# Imperative Analysis on an IOT Based Door Answering System

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**Abstract-** The IoT based door answering system, as name suggests aims at controlling and monitoring the door answering process through internet-based protocols and computing. In the spotlight, the system's IoT module is built using raspberry pi, an LCD 2×16 I2C module, 16 key membrane switch alphanumerical keypad, electric strike lock, RFID card and reader, web camera and a buzzer. Using Open-source computer vision library (Open CV), image processing and recognition is done. Security for authentication and access grants is also achieved with the help of powerful python programming.

**Keywords-** Open CV, IoT, LCD, ZigBee.

## I. INTRODUCTION

A long ago, Smart homes were just ideas. There was no proper structure for those ideas. For decades, everyone has imagined interactive homes, homes that would "manage" themselves with little or no human intervention. The early stage of inventions focused on easing the day- to-day home tasks such as inventions of home appliances even though they weren't "smart".

Home automation began rising to popularity in early 2000s. It became an affordable option and hence a viable technology. Since past few years, home automation has been all about security and making our houses as smart as possible.

Looking forward, from today home automation will focus more on being green i.e., energy efficient. Digital cutting boards, molecular cooking devices etc. might not look crazy to expect in the upcoming years.

Connectivity and interactivity are the gluing force between people/groups. Ever since internet became available to the public, it has transformed lives and it continues to do so. Smart home market has been expected to grow to US$174 Billion by 2025. Inclusion of latest technologies in home automation has ensured advanced technological devices / appliances and security.

Better connectivity, In-House Robots, Wireless remote control, Sentiment home, security, privacy etc. will be some of the most dominating trends in the upcoming years in the home automation sector.

## II. LITERATURE STUDY

[1] The authors of this paper talk about a smart digital door lock system that uses passwords, semiconductors, smart cards, fingerprints, ZigBee modules, and other technologies to replace the old system. The ZigBee module is integrated into the digital door lock, which also serves as the main controller for the home automation system.

A network of sensor nodes and actuators is proposed, with a digital door lock serving as the base station. The door lock system suggested here includes an RFID reader for user authentication, touch LCD, motor module for opening and closing the door, sensor modules for sensing the condition within the house, communication module, and control module for controlling other modules.

Environmental sensing sensor nodes are strategically distributed throughout the house. The digital door lock, a centralized controller, can monitor and control the status of each ZigBee module.The home automation feature in a digital door lock system allows users to control and monitor the home environment and condition all at once before entering or departing because the door lock is the

first and last thing people notice when entering and leaving the house. It also allows customers to check on the house's condition from anywhere in the world via the Internet or another public network.

## III. PROPOSED SYSTEM

In this section a brief description of the proposed system followed by the operation of the components used in the building of the system is provided.

IoT based door answering system is a system designed to monitor and control the access to enter an individual's house.

Our system can be divided based on the following functionalities: Capture module, I/O module, and control module. The capture module consists of a web camera that is used for real live image capturing. Using Open CV the real live image captured is undergone training to identify the images accordingly.

The control module works on a key lock that grants access after successful security check. The I/O module includes a keypad module to provide authentication access key, LCD screen for displaying the relevant information. Once the user is authenticated by the system, user will gain entry to the house.

### 1.Raspberry Pi Module:

Raspberry Pi is a single-board computer (SBC) with a CPU. It is a widely used and popular board. Because it is virtually a full computer, it can run an operating system. It offers the Raspberry Pi OS, formerly known as Raspbian OS, a Debian-based Linux distribution. We can develop applications using several programming languages like as C, C++, Python, Java, HTML, and others because it is a Linux-based computer.

We're utilizing the Raspberry Pi 3 Model B+, which was released by the Raspberry Pi Foundation, to build this system. Some of the noticeable advancements in the model include a faster processor, greater Wi-Fi speeds, and faster ethernet. Four USB 2.0 connectors, a 40-pin GPIO header, one full-size HDMI port, display camera ports and four-pole stereo output and composite video ports are all included.



Fig 1. Raspberry Pi 3B+ model architecture.

### 2.Open CV:

For image processing and computer vision tasks, Open CV is a fantastic programme. It's an open-source library that may be used for tasks like facial recognition, object tracking, landmark identification, and more. Python, Java, and C++ are just a few of the languages that can be used.

The library contains hundreds of useful functions and algorithms, all of which are free to use. Some of these routines are frequently used in computer vision and can be found in almost any task. On the other hand, many of the functions are still unknown and have received little attention.

It's utilized for image processing, computer vision, and machine learning. When you combine Open CV with strong libraries like NumPy and Pandas, you can get the most out of it.

### 3. I2C Module:

The I2C module's PCF8574 I2C translates serial I2C data into parallel data for the LCD display. Currently, the default I2C address for these modules is either 027 or 03F. If there are three sets of pads designated A0, A1, and A2, the default address is 03F. The default address is 027 if no pads are present. A contrast adjustment pot is located on the display's underside. This may demand some changes to ensure that the text appears correctly on the screen. The operational voltage of the I2C module is 5V.

The LCD display's serial I2C is controlled by the PCF8574. It has two IIC ports that can be coupled using a Dupont Line or a dedicated IIC connection. A 16x2 LCD screen can be used with it. Another great

serial interface for IIC/I2C/TWI/SPI. With this I2C interface module, we will be able to display data using only two wires.
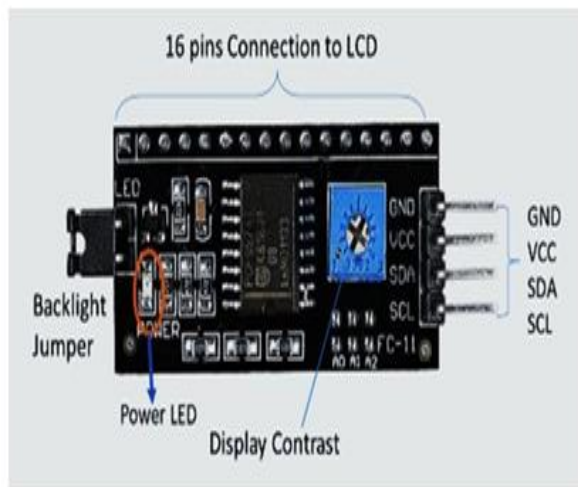


Fig 2. I2C Architecture.

### 4. Buzzer:

A buzzer or beeper is a mechanical, electromechanical, or piezoelectric audio signaling device. It's commonly seen in alarm clocks, timers, and confirmation of user input like mouse clicks or keystrokes.



Fig 3. Image of a 5V Buzzer.

### 5. Servo Motor:

A servo motor (or servomotor) is a rotary or linear actuator that provides for accurate angular or linear position, velocity, and acceleration control. A fitting motor is connected to a position feedback sensor.

### 6. Jumper Wires:

Cables for Jumping In a circuit, jumper cables are used to connect two wires. Male to Male, Male to Female, and Female to Female are the three options.

The distinction between the two is at the thread's conclusion. The male ends feature a projecting pin that can be put into items, but the female ends don't have one and are used to link objects.

### 7. Membrane Keypad:

Membrane keyboards rely on an electrical connection between the keyboard and the circuits under which the keys are pressed. These keyboards operate by electrical contact between the surface of the keyboard and the underlying circuitry when the upper areas of the keys are depressed using an external force.

## IV. ARCHITECTURE

Let us now see in detail how this project is constructed and how it works. The Raspberry pi is connected to an USB webcam via the USB port. Using breadboard as a connection medium a 2 X 16 LCD with i2c module, servo motor, and buzzer and Keypad module extended wire with pin is connected to the raspberry pi using jumper wires of types Male to male, female to female and male to female.

### 1. Derivation of Capture Module:

To train our raspberry pi to detect faces, we first install and load our raspberry pi with necessary dependencies. Open CV is a powerful library which provides real time computer vision tools and libraries, and is the base of the entire facial recognition training and detecting process. Next we use another library called face recognition, which is the simplest face recognition library which is built using dlib and deep learning. Various libraries like pillow, cmake etc are used in the process.

To train our model to identify the faces we have used Haar Cascade algorithm to identify faces in real time. After assembling the data set, we then train the model. Pi will take approximately 2 minutes to analyze the photos and build the encodings file. We are using HOG method [Histogram of Oriented Gradients] detection method to recognize the faces.

### 2. Derivation of Control Module:

Upon successful recognition of face, the Raspberry pi is coded in such a way whenever a valid attempt is made to unlock the door the servo motor rotates to angle which results in door open action and an invalid attempt would not invite any action on door. Here valid attempt refers to successful facial

recognition as per the model is trained on. Other possibility could be the owner sharing a secure password with the access requester and upon entering a valid password through the keypad connected to the pie the door will be unlocked.

Other features that are provided through this module are display of the password entered and the status of the action enforced on the system. [Door is closed OR opened]

### 3. Derivation of Input/Output Module:

This module provides a feature through which the live video stream can be viewed on a Tkinter application through the webcam connected to the pi via the USB port. Also providing an option to capture a snapshot of the face detected in front of the camera and stores it in pi home directory.
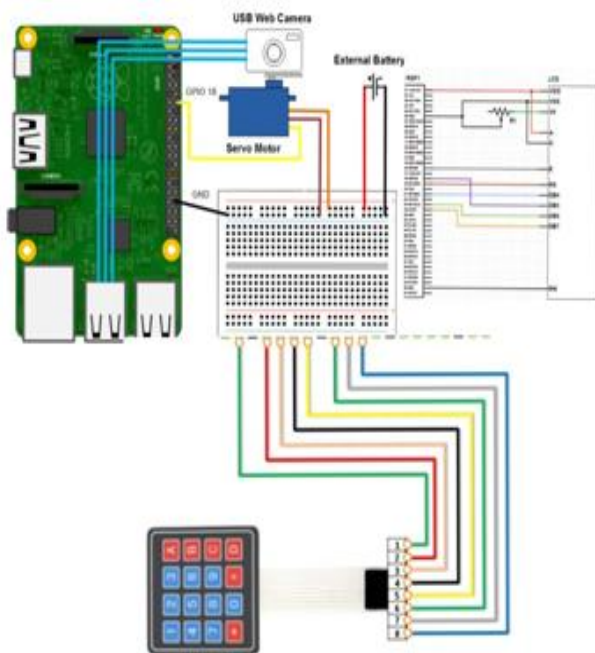


Fig 4. Architecture.

## V. RESULTS & FINDINGS

Humans can quickly detect faces in photographs, but computers have had difficulty doing so in the past given the dynamic aspect of faces.

Faces, for example, should be recognized independently of their position or angle of the forehead, light levels, clothing, accessories, hair colour, facial hair, makeup, age, or other factors. The Raspberry Pi has been successfully trained to recognize faces in real time.
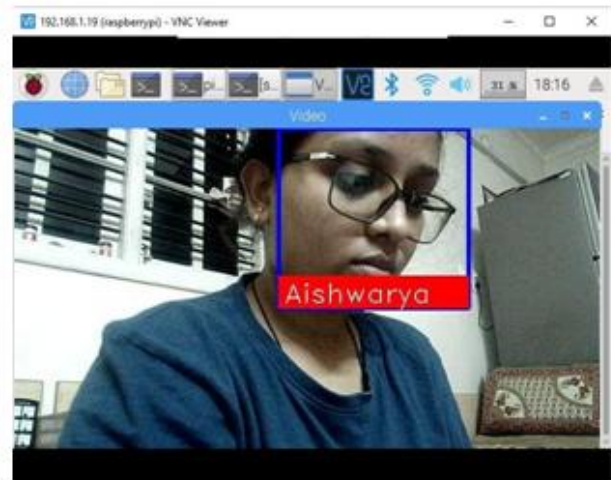


Fig 5. Image of a Identified face.

## VI. SYSTEM REVIEW

The technology for door answering system has progressed exponentially. This has led in door entry systems being suitable for all homes and not just expensive properties.

Benefits:
- Cost-effective technology hence is a viable option for everyone.
- Elderly or people living on their own will feel a lot confident and safe answering the door if they could see who it is first.
- Easy to use & presence of home security system is a step against reducing vandalism, burglary etc,.

A coin has two faces, similarly so does any technology. The way a technology will be used will determine its scope. Installation of the system, maintaining the system etc., will always be some factors for a lookout. IoT, Machine Learning areas might be the latest technology that the whole world is going frenzy about, which means it's still developing. Today's new invention will be yesterday's news when a better prototype is built or created.

## VII. RECOMMENDATIONS

The future of automated door system would be based on the concepts of computer vision, sensor fusion and deep learning which brings in more robustness to the concept and would eliminate the aspects of webcam, keypad and code generators, enabling a highly efficient, secure, quick and touch

less access entry system ready to serve the end users needs.

## VIII. CONCLUSION

This project is a cost-effective IoT based door answering system that can be implemented and maintained almost anywhere. It provides a safe and easy method to view and control the door entry access.

## REFERENCES

[1] G.Singh and A. K. Goel, "Face Detection and Recognition System using Digital Image Processing," 2020 2nd International Conference on Innovative Mechanisms for Industry Applications (ICIMIA), 2020, pp.348-352, DOI: 10 .1109/I CIMIA48430.2020.9074838.

[2] "L. Peng, Z. Xin, and G. Ping, "Design and Implementation of Remote DeepFace Model Face Recognition System based on sbRIO FPGA Platform and NB-IOT Module," 2019 2nd International Conference on Safety Produce Informatization (IICSPI), 2019, pp. 505-509, DOI: 10.1109/IICSPI48186.2019.9095951."

[3] "C.N. Vanitha, V. N. Jeevaa and S. P. Shriman, "Image and Face Recognition using CV Lens Machine Learning Android Application," 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS), 2019, pp. 972- 975, DOI: 10.1109/ICACCS. 2019 .8728435."

[4] "J.R. Paone et al., "Double Trouble: Differentiating Identical Twins by Face Recognition," in IEEE Transactions on Information Forensics and Security, vol. 9, no. 2, pp. 285- 295, Feb. 2014, DOI: 10.1109/TIFS.2013.2296373."

[5] "R. Prema and P. Shanmugapriya, "A review: Face recognition techniques for differentiating similar faces and twin faces," 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS), 2017, pp.2899-2902, DOI: 10.1109/ICECDS.2 017.8389 985."

[6] U.Park and A. K. Jain, "Face Matching and Retrieval Using Soft Biometrics," in IEEE Transactions on Information Forensics and Security, vol. 5, no. 3, pp. 406-415, Sept. 2010, DOI: 10.1109/TIFS.2010.2049842.

[7] Agarwal, A. Agarwal, and G. Misra, "Review and Performance Analysis on Wireless Smart Home and Home Automation using IoT," 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics, and Cloud) (I- SMAC), 2019, pp. 629-633, DOI: 10.1109/I- SMAC4794 7.2019.9032629.

[8] Samuel Manoharan, "Image Detection Classification and Recognition for Leak Detection in Automobiles", Journal of Innovative Image Processing (JIIP), vol. 1, no. 02, pp. 61- 70, 2019.

[9] Md. Khalid Rahmani, M.A. Ansari, and Amit Goel, "An efficient indexing algorithm for CBIR", Proceedings- 2015 IEEE International Conference on Computational Intelligence and Communication Technology CICT 2015, pp. 73- 77, 2015.

[10] Junjue Wang, Brandon Amos, Anupam Das, Padmanabhan Pillai, Norman Sadeh, and Mahadev Satyanarayanan, "Enabling Live Video Analytics with a Scalable and Privacy-Aware Framework", ACM Transactions on Multimedia Computing Communications and Applications (TOMM), vol. 14, no. 3s, pp. 64, 2018.

[11] Y Taigman, M Yang, M Ranzato, et al., "DeepFace: Closing the Gap to Human-Level Performance in Face Verification[C]", Conference on Computer Vision and Pattern Recognition (CVPR), 2014.

[12] Gillis, Alexander (2021). "What is the internet of things (IoT)?". IoT Agenda. Retrieved 17 August 2021.

[13] "Internet of Things Global Standards Initiative". ITU. Retrieved 26 June 2015.

[14] Mattern, Friedemann; Floerkemeier, Christian (2010). "From the Internet of Computer to the Internet of Things" (PDF).

[15] "The smart home: a glossary guide for the perplexed". T3. Retrieved 27 March 2017.

[16] Home Automation & Wiring (1 ed.). New York: McGraw-Hill/TAB Electronics. 1999-03-31. ISBN 978-0-07- 024674-4.