Smart Door Lock and Lighting System using Internet of Things

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Abstract: In the proposed approach, a smart door lock and lighting system using IOT for smart home is presented with the additional add on feature of facial recognition. A smart door lock system is a system which uses digital password for opening and closing the door. With the advancement of modern technologies areas related to robotics and computer vision, real time image processing has become a major technology under consideration. So here a try has been made for a novel approach for capturing images from the Pi Camera in real time environment and process them as we are required. Here in this project depicts a basic and simple equipment execution of face location framework utilizing Raspberry Pi, which itself is a minicomputer of a small estimate and is of a low cost. The framework is modified utilizing Python programming language. The destinations of the face recognization are to recognize appearances and its spatial area in any pictures or recordings .The proposed framework distinguishes the faces present in a grey scale and colored image. Here in this project the idea of identification has been built up by composing distinguishable code for dataset generator, trainer and indicator. Effectiveness of the framework is examined by as certaining the Face recognization rate for every one of the database. At last the data that will be shown alongside recognized photograph has been put away on database. This concept has a higher scope on security and surveillance projects and various operations.

Keywords— Smart door lock; Face recognition; IOT; Home automation

1. INTRODUCTION

In the proposed approach, a smart door lock and lighting system using IOT for smart home is presented with the additional add on feature of facial recognition. A smart door lock system is a system which uses digital password for opening and closing the door. The door lock is the foremost and endmost thing people come across in entering and leaving their homes respectively, the home automation function in digital door lock system allows users to comfortably control and monitor home environment and situation all at once. It also allows users to remotely overlook the situation inside the house through World wide web or any other public network. A smart lighting is proposed which can be remotely controlled using Internet.

Nowadays, technology is an integral part of everyone's lives. It influences several facts of everyday life and allows improved social synergy, easy transportation, the capability of indulging in entertainment and media and helps in the advancement in medicine. Internet has played a pioneering role in providing immediate solutions for various problems and has given the ability and has connected all the remote places which has contributed to significant reduction in cost and also energy consumption. Home automation or intelligent home is defined as initiation of technology inside the home surroundings to provide ease and safety to its inhabitants. The technology of the Internet of Things is used to examine and execute home automation. GPRS, GSM, Bluetooth, Wi-Fi and cellular networks support remote data transferring and are used to enter abundant levels of acumen within the home. Home automation has the ability to greatly assist and improve the quality of life of older people. IOT also greatly contributes to supply management and observance with ease of control. The user can remotely control the gate, home appliances, etc. comfortably and conveniently anywhere and anytime.

The Internet of things (IoT) is known as connecting objects like cell phones, personal computer and other devices to the world wide web, which introduces a new era in the area of communication, where objects communicate with each other without human intervention. Most of the equipment and gadgets are controlled and monitored to help and assist humans. Moreover, various wireless technologies assist in communicating with remote places which play a great role in the intelligence of house surroundings. IOT is a sophisticated network of nodes with the unique ability of exchanging data and knowledge wirelessly which enables communication between two objects thereby making them smart and omitting the need of humans for machine to machine communication.

2. METHODOLOGY

2.1 Main features of the proposed system

The main objective of this project is to provide remote access to door lock and lighting system. The obvious motivation for providing such a kind of remote access to door lock is to make homes much more secure and enable us to remotely unlock or lock door for guests etc.

Smart lighting: The remote lighting system allows user to remotely control lighting i.e. switching it ON / OFF and also vary the intensity of light. This ensures that electricity is never wasted even if the user forgets to switch off the lighting as it can be remotely switched OFF.

Door Locking: This project also ensures that the user need not worry about whether the door is left unlocked or not and hence ensures peace of mind for the user.

Facial Recognition: This is an additional add-on feature which is implemented in this project. This feature is enabled for the door locking and unlocking system, which also imbibes a sense of security. It allows the user to add the images which are only restricted to the house owners.

2.2 Overall structure of the proposed system

The following figure shows the block diagram of proposed system which controls the door locking and lighting system for the smart home using Internet of things .The block diagram consists of a battery, voltage regulator, a Raspberry Pi module which is the heart of our proposed system, a keypad and a relay board.
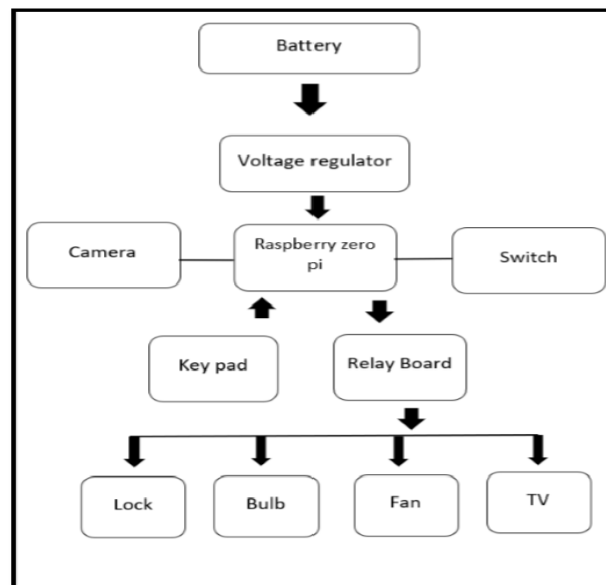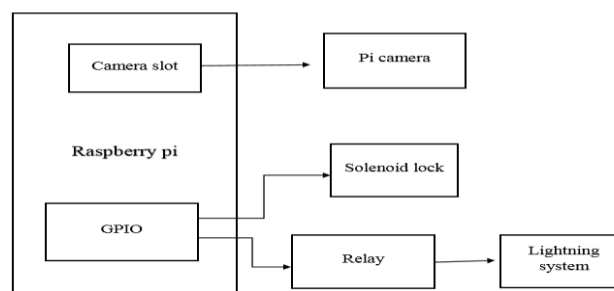

Fig .1. Block diagram of proposed work

Fig. 2. Circuit Diagram

Here one can see that the Pi camera is attached to the camera slot and the Solenoid Lock and Relay is attached to the GPIO pins of the Raspberry Pi. As it is a two channel relay so it is connected to the Lightning System and the Solenoid lock. Here the camera module is being used for a door locking system for surveillance purposes. The door only opens after a successful recognition process, when the face is stored previously in the database and that image has got the access to open the door then it will work otherwise it won't open and also another feature called Keypad system for door lock system where by entering 4 digit password as a secret key and lightning System works both manually by switches and also by Blynk app Server and by modern features called Alexa, Google home etc.

The following flowchart shown in Figure 3 describes the algorithm of the proposed system:-
With the locking system we have also included lighting system and the facial recognition feature.
The locking and lighting system is the most essential part of our day to day lives since keeping our houses locked gives us a sense of security and we can also save up on the electricity bill time to time. We have tried to implement this project which does both the above mentioned things with an additional feature of facial recognition.
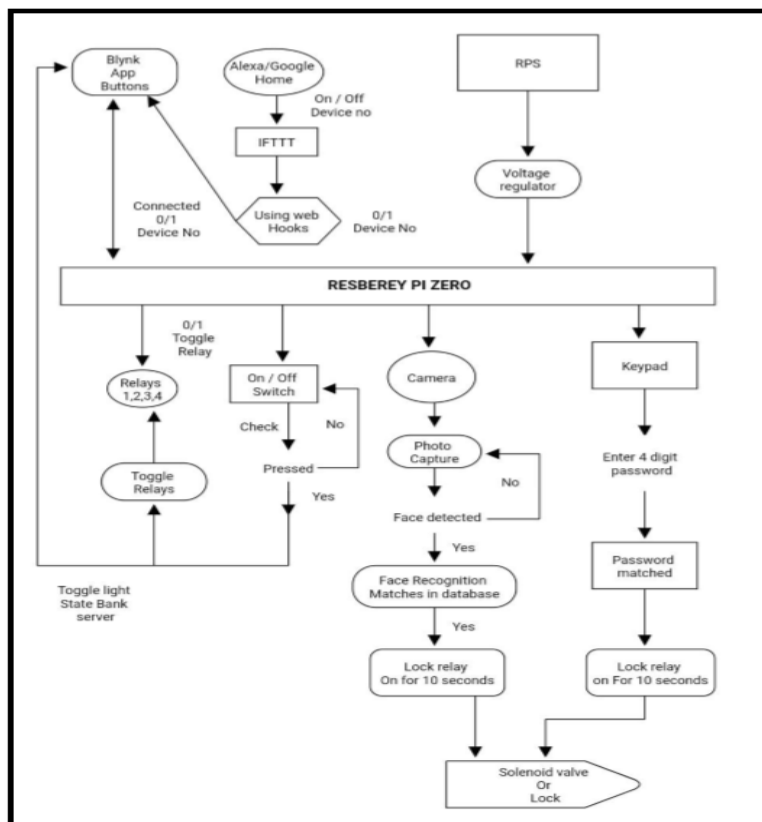

Fig. 3. Flowchart of proposed work

We have used the Raspberry pi 0 module which acts as a bridge between the software and the hardware parts of the projects. We have also taken the help of an application called Blynk App to connect our module over the internet. So, we have created a few buttons on the app which acts like a switch for turning ON/OFF the lights and locking/unlocking the door from anywhere around the world over the internet.

So basically, these buttons created are connected to the internet through the Blynk App and also in a way connected to the physical relays which are synced with the Raspberry pi 0 module. The programming for lighting/locking system as well as the facial recognition is written on the Raspberry Pi 0 module. It controls camera, keypad and communication between server and all the important processes are done by this module. The control module" Raspberry pi" is the centre of the door lock system where all the process cycle is done. This module is the server for verification of the user id. Camera is connected to Raspberry pi0 for surveillance purposes. All the operations are done by the control module which includes sending notification to the owner, to check that the guest is authorized to enter the house.

3. RESULTS AND DISCUSSIONS

The main objective of the proposed work here is to create a system where it will be easy to operate home appliances and equipment very easily by making this system user friendly. Developing a smart home system was not easy at first.

The most important part of this proposed work is human surveillance which is important due to the security issues of smart homes. For surveillance using face detection and face recognition is being used which are the most modern form of surveillance. For this purpose, Raspberry Pi is being used camera and which is a open source which is a part of Python language. Python here acts as the main platform where most of the work is going to be done.

Here mainly we have introduced two features :

1. Remote access to switches of electrical devices
2. Door lock system which uses face recognition

1. For example, we have shown connections for remote access to switches of electric bulbs
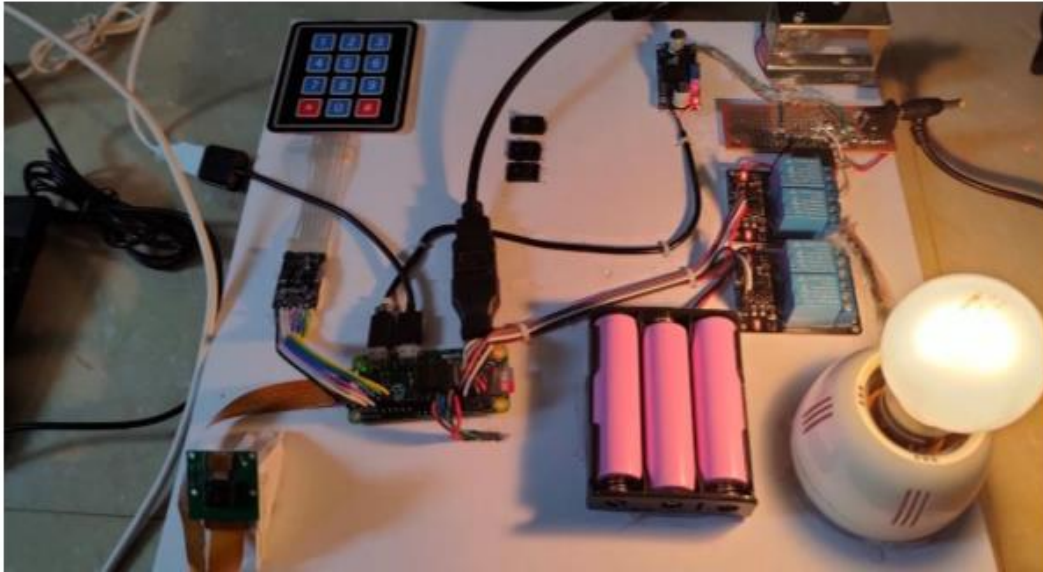

Figure 4. Turning ON the bulb which is connected to Raspberry Pi Zero

Raspberry Pi will be used for the remote switch. Raspberry Pi will host a local webpage (which contains the remote switch) and also connect to WIFI. So, User may use a phone (connected to WIFI) to open the local webpage and turn on/off the light. For this project equal effort is needed both in software and hardware. Firstly, we connect electric devices to raspberry pi as shown in the figures, then we should program the raspberry pi using python language to give access to the web we are using for remote control.
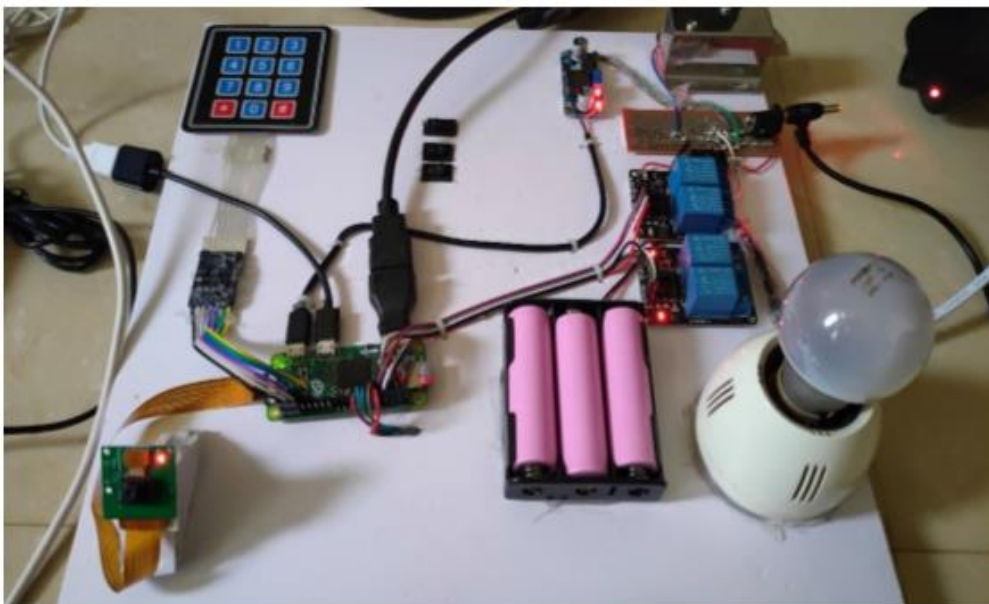

Figure 5. Turning OFF the bulb which is connected to Raspberry Pi Zero

2. Door locking and unlocking system using face recognition:

The box like structure is holding the Raspberry Pi camera which is used for capturing pictures of faces to store in the database and then later detect those faces and recognize those faces which is being used for a door locking system for surveillance purposes. The door only opens after a successful reorganization process, when the face is stored previously in the database and that image has got the access to open the door then it will work otherwise it won't open.
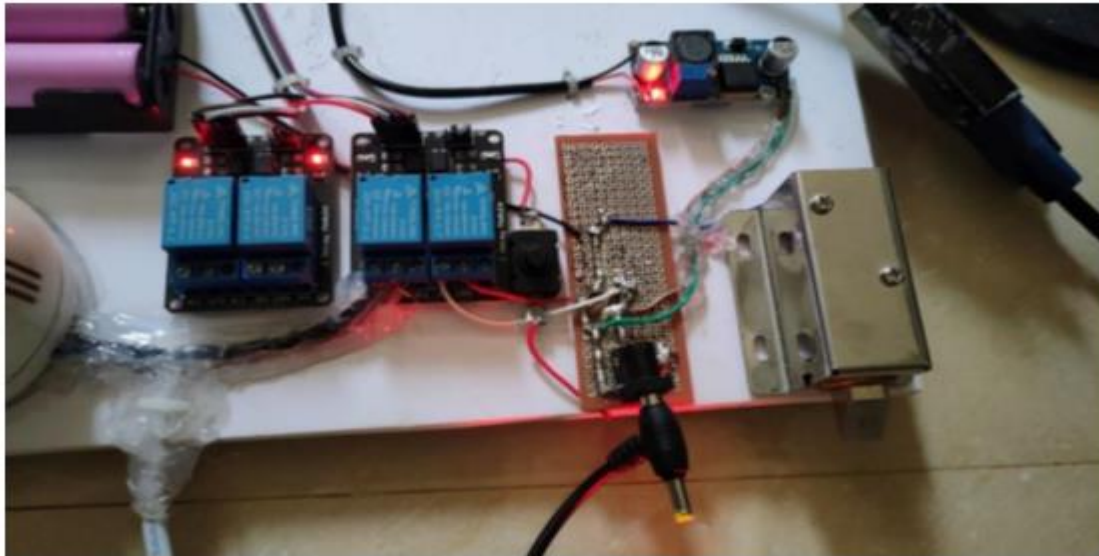

Figure 6 . Door locking

The picture is taken by the Raspberry Pi camera which is used for the face recognition. Firstly taking the pictures and storing it in the database then during the recognition process the outcome shows the name of the identity if it is stored in the database and it also shows the matching index which is previously mentioned that if it is above the fixed threshold then, it is successful otherwise not. Here clearly it is not the case as the matching index is below threshold hence door is locked.
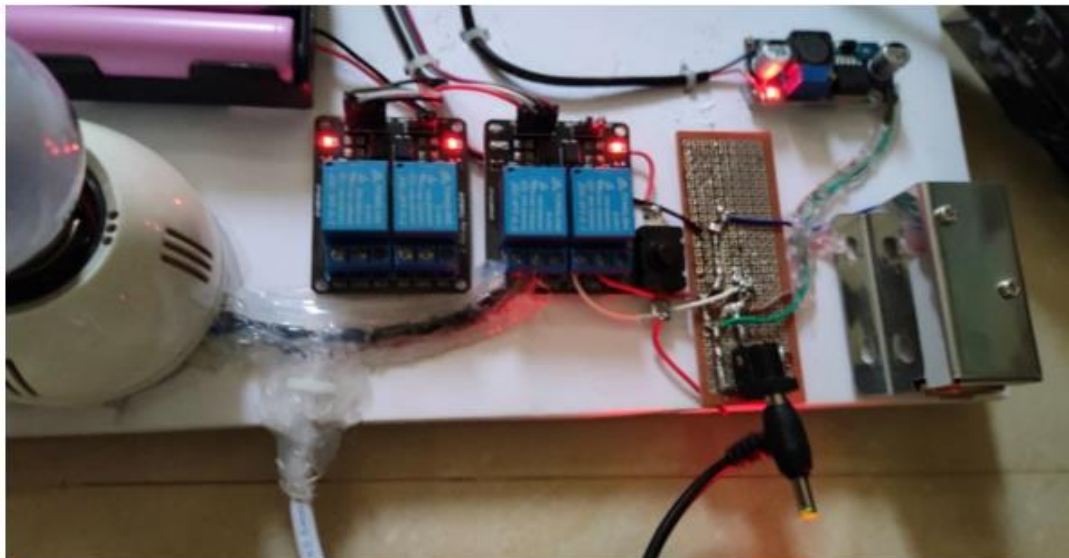

Figure 7. Unlocking

Here the matching index is above the threshold hence the door is unlocked. This is the case of successful face recognition.

The main advantage of this system is that it's very small in size and lightweight, thus can be easily integrated into wooden/metal doors. It has a good recognition rate with 95% accuracy and the recognition time is less than 0.5 second. It's extremely power efficient requiring only 5 watts of power to operate. Low power consumption enables the system to run on batteries for hours at a stretch in case of power failure. Also, The low cost and long battery life increase

usability and overall efficiency. The aim of this system is to assist people in maintaining security in their homes, offices and other important places. The system can efficiently manage the entry of people at a particular place and with the help of IoT it can also materialize remote controlling of entrances. Also, it saves valuable time of people and reduces the hassles of the security guards and staff, increasing the degree of security.

The above setup makes up an easy to use web app which switches on or off the Electrical devices connected to the Raspberry Pi Zero W and makes it remote accessible and thus fulfils the objectives.

CONCLUSION

In this modern era, machine learning and IoT have become two of the most prominent fields which have made our lives easier, safer and efficient through variety of their applications. In almost every aspect of our daily life, we can see the benefits of these fields. However, our effort was to develop a helping hand for maintaining security at important places. Faces were extracted out of images and the machine was trained with some positive and negative images.

Home Automation is the most trending technology currently. This form of technology includes a lot of prospects from a lot of topics or subject assembled together. Home automation here has almost brought a evolutionary change in handling or operating home appliances and equipment's and made it easy and convenient to use home appliances. A lot of home appliances can be controlled through home automation such as lights, fans, TV, air conditioners, fridge etc. Home automation helps us in operating this appliances from far away. In this proposed scheme an effort has been made to build a home automation system with the main virtue of Face Recognition. Face Recognition here has been done with the help of a Raspberry Pi camera which was used to take pictures of the faces and store it in the database where.

To better the Face recognition performance, there are miscellaneous things that can be improved here, some of them being fairly easy to go with. For example, you could add colour processing, edge detection, etc. Today, one of the fields that utilizes facial recognition the most is security. Facial recognition is an extremely viable apparatus that can help law masters perceive offenders and programming organizations are utilizing the innovation to enable clients to get to their innovation. Home Automation built upon IoT is a reliable, scalable and highly cost-efficient than the other different ways of Home-Automation System.

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