

Design and Implementation of an IoT-Based Smart Door Security System

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ABSTRACT

The term "Internet of Things" refers to the linking of machines, buildings, and other objects using sensors, electronics, software, and other accessories to connect, share, and exchange data.. As technology advances daily, intelligent security solutions are created and put into place to prevent unauthorized access. The main goals of using security systems are to ensure user safety, confidentiality, and privacy. Our effort centered on creating an Internet of Things (IoT)-based smart door with an Arduino as its microcontroller, a servo-motor to regulate whether the lock is pulled or pushed, and a Wi-Fi module to connect to other devices. The user's smart phone was configured as the principal device for system control, and the installation of the program on that phone have provided enough security. Password is being used to authenticate the systems.

Keywords: Internet of Things, Arduino, lock systems, Servo-motor, Android Smartphone, Password.

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1. INTRODUCTION

Door locks have been used for security purposes since early time with the main goal of preventing unauthorized access to specified areas, Anaza et al (2017). Over the ages, these lock systems have undergone numerous revolutions and modifications, helping to provide the groundwork for contemporary security systems. The development of digital and computer technology opened up a lot of new possibilities and enhanced door locking mechanisms. Additionally, new door lock inventions that combine the idea of conventional lock systems with digital technologies have been made in response to the constantly expanding demands for security, privacy, and safety in contemporary society.

These modern lock technologies include things like biometric scanners, PIN codes, and thumbprint recognition. These modern digital locks differ significantly from their older physical counterparts in that they can be opened without a physical key. As a result, there is less chance that users may misplace their key and be unable to open the lock. Due to the high cost of many digital lock systems, many individuals still use traditional combination or physical key locks today. The demand for a sophisticated system to efficiently monitor and control all major appliances in a building rises along with technological advancements. Digital homes have developed into smart homes in recent years. Smart home technology is expanding along with the use of smartphones and the Internet.

This work however present a smart door security system based on IoT been designed and implemented. The technology protects the building's resources from unauthorized users accessing the smart door.

2. LITERATURE REVIEW

The Internet of Things (IoT) is a global network of IP-connected computer networks, sensors, actuators, machines, and other things that links the offline world to the online environment. It is also known as ambient technologies or embedded systems. Numerous smart home models have been put forth to enhance quality of life. The house door is a significant and essential component of any smart home since the door system must be user-friendly, effective, and safe enough to function properly and prevent unauthorized access to the home. The use of ESP8266 and Arduino to create a cloud-based device was discussed by Mahindra et al. in 2020. The main goal is to open an electric door lock with an IoT-enabled Android app on a smart phone which no longer requiring direct user interaction, the Android Operated Door Lock utilized Bolt. This system is simple to install and extremely cost-effective.

A microcontroller-based home security system using GSM technology was created by Begum et al. in 2019. A cell phone connects to the microcontroller through Bluetooth to control the system. The security system is reliable because of its bi-modal (parallel) architecture, however neither the code registration mechanism nor the auto-generated code routine are present in the microcontroller programme. The design can be changed to become a multiprotocol device by including an automatically generated code device and serializing the security features.

Anaza et al. (2017) reviewed part of the literature on intelligent security lock systems and discussed their concepts, benefits, and potential modifications. Each item of examined literature is split into one or more protocols depending on the amount of security features in the lock system. While many protocols have several security features, a single protocol system only has one. The method generates a singular solution that addresses the issue of a time-consuming literature review.

A microcontroller-based biometric locker system with short messaging service was created by Crystalynne et al. (2016). The locker is unlocked after the fingerprint scan and saved pattern match. When an unidentified fingerprint was found, the worldwide system for mobile (GSM) module was able to send a text message with the locker's automatically created pass code. It is an easy and dependable method of locking down a system, but there is no mechanism for registering a new user's finger pattern. The security reliability can be improved by including registration mode and adding more security elements.

Shaik et al. (2016) presented a solution that is using a cheap and power-efficient controller interface system with a Raspberry Pi. When a visitor makes a motion detection at the door, a camera module connected to a Raspberry Pi takes a picture, saves it, and then sends an email alert using TCP/IP. The system can be managed and the camera module's video stream can be viewed on a smart phone by the responsible authority. When an intruder was identified, the system also allowed concerned authorities to send a voice alarm command using a smart phone. On an active SSH (Secure Shell) page built on the Android platform and supplemented with JavaScript, users may keep an eye on visitors and manage the door lock. In places where actual presence is not always available, this approach finds widespread application. The entire control system is built using ARM1176JZF-S microcontroller and tested for actual use in home environment. Using an ARM1176JZF-S microprocessor, the full control system was constructed and evaluated for use in a domestic setting.

3. METHODOLOGY

3.1 Design of Prototype

The Smart Door Lock, SDL functionality was handled by the prototype, which also included a suitable microcontroller, wireless devices that continuously transmit radio signals that can be detected by smart devices (such as smartphones) via a connective protocol (such as WiFi), a cloud that can contribute to secure and reliable communication, and an API that can handle SDL functionality. The system can notify the homeowner and/or authorities in the event of unwanted access.

3.2 Architecture of System

The System Architecture is depicted below

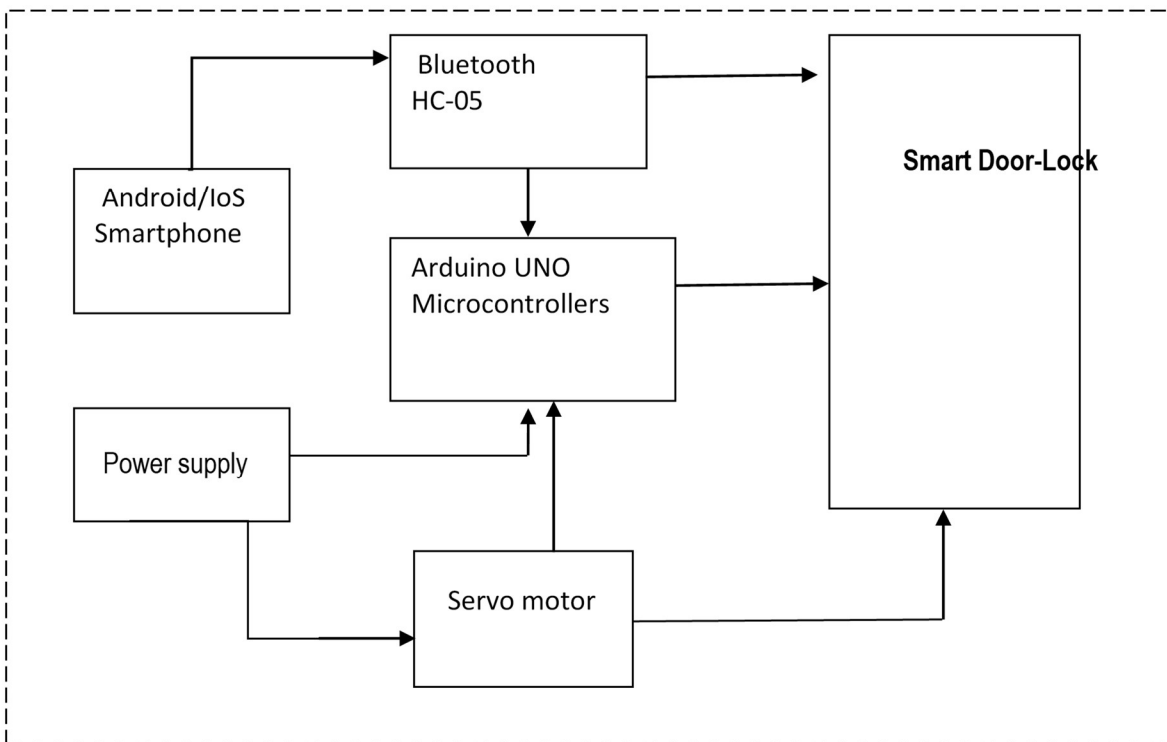


Figure 1: Block Diagram of the Smart Door-Lock

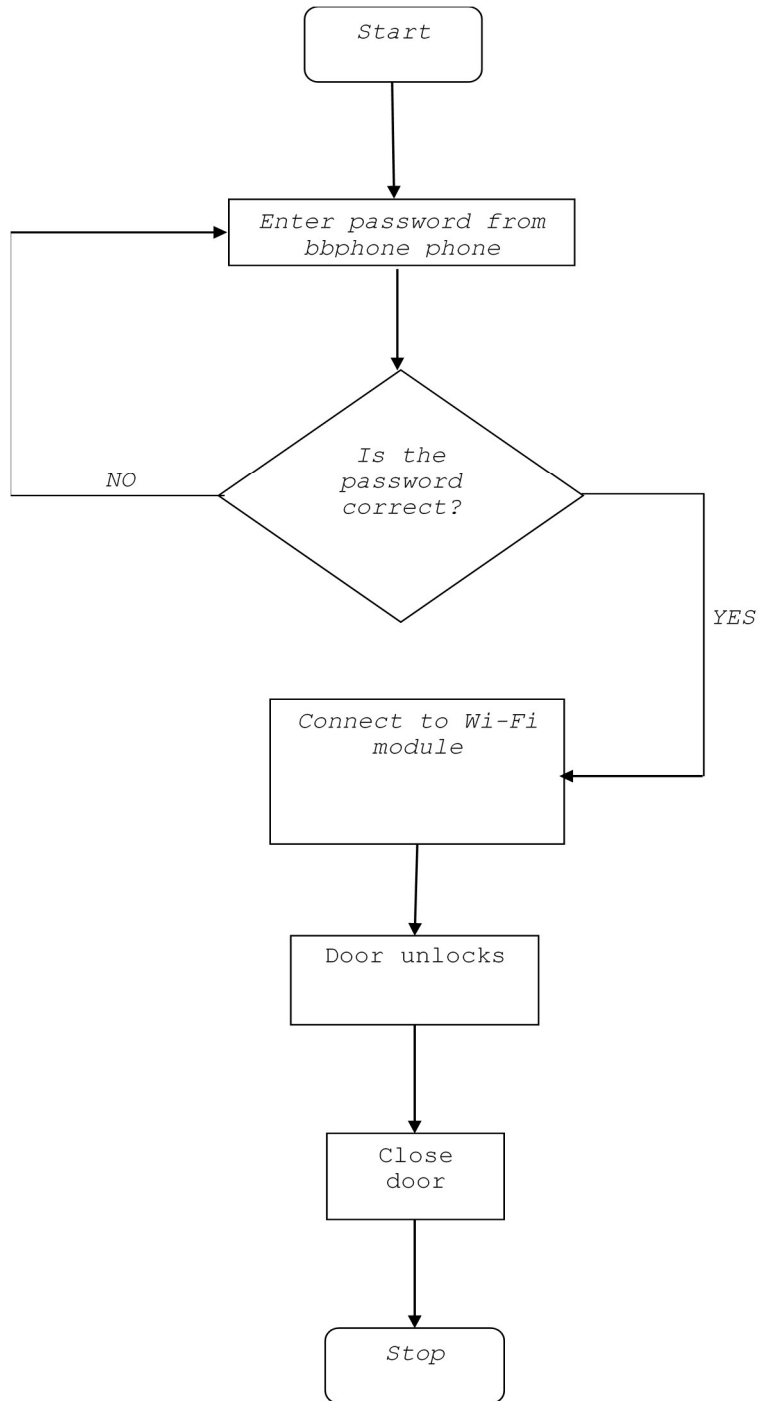


Fig 2: System Flowchart

3.4 Algorithm

1. Start
2. Enter password from phone.
3. Authenticate API (Check user input)
4. Valid user? YES
5. Connect to Wi-Fi module
6. Door Opens
7. Else, go back to number 2
8. Close door

4. IMPLEMENTATION OF THE DESIGN

4.1 Hardware Implementation



Figure 3: Arduino ATmega 328 UNO

The ESP8266 IOT Device shown in figure 4 sends a password command to the Arduino Board shown in figure 3 above, which is in charge of unlocking the door lock. The Arduino board can be powered through an AC-to-DC adapter or a battery. The Android servo motor shown in figure 5a makes the door to turn through 180 degree or any position within. The Solenoid Lock shown in figure 5b serves as the door lock which is used in the work. The Arduino ATmega 328 UNO's Relay Module is in charge of connecting the solenoid lock and the power supply. The IoT ESP8266 device is in charge of sending data to the cloud, to which the Android app on the smartphone is linked. It requires to be connected to WIFI. The ESP8266 hosted the android application (Blynk) The Arduino UNO, Servo motor and WIFI module and other devices are connected to each other and are configured to be controlled by android app.

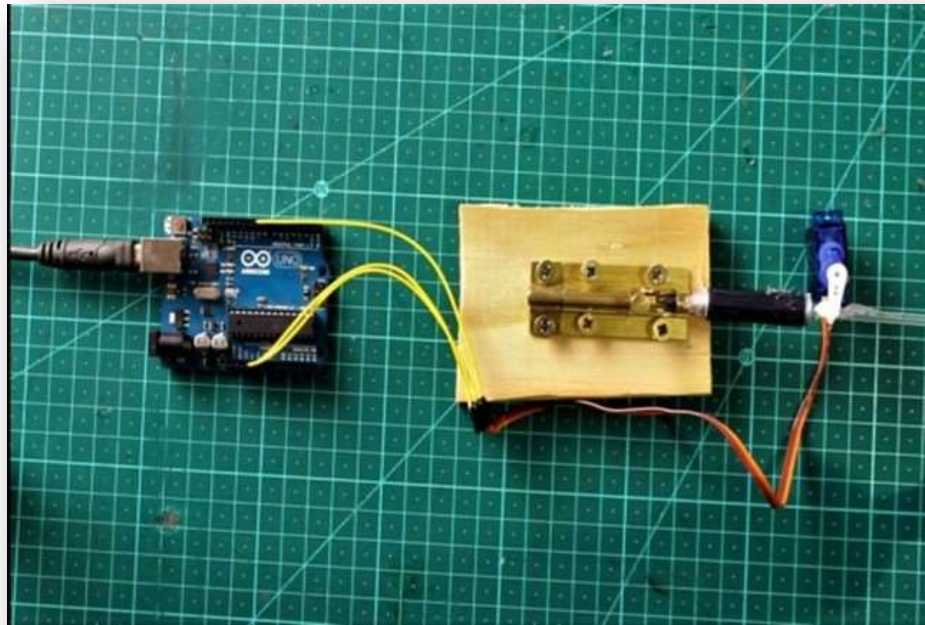


Figure 4: ESP8266 WiFi Module



Figure 5a. Servo Motor



Figure 5b: Solenoid Lock

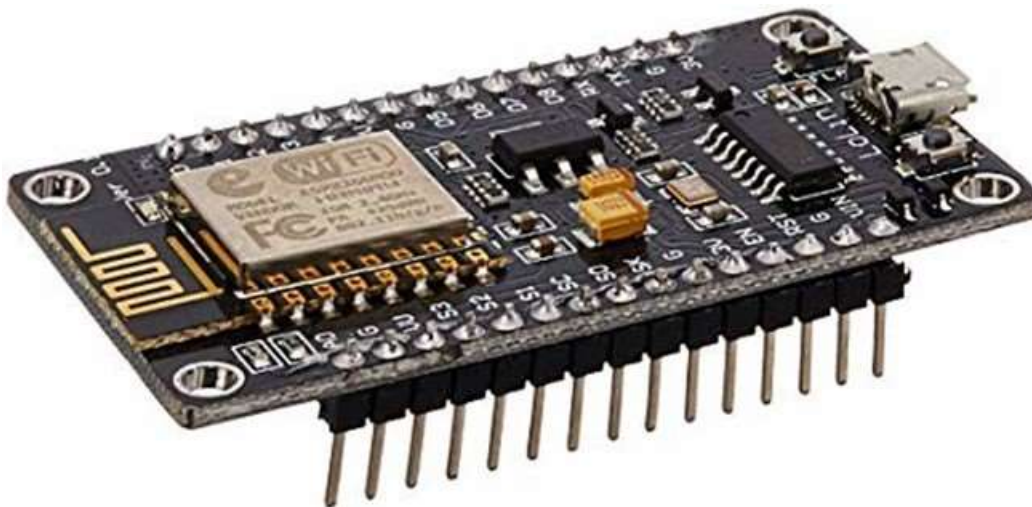


Figure 6: Design Construction

4.2 Installation and Configuration Process

The Arduino IDE is fully installed on the Arduino UNO board via the Arduino COM Port linked to the computer via USB after being downloaded from the official Arduino website. The IDE needs to be aware of the Arduino's COM port. As seen in figure 7, go to Tools > Port > COM7 to accomplish this. By selecting Tools > Board > Arduino Uno from the menu, the IDE is launched and set up to use the same device and port as in figure 8.

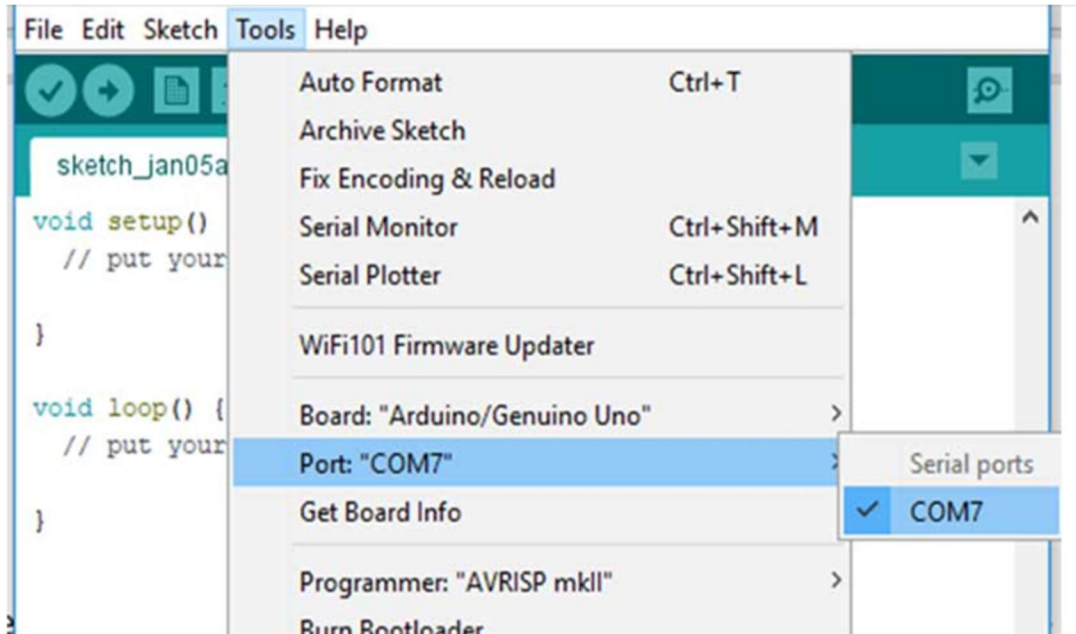


Figure 7: Arduino COM Port connection

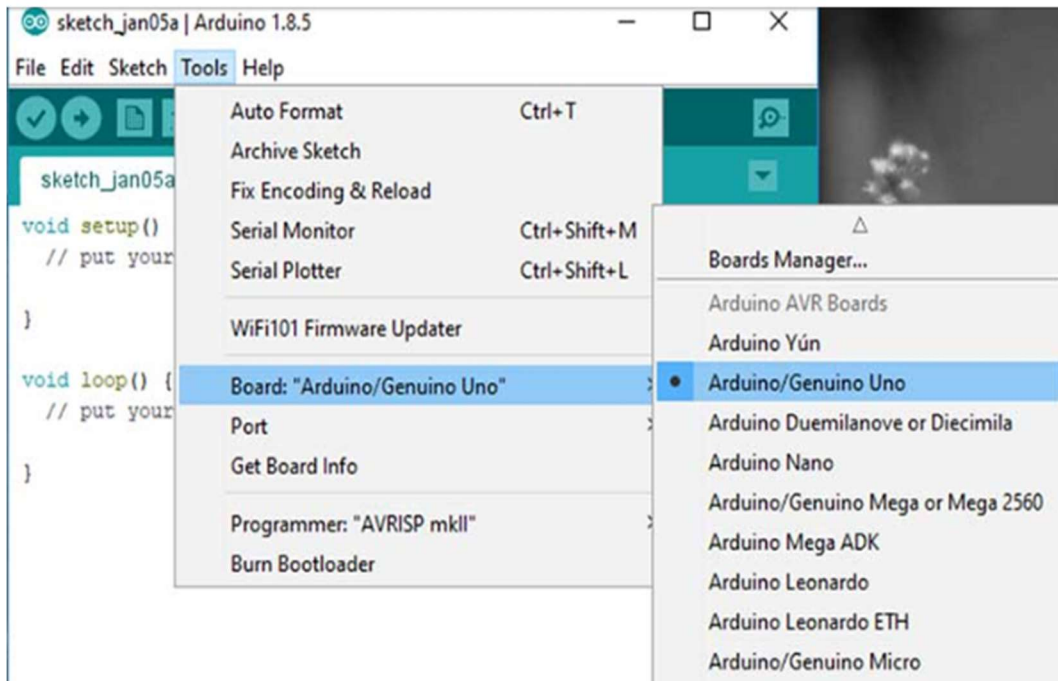


Figure 8: IDE is loading and configuration

4.3 Connection of Arduino to android application (Blynk)

- i. Create an account or log in first.
- ii. Select New project after signing up for an account or checking in.
- iii. Give your project a name, choose the board, and choose the USB connection type.
- iv. Create a button that, when pressed, will send a message stating that an authentication token has been sent.
- v. When you tap the screen, a widget box will appear.
- vi. A button will be added to your project screen when you click a button.
- vii. When you click the button, the characteristics will appear. Choose the push or switch button after selecting the pin.
- viii. Save the Arduino IDE library to your computer. Open the Arduino, then add the library to the folder.
- ix. Paste the auth token and upload the code, After saving the file, run it and you will see the cmd as shown below.

5. CONCLUSION AND RECOMMENDATION

In order to lessen the harm caused by lock tampering due to physical touch and to improve the various security and monitoring functions around the door using IoT technologies, we devised and implemented a very cost-effective and simple to install IoT based digital door lock. In this work, we were successful in achieving our goal. However, this system can be enhanced for more effective functionality in the future employing artificial intelligence, motion detection sensors, web cameras for image capture, and more biometric traits for distinct identification

Additionally, the system should be configured to lock and unlock a building automatically without the need of a smartphone whenever an authorized person approaches the entry or is about to leave.

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