

SMART DOOR ACCESS SYSTEM

THE SECURED DOOR AUTOMATION FOR SAFETY AND PROTECTION USING RFID

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Abstract—Abstract—Today the term “Automation” has gained a lot of significant attention in terms of improving or increasing safety, comfort, energy efficiency, convenience and also the most important thing security in our daily life that allows users to control and monitor their homes. As mentioned “ Door automation” here it refers to integration of various embedded systems that can be controlled remotely through via smart-phones or automated schedules. It is designed to improve security and convenience in modern homes by integrating computer vision and IOT-based control mechanisms.

Index Terms—:Smart Door, Servo Motor,LCD Display

I. INTRODUCTION

In this era of rapid increase in technological advancement, the Internet of things (IOT) and the Artificial intelligence development in technologies has improved significantly in various aspects of our day to day lives. The journey of IOT has evolved in terms of many years, in terms of our survival and also interact with world outside. Among many applications present nowadays, One of the major use of IOT is in Automation system itself.

In Automation the devices and the systems are connected to each other to deliver the improved version of energy efficiency required , also security (one of the major thing), and better usage efficiency within households. IOT give access to the users to monitor and control their home environment remotely and effectively with security . Among various home automation applications we have come across, Smart Security systems have more scope in this technology enhancement and it has also gained significant impression due to the improving requirement in terms of secure, safety and consistent access control. But due to the use of traditional lock-and-key mechanisms which were mostly used by many or some physically operated systems it basically resulted in poor security risks and several limitations because physically keys could be lost, duplicated or stolen allowing unauthorized

access inside the system. These Systems even offered either ways to track or monitor while entering or exiting a place. Because of all these drawbacks faced earlier, this problems leads to arise of smart, automated, and more secure access systems making path to the development of IOT-based and computer vision enabled smart door systems that provide remote control access, authentication and real-time monitoring mechanism which is highly secured.

In this research paper, we have made use of the main component that is RFID (Radio frequency identification) as mentioned in the system components it is a wireless communication technology used to identify and authenticate objects or individuals. This SMART DOOR ACCESS SYSTEM, consist the RFID module which is implemented to verify the person identity before granting access to them to enter through the door. The RFID has been widely used everywhere this days across various technology implemented fields globally.

A COMPUTER VISION is one of the major rapidly involving field in Artificial Intelligence (AI) which helps in boosting machines to interpret, analyze, and also understand the visual or graphical information from the real world atmosphere. This concept computer vision was started in 1960s, when researchers were developing and implementing their systems that are having ability to recognize simple shapes with sizes and patterns. As time passed by, the increasing ability in image processing and quality enhancing in scanning, having a developed computer vision that provides the access to systems to ease of access to identify and also track objects and facial recognition in real time.

Along with the rapid increase in technology of embedded system, computer vision(CV) has become a most important technology in modern automated system and security applications.Starting from the cameras and face recognition

door locks by scanning to several vehicles, object, or any other industry computer vision has rearranged how machines interact with their environment using few application and the technology. The integration with IOT has allowed smart systems to make a smart implementations based on the inputs provided by the user, improving both security and automatic use case efficiency.

As this research paper deals with SMART DOOR ACCESS SYSTEM, Computer Vision play a very important role in providing security through facial recognition based access control. This work of the system is to capture real-time images of a person standing near the door using camera. During the first step, the system takes multiple images samples of authorized or even unauthorized individuals and stores them in its database for either future comparison (which is optional) and result whether the access granted or denied on the display When someone tries to enter inside, the computer vision algorithm scan live image, extract facial expressions, and also compares them with already stored data.

The end result would be like, If the features of authorized user matches the identity of the stored data , the system grants access; otherwise the system denies the access. Now the combination of both Computer vision with RFID authentication actually creates like a dual-layer security mechanism throughout.

II. LITERATURE REVIEW

Multiple studies have been implemented to improve security systems using electronic systems and automated technologies in present days . Traditionally, people have used mechanical keys to lock and unlock doors, but such systems are no longer reliable because keys can be lost, copied, or misused easily. To overcome these issues, researchers started working on electronic locking systems based on RFID and IoT automated technologies.

Few previous works have similar systems. Meera M. and Divya R.S. (2017) presented an advanced security setup using microcontrollers and sensors for controlled access. Chi-Huang H. et al. (2017) proposed an electronic consumer system that focused on safety and ease of use. Naser A.H. and also Inas A.M. (2017) together developed a door security system, showing how technologies can improve safety.

Lets us dive into the studies, like that of Lia K. et al. (2018), used RFID not only for door access but also for automatic lighting control, combining comfort and energy efficiency. Andreas et al. (2019) worked on a complete smart home security model that consist door monitoring and access control. In addition, Yuan-Chih Y. (2018) thought digital door locks operated through keypads, while Thomas H. et al. (2017) worked on enhancing RFID security in IoT devices.

It is clear that RFID-based systems are highly useful for secure and automated access. They provide quicker response, better control, and can easily be linked to servers or databases for real-time monitoring. However, we come across the challenges like signal and data loss.

This literature helped the authors design their own RFID based automatic door lock system for the security purpose using Arduino UNO or we can make use of similar kind that's ESP32, servo motors, magnetic locks, and proximity sensors. The system aims to improve home door safety and prevent unauthorized entry effectively as required.

III. SYSTEM COMPONENTS/ARCHITECTURE

A. RFID TAG:

As mentioned RFID(Radio frequency identification) is used for user verifying without any communication practically. It consists of RFID Reader and RFID Tags. RFID tag is a electronic device which has two main parts integrated in it : a microchip and antenna. The microchip stores a unique identification number (UID) or any other information, whereas antenna make possible for the reader to receive transmitted signals. The RFID tags can also be classified into two types : Active tags are the tag which can transmit the data or signals over long distances ; and the other is passive tags which does not have any power source of their own, but draw energy which generated from RFID reader.



Fig. 1. RFID TAG

B. RFID READER:

As mentioned this RFID reader id used for generating radio frequency signals and also establish communication between with nearby RFID tags that are available. It also contains an antenna that emit electromagnetic waves and receive the response signals. Once the reader detects tag, it verify the UID number of RFID tag and send it to ESP32, a microcontroller for further communication for identifying and providing the access permission. In our smart door home automation system, the RFID reader is responsible for connection between user and system. It is first step of

authenciation, which allows the system to identify users before granting the permission through the door.



Fig. 2. RFID READER

C. ESP32:

ESP32 is a powerful microcontroller which is same as the CPU which is connected with the computer. ESP32 has built in wi-fi and Bluetooth ability , making it more reliable for various IOT based application. The ESP32 will be receiving the input signals from both RFID reader and computer vision module, verify and control the components such as servo motor and LCD display. It is act as brain of our project, which is responsible for managing the communication and coordination between all the components.



Fig. 3. ESP32

D. SERVO MOTOR:

The Servo motor plays a major role for controlling the opening and closing of the door. Depending on the result from the ESP32, the motor will rotates in a specific angle to open the door for authorized user and denying the opening the door for unauthorized users. The servo motor is preferred due to its quick response time which ensures smooth operation of lock mechanism. It consumes low power and is known for its best

use in IOT-based systems where efficiency and quick response on time is considered as the major operation.



Fig. 4. SERVO MOTOR

E. BREAD BOARD:

Breadboard is used for connecting all the electric components of the system without any permanent connection and it can also be used for developing a prototype model. The breadboard serve as base where the components such as : RFID reader, ESP32,Servo motor and LCD are connected using jumpers wires. The other components used in the automation system are : Jumper wires,that are used for connecting the components to each other,Lcd display, that is used to display the information required on the door screen and LED lights.

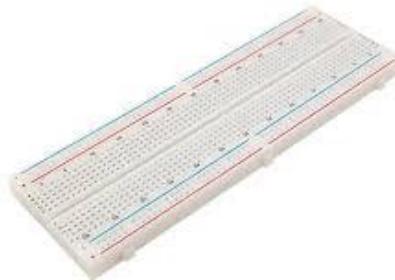


Fig. 5. BREAD BOARD

IV. WORK FLOW OF THE SYSTEM

In this system, the work flow is divided into two phases : ENROLLMENT and AUTHENCIATION. During the enrollment phase, the authorized user's RFID UID is ready to create a set of facial sample images (creating a user profile).

During the authentication the system need both RFID verification and also the face recognition for the successful opening of door. This phases are useful and also prevents

unauthorized persons from opening door even though they use authorized card.

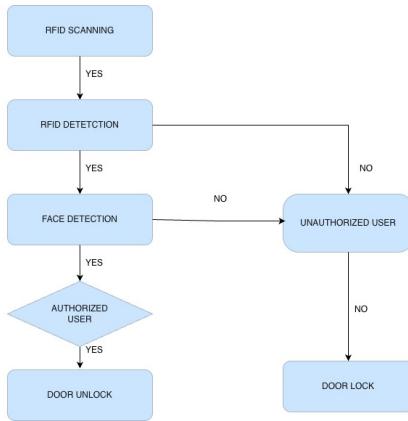


Fig. 6. WORK FLOW

A. ENROLLMENT PHASE (SETUP) :

Administrator will be responsible for enrollment mode.

- Once the user tap RFID tag to reader– the system reads the UID.
- It captures n number of images (samples) of the same person using the camera (different angle/lighting).
- Creating a user profile : it stores the UID together with captures face samples and the user data is stored in the database.
- The confirm successful enrollment is done.

B. AUTHENTICATION PHASE (NORMAL OPERATION) :

- In the idle state, the system waits for an RFID tag. The LCD shows “Ready or Tap card”.
- Once the user taps the RFID card, the reader sends the UID to ESP32.
- Them, the ESP32 checks if UID exists in the authorized user database.
- If the UID is not found : the LCD displays “Access denied/Unknown card”. If the UID is found : the face verification starts.
- Camera opens the live face image of then person who is at door.
- Then the face which is being seen by the camera will be compared with the already captured images of the person done during enrollment phase.
- If the face match is succeeded the LCD displays “Access granted”, the LED light glows and the servo motor is rotated to open door for the present duration.
- If the face match fails, the LCD displays “Access denied” as the face captured at the door matches with the already stored face samples. Then right after this the servo motor rotate back to locked position, again the system will be in idle state.

C. NOTE:

the door will be opened only if the two conditions are satisfied : firstly, authorized UID is used by authorized person the door is opened. Secondly, even though the authorized card used by the unauthorized person the door will not be opened, as the facial expressions stored will not be matching with the live person who is at the door.

V. CIRCUIT DIAGRAM

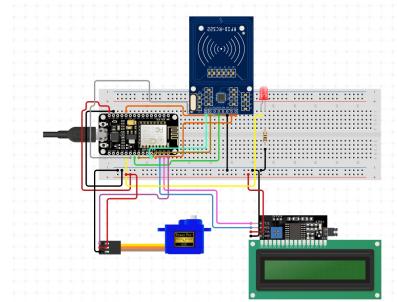


Fig. 7. This is a circuit diagram of smart door system

VI. RESULT AND DISCUSSION

The RFID face detection-based door security system was built and tested successfully. The system was mainly built to allow people whose face and RFID card were both access. When a user place the RFID tag on the RFID READER , the system first check the card is valid or not. Later, the camera capture's the user face and matched it with the stored data. If both the verifications are correct, the servo motor will unlock the door automatically. During this testing, the system works faster and accurately. The RFID card was detected within a few centimeter, and the face was identified clearly. The average time for both checks was about two to three seconds. If an unauthorized face or unautorized card was used, the system denied access and showed a warning message on the LCD display. The system is easy to operate, and suitable for homes, offices, or restricted area.

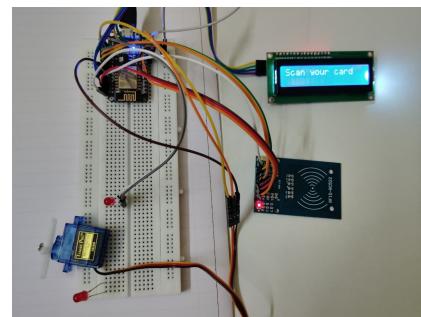


Fig. 8. RESULT

VII. CONCLUSION

The RFID and face detection-based door security system was successfully designed and tested. It provided a secure and automatic way for controlling entry for the restricted area. By combining RFID card scanning with face recognition, the system made sure that only authorized people are allowed to enter. Even if other's tried to use another person's card, access will be denied without a face match.

The system worked smoothly, answer frequently, and was easy to operate. It also reduced the chances of security issues that happen with traditional lock-and-key or password systems. The design is low-cost and can be used in homes, offices, and other secured places.

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