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Smart Wi-Fi Door Lock System

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Abstract: ***As technology has advanced, Smart Door Locking systems have also evolved, which also appears to be required after considering rising levels of criminal activities. Thefts like stealing money, jewels or any other documents for personal benefit, robbery, and many more from banks, corporate offices, financial and government organizations have prompted the foundation to raise the security level. This project enables owner to be fully in control of locking/unlocking of door despite being miles away from it. Android based this intelligent internal door locking system has been developed for blocking unauthorized entry, trespass, and intrusion. With remote access, high-level security features, and seamless integration functionality, the suggested system signifies a revolutionary progress in smart lock technology. The affordable deployment with improved functionality and user friendly interface makes it extremely helpful. This suggested idea is a step ahead in the innovation and revolution of the security levels system. The machine doesn't enable the door to open without receiving the signals from the application sent.***

I. INTRODUCTION

Over the last few years, there has been an unprecedented rise in the demand for more intelligent and secure access control systems owing to heightened issues regarding security and convenience. Mechanical locks, though highly prevalent, carry a number of drawbacks such as the possibility of lost or replicated keys, the complexity of handling access for multiple users, and the absence of remote control capabilities. These problems have motivated the creation and implementation of Internet of Things (IoT)-based smart locks. Of these, the Smart Wi-Fi Door Lock System is a contemporary, effective, and convenient solution for home, office, and factory security requirements.

Through Wi-Fi connectivity and IoT technologies, smart door locks also offer remote access and control using specialized smartphone applications. These allow users to lock or unlock doors remotely from any location, access logs, receive real-time notifications of door activity, and grant or withdraw access permissions in real time. Integration with other smart home components like surveillance cameras, alarms, and voice assistants adds to the overall security environment. Along with this, smart locks now offer sophisticated capabilities such as fingerprint- or face-recognition-based biometric authentication, anomaly detection powered by artificial intelligence, and end-to-end encryption-based communication, making them exponentially more secure and dependable compared to traditional locking solutions.

The goal of this project is to create a low-cost, secure, and easy-to-install Smart Wi-Fi Door Lock System that fits the particular requirements of the Indian market. In contrast to most commercially sold smart locks, which are costly and come with periodic subscription or professional installation, this system is focused on ease and low cost. It employs ordinary components and open-source platforms to keep production costs low without sacrificing rudimentary security features. The lock is easy to be installed and configureured by end –users without technical skills, and the provided mobile app is very user-friendly for controlling access.

Indian home security and smart lock market is expanding at an incredibly high level. The market was approximately USD 1.30 billion in 2024 and is expected to reach USD 12.59 billion in 2033 with a healthy compound annual growth rate (CAGR) of 28.70%. Growth is driven by increasing digital awareness, increasing internet penetration, and growing concern over office and housing security. Important players such as Godrej & Boyce, Assa Abloy, and Dormakaba are heavily investing in smart locking solutions.

These include high prices, complicated installations, dependence on proprietary software, and cybersecurity threats arising from wireless communication vulnerabilities.

To overcome these issues, this project suggests a smart door lock system with some unique characteristics. It is made highly cost-effective by not using costly proprietary hardware and instead utilizing open-source software. The plug-and-play feature of the system makes it easy for even non-technical users to install and use it. Functionality-wise, the system offers real-time alerts for door usage, such as unauthorized access attempts, and remote locking/unlocking through a smartphone. Strong encryption protocols used make data secure, avoiding hacking and unauthorized access. Additionally, the device has a battery backup and offline access mode, which allows it to continue functioning during power outages or Wi-Fi disconnections.

This intelligent lock system can be used in a vast array of applications. In home use, it enables remote monitoring and control of entry, grants temporary access to visitors or maintenance staff, and keeps an audit trail of all entry occurrences. In office application, it facilitates control of access of employees to sensitive spaces and enhances management of overall security. Industrial complexes like factories and warehouses can also take advantage of secure access to equipment rooms and storerooms. Banks and other financial institutions can also use the system to lock vaults and sensitive areas of operation.

Briefly, the Smart Wi-Fi Door Lock System developed by this project is an affordable, feasible, and marketable option that addresses the current shortcomings of both traditional and commercial smart locks. With affordability, convenience, and efficient security measures being top priorities, the system aims to serve the growing demands of users in the Indian market while promoting the overall adoption of IoT-based security systems.

II. COMPONENT DESCRIPTION

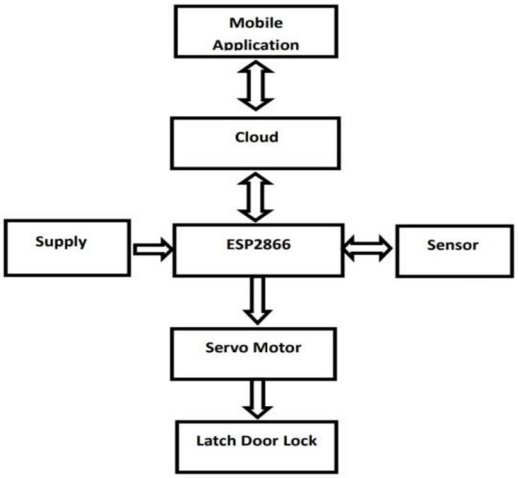

Figure 1: Block Diagram of Smart Wi-fi DoorLock System

A. ESP8266 Node MCU (Microcontroller unit) Wi-Fi Development Board

Node MCU is an ESP8266 Wi-Fi System-on- Chip (SoC) board. It is a mix of microcontroller functionality with an integrated TCP (Transmission control protocol)/IP (Internet protocol) stack, making it simple to communicate over Wi-Fi. It contains a series of GPIO (General purpose input/output) pins, therefore perfect for use with a lot of sensors and actuators.

- It supports serial communication and can be programmed using popular platforms such as the Arduino IDE (Integrated development environment) and Lua.
- Due to its low cost, compact size, and built- in Wi-Fi module, it is highly suitable for Internet of Things (IoT) applications.
- The board is commonly used in research and development for rapid prototyping of smart systems, remote monitoring, and automation based applications.
- Its flexibility and open-source hardware/software environment make it a preferred choice in both academic and industrial research.

Figure 2: ESP8266

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B. SG90 Micro Servo Motor

The SG90 micro servo motor is widely used in embedded systems, robotics, and automation due to its compact size, low cost, and ease of integration. It is designed to operate within a voltage range of 4.8V to 6V DC and is capable of delivering a torque of up to 1.8 kg/cm, which is suitable for light mechanical operations and precise control operations. The servo motor employs Pulse Width Modulation (PWM) to control the angular position, which delivers a range of rotation typically between 0° and 180°, which is suitable for applications requiring precise angular displacement.

Designed using plastic gears, the SG90 is ideal for light-duty operations, hence economical and widely used in education and research prototypes. It is compatible with various microcontrollers such as the Arduino, ESP8266, and Raspberry Pi, and can be powered by regular PWM signals without the need for additional driver circuits.

The simplicity of the mechanisms and the high power efficiency of the SG90 make it ideal for motion control in experimental study projects, particularly in automation, mechatronics, and Internet of Things-based projects. With its accessibility, reliability, and large community following, the SG90 is a basic hardware device in experimental set-ups, particularly in projects that are concerned about space and finances.

Figure 3: Servo Motor

C. Rocker switch

A rocker switch is a widely used electromechanical device for regulating the flow of current in an electric circuit. Because of their ease of use, dependability, and durability, rocker switches are widely used in appliances, power supplies, and embedded electronic systems. They are a basic interface in research and development applications where components or systems must be turned on or off manually, and their ease of construction and handling make them suitable for prototyping and end-product usage. Depending on their intended use, rocker switches can be single or double pole and can be applied to AC or DC circuits.

Their straightforward design and tactile feedback make them ideal for both prototyping and final product implementations. Depending on the application, rocker switches are available in single
or double pole configureureurations and are compatible with both AC and DC circuits.

Specifications:

- Switch type: SPST (Single Pole Single Throw)
- Rated voltage: Typically 125V AC or 250V AC
- Current rating: Around 6A to 10A
- Mounting type: Panel mount
- Function: ON/OFF control

Figure 4: Rocker switch

D. Reed Switch Door Sensor

Reed switch door sensor is one of the magnetic sensors employed to detect the opening or the closing of doors and windows. The operation of the sensor is on the principle of the interaction between a couple of ferromagnetic contacts contained in a glass capsule and the external magnetic field. As the magnet approaches the reed switch, the contacts are closed, thus making an electrical circuit; as the magnet recedes, the contacts open. Such a simple yet efficient mechanism makes reed switches very appropriate for security systems, home automation, and monitoring.

In research uses and in embedded systems, reed switch door sensors have widespread use for position detection, event-triggered automation, and access control.

Specifications:

- Sensor type: Magnetic reed switch
- Operating voltage: 3.3V to 5V (logic level compatible)
- Switching type: Normally open (NO) or normally closed (NC)
- Sensing distance: Typically 10-20 mm
- Contact rating: ~100 mA at 100V DC (varies by model)
- Application: Door/window position detection, security systems, IoT-based monitoring.

Figure 5: Reed Switch Door Sensor

E. Battery

A 9V battery is an easily available handheld power source, which is used extensively in low-voltage electronic circuits, prototyping, and embedded system design. It is formed of six 1.5V cells connected in series in a small rectangular package. The nominal output voltage of the battery is 9 volts, which is suitable to power a number of sensors, modules, microcontrollers, and wireless devices

In research and academic settings, 9V batteries are used generally because they are readily available, easy to incorporate, and can supply enough power for small systems like IoT nodes, test circuits, and single-board embedded systems. They are plug-and- play, enabling flexible, mobile, and wire-less operations during test time, especially in proof-of- concept prototypes and presentations.

Specifications:

- Nominal Voltage: 9V DC
- Battery type: Alkaline (commonly), also available in rechargeable (Li-ion or NiMH) variants
- Capacity: Typically 400–600 mAh (alkaline)
- Connector type: Snap-style (PP3)
- Applications: Portable electronics, embedded systems, IoT devices, testing circuits

Figure 6: Battery

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III. SYSTEM IMPLEMENTATION

A. Implementation

Setting up hardware components- First assemble all the required components, such as the ESP8266, Servo Motor, Latch Lock, Battery, Reed Door Sensor.

Writing- The code for the Arduino UNO board should be written. The code consists of giving the signal to sensor and servo motor and then motor rotates at a certain angle and latches and unlatches the lock. Then a code is written for providing a security alert message for any forced Entrance and message is to person's G Mail.

Uploading the code to the ESP8266 board- Once the code is written, it is uploaded to the ESP8266 Board through a USB cable connected to the computer.

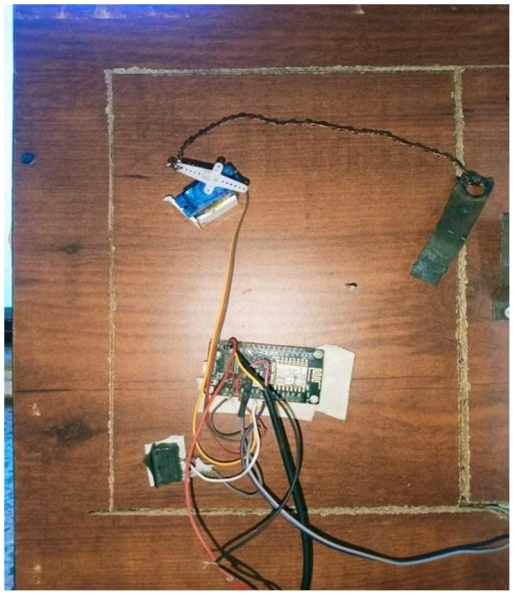

Figure 7: Components implementation

Displaying the message- The message "Intruder Alert!" for any forced entrance without the permission of the individual.

B. Connection

IR Sensor → Arduino

- VCC: 5V
- GND: GND
- Output: Digital Pin 10

Relay Module → Arduino

- VCC: 5V
- GND: GND
- IN: Digital Pin 7

Motor & Battery

- Motor connected to Relay NC (Normally Closed) through switch
- Relay NO (Normally Open) left unconnected
- Positive of 4V Battery to Motor
- Negative of 4V Battery to Relay COM

Buzzer Connection

- Positive: Digital Pin 13
- Negative: GND

Switches

- Connected to 9V Battery for manual control.

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IV. RESULTS

A. Testing

The system was also tested by manually pushing the door at the locked position and by intruding to see if the sensor is in good condition and senses the door activity properly. The circuit is functioning correctly and sends the alert message to the user. Then, unlock the door by using mobile application and test if the mechanical lock is rotating or not.

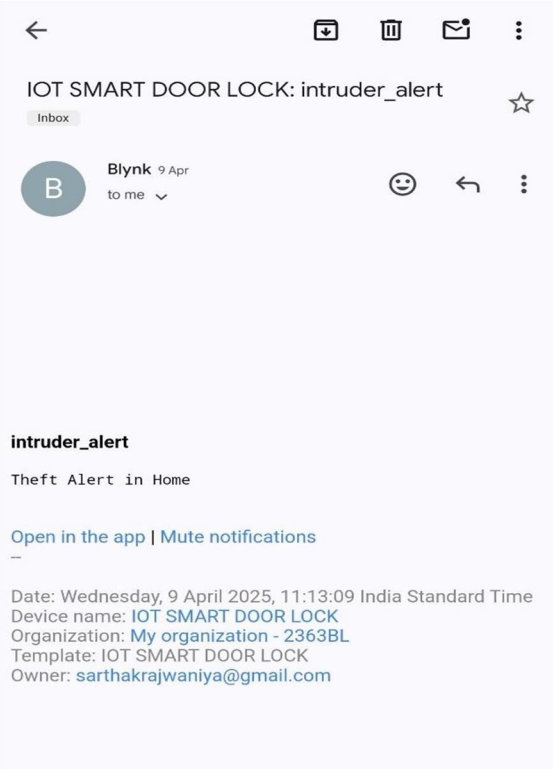

Figure 8: Snapshot of alert notification

B. Result

The Smart Door Lock System demonstrated has reliable performance in locking/unlocking of the door through mobile application irrespective of the distance globally. The development and evaluation have promising results in terms of usability, security, and functionality. The prototype was tested and yields some findings such as response time of 1.4 sec for locking/unlocking, success rate of 98%, satisfaction level of user increased to a large extent. Overall, the system is proved effective in enhancing and leveling up the security system, offering a responsive and automated solution for trespassing and intrusion detection. The integration of alerting on unauthorized access could further improves the importance in real- world applications.

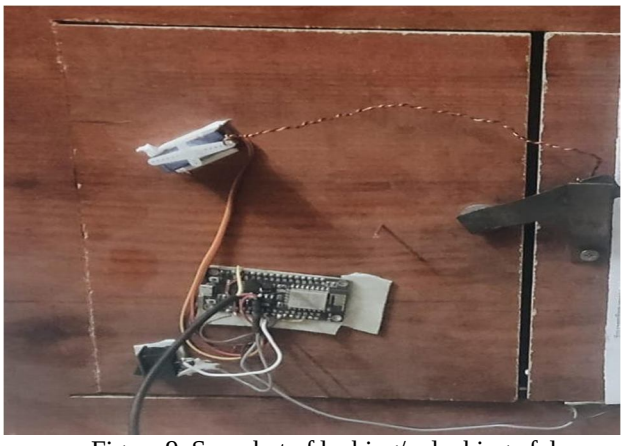

Figure 9: Snapshot of locking/unlocking of door

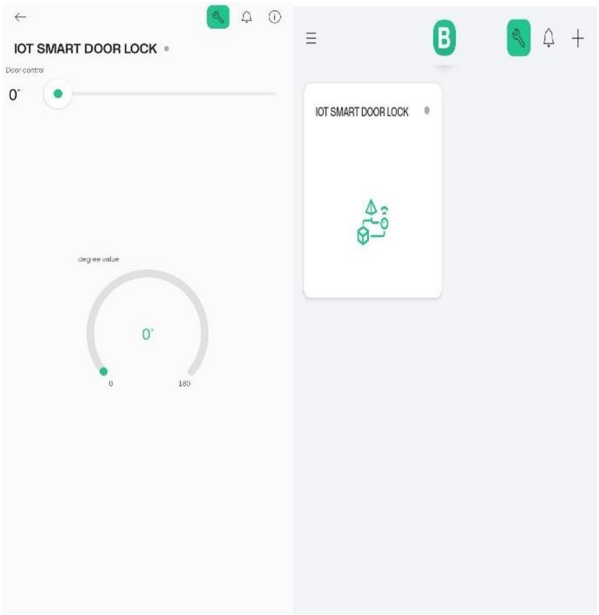

Figure 10: Snapshot of mobile application

V. CONCLUSION

In conclusion, in this research, we have discussed the key points of the chosen subject in detail. The results present significant trends and observations of relevance to the subject matter. On assessment and review, we have exposed strengths and weaknesses of current methodologies. The evidence supports our initial hypothesis underpinning the research agenda. Additionally, pragmatic uses of this research can be beneficial to academia and industrial application. Found limitations provide the scope for further research. Applied methodologies were fruitful in gathering genuine information. Our research significantly contributes to the literature. Further study in the field is needed for further understanding. Finally, this research provides an effective platform for future development.

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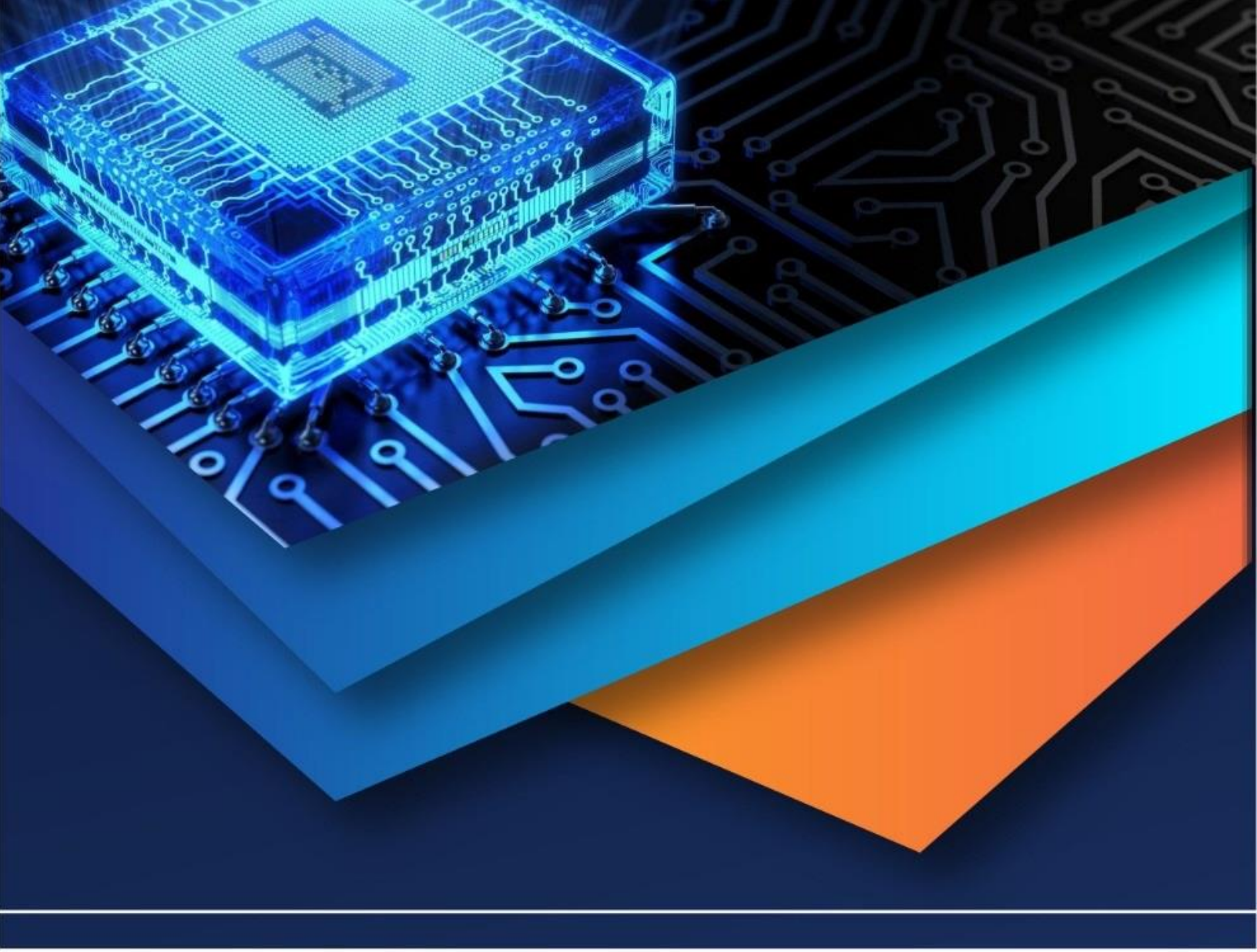

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