KEYLESS INFORMATION ENTRY

Prof. Ashvini. H. Kale[1], Prof. Gayatri B. Ghangale[2], Prof. Deepak U. Chaudhari[3], Prof. Sanika S.Lokhande[4]

[1] Department of Electronics & Telecommunication Engineering
[2] Department of Electronics & Telecommunication Engineering
[3] Department of Electronics & Telecommunication Engineering
[4] Department of Electrical Engineering

ABSTRACT-

Humans have invented locks since ancient times; to use them to protect their privacy and personal belongings, they are constantly evolving over the ages for better protection. But the problem is that locking the door these days is not safe and can be easily bypassed. Our doors can be forgotten, and this is a common occurrence for most people. Locks are trying these days to depends on technology by using a code or phone or by card to make our things safer. But there are limits, which are the lack of features to be combined in one place. also, the lack of high-security features. To solve this problem, we need to combine all the modern security features into one lock as well as monitoring features. Thus, we have high security, comfortable opening, and closing systems, and features that help us easier and faster, all requirements do not conflict and help to make our homes safer than before.

1. Introduction :

With the continuous evolution of technology, the need for reliable home security systems has become more pressing than ever. The rise in home intrusions has amplified the demand for advanced security solutions, as users now seek to protect their homes and belongings, especially with the proliferation of smart home devices, wearable tech, and connected vehicles. Biometric-based security systems, currently popular in the market, rely on physical traits like fingerprints for access control. However, these systems can be impacted by environmental factors, such as wet or dirty conditions, which reduce their reliability. Additionally, the high cost of biometric systems makes them inaccessible to many users.

For instance, fingerprint locks may struggle to function efficiently in rainy weather, where moisture can compromise the scanner's ability to read the fingerprint accurately. This scenario highlights the limitations of these technologies and the need for more adaptable, cost-effective alternatives that provide reliable security regardless of physical conditions. As economies grow, the importance of security has become increasingly critical. Banks, financial institutions, and government offices are seeking intelligent systems to prevent unauthorized access, trespassing, and intrusion. Traditional locking and unlocking methods present significant challenges, such as the risk of lost or stolen keys.

The advent of smartphones, which typically support various short-range technologies like Wi-Fi, Bluetooth, and GSM/GPRS, has paved the way for innovative solutions in access control. This evolution allows for the development of smart locking systems that users can operate securely through their mobile devices.

In today's digital landscape, most mobile phones are smartphones, which offer advanced connectivity features far beyond those of traditional cell phones. According to ABI Research, by the end of 2013, there were approximately 1.4 billion smartphones in use globally, with 798 million running Android, 294 million on Apple's iOS, and 45 million using Windows Phone. These devices typically support various short-range wireless technologies, such as Bluetooth and infrared, enabling seamless data transfer.

2.1 Literature Review :

Ensuring home security has always been a critical concern, and the advancement of technology has brought about innovative solutions for securing residential and commercial properties. Recent studies have explored various smart locking systems that combine multiple communication technologies, improving both security and user convenience. This chapter reviews several research papers that focus on smart door lock mechanisms using technologies such as Keypad, bluetooth, GSM, and Bluetooth Low

Energy (BLE). The literature emphasizes improved safety features, user-friendly interfaces, and remote control capabilities for enhanced protection.

2.2 Review of Related Literature

2.2.1 Keypad/Bluetooth/GSM Based Digital Door Lock Security System (Umbarkar et al., 2017)

Umbarkar et al. (2017) proposed a digital door lock security system that integrates multiple access methods: Keypad, Bluetooth, and GSM. The system utilizes an Arduino microcontroller to coordinate the lock mechanism, ensuring enhanced versatility. A 4-digit password mechanism is employed across all three modules to ensure user authentication. Notably, the system provides enhanced security by alerting the owner via SMS and triggering a buzzer alarm in case of unauthorized access attempts after three failed password entries. The authors demonstrated that the system effectively balances security with accessibility, proving highly effective during experimental testing. The integration of multiple technologies enhances security while ensuring a flexible access mechanism for users.

2.2.2 Smart Door Locking System Using Bluetooth (Anjaiah et al., 2024)

Anjaiah et al. (2024) developed a Bluetooth-enabled smart door locking system designed for home automation applications. This system employs an Arduino microcontroller connected to a Bluetooth module to facilitate smartphone-based access control. By enabling users to lock and unlock doors via a mobile application, the solution emphasizes convenience and accessibility. The authors highlighted the system's practical implementation, which simplifies the user experience through remote access features. By eliminating the need for physical keys, this system offers enhanced security while providing a seamless user interface for controlling door access. The study demonstrates how Bluetooth connectivity effectively addresses the growing need for smart home automation systems.

2.2.3 Smart Door Locking System Based on Smartphone and GSM Module (Khalid & Abd, 2021)

Khalid and Abd (2021) explored the integration of smartphone connectivity with GSM modules for enhanced door lock security. Their system is based on an Arduino microcontroller and SIM 900 GSM module, facilitating both proximity control and remote access. Users interact with the system via a graphical user interface (GUI) developed using Arduino IDE and MIT App Inventor, allowing intuitive control over the lock mechanism. The study emphasizes the system's enhanced security features, particularly in critical situations requiring immediate access control. This combination of Bluetooth and GSM modules offers a comprehensive solution that effectively meets the demands of modern home security requirements.

2.2.4 A Review on Bluetooth Low Energy Enabled Door Locking Systems (Kumar et al., 2022)

Kumar et al. (2022) conducted a detailed review of Bluetooth Low Energy (BLE) technology and its applications in smart door locking systems. The study highlights BLE's low power consumption, reliability, and ability to unlock doors automatically when the user approaches. By integrating an Arduino microcontroller, Bluetooth module, and solenoid actuator, the system minimizes manual intervention, enhancing user convenience. The research also emphasizes key factors such as signal strength, connection latency, and energy efficiency, showcasing BLE's potential as a viable solution for smart home security. The review underscores BLE technology's growing adoption due to its energy-efficient design and effective performance in securing residential properties.

2.3 Comparative Analysis

The reviewed studies collectively address key limitations of conventional door-locking mechanisms by introducing advanced features such as keyless control, remote accessibility, and real-time alerts. While Umbarkar et al. (2017) introduced a multi-modal access system combining Keypad, Bluetooth, and GSM for versatile access, Anjaiah et al. (2024) emphasized simplicity and user convenience through smartphone-based Bluetooth control. Khalid and Abd (2021) provided a comprehensive system with GSM integration, allowing users to manage entry points remotely. Kumar et al. (2022) highlighted BLE's efficiency and automated unlocking feature, making it an ideal choice for smart home security. Each approach brings unique strengths, offering improved security, reliability, and user convenience.

2.4 Problem Statement

Traditional door-locking mechanisms often rely heavily on physical keys, which are prone to loss, duplication, and unauthorized access. Additionally, conventional systems typically lack real-time notification features, limiting their effectiveness in securing properties when occupants are away. The existing research highlights the need for a comprehensive solution that integrates multiple technologies for both proximity and remote access control. This study aims to address these limitations by proposing a smart door-locking system that combines Bluetooth for local access, GSM for long-range control, and real-time notifications for improved security. By leveraging these technologies, the proposed system offers a reliable, efficient, and user-friendly solution for modern security needs.
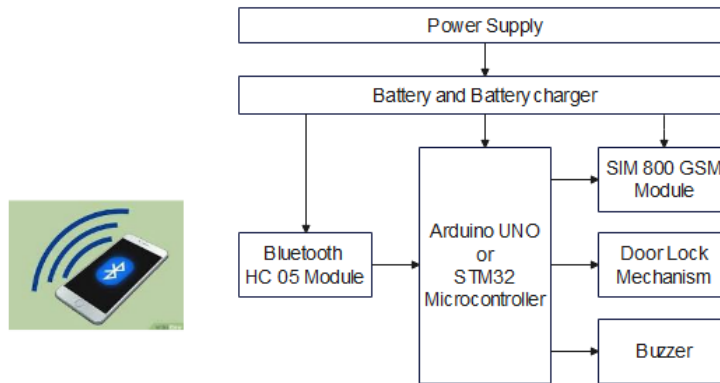
3.1 Block Diagram :

Fig 3.1: Block Diagram

Components and Operation:

1. **Power Supply**:
   o This supplies electrical power to the entire system. It could be a DC source or connected to an AC supply through a converter.

2. **Battery and Battery Charger**:
   o A backup battery is included to ensure the system remains operational even during power failures. The battery charger ensures the battery is always charged and ready to use.

3. **Arduino UNO or STM32 Microcontroller**:
   o This is the brain of the system, responsible for processing inputs from the Bluetooth module, GSM module, and managing the door lock mechanism and buzzer.
   o It controls the communication between the smartphone (via Bluetooth), GSM module, and other connected hardware like the door lock and buzzer.

4. **Bluetooth HC-05 Module**:
   o This Bluetooth module enables wireless communication between the user's smartphone and the microcontroller.
   o Users can connect their smartphone to the Bluetooth module to control the door lock. Commands sent via a mobile app (e.g., lock/unlock) are transmitted to the microcontroller.

5. **SIM 800 GSM Module**:
   o The GSM module is used for sending and receiving SMS, especially for security purposes.
   o If there is any unauthorized access or tampering with the microcontroller, it will send a warning SMS to the preset owner's phone number using this GSM module.

6. **Door Lock Mechanism**:
   o This is the physical locking mechanism controlled by the microcontroller.
   o The door can be locked or unlocked based on the instructions sent by the microcontroller after receiving input from the Bluetooth or GSM system.

7. **Buzzer**:
   o The buzzer acts as an alert system. If there is unauthorized access (such as multiple incorrect password attempts), the buzzer will sound, warning of an intrusion.

3.2 Working Principle

1. **Bluetooth Operation:**
   a) The user connects their smartphone to the system via the Bluetooth HC-05 module.
   b) Once connected, the user can send a command to lock or unlock the door using a mobile app. The command is received by the Bluetooth module and passed to the STM32 microcontroller.
   c) The microcontroller processes this command and activates the door lock mechanism, either locking or unlocking the door accordingly.
2. **GSM Operation:**

a) If there is any unauthorized access or tampering with the microcontroller or failed attempts to unlock the door, the microcontroller triggers the GSM module to send a warning message to the owner's phone.

b) The GSM module can also be used for remote locking/unlocking by sending an SMS command to the system.

3. Security and Alerts:

a) If unauthorized access is detected, the system will trigger both a physical and digital alert:

b) The **buzzer** will start sounding, indicating an intrusion.

c) Simultaneously, the **GSM module** will send a security alert SMS to the registered mobile number, informing the owner of the potential security breach.

4. Power Management:

a) The system runs on external power, but in case of a power failure, the battery backup ensures continuous operation. This is critical for ensuring that the lock functions even in the absence of mains power.

3.3 Circuit Diagram
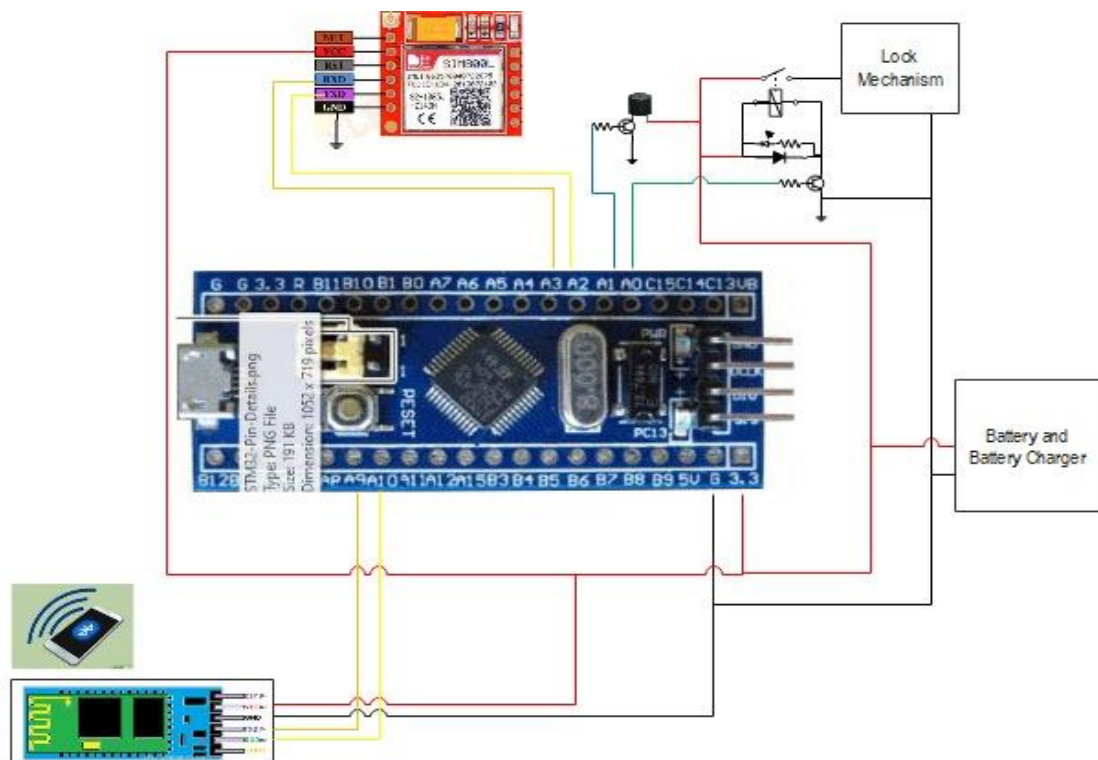
Conclusion :

Implementing a smart door lock system using STM32 microcontrollers along with Bluetooth (HC-05) and GSM (SIM800) modules is an innovative and feasible project. The system leverages the advantages of modern technology to provide a secure and convenient solution for controlling door locks both locally and remotely. Through Bluetooth, the system allows short-range wireless control via a smartphone, offering a quick and easy way to lock and unlock doors without physical keys. Additionally, the integration of the GSM module enables remote control through SMS or calls, making it possible for users to manage their door lock from anywhere, thus enhancing security. This project not only caters to smart home applications but is also suitable for offices, rental properties, and other secure areas where remote access and real-time alerts are beneficial.

The system's hardware components, including STM32 as the core microcontroller, are widely available and supported by a large community, making the development process straightforward and cost-effective. Programming is flexible using popular platforms like Arduino IDE or STM32CubeMX, and the system can be further enhanced by incorporating additional features such as fingerprint identification for biometric access or encryption protocols to

safeguard against unauthorized access. With proper power management techniques, this battery-operated system can be designed to operate efficiently for long periods, making it reliable for real-world use.

In conclusion, building a smart door lock system is not only an educational endeavour but also a highly functional project with real-world applicability in modern security systems.