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IoT based Smart Door Lock

Embedded Systems

Semester Project

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Table of Contents

Abstract…… 2

Introduction…… 2

Literature Review…… 3

Internet of things IoT…… 4

Fingerprint locking system…….. 4

Knock pattern using Arduino and GSM communication…… 4

August Door lock…… 5

Kwikset Kevo Locks…… 5

Analysis and Design…… 5

Block Diagram…… 6

Schematic Diagram…… 8

ASM Chart…….. 9

Conclusion…….. 10

References……

Abstract:

There are some scenarios through which every homeowner goes with, like waiting outside home for long since without the keys. In such circumstances Smart locks are the superheroes, with special powers that make life more convenient. The proposed model consists of a lock system which can be administered with remote access through an app using our smartphones. The owner has access to the movement of the door. Upon ringing of the doorbell, they can unlock the door using phone. All they need to do is to connect their smart phone with the internet and life will be easier.

Moreover, this system also adds a feature of Security by allowing to open the door from outside through RFID cards. All they need to do is to scan their RFID cards in allotted slot and access will be given if you are an authentic person. Otherwise, access will be denied.

Thus, this will resolve the problem of elderly, disable and couch potato persons who can't or don't want to go to the door when doorbell rings. It is also helpful when your house is big enough that it's difficult to reach out to the door again and again. Also, effective because it ends the overhead of finding keys from the purse again and again when you want to come in.

Introduction:

Physical keys are the most natural way to lock or open a door, and everyone is familiar with it. Although the physical key is a well proven and well-known technology, it is not without faults. For a lock there can be one unique key. Different keys are required for various locks. Carrying a big number of keys is also inconvenient. Smart locks are key-less door locks that let you unlock your door without having to use a real key. A smart lock is an electromagnetically lock that is meant to lock and unlock a door when it receives instructions from an authorized device. Smart locks are an extension of home automation into home security.

This system uses mobile app to allow homeowners to grant access to third parties. Through this project, we are working on two main issues of today i.e., safety and inability to unlock the door when doorbell rings. Nowadays, security is the most essential issue in the world so security of everything gains higher and higher importance in recent years.

This system uses ESP-32 as micro-controller where in once the RFID detects the authentic code, it opens the door, and the concerned person is allowed access to the secured area. This RFID doesn't respond to any other thing except RFID cards having 13.5MHz frequency. In these 13.5MHz frequency cards, only those persons are allowed who have "special codes".

For making this system as "Internet of things", we used Realtime database of Blynk. Through this database, we will pass our data to microcontroller. On Blynk software, we can visualize the data, connectivity management, control permissions, device provision and much more.

Two types of locks can be used i.e., Solenoid lock that operates on voltage or conventional lock (tower bolt) that is operated manually. In case of Tower Bolt, we will use servo motor to unlock. Optocoupler module will also be used that will act as a switch. This optocoupler will provide power to solenoid lock for some time when we want to open door. Door will be then locked after delay of some time. Lastly, buzzer will be used that will act as an alarm to generate sound whenever somebody tries to unlock the door.

Literature Review:

In this current system for door locking, there are few points of view. a traditional door and key locking system that integrates the latest smart locking technology. Modern existence is widely reliant on technical improvements such as the ability to open doors and control modern gadgets and devices. People want their appliances to make them feel comfortable and protected. People's requirements are the key reasons for the

Creation of smart locks. Some of these systems are given below.

- *Internet of Things IoT:*

The internet of things, or IoT, is a wireless link that works in a door lock. With the help of IoT-enabled applications, the user may unlock the door with his smartphone. Connecting devices in homes with internet makes home more comfortable. Provident, pleasant and secure. The door lock system sets up security by allowing the owner to check the buildings with using an Arduino UNO-controlled, Bluetooth-connected system. Installing the applications on devices allows users to open or close the door lock by entering login credentials such as username and password which are confirmed in a database over the internet. If the credentials are incorrect, the buzzer sounds and an SMS is issued to the building's owner, increasing security.

- *Fingerprint locking system:*

A fingerprint locking system is a locking system that uses a fingerprint sensor module to secure the user's fingerprint. The fingerprint sensor module uses an Arduino or a RaspberryPi to operate. user must register his or her fingerprint in the system. The registered person's mobile number is then added to GSM, and a permanent image password is assigned to this user. As a first step, the unauthorized individual must choose unauthorized as the user type. The admin receives a random picture. The person must properly choose the random image. Otherwise, the system will go back to the first page.

- *Knock pattern using Arduino and GSM communication:*

This system, which consists of Arduino, GSM Module, Servo Motor, and other components, employs a 'Secret Knocking Pattern' that is only known by the owner of the safe, luggage, or other property or item on which the device is mounted. For the lock to open, the knocking pattern must be used only at a certain location, which is only known by the owner. The secret pattern can only be changed after the secret knock has been unlocked.

- *August Door Lock:*

This system offers a mobile application, where you can check the history of the activity, like who locked or unlocked it at different times. From the mobile app, you can also grant unlimited digital keys to different friends. The hardware installed on the door can also indicate whether the door is completely closed or not. Some of the higher-end versions of this system includes a camera for users to see who is at the front door and whether they want to unlock the door for them.

- *Kwikset Kevo Locks:*

This system offers similar features with August door lock, but to unlock the door they use a digital keypad. Each user has its own access code, so the lock's accompanying mobile application can give a history of the lock's activity. For friends or temporary users needing to access the house, you can easily send a new access code and assign the time period for the temporary user to access the lock. Since every user needs to use an access code to unlock the door, you can't unlock via proximity to your phone.

Analysis and Design:

The components that we will use are:

1. ESP32 as our microcontroller (operating voltage: 5V).
2. Optocoupler module (operating voltage: 3.3V).
3. Solenoid Lock (operating voltage: 12V).
4. Buzzer.
5. 2N2222A transistor
6. RFID module.
7. 16x2 Alphanumeric LCD.
8. Power adapter (12V).
9. Arduino IDE.

According to the proposed system, we designed a system structure shown in the block diagram given below. It is done in the easiest and lowest cost possible. However, the system is flexible and can be customized for future enhancement. Changing one of the component's setups has to be compatible with the right software available. Every component used in this system was Programmed and tested separately for safety measures and matching with the right driver. Each component was programmed separately with ESP32 using Arduino IDE. Later, all codes were combined in a single Arduino IDE project.

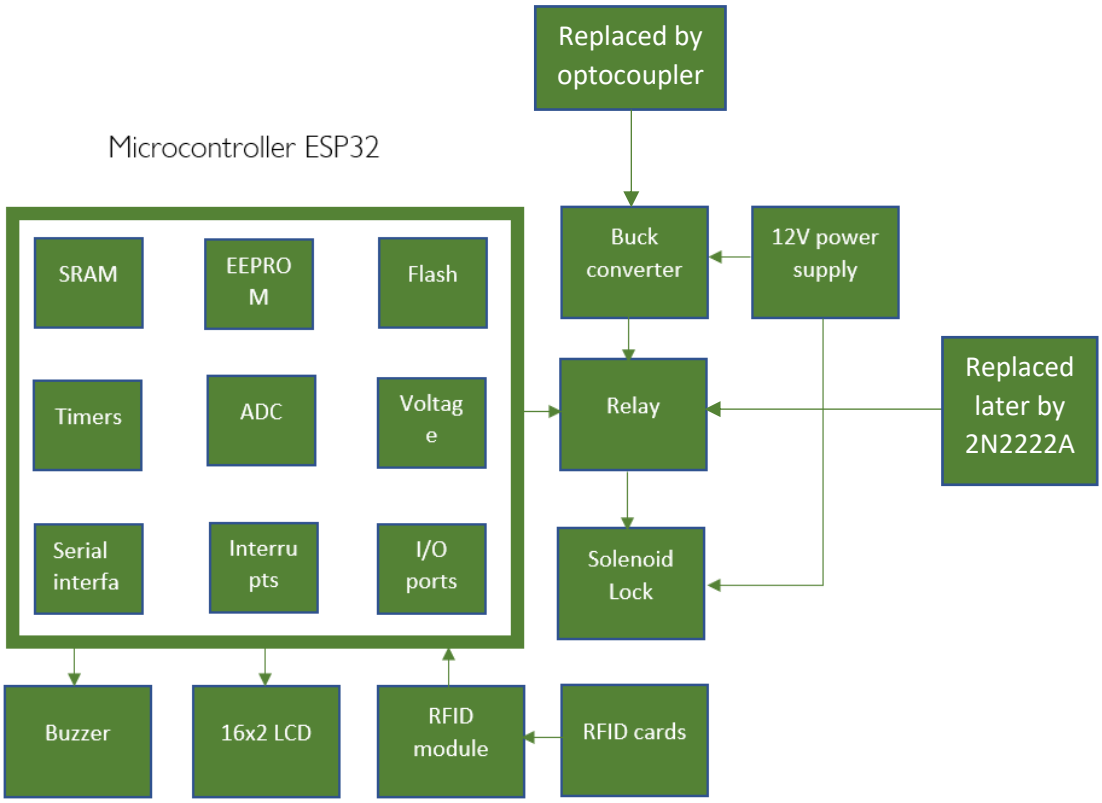


Figure 1 Block Diagram of proposed System

Very first unit in this design is the *Input unit*. This is the unit in which command is given to start the execution of a program and in this project the smartphone is the device that serves the purpose of sending command as input. The smartphone sends signal when connection is established between the device's internet and the ESP32 Wi-Fi through Blynk. Mobile application has lock and unlock slider in the application which tells a user that either he can send lock (door close) or send unlock (door open). RFID

Next unit is the *Receiver unit* in which RFID module and ESP32 are the receivers. Signal sent by mobile application is received by ESP32 whereby it starts processing. Also, RFID module receives the codes that it scans.

Next comes the brain of any project. This unit determines the output of the project, it determines what command to execute, how to execute, when to execute and where to execute it. The *ESP32 microcontroller* serves the purpose of processing the command of this project. It receives the command from smartphone and RFID and then determines what function to perform and how to perform the given task and give the required output of the given task.

Final stage on receiving the command from the microcontroller is *Output unit*. The task to be performed could either be to open or close the door. Solenoid lock is the device used in this unit to perform the task. When the lock receives the command from microcontroller to open, it contracts. All the action that is performing is written in form of a computer code in the Arduino IDE.

All used component's description is given below:

1. *Optocoupler:* Acts as electronic switch. It's operating voltage is 3.3V. It has 4 pins. Pin 1 of IR led i.e., Anode is connected to 3.3V of ESP. Pin 2 i.e., cathode of IR led is connected of ground of ESP. pin 3 i.e., emitter pin of transistor is connected with positive terminal of solenoid as well as with positive terminal of 12V adapter. While pin 4 i.e., collector is connected to the Base of a N-P-N transistor 2N2222A.
2. *Solenoid Lock:* It' s operating voltage is 12V. It has 2 pins. Positive pin is connected to optocoupler while negative pin is connected with collector of 2N2222A transistor.,

4. *16x2 Alphanumeric LCD LM016L:* It has 2 rows and 16 columns (16 characters in 1 line and 32 characters in 2 lines). 'LiquidCrystal' is the library which will be used in our code to sends data on LCD. It has 16 pins out of which 8 pins are for data and rest of the pins are for settings and enable.
5. *RFID-RC522:* it has 8 pins out of which 4 are for SPI which are connected directly to controller. 'RST' pin is used to enable reset. 'MFRC522' is the library that has built-in functions for card scanning.
6. *Buzzer:* it generates sounds and indicates a warning when someone tries to open the door illegally.
7. *Voltage Regulator 7805:* It are used for stepping down the 12V voltage to 5V. 9V regulator 7809 is used in between 12V and 5V regulator so that regulator don't get heatup.
8. *Resistors and capacitors.*

The Schematic diagram for our proposed design is given below:

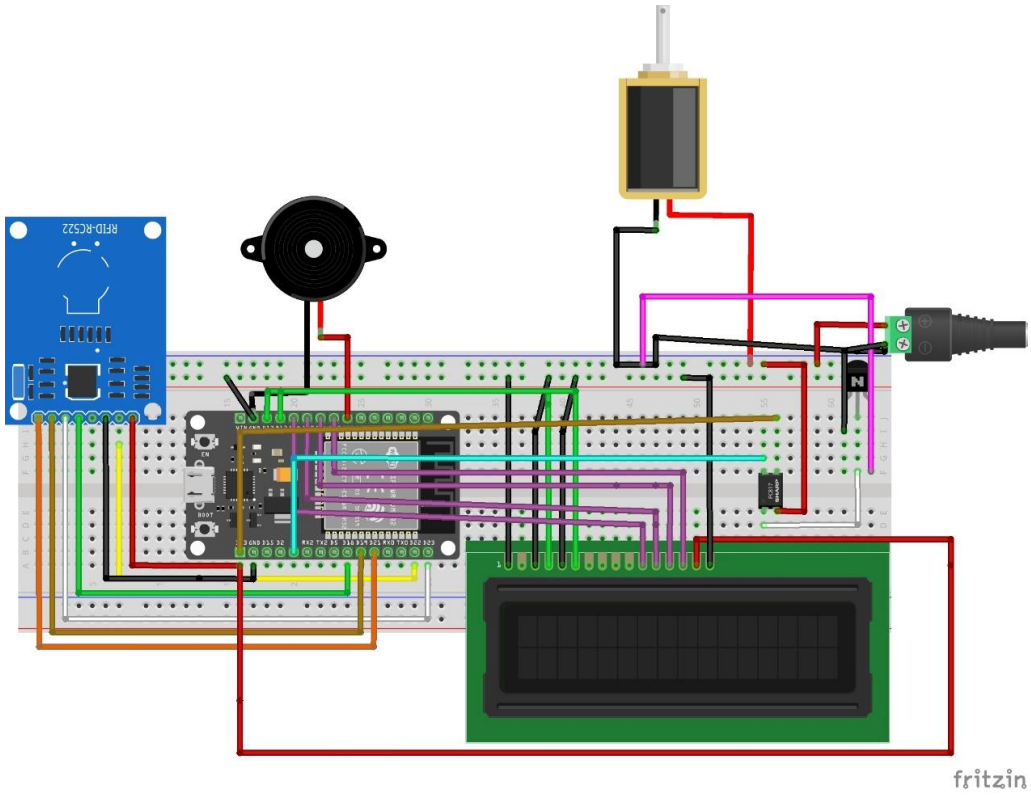
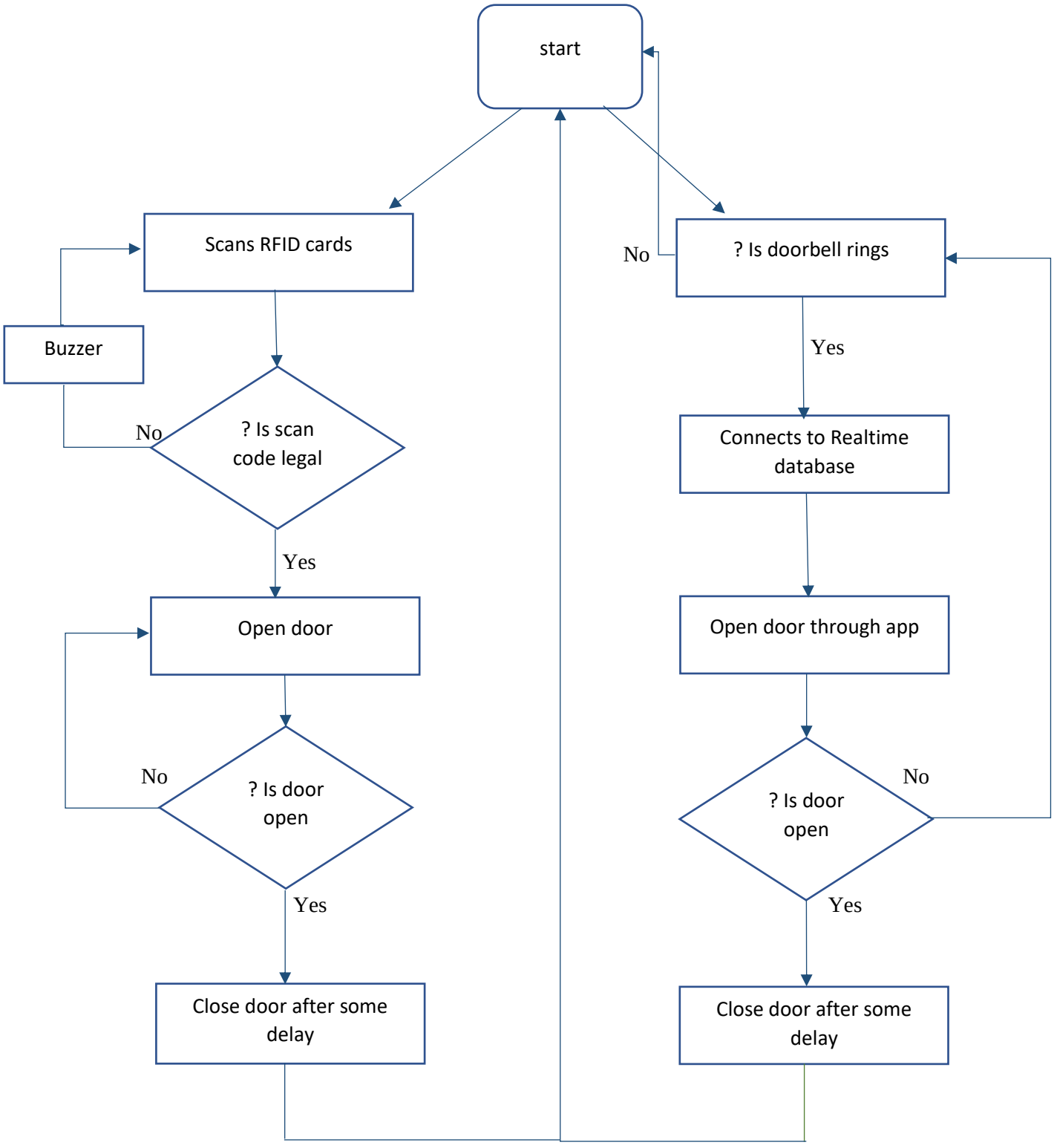


Figure 2 Schematic Diagram

The ASM Chart is as follows.



Conclusion:

The main aim of this paper is to design a smart door security system using ESP and RFID module, so that people can feel safe about their home whether they are away from home or are in the house. This project is based on ESP microcontroller, and the coding is done on Arduino IDE platform. At the end of this research the aim and objectives of the project was achieved. People can now feel more secure about their doors all the time. Doors can be controlled conveniently to those with access. Older and disable persons are also taking advantage by not going to door repeatedly. Lazy persons are also very happy with the design as their requirement for reaching out to door has been reduced.

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