A Contactless Door-Lock System for Attendance Tracking Using IOT-Based RFID Technology

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Abstract. In recent years we have seen how the world has taken a turn! People have started to cover their faces with not just face masks but also with Face-Shields for extra precaution. Similarly, people are not stepping out of their homes without a sanitizer in their hands-reach. As the world is trying to evolve back to being normal, in other words, people transitioning back to their workplaces, students going back to their institutions, and basically, everyone else resuming where they left off in 2019. This evolution is all well and good in fact it is great that people are finally getting back into the world. But there is always a slight hindrance in the heads of many people wondering "WEATHER OR NOT IS IT SAFE?" before touching anything. Therefore, we as a team have introduced a Door-Lock System that is intended to remove the traditional fingerprint-based scanner in any organization with a much safer and contactless system using RFID technology. This project is not just a contactless door-lock mechanism but also a smart system that keeps track of the user's attendance by immediately updating it in a database such as a google firebase or even a simple spreadsheet, wherein the organization can monitor their people. Finally, this project will surely make the world in which we live-in today feel much safer than it was yesterday.

Keywords: Contactless · RFID Based · Attendance Tracker

1 Introduction

Every individual always is concerned about their safety alongside with the security of their personal belongings in-and-around their surroundings. Thereby we introduced a Door-Lock System that is intended to remove the traditional fingerprint-based scanner in any organization with a much safer and contactless system using RFID technology. This project is not just a contactless door-lock mechanism but also a smart system that keeps track of the user's attendance by immediately updating it in a database such as a google firebase or even a simple spreadsheet like Microsoft Excel, where in the organization can monitor their people within their premises.

The evolution of security systems has travelled a long way since inception from the simple latch to highly sophisticated Automatic Access controls. This continuous

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technological advancement is owing to the fact that one's privacy and security are always at risk, whether on a personal or organizational level.

Our system may be put at multiple gates inside an organization to keep track of staff mobility and limit entry to zones where they do not have authority or approval.

2 Related Work

In the literature, various studies were proposed in which Umar from Punjab University, India has proposed an RFID-based security and Access control system [1]. His proposal was based on the scenario of his very own hostel room. His intention was based upon the fact that the university only provided 2 keys for a room shared by 4 people. Thereby he wanted to bridge the gap by introducing an RFID-based access control so that all his roommates can have their access key to their shared room.

James presented that RFID-based systems are now rapidly emerging everywhere in our day-to-day use. He pointed out that we humans come across them every day but do not notice the work behind this simple technology. As he mentioned RFID is widely used for swift access in and around public transportation terminals. He also explains how this is a cost-effective solution in today's modern era.

Dr. N. Krishnamoorthy suggested using a smart remote system to communicate information about the door lock's status [2]. His goal was to prevent security difficulties with manual physical keys while also sending an automated SMS to the home owner about the status of the door. Based on security improvements in different remote-controlled automation units, such as ATMs, KIOSKs, and marketing machines, his study suggests a Secure Door Lock System.

A passive RFID security system with a door lock mechanism has been presented by Tarun Agarwal [3]. When the user places the tag against the scanner in their prototype, the door locking system functions in real time. The goal of this project was to address one of the most pressing concerns of modern business owners: the safety and security of customers, employees, and the company. On a regular basis, all business owners deal with lost keys, larceny, and forgotten pins. RFID locker locks are a fantastic answer for these issues.

2.1 Existing Systems

Traditional RFID based Key-Lock Systems: Organizations throughout the world have been using and still do use RFID cards for their employees to have swift access in & out of their premises. This is not only an efficient means of authorizing one into a certain area but also a time-saver when compared to the traditional way of cross-checking everyone with their organization's database. *Fingerprint Based Biometric Scanners*: Most organization's also have some means of maintaining a record of all their employee's attendance. A lot of them have switched over from the traditional way of cross-referencing an individual to their database & marking them based upon the time-of-day to an automated-biometric means which reduces the time and effort of human resources. There are many more access control systems pre-existent in the world such as barcode, keypad-based,

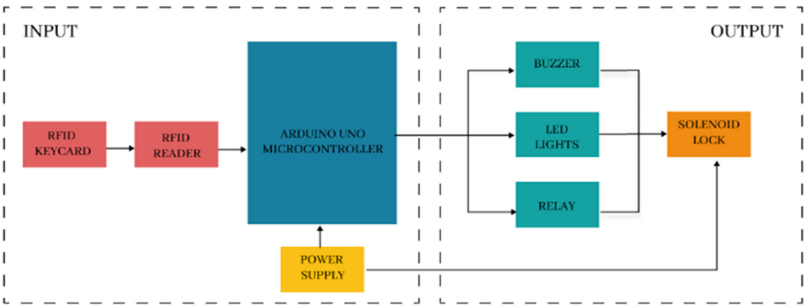


Fig. 1. Block Diagram

etc. alongside with RFID technology. When it comes to today's current day, Radio Frequency Identification (RFID) is becoming a key global system that provides a quick way for people in a variety of domains, including public transit, inventory monitoring, access control, sports timing, and many others.

3 Proposed System Architecture

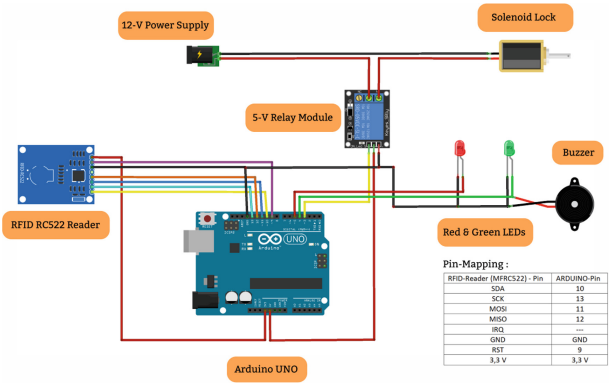
In this proposed system, we intend that the RFID reader reads the data from tag and sends the card UID number to Arduino microcontroller for cross-verification, only if the card is detected as an "Authorized User's Card" it's granted access by the simultaneous indications of the glowing of a green led along with the lock changing its state from 'locked' to 'unlocked' as well as the Date & Time of entry of that particular UID Tag reflecting in our database (Microsoft Excel File). In the case of an "Un-Authorized User" there will be an indication of a flashing red led and the entry will not be recorded into the database nor will the look change its state.

3.1 Block Diagram

On a high level, this block diagram depicts how the entire system works. We have two sub-systems, as shown. The input block and the output block are two different types of blocks. The RFID reader's operation to detect an RFID tag is covered in the input block. When a tag is discovered, the Arduino Uno Microcontroller checks to see if the scanned tag belongs to a valid user. After the RFID Tag has been validated, the procedure moves to the OUTPUT sub-system, which handles with indications like red and green LEDs, a buzzer, and a 12V solenoid lock. If the green LED illuminates and the lock flips from closed to open, a registered RFID tag has been detected. If, on the other hand, the red LED begins to blink instead of the green LED and the Lock remains in the same state, the scanned Tag is not approved (Fig. 1).

3.2 Circuit Diagram

The circuit diagram clearly shows how the components are connected in accordance with their respective pin-mappings (Fig. 2).



RFID-Reader (MFRC522) - Pin	ARDUINO-Pin
SDA	10
SCK	13
MOSI	11
MISO	12
IRQ	---
GND	GND
RST	9
3,3 V	3,3 V

Fig. 2. Circuit Diagram

The following components were used in building the circuit:

Solenoid Lock - The 12-V Solenoid Lock has only two states, which are:

Locked State: This is the Lock's default state. In other words, the door is locked and only authorized workers with an RFID Tag can unlock it.

Un-Locked State: This is the state of the lock after it has been changed from its default state (Locked). At this point, the user has five seconds before the door lock times out and returns to its default locked state [11] (Fig. 3).

5V-Relay Module - Controlling high-voltage, high-current loads such solenoid locks, motors, AC loads, and lighting is done with a single-channel relay module. The main purpose of this module is to work with microcontrollers like the PIC and Arduino's.

Arduino Uno – The Arduino Uno microcontroller is referred to as the heart of the system [9] as it binds all other components together as shown in Fig. 2.

RFID – It is an essential component of the system as it forms the foundational technology for the project which is referred to a as RFID – Radio Frequency Identification. The RFID [5, 8] is split into two sub components [RFID Reader and RFID Tags].

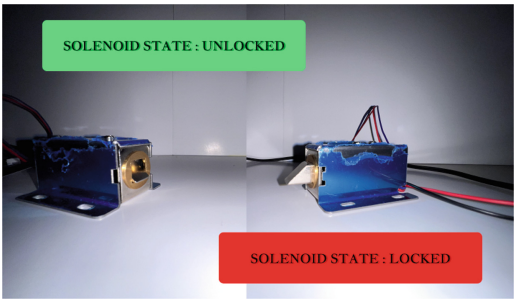


Fig. 3. The two possible lock-states of the system

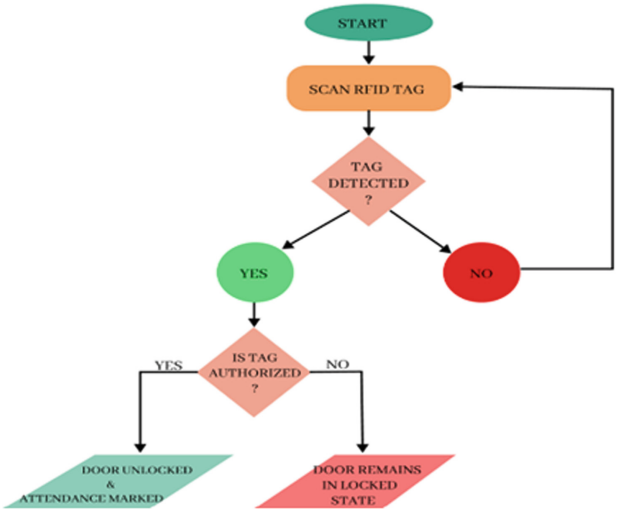


Fig. 4. Project Flowchart

4 Implementation

4.1 Project Walkthrough

Installation – Download the Arduino software from official website and run the software.

Reading Data from the RFID tags - Download the miguelbalboa-made MFRC522 library file. Set up the Arduino UNO using the RFID library. View it on the serial monitor. We are using RFID keychains and electromagnetic RFID cards to read data from RFID tags [6].

Accessing Correct Data - Include the UID of the card that needs access. View the code on the serial monitor after uploading it. Bring the tag and reader closer together. It will display the authentication status.

Communicate with the Lock – The Arduino will send a signal to the solenoid lock to open the door [7, 10].

Mark Attendance – As soon as the system detects an authorized user's RFID tag, the current date and time will be updated in the database.

Reset the Lock - After a specified duration (typically 10 s) the lock will change its state back to being locked for the next user (Fig. 4).

5 Results

5.1 Test Cases

The following table display's the test cases used to evaluate the functioning of the system.

TEST CASE NO.	TEST CASE NAME	USER SPECIFICATIONS:		LOCK OUTPUT	
		TAG REGISTERED	TAG AUTHOURIZED	EXPECTED	ACTUAL
1.	Un-Registered User	NO	NO	Lock should be in Locked State.	Lock State Unchanged.
2.	Registered User but not Authorized	YES	NO	Lock should be in Locked State.	Lock State Unchanged.
3.	Authorized User	YES	YES	Lock state should change.	Lock state changed from **LOCKED to UNLOCKED.** The *Green LED* turned ON and the *data was sent* to the excel database.

5.2 Response to an Un-Authorized Tag

Figure 5 represents the response of the system when an un-registered or un-authorized tag is placed near the RFID Reader, the system denies access by flashing the red LED and the state of the solenoid lock remains unchanged. At this moment the system buzzer is also turned on, to increase awareness that a tag that does not have authorization has tried to enter the system.

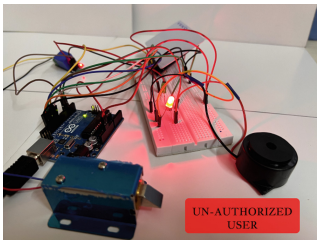


Fig. 5. System's response to an un-authorized tag

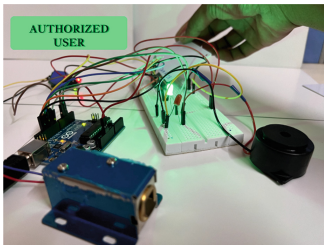


Fig. 6. System's response to an authorized tag

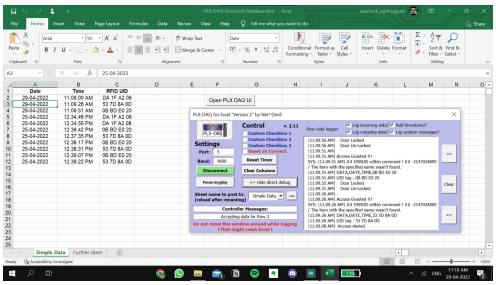


Fig. 7. System's response after a tag is scanned

5.3 Response to an Authorized Tag

Figure 6 represents the response of the system in the circumstance when an authorized tag is placed near the RFID reader, the user is provided access to open the door as the lock has changed its state from locked to unlocked alongside the glowing of the green LED to indicate a valid user. In the contrary the LED would have turned red if the detected tag does not have authorization [12].

5.4 Response at the Database

The graphic shows how an authorized user's data is saved in the database. When an approved RFID Tag comes close enough to the RFID Reader, the DATE and TIME, as well as the RFID UID, are immediately entered in an excel spreadsheet. As shown here, a local database was used (MS Excel) for the sole reason to keep the data of an organization as private and protected as possible (Fig. 7).

6 Conclusions and Future Scope

This Contactless Door-Lock is a very cheap and affordable design that plays a crucial need in both security and safety, especially during the current pandemic crisis. This design is relatively compact and can be installed at any door with ease. It depends upon how one wants to enhance this project for their specific requirements. Well, is not that the beauty of IoT, where one can plug and play with various components to match their requirements. For instance, this project can be taken to the next level by creating a dedicated mobile/web application where the information of users in and out of the premises is entirely stored on the cloud, so that it can be accessed remotely. The system has the potential to be enhanced in the future to provide more extensions and to be as curated to one's particular needs as possible. As with an increase in an organization's users the database most likely needs to also shift from being a local database to a solution which is cloud accessible such as google firebase or any other suitable resource that is catered to the needs of an organization. As well as we can also integrate 2-factor authentication like that of a bank locker where a personal need the access of a master card alongside one's own to open their very own safe. Another enhancement that can be integrated to this proposed system is the addition of artificial intelligence to verify a

user using face reorganization. In the end, IoT is known to be an open-ended technology where in human's are left with the choice to introduce features and provisions to enhance an already existing system.

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