IoT Enhanced Smart Door Locking System

Shanthini M[a], Vidya G[b], Arun R[c]

[a]UG Student of CSE, PSG Institute of Technology and Applied Research, 641 004 India
[b]Assistant Professor (Sr. Gr) of CSE, PSG Institute of Technology and Applied Research, 641 004 India
[c]UG Student of CSE, PSG Institute of Technology and Applied Research, 641 004 India

Abstract— **In recent trends, smart buildings have become the base for the Internet of Things (IoT). The usage of the internet is increased by connecting the devices in the homes to make the places more comfortable, provident, delightful, and secure. The proposed approach addresses a security aspect in smart home technologies, namely the door lock system. The door lock system determines the security by allowing the owner to monitor the buildings with a Smartphone-controlled, Bluetooth-connected system using Arduino UNO. Users can open or close the door lock by installing the developed android application in devices like tablets, smartphones, laptops, etc. by providing the login credentials like username and password which is verified in the database over the internet. If the credentials are invalid, the buzzer rings and an SMS alert is sent to the owner of the building which enhances the security. This approach can further be scaled to commercial sectors like ATMs, vending machines, etc. by using other wireless communication.**

Keywords— Internet of Things, Andriod application, Bluetooth, Digital door lock system, Database verification, Short Message Service (SMS), Buzzer alarm.

I. INTRODUCTION

The main idea of Smart Home Technology is to introduce networking devices and equipment in the house for better quality living. A smart home allows the entire home to be automated and therefore provides comfortable living as well as added benefits for disabled individuals. All the existing door locking systems are old-fashioned ways of accessing the system with either a traditional key or some means of RFID (Radio-Frequency Identification) chips [3]. For example, with a traditional lock, a friend or a guest cannot be allowed to get to the place if the doors are locked when the owner is unavailable. Or if the keys are lost, either a locksmith has to be found or the lock should be broken [6]. This is where the smart door locking system comes to the scene. Security is a primary concern for every individual where humans cannot find ways to provide security to their confidential belongings manually. Instead, humans find an alternative solution that provides reliable and automized security. This paper describes a security system that can control the home door lock. The safety enhancements in the system should not only improve the robustness of the system but also not complicate the system accessibility, in other words, it should provide the ease of access. In [5]a wireless home security solution using IoT and a Bluetooth module namely HC-05 is interfaced with Arduino UNO that connects to the Bluetooth of the phone . Each user will have a unique login credential stored in the firebase database which is a cloud-hosted database. Users can access the door lock once the user credentials are verified with the database over the internet by using smart devices like mobile phones with an app installed in it which will communicate via Bluetooth to the lock by sending signals.

II. LITERATURE SURVEY

As per the survey, there exist many such systems to control the door. Each system has a unique feature. The system shown in [1] aims to develop a door security system using an LDR sensor, Ultrasonic sensor, servo motor, and laser module connected with the Arduino and Bluetooth application. Here, the Bluetooth module controls the door through an application and the Arduino UNO receives and processes data such as the intensity at a particular place and the distance from all these sensors continuously. This method focussed more on the ultrasonic and LDR sensor. One of the main drawbacks of the system is that it does not have intrusion detection.

In the study [4], a smart door lock and lighting system using IoT for the smart home is presented. The user can control the opening and closing of the door and can also control the lighting using the Internet. One of the demerits is that the relay is used to lock or unlock the door and to switch ON/OFF the lighting but the relay usually requires a high voltage to operate and the motors also need a higher voltage and current which cannot be given from the microcontroller.

III. PROPOSED SYSTEM

A. Modeling and function of the proposed system

The main objective of this paper is to enhance the security of the door locking system. The hardware and software requirements for the proposed system is shown in Table 1. The mobile device will be sending a signal via Bluetooth to the Arduino circuit [7] that acts as a connection between the smartphone and the servo motor after proper authentication is provided using the database. The use of Bluetooth on smartphones is to provide ease of access with better security than the conventional key.

TABLE 1. HARDWARE AND SOFTWARE REQUIREMENTS

Category	Component	Function
Hardware	Conventional lock	To Open/Close door
	Servo motor	To Control lock
	Piezo buzzer	As Intrusion detector
	Bluetooth module (HC-05)	Communication channel
	Arduino UNO	As Data processor
Software	MIT App inventor	To create an Android app
	Arduino IDE	To Write and upload Arduino code/sketch
	Firebase database	To store and retrieve user credentials
	Wireshark	To capture network packets

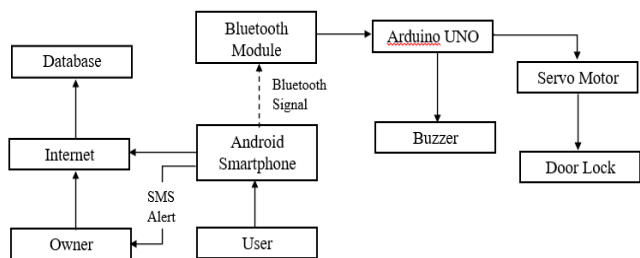*B. Implementation of the proposed system*

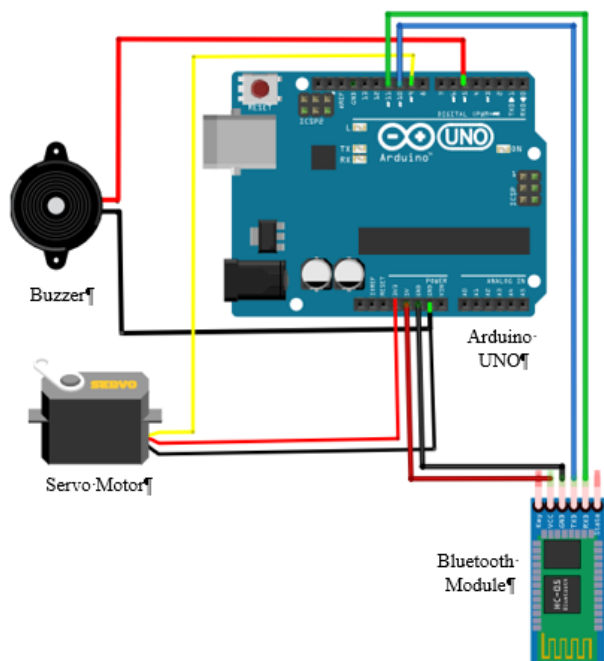

Fig. 1. Block diagram of the proposed system.

Fig. 2. Hardware circuit connection of the proposed system.

Fig. 1 shows the block diagram of the automated door security system using the Android app. The circuit connections of the proposed system are shown in Fig. 2. Connect the board to the computer using the USB cable. The USB (Universal Serial Bus) connection with the PC is necessary to program the board and also to power it up. The UNO board automatically is powered from either the USB or an external power supply.

In the IDE (Integrated Development Environment) of Arduino, under the tools menu, select the board as Arduino UNO and port as Arduino UNO (COM3). The Arduino sketch written in C++ is uploaded to the Arduino UNO from the IDE [2]. Next, the Android application is installed on the smartphone and the Bluetooth devices are paired (connect phone and HC-05). Once the Bluetooth module is paired with the phone, the user can start using the app.

Open the android application and click on CONNECT TO BLUETOOTH. Select Door Lock i.e., HC-05 from the list of paired Bluetooth devices that appears on the screen. The user is now intended to enter the pre-defined username and password in the required fields. The user credentials are stored in the database. The owner can update or modify the user credentials in the firebase database and register the app with the database. After entering the information, click on LOGIN. The entered information is verified by retrieving the user credentials from the database over the internet [10]. The

verification can be monitored by capturing the requests and responses that are sent and received by the application [8] using the Wireshark software, a network protocol analyser which captures network packets and displays it as human-readable [9]. If the credentials (username and password) are correct, the buttons to control the door lock i.e., the LOCK and the UNLOCK buttons will be enabled for the user on the screen. If the user clicks the LOCK button, the application will send a value to the servo motor interfaced with the Arduino via Bluetooth module and thus, the servo motor will rotate with that value and the lock will be closed. Likewise, if the user clicks the UNLOCK button, the application will send a value to the servo motor interfaced with the Arduino via Bluetooth module and the servo motor will rotate with that value and the lock will be opened. If the username or password is incorrect, the user will not be enabled with the buttons to control the door lock and a signal will be sent to the buzzer that makes it ring along with which an alert SMS will be sent from the user's phone number to the owner's phone. A warning notification also pops up on the screen to the user.

Fig. 3 shows the flowchart, which is the step by step approach that was followed in the writing the automated door security program, that enables the execution of a command from the android application developed.
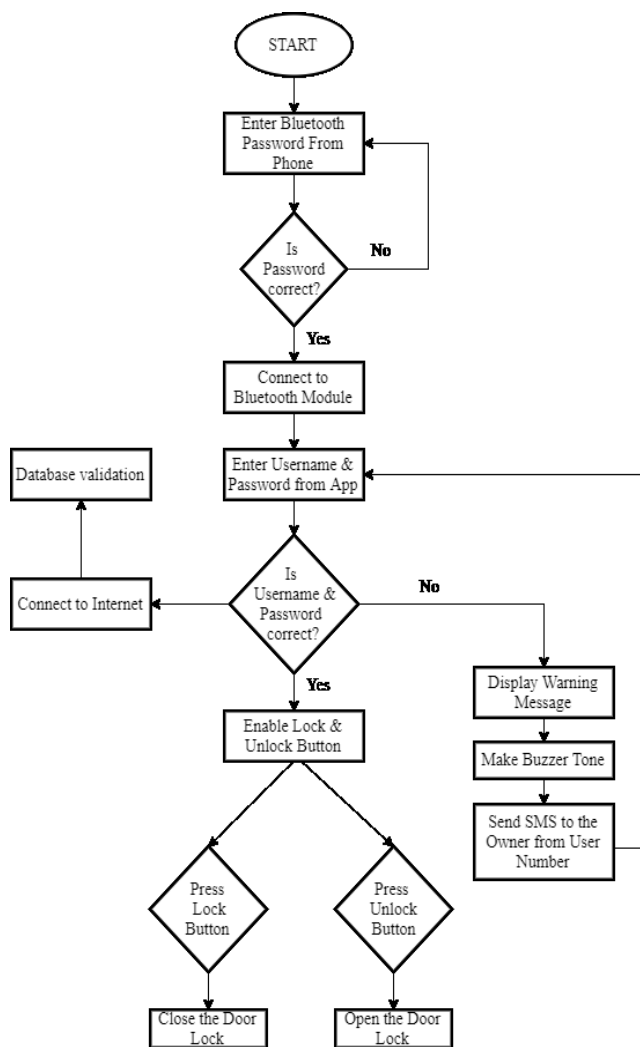

Fig. 3. Flow chart of the proposed system.

C. Safety of the proposed system

Rather than using a physical key, this system uses a signal that is delivered digitally via Bluetooth from any smartphone or other mobile devices. The proposed system has a unique username and password for each user maintained in the database, which makes it robust in case of theft or security breach of the mobile device. If the user enters the wrong user credentials, the system will generate a popup warning notification to indicate the invalid user credentials and will alert the neighbours with a buzzer ring and also intimate, the house owner with an alert SMS. These features enhance the total safety of the system.
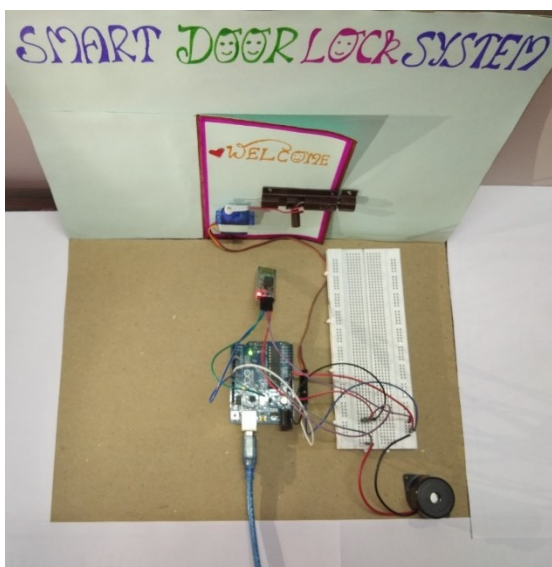
Fig. 4. A prototype of the proposed system.
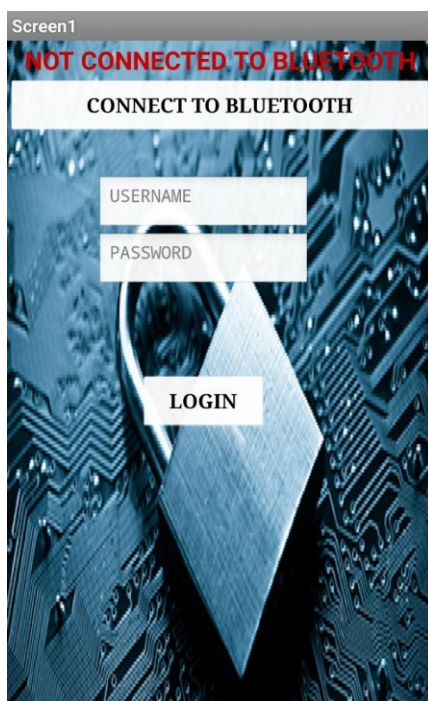
Fig. 5. Smart door locking app home screen.

IV. RESULT

A functional prototype of the proposed system as shown in Fig. 4 has been developed and tested. The home screen of the application created is shown in Fig. 5. Once the connection between the hardware and the software has been established, it was indicated in the user application showing a green text CONNECTED TO BLUETOOTH. When the LOGIN button was pressed, the entered user credentials were verified with the credentials stored in the database over the internet. The credentials stored in the database are shown in Fig. 7. The requests and responses sent and received between the application and database over the internet were captured using the Wireshark software during the live testing of the application is shown in Fig. 8 and Fig. 9. Once the user credentials were verified as valid, the control buttons were enabled as shown in Fig. 6. When the LOCK or UNLOCK button in the user application was pressed after validation, the corresponding values were sent to rotate the servo motor to lock or unlock the door lock respectively as shown in Fig.10 and Fig.11 and was also displayed in the serial monitor. If the user credentials were incorrect, the owner received an alert SMS along with the generation of a buzzer ring, and the user was prompted to try again with a notification in the application as shown in Fig. 12 and Fig. 13.
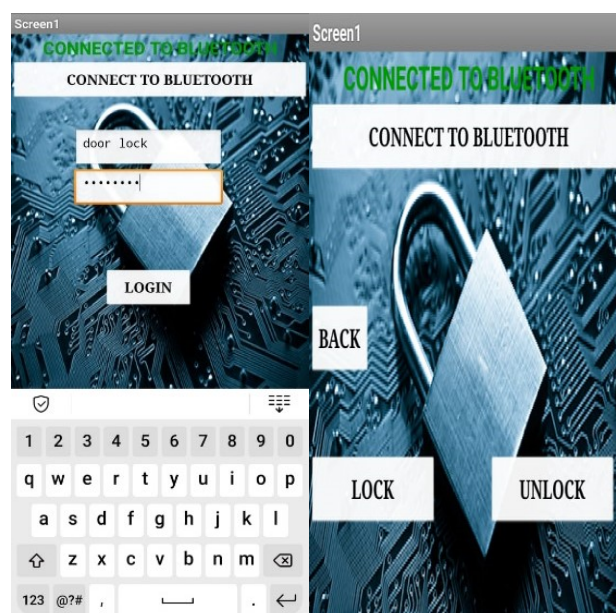

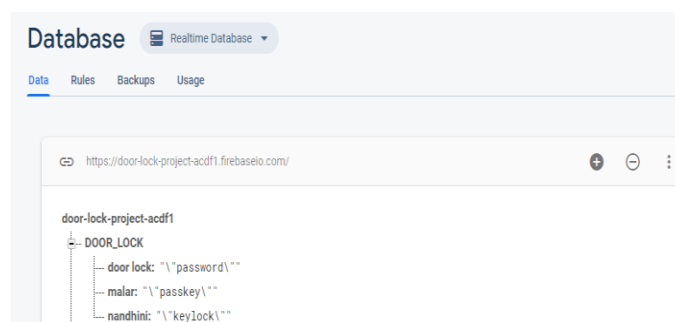Fig. 6. Valid credentials [Control Buttons Enabled].

Fig. 7. User Credentials in Real-time Database.

Fig. 8. Request sent by the application.

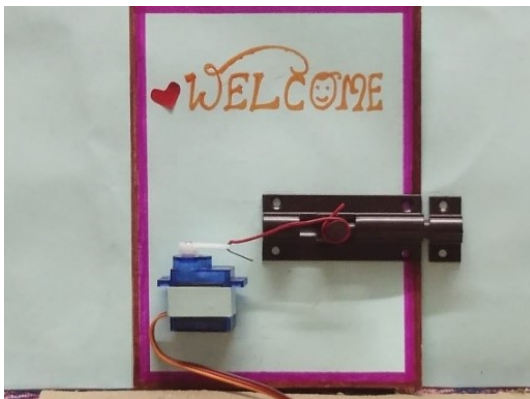Fig. 9. Response received by the application.
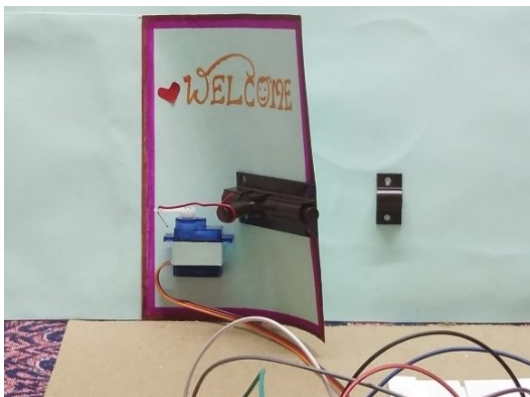

Fig. 10. Emphasis on Lock.
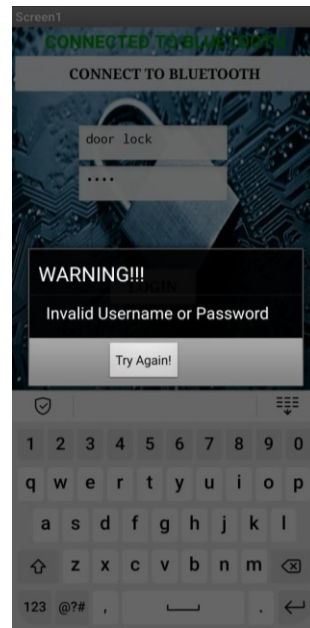

Fig. 11. Emphasis on Unlock.

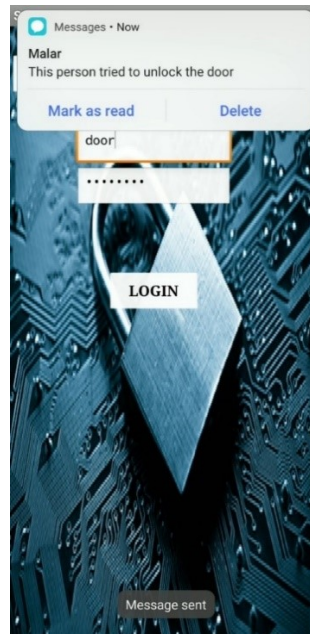Fig. 12. Invalid Credentials [Warning Notification].

Fig. 13. Invalid Credentials [SMS Alert].

V. CONCLUSION

In this paper, a smart home automation system namely a digital door lock is proposed to provide security. The system doesn't require any physical keys to lock or unlock the door, instead, an android application is installed on smart devices, and credentials are used for the same. The user credentials are validated by the database. If invalid credentials are provided in the application, a buzzer alarm is produced with an SMS alert to the house owner along with a popup warning notification to the user. This enhances the security of the proposed method. It is a flexible system that is simple to install at a low cost with no overhead like drafting and construction works.

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