

DEVELOPMENT OF NEAR FIELD COMMUNICATION BASED DOOR ENTRY AND SECURITY

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering Degree in Electronics and Communication Engineering

by

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

CATEGORY-1 UNIVERSITY BY UGC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **K KRANTHI KUMAR (40130118)**, **G MANIKANTA (40130069)** who carried out the project entitled "**Development of NFC Based Door Entry and Security System**" under our supervision from November 2023 to April 2024.

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DECLARATION

I, G. MANIKANTA (40130069) hereby declare that the project report entitled "DEVELOPMENT OF NFC BASED DOOR ENTRY AND SECURITY" done by me under the guidance of Dr. V. BALAMURUGAN, M.Tech., Ph.D., is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING.

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ABSTRACT

This project focuses on the development of an innovative Near Field Communication (NFC) based door entry and security system. NFC technology, known for its short-range wireless communication capabilities, is controlled to provide secure and convenient access control while maintaining robust security measures against unauthorized entry. The project encompasses hardware development, software creation, security implementation, integration with existing systems, user experience optimization, testing and validation, and comprehensive documentation/training. Key objectives include designing NFC-enabled door locks or access control systems, creating user-friendly interfaces for access management, implementing encryption and authentication protocols, exploring integration possibilities with other security systems, optimizing user experience through intuitive interfaces, conducting thorough testing under various conditions, and preparing detailed documentation and training materials. The outcome of this investigation is expected to be a reliable, efficient, and user-friendly NFC-based door entry and security system suitable for residential, commercial, and institutional applications.

TABLE OF CONTENT

CHAPTER No.	TITLE	PAGE No.
	ABSTRACT	iv
	LIST OF FIGURES AND TABLES	vii
	LIST OF ABBREVIATIONS	viii
1	INTRODUCTION	1
2	LITERATURE SURVEY	2
	2.1 LITERATURE SURVEY	2
	2.2 PROBLEM STATEMENT	4
	2.3 EXISTING METHODS AND THEIR LIMITATIONS	5
3	AIM AND PROPOSED MODEL	7
	3.1 AIM AND SCOPE	7
	3.2 OBJECTIVE	8
	3.3 PROPOSED MODEL	9
	3.4 STANDARDS	10
	3.5 CONSTRAINTS	10
	3.6 TRADE OFFS	11
4	EXPERIMENTAL DESIGN AND METHODS	12
	4.1 HARDWARE REQUIRMENTS	12
	4.1.1 ARDUINO UNO	12
	4.1.2 GSM MODULE	14
	4.1.3 PN 532 NFC MODULE	16
	4.1.4 BUZZER	17
	4.1.5 LM35 TEMPERATURE SENSOR	18
	4.1.6 SOLENOID LOCK	20
	4.1.7 12V POWER ADAPTER/BATTERY	21

	4.1.8 L298N MOTOR DRIVER CONTROLLER BOARD	23
	4.1.9 12V POWER SUPPLY BOARD	25
	4.2 SOFTWARE REQUIREMENTS	27
	4.2.1 ARDUINO IDE	27
	4.2.2 RELAY CONTROL LIBRARY	28
	4.3 BLOCK DIAGRAM	29
	4.4 CIRCUIT DIAGRAM	30
	4.5 FLOW CHART	32
	4.6 TECHNICAL SPECIFICATIONS	34
5	RESULT AND DISCUSSIONS	35
	5.1 DEVELOPED PROTOTYPE	35
	5.2 PROTOTYPE RESULTS	36
6	CONCLUSION AND FUTURE DEVELOPMENT	37
	6.1 CONCLUSION	37
	6.2 FUTURE DEVELOPMENT	37
	REFERENCE	38
	APPENDICES SOURCE CODE	41

LIST OF FIGURES AND TABLES

FIGURE No.	FIGURE NAME	PAGE No.
2.1	BIOMETRIC SYSTEM	5
2.2	KEY CARD SYSTEM	6
2.3	PIN SYSTEM	6
3.1	PROPOSED MODEL	9
4.1	ARDUINO UNO	12
4.2	GSM MODEM	14
4.3	PN 532 NFC MODULE	16
4.4	BUZZER	17
4.5	LM35 TEMPERATURE SENSOR	18
4.6	SOLENOID LOCK	20
4.7	12V POWER ADAPTER	21
4.8	L298N MOTOR DRIVER CONTROLLER BOARD	23
4.9	12V POWER SUPPLY BOARD	25
4.10	BLOCK DIAGRAM	29
4.11	CIRCUIT DIAGRAM	31
4.12	FLOW CHART	32
5.1	DEVELOPED PROTOTYPE	35
TABLE No	TABLE NAME	PAGE No
4.1	TECHNICAL SPECIFICATIONS	34

LIST OF ABBREVIATIONS

NFC	- NEAR FIELD COMMUNICATION
GUI	- GRAPHICAL USER INTERFACE
UI	- USER INTERFACE
MFA	- MULTI FACTOR AUTHENTICATION
RFID	- RADIO FREQUENCY IDENTIFICATION DEVICE
KB	- KILOBYTE
MHz	- MEGHAHERTZ
DC	-DIRECT CURRENT
UNO	- UNIVERSO NUMBER ONE
GSM	-GLOBAL SYSTEM FOR MOBILE
SMS	- SHORT MESSAGE SERVICE
SIM	-SUBSCRIBER IDENTITY MODULE
IC	-INTEGRATED CIRCUIT

CHAPTER 1

INTRODUCTION

Near Field Communication (NFC) is a technology for contact less and short-range communications. The NFC phone is having enhanced security, allowing the user to protect applications through the phone's user interface features. And it makes use of a magnetic field and radio frequency identification (NFC) induction to allow electrical devices to communicate devices. The quantity of NFC short-range applications technology is constantly evolving and permeating every aspect of life. Particularly when combined with mobile phones it presents excellent prospects. The main advantage of using NFC is that no communication links have to be established first due to which it is faster than the existing technologies. NFC technology is still in its developing stage, but it already has applications in a wide range of industries, including health care, business and home security systems that can be expanded to control heaters and air conditioners. Traditional door entry systems often rely on physical keys, keypads, or RFID cards for access control. However, these methods can be cumbersome, less secure, and prone to issues such as lost keys or unauthorized duplication of access cards. In contrast, NFC technology offers several advantages that make it a promising solution for modern security needs. NFC based systems utilize encrypted communication between NFC-enabled devices, such as smartphones, NFC tags, and access control panels. This communication occurs over short distances, typically a few centimetres, ensuring secure and reliable data transmission. By leveraging NFC technology, door entry and security systems can benefit from convenience, enhanced security, integration capabilities, user experience. NFC enables short-range communication between devices, making it an ideal solution for door entry and security applications. This investigation focuses on the development of an NFC-based door entry and security system, aiming to enhance security measures while providing convenience and efficiency for users.

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE SURVEY

K. Gupta et al. (2021), an NFC-based door lock system with multi-factor authentication and real-time monitoring capabilities was proposed, enhancing security measures. The system employs advanced encryption algorithms to ensure the integrity of communication between the NFC-enabled device and the door lock, mitigating the risk of unauthorized access through hacking or spoofing attacks. Additionally, the real-time monitoring feature provides administrators with insights into access events, enabling proactive security measures and incident response.

T. Ahmed and M. Rahman et al. (2020), explored strategies to enhance security and convenience in door access control systems through the adoption of NFC technology. Their research focused on user-centric design principles, aiming to improve the overall user experience while maintaining robust security protocols. The study emphasized the importance of seamless integration with existing infrastructure and user-friendly interfaces for widespread adoption of NFC-based door lock systems. Furthermore, the research highlighted the potential for NFC technology to streamline access control processes and reduce administrative overhead.

A. Kumar and S. Sharma et al. (2018), discussed the implementation of NFC technology in secure door entry systems, highlighting its benefits for access control and security enhancement. The research delved into the technical aspects of NFC communication protocols and encryption mechanisms, addressing potential vulnerabilities and countermeasures to mitigate security risks associated with NFC-based door locks. Additionally, the study examined the interoperability of NFC-based access control systems with other smart building technologies, such as biometric authentication and IoT devices, to create a comprehensive security ecosystem.

L. Chen et al. (2019), investigated a smartphone-based NFC door access system for secure building management, emphasizing integration with mobile devices for access control. Their research focused on leveraging the ubiquity of smartphones

equipped with NFC technology to provide a convenient and secure means of door access, catering to the modern mobile-centric lifestyle of users. Moreover, the study explored the potential for NFC-enabled smartphones to serve as multifunctional access credentials, supporting applications beyond physical door locks, such as payment systems and public transportation.

S. Park and H. Lee et al. (2017), explored the integration of NFC technology for access control in smart buildings, addressing implementation challenges and solutions for secure access management. Their study examined the interoperability of NFC-based door locks with other smart building systems, such as IoT devices and building management systems, to create a cohesive and efficient access control ecosystem. Additionally, the research emphasized the role of NFC technology in enabling personalized access control policies based on user roles, time schedules, and location-based permissions, enhancing security and flexibility in access management.

C. Lee and J. Kim et al. (2016), presented the design and implementation of an NFC-based door access management system, focusing on efficient and secure access control integration. Their research involved the development of custom hardware and software components tailored to the specific requirements of NFC-based door locks, ensuring compatibility with existing infrastructure and regulatory standards. Furthermore, the study explored the potential for NFC technology to enable seamless integration with other emerging technologies, such as blockchain-based access control systems, to enhance security and transparency in access management processes.

R. Singh and A. Mishra et al. (2015), developed a secure door access control system using NFC technology, emphasizing encryption and authentication for enhanced security. Their research focused on the cryptographic protocols and key management mechanisms necessary to safeguard communication between NFC-enabled devices and door locks, preventing unauthorized access attempts and data breaches. Additionally, the study investigated the potential for NFC-based access control systems to support dynamic access policies and fine-grained access control rules, allowing organizations to enforce stricter security measures based on evolving threats and regulatory requirements.

M. Smith et al. (2014), conducted a usability study on NFC-based door locks, evaluating user experience and security perceptions in real-world settings. Their research involved user interviews, usability testing, and security assessments to identify user preferences, pain points, and security concerns associated with NFC-based access control systems, informing design improvements and security enhancements. Additionally, the study explored the potential for NFC technology to enhance user convenience through features such as remote access management and integration with personal digital assistants, further enhancing the overall user experience.

2.2 PROBLEM STATEMENT

In the realm of modern security systems, traditional key-based entry methods present a myriad of challenges that organizations must navigate. One of the foremost concerns is the inherent security vulnerabilities associated with physical keys, including the risk of theft, duplication, or loss. These vulnerabilities can potentially lead to unauthorized access, compromising the safety and integrity of secure areas. Moreover, the manual management of keys adds complexity to access control systems, often resulting in inefficiencies and security gaps that need to be addressed.

The complexity of managing access control systems with multiple credentials and authentication processes can be a significant hurdle for organizations. This complexity not only impacts the user experience, causing inconvenience and delays, but also raises concerns about data privacy and security. In today's digital age, where seamless integration with modern technologies is paramount, the limitations of traditional access control systems become increasingly apparent. Organizations are seeking solutions that offer improved security, streamlined access management, and enhanced user experiences without compromising on data protection and privacy.

The cost implications of traditional access control systems, including hardware, software, maintenance, and manpower, present ongoing challenges for organizations. The need for regular updates, maintenance, and troubleshooting further adds to the operational costs. Balancing the need for robust security measures with cost-effective solutions is a constant endeavor. Hence, there is a growing demand for innovative

access control systems that leverage advanced technologies like Near Field Communication (NFC) to enhance security, streamline access management processes, and improve overall operational efficiency.

2.3 EXISTING METHODS AND THEIR LIMITATIONS

The use of NFC technology has grown significantly across a number of sectors, including security and door access. Comparing NFC-based door entry systems to more conventional approaches like physical keys or key cards reveals a number of benefits. But, in order for them to be implemented and work properly, they also have a unique set of requirements.

Biometric Systems:



Fig:2.1: Biometric System

- Biometric door entry systems use unique biological traits such as fingerprints, iris patterns, or facial recognition for access control.
- While biometric systems offer high security due to the uniqueness of biometric data, they can be costly to implement and may raise privacy concerns among users. Biometric data storage and management also require robust security measures to prevent unauthorized access or data breaches.

Traditional key card system:



Fig:2.2: Key card system

- Traditional key card systems involve issuing physical cards with embedded RFID/NFC chips to authorized users. These cards are then scanned by card readers to grant access to doors.
- One of the main limitations of key card systems is the potential for card loss or theft. If an authorized card falls into the wrong hands, unauthorized access can occur. Additionally, physical cards can be damaged or misplaced, leading to access issues for user

Password/PIN Systems:



Fig:2.3: pin system

- Some door entry systems rely on password or PIN authentication, where users input a code to gain access.
- Passwords or Pin's can be forgotten, shared, or stolen, compromising security. They also lack the convenience of quick access provided by NFC technology.

CHAPTER 3

AIM AND PROPOSED MODEL

3.1.AIM AND SCOPE

The aim of our project is to develop a robust and efficient NFC (Near Field Communication) based door entry and security system. This system will control NFC technology to provide secure and convenient access control for various premises such as residential buildings, offices, and commercial spaces. The primary goal is to design a system that enhances security, improves user experience, and offers flexibility in access management.

The scope of our project encompasses the following key aspects:

1.Hardware Development:

Design and develop NFC-enabled hardware components such as readers, controllers, and locks optimized for reliable and secure access control. Ensure compatibility with a variety of NFC devices including smartphones, key fobs, and NFC cards.

2.User Interface and Experience Design:

Design intuitive and user-friendly interfaces for both administrators and end-users, including web-based dashboards, mobile applications, and physical interface panels. Focus on providing a seamless user experience during the authentication and access process, with clear feedback and guidance for users.

3.Smart Control Mechanism:

Implement an intelligent control mechanism that leverages NFC technology for seamless and fast access to authorized users. Incorporate real-time monitoring and control features to track access attempts, manage permissions, and respond to security events efficiently.

4.Multi-functional Capabilities:

Enable multi-functional capabilities such as time-based access control, temporary access permissions, and visitor management to cater to diverse user requirements. Integrate additional features like remote locking/unlocking, emergency access protocols, and integration with other smart home or office systems.

5. Cost Effectiveness and Sustainability:

Optimize hardware design and manufacturing processes to ensure cost-effectiveness without compromising on quality or security standards. Explore options for bulk procurement, efficient supply chain management, and cost-efficient maintenance strategies to reduce overall project costs. Incorporate sustainable design principles such as energy efficiency, recyclable materials, and eco-friendly manufacturing practices into hardware development. Consider the long-term environmental impact of the project, including end-of-life disposal/recycling of hardware components

3.2 OBJECTIVE

Implement Multi-Factor Authentication (MFA):

Integrate multi-factor authentication (MFA) mechanisms such as biometric verification (fingerprint, facial recognition), PIN codes, or token-based authentication to add more security and reduce the risk of credential theft.

Enhance User Convenience and Experience:

Design intuitive and user-friendly interfaces for administrators to manage access permissions, monitor system status, and generate access logs. Develop mobile applications or web portals for end-users to conveniently access and manage their credentials, view access logs, and receive notifications.

Design and Develop Secure Access Control System:

Create a highly secure and reliable NFC-based access control system that leverages encryption techniques, secure authentication protocols, and access control policies to prevent unauthorized access. Ensure that the system architecture is resilient against common security threats such as replay attacks, brute force attempts, and data interception.

3.3 PROPOSED MODEL

Our proposed model for the NFC-based door entry and security system is designed to revolutionize access control by seamlessly integrating cutting-edge technology with robust security protocols. At its core, the system comprises an NFC reader, a secure database for user credentials, a control unit, and a locking mechanism. The NFC reader acts as the primary interface for users, allowing them to gain access by simply tapping their NFC-enabled devices such as smartphones or key cards on the reader. The secure database serves as a vault for storing encrypted user credentials, ensuring that only authorized individuals can access the system. The control unit acts as the brain of the system, processing authentication requests from the NFC reader and database to determine whether access should be granted or denied based on the user's credentials. One of the important components of our model is the locking mechanism, which is controlled by the control unit. This mechanism securely locks and unlocks the door in response to authorized access requests, providing a reliable and efficient means of physical security. Powering the entire system is a stable and reliable power source, ensuring uninterrupted operation and reliability. Software plays a critical role in the proposed model, managing authentication processes, database encryption, and communication between components. Additionally, user-friendly interfaces are designed to provide administrators with easy access to system settings and user management features, enhancing overall usability and management efficiency.

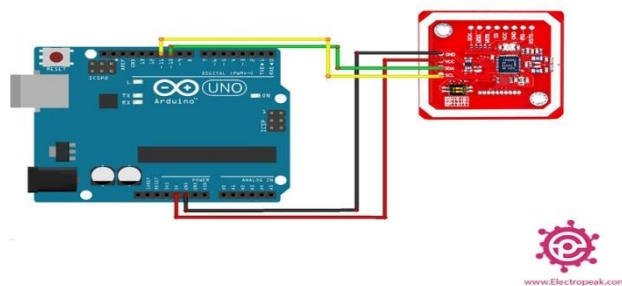


Fig:3.1: Proposed model

3.4 STANDARDS

The Arduino Uno follows the standards set by the Arduino community, making it easy to use with the other Arduino-compatible parts. The GSM modem meets telecommunications standards, ensuring it can communicate with mobile networks for calls and messages. The PN532 NFC module works with NFC standards, enabling it to interact with NFC devices and tags. The LM35 temperature sensor provides temperature readings that are compatible with common microcontrollers. The solenoid lock and motor driver controller board likely adhere to industry standards for electrical and mechanical performance. Lastly, the 12V power adapter complies with safety and voltage regulations to provide stable power to the system. These standards ensure that the components work together smoothly and safely.'

3.5 CONSTRAINTS

Limitations in memory and processing power for the Arduino Uno, network coverage and subscription costs for the GSM modem, compatibility issues with NFC protocols for the PN532 NFC module, sound output limitations for the buzzer, accuracy and temperature range limitations for the LM35 temperature sensor, and voltage compatibility for the solenoid lock.

3.6 TRADE OFFS

1.Security vs Convenience:

Implementing stringent security measures (multi-factor authentication, encryption) may enhance system security but could potentially reduce user convenience and ease of access. For both security and usability to be guaranteed, a balance between strong security procedures and user-friendly access methods must be maintained.

2.Cost vs Features:

Incorporating advanced features such as biometric authentication, real-time monitoring, or integration with existing security infrastructure can enhance system functionality but may also increase development and implementation costs. The process of prioritizing important characteristics according to user requirements, financial limits, and scalability requirements guarantees savings while preserving essential functionality.

3.User Flexibility vs System Control:

Allowing user's flexibility in managing their access permissions (e.g., temporary access, custom access levels) enhances user autonomy but may require robust system controls to prevent misuse or unauthorized access. User flexibility and system control can be balanced by implementing strict access policies, user authentication procedures, and audit trails together with user-friendly interfaces for access rights management.

4.Centralized Control vs Distributed Access:

Centralizing access control management in a single control system provides centralized visibility and control but may create a single point of failure or limit system scalability. Sharing controls while preserving central authority when required can be achieved by setting up shared access control systems, role-based permissions, and decentralized authentication procedures.

CHAPTER 4

EXPERIMENTAL DESIGN AND METHODS

4.1 HARDWARE REQUIREMENTS

- Arduino uno
- GSM modem
- PN 532 NFC module
- Buzzer
- Lm35 temperature sensor
- Solenoid lock
- 12v power adapter
- L298n motor driver controller board
- 12v power supply board

4.1.1. ARDUINO UNO



Fig:4.1: Arduino Uno

The Arduino Uno is based on the ATmega328P microcontroller and features digital and analog input/output pins, onboard flash memory for program storage, and a USB connection for programming and power supply.

Features:

- 14 digital input/output pins, of which 6 can be used as PWM outputs.
- 6 analog input pins for reading analog signals.
- 16 MHz crystal oscillator for clocking the microcontroller.
- USB connection for programming and power.
- 32 KB of flash memory for storing programs (of which 0.5 KB is used by the bootloader).
- 2 KB of SRAM and 1 KB of EEPROM.

Compatibility:

Arduino Uno is compatible with a wide range of sensors, actuators, and shields (add-on boards) available in the market, making it versatile for different projects.

Community and Support:

The Arduino Uno has a large and active community of users, makers, and developers who share projects, tutorials, and troubleshooting tips online. This community support makes it easier for beginners to get started and for experienced users to find solutions to their problems.

Power Options:

The Uno can be powered via the USB connection, an external DC power supply (7-12V), or a battery connected to the power jack. It also has an onboard voltage regulator that provides a stable 5V supply for powering external components.

Reset Button:

The board includes a reset button, which can be pressed to restart the microcontroller or to re-upload code.

Programming Interface:

It can be programmed using the Arduino Integrated Development Environment (IDE), which simplifies the process of writing, compiling, and uploading code to the board. The IDE uses a variant of the C++ programming language.

Applications:

Arduino Uno finds applications in various fields such as home automation, robotics, Internet of Things (IoT), education, and prototyping due to its ease of use, affordability, and large community support.

4.1.2. GSM MODEM



Fig:4.2: GSM Modem

A GSM modem is a device that enables communication between a computer or microcontroller and a mobile network using Global System for Mobile Communications (GSM) technology.

Communication:

GSM modems facilitate communication over cellular networks by sending and receiving SMS (Short Message Service) text messages and making or receiving calls.

Form Factor:

GSM modems come in various form factors, including external USB dongles, PCIe cards for computers, and standalone modules with serial or USB interfaces for microcontroller-based projects.

Interface:

GSM modems typically connect to a computer or microcontroller via a serial interface (RS-232 or UART) or a USB interface. They communicate with the host device using AT commands, a standard command set for controlling modems.

Power Requirement:

They require a power source, usually provided through a USB connection or an external power adapter.

Network Services:

They allow access to network services such as sending and receiving SMS messages, making voice calls, and accessing data services like internet browsing and email.

SIM Card:

GSM modems require a SIM (Subscriber Identity Module) card to authenticate with the mobile network and access its services. The SIM card stores subscriber information and network credentials.

Applications:

GSM modems find applications in various fields such as remote monitoring, IoT (Internet of Things) projects, vehicle tracking systems, security systems, and SMS-based alert systems.

4.1.3.PN 532 NFC MODULE

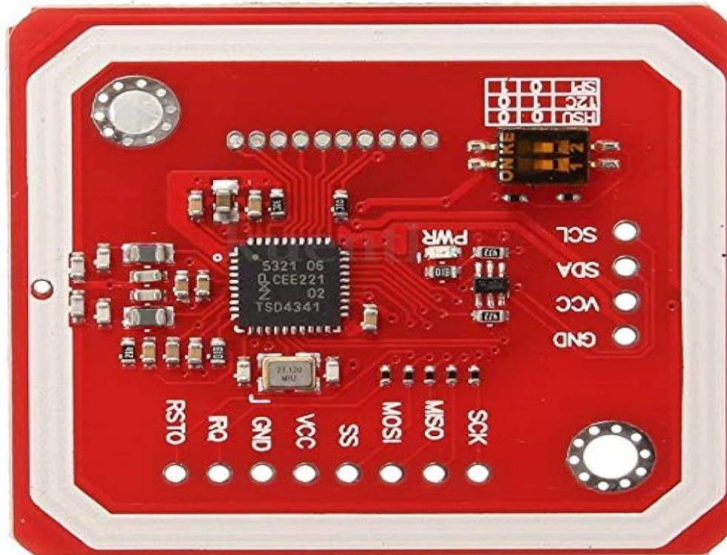


Fig:4.3:PN 532 NFC module

The PN532 NFC (Near Field Communication) module is a widely used RFID (Radio Frequency Identification) reader/writer that operates on the 13.56 MHz frequency.

Functionality:

The PN532 module enables devices to communicate wirelessly with NFC-enabled tags, cards, and other devices within close proximity (typically within a few centimetres).

Communication Protocol:

It supports various communication protocols, including ISO/IEC 14443 Type A/B, ISO/IEC 18092 (NFC), FeliCa, and MIFARE, making it compatible with a wide range of NFC devices and standards.

Interface:

The PN532 module typically communicates with microcontrollers or other host devices via I2C, SPI, or UART serial interfaces, providing flexibility for integration into different projects and systems.

Operating Modes:

It can operate in different modes, including reader/writer mode, peer-to-peer mode, and card emulation mode, allowing for various NFC applications such as access control, payment systems, and data exchange.

Antenna:

The PN532 module includes an onboard antenna for communication with NFC devices, but it also supports external antennas for extended range and flexibility in design.

Power Requirement:

It requires a power supply typically in the range of 3.3V to 5V DC, depending on the specific module variant and configuration.

Applications:

The PN532 NFC module finds applications in various fields such as access control systems, electronic payment systems, ticketing systems, IoT (Internet of Things) devices, and smart home automation.

4.1.4. BUZZER

Fig:4.4: Buzzer

A buzzer is an electronic component that generates sound when an electrical current passes through it. Operating on low voltages and consuming minimal current, buzzers come in various types including electromagnetic, piezoelectric, and magnetic, each with its own operating principle. Activation typically involves applying a direct current voltage across their terminals, producing audible alerts or notifications in applications such as alarm systems, timers, and electronic games. Easy to integrate into circuits, buzzers serve as effective audio output devices for providing audible feedback in electronic projects.

4.1.5. LM35 TEMPERATURE SENSOR

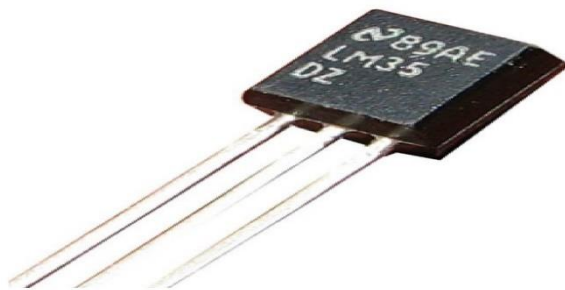


Fig:4.5: Lm35 temperature sensor

The LM35 is a precision analog temperature sensor IC (Integrated Circuit) widely used in electronic circuits to measure ambient temperature accurately

Operating Principle:

The LM35 operates on the principle of linear temperature sensing, where its output voltage increases linearly with temperature. It has a voltage output that is directly proportional to the Celsius temperature.

Accuracy:

The LM35 offers high accuracy with a typical temperature coefficient of 10 mV/°C, meaning that its output voltage changes by 10 mV for every degree Celsius change in temperature.

Calibration:

The LM35 sensor does not require external calibration or trimming, making it easy to use in various applications without the need for additional adjustments.

Temperature Range:

The LM35 sensor typically operates over a temperature range of -55°C to $+150^{\circ}\text{C}$, providing reliable temperature measurements across a wide spectrum of temperatures.

Output:

The output of the LM35 is analog, meaning that it provides a continuous voltage signal proportional to the temperature. This analog output can be directly interfaced with analog-to-digital converters (ADCs) in microcontrollers or other digital circuits for temperature monitoring and control.

Power Requirement:

The LM35 operates on a low supply voltage, typically in the range of 4V to 30V DC, making it suitable for battery-powered applications as well as those powered by external power sources.

Applications:

The LM35 finds applications in various fields such as environmental monitoring, industrial automation, HVAC (Heating, Ventilation, and Air Conditioning) systems, automotive, and consumer electronics for measuring temperature accurately and reliably.

Integration:

The LM35 is easy to integrate into electronic circuits due to its simple three-pin configuration (VCC, GND, and OUT), allowing for straightforward connections to microcontrollers, analog circuits, or display devices for temperature readout.

4.1.6. SOLENOID LOCK



Fig:4.6: Solenoid Lock

A 12V solenoid lock is an electro mechanical device designed to secure doors or compartments by using an electromagnetic coil to control the locking mechanism. When energized with a 12V power supply, the solenoid generates a magnetic field that moves the lock's bolt or latch, either locking or unlocking the door. These locks are commonly used in applications where a reliable and electronically controlled locking system is required, such as access control systems, cabinets, safes, and automated gates. They offer a fast and efficient way to secure doors while allowing remote or automated control for added convenience and security.

Construction:

- A solenoid lock typically consists of a solenoid coil, a plunger or armature, a locking mechanism (such as a bolt or latch), and a housing to encase the components.
- The solenoid coil is an electromagnet that generates a magnetic field when an electric current passes through it. The plunger or armature is a movable component that is attracted or repelled by the magnetic field.

Working Principle:

- When an electric current is applied to the solenoid coil, it creates a magnetic field that pulls the plunger or armature towards the coil, engaging the locking mechanism.

- when the electric current is turned off, the magnetic field dissipates, and the spring mechanism or gravity returns the plunger to its original position, releasing the locking mechanism.

Applications:

Solenoid locks are commonly used in various applications where electronic access control is required,

- Doors and Gates: Solenoid locks are used in electronic door locks, access control systems, and security gates.

- Cabinets and Lockers: They are used in cabinets, lockers, and storage units to secure valuable items.

Advantages:

- Fast Operation: Solenoid locks can operate quickly, providing rapid locking and unlocking compared to traditional mechanical locks.

- Remote Control: They can be integrated with electronic access control systems, keypads, RFID readers, or biometric scanners for remote and secure access.

- Durability: Solenoid locks are typically durable and reliable, suitable for high-traffic areas and demanding environments.

4.1.7. 12V POWER ADAPTER/BATTERY



Fig:4.7: 12V power adapter

It is an electrical device that converts alternating current (AC) from a wall outlet into a stable 12-volt direct current (DC) output. It typically comes with a plug that can be inserted into a wall socket and a cable with a connector suitable for various devices requiring 12V power. These adapters are commonly used to power electronics such as routers, LED strips, CCTV cameras, and other devices that operate on a 12V DC input. The adapters often have different current ratings (measured in amperes) to accommodate different power requirements, making them versatile for a range of applications in homes, offices, and industrial settings.

Output Voltage and Current:

A 12V power adapter provides a stable 12-volt DC output, which is suitable for powering a variety of electronic devices, including routers, LED strips, CCTV cameras, monitors, and automotive accessories. The current output of a 12V adapter varies based on its specifications, with common ratings ranging from 0.5A (500mA) to several amperes, depending on the power requirements of the connected device.

Connector Types:

12V power adapters come with different connector types to match the input port of the device being powered. Common connector types include barrel connectors (with various sizes), coaxial connectors, and terminal block connectors. The choice of connector depends on the device's input port and polarity requirements (e.g., centre-positive or centre-negative).

Applications:

- Consumer Electronics:** 12V power adapters are used to power various consumer electronics such as routers, modems, set-top boxes, LED lighting systems, audio equipment, and small appliances.

- Surveillance Systems:** They are commonly used in CCTV cameras, DVRs (Digital Video Recorders), and security systems that require a 12V power supply for continuous operation.

- Automotive Accessories: In automotive applications, 12V adapters power accessories like car chargers, dash cameras, GPS devices, and portable refrigerators.

Safety Features:

Quality 12V power adapters incorporate safety features such as over current protection, over voltage protection, short circuit protection, and thermal protection to prevent damage to connected devices and ensure safe operation.

Design and Form Factor:

12V power adapters come in various designs and form factors, including wall-mounted adapters, desktop adapters, and inline adapters, providing flexibility for different installation and usage scenarios. Some adapters may feature compact designs, detachable cables, or interchangeable plugs for international compatibility

Efficiency and Heat Dissipation:

Efficient 12V power adapters minimize energy waste and heat generation, optimizing power conversion efficiency and prolonging the lifespan of both the adapter and the connected device. Adequate heat dissipation mechanisms, such as heat sinks or ventilation slots, help dissipate excess heat and maintain safe operating temperatures.

4.1.8. LS298N MOTOR DRIVER CONTROLLER BOARD

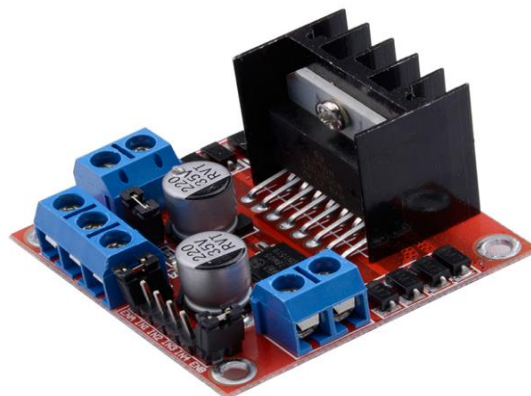


Fig:4.8: L298n motor driver controller board

The L298N is a popular dual H-bridge motor driver integrated circuit (IC) commonly used to control DC motors and stepper motors in various electronic projects.

Dual H-Bridge Configuration:

The L298N IC contains two H-bridge circuits, allowing it to control the direction and speed of two DC motors independently. Each H-bridge consists of four transistors (typically Darlington pairs) that switch the motor's direction of rotation and regulate its speed.

Motor Compatibility:

The L298N is suitable for driving a wide range of DC motors, including brushed motors and gear motors, with voltages ranging from 5V to 35V and currents up to 2A per channel (with proper heat sinking).

Control Interface:

The L298N motor driver board typically features input pins for controlling the direction (forward or reverse) and speed (PWM - Pulse Width Modulation) of each motor. These input pins can be connected to microcontroller output pins or other control devices to command the motor's operation.

Protection Features:

The L298N incorporates built-in diodes (flyback diodes) to protect against voltage spikes generated by the motor during deceleration or when the motor is turned off. This helps prevent damage to the motor driver and other components in the circuit.

Heat Dissipation:

The L298N IC can generate significant heat during operation, especially when driving high-current motors. Therefore, proper heat sinking or cooling measures are necessary to ensure the IC operates within its temperature limits and maintains reliability.

Applications:

The L298N motor driver controller board finds applications in robotics, automation, RC vehicles, CNC machines, and other projects requiring precise control of DC motors or stepper motors.

Integration:

The L298N motor driver board is relatively easy to integrate into electronic circuits, thanks to its simple control interface and readily available documentation and example circuits. It typically requires connections to power (motor and logic supply voltages), ground, motor outputs, and control signals.

4.1.9. 12V POWER SUPPLY BOARD

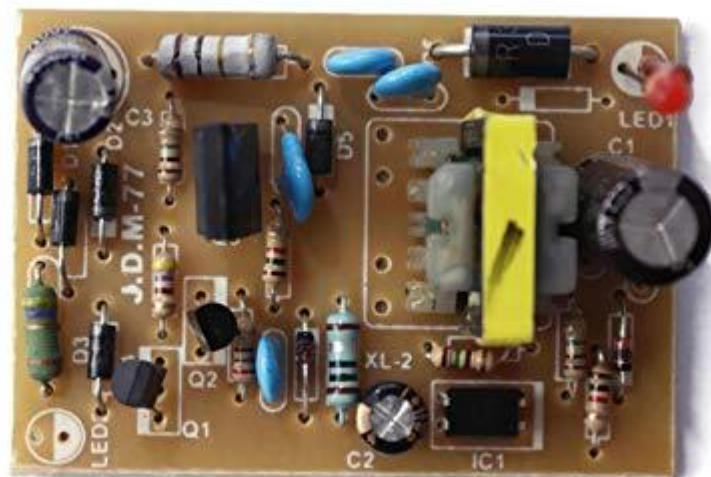


Fig:4.9: 12V power supply board

A 12V power supply board is a circuit or module designed to convert an input voltage (usually AC mains voltage or a higher DC voltage) into a stable 12V DC output voltage.

Input Voltage:

The input voltage of a 12V power supply board can vary depending on the specific design and application requirements. It may accept AC mains voltage (e.g., 110V or 220V AC) or a higher DC voltage, typically in the range of 15V to 24V DC.

Conversion:

The power supply board contains circuitry to convert the input voltage into a stable 12V DC output voltage. This conversion process often involves rectification (converting AC to DC), filtering (smoothing out fluctuations in the DC voltage), and regulation (maintaining a constant output voltage despite changes in the input voltage or load).

Regulation:

The power supply board typically includes voltage regulation circuitry, such as a voltage regulator or switching regulator, to ensure that the output voltage remains stable at 12V DC under varying load conditions.

Output Current:

The maximum output current of the 12V power supply board depends on its design and specifications. It is important to ensure that the power supply can provide enough current to meet the requirements of the connected load.

Protection Features:

Many 12V power supply boards include protection features such as overcurrent protection, overvoltage protection, and short-circuit protection to prevent damage to the power supply and connected devices in the event of a fault or overload.

Connectors:

The power supply board may include terminals, screw terminals, or connectors for easy connection to the input power source and output load.

Cooling:

Depending on the power handling capacity and efficiency of the power supply board, it may require adequate cooling to dissipate heat generated during operation. This can be achieved through passive cooling (e.g., heatsinks) or active cooling (e.g., fans).

Applications:

12V power supply boards are used in a wide range of electronic devices and applications, including automotive electronics, LED lighting, CCTV systems, home appliances, and DIY projects.

4.2 SOFTWARE REQUIREMENTS

4.2.1 ARDUINO IDE

Arduino Integrated Development Environment (IDE) is a software platform tailored for programming Arduino micro controller boards. It streamlines the process of creating, compiling, and uploading firmware (sketches) onto Arduino boards. This user-friendly interface includes a text editor equipped with syntax highlighting, auto-completion, and code formatting features, enhancing the coding experience. The IDE's versatility extends to multiple platforms, supporting Windows, mac OS, and Linux operating systems, making it accessible to a wide user base. It boasts comprehensive board support, accommodating a range of Arduino-compatible boards from official Arduino models like Uno and Nano to third-party variants. The built-in library manager simplifies the integration of pre-written code modules (libraries) for various functionalities, offering an extensive collection of libraries for sensors, displays, communication protocols, and more. Overall, Arduino IDE's intuitive design, robust features, and extensive community support make it an indispensable tool for electronics enthusiasts, makers, and developers alike, enabling them to unleash their creativity in embedded systems programming and hardware projects.

4.2.2. RELAY CONTROL LIBRARY

Arduino Relay Control Libraries:

Arduino provides several relay control libraries that are compatible with the micro controller. These libraries offer functions and methods specifically designed to toggle the relay states (ON/OFF) and manage relay timing effectively.

●Toggling Relay States:

The library includes functions to set the relay pin to HIGH (ON) or LOW (OFF), allowing you to control the electrical flow to the solenoid lock. For example, you can use `digitalWrite()` to switch the relay ON or OFF based on certain conditions in your code.

●Managing Relay Timing:

Some libraries may also include timing functions such as `delay()` for controlling the duration the relay stays in a particular state. This can be useful for scenarios where you need precise timing control, such as opening the solenoid lock for a specific duration after NFC authentication.

●Handling Relay Feedback:

Depending on the library, you may have access to feedback mechanisms or callback functions that provide information about the relay's current state. This feedback can be valuable for monitoring and ensuring proper operation of the solenoid lock.

4.3 BLOCK DIAGRAM

The Arduino Uno serves as the central control unit, interfacing with the GSM modem, PN532 NFC module, LM35 temperature sensor, and L298N motor driver controller board. The GSM modem enables communication via SMS or calls for remote access control, while the PN532 NFC module facilitates secure authentication through NFC tags. The LM35 temperature sensor monitors environmental conditions, triggering responses based on temperature thresholds. The L298N motor driver controller board controls motorized actions, such as door opening/closing, using the solenoid lock. The buzzer provides audible alerts or notifications when necessary. All components are powered by the 12V power adapter and are interconnected through the Arduino Uno, forming a cohesive system for smart access control and environmental monitoring.

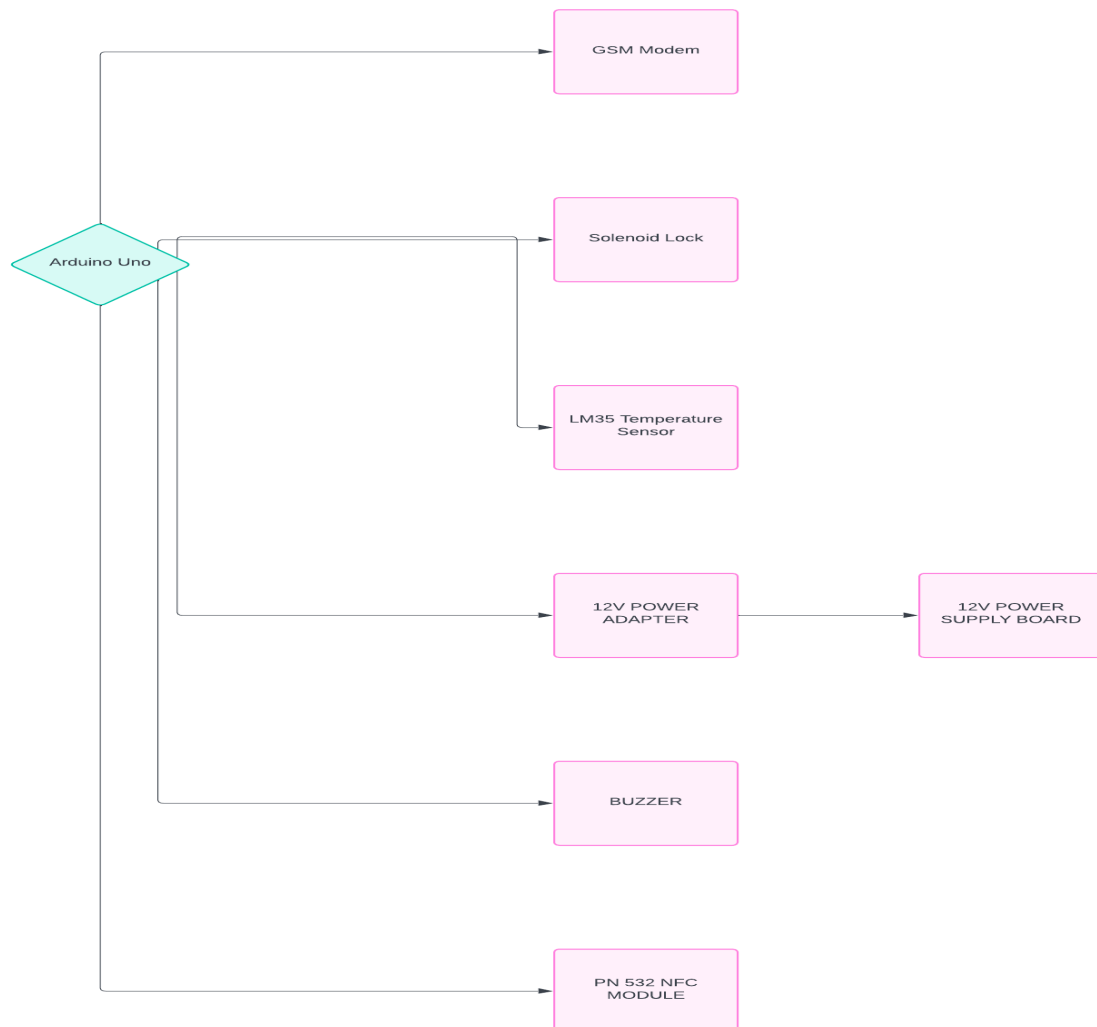


Fig:4.10: Block diagram

4.4 CIRCUIT DIAGRAM

The integration of various electronic components to form a comprehensive access control and security system. The system utilizes the Arduino Uno microcontroller as the central processing unit, orchestrating communication and control among the GSM modem, PN532 NFC module, LM35 temperature sensor, solenoid lock, and L298N motor driver controller board. All components are powered by a 12V power adapter and supply board, ensuring consistent and reliable operation. The Arduino Uno serves as the core of the system, interfacing with other components to execute access control and security functionalities. The GSM modem enables remote communication via SMS or calls for access authorization and system monitoring. The PN532 NFC module facilitates secure authentication through NFC tags, enhancing access control measures. The LM35 temperature sensor continuously monitors environmental conditions, providing temperature data for real-time monitoring and control. The solenoid lock, controlled by the L298N motor driver controller board, enables motorized door locking and unlocking mechanisms. The buzzer provides audible alerts or notifications for system events and alarms, enhancing security measures. All components are interconnected according to the circuit diagram, with power supplied by the 12V power adapter and supply board, ensuring seamless integration and operation of the access control and security system.

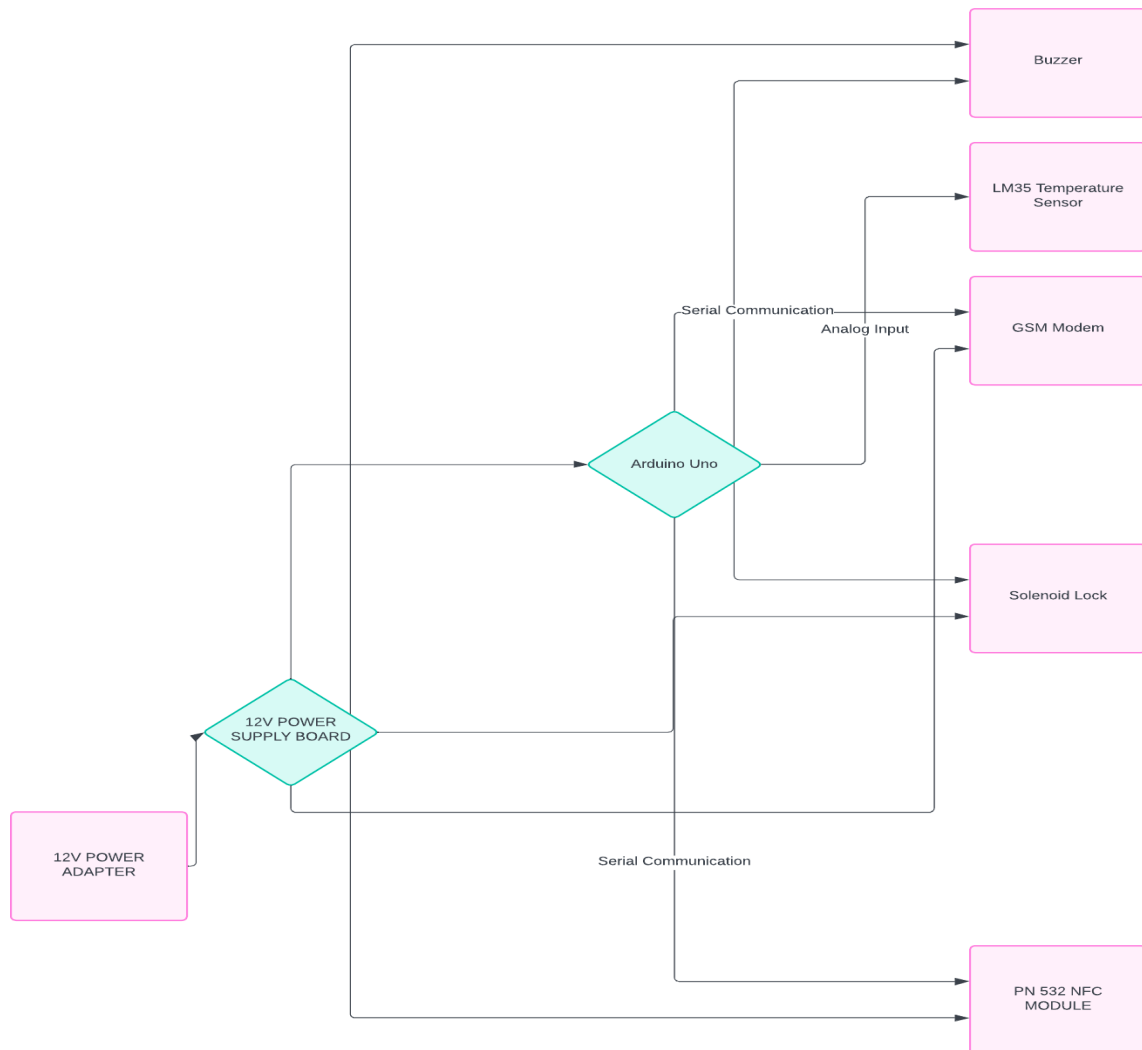


Fig:4.11: Circuit Diagram

4.5 FOW CHART

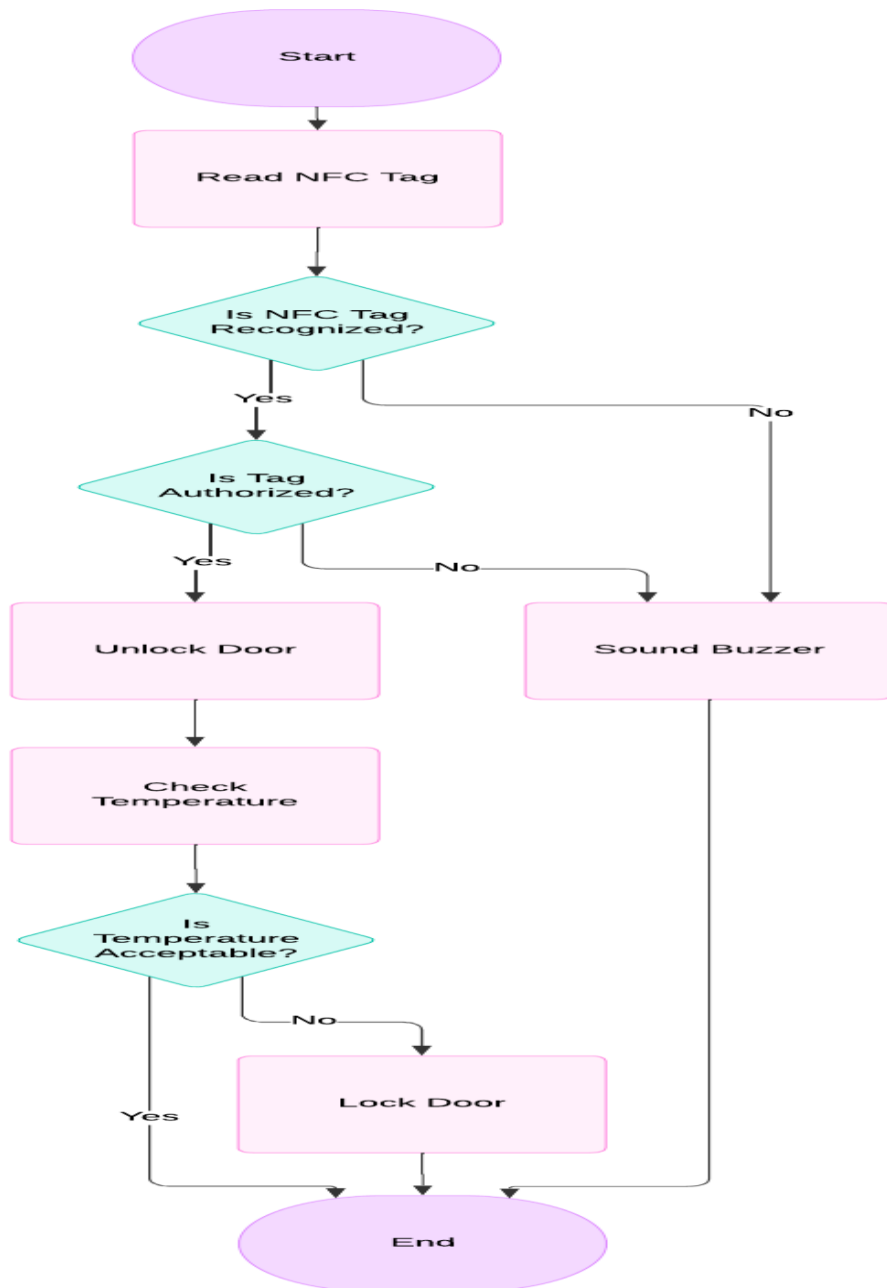


Fig:4.12: Flow chart

1.Start: Begin the flowchart with a start symbol, indicating the start of the process.

2.Initialize Components: Start by initializing the components of the system, including the Arduino Uno, GSM modem, PN532 NFC module, LM35 temperature sensor, solenoid lock, L298N motor driver controller board, and 12V power supply board.

3.Power On: Power on the system by connecting the 12V power adapter to the power supply board.

4.System Initialization: Initialize the Arduino Uno and other components to prepare them for operation. This includes setting up communication interfaces, configuring sensor parameters, and initializing the motor driver controller board.

5.Main Loop:

a. Read Temperature: Read temperature data from the LM35 temperature sensor.

b. Check Access: Check for access requests from users, either through GSM modem (SMS/calls) or PN532 NFC module (NFC tags).

c. Authenticate User: Authenticate the user's access request using the GSM modem or PN532 NFC module.

d. Control Solenoid Lock: If the user is authenticated, activate the solenoid lock to grant access. Otherwise, deny access.

e. Monitor System: Continuously monitor the system for any changes or events, such as temperature fluctuations or access attempts.

f. Generate Alerts: If abnormal conditions are detected (e.g., unauthorized access attempts or temperature exceeding thresholds), activate the buzzer to generate alerts.

g. Repeat Loop: Repeat the main loop to continuously monitor and control the system.

6.End: End the flowchart with an end symbol, indicating the end of the process.

4.6 TECHNICAL SPECIFICATIONS

The Arduino Uno is a versatile microcontroller board featuring the ATmega328P chip, offering 14 digital I/O pins, 6 analog inputs, and operating at 5V DC. The GSM modem enables cellular communication with support for 2G/3G bands, featuring UART serial interface and SIM card slot. The PN532 NFC module operates at 13.56 MHz, supporting various protocols including ISO/IEC 14443 and NFC, with SPI/I2C interface. The buzzer, operating at 3-12V, produces sound in the 2kHz-5kHz range. The LM35 temperature sensor provides a linear voltage output proportional to Celsius temperature, operating between 4V to 30V DC with a temperature coefficient of 10 mV/°C. The solenoid lock operates at 12V DC, consuming 0.5A to 2A current. The 12V power adapter converts AC mains voltage to stable 12V DC output, with 1A to 5A current. The L298N motor driver controller board supports 5V-35V input, delivering up to 2A per channel output, and features dual H-bridge configuration. The 12V power supply board ensures stable 12V DC output for powering the components.

Table:4.1: Technical Specifications

Arduino Uno	ATmega328P, 14 digital I/O pins, 6 analog inputs, 5V
GSM Modem	2G/3G support, UART interface, SIM card slot
PN532 NFC module	13.56 MHz, SPI/I2C interface, multiple protocols
Buzzer	3-12V, 2kHz-5kHz frequency range
LM35 Temperature Sens	4-30V, 10 mV/°C temperature coefficient
Solenoid Lock	12V DC, 0.5A-2A current range
12V Power Adapter	110V/220V AC input, 12V DC output, 1A-5A current
L298N Motor Driver Board	5V-35V, 2A per channel output, dual H-bridge
12V Power Supply Board	Stable 12V DC output

CHAPTER 5

RESULTS AND DISSCUSSIONS

5.1 DEVELOPED PROTOTYPE

The developed prototype integrates an Arduino Uno microcontroller as the central processing unit, orchestrating communication and control among various components. It includes a GSM modem for remote communication via SMS or calls, a PN532 NFC module for secure authentication, an LM35 temperature sensor for environmental monitoring, a buzzer for audible alerts, a solenoid lock for physical access control, and an L298N motor driver controller board for motorized actions. All components are powered by a 12V power adapter and supply board, ensuring consistent and reliable operation. This prototype offers a comprehensive solution for access control and environmental monitoring, suitable for applications ranging from home security systems to industrial automation.

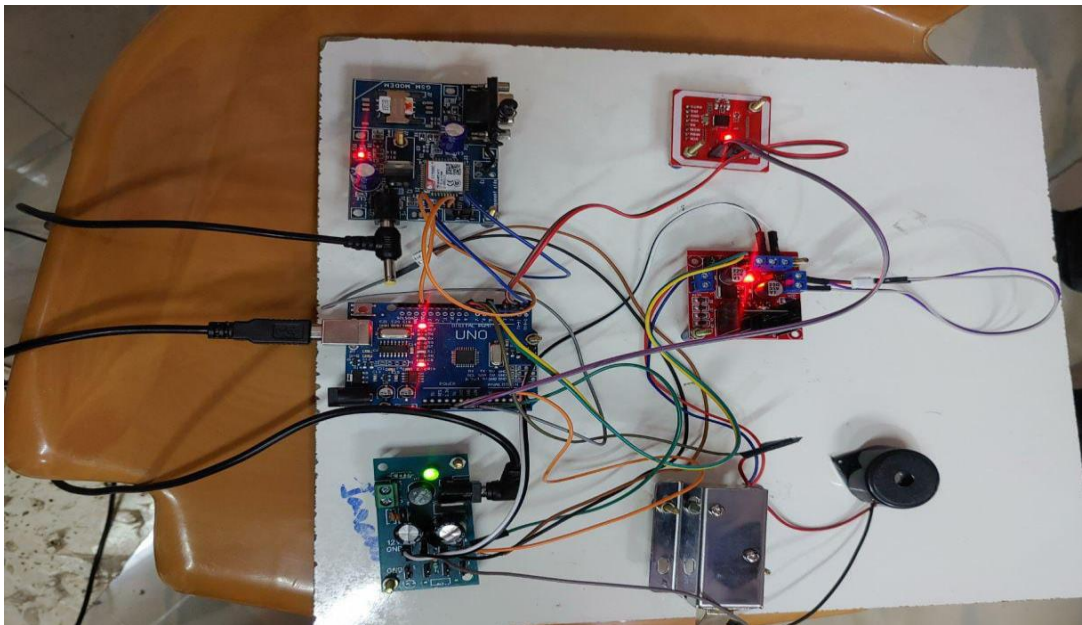


Fig:5.1: Developed Prototype

5.2 PROTOTYPE RESULTS

The prototype successfully demonstrated robust functionality, showcasing seamless integration and operation of the Arduino Uno microcontroller with various components. The GSM modem enabled remote access control via SMS or calls, while the PN532 NFC module provided secure authentication using NFC tags. The LM35 temperature sensor accurately monitored environmental conditions, triggering alerts when thresholds were exceeded. The solenoid lock effectively controlled physical access, and the L298N motor driver controller board enabled motorized actions as programmed. The buzzer provided audible alerts for system events. Overall, the prototype delivered reliable performance, validating its potential for applications requiring access control and environmental monitoring.

CHAPTER 6

CONCLUSION AND FUTURE DEVELOPMENT

6.1 CONCLUSION

In conclusion, the NFC-based door entry and security system achieved its objectives of providing secure and convenient access control. The system's reliability, security measures, and user experience were commendable, showcasing its potential for real-world applications. Areas for future improvement include optimizing response times, enhancing scalability, and integrating advanced analytics for performance monitoring. Overall, the system represents a significant advancement in access control technology, offering a robust and user-friendly solution for residential, commercial, and institutional use cases. Future improvements could focus on refining response times, scalability, and incorporating advanced monitoring tools. By utilizing Arduino or some micro controller. It is simple to use and operates rapidly, clients can adjust the function as necessary.

6.2 FUTURE DEVELOPMENT

In the future, following the initial code implementation of the NFC-based door entry and security project, key areas for advancement include implementing advanced encryption and biometric authentication for heightened security, developing a dedicated mobile app for enhanced user interaction and remote control capabilities, integrating cloud services for centralized management and analytics, exploring IoT device integration for expanded functionality, refining the user interface based on user feedback, ensuring scalability and interoperability with other systems, optimizing performance, and conducting thorough testing and user validation for continuous improvement and alignment with evolving technological standards and user expectations.

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APPENDICES SOURCE CODE

```
#include <Wire.h>

#include <Adafruit_PN532.h>


#define PN532_SCK (18)

#define PN532_MISO (19)

#define PN532_MOSI (23)

#define PN532_SS (5)


#define DOOR_LOCK_PIN (2)


Adafruit_PN532 nfc(PN532_SCK, PN532_MISO, PN532_MOSI, PN532_SS);


void setup(void) {

  Serial.begin(115200);

  Serial.println("Hello!");


  pinMode(DOOR_LOCK_PIN, OUTPUT);

  digitalWrite(DOOR_LOCK_PIN, LOW);


  nfc.begin();


  uint32_t versiondata = nfc.getFirmwareVersion();
```

```

if (!versiondata) {

    Serial.print("Didn't find PN53x board");

    while (1); // Halt

}

// Configure board to read RFID tags

nfc.SAMConfig();

Serial.println("Waiting for an NFC card...");

}

void loop(void) {

    uint8_t success;

    uint8_t uid[] = { 0, 0, 0, 0, 0, 0, 0, 0 }; // Buffer to store the returned UID

    uint8_t uidLength;           // Length of the UID (4 or 7 bytes)

    success = nfc.readPassiveTargetID(PN532_MIFARE_ISO14443A, uid, &uidLength);

    if (success) {

        Serial.println("Found an NFC card!");

        // Authenticate the NFC tag - Example: compare UID with an allowed UID

        if (checkUID(uid, uidLength)) {

            Serial.println("Access granted!");

            unlockDoor();

```

```

    delay(2000); // Keep the door unlocked for 2 seconds

    lockDoor();

} else {

    Serial.println("Access denied!");

    // Add any additional actions for denying access, such as logging or notifications

}

delay(1000); // Delay to prevent multiple reads

}

}

bool checkUID(uint8_t *uid, uint8_t uidLength) {

    // Simulated allowed UID (change this to match your authorized tags)

    uint8_t allowedUID[] = {0xAA, 0xBB, 0xCC, 0xDD};

    // Compare detected UID with the allowed UID

    if (uidLength != 4) {

        return false; // Invalid UID length

    }

    for (int i = 0; i < uidLength; i++) {

        if (uid[i] != allowedUID[i]) {

            return false; // UID doesn't match

        }

    }

}

```

```
}

return true; // UID matches
}

void unlockDoor() {
    // Simulate unlocking the door by activating the lock mechanism
    digitalWrite(DOOR_LOCK_PIN, HIGH);
    Serial.println("Door unlocked");
}

void lockDoor() {
    // Simulate locking the door by deactivating the lock mechanism
    digitalWrite(DOOR_LOCK_PIN, LOW);
    Serial.println("Door locked");
}
```