

Modern Home Technology

¹Ravijeet Doctor, ²Nupur B Shah, ³Jasvir Singh Dhillon, ⁴S.Aravinda Krishnan, ,
¹Student, ²Student, ³Student, ⁴Assistant Professor
 Computer Science And Engineering
 SRM Institute of Science and Technology
 Chennai, India

Abstract— This project is about the enhancement of the old-style houses to adapt the advancement towards automation. It is based on the core concepts of Artificial Intelligence which are integrated into embedded systems (here used raspberry pi3 model b) that leads to a smart internet of things. There are two modules: 1) Door 2) Control over voice. The door module uses face recognition for the process of door lock and unlock and control over voice module uses voice recognition to control the appliances of the house.

Index Terms - Internet of things, Artificial Intelligence, Home automation, Raspberry pi

1.Introduction

In today's world, everything around us seems to be automated or progressing towards it and replacing the old manual systems. The life of humans is getting easier and in addition to that humans are able to communicate with the system from a distance in spite of not being present physically. The Raspberry Pi is a single board computer and it can be used to achieve this level of automation at an affordable cost. The Raspberry Pi system functions like a computer with small setup. It contains GPIO and various other ports just like a personal computer. Using these GPIO pins the appliances can be controlled with the use of relay board[10] as well as interface the camera for security purpose.

2. Problem Definition

There are existing systems [7] that are complex and difficult to configure which results into a problem that whenever an error or fault occurs into the system the owner cannot fix it on its own. Apart from that most of the home automation system are costly which cannot be afforded by all. These system use a specific application for controlling the appliances which will be less secure and involves manual controlling.

3. Proposed System

This paper demonstrates use of raspberry pi for creating a digital home environment which is easier to configure and simple to use with less cost without affecting the security making it more reliable. The components used are listed below:

3.1. Raspberry pi model B

Raspberry Pi 3 Model B [8] is a powerful hand sized computer that is useful for various applications and this in turn replaces the models that are in use. It comes with a more powerful processor, 10 times faster than the first-generation Raspberry Pi[8]. Additionally, it adds wireless LAN and Bluetooth and this is ideal for powerful connected designs. It is 10x Faster - Broadcom BCM2387 ARM Cortex-A53 Quad-Core Processor powered by Single Board Computer running at 1.2GHz. Fully HAT compatible and a Micro SD slot to store information and load the operating systems. 10/100 BaseT Ethernet socket is for quick connection of the Raspberry Pi to the Internet.

3.2. Relay Board

Relays are connected directly to each output channel. The relay board has four relays driven by ULN2803 IC[10]. It operates on 12V but the input signal could be from microcontroller output working at 3V or 5V to control relays[11]. Each relay [10] can switch a variety of AC or DC high voltage, high current loads operating at 110V or 220V AC mains like fridge, ac and such. The status of a relay is indicated by individual LEDs.

3.3. Raspberry pi Camera

The Raspberry Pi Camera Board v2[9] is 8 megapixel Sony IMX219 image sensor board for Raspberry Pi with a fixed focus lens. The camera has a 3280pi x 2464pi static images, and also supports 1080p30f, 720p60f video. It is attached to the raspberryPi[8] by small sockets on the board and uses the CSI interface. All soft wares are supported with the latest version of Raspbian Operating System with 1.12 m X 1.12 m pixel and OmniBSI technology[1] for high performance.

3.4. Google assistant

Google Assistant[2] is one of the Google's product for providing voice assistant AI. It is a virtual assistant that uses a natural language speech interface to perform a variety of tasks. Google Assistant[2] adds two-way communication abilities to Google's previous assistant service, Google Now, a text-based service. The assistant makes use of cognitive computing, machine learning and voice recognition technology.

3.5. IR Sensor

IR sensors[4] (Infrared sensor) are modules which detect the presence of objects in front of them. If there is a presence of an object it gives 3.3V as output and if there is no object present it gives 0 volt. This happens because a pair of IR pair[4] that consists of transmitter and receiver, the transmitter (IR LED) will emit an IR ray which will be reflected if there is an object present in front of it. The reflected IR ray will be received back by the receiver and the output will be made high after amplifying input got from the receiver using an op-amp link LM358.

3.6. LDR Sensor

LDR sensors[6] are one of the essential devices in our circuit. It helps to check the density of light present in the environment. In order to do that, the sensor has a few hundred ohms of resistance in the presence of light and in the dark it can have a few megaohms of resistance. The capacitor is like a battery that is charged while receiving power and then discharged when it is no power supply. Using this capacitor in series with the LDR[6], we can calculate how much resistance the LDR gives so that it is light or dark.

4. Methodology

The architecture of the system contains two modules: 1) Door lock and unlock 2) Control over voice for various appliances.

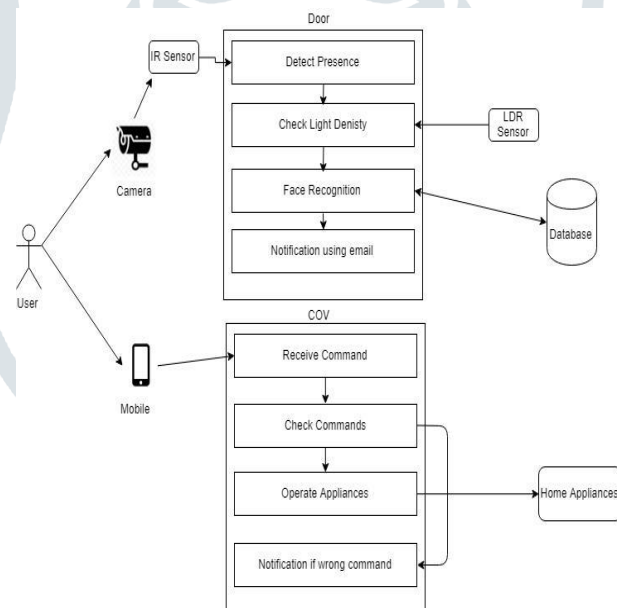


Fig 1. Architecture

4.1. Door lock and unlock

Camera is installed which uses face recognition to operate the functioning of door to get input and control the locking and unlocking. This is possible when there is enough light to detect the individual's face but there may be a possibility of darkness during night so to allow detection at night a LDR sensor is used to check the density of light and an ultra-sonic sensor is used to check for the presence of the person. If a person is standing near door and the light density is low to detect a face, LED which is fixed near camera turns on automatically which will allow the detection of a face properly. Under certain circumstances if the face is not detected an email will be sent to the user.

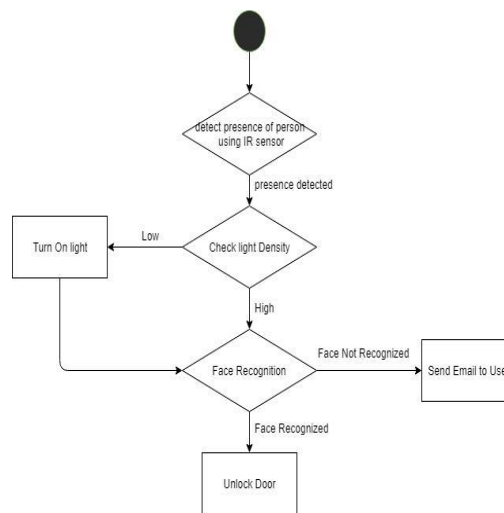


Fig 2.Door Module

4.1.1. Face Recognition.

Here in this project for the authentication of house owner face recognition system is used. A face recognition is capable of identifying or verifying a person from the live camera. There are various ways in which facial recognition is done but in general they work by comparing facial features from given input with the faces that are stored in a local database. Here we are using deep learning matrix and its architecture is based on ResNet-34 [5] The face recognition is done in various parts.

Training

This is the first most step of face recognition which will capture the face of the user and store it in the local database as seen in fig 3. It will create various training dataset which we taken from the live camera as a image and will pre-processed it and the coordinates of features like width of mouth, width of eyes, pupil etc. will be extracted and stored in a local database.

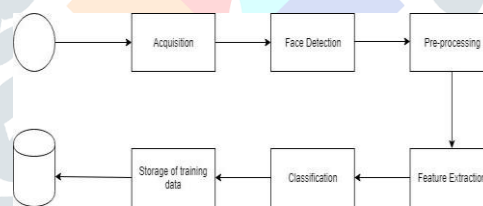


Fig 3.Training of Face recognition System

Recognition

Once the system has been trained and all the data has been stored in the database a system is ready to be used. Whenever a face is detected it pre-processes the image and extracts the feature of the detected face after the extraction is done it uses classification algorithm to compare the extracted feature to that of present in the database if it matches the data in the database it classifies the face as known or else as an unknown.

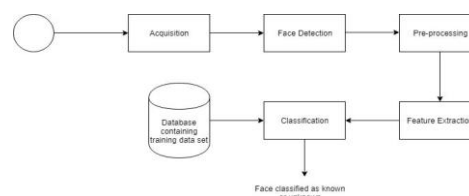


Fig 4.Face Recognition

4.2. Control Over voice

Control over voice gives the liberty to user to operate any house appliances using their voice. For this purpose, google assistant will be used so that we can send commands to the raspberry pi as shown in figure 5. The commands are configured on assistant before itself using IFTT [3]. Here as raspberry pi being the master controller all the commands are transmitted over Wi-Fi to it from

the phone using a cloud-based publisher subscriber model. Depending on the command given the by the user raspberry pi will operate its GPIO pins which are attached to the relay board in order to operate the appliances attached to relay board.

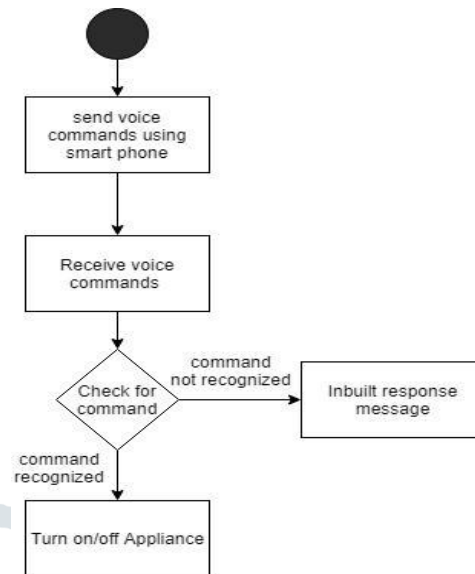


Fig 5.Control Over Voice

5. Results

The figure 6 show the experimental setup of the pro-posed system and following inputs can be given through google assistant:

- 1.Turn on/off Lights
- 2.Turn on/off Ac
- 3.Turn on/off fridge
4. Turn on/off fan

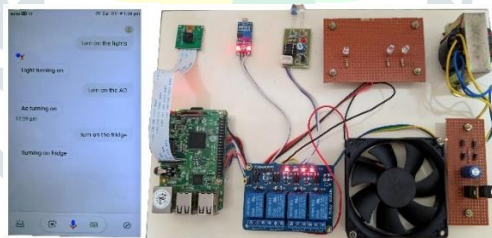


Fig 6.Experimental Setup

In the figure 6 on function of lights, ac and fridge is given and respective red lights indicating on function on relay board is seen.

The below fig 7 and 8 shows the working of face recognition for door module in the presence of a person in front of the camera. The accuracy of face recognition is 98.64%.If face is recognized the green led turns on indicating the opening of door and if the face the is not recognized the red led turns on and email is send to the user.

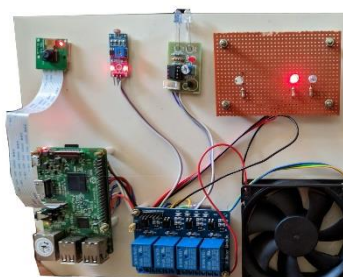


Fig 7.Faced Not Recognized

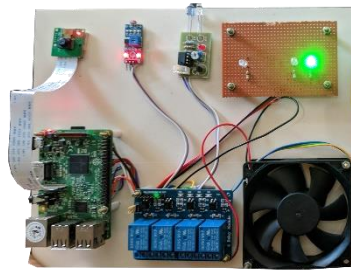


Fig 8 Face Recognized

6. Conclusion and Future Scope

In this paper we focus on operating the system and voice controlling the appliances which will be convenient for a large number of members to control using their voice not making it limited to one voice which is highly efficient. The face recognition focuses on providing security to the house by the authentication of the house member using their face. The main aim of this paper is to make house automation simple and economical. The system is configured in such a way that on occurrence of any error or problem in the system user can rectify on its own thus saving the cost to repair such systems.

None of the system is limited to a particular scope, it keeps on evolving as the time passes by and in the field of automation there are new innovations. The proposed system in this paper is potential towards change, there are various fields where changes can be made in coming time. The door module can be transformed further to make it fully automated by allowing the user to operate the door by their voice on recognition of an unknown person standing outside the door. There can also be an advancement where, in case of robbery or any suspicious conditions or sensing the weather to operate A.C., or any such conditions the system can act on its own accordingly making it more efficient and reliable.

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