VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JNANA SANGAMA", BELGAUM-590014, KARNATAKA

An Internship Project Report on

"Smart Door Security System"

Submitted in partial fulfilment of the requirement for the VII semester course of

BACHELOR OF ENGINEERING In

COMPUTER SCIENCE AND ENGINEERING

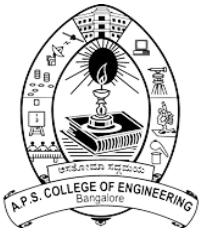
ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted By

Preeti kumari	**1AP21CS036**
Sudarshan C S	**1AP21CS046**
Thanushree	**1AP21EC018**

Under the guidance of

Sai Charan Teja



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ELECTRONICS AND COMMUNICATION ENGINEERING

APS COLLEGE OF ENGINEERING

Anantha Gnana Gangothri

26thk.m, N.H-209, Kanakapura Road, Bangalore–560 082

Project Completion Certificate

I, **Preeti Kumari** (Roll No: 1AP21CS036), **Sudarshan C S (**Roll No: 1AP21CS046), **Thanushree (**Roll No: 1AP21EC018), hereby declare that the material presented in the Project Report titled **"Smart Door Security System"** represents original work carried out by me in the **Department of Computer Science and Electronics & Communication Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12 December, 2024**.

With My signature, I certify that:

- I have not manipulated any of the data or results.
- I have not committed any plagiarism of intellectual property and have clearly indicated and referenced the contributions of others.
- I have explicitly acknowledged all collaborative research and discussions.
- I understand that any false claim will result in severe disciplinary action.
- I understand that the work may be screened for any form of academic misconduct.

Date: **Student Signature**:

In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.Tech. Internship Work.

Advisor's Name: **Guide Name:**

Dr. Shivamurthaiah Sai Charan Teja

Advisor's Signature **Guide Signature**

Evaluation Sheet

Title of the Project: Smart Door Security System

Name of the Students: Preeti Kumari
Sudarshan C S
Thanushree

External Supervisor:

_____

Internal Supervisor:

_____

_____

Date:

Place:

ABSTRACT

This project focuses on designing a smart door security system that integrates face recognition technology with keypad-based authentication for enhanced access control. Using a Raspberry Pi as the core processor, the system combines hardware like a camera for real-time face detection, a stepper motor for automated door operations, and a keypad for backup password entry.

The system uses face recognition to identify and grant access to authorized individuals, while the keypad serves as a fallback in low-light conditions or other scenarios. Unrecognized faces trigger the system to log and save images for security audits, adding another layer of protection.

This dual-authentication mechanism ensures a balance between security and convenience, making it suitable for home and office applications. The project enhances safety by preventing unauthorized access while automating door operations for seamless user experiences

Chapter 1

INTRODUCTION

A high-security system is needed in day-to-day life which can save us from security deft. Today we have so many issues related to this which can be solved by updated technology. We have moved from fingerprint to face recognition to enhance security.
Face Recognition is a very complicated process due to its unstable characteristics. The study of Open CV and its inbuilt libraries helps to generate a code that will authenticate and provide greater efficiency. This will improve the whole security system.

In the era of advanced technology, securing personal spaces and properties is more critical than ever. Traditional door locks and security systems are increasingly being replaced by smart alternatives that offer higher levels of security, convenience, and automation. One such innovative solution is the **Smart Door Security System**, which integrates multiple technologies like **Face Recognition**, **Keypad Authentication**, and a **Stepper Motor** for precise control. Powered by a **Raspberry Pi**, this system provides a highly secure and flexible way to control access to your premises.

This Smart Door Security System provides an affordable, highly secure, and automated solution for home, office, or industrial use, replacing traditional locks with a more efficient and reliable access control system. It represents the future of smart security, combining advanced technology with practical everyday applications.

1.1 Objective

- Develop a face recognition algorithm for accurate identification.
- Integrate Raspberry Pi for hardware control and data processing.
- Implement a secure door locking mechanism, e.g., solenoid Lock.
- Develop Backup lock option (Matrix Keypad) in case of Face recognition

Enhanced Security:

Develop a multi-layered security system by combining face recognition and keypad authentication to provide two-factor authentication. This ensures that only authorized individuals can access the door, reducing the risk of unauthorized entry.

Automation and Convenience:

Automate the process of door locking and unlocking using a stepper motor controlled by a Raspberry Pi. The system should allow authorized users to gain access without needing physical keys, providing greater convenience and reducing the chances of losing or misplacing keys.

User-Friendly Interface:

Provide an intuitive user interface for system operation, including easy enrollment for face recognition and PIN setup, as well as clear visual or auditory feedback when access is granted or denied.

1.2 Problem Statement

Many traditional and biometric security systems face limitations such as susceptibility to hacking, environmental interferences, or system downtimes. This project addresses these challenges by combining facial recognition with a secondary authentication method, enhancing reliability, usability, and security.

Chapter 2

APPLICATIONS

1. **Residential**:

- Enhances home security with face recognition and PIN access.
- Remote monitoring and temporary access for guests.

2. **Commercial**:

- Secures office spaces and sensitive areas.
- Maintains access logs for audit trails.

3. **Industrial**:

- Protects restricted zones and critical assets.
- Shift-based access control for employees.

4. **Institutional**:

- Manages access in schools, hospitals, and administrative areas.

5. **Retail and Hospitality**:

- Secures stockrooms, hotel rooms, and cash registers.

6. **Smart Communities**:

- Integrates with IoT for smart homes and gated communities.

7. **Temporary Use**:

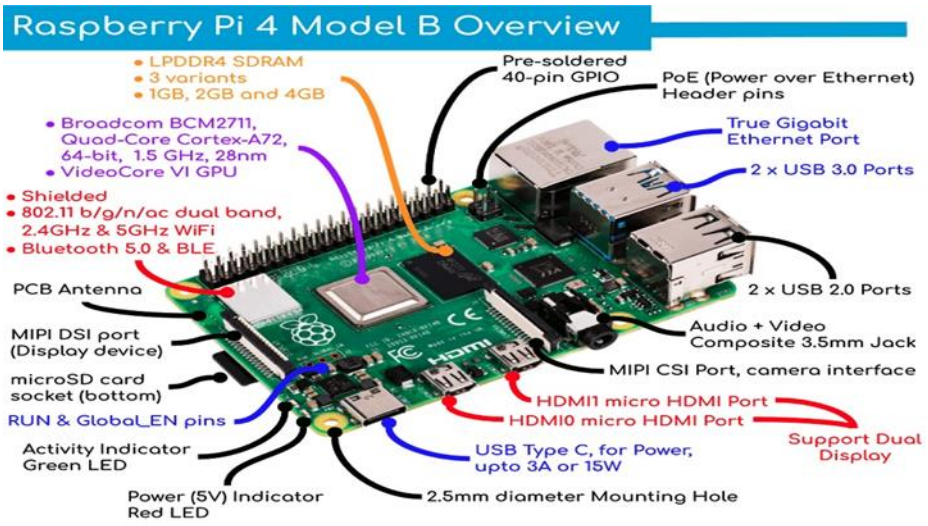
- Event security and access control for pop-up shops.

Chapter 3

COMPONENTS

Hardware Components

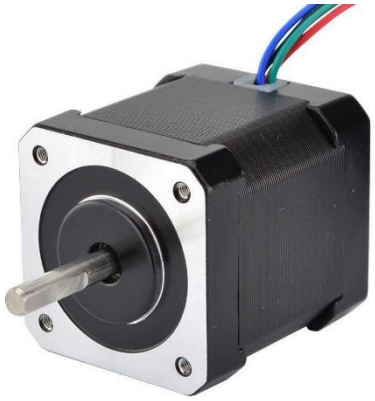
- Raspberry Pi



Raspberry Pi 4 model B is a compact, low-cost, and powerful single-board computer that supports various programming languages and interfaces with sensors and external devices. It is equipped with GPIO (General Purpose Input/Output) pins, Wi-Fi, and Bluetooth capabilities, making it ideal for IoT and automation projects.

- Camera Module
  - For face recognition, captures images of individuals at the door.

- Stepper Motor



A stepper motor is a brushless, synchronous electric motor that converts digital pulses into mechanical shaft rotation. Every revolution of the stepper motor is divided into a discrete number of steps, in many cases 200 steps, and the motor must be sent a separate pulse for each step.

- Keypad

A 4x4 keypad for a Raspberry Pi is a numeric matrix keypad with 16 buttons in a telephone-style grid that can be used for data entry and passwords. To connect a keypad to a Raspberry Pi

- Power Supply

The Raspberry Pi 15W USB-C Power Supply is designed to power Raspberry Pi 4 and Raspberry Pi 400 computers. Featuring a 1.5m captive USB cable, this reliable, high-quality power supply provides an output of 5.1V / 3.0A DC via a USB-C connector, for all the power your Raspberry Pi 4 or 400 will need..

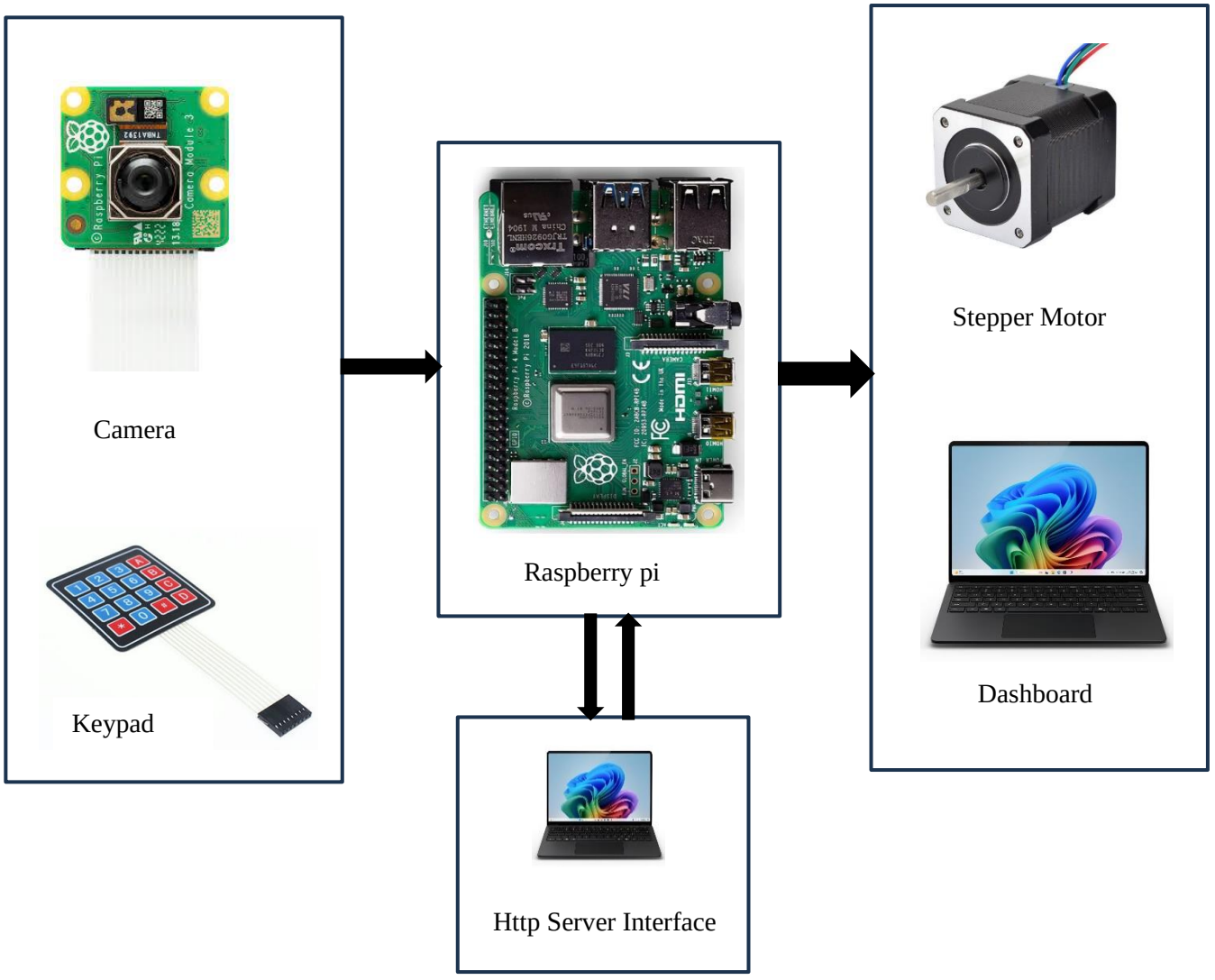
- Laptop
  - Used for face recognition processing and monitoring system status.
- Wires and Connectors
  - Facilitates connections between components.
- Locking Mechanism
  - The physical lock controlled by the stepper motor.

Software Components

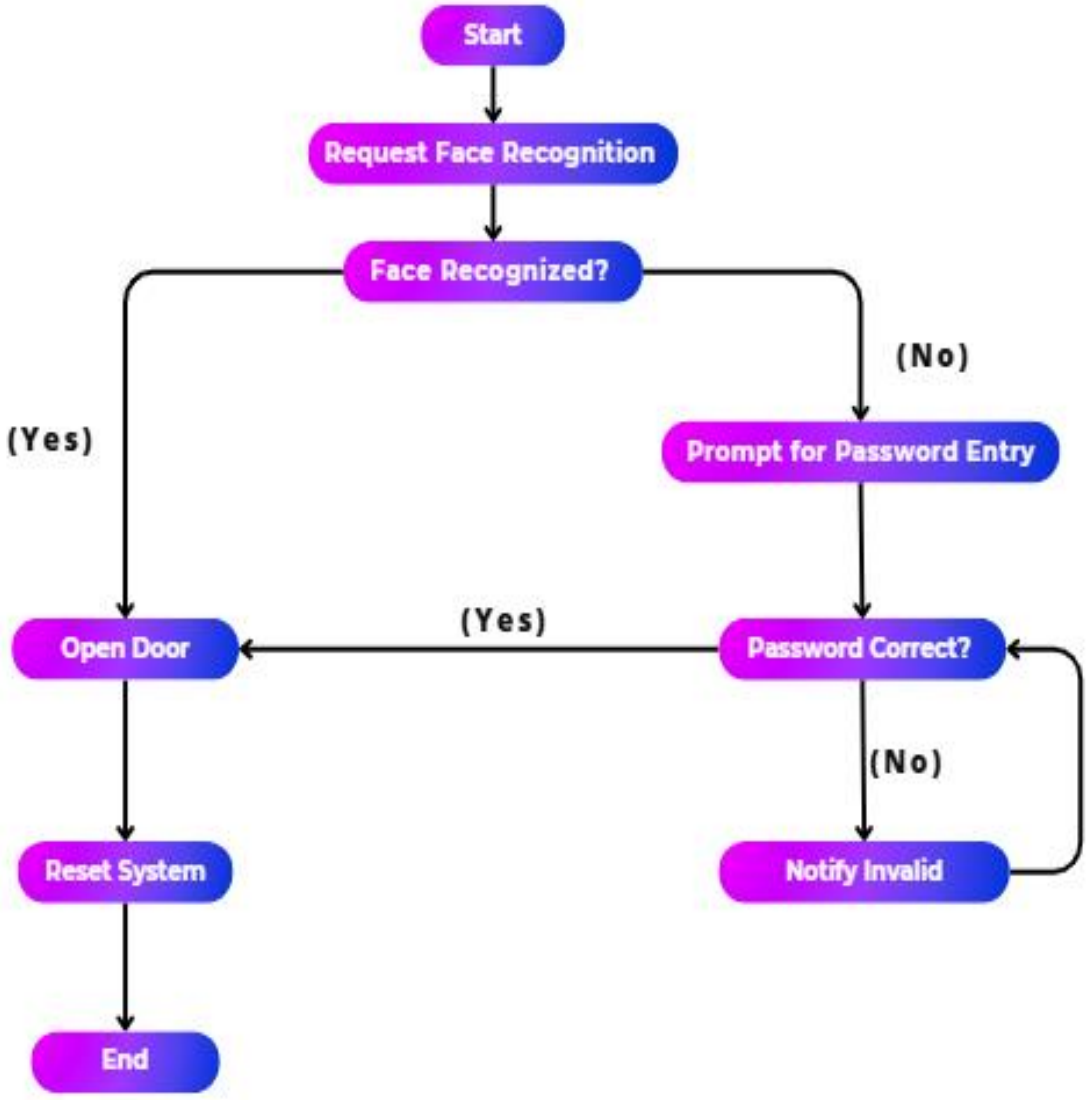
- Operating System
  - Raspberry Pi OS: Runs on the Raspberry Pi and serves as the base for the software setup.
- Programming Language
  - Python: Primary language for interfacing with hardware and implementing face recognition logic.
- Face Recognition Library
  - OpenCV: For capturing and processing images for face detection and recognition.
- Stepper Motor Control Library
  - Rpi.GPIO or gpiozero: Used for controlling the stepper motor.
- Keypad Input Handling
  - Python libraries to interface with the keypad (e.g., matrix-keypad).
- User Interface
  - Custom Python script running on the laptop to display system status, video feed, and logs.
- Networking Tools
  - Libraries for communication between the Raspberry Pi and laptop, such as socket or HTTP server

Chapter 4

FLOWCHART



Flowchart


Start
Request Face Recognition
Face Recognized?
(No)
(Yes)
Prompt for Password Entry
Open Door
(Yes)
Password Correct?
(No)
Reset System
Notify Invalid
End

Chapter 7

CONCLUSION

The Smart Door Security System demonstrates the integration of advanced technologies such as face recognition, keypad-based authentication, and motorized locking mechanisms to create a robust and scalable access control solution. By leveraging a Raspberry Pi as the central controller and utilizing efficient hardware and software components, the system ensures enhanced security, real-time monitoring, and user convenience.

This system is versatile, with applications ranging from residential security to commercial, industrial, and institutional environments. It not only improves security by restricting unauthorized access but also offers a seamless user experience through remote management and live monitoring via a laptop interface. Additionally, the dual authentication methods (face recognition and PIN) enhance reliability and accessibility.

The project showcases the potential of integrating modern technologies to address contemporary security challenges. With further development, this system can be expanded to include IoT integration, cloud-based data storage, and mobile app support, making it a comprehensive solution for smart security needs.

FUTURE WORK

To enhance the capabilities and functionality of the Smart Door Security System, several improvements and additions can be implemented. Below are some suggestions for future work:

1. Integration with IoT Ecosystem

- Connect the system to smart home platforms (e.g., Alexa, Google Home) for centralized control.
- Enable seamless communication with other IoT devices like smart lights, alarms, and surveillance systems.

2. Mobile Application Development

- Develop mobile apps for Android and iOS to allow users to monitor, control, and receive real-time notifications remotely.
- Include features like remote unlocking, visitor history, and system status alerts.

3. Cloud-Based Features

- Implement cloud storage for access logs, facial data, and activity records to ensure data safety and accessibility.
- Enable remote updates for software and facial recognition models.

4. Advanced Security Features

- Introduce multi-factor authentication (e.g., combining face recognition with fingerprint or OTP).
- Add intrusion detection systems using sensors or AI-based activity monitoring.

5. Enhanced Facial Recognition

- Upgrade to advanced facial recognition models with deep learning for faster and more accurate recognition in varying lighting conditions.
- Add spoof detection to prevent unauthorized access using photos or videos.

6. Voice Command Integration

- Incorporate voice commands as an additional method of authentication using natural language processing.

REFERENCES

[1] Smart Door Lock System Using Rasbarry PI Omkar Vedpathak1, Sayali Junghare2, Sapna Satpute3,Amol Mohite4, Reshma Pawar5 IC-CUBEA. 2015.153, 10. 1109

[2] Door Lock Security System Using Raspberry Pi & QR Code Dr. Badugu Suresh1, Arigela Sai Kalyan2, Balibineni Bharat Teja Raju3, Mudraboina Venkatesh

[3] U. Farooq, M. Hasan, M. Amar, A. Hanif, and M. U. Asad, "RFID Based Security and Access Control System," Int. J. Mod. Trends Sci. Technol., vol. 57, no. 4, 2016.

[4] Jae Hoon Lee ; Yong-Shik Kim ; Bong Keun Kim ; Ohba,K. ;Kawata,H. ; Ohya,A. ; Yuta,S. "Security Door System Using Human Tracking Method with Laser Range Finders" , IEEE International Conference on Mechatronics and Automation 2007. ICMA 2007.

[5] X. Wei, A. Manori, N. Devnath, N. Pasi, and V. Kumar, "QR Code Based Smart Attendance System," Int. J. Smart Bus. Technol., vol. 5, no. 1, pp. 1–10, 2018.

[6] K. Rajesh, S. . Waranalatha, K. V. M. Reddy, and M. Supraja, "QR Code-based Real Time Vehicle Tracking in Indoor Parking Structures," in Second International Conference on Intelligent Computing and Control Systems (ICICCS), 2018, pp. 11–16.

APPENDIX

A. System Architecture

The system architecture revolves around a Raspberry Pi that serves as the central control unit for the smart door. It integrates hardware and software components for dual authentication using face recognition and a keypad. The system operates entirely through the terminal interface, displaying authentication results and door status updates.

B. Hardware Overview

- **Raspberry Pi GPIO**: Configures and controls connected devices, including the keypad for password input and a stepper motor for door operation.
- **Camera Module**: Captures images for face recognition to authenticate users.
- **Stepper Motor**: Operates the door mechanism for opening and closing.
- **Keypad**: Provides a secondary authentication mechanism through PIN entry.

C. Software Functionality

1. **Face Recognition**:

The system uses the face recognition library to compare captured face images with pre-stored authorized face encodings.

Successful recognition triggers the door motor to unlock, while failure prompts a PIN-based fallback authentication.

2. **Keypad-Based Access**:

Users can input a predefined PIN to gain access if facial recognition fails or is disabled.

3. **Real-time Terminal Display**:

The terminal provides real-time updates on system status, including successful or failed recognition attempts, PIN validation results, and door operations (open/close).

4. **Data Logging**:

Unauthorized face recognition attempts are logged, and the images of unrecognized faces are stored locally for security purposes.

D. Workflow Details

The workflow begins with face detection via the camera. If the detected face matches an authorized profile, the door opens automatically, and the status is displayed on the terminal. If face recognition fails, the system transitions to keypad authentication, where users can input a PIN. Successful PIN validation triggers door operation, while failure logs the attempt. Throughout, the terminal provides real-time feedback on all actions.

E. Testing and Validation

1. **Hardware Testing**:
   - The stepper motor was calibrated to ensure smooth door operation without jamming.
   - The keypad was tested for accurate input detection under various conditions.
2. **Face Recognition Testing**:
   - Multiple authorized and unauthorized faces were tested under different lighting conditions to validate the accuracy and robustness of the system.
3. **Integrated System Testing**:
   - End-to-end testing verified seamless integration of hardware and software, ensuring correct operation in both face recognition and PIN-based modes.

F. Ethical Considerations

- User data, including facial images, is stored locally to protect privacy.
- Unauthorized access attempts are handled securely, and captured images are stored only for security monitoring without external sharing.

G. Limitations

- Reliance on terminal-based interaction limits user convenience compared to graphical interfaces.
- Face recognition performance may degrade under poor lighting conditions or with partial obstructions like masks.
- The system currently supports single-door operation, making it less scalable for larger setups.

Pseudo Code


Start System
Initialize face recognition and keypad
While system is active:
If face recognized:
• Authenticate user
• Open door
• Close door after delay
Else
Prompt user for password
• Validate password
If password correct:
• Open door
• Close door after delay
Else
• Notify invalid password
End