

An Efficient and Cost-effective Security System using Face Recognition based Automatic Gate Opening

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ABSTRACT

In an age where public security is a priority, there is a growing need for autonomous systems capable of monitoring hotspots to ensure public safety. Face recognition technology could create an increased level of security, enable businesses and governments to save money on CCTV monitoring staff, and increase business productivity by automating processes like home, colleges, industries etc. Day to day several crimes are getting increased such as robbery, murder, burglary etc. Thus, it is required to build a system that automates the security. In recent decades, such a system would have been unfeasible to implement due to cost and technological restraints. Hence there is a need for an efficient and cost-effective security system. This article implemented an automatic gate opening system using raspberry pi model which utilizes the authentication system with face recognition to make the house/office only accessible when the face is recognized by the algorithms from Open CV library and meanwhile a person is allowed in by the authorized person, who could monitor entrance remotely. By doing so, the system is less likely to be deceived: since the authorized people can check each visitor in the remote console.

Keywords: Face recognition, raspberry pi, open CV, wireless camera, DC motor and LCD.

1. INTRODUCTION

The big competitive world and new technologies are introduced new ways towards security and automation. The people are busy in their day to day work by doing job or business, so they want to ensure safety of their things, therefore security does matters in daily life. A home security system means to protect your home and keep safe valuables, and to keep your family safe from potential break-ins by burglars and thief. In the United States, there is a home related burglary that takes place every 13 seconds, 4 burglaries a minute, 240 an hour and nearly 6,000 a day! some of the statistics are 88% of all burglaries are residential in nature, 77% of all crimes are property crimes, 38% of all robberies are committed with guns, identity theft is the fastest growing crime in the U.S., Canada and U.K.. As per the statistics of home burglary crime, 3 out of 4 homes in the U.S. will be broken within the next 20 years [9]. For the security of home, the door locks are used, for that specific key is used by owner. But burglary can happen by breaking this lock. After that password-based door lock system is used, but in a case of forgotten password or any other person hack that password and the critical situation occurs. In this case may be home security can be possible, but any stranger person can be harm to the owner, this cannot be avoided. So that biometric identification is the good technique of overall security systems.

1.1. Need of improvising current system

Security becomes one of the important things that must be considered by the community as well as in the smart home systems. The major drawbacks of currently used conventional security system, that is a security with a mechanical system that requires user to always use key to open or close door but chances of losing or duplication of keys are more [1], other example includes password security at doorstep which uses radio frequency signal sent between door and windows to control panel but which can also be cracked easily using advanced technologies such as by intercepting data, decipher commands and play them back to control panel at will. These signals can also be jammed to prevent them from tipping an

alarm by sending radio noise to prevent the signal from getting through from sensors to the control panel [10]. In the present situation of the modern digitizing world, everything is equipped with modern technology and internet to ease our work and gain more efficiency. But the current system lacks it, the major problems with security that our system targets are:

- Today's security system is from 90's that is, key-lock based.
- High-level security system comes with high cost and maintenance.
- Owners are not aware of their own security system; how does it work because of their complex nature.

2. RELATED WORK

Varieties of other latest technologies available are RFID card technologies, biometric protected systems, OTP based, cryptography-based and many more. each system is applicable for different application zones depending upon their technology usage. Also, there are systems that use some of these techniques for security, yet they do not provide a complete security system as there is only single-factor authentication [5]. Though large numbers of researchers have already addressed the issues of the home security system and proposed home security techniques, quite a few are done on face recognition which really has an exceptionally good scope in eliminating these problems. In [1], face detection and recognition system for smart home security is presented, which captures image and performs image processing using MyRIO 1900 is main controller which contains the software of image acquisition, face detection and face recognition. Personal computer (PC) is applied as user interface, image display and monitoring. Both MyRIO and PC is programmed using LabVIEW which is graphical programming language called 'G'. The major disadvantage here is cost of MYRIO is extremely high as compared to the raspberry pi. Author in [2] presented, a face recognition system based on local binary patterns and support vector machine and explained in detail how does local binary pattern works in face recognition module, but nothing has done in case of power failure. In [3], IoT-based face recognition system is proposed and the methodology is quite well, explain in detail working of gate lock-unlock on face recognition but, use of Wi-Fi limits it's area covered as the system cannot be accessed remotely by homeowner. Another disadvantage of above-mentioned systems is that they are not interactive so that the person in front of the camera will not able to understand the reason for not allowing to get inside the home. These reasons may include that, the system is not able to recognize the face, or a person is not authorized individual or any other technical issue. there are many such issues so, a person should be aware of that.

3. PROPOSED METHODOLOGY

Our proposed system delivers a cost and energy efficient solution for security by using raspberry pi and face recognition system as shown in Figure 1 . Person should stand in front of the camera then camera will capture and compares the person image with the face images already stored in the database in raspberry pi. Then it utilizes open CV models for recognizing the captured face whether it is authorized or not by means of presence of that face image in the database. If the face matches found, then gate will be automatically opened with the help of turning on the DC motor else it will remain unlock by keeping the DC motor in off condition and buzzer will be used to alert the neighbourhood. As shown in Figure 1, LCD also interfaced to display the locking and unlocking of gate after the process of face recognition.

Advantages

- Used in authentication services.
- Detects the fraudulent transactions.
- Eliminates the need for passwords.

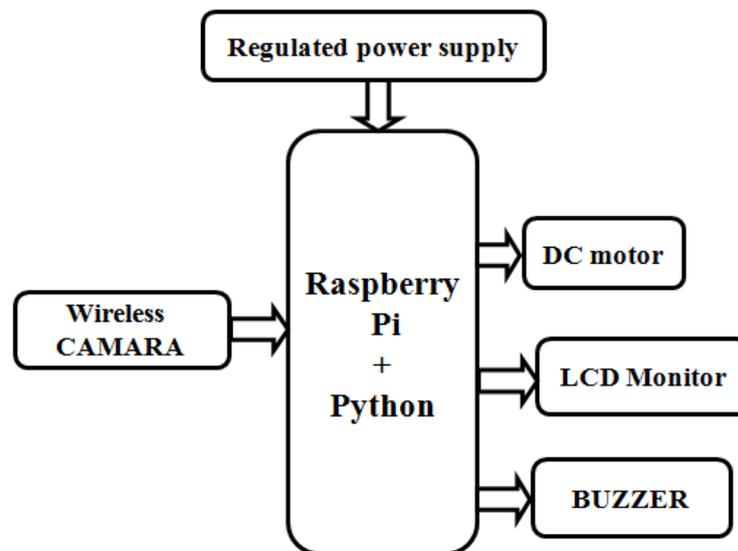


Figure 1. Proposed block diagram of automatic gate opening system using face recognition.

Applications

- ✦ Authentication services.
- ✦ Advanced security.
- ✦ Mobile Phones .
- ✦ For government law enforces.
- ✦ Unusual behaviour detection

4. HARDWARE DESCRIPTION

4.1. Liquid crystal display

LCD is liquid crystal display technology works by blocking light as shown in Figure 2. Specifically, it is made of two pieces of polarized glass that contain a liquid crystal material between them. A backlight creates light that passes through the first substrate. It is used for display purpose.



Figure 2. LCD display

4.2. DC motor

The DC motor is the device which converts the direct current into the mechanical work. It works on the principle of Lorentz Law, which states that “the current carrying conductor placed in a magnetic and electric field experience a force”. And that force is called the Lorentz force. The Fleming left-hand rule gives the direction of the force. The schematic of DC motor is disclosed in Figure 3.

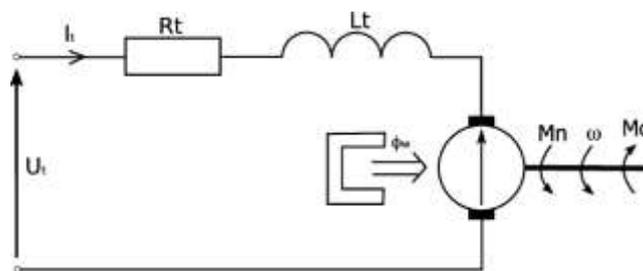


Figure 3. Schematic diagram of DC motor

4.3. Raspberry Pi

It is an ultra-cheap minicomputer with 5.5 cm width and 9 cm length. It consists of a component named System on Chip (SoC) which comprises of single core CPU with a supportive processor for computing floating points, GPU and RAM with 512 MB size (SD-RAM). Moreover, it consumes less power, which is just around 5-7 watts. The architecture of raspberry pi is given in figure 4. It has couple of cache memory levels, where first level is of 32KB size and the latter is of 128KB size. These are utilized to store recent programs and ALU is utilized to execute instructions. It is a very small device and can incorporate other devices also. It consists of both the hardware and software. It requires an SD card and a power supply to related mouse and keyboard. Additionally, a display also exists for functioning OS such as Windows and Linux.

Table 1. Specifications of Raspberry pi

Chip	Broadcom BCM2835 SoC
Core architecture	ARM 11
CPU	700 MHz Low power ARM1176JZFS
RAM	512 MB (SD-RAM)
OS	Linux
Dimensions	85.6 × 53.98 × 17 mm
Power	Micro USB socket, 5 V, 1.2 A

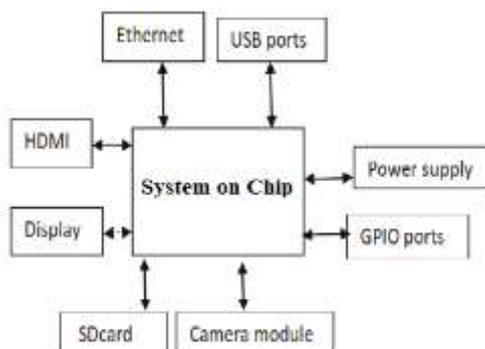


Figure 4. System architecture of raspberry pi

5. RESULTS AND DISCUSSION

Cloud storage is a data storage model where the data storage will be in logical pools. The physical storage pairs several hosts (probably numerous areas) and this environment is normally copped to and maintained by a hosting organization. These cloud renders are creditworthy for maintaining this data feasible and approachable with security. Practically, users or any companies will purchase or lease the capacity of storage from the renders for storing company, user or any application data. The schematic diagram of

proposed cost-effective security system is demonstrated in Figure 5. Figure 6 disclose the hardware kit of proposed automatic gate opening system with face recognition.

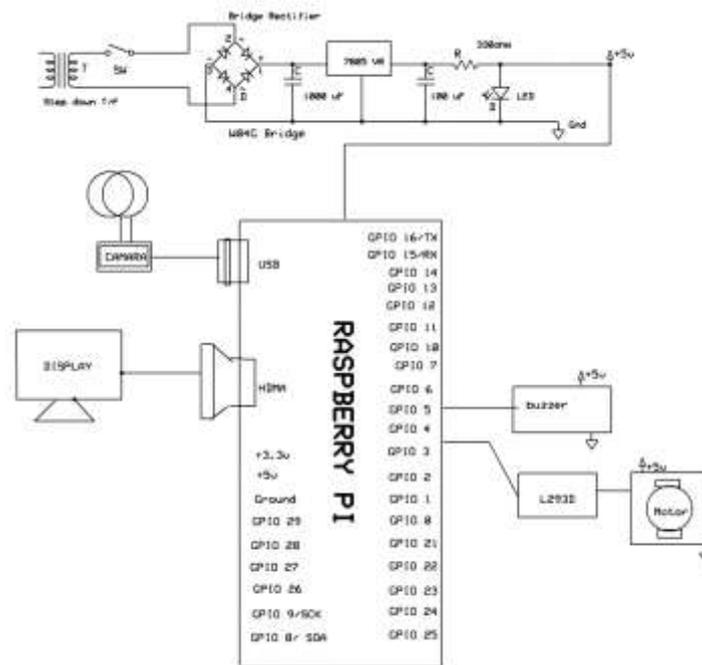


Figure 5. Schematic diagram of proposed automatic gate opening system using face recognition.



Figure 6. Hardware kit of proposed automatic gate opening system.

6. CONCLUSIONS

This article proposed an automatic gate opening system using raspberry pi model which utilized the authentication system with face recognition that makes the house/office can be accessible when the face is recognized by the algorithms from Open CV library and meanwhile a person is allowed in by the authorized person, who could monitor entrance remotely.

7. FUTURE SCOPE

The analysis of facial recognition and facial expression recognition methods shows that facial expression and occlusions pose a bigger challenge to robust automated facial and expression recognition methods than gender, ethnicity and age of subjects. Future efforts in the field of facial and expression recognition may involve identification of expression-based biometrics that can be useful for automated security, surveillance, and identification tracking tasks. Robust automated Facial/expression recognition can be used as personal identification systems at grocery stores, travel documentation, banking documentation, examinations and security, and criminal tracking.

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