
Smart Face Door Lock System using AI and Edge Computing

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Abstract

Anyone today is concerned about security, whether it is data security or the security of their own house. Digital door locks have grown quite prevalent in recent years, thanks to technological advancements and the increased usage of IoT and AI. Because of its ability to assess facial points and detect identity in an unobtrusive manner, face recognition systems are widely employed for human identification. Face recognition systems may be used for surveillance at home, at work, and on college campuses, as needed. The difficulty with current face recognition systems is that they depend on either facial key points and landmarks or FaceNet face embeddings for recognition. Face detection has recently been effectively deployed using deep convolutional neural networks. Despite significant improvement, most current detection algorithms only use a bounding box to locate each face, making it impossible to segment each face from the background picture at the same time. To address this shortcoming, this study proposes G-Mask, a face detection and identification approach based on enhanced Mask R-CNN, which combines face detection and recognition into a single framework with the goal of obtaining more fine-grained face information. The resilience of the facial recognition system when an unfamiliar individual is discovered is also investigated in this research, with the system sending an SMS Web link to the home owner using edge computing. Using a door lock integrated server account, the door lock may also be accessed remotely from anywhere in the globe.

Keywords: AI, Deep Learning, Mask R-CNN, G-Mask, SMS, Face recognition

1. INTRODUCTION

Locks have been around for a very long time. Locks have probably been around for as long as there have been treasures to safeguard, in some form or another. Every day, one is likely to come across a variety of locks. Locks are all around us, from combination locks on school lockers to deadbolt locks on front doors. There are several types of locks available nowadays. Some of the locks are fairly basic, requiring just a key or a sequence of digits to unlock. Other locks are exceedingly complex, requiring fingerprints or unique electronic key cards to access. To strengthen security, today's locks include a variety of mechanical and technological mechanisms. Traditional door locks have a variety of effects. Our front door had typical door locks, which we were all acquainted with. And we can't forget the most aggravating experience of our lives: almost stepping out the front door only to realise you've locked the door and left your keys on the kitchen table. If your children or pets are trapped inside, though, it may constitute a major security concern. Pin-and-tumbler locks are distinct from other locks in that they need a key to open. Several spring-loaded pins are contained inside a succession of tiny cylinders in basic pin-and-tumbler locks. One or more of the pins will stay in the path of the shear line if you don't have the correct key. The cylinder will not be able to revolve, and the lock will stay closed. Locks are now found on practically everything, from your front door to your smartphone, and are designed to protect privacy and secure access. This demonstrates how, through time, we as a society have evolved to value privacy and safety more and more. Choosing the correct kind of door lock for yourself is more vital than ever, in our opinion. First, let's define the difference between 'smart' and 'conventional' locks. Most people aren't familiar with the word 'conventional' locks; we just refer to them as 'locks,' which refers to the typical non-automated door lock that must be manually engaged. You turn the key, and a deadbolt locks the door - it's that simple! Smart locks, on the other hand, are automated versions of standard locks or retrofitting accessories that may be connected into smart home systems in their most basic form. They, too, normally use a standard lock, but the mechanism may be engaged and operated remotely, which can enhance the whole home security experience significantly. Smart locks, like regular locks, come in a variety of designs and sizes. Keep the lock clean and well-maintained to prevent unauthorised access to the code! Some digital door locks feature PIN codes that are up to ten digits long, which isn't what you want![1]-[5]

Recognize that you are short on time and in a rush to achieve a deadline. If the key is jammed in the lock, however, do not push it to open or shut; you may wind up exacerbating the situation. The buildup of dirt or filth in your locks might cause stiffened or delayed door locks. If you find that your lock's handle is sluggish or that putting the key

into the lock is problematic. It will be difficult to close or lock your door effectively if the door latch does not catch the strike plate. This issue might arise from time to time and is caused by improperly placed or bolted hinges, moist conditions, or excessive heat. The main goal of this research is to create a reliable face recognition and identification system called G-Mask that is based on an upgraded Mask R-CNN for a safe and secure door lock system. In a hotel-like setting, a password (OTP) and SMS processing are utilised to create a secure and easy-to-use smart door lock. Locks have been around for almost 4,000 years. There is no such thing as a proper conventional lock even now. Smart locks, which have only been on the market for around 10 years, have certain technical restrictions[6]-[7]

2.RELATED WORK

Artificial intelligence (AI) is a branch of computer science devoted to resolving cognitive issues such as learning, problem solving, and pattern recognition that are often associated with human intelligence. Artificial intelligence, abbreviated as "AI," may connote robots or future scenarios, although AI extends well beyond science fiction's automatons and into the non-fiction of today's sophisticated computer science. Professor Pedro Domingo, a well-known machine learning researcher, divides machine learning into "five tribes": symbolists, who have roots in logic and philosophy; connectionists, who have roots in neuroscience; revolutionaries, who have roots in evolutionary biology; Bayesians, who deal with statistics and probability; and analogizers, who have roots in psychology. Bayesians have recently been effective in advancing the science in a variety of areas under the moniker "machine learning," thanks to recent improvements in the efficiency of statistical calculation. Similarly, breakthroughs in network computing have led to the development of an area known as "deep learning" by connectionists. Both machine learning (ML) and deep learning (DL) are computer science topics that stem from the Artificial Intelligence discipline.

Deep learning startups have had success using it to huge data for knowledge discovery, application, and prediction. To put it another way, deep learning has the potential to be a strong engine for generating actionable outcomes. • The power of deep learning may also be demonstrated in how it's being applied to social media technologies. Consider Pinterest, which has a visual search feature that allows you to zoom in on a certain item in a "Pin" (or pinned picture) and find visually comparable things, colours, patterns, and more. Using a heavily annotated data set of billions of Pins collected by Pinterest users, the company's technical team employed deep learning to train its system how to detect picture attributes. The characteristics may then be utilised to choose the best matches by computing a similarity score between any two photos.

3. PROPOSED SYSTEM

Authorized access has come a long way from using keys, pin codes, cards, and fingerprints. We now find We're about to enter the age of facial recognition. Traditional door locks are generally the first thing that springs to mind when you think about locks. There is a keyhole and a manual latch on these locks. Traditional locks have a number of drawbacks, including the inability to remember one's keys, door locks being jammed, and the ability to quickly break the lock. People believe that conventional locks are unsafe, so they switch to smart locks. However, smart locks have their own problems, such as forgetting their codes or not being able to use their fingerprints. For accessing door lock systems, this study suggested a model Mask R-CNN dubbed G-Mask. As a result, when an unfamiliar person's face is identified or recorded, this project devised a technique for the facial recognition system to send an SMS link to the system's owner.

When an unknown person's face is captured using Mask R-G-Mask CNN's model, the system will send an SMS link to the owner with that unknown or unauthorised person's captured face and a request for permission from the owner. If the owner or user grants permission, the door will be opened; otherwise, it will not. The suggested technique is based on the Mask R-CNN framework, which is the current state-of-the-art object recognition system that has shown remarkable results on a variety of object identification benchmarks. The proposed G-Mask approach has two branches, one for face identification and the other for face and background picture segmentation, as shown in Figure 3.1. The input image's face characteristics are extracted using the Face Feature Module, and the Region of Interest (RoI) is quickly constructed on the feature map using the Region Proposal Network (RPN). We also employ the Region of Interest Align (RoIAlign) to accurately retain specific spatial coordinates and create a fixed-size feature map. The bounding box is identified and categorised at the network's end in the detection branch, and the associated face mask is formed on the image in the segmentation branch using the Fully Convolution Network (FCN).

Mask The RCNN is a deep neural network designed to handle the issue of instance segmentation in machine learning and computer vision. To put it another way, it can distinguish between various things in an image or video. You feed it a picture, and it returns the bounding boxes, classes, and masks for the item. This is a big plus for the

end user, but it's also a big plus for multifamily buildings and workplaces since it relieves them of the chore of handling key cards.

- Access to remote control

Using the registration procedure, new users may be granted access quickly and easily, even from afar. Furthermore, you may quickly change settings and provide one-time or temporary access to your premises. It analyses the faces of all those seeking to enter and only lets people in who have been pre-approved by the user.

- Link to Face Verification Face Verification A link will be generated and sent to the user in order to verify the identity of an unauthorised user via some dedicated artificial intelligent agents for remote certification, which either authorises the door to open appropriately or signals a security-violation alert to the security guard and activates the buzzer is shown in fig.1

- Blacklist

It enables the user to build a "blacklist" of persons who are prohibited from accessing your company.

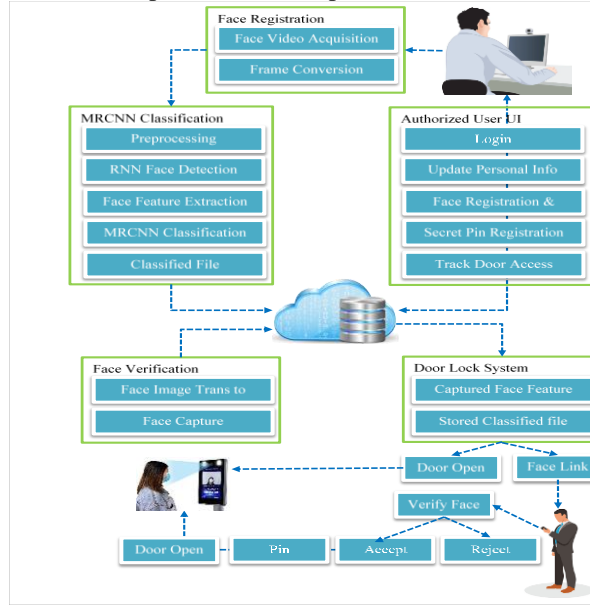


Fig.1.Face Identification

Face Identification

The picture is supplied to the face detection module after the Smart Glass Camera captures the object or face image. This module identifies the areas of a picture that are most likely to be human. After utilising the Region Proposal Network (RPN) to identify faces, the face picture is sent into the feature extraction module, which extracts the main characteristics that will be utilised for classification. The module creates a short feature vector that accurately represents the facial picture. The retrieved characteristics of the face picture are compared with those stored in the face database using FRCNN with the assistance of a pattern classifier. The picture of the face is then classed as known or unknown. If the picture face is recognised, the relevant individual is found and the process continues.

4. RESULT AND DISCUSSION

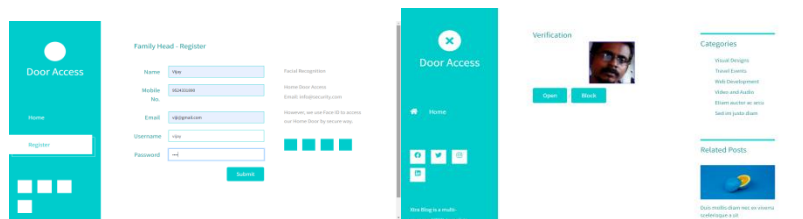


FIG NO .2. REGISTER AND LOGIN

FIG NO .3. Verification

The shown in fig.2 and fig.3 for register and verification

5. CONCLUSION

This paper outlines a Smart Home Security system. For user authentication, models for face and vocal recognition have been suggested. Region - Mask For face authentication, a convolutional neural network using Face Net based on one-shot learning is utilised to analyse the user's taken picture. The minimal distance for face recognition based on the retrieved characteristics. The user is classed as a database member or unidentifiable based on these factors. Aside from that, the model not only identifies the identities of uncovered faces, but it also recognises the identities of masked faces. The eye and nose area of a masked user should be readily visible. For the overall Home Security system, the suggested model yields a final accuracy of 82.71 percent.

6. FUTURE SCOPE

This system has many characteristics, including a facial recognition system for a safe and secure door lock system. As a result, if an unauthorised person or relatives gain access to the residence, they will only do so after receiving permission from the family head or approved users who receive the illegal person's or relatives' SMS link. Only if those authorised users provide their consent does the door open; otherwise, the door does not open. As a result of this strategy, individuals feel comfortable and secure about their home door lock systems since no one can enter without the consent of the authorised user.

7. REFERENCES

- [1] B. Septian, A. Wijayanto, F. Utamingrum, and I. Arwani, "Face Recognition Untuk Sistem Pengaman Rumah Menggunakan Metode HOG dan KNN Berbasis Embedded," *Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. 3, no. 3, pp. 2774–2781, 2019.
- [2] R. A. Isaac, A. Agarwal, and P. Singh, "Face Recognition Security Module using Deep Learning," *J. Netw. Commun. Emerg. Technol.*, vol. 8, no. 10, pp. 10–13, 2018.
- [3] J. Nasir and A. A. Ramli, "Design of Door Security System Based on Face Recognition with Arduino," vol. 3, no. 1, pp. 127–131, 2019.
- [4] F. Faisal and S. A. Hossain, "Smart security system using face recognition on raspberry Pi," 2019 13th Int. Conf. Software, Knowledge, Inf. Manag. Appl. Ski. 2019, no. August, 2019.
- [5] M. F. A. Hassan, A. Hussain, M. H. Muhamad, and Y. Yusof, "Convolution neural network-based action recognition for fall event detection," *Int. J. Adv. Trends Comput. Sci. Eng.*, vol. 8, no. 1.6 Special Issue, 2019.
- [6] A. R. Syafeeza, M. K. Mohd Fitri Alif, Y. Nursyifaa Athirah, A. S. Jaafar, A. H. Norihan, and M. S. Saleha, "IoT based facial recognition door access control home security system using raspberry pi," *Int. J. Power Electron. Drive Syst.*, vol. 11, no. 1, pp. 417–424, 2020.
- [7] Meera Mathew, Divya R S, "Survey on Various Door Lock Access Control Mechanisms," *International Conference on circuits Power and Computing Technologies (ICCPCT)*, pp. 1–3, 2017. DOI: 10.1109/ICCPCT.2017.8074187R. Xu and Q. Zhang, "Understanding online health groups for depression: Social network and linguistic perspectives," *J. Med. Internet Res.*, vol. 18, no. 3, p. e63, Mar. 2016.
- [18] Parameswari Subbian, Chitra Chinnasamy and Kannadhasan Suriyan, Textile UWB Antenna Performance for Healthcare Monitoring System, *Frequenz*, De Gruyter, 15 March 2022, <https://doi.org/10.1515/freq-2021-0227>
- [19] S. Kannadhasan, R. Nagarajan and R. Banupriya, Performance Improvement of an ultra wide band antenna using textile material with a PIN diode, *Textile Research Journal*, DOI: 10.1177/00405175221089690 journals.sagepub.com/home/trj