rec.py

```python
import face_recognition as fr
import os
import cv2
import face_recognition
import numpy as np
from time import sleep


def get_encoded_faces():
    """
    looks through the faces folder and encodes all
    the faces

    :return: dict of (name, image encoded)
    """
    encoded = {}

    for dirpath, dnames, fnames in os.walk("./faces"):
        for f in fnames:
            if f.endswith(".jpg") or f.endswith(".png") or f.endswith(".jpeg"):
                face = fr.load_image_file("faces/" + f)
                encoding = fr.face_encodings(face)[0]
                encoded[f.split(".")[0]] = encoding

    return encoded


def unknown_image_encoded(img):
    """
    encode a face given the file name
    """
    face = fr.load_image_file("faces/" + img)
    encoding = fr.face_encodings(face)[0]

    return encoding


def classify_face(im):
    """
    will find all of the faces in a given image and label
    them if it knows what they are

    :param im: str of file path
    :return: list of face names
    """
    faces = get_encoded_faces()
    faces_encoded = list(faces.values())
    known_face_names = list(faces.keys())

    img = cv2.imread(im, 1)
    #img = cv2.resize(img, (0, 0), fx=0.5, fy=0.5)
    #img = img[:,:,::-1]

    face_locations = face_recognition.face_locations(img)
    unknown_face_encodings = face_recognition.face_encodings(img, face_locations)

    face_names = []
    for face_encoding in unknown_face_encodings:
        # See if the face is a match for the known face(s)
```

Output



6.3 second step Creating database in SQLite:

SQLite stores its SQL information in a file that is present alongside your software rather than relying on an external system.

The following are some of the different factors that make SQLite a viable solution for the Raspberry Pi.

•SQLite has a relatively low overhead.

•It is a self-contained system. No external dependencies are required to make it function.

•No separate server process. SQLite won't chew up your Raspberry Pi's RAM and CPU when not being utilized.

•Zero configuration is needed making it easy to use right out of the box.

The process of installing SQLite on the Raspberry Pi is straightforward and quick. The reason for this is that SQLite is easily obtainable from the default Raspberry Pi package repository.

Installing SQLite

1-To make sure we don't run into any issues when installing SQLite, we should first update the operating system. You can update your Raspberry Pi's operating system by running the following two commands:

```
sudo apt update
```

```
sudo apt full-upgrade
```

2-These commands will update the list of packages on your device and then upgrade any out-of-date packages. These commands will update the list of packages on your device and then upgrade any out-of-date packages.

```
sudo apt install sqlite3
```

You will notice that we are using SQLite 3 which is the latest major version at the time of publishing. The exact version the Raspbian repository provides is, at the time of publishing, “3.27.2“.

3- As SQLite stores all of its data within a single file on your disk, we will need to reference that file when launching the command line interface.

If the file does not exist, the SQLite command-line interface will generate the file for you.

sqlite3 Student. dB

4- now we can add students and all the data needed (Name, ID, Photo, ……..)

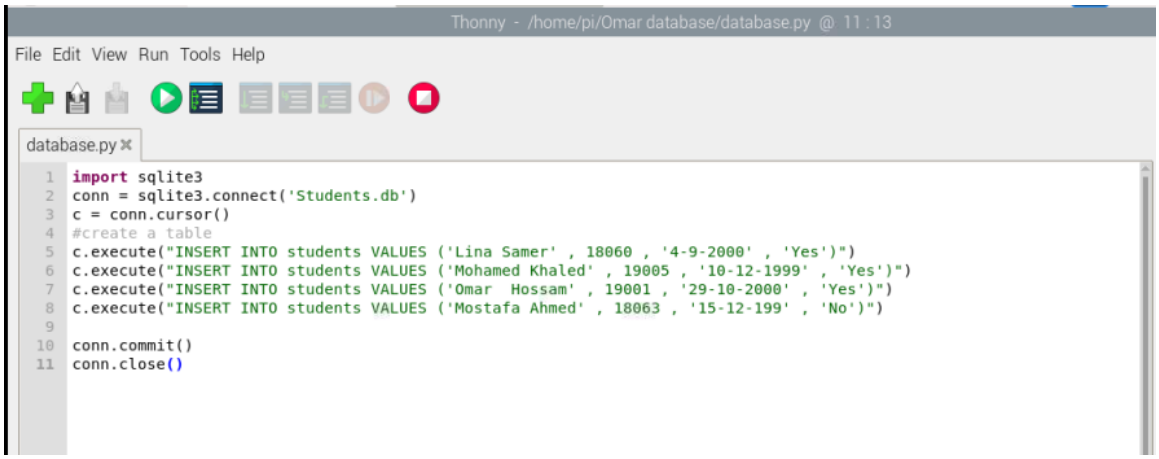


Figure 39 Insert student using code

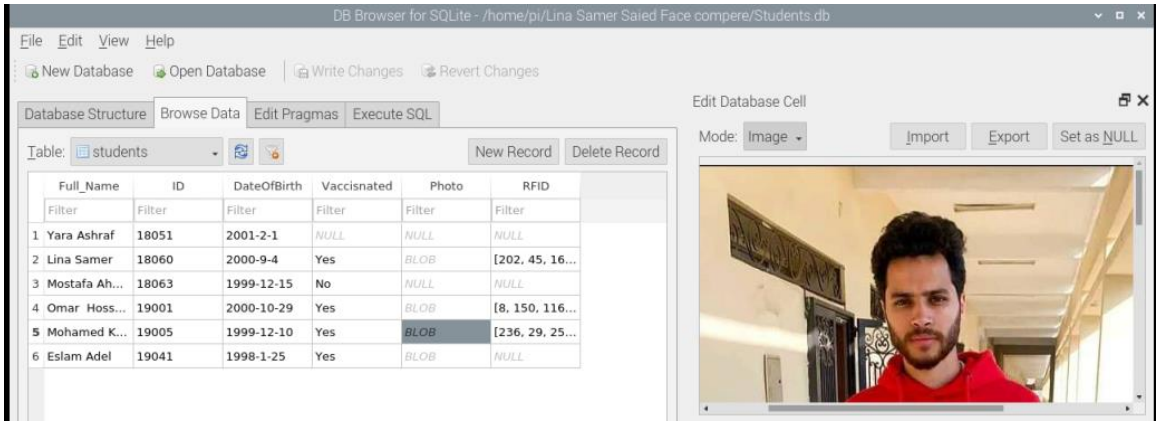


Figure 40 insert using GUI

6.4 Third step RFID:

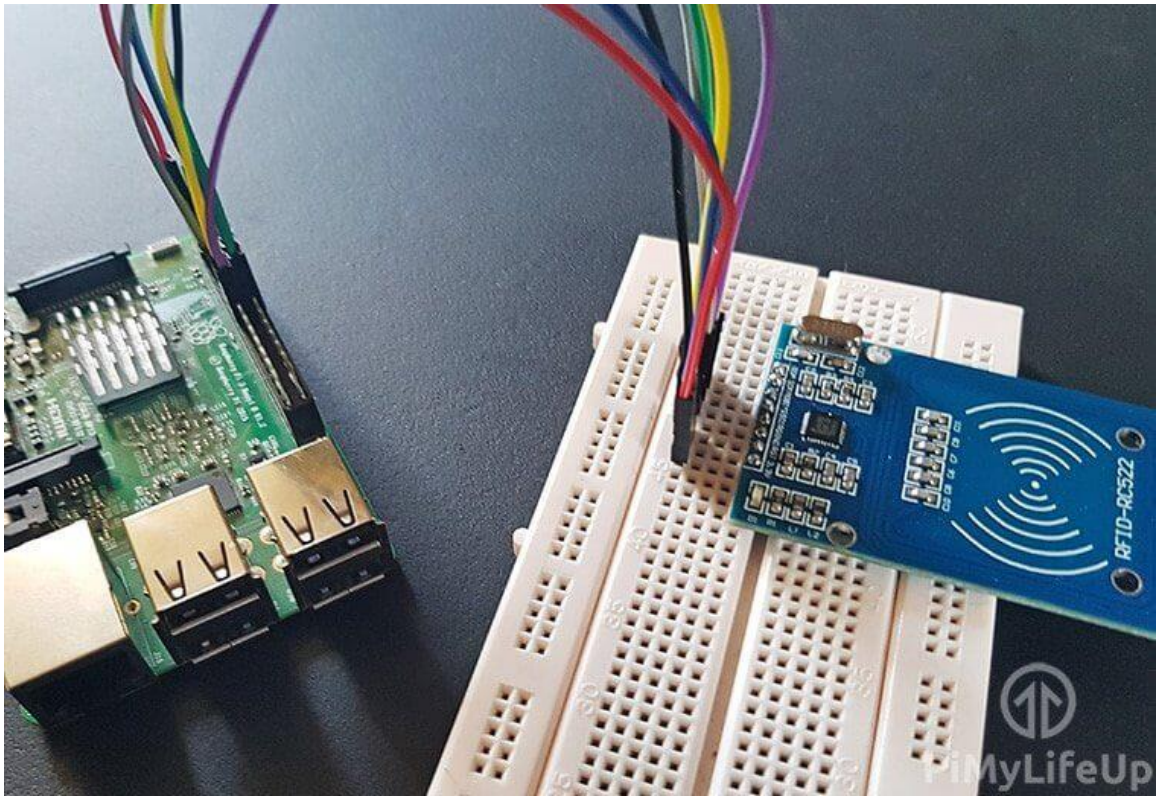


Figure 41 RFID Sensor

In order for us to read the tags you buy for your RFID RC522, they must operate at a frequency of 13.56MHz.

To enable you to read and write RFID tags, we'll demonstrate how to set up the RC522 and how to interface with it by writing Python scripts.

If you want to show the end user some information or a visual prompt, you can adapt this method to utilize something like a 162 LCD for the Raspberry Pi.

When purchasing an RFID RC522 reader, you'll see that 90% of them don't have the header pins soldered in previously. You will have to do it yourself because the pins are missing, but soldering header pins is actually a rather easy process, even for beginners.

- To start, if the header pins that came with the RC522 are the wrong size, snap them down so that there is only one row of eight pins.
- Put the header pins through the RC522's holes. One helpful tip is to place the circuit over the top of the header pins after inserting the long side of the header pins into a breadboard. It will be simpler to connect the pins to the RFID RC522 circuit since the breadboard will retain the pins firmly.
- Now slowly solder each pin using a hot soldering iron and some solder. To guarantee that the solder adheres to the junction better and decreases the likelihood of generating a cold joint, remember that it is advisable to briefly heat the joint before applying solder to it. Additionally, we advise being cautious with the quantity of solder you use.
- With the header pins now soldered to your RFID circuit, it is now ready to use, and you can continue with the tutorial.

SDA (Serial Data Signal), SCK (Serial Clock), MOSI (Master Out Slave In), MISO (Master In Slave Out), IRQ (Interrupt Request), GND (Ground Power), RST (Reset-

Circuit), and 3.3v are the 8 connectors that your RFID RC522 may support (3.3v Power In). All of them, excluding the IRQ, must be connected to the Raspberry Pi's GPIO pins.

- SDA connects to Pin 24.
- SCK connects to Pin 23.
- MOSI connects to Pin 19.
- MISO connects to Pin 21.
- GND connects to Pin 6.
- RST connects to Pin 22.
- 3.3v connects to Pin 1.

- Let’s begin by first opening the raspi-config tool, and we can do this by opening the terminal and running the following command.

  sudo raspi-config
- tool will load up a screen showing a variety of different options. If you want a more in-depth look into these options, you can check out our raspi-config guide.
- On here use the arrow keys to select “5 Interfacing Options “. Once you have this option selected, press Enter. on this next screen, you want to use your arrow keys to select “P4 SPI “, again press Enter to select the option once it is highlighted.
- You will now be asked if you want to enable the SPI Interface, select Yes with your arrow keys and press Enter to proceed. You will need to wait a little bit while the raspi-config tool does its thing in enabling SPI.
- Once the SPI interface has been successfully enabled by the raspi-config tool you should see the following text appear on the screen, “The SPI interface is enabled “.
- Before the SPI Interface is fully enabled, we will first have to restart the Raspberry Pi. To do this first get back to the terminal by pressing Enter and then ESC.

Once your Raspberry Pi has finished rebooting, we can now check to make sure that it has in fact been enabled. The easiest way to do this is to run the following command to see if spi_bcm2835 is listed.

```
lsmod | grep spi
```

If you see spi_bcm2835, then you can proceed on with this tutorial and skip on to the next section. If for some reason it had not appeared when you entered the previous command, try following the next three steps.

Now that we have wired up our RFID RC522 circuit to the Raspberry Pi, we can now power it on and begin the process of programming simple scripts in Python to interact with the chip.

The scripts that we will be showing you how to write will show you how to read data from the RFID chips and how to write to them. These will give you the basic idea of how data is dealt with and will be the basis of further RFID RC522 tutorials.

References

Adnan, Rukhiyah & Abd Samad, Nor Hafiza & Miserom, siti faizah. . (2015). Raspberry Pi & Arduino What Makes Them Awesome!!!. .

C. Fuhrer, J. E. (2016). Scientific Computing with Python 3. *Packt Publishing Ltd*.

Gupta, I. &. (2016). Face detection and recognition using Raspberry Pi. *IEEE*, 83-86. .

H. W. Ng, a. S. (2014). "A data-driven approach to cleaning large face datasets,". *IEEE International Conference on Image Processing (ICIP)*, pp. 343.

Hanggara, Indira & Rakhmadi, Frida. (2021). esign of Prototype Home Door Security System Based Solenoid Door Lock, Magnetic Sesor,. *Microcontroller Nodemcu Esp8266 and Blynk Application*.

Hattem, R. V. (2016). Mastering Python: master the art of writing beautiful and powerful Python by using all of the features that Python 3.5 offers. *Packt Publishing*.

Hetland, M. L. (2017). Beginning Python: from novice to professional. *3rd Ed., Apress*.

io — Core tools for working with streams — Python 3.10.5 documentation. (2001, March 1). Retrieved from https://docs.python.org/3/library/io.html#text-i-o

N. Dalal, a. B. (2005). "Histograms of oriented gradients for human detection,". *" IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR)*, vol. 1, pp. 886-893.

Nafis Mustakim, N. H. (2019). Engineering and Robotics Technology 2019. *1st International Conference on Advances in Science.* IEEE.

Nagar, S. (2016). r, Introduction to Python: For Scientists and Engineers. *Bookmuft*.

Python: Pillow (a fork of PIL) - GeeksforGeeks. (2020, January 22). Retrieved from GeeksforGeeks: https://www.geeksforgeeks.org/python-pillow-a-fork-of-pil/

Ramadan TH. Hasan, ,. A. (2021). Face Detection and Recognition Using OpenCV. *JOURNAL OF SOFT COMPUTING AND DATA MINING* , VOL.2 86-97.

Sanchit Dass, M. S. (June 2020). Real Time Face Recognition using Raspberry Pi. *International Journal of Computer Applications*, Volume 176 - No.33.

trademarks, V. (2022). *What is a Relational Database? Features & Uses - Salesforce UK Blog*. Retrieved from Salesforce UK Blog: https://www.salesforce.com/uk/blog/2022/01/what-is-a-relational-database.html#:~:text=A%20relational%20database%20model%20ensures,out%2Dof%2Ddate%20information.

Understanding Facial Recognition Systems. (February 19, 2020). *How a Facial Recognition System Works*.

What is SQLite? Top SQLite Features You Should Know. (2022, April 3). Retrieved from SQLite Tutorial: https://www.sqlitetutorial.net/what-is-sqlite/