SECUREKEY: DOOR LOCK SYSTEM

A

MINOR PROJECT-II REPORT

Submitted in partial fulfilment of the requirements for the degree of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS AND COMMUNICATION ENGINEERING

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June 2024

Sagar Institute of Science & Technology, Bhopal
Department of Electronics and Communication Engineering

CERTIFICATE

We here by certify that the work which is being presented in the B.Tech. Minor Project-II Report entitled **"SecureKey: Door Lock System",** in partial fulfillment of the requirements for the award of the degree of ***Bachelor of Technology*** *in* ***Electronics and Communication Engineering*** and submitted to *Sagar Institute of Science & Technology***,** Bhopal (M.P.) is an authentic record of my own work carried out during the period from February-2024 to June-2024 under the supervision of **Prof. Deepti Malviya.** The content presented in this project has not been submitted by me for the award of any other degree elsewhere.

Arpit Shrivastava (0187EC211006)
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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Date:

Supervisor **HOD** **Principal**

ACKNOWLEDGEMENT

We owe an enormous debt of gratitude to my Minor Project-II supervisor, **Prof. Deepti Malviya**, for guiding and inspiring me from the beginning through the end of this thesis with his intellectual advice and insightful suggestions. I truly appreciate and value his consistent feedback on my progress, which was always constructive and encouraging, and ultimately drove me in the right direction. We also owe a lot of thanks to several people who have helped and motivated me throughout my thesis work as well as throughout my undergraduate course at SISTec, Bhopal, in particular, **Dr. Dinesh Kumar Rajoriya (Principal, SISTec, Bhopal), Dr. Ravi Shankar Mishra,** (**Prof. & HOD, SISTec, Bhopal),** all teaching and non-teaching staff of Electronics and Communication Department for their valuable assistance they offered me generously during the past one year. We wish to thank our father&our mother, all my family members and my friends for their unwavering faith and belief in me throughout my life.

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ABSTRACT

This project focuses on developing a password-based door lock system utilizing the Arduino platform to enhance security measures in residential and commercial buildings. The core of the system is an Arduino microcontroller, which is programmed to control the locking mechanism based on password verification. The user interacts with the system via a keypad for password entry, an LCD screen for visual feedback, and a servo motor to physically lock and unlock the door.

The Arduino is preloaded with a predefined password stored in its memory. When a user enters a password using the keypad, the Arduino compares this input with the stored password. If the entered password matches the stored one, the microcontroller sends a signal to the servo motor, prompting it to rotate and unlock the door. In contrast, if the password is incorrect, the system triggers an alert (such as an LED indicator or a buzzer) and remains locked, thereby preventing unauthorized access.

The system's LCD screen provides real-time feedback to the user, displaying messages such as "Enter Password," "Access Granted," or "Access Denied," which enhances the user experience by providing clear and immediate status updates. Additionally, the project incorporates features to handle incorrect password attempts, such as locking out the system after a certain number of failed attempts to thwart potential break-in attempts.

This Arduino-based password door lock system offers a cost-effective and reliable solution for improving security. Its modular design allows for easy customization and integration with other security systems, such as RFID readers or mobile applications, providing flexibility for future enhancements. The project demonstrates the practical application of microcontroller technology in security systems, emphasizing its potential to create robust and user-friendly solutions in various security contexts.

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LIST OF ABBREVIATIONS

Acronym	Full Form
LCD	Liquid Crystal Display
USB	Universal Serial Bus
LDR	Light Dependent Resistor
VCC	Voltage Common Collector
GND	Ground
PWM	Pulse Width Modulation
LED	Light Emitting diode
DC	Digital Current
TWI	Two-Wire Interface
SPI	Serial Peripheral Interface
NFC	Near Field Communication
AC	Analog Current
RFID	Radio-Frequency Identification
AREF	Analog Reference
I2C	Inter-Integrated Circuit
TX	Transmitter
RX	Receiver
ICSP	In-circuit serial programming
SCL	Serial Clock Line
SDA	Serial Data Line
MOSI	Multiple Output Single Input
MISO	Multiple Input Single Output
SCK	Serial Clock

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

The advent of affordable and versatile microcontrollers like Arduino has revolutionized the development of security systems, enabling the creation of highly effective and customizable solutions. This project introduces a password-based door lock system designed to enhance security in residential and commercial settings. By leveraging the capabilities of the Arduino microcontroller, the system provides a robust method for controlling access through password authentication. Users interact with the system via a keypad for password entry and an LCD screen for feedback, while a servo motor operates the locking mechanism. This innovative approach not only ensures secure access but also offers a user-friendly experience, making advanced security technology accessible and practical for everyday use.

The heart of this system is the Arduino microcontroller, which serves as the central processing unit. It is programmed to store a predefined password and to compare it with user input. When a correct password is entered via the keypad, the microcontroller signals the servo motor to unlock the door. In contrast, an incorrect password triggers an alert and keeps the door locked, thus preventing unauthorized access.

This project not only enhances security but also incorporates several advanced features to improve usability and resilience. For instance, the system can be configured to lock out after a certain number of incorrect password attempts, thereby thwarting potential break-in attempts. Moreover, the modular design of the system allows for easy integration with other security technologies, such as RFID readers or mobile applications, providing flexibility for future enhancements.

1.2 OBJECTIVE

The objective of this password-based door lock system project is to create a secure and user-friendly access control solution using Arduino technology. The system aims to enhance security by allowing entry only through correct password verification, while providing an intuitive interface via a keypad and LCD screen for user interaction.

1.3 USER INTERACTION

The password-based door lock system is designed to offer a seamless and intuitive user interaction experience. When a user approaches the door, they are prompted by the LCD screen to enter the password using the keypad. This user-friendly interface ensures that the system is easy to use while providing clear and immediate feedback at every step of the process.

1.4 TECHNOLOGY MILESTONES

The development of the password-based door lock system involved several key technology milestones. Initially, the Arduino microcontroller was selected and integrated to enable precise control and processing capabilities. The keypad and LCD screen were implemented for password input and user feedback. Programming the Arduino enabled accurate and secure password storage and comparison. Integrating the servo motor provided mechanical control of the door lock. Adding an alert system with LEDs and buzzers enhanced security. Incorporating resilience features like lockout mechanisms after failed attempts ensured a robust, user-friendly, and expandable security solution.

1.5 PROBLEM-SOLVING PROWESS

The password-based door lock system demonstrates impressive problem-solving prowess by addressing security and user interface challenges. It ensures secure access control with password authentication. An Arduino microcontroller integrates versatile processing and control capabilities. A keypad and LCD screen provide clear user interaction. A servo motor controls the locking mechanism. LEDs and buzzers alert users to incorrect attempts, with a lockout feature to prevent brute force attacks. This comprehensive approach results in a robust, efficient, and user-friendly system enhancing security.

CHAPTER 2
LITERATURE SURVEY

2.1 INTRODUCTION

The development of smart home technologies has advanced security systems, with password-based door locks emerging as a key focus. Studies highlight the transition from traditional locks to electronic systems utilizing microcontrollers like Arduino for enhanced security and convenience. Arduino's versatility and cost-effectiveness in managing inputs from keypads and LCDs, controlling servo motors, and integrating alert mechanisms are well-documented. Research underscores the importance of user-friendly interfaces and resilience features, such as lockout mechanisms, in creating robust and reliable security solutions for modern applications.

2.2 SURVEYS

Physical keys are the most-used and well-known technology to lock or unlock a door. People are familiar with it. Despite the physical key locking system being well-proven, it is not without liabilities. Roaming outside of the home with physical keys is inconvenient and there is a risk of losing physical keys. Smart-locking system is a keyless technology that lets a person unlock without having to use a physical key. [1]

This is paper proposes a keyless Entry System that focus on using Arduino circuit board together with a Wi-Fi module and PHP language in order to grant access to a locked door. The main goal of this work is to combine both software and hardware to solve real-life problems like the one this paper focusing on. The second goal is to explore which services can be obtained when such systems applied on the ground. Finally, to gain the knowledge regarding basic Electrical Engineering concepts with respect to circuit boards and hardware implementation. [2]

In day to day life home security is very important factor. It is a trending issue in 21st century. Security is primary concern everywhere and for everyone. Every person wants his home, industry, banks etc to be secured. This project describes a security system that can control doors.

This is a useful and simple security system. Our application uses arduino as its controller and detects whether the door is unlocked or locked using ultrasonic sensor & LDR values. [3]

This paper presents an enhanced methodology in implementing and designing a security system for door locking purpose based on fingerprint, GSM technology, monitoring camera, alarm system and password system. This security system will provide enough security by limiting unauthorized people access and taking a record of those who pass through it. So this paper introduces some security solutions for that problem. [4]

The personal safety of the population in public and private building has always been a concern in current daily life. Access control for buildings represents an important tool for protecting both building occupants and the structure itself. One of the important security systems in building security is door access control. The door access control is a physical security that assures the security of a room or building by means limiting access to that room or building to specific people and by keeping records of such accesses. [5]

2.3 PROBLEM IDENTIFICATION

The following problems have been identified, motivating the development of Arduino-Based Password Protected Door Lock System:

1. Unauthorized Access:

- Preventing unauthorized individuals from gaining entry to secure areas.
- Enhancing the security of homes, offices, and other facilities.

2. Key Management Issues:

- Eliminating the need for physical keys, this could be lost, stolen, or duplicated.
- Providing a convenient and secure alternative to traditional lock-and-key mechanisms.

3. Limited Access Control:

- Allowing selective access to authorized individuals only, improving overall security management.
- Providing a method to easily change or revoke access without needing to change physical locks.

4. Brute Force Attacks:

- Implementing measures to prevent brute force attacks, such as limiting the number of incorrect password attempts.
- Enhancing security by incorporating features like time delays or alarms after multiple failed attempts.

5. User-Friendly Security:

- Designing an intuitive system that is easy for users to understand and operate.
- Ensuring that users can easily change their passwords for added security.

6. Integration with Existing Systems:

- Providing a solution that can be integrated with existing door locking mechanisms and security systems.
- Ensuring compatibility with other access control methods for comprehensive security.

7. Cost-Effective Solution:

- Offering an affordable security solution compared to more expensive commercial systems.
- Using readily available and inexpensive components to keep costs low.

8. Maintenance and Reliability:

- Creating a system that is easy to maintain and troubleshoot.
- Ensuring the system is reliable and durable for long-term use.

CHAPTER 3

METHODOLOGY

3.1 ARCHITECTURE

The Arduino-Based Password Protected Door Lock System features an Arduino microcontroller interfacing with a keypad for password input, an LCD for feedback, and a servo motor or solenoid to control the lock. Upon correct password entry, the Arduino activates the lock mechanism. The system includes an LED indicator for visual signals, indicating successful or failed attempts. Security features like timeouts or alarms after multiple incorrect entries can be integrated. Power is provided by a stable source with an optional backup battery for reliability. This architecture ensures a robust, user-friendly, and secures locking system suitable for various applications.

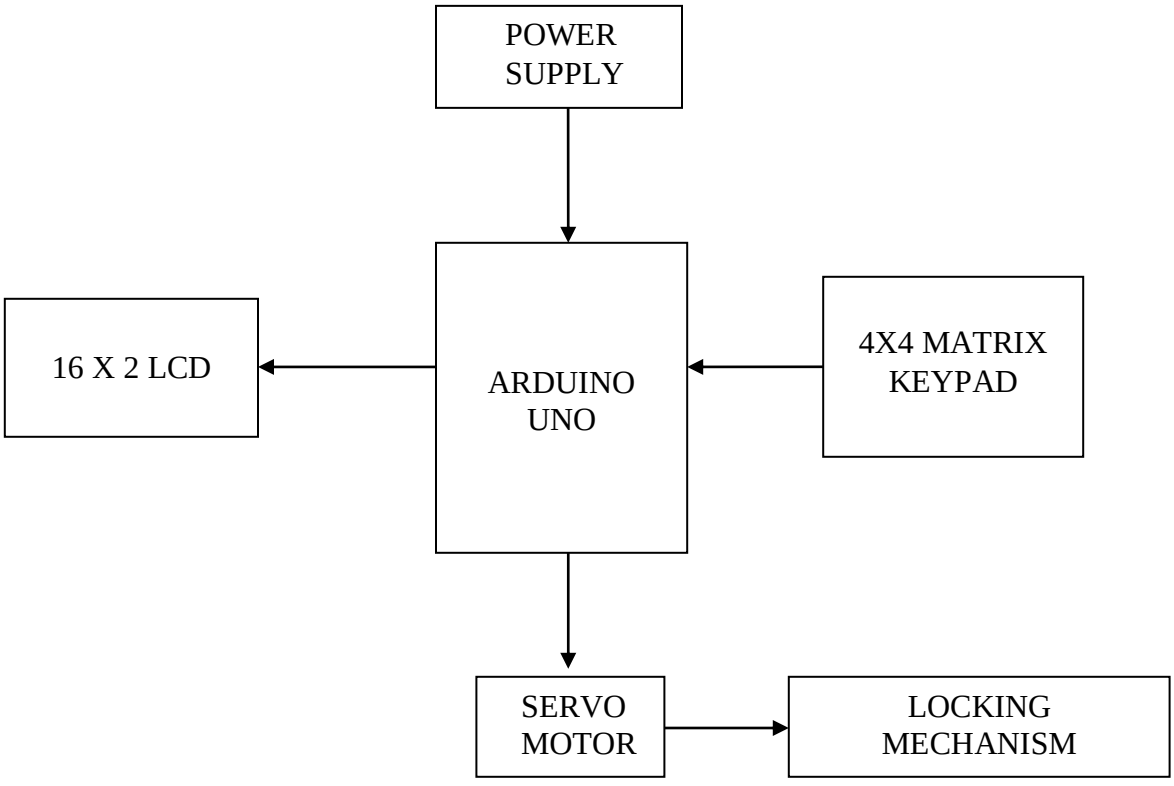

Fig. 3.1 Architecture

3.2 HARDWARE REQUIRED

3.2.1 Arduino Uno ATMega 328P

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. Arduino Uno, due to its user friendly interface, simple design and cheap price, is good to go for simple applications.

Features:

• The Arduino Uno is a microcontroller board based on the Atmel's ATmega328.

• It has 14 digital input output pins of which 6 can be used as PWM outputs and 6 analog inputs.

• The Arduino Uno can be powered via USB connection or with an external power supply.

• The Arduino Uno original contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable.

Specifications:

• The operating voltage is 5V; recommended input voltage will range from 7V to 12V

• The input voltage ranges from 6V to 20V

• Digital input/output pins: 14

• Analog i/p pins: 6

• DC Current for each input/output pin: 40 mA

• DC Current for 3.3V Pin: 50 mA, Flash Memory is 32 KB.

• SRAM is 2 KB, EEPROM is 1 KB

• CLK Speed is 16 MHz

Pin Description:

- **Pin1 (TX) & Pin0 (RX) (Serial):** This pin is used to transmit & receive TTL serial data, and these are connected to the ATmega8U2 USB to TTL Serial chip equivalent pins.
- **Pin 2 & Pin 3 (External Interrupts):** External pins can be connected to activate an interrupt over a low value, change in value..
- **Pins 3, 5, 6, 9, 10, & 11 (PWM):** This pin gives 8-bit PWM o/p.
- **SPI Pins (Pin-10 (SS), Pin-11 (MOSI), Pin-12 (MISO), Pin-13 (SCK):** These pins maintain SPI-communication, even though offered by the fundamental hardware, is not presently included within the Arduino language.
- **Pin-13(LED):** The inbuilt LED can be connected to pin-13 (digital pin). As the HIGH-value pin, the light emitting diode is activated, whenever the pin is LOW.
- **Pin-4 (SDA) & Pin-5 (SCL) (I2C):** It supports TWI-communication with the help of the Wire library.
- **AREF (Reference Voltage):** The reference voltage is for the analog i/p's
- **Reset Pin:** This pin is used for reset (RST) the microcontroller.

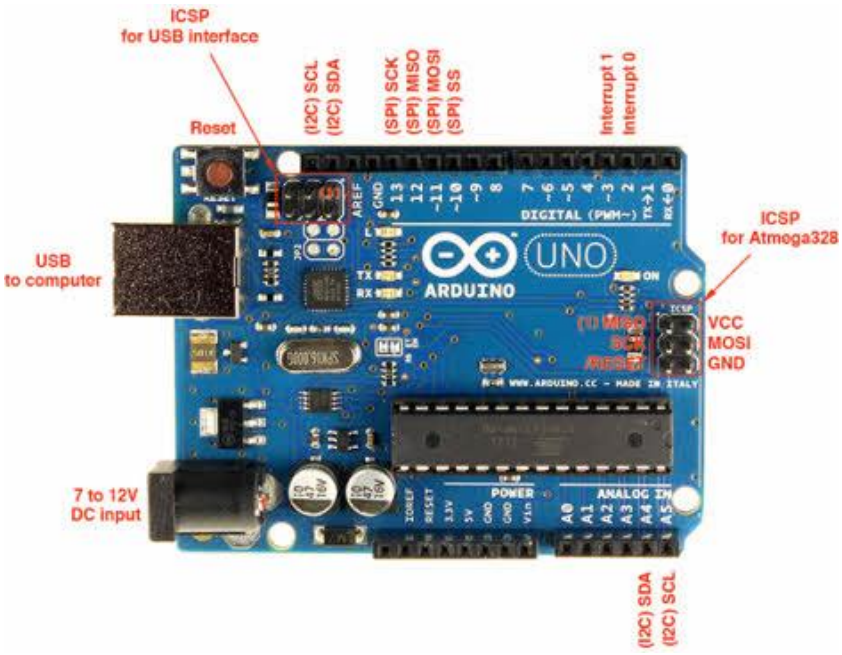

Fig. 3.2 Arduino Uno ATMega 328P

3.2.2 4x4 Matrix Keyboard

This 16-button keypad provides a useful human interface component for microcontroller projects. Convenient adhesive backing provides a simple way to mount the keypad in a variety of applications. Matrix keypads use a combination of four rows and four columns to provide button states to the host device, typically a microcontroller. Underneath each key is a pushbutton, with one end connected to one row, and the other end connected to one column.

Features:

• Ultra-thin design

• Adhesive backing

• Easy interface to any microcontroller

• Excellent price/performance ratio

• Example programs provided for the BASIC Stamp 2 and Propeller P8X32A microcontrollers

• Long life.

Specifications:

• Maximum Voltage across EACH SEGMENT or BUTTON: 24V

• Maximum Current through EACH SEGMENT or BUTTON: 30mA

• Maximum operating temperature: 0°C to + 50°C

• Dimensions:

Keypad: 2.7 x 3.0 in (6.9 x 7.6 cm)

Cable: 0.78 x 3.5 in (2.0 x 8.8 cm)

Pin Description:

4X4 Keypad has eight terminals. In them, four are rows of matrix and four are columns of the matrix. These 8 pins are driven out from the 16 buttons present in the module. Those 16 alphanumeric digits on the module surface are the 16 buttons arranged in matrix formation.

Fig. 3.3 4x4 Matrix Keyboard

3.2.3 16x2 LCD:

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are it is inexpensive, simply programmable, used for animations, and there are no limitations for displaying custom characters, special and even animations, etc.

Features:

• It includes two rows where each row can produce 16-characters.

• Backlight: LED backlight

• Display Colour: Blue or Green

• The alphanumeric LCDs alphabets & numbers.

• It displays a few custom generated characters

• LCDs are inexpensive and simply programmable.

Specifications:

• The operating voltage of this LCD is 4.7V-5.3V

• Character Format: 5x8 dots matrix format

• Display Size: 16 characters x 2 lines

• The utilization of current is 1mA with no backlight

• Voltage Supply: 5V DC

• Operating Temperature: -20°C to +70°C

• Interface: 4-bit or 8-bit mode

• Dimension: 84.0 x 44.0 x 13.0 mm

Pin Description:

Pin 3 - VEE pin: This pin is used for adjusting the contrast of the display. Voltage on this pin defines contrast on display, lower the voltage, higher the contrast

Pin 4 –RS: Register Select pin

RS = 0: Data on the D0 to D7 pins is considered as a command.

RS = 1: Data on the D0 to D7 pins is considered as data to display on LCD16x2.

Pin 5 – RW: Read / Write pin

RW = 0: Write data to the LCD

RW = 1: Read data from the LCD

Pin 6 –E: This pin is used to latch the data present on the data pins D0 to D7. High to low pulse with a minimum width of 450 ns is required to latch the data to the display.

Pins 7:14: Data pins are used to send data/command to the LCD16x2 as parallel 8 data bits.

Pin 15:16 - LED + and LED: Liquid Crystal Displays don't have their own light like seven segment displays. Therefore, the module has a backlight LED. Supply to this LED is provided through these pins.

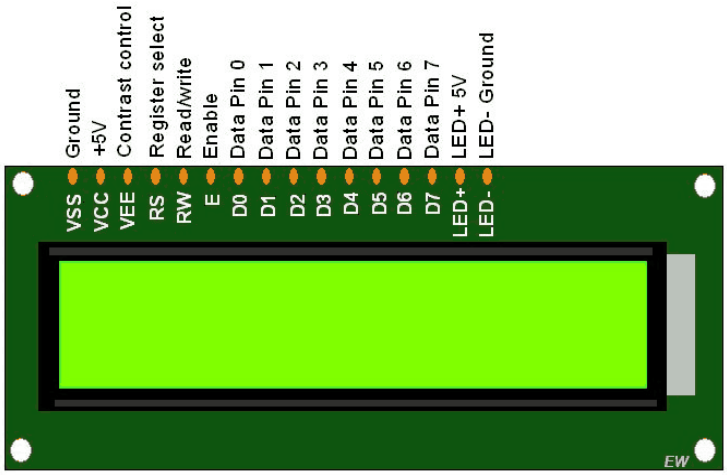

Fig. 3.4 16x2 LCD

3.2.4 Servo Motor:

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with 3 horns (arms) and hardware. The gears in the motors are easily subjected to wear and tear, so if your application requires stronger and long running motors you can go with metal gears or just stick with normal plastic gear.

Features:

• Position Control: Servo motors are capable of precise position control, which makes them ideal for applications where accurate movements are essential.

• Speed Control**:** They offer excellent speed control, allowing for smooth acceleration and deceleration.

• Torque Control**:** Servo motors can provide high torque at low speeds, which is beneficial for tasks requiring significant force.

• High Efficiency: They are known for their high efficiency, which reduces energy consumption and operational costs.

• Compact Size: Servo motors are generally compact, making them suitable for applications with space constraints.

• High Performance: They can achieve high speeds and accelerations, making them suitable for dynamic applications.

• Reliability and Durability: Servo motors are designed to be robust and durable, often featuring components that can withstand demanding environments.

• Low Noise: They operate with minimal noise and vibrations, which is important in applications where noise levels need to be controlled.

Specifications:

• Weight: 9 g

• Dimension: 22.2 x 11.8 x 31 mm approx.

• Torque: 2.5 kg/cm

• Operating speed: 0.1 s/60 degree

• Operating voltage: 4.8 V (~5V)

• Dead band width: 10 µs

• Temperature range: 0 ºC – 55 ºC

• Gear Type: Plastic

• Rotation: 0°-180°

Pin Information:

1. Red(VCC): Powers the motor typically +5V is used
2. Brown(GND): Ground wire connected to the ground of system
3. Orange(PWM): PWM signal is given in through this wire to drive the motor

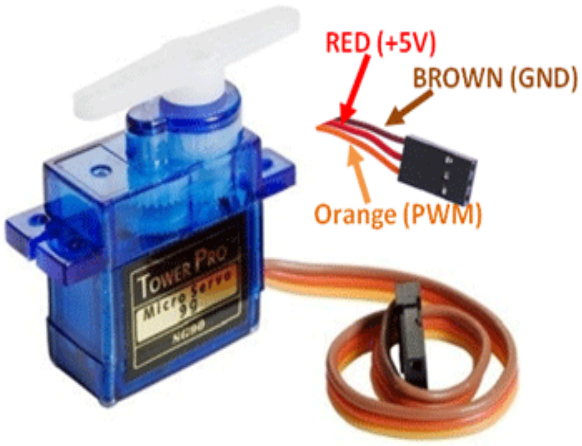

Fig. 3.5 Servo Motor

3.3 WORKING OF ARCHITECTURE

The working of the Arduino-Based Password Protected Door Lock System begins with the Arduino initializing the keypad, LCD display, servo motor (or solenoid), LED, and buzzer upon powering up. The user inputs a password via the keypad, with each key press shown on the LCD. The Arduino then compares the entered password with the stored one. If the password matches, the Arduino activates the servo motor or solenoid to unlock the door, lights up a green LED, and emits a success tone from the buzzer, while the LCD displays "Access Granted." If the password is incorrect, the door remains locked, a red LED lights up, and the buzzer emits an error tone, with the LCD displaying "Access Denied."

3.4 FLOW CHART

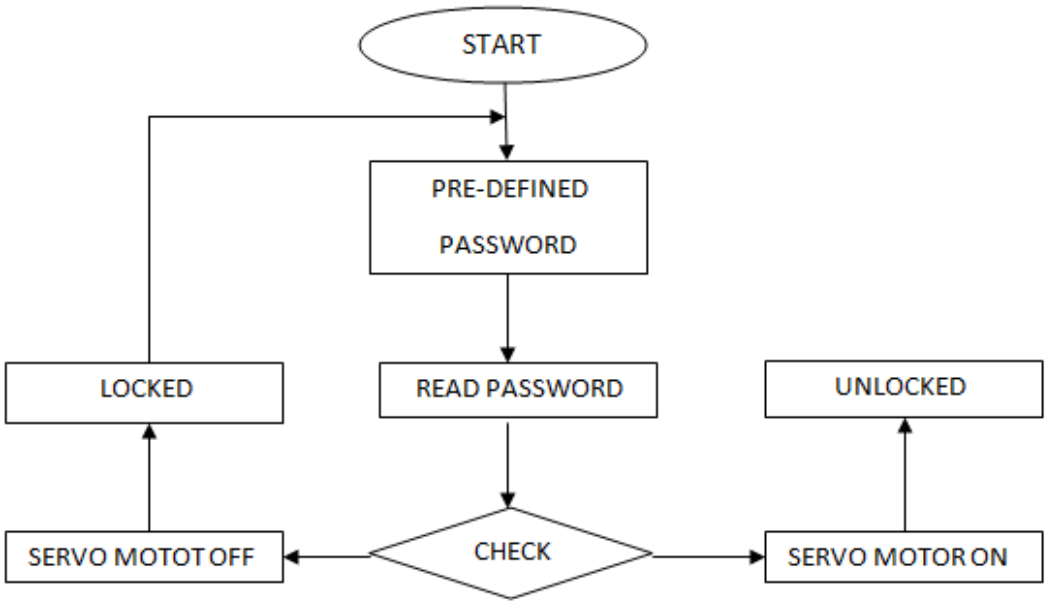

Fig. 3.7 Flow Chart

CHAPTER 4
CONCLUSION AND FUTURE SCOPE

4.1 CONCLUSION

In conclusion, the Arduino-Based Password Protected Door Lock System offers a robust, reliable, and user-friendly solution for enhancing security. By integrating an Arduino microcontroller with a keypad, LCD display, servo motor, LED indicators, and a buzzer, the system ensures secure access control through password verification. The architecture is designed to provide clear feedback to users and implement additional security features such as timeouts or alarms for multiple incorrect attempts.

This project not only replaces traditional lock-and-key mechanisms with a more secure and convenient alternative but also demonstrates the practical application of Arduino in building custom security solutions. Its cost-effectiveness and ease of implementation make it suitable for a wide range of security needs in homes, offices, and other facilities..

4.2 FUTURE SCOPE

The future scope of the Arduino-Based Password Protected Door Lock System is vast, offering numerous enhancements and integrations:

1. Biometric Integration: Incorporate fingerprint or facial recognition for multifactor authentication, increasing security and convenience.

2. Remote Access and Control: Integrate with IoT platforms to allow remote monitoring and control via Smartphone apps or web interfaces, enabling users to lock or unlock doors from anywhere.

3. RFID/NFC Integration: Add RFID or NFC capabilities for quick and secure access using cards or smart phones.

4. Advanced Security Features: Implements encryption for password storage and communication and add tamper detection and alerts for any unauthorized access attempts.

5. Energy Efficiency: Develop power-saving modes and use alternative energy sources like solar power to enhance sustainability.

6. Voice Recognition: Incorporate voice recognition technology for an additional layer of security and convenience.

7. User Management: Develop a user-friendly interface for managing multiple users and access levels, allowing for easy addition and removal of authorized personnel.

8. Emergency Features: Add features such as emergency access codes and integration with fire alarm systems to ensure safety in emergency situations.

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APPENDIX A

TEAM INTRODUCTION

Our team, comprising four members with diverse skills, is dedicated to delivering exceptional results and innovative solutions for the project.

Team Approach:

We plan to utilize agile methodology to manage both the project and the development process. By incorporating various tools and techniques such as user testing, prototyping, and continuous integration and deployment, we aim to maintain a high level of efficiency and adaptability.

Team Dynamics:

Our diverse team brings a range of skills and experiences, allowing us to tackle the project from multiple perspectives. We are committed to working collaboratively and maintaining regular communication to ensure the project's success.

TEAM MEMBERS:

Sahil Soni

(0187EC211040)

Arpit Shrivastava

(0187EC211006)

Gourav Sahita

(0187EC211014)

Riya Shrivastava

(0187EC211036)

PROJECT GUIDE:

Prof. Deepti Malviya

(Assistant Professor)

APPENDIX B

PROJECT SUMMARY

Title of the project	Arduino-Based Password Protected Door Lock System
Semester	6th
Members	Gourav Sahita, Arpit Shrivastava, Riya Shrivastava and Sahil Soni
Team Leader	Arpit Shrivastava
Describe role of every member in the project	Gourav Sahita – Designing the hardware, tested the system to ensure it meets all requirements and functions correctly. Sahil Soni – Hardware Assembly, worked on the interface between hardware and software. . Riya Shrivastava – Report and Documentation, provided insights for the project development. Arpit Shrivastava – Oversees the entire project, developed the software that controls the door lock system. .
What is the motivation for selecting this project?	The motivation for selecting the Arduino-Based Password Protected Door Lock System project is driven by the need for improved security in homes and businesses, addressing vulnerabilities of traditional locks. This project offers a cost-effective, user-friendly solution leveraging Arduino's capabilities. It allows for the integration of modern technologies like IoT and biometric authentication, enhancing security and convenience. Additionally, it provides practical experience in hardware-software integration and system design, making it a valuable and relevant learning opportunity.
Tools and Technologies	Arduino IDE, Embedded Systems

	Guide Signature and name

APPENDIX C

STANDARD OPERATING PROCEDURE

1. The user approaches the door and enters their password using the keypad.
2. When the system is powered on, the Arduino initializes all the connected components: the keypad, LCD display, and the servo motor.
3. The LCD displays a welcome message or a prompt to enter the password.
4. Each key press is displayed on the LCD.
5. Once the password is fully entered, the user presses a designated key to submit the password.
6. The Arduino reads the entered password and compares it with the stored password in its memory.
7. **Correct Password**: If the entered password matches the stored password: The Arduino sends a signal to the servo motor to unlock the door.
8. **Incorrect Password**: If the entered password does not match the stored password: The door remains locked.
9. If any user wants to change the password he/she can set new password and by confirming, the new password is set.
10. The LCD displays a message such as "Access Denied" or "Incorrect Password."
11. Throughout the process, the system provides clear visual and auditory feedback to the user.

This process ensures a secure, user-friendly, and efficient door locking mechanism, providing reliable access control based on password authentication.

APPENDIX D

BUDGET

S. No.	Component	No. of units	Price per unit	Cost
1.	Arduino Uno ATMega 328P	1	500	500
2.	4x4 Matrix Keyboard	1	70	70
3.	Jumpers	20	3	60
4.	16x2 LCD	1	200	200
5.	Servo Motor	1	150	150
6.	Breadboard	1	80	80
Total Cost	-	-	-	1060