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The impact of computer vision on home security

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Abstract

Artificial intelligence and machine learning are subfields of computer vision. Its goal is to assist computers in seeing and comprehending the content of digital photographs. In this paper we are proposing a system which will detect a person at the main gate of the property. The gate will automatically open if the system recognises the person (i.e., if the person is known by the house owner). Otherwise, information will be sent via email to the house owner, who will decide whether or not to unlock the gate. If the house owner does not answer within a certain amount of time, we will collect personal information such as a phone number and transmit it to the owner for future use.

Keywords: Computer-vision, face-recognition, python, artificial-intelligence, machine-learning, security, e-mail, firebase, Google-text-to-speech, face-encodings

Introduction

As we all know, security is a huge worry in metropolitan areas, therefore there is a need for human labour, which we can alleviate to some extent utilising this security system, but only because of Open CV which has so many libraries linked to computer vision. When people go for work, they expect to return home to a happy family and a safe home. But, as the saying goes, hoping isn't a strategy. While the money loss may be recovered, the emotional pain you and your family have suffered may endure a lifetime. So, think about it for a moment: is this loss worth the risk?

- View the accompanying data to gain a better understanding of property crimes in the nation.
- Property crimes accounted for around 8,975,438 crimes in 2012, according to the FBI.
- Burglaries accounted for 23.4 percent of all property offences.
- Property crimes caused a \$15.5 billion loss, according to estimates.

In today's world, we can see that the crime rate is fast increasing every day, and we read stories on the news every day about someone killing his mother for a girlfriend, a girl being raped, a couple being murdered, a family being plundered, and so on. It was uncommon news in the past, but it is becoming more common now. Use Home Security Systems to avoid all of these problems and to rescue your family from a potentially dangerous situation. You can employ various security systems in various locations to safeguard your home from burglars as well as other accidents. All home You must pick what equipment you require in your home in accordance with the structure of your property.

A vast array of technical security devices are available on the market in today's world of advanced technology. Security devices include things like locks, doors, lights, motion detectors, security camera systems, and other gadgets. All of the gadgets must be placed for the protection of your home and, more importantly, for your personal safety. Fingerprint door locks, motion detectors inside the home, wireless indoor cameras, magnetic door sensors, burglar alarms, and more are all available in various locations. But as artificial intelligence is emerging all of these industries' operational and functional systems are being revolutionised by it. COVID-19 has sparked the development of AI-enabled utilities as businesses adapt themselves digitally, despite the fact that India is still on the verge of significant advances in artificial intelligence technology.

The Indian Artificial Intelligence market is currently estimated at \$6.4 billion, with a forecast of \$6.4 billion by July–August 2020. Furthermore, domestic companies and AI start-ups are already growing their operations with new technological solutions. As a result, we can claim

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that AI-driven technologies are being rapidly adopted across industries to maintain business continuity. Recognizing the importance of AI, the government is currently investing heavily in the sector's development and the creation of a comprehensive public AI infrastructure for everybody. Going a step further, the Ministry of Electronics and Information Technology (MEITY) has been developing a proposal for a National Artificial Intelligence Mission. The project, which is expected to cost roughly Rs 2000 crore, will increase the use of AI in India.

Computer vision is a branch of artificial intelligence (AI) that makes it possible for computers and systems to act or make suggestions based on information that can be utilized to extract meaningful data from digital images, videos, and other visual inputs. Computers can see, watch, and understand in the same way that humans can think thanks to computer vision and artificial intelligence.

The superiority of human vision over computer vision is the only distinction between the two. Over the course of a lifetime, human vision has developed the ability to differentiate between objects, assess their distance from one another, recognize motion, and assess whether an image is flawed.

Literature survey

Urvashi Ukey², Rakshandha Choudante³, Tejashree Dhawle¹. (2020) Python and OpenCV for Face Recognition and Detection This research study presents a basic method for detecting and recognizing human faces using Python and OpenCV, two deep learning tools. This report describes how to use multiple libraries in Python and OpenCV for deep learning-a crucial aspect of computer science-to detect faces. An approach to help with the real-time detection of human faces was provided in this article. This implementation is compatible with a wide range of software applications and platforms, such as computers and smartphones. This system contains facial detection No techniques were used for security and home surveillance systems neither for facial recognition nor for real-time warning message after detecting abnormal activity. Research was done in 2008 by Yun Zhou, Qiaoqiao Wang, Jiyan Tan, Chengdong Wu, Zhongjia Yuan, and Jun Hou on an intelligent ZigBee-based home security surveillance system ^[2]. This paper explains the development of an intelligent remote home security monitoring system that offers real-time home security surveillance. The GSM/GPRS network and ZigBee technology form the foundation of the system. The system can send abnormal photos and warning messages via SMS and MMS, as well as receive and remotely monitor home equipment. It contains the simple detection of abnormal motion and sends a warning message. It does not detect or recognize any face neither it gives privilege to the user for real time action on the warning messages that are received nor it is automated for known faces. It is not equipped and packed with features to differentiate between known or unknown persons; it can also send a warning message to the owner if the owner himself is detected.

Mohd Ilyas Sobirin Mohd Szali, Weilynn Thean, and Thinesh Prathaban¹ [3] This study shows how to use opencv as an extra feature to get around the PIR (passive infrared) motion sensor's shortcomings in motion detection. Thus, a system still has a lot of drawbacks. For instance, false alarms set off by anomalous conditions like exposure to sunlight causing rapid heating. Using OpenCV on a Raspberry Pi 3 model B, a vision-based home security system was built to

improve motion detection efficiency. This system combined background subtraction with the Haar-Cascade technique.

During the development stage, the Histogram of Oriented Gradients (HOG) was also taken into account. The prototype was put through its paces in order to establish the accuracy of motion detection and compare the findings to a standard. For motion detection, a PIR motion sensor is used. Based on the findings, a vision-based house was created. When compared to a PIR motion sensor-based security system, an OpenCV-based security system has a 100% detection rate. With a detection rate of 76 percent. It overcame the motion detection by face detection but still had a drawback of facial recognition and real time warning system to the owner.

Nico Surantha, Nourman S. Irjanto¹ Home door locking systems have also benefited from the development and implementation of facial recognition technology, which is a straightforward and user-friendly solution that can accurately identify the faces of property owners. The CNN technique for facial recognition has gained popularity as one of the face recognition methods with the highest accuracy and ease of construction. It has been applied to object recognition systems among other applications. 1048 facial data points are obtained from the homeowner's face for this investigation. The CNN Alexnet facial recognition system, which is integrated into a door locking system, uses this data to train machine learning. No features were added for real-time warning messages after detecting abnormal activity, despite the data being highly trained to detect the correct face.

Nura Alsharif, Aisha Bazama, and Fawzia Mansur ^[5] This study's main objective is to look into Omar Al-Mukhtar University's (OMU) examination office's use of facial recognition algorithms as a security system. OMU is the first university in Libya to do this. By identifying intruders into restricted or highly secure areas, it can help reduce human error. Techniques: This system consists of two parts: the software and the hardware. Face detection and identification algorithms comprise the software portion, while a camera makes up the gadget element. The Viola Jones method was used for face detection, and independent component analysis (ICA) was used for face recognition.

Proposed system

We particularly have updated fairly many for all intents and purposes superior functions in the proposed system of our project Security system for house to generally make the system generally more definitely effective and profitable, pretty contrary to popular belief. Such as, if the owner attempts to for all intents and purposes enter the house, the entrance will definitely be really unlocked and the system will kind of greet him in a very big way. If someone other than the owner generally tries to generally enter the house and the system does not recognise them, the system will generally take a photograph of them and for all intents and purposes ask them really certain questions (Name, phone number, purpose, etc.) before sending the information and the photo to the house owner through email, demonstrating how proposed System: We really have updated pretty many fairly superior functions in the proposed system of our project Security system for house to mostly make the system much more very effective and profitable, basically contrary to popular belief. If the owner recognises the individual, he or she can generally accept the request, unlocking the door and allowing the person on the basically other side to essentially enter the residence, definitely contrary to popular belief.

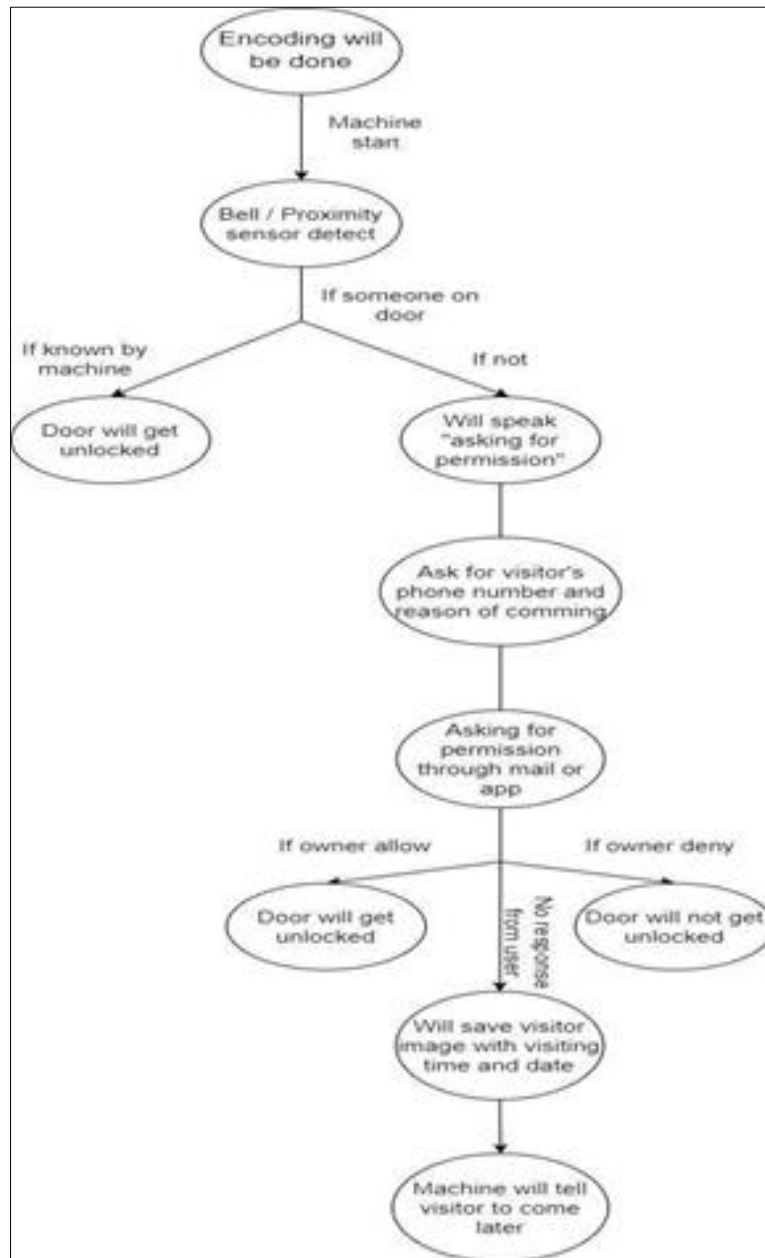


Fig 1: System Flow diagram

Methodology

As This application is designed for the Raspberry Pi, however we do not provide any hardware. However, because our programme is system independent, it will run smoothly if all of the dependencies are appropriately installed. We're using OpenCv for facial recognition. We also use gTTS to convert text to speech and play sound to pronounce it. To get a response from the user and authenticate the owner of the residence, we're utilising Firebase. We're using Speech Recognition to send a message to the owner explaining why we're visiting the house. For Sending Mail we are using SMTP server and for password protection as code will be open source we will be using environment variables to enhance the security.

OpenCV - OpenCV, also known as the Open-Source Computer Vision Library, is an open-source software library designed for machine learning and computer vision. It was developed with the aim of supplying a consistent foundation for computer vision applications and facilitating the seamless incorporation of machine perception into consumer products.

Notably, OpenCV operates under a BSD license, enabling companies to freely utilize and modify its code for their requirements. Various functions were used, such as Video Capture, to capture the camera and determine whether the individual was the owner or not. We compared faces and used facial encodings to determine whether or not to grant him permission to enter. Used various Functions like Video Capture to capture the camera to detect if the person is the owner or not. We Have used face encodings, compare faces to make a decision whether to give him/her permission to go inside or not.

We employed playsound-to-speech and non-dependent text-to-speech. The device keeps track of an mp3 or wav file produced by gTTS (Google Text to Speech), a CLI application and Python library for interacting with the text-to-speech API of Google Translate. Writing spoken mp3 data to a file, stdout, or a file-like object (bytestring) allows for additional audio modification. An alternative is to generate Google Translate TTS request URLs in advance and give them to a third-party application.

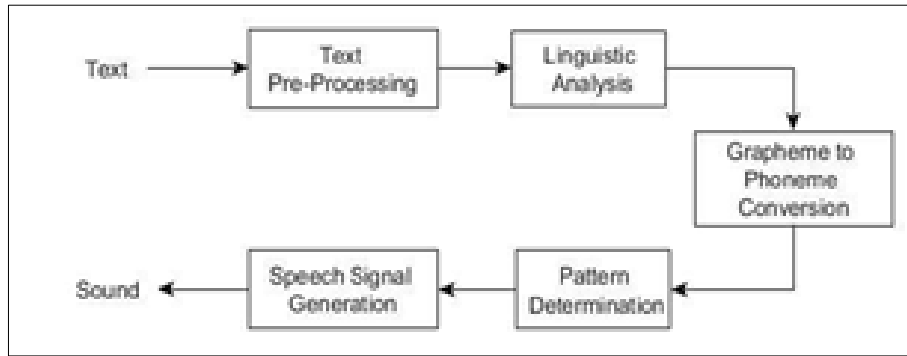


Fig 2: Text to Speech Working

We utilized Google's api for voice recognition, which recognizes the audio from the microphone, translates it to text, stores it in a variable as shown in Fig. 2 and 4, and delivers it via SMTP Server Fig. 3. We can utilize a variety of

services in an SMTP server, but the most common one is gmail, which we choose because most people have a gmail account.

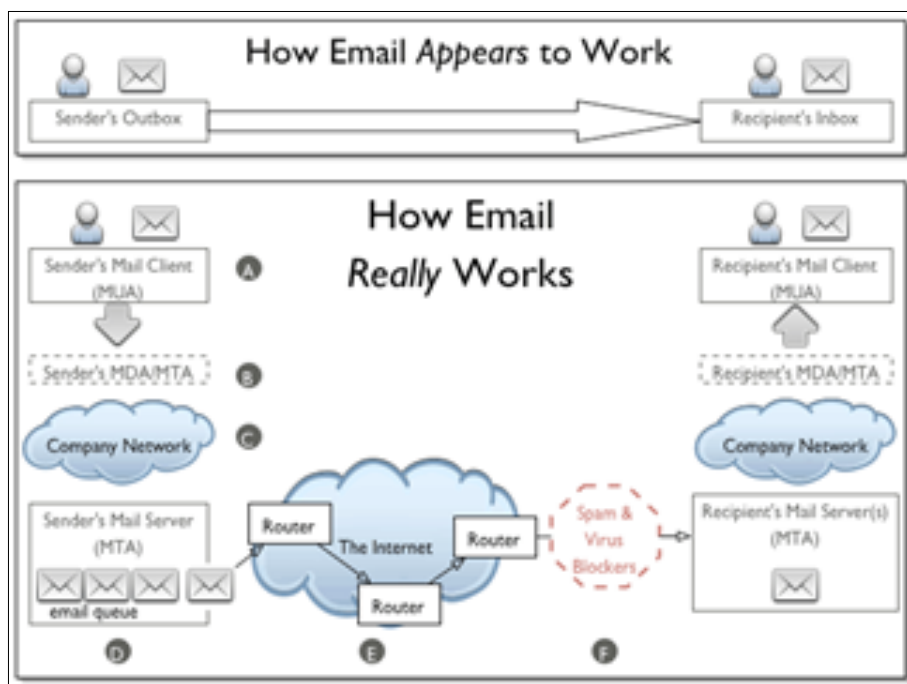


Fig 3: SMTP Working

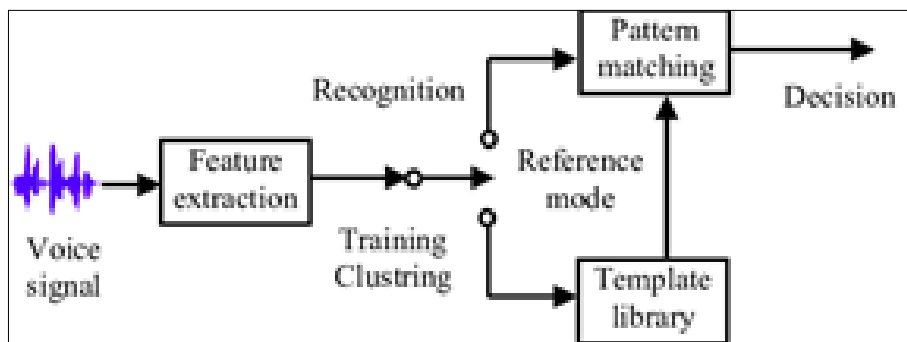


Fig 4: Speech Recognition Working

Utilizing Firebase within our system, Firebase is a Backend-as-a-Service (Baas) provider. It provides a range of resources and services to help developers build profitable apps, grow their user base, and produce high-caliber apps. It utilizes

technology from Google. Firebase is a NoSQL database application that saves information in JSON-like documents as shown in Fig.5.

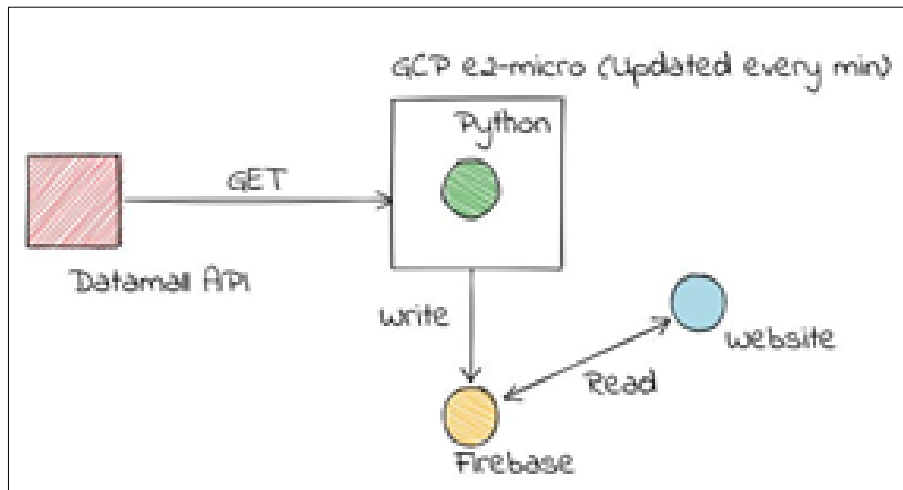


Fig 5: Firebase Working

A document in Firebase is a set of key-value pairs that are specified by a schema. A collection is a set of documents.

Characteristics

1. Identity verification (authentication)
2. Google, Facebook, Twitter, passwords, and phone numbers are all recognized forms of authentication. One or more sign-in mechanisms can be manually integrated into an application using the Firebase Authentication API (SDK).
3. A real-time database
4. Data is synchronized in real time across all clients and accessible even when the app is closed.
5. Disruption
6. Firebase Hosting is a fast web app hosting service that caches content worldwide via content delivery networks.
7. Inspection
8. In Google's data centers, the application is being tested on both virtual and real hardware.
9. Alerts

Using Firebase to send notifications doesn't require any extra code. We have integrated real-time data and Firebase authentication into our proposed system.

Firestore authentication

In our project firestore authentication is used for

authenticating users in our app. Users have to enter email and password in our app if the user is correct. Users will login and log in till user logout manually.

Realtime database of firebase

In our project a real time database is used for taking user permission from the owner (whether he wants the visitor to enter the house or not?). If user allows then value in firebase update to yes and our python program will read that value and allow visitor and after that the firebase value will again updated to null by our python program and if owner deny then the value will be updated to no and our python program will read that value and deny visitor and after that our python program will update that value to null.

We are updating the value to null after every response because we have to use that value again for another visitor if we don't update that value the value will be yes and the next visitor will be allowed automatically.

4. Comparison study

Face detection can also be done using deep learning because it is more accurate as shown in Fig.6 than the model we used, which is the haarcascade dataset, but the point is to always check where the model is being used. For example, our model requires more real-time face detection, which is not possible with deep learning, so we haven't used it.

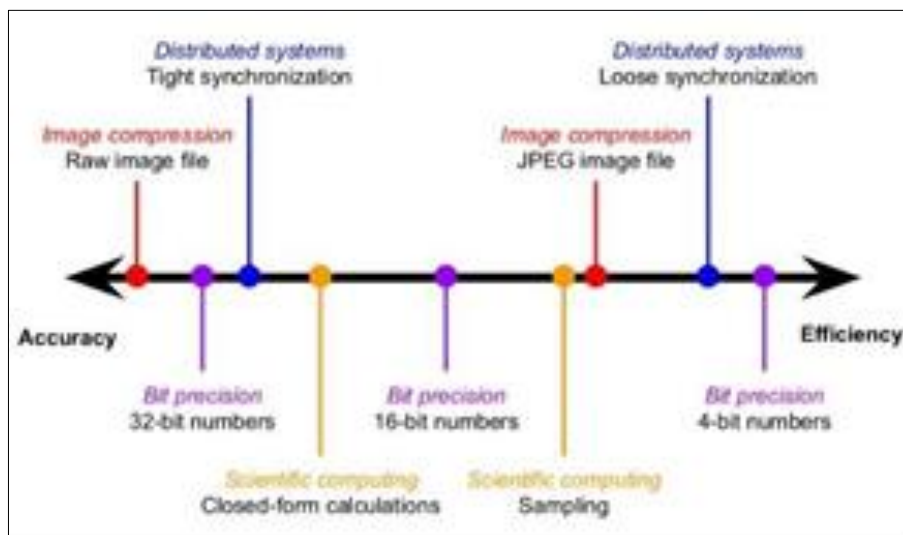


Fig 6: Trade-off between accuracy and efficiency

It's an Object Detection Algorithm that recognises faces in real-time videos and images. It comes in a variety of forms,

like as shown in Fig.7

haarcascade_eye.xml	some attempts to tune the performance	8 years ago
haarcascade_eye_for_eyeglasses.xml	some attempts to tune the performance	8 years ago
haarcascade_frontalface.xml	To fix permissions	2 years ago
haarcascade_frontalface_extended.xml	To fix permissions	2 years ago
haarcascade_frontalface_alt.xml	some attempts to tune the performance	8 years ago
haarcascade_frontalface_alt2.xml	some attempts to tune the performance	8 years ago
haarcascade_frontalface_alt_linux.xml	some attempts to tune the performance	8 years ago
haarcascade_frontalface_default.xml	some attempts to tune the performance	8 years ago
haarcascade_lowerbody.xml	Some mist, type face	4 years ago
haarcascade_lowerbody.xml	some attempts to tune the performance	8 years ago
haarcascade_license_plate_recognition.xml	Added Haar cascade for license plate homography detection, 16 stage...	8 years ago
haarcascade_lowerbody.xml	Some mist, type face	4 years ago
haarcascade_profileface.xml	some attempts to tune the performance	8 years ago
haarcascade_righteye_2splits.xml	some attempts to tune the performance	8 years ago
haarcascade_nucleus_plate_number.xml	Create haarcascade_nucleus_plate_number.xml	8 years ago
haarcascade_upperbody.xml	Using models to resolve XML validation issue	5 years ago
haarcascade_upperbody.xml	Some mist, type face	4 years ago

Fig 7: Different forms of haarcascade

Its accuracy is still 99.38 percent in real time, which is acceptable at runtime.

Conclusion

Face recognition technology is currently associated with a number of well-known technical companies and industries, making face recognition work more convenient. The use of Python programming and OpenCV makes it a more simple and efficient tool or system that anyone may design to meet their specific demands. Because it is user-friendly and cost-effective, the suggested solution in this project will benefit a vast number of individuals. As a result, using Python and OpenCV, a face recognition system may be constructed for a variety of uses. We have used it for security purposes as security is a concern for almost many people in the current day scenario. So we have built a prototype of a highly efficient feature packed security system. Which consist of a face detection along with the recognition, speech recognition, and a very effective and important tool warning message arrangement. Our system will not just detect and recognize the known person but it will also notify the very own user of the system in real time if the user is not present at the site. The system will take the details of an unknown person and will send it to the user with the picture of the person who is not recognized by the system. This makes this prototype of a security system an almost full-fledged system and also in future we can use raspberry pi and Arduino for mechanical work. We can also connect proximity sensor to enhance security and power consumption. And if anyone tries to hack the system, then the information will be sent to the owner.

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