FINAL REVIEW - J COMPONENT

COURSE CODE : SWE 2015
COURSE TITLE : BIOMETRIC SYSTEMS

TITLE – FINGERPRINT RECOGNITION BASED DOOR UNLOCK-ING SYSTEM USING ARDUINO NANO

UNDER FACULTY – PROF.RAMYA.G

TEAM MEMBERS:

NAME	REGISTER NUMBER
DIVAKAR.R	16MIS0069
BARATH.D	16MIS0173
HARIHARAN.P	16MIS0055
ROSHINI.A	16MIS0094
MEGHANA.D	16MIS0005

ABSTRACT:
Biometrics is the measurement and statistical analysis of people's unique physical and behavioural characteristics. The technology is mainly used for **identification and access control,** or for identifying individuals who are under surveillance. The basic premise of biometric authentication is that every person can be **accurately identified** by his or her intrinsic physical or behavioural traits. The term biometrics is derived from the Greek words bio meaning life and metric meaning to measure. A **fingerprint** is an impression left by the friction ridges of a **human finger**. Human fingerprints are detailed, nearly unique, difficult to alter, and durable over the life of an individual, making them suitable as long-term markers of human identity. They may be employed by police or other authorities to identify individuals who wish to conceal their **identity**, or to identify people who are incapacitated or deceased and thus unable to identify themselves, as in the aftermath of a natural disaster.

INTRODUCTION:
Fingerprint recognition refers to the automated method of identifying or con-firming the identity of an individual based on the comparison of two fingerprints. Fingerprint recognition is one of the most well known biometrics, and it is by far the most used biometric solution for authentication on computerized systems. The reasons for fingerprint recognition being so popular are the ease of acquisition, established use and acceptance when compared to other biometrics, and the fact that there are numerous (ten) sources of this biometric on each individual. We are using this biometric system namely fingerprint recognition system for unlocking the door with the help of Arduino. We are going

to make a miniaturized setup of door unlocking system using Arduino and also demonstrate the working model in the upcoming reviews. and also demon-strate the working model in the upcoming reviews. Along with the hardware we are also using demonstrating our project using MATLAB.

APPLICATION OF FINGERPRINT RECOGNITION:

recognition refers to the automated method of identifying or confirming the identity of an individual based on the comparisson of two fingerprints. Fingerprint recognition is one of the most well known biometrics, and it is by far the most used biometric solution for authentication on computerized systems. The reasons for fingerprint recognition being so popular are the ease of acquisition, established use and acceptance when compared to other biometrics, and the fact that there are numerous (ten) sources of this biometric on each individual. Because it is one of the cheapest biometric solutions, fingerprint recognition already knows many different applications. We only list a few examples here: 1)Logical access control, for example there exist numerous fingerprint reader devices and softwares for access control to personal computers 2)Physical access control, for example locks with a fingerprint reader 3)Fingerprint attendance systems for time and attendance management 4)Biometric alternative to loyalty card systems

HOW FINGERPRINT WORKS:

A fingerprint usually appears as a series of dark lines that represent the high, peaking portion of the friction ridge skin, while the valley between these ridges appears as white space and are the low, shallow portion of the friction ridge skin. Fingerprint identification is based primarily on the minutiae, or the location and direction of the ridge endings and bifurcations (splits) along a ridge path.

A variety of sensor types — optical, capacitive, ultrasound, and thermal — are used for collecting the digital image of a fingerprint surface. Optical sensors take an image of the fingerprint, and are the most common sensor today.

The two main categories of fingerprint matching techniques are minutiae-based matching and pattern matching. Pattern matching simply compares two images to see how similar they are. Pattern matching is usually used in fingerprint systems to detect duplicates. The most widely used recognition technique, minutiae-based matching, relies on the minutiae points, specifically the location and direction of each point

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LITERATURE SURVEY:

1.Smart door lock system

Author: Nayana R and Shashidhar R **Year:** 2019

Inference: In this paper, author Nayana R and Shashidhar R explained about how we can protect the door using the latest technologies. Here they used fingerprint sensor, GSM module and arduino microcontroller to unlock the door.. After typing the OTP in the keypad then the fingerprint verification takes place.

If its match, then the door will be open. The main aim of this research is to provide high security with low cost, because security plays major role in our society in almost every sector

2. Secured door lock system based on fingerprint authentication

Author: B. Tadikonda, A.V. Prabu, S. Rajasoundaran, K. Raghava Rao and P.S.G. Aruna Sri

Year: 2019

Inference: In this paper, they explained about the how the security plays a important role in the door lock system. In this way, security has been a noteworthy issue in numerous applicationss. To provide security to the system we use two technologies i.e. Biometrics and embedded systems. Fingerprint sensor sensed only authorized person's biometrics.

3. Property Security Using a Biometric Based Door Lock System

Author: Onyan AO, and Enalume KO **Year: 2019**

Inference: In this paper they discussed about the security system in door lock. They used fingerprint recognition to unlock the door to make more secured. The procedure is first they initialize the program and place the finger in the sensor to check whether it is matching else it displayed as access denied and he cannot open the door and the buzzer will played, if it is correct and finger is matched it will open the door. After 5-10sec it will automatically closed.

4. Fingerprint Verification System using Minutiae Extraction Technique

Author: S Manvjeet Kaur, Mukhwinder Singh, Akshay Girdhar, and Parvinder. Sandhu

Year: 2019

Inference: In this paper, the authors discussed about the fingerprint recognition using minutiae extraction methods. There are going to find the prints using the False accept rate and false reject rate. Technologies they used was minutiae extraction technique, pattern matching or ridge techniques, correlation technique and image based technique. They explained about 4 methods and conclude that image based is newly arrived and they explained about how to implement the minutiae extraction method. It has three parts pre-processing, minutiae extraction and post-processing. In the future, we can improve the quality of the image by improving the hardware to capture the image or by improving the image enhancement techniques.

5. Implementation of Enhanced Finger Print based Door Locking System

Author: Alfakhri M.Murshed*1, K. Lokesh Krishna2, Hussam Alqubati3, Noordin Ali4

Year: 2019

Inference: In this paper, author discussed about the fingerprint verification in the door lock. They used fingerprint sensor and Arduino microcontroller and some other components to implement the fingerprints in the door lock. The procedure for the implementation is first the welcome message will be displayed and then scan the finger. If the finger matches, the 2 options will be displayed else buzzer will be played. After the finger matches, the 2 options are open the door and modify the user.

6.**Clustering Method of Fingerprint Flow Map and Coherence:**

Author: H I Wahhab
Year: 2019
Inference: We've inferred that the method proposed in this paper is based on the variable size of the cluster and the correspondent analysis of measurement data. Such an approach allows for automatic determination of optimal local direction of ridges, selection of minimal and maximal values of coherence and the quality for each local neighbourhood specified by the cluster.

7.A Feature Matching Method Towards Contactless and Low-Cost 3D Fingerprint Reconstruction:

Author: Yonghe Tang, Liehui Jiang, Hongqi He, Weiyu Don **Year:** 2019
Inference: We've Inferred that This paper presented a feature matching method towards contactless and low-cost 3D fingerprint reconstruction. The approach is consisted of pre-processing, feature extraction, feature matching and post-processing. Fingerprint images are segmented from background and enhanced in preprocessing step, while in the feature extraction step, minutiae and ridges are extracted followed by binarization and thinning. Feature matching is done with minutiae matched first on the basis of the proposed feature descriptor, and ridges are matched guided by the

8.Research and Application Based on Improved Call Fingerprint Identification Algorithm:

Author: Yunxiang Liu, Bin Chen, Wei Shi
Year: 2019
Inference: We've Inferred that In order to effectively determine whether a user is a re-entry user, this paper is based on an improved call fingerprinting algorithm. Research and analysis were carried out by mining relevant characteristics of new and old user's contact circles (which includes call characteristics and SMS features). On the basis of weighing algorithm TF-IDF in the call fingerprint algorithm, Along with it, on the basis of the speech and audio times, the parameter of the ength of the call was increased to further reflect the weight of the user's communication circle number.

9.Unrolling Post-Mortem 3D Fingerprints using Mosaicking Pressure Simulation Technique

Author: Karen Panetta, Srijith Rajeev, K M Shreyas Kamath, SOS S Agaian
Year: 2019
Inference: We've Inferred that Post-mortem fingerprints are a valuable biometric used to aid in the identification of a deceased individual. However, fingerprints from the deceased undergo decomposition leading to indefinite structure when compared to ante-mortem fingerprints. Computer simulations demonstrated that MPS could be a useful tool to unroll post-mortem fingerprints for identification purposes. Similarly, MPS can be used to achieve reliable ante-mortem/ post-mortem recognition. MPS can be used as an in as an intermediary step to find correspondences between 2D and 3D fingerprint until a time comes when 3D to 3D matching is entirely feasible.

10. Successive minutiae-free mosaicking for small-sized fingerprint recognition:

Author: Jiong Chen, Heng Zhao, Zhicheng Cao, Weiqiang Zhao, Liaojun Pang

Year: 2019

Inference: We've Inferred that Small-sized fingerprint sensors, due to the convenience of integration, are widely used in many applications, especially on smart phones. However, the friction ridge information decreases with the reduction of the collected fingerprint area, resulting in degraded recognition performance. Mosaicking fingerprint impressions has been proved to be effective in boosting the recognition accuracy. Nonetheless, the minutiae-based mosaicking methods do not work well when there is no sufficient number of minutiae in the overlapping area while existing minutia-free mosaicking methods are not robust to distortion and result in low mosaicking accuracy.

11. Estimation of fingerprint image quality based on neighbourhood Strengthness Homogeneity:

Author: Raimundo Claudio da Silva Vasconcelos, Helio Pedrini

Year: 2019

Inference: We've Inferred that this paper proposed a new fingerprint image quality indicator based on directional information inherent to fingerprint ridges denoted as neighbourhood strengthness homogeneity(NSH) and evaluated. On comparison of FVC datasets and NFIQ index, the applicability of the proposed index has been demonstrated. This quality index can be used to assess the significance of many other methods related to directional information.

12. Express delivery system based on fingerprint recognition system:

Author: Hu Huang, Ya Zhong, Shiying Yin, Junlin Xiang, Lijun He, Peng Huang

Year: 2019

Inference: We have inferred that an express delivery system based on fingerprint recognition is designed that is like a software which is small in size and can realize functions such as fingerprint collection and storage, verification and display. Also the experimental results show that system can be used for express delivery, solving the problems of unknown identity of the signers.

13. Fingerprint recognition system using MATLAB:

Author: Arun Pratap Srivastava, Shashank Awasthi, Awanish Kumar Kaushik, Shubham Shukla

Year: 2019

Inference: We have inferred that this paper gives us the harsh thought what is required and improved the situation the unique fingerprints check. It comprises of numerous phases in which pre-handling is done first by upgrade, linearization and division which is trailed by the minutia extraction, post handling and minutia coordinating stages. This work manages the coordinating and ID forms dependent on the possibility of the unique finger impression confirmation

14. Fingerprint Recognition under Missing Image Pixels Scenario:
Author: Dejan Brajovic, Kristina Tomovic, Jovan Radonjic **Year: 2019**
Inference: We have inferred that this paper observed the problem of fingerprint image recognition in the case of missing pixels from the original image. The possibility of missing pixels recovery is tested by applying the Compressive Sensing approach. Namely, different percentage of missing pixels is observed and the image reconstruction is done by applying commonly used approach for sparse image reconstruction.

15. Arduino Based Smart Fingerprint Authentication System
Author: Meenakshi N, Monish M, Dikshit K J , Bharath S
Year: 2019
Inference: We have inferred that in this paper uses internet of things concept with the help of Arduino door unlocking process is being authenticated This task displays a keyless framework for locking and opening purposes utilizing a predefined PICTURE secret key and OTP. This hardware project achieves 3 levels of security with commonly available component and also consumes less power and overcomes the drawbacks present in the existing system.

16. End to End Fingerprint Verification Based on Convolutional Neural Network
Author: Behnam Bakhshi & Hadi Veisi
Year:2019
Inference: In this paper we have proposed a system model called CNN-BASED FINGERPRINT VERIFICATION . This proposed model helps us to categorize every two fingerprints as truly authenticated fingerprint or impostor pair that is taken from the user.The Index terms used in this paper are fingerprint matching and convolutional neural net- works (CNN). .The architecture of this method is not capable of recognizing all the patterns although it is better than any of the other methods that has been proposed.

17. Fingerprint Based Door Access System
Author: Shaikh Mohd Adil, Ansari Umair, Usama Shaikh, Tushar Kamble, Vijaya Sagvekar
Year: 2018
Inference: We've inferred that Security has been playing a major role in today's smart environment. The rise in technology rapidly should also leads in improving the security to the technology. Fingerprint method is proposed to keep the datas and files more confidential for the users to use so that the unauthorized person cannot be able to access it. This paper follows three modes of security such as for securing the transactions of the user ,providing the security for the locker system and and for passport verification. The system has successfully overcome some of the aspects existing with the present technologies

18. RFID and Finger Print Based Dual Security System:
A Robust Secured Control to Access Through Door Lock Operation

Author: Md Mostafizur Rahman Komol1, Amit Kumer Podder2, Md Nesar Ali3,
Shariar Mohammed Ansary1
Year: 2019
Inference: This paper focuses on research works of control engineering field and aims at impenetrable security system especially in case of medication, jewelry, documents & others valuable items and mandatorily in the higher intelligence agency. Here, a developed security system with automatic sensing is introduced by the use of both Radio frequency identification (RFID) card tagging system and fingerprint sensing biometric security system to maintain the valid access of a person to a secured place. A prototype of the security system is also designed and the performance of it is tested. The satisfactory results of its performance show the validity of the system and indicate a better solution for the future security system.

19. Medicine Tablet Authentication Using "Fingerprints" of Ink-Jet Printed Characters:
Author: Rui Ishiyama, Yuta Kudo, Toru Takahashi, Martin Kooper, Kengo Makino, David Abbink,D.A
Year: 2019
Inference: We have inferred that This paper proposed a new system for authenticating medicine tablets as-is by matching "fingerprints" images of ink-jet printed characters. The printed characters on individual tablets of the same medicine seem identical to human eyes, but each has tiny unique differences. These act as "fingerprints" that can be detected by pictures with regular smartphones

20. Application of Time-Fractional Order Bloch Equation in Magnetic Resonance Fingerprinting
Author: Haifeng Wang1, Lixian Zou1,2, Huihui Ye3, Shi Su1, Yuchou Chang4, Xin Liu1, Dong Liang1 .
Year: 2019
Inference: We have inferred that Magnetic resonance fingerprinting (MRF) is one novel fast quantitative imaging framework for simultaneous quantification of multiple parameters with pseudo randomized acquisition patterns. The representative results of phantom experiments demonstrated the good accuracy performance when applying the time-fractional order Bloch equations to generate dictionary entries in the MRF framework.

21. End to End Fingerprint Verification Based on Convolutional Neural Network
Year:2019
Author:Behnam Bakhshi & Hadi Veisi
Inference: We have inferred that they have proposed a system model called CNN-BASED FINGERPRINT VERIFICATION . This proposed model helps

us to categorize every two fingerprints as truly authenticated fingerprint or impostor pair that is taken from the user.. There are two CNN modules proposed in this system to extract the features of two fingerprints os the user.One is ConvNet layer and AlexNet . Additionally, we proposed a start to finish CNN approach that contains the component extraction part of the trained dataset.

22. Fingerprint Based Door Access System
year: 2018
Author: Shaikh Mohd Adil, Ansari Umair, Usama Shaikh, Tushar Kamble, Vijaya Sagvekar
Inference : Security has been playing a major role in today's smart environment.The rise in technology rapidly should also leads in improving the security to the technology. Fingerprint method is proposed to keep the datas and files more confidential for the users to use so that the unauthorized person cannot be able to access it. This paper follows three modes of security such as for securing the transactions of the user ,providing the security for the locker system and and for pastport verification. The system has successfully overcome some of the aspects existing with the present technologies

23. Security and Accuracy of Fingerprint-Based Biometrics: A Review
Year : 2019
Author: Wencheng Yang, Song Wang , Jiankun Hu, Guanglou Zheng and Craig Valli
Inference : In this paper it tells about the challenges faced in the biometric system related to accuracy recognition and security .Deep learning have enhanced the performance of biometric systems but it is a potential threats to biometric systems because of deep learning algorithms . Biometric system on different platforms are also valid to any security issues.Trade-off between security and recognition accuracy in fingerprint template protection remains a challenge.The use of multiple biometric is the challenge for the future research.

24. A particle filter based reference fingerprinting map recalibration method
year:2019
Author : CHENGBING CHU, SHIDONG YANG
Inference : In this paper we have proposed a method called a particle filter based Reference Fingerprinting Map (RFM) .It is a fingerprinting method based on wifi-positioning.the RFM recalibration problem is keeping the RFM problem up-to-date.The method used in this paper are categorize into adopting external measurements and adopting the measurements available from a common commercial off-the-shelf (COTS) .The proposed method has a advantage of independent of human interaction or additions hardwares.The actual Received Signal Strength (RSS) values are not counted rather the actual points of the RFM shows off or on.

25. A Novel Convolutional Neural Network Based Indoor Localization Framework with WiFi Fingerprinting

Year : 2019

Author: XUDONG SONG, XIAOCHEN FAN, CHAOCAN XIANG, QIAN-WEN YE1, LEYU LIU ZUMIN WANG, XIANGJIAN HE, NING YANG, GENGFA FANG1

Inferene: In this paper we proposed a method called Convolutional Neural Network .It works by giving connection to wifi for the location .In this paper the fingerprint is based on multi- building and multi-floor localization .we have proposed CNNLoc, a deep-learning framework for multi-building and multi-floor localization with WiFi fingerprinting. We present a novel algorithm to extract a verification set from the training dataset when the volume of the set is small

KEYWORDS:

 Minutiae extraction, image enrolment, image authentication Arduino, MATLAB, Arduino UNO

MODULES COVERED:

IMAGE ENROLLMENT: Capturing of images and storing in the database and importing the image from the database.

IMAGE AUTHENTICATION: Verification of the imported image from the database and further process-ing of the image to which the minutiae extraction images to be collected.

FINGERPRINT SENSOR IN DOOR: A fingerprint scanner is a type of technology that identifies and authen-ticates the fingerprints of an individual in order to grant or deny access to a computer system or a physical facility. It is a type of biometric security tech-nology that utilizes the combination of hardware and software techniques to identify the fingerprint scans of an individual. Fingerprint scanners work by capturing the pattern of ridges and valleys on a finger. The information is then processed by the device's pattern analysis/matching software, which compares it to the list of registered fingerprints on file. A successful match means that an identity has been verified, thereby granting access. The method of capturing fingerprint data depends on the type of scanner being used:

IMAGE ACQUISITION: The first stage of any vision system is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even with the aid of some form of image enhancement

FEATURE EXTRACTOR: The main goal of feature extraction is to obtain the most relevant information from the original data and represent that information in a lower dimensionality space. When the input data to an algorithm is too large to be processed and it is suspected to be redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the

input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input

MINUTIAE EXTRACTION:

Thinning is a morphological operation that is used to remove selected foreground pixels from binary images, somewhat like erosion or opening. It can be used for several applications, but is particularly useful for skeletonization. In this mode it is commonly used to tidy up the output of edge detectors by reducing all lines to single pixel thickness. Thinning is normally only applied to binary images, and produces another binary image as output. Ridge endings and ridge bifurcations are the most commonly used minutia types since all other types of minutiae are based on a combination of these two types.

SERVO MOTOR: A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through servo mechanism. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor.We can get a very high torque servo motor in a small and light weight packages.Due to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.

ARDUINO UNO: Arduino is an open-source prototyping platform based on easy-to-use hard-ware and software. Arduino consists of both a physical programmable circuit-board and a piece of software, or IDE runs on your computer, used to write and upload computer code to the physical board.
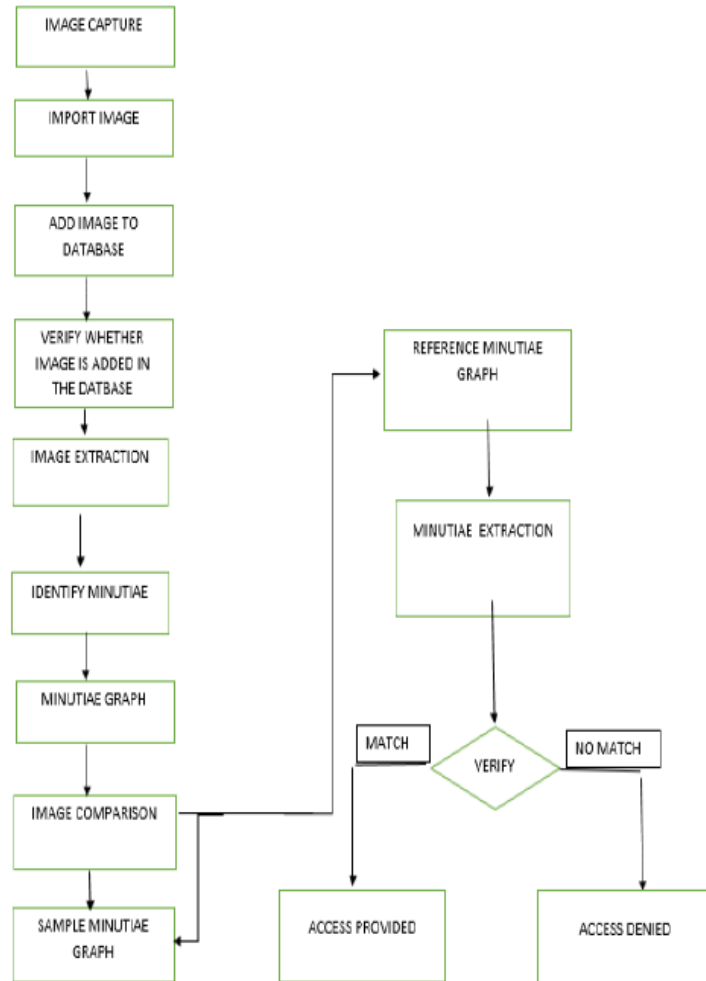
ARDUINO NANO: The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

LCD DISPLAY: The LCD display is used to see whether the entered password is correct or not.It is also used to interface with the project to output lock status.

ACCEPTION/REJECTION STATUS: This process is done after the authentication of the entered user with the fingerprint templates that are already stored. Based on verification results, the acception or rejection status is made available to the user.
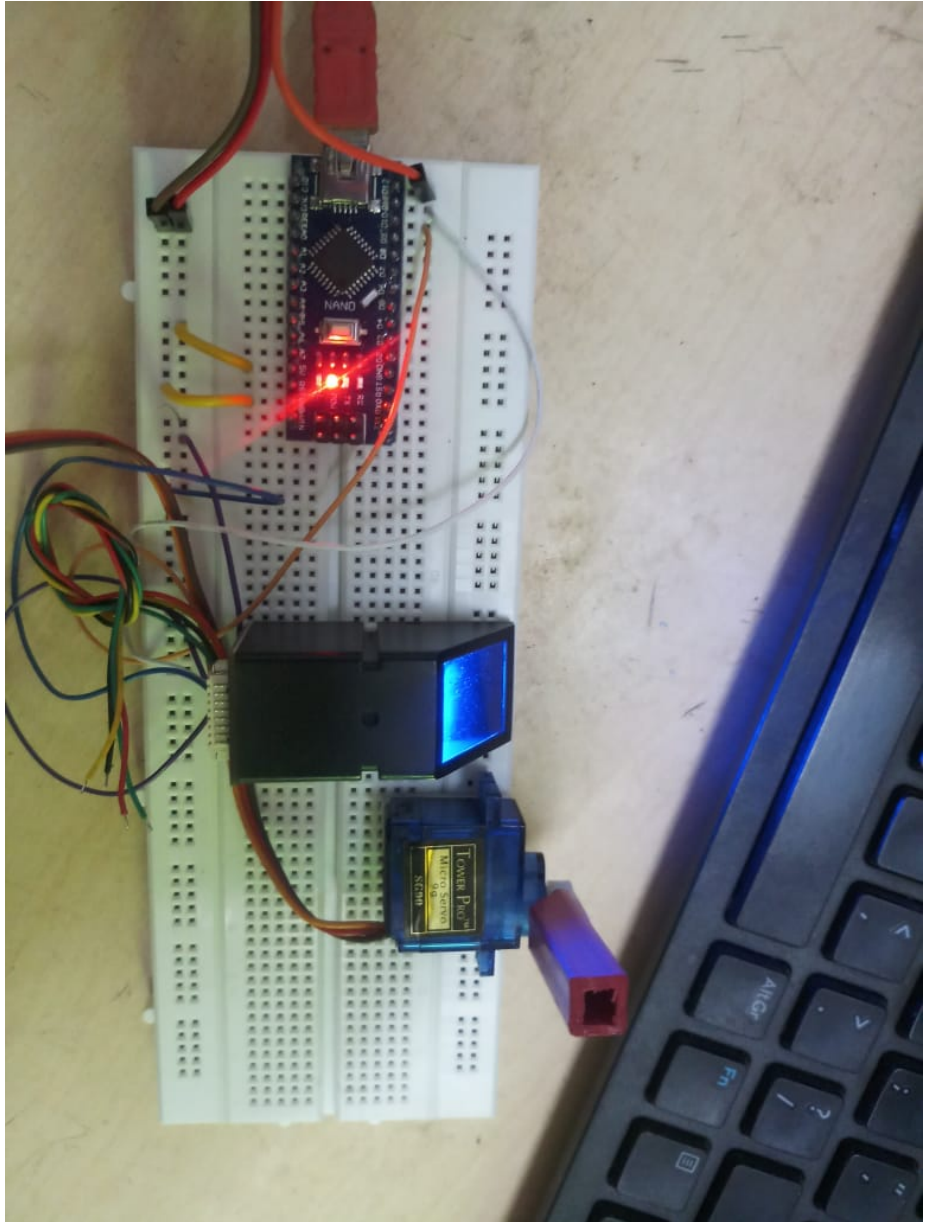
ARCHITECTURE

The below enclosed image represents the architecture of our project finger-print recognition system, Here we included every step by step process of overall project workflow and the demonstration

HARDWARE SETUP

The below enclosed image represents the miniaturized setup of our project fingerprint recognition system, Here we included sample snapshot of every whole other process of overall implementation workflow
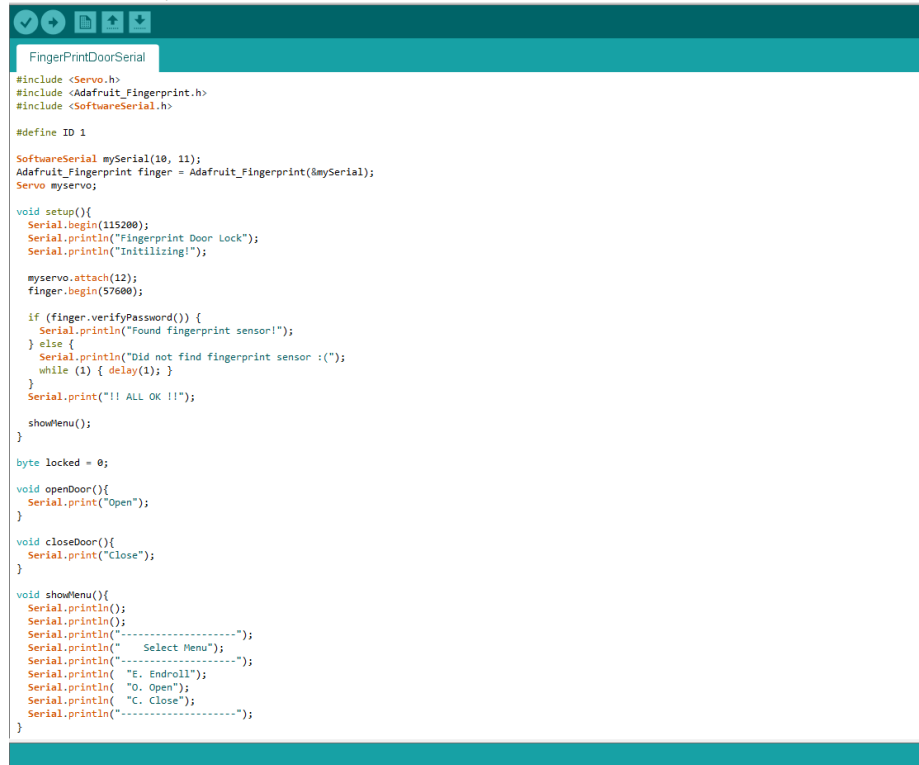

unlock.jpg unlock.jpg

ARDUINO CODE

The below enclosed image represents the programming of our project fingerprint recognition system, Here we included sample snapshot of every whole other process of overall implementation workflow

```
FingerPrintDoorSerial | Arduino 1.8.9 (Windows Store 1.8.21.0)
File Edit Sketch Tools Help

  FingerPrintDoorSerial

#include <Servo.h>
#include <Adafruit_Fingerprint.h>
#include <SoftwareSerial.h>

#define ID 1

SoftwareSerial mySerial(10, 11);
Adafruit_Fingerprint finger = Adafruit_Fingerprint(&mySerial);
Servo myservo;

void setup(){
  Serial.begin(115200);
  Serial.println("Fingerprint Door Lock");
  Serial.println("Initilizing!");

  myservo.attach(12);
  finger.begin(57600);

  if (finger.verifyPassword()) {
    Serial.println("Found fingerprint sensor!");
  } else {
    Serial.println("Did not find fingerprint sensor :(");
    while (1) { delay(1); }
  }
  Serial.print("!! ALL OK !!");

  showMenu();
}

byte locked = 0;

void openDoor(){
  Serial.print("Open");
}

void closeDoor(){
  Serial.print("Close");
}

void showMenu(){
  Serial.println();
  Serial.println();
  Serial.println("--------------------");
  Serial.println("    Select Menu");
  Serial.println("--------------------");
  Serial.println("  "E. Endroll");
  Serial.println("  "O. Open");
  Serial.println("  "C. Close");
  Serial.println("--------------------");
}
```
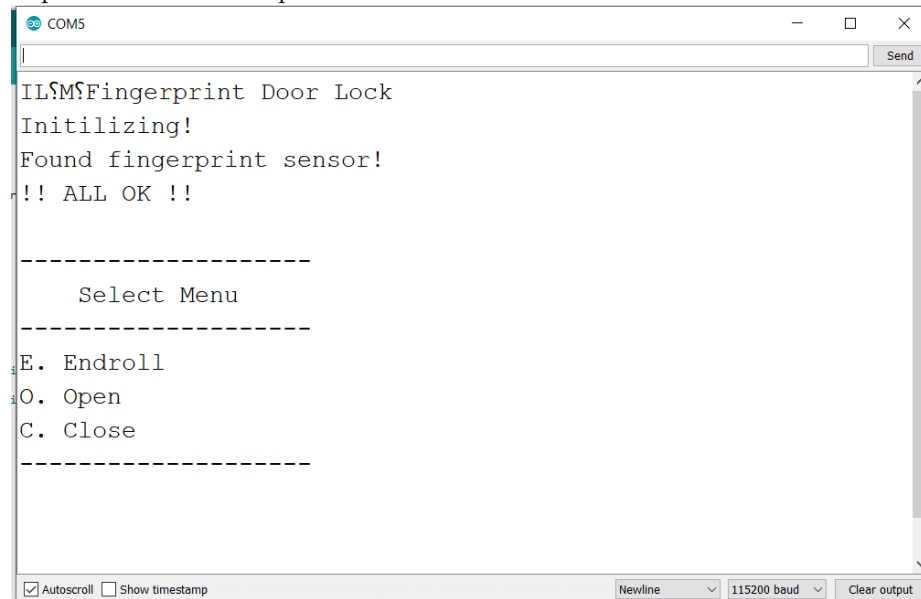
13

ARDUINO CODE

The below enclosed image represents the programming of our project fingerprint recognition system, Here we included sample snapshot of every whole other process of overall implementation workflow

```
COM5                                                    —    □    ×
|                                                              Send

IL?M?Fingerprint Door Lock
Initilizing!
Found fingerprint sensor!
!! ALL OK !!


--------------------
    Select Menu
--------------------
E. Endroll
O. Open
C. Close
--------------------



☑ Autoscroll  ☐ Show timestamp        Newline ∨  115200 baud ∨  Clear output
```
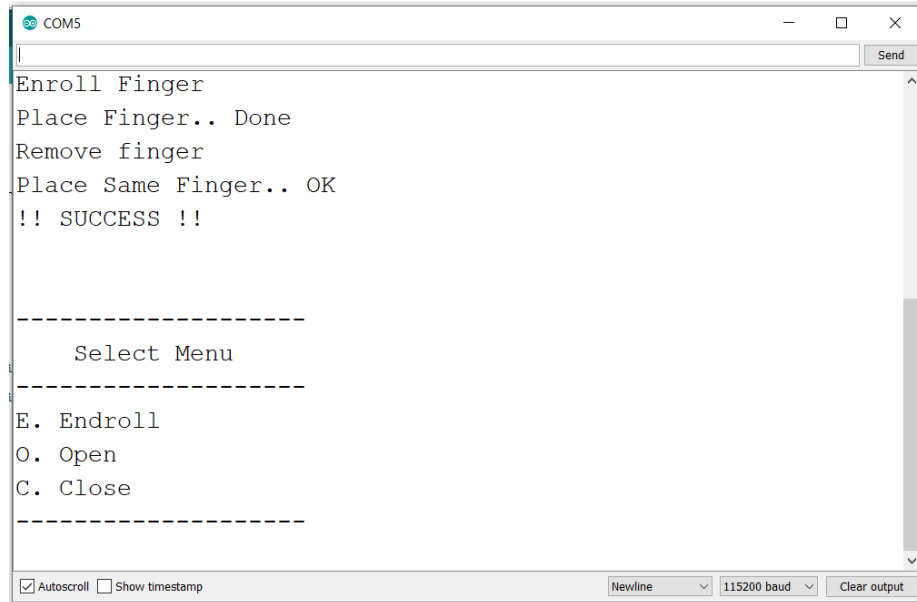
ARDUINO CODE

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