

EL 213: ANALOG CIRCUITS PROJECT REPORT



GROUP-04

Project 05 : BUILD AN AUTOMATIC DOOR WHICH UNLOCKS
ITSELF USING FACIAL RECOGNITION

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INTRODUCTION

Motivation of the Project

These days with the advent of IoT, a lot of things are getting automated. The main motive behind this project is to use the IoT to solve the daily life problems of forgetting the keys, trusting your son/daughter with the keys. By this project, we aim to increase the security level and that too with a cheaper cost in our daily lives by using the Face Recognition.

Facial Recognition and Retinal Recognition are the next big things in the line of security of our daily devices. This would not allow any untrusted source while allowing only the group members to access the room. This security can be enhanced by using the locks with Face Recognition Algorithm instead of a motor that we propose to use.

Project Objective

A Face Recognition System is a system which automatically identifies and/or verifies the identity of a person from digital images or a video frame from a video source. The basic flow of the face recognition system is the image is captured by camera. The API detects the face and extracts its features. After the extraction, system matches the captured images with data base images. In the decision box the result of the matching is decide which is face match or the no face match. After that if the face matches then the door is unlocked else it is kept closed. On being successful, with further optimizations and improvements, the system may be implemented in real time systems requiring user authentication such as attendance systems, ATM security, Network security, In Bank locker, Home automation.

The main objective of this project is to develop a working model of a face detection system using the **Face API** (provided by the Oxford University) and dump it into the microcontroller specifically the raspberry pi series so that it executes the program and evaluates whether or not to unlock the door. Primarily the face is captured using a webcam which is connected to the microcontroller, the current image checks the predefined database of images that was previously stored. If the previous image is matched with the current image the door is opened or else the door remains locked .The API used is the face API as stated above.

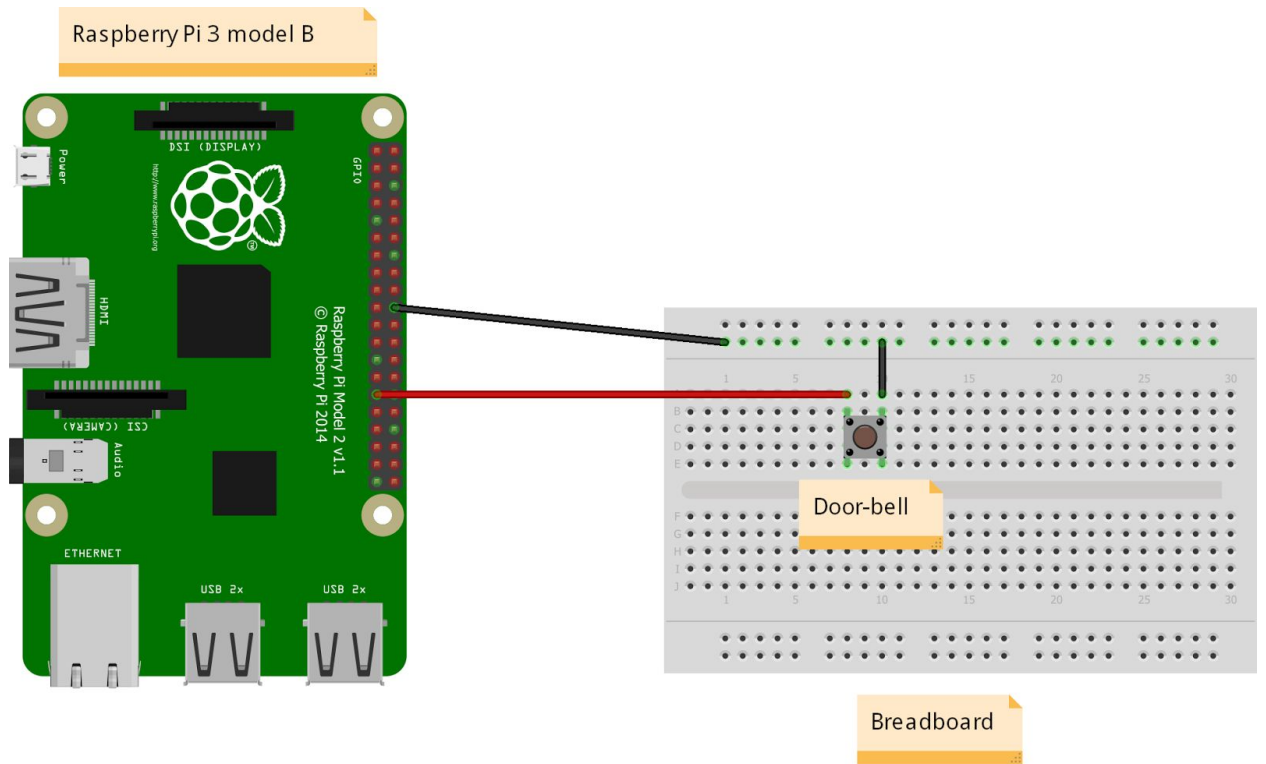
The whole projects if divided to steps contains, analysis of requirements, specifying the components required, choosing the apt components, understanding the API, testing the web camera, circuiting the components and running a trail.

The aim of our project is to provide a high security system using face recognition on Raspberry Pi board. The proposed work is as follows:

- 1) Interfacing of camera module to capture live Face image.
- 2) Create a database of authorized person
- 3) Capture current face, save it and compare with database image.
- 4) Interface relay as an output module.

Project Details

Circuit Diagram



fritzing

Description

Pins 3,4 and pins 1,2 of the doorbell are connected through the breadboard with the Raspberry pi. Pin 3 is also connected to the GPIO-5 of Raspberry pi and Pin 1 is connected to the ground. Other external components like: Keyboard, mouse, speaker and the I-ball webcam are connected to the pi through the USB ports provided. An LCD screen is also connected to the Raspberry pi using HDMI cable. A constant power supply of 5-V is also given to the Raspberry pi using an adapter.

Working

The system will first check whether all the connections are working properly and will throw an error if any of the connected devices have any problem. After the system is setup the software will download all the stored (whitelisted) pictures and will give a welcome message.

After that when the doorbell is rung the camera feed is checked and if any face isn't detected then the person would be asked to stand properly in front of the door. If a human is detected then his/her face is checked against the whitelisted faces.

If the face matches then the software gives a door opening message and announces the name of the visitor and if not then it gives a message that the person isn't recognised and a message is given that the door won't open.

If more number of people are there then it tells the number of recognised people and opens the door if anyone of them is recognised. Also it announces the name of all recognised people.

Components Used

Hardware Components:

- 1) Raspberry pi 3 model B
- 2) i-ball webcam
- 3) Key-board and mouse
- 4) Breadboard
- 5) Door-bell switch

Software Components:

- 1) Windows 10 IOT core:

Windows 10 IOT core is Operating system for the raspberry pi 2/3 model B , Which is version of Windows 10 . This OS is optimized for smaller devices with or without a display, and that runs on both [ARM and x86/x64 devices](#). Windows 10 IoT Core utilizes the rich, extensible Universal Windows Platform (UWP) API for building great solutions.

- 2) Universal Windows Platform(UWP)

Windows 10 introduces the Universal Windows Platform (UWP), which provides a common app platform available on every device that runs Windows 10. you can create a single app package that can be installed onto a wide range of devices. And, with that single app package, the Windows Store provides a unified distribution channel to reach all the device types your app can run on.

The requirements for Windows 10 IoT Core depend on whether it is run in a headed or headless mode. Headed devices have a video display and use Windows video subsystem to address it. Headless devices have no display.

Memory

Headless

256 MB RAM (128 MB free to OS) / 2 GB Storage

Headed

512 MB RAM (256 MB free to OS) / 2 GB Storage

Processor

400 MHz or faster

(x86 requires PAE, NX and SSE2 support)

Windows 10 IOT dashboard:

Windows 10 IoT Core Dashboard is the best way to download, setup and connect your Windows 10 IoT Core devices, all from your PC.

3) Visual Studio community:

A fully-featured,extensible, free IDE for creating modern application for android, iOS , Windows, as well as web application and cloud services.

4) Windows 10 SDK

The Windows 10 SDK (10.0.15063.0) provides the latest headers, libraries, metadata, and tools for building Windows 10 apps. The Windows 10 SDK, when used in conjunction with Visual Studio 2017, will provide the optimum experience for building apps for Windows- allowing you to take advantage of the latest tools and APIs delivered the Windows 10 Creators Update.

In addition to targeting the Windows 10 Creators Update, this SDK allows you to build [Universal Windows Platform apps](#) as well as desktop apps on all versions of Windows 10. This SDK also supports building desktop apps on Windows 8.1, Windows 7 SP1, Windows Server 2016, and Windows Server 2012 R2. For earlier versions of the Windows and Windows Phone SDKs.

Component Details

- Raspberry Pi 3 Model B:

Raspberry pi 3 is the third generation of the raspberry pi. It contains following features.

- 1) 1GB RAM
- 2) 4 USB ports
- 3) 40 GPIO pins
- 4) Full HDMI port
- 5) Ethernet port
- 6) Combined 3.5mm audio jack and composite video
- 7) Camera interface (CSI)
- 8) Display interface (DSI)
- 9) Micro SD card slot (now push-pull rather than push-push)
- 10) VideoCore IV 3D graphics core
- 11) A 1.2GHz 64-bit quad-core ARMv8 CPU
- 12) 802.11n Wireless LAN
- 13) Bluetooth 4.1
- 14) Bluetooth Low Energy (BLE)

The Raspberry Pi 3 model B is very useful for the embedded projects or projects which operates on the low power.

The software available on the Raspberry(raspbian OS) are as follows:

1. Scratch: Visual programming tool to create animation and games.
2. Python: General purpose programming language that is easy to use and very powerful.
3. Sonic Pi: Write code to make music.
4. Terminal: The linux terminal to get around filesystems and issuing commands.
5. GPIO (General Purpose Input/Output) pins: The General Purpose Input/Output pins allows to control and interact with the real world from python,Scratch and other programming environments.
6. Minecraft: The edition has programming interface,means we can control Minecraft using python and interact with real world using GPIO.
7. Wordpress: A content management and blogging system.
8. Camera module: Capable of taking 1080p full HD photo and video also controlled programmatically.
9. Webcams: Using standard USB webcams by USB port.

2. I-ball webcam:

Specification:

- 720P High-Definition Webcam with exceptional image quality
- Interpolated 20M pixels still image & 2.1M pixels video resolution
- Video calling & High Quality still picture

For live feeding of the front area of door . And to take snap of user ,when it comes to door and presses the doorbell button.

3. Keyboard and Mouse:

To interact with Raspberry pi.

4. Breadboard:

For proper connection of the circuit , which contains connections from doorbell, door lock and Raspberry pi.

5. Doorbell Switch:

When user comes to door and if he/she wants to enter he/she will press this doorbell switch and then camera snaps the photo of user.

Test

Results

- The software is able to recognize the face of authorised users. We tested a maximum of 4 faces and it recognises the faces of all authorized users.
- The software is able to count the number of authorised faces.
- Internet connectivity affects the performance a lot. It can cause problems to detection.
- As the number of user pictures increase i.e. the training set of the software increases the detection speed and the detection accuracy also increase. Also with more number of pictures it is difficult to fool the system.
- The following changes have been made to the original API by us to add more features:
 - ◆ Recognition of more than one face
 - ◆ Saying names of all the present authorized users
 - ◆ If no face is detected then it requests to stand in a proper position

Limitations

- The software can be fooled by an image of a person.
- Low light conditions can hinder the recognition of the person.
- The quality of the camera also plays an important role in the face detection.
- The total number of faces can't be recognized. Only the authorised faces are counted.
- It is a completely online system so lack of internet connectivity can lock you out.
- Due to the delay in components' delivery we couldn't make a door open physically. If we get the required components then a better working model could be provided.

Project Manual

Visitor's perspective:

- The visitor has to stand in front of the camera. A live feed of the camera view is shown inside the house.
- The person then has to press the doorbell.
- The camera takes a live feed of the person standing in front of the door. Our system then compares that to the pictures that are already stored in the database.
- If the picture matches any of the stored pictures, it opens the door and allows that person in the house with a welcome message i.e. "Welcome to the facial recognition door 'your name'. I will open the door for you."
- Otherwise it prints a message: "Sorry I don't recognize you, so I cannot open the door."

Admin's perspective:

- If the admin wants to add pictures in the database, he can do so by clicking the '+' button on the home page. It adds a new user in the database. After clicking the '+' button, camera feed will show on the screen.
- Admin can capture the image by 'Capture Photo ID' button. This will add a picture into that person's folder in the database.
- If he wants to add more pictures of that person, he can do it easily by repeatedly clicking the '+' button to add pictures from different angles. This will make our system more precise as the algorithm will learn to recognize faces more accurately.
- Admin can also delete a user or some pictures of user by clicking the delete button.

Acknowledgement

And

Conclusion

It is our pleasure to acknowledge Prof. Rutu Parekh (DA-IICT, Gandhinagar) who gave us such a great opportunity and providing valuable experience about analog circuits during the hands-on project assigned to us.

With great pleasure, we extend our deep sense of gratitude to our professor and our teaching assistants for providing facilities and valuable suggestion throughout the project work. Our deepest thanks to everyone who helped us along the way for this course and especially this project work for sharing their best knowledge and experience with us.

After the completion of this project we have got a great insight into the working of Raspberry Pi system, analog circuits, its components and their working. Also we have learnt a lot about the real life applications of the IoT and the small circuits which can make such a large impact on the world.

Appendix

References

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Future Improvements

- Hair: To date, there are quirks in facial recognition software relative to hair growth and styles. Men who grow facial hair or remove it and people who have their hairstyles changed will often not be recognized. The "fix" for this is to have new photos taken when such changes occur.
- Weight Change: This usually has to be pretty big weight change; however, if someone is losing weight, the software will at some point fail to recognize them. Again, new photos have to be taken.
- Any Major Change in Appearance: Returning from vacation with a tan can impact recognition as will sunglasses and hats that may cause shadows. In fact, any clothing that hides or shadows any part of the face will throw the system off.
- Need for high-quality equipment: There is no point in installing a facial recognition system unless an organization is willing to go the cost of top quality cameras that can capture extremely high-quality images for placement in databases. Likewise, the software infrastructure must be able to recognize instantly, or there will be waiting time and frustration. Mediocre quality of any type may result in people who are similar in appearance being mistaken for one another. Windows 10 new face detection, for example, cannot even be fooled by identical twins

Facial recognition systems for identity and verification are probably just the proverbial tip of the iceberg. There is every reason to believe that new technologies will continue to be developed. As they are, developers will have to continue to be mindful of individual rights and privacy.

Future Prospects

- It is going to be 9.6 Billion Dollar Industry by 2022.
- Biggest Growth of FR is in homeland security & border patrolling.
- Projected that even Internet Banking Systems and Retailers may be using it, in coordination with the banks, to prevent fraud in the use of credit and debit cards in online purchase.
- The new cameras make Face Recognition processing in seconds resulting in virtually no wait time.
- A new Technology called Faception, recently developed, goes beyond FR. Using smart algorithms analyzing facial features, expressions, posture and stance, can identify individuals who may be prone to committing criminal acts
- If top quality cameras are used, Windows 10 new FR Algorithm, cannot even be fooled by identical twins.

“Selfies are the new Security” - Mastercard