

IOT BASED DIGITAL DOOR LOCK

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Abstract - The digital technology is being satisfied by some ambient and prevalent intelligence but such technologies are not closely correlated with the world of Internet, thereby we need an alternate extension of the technology which can only be sufficed by Internet of Things (IoT) for influencing the internet and communication technologies. IoT is connected with people at anyplace, anytime, with anyone and anything through any network/path. Albeit it's far more secured than the manual locks but thanks to its unaffordability on the value to most folks have restrained using it in spite of the expansion of Smart door Locks in Residential and company sector at CAGR of 35.6% during 2019-2025. It should be easily afforded by any soul without compromising the safety. In this paper we've built a sensible lock which is predicated on Internet of Things (IoT), where user are going to be given access to the lock only they supply the right PIN and Authenticate the Fingerprint within the lock application on their Smartphone and has multiple accessible modes i.e. this smart lock are often utilized in case of blackout/ (or when Smartphone is dead) by entering the key pattern which was previously recorded by the user by tapping on the door. The knock pattern is totally customizable as per user's satisfaction. Abstract summarizes, in one paragraph (usually), the major aspects of the entire paper in the following prescribed sequence.

Key Words: Arduino Uno, ESP 32, Smartphone, Piezo Sensor, Relay, Firebase, Mit App Inventor.

1.INTRODUCTION

In this 21st Century, we love experiencing new gadgets for our daily life to keep ourselves more updated and to simplify our daily routines. Previous to the year in 1999, with the commence of "Internet of Things" which was non-existence, where the IoT[1][2] has surpassed many technologies since 1832 during which the first electromagnetic telegraph was invented and followed with many new inventions. Nevertheless, the "Internet of Things" saga evolved with the innovation of the internet, which was an integral element during the late 1960s which then evolved at a greater speed during the next few decades. However, IoT devices require more human interactions, apps, and interface for monitoring. The paper describes the usage of IoT-connected Smart lock which utilizes highly secured database of Google with an alternate option of manual interference through a secured unlocking methodology. The introduction of manual knock

through a pre-recorded pattern and allowing to open the door was to avoid blackouts along with experiencing a dead Smartphone when out of battery and an alternative to unlock the door through Mobile App with a Secret PIN[3] and Fingerprint Authentication[4] is a boon for every citizen as it enhances the security more than that of the available Smart Locks which leaves the crooks with nothing except thinking of how to unlock the door.

Security remains the leading barrier for IoT adoption

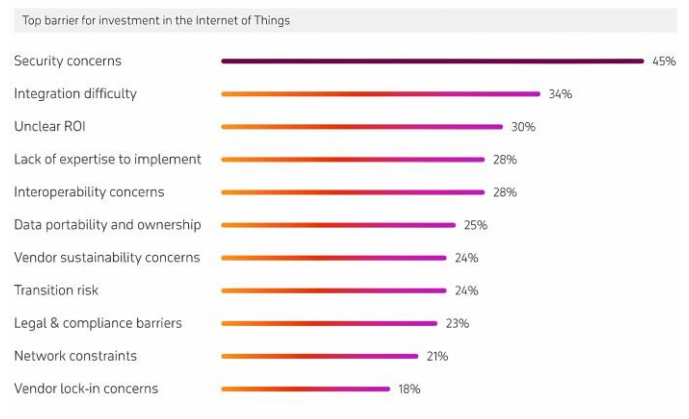


FIG 1 : Top barrier for investment in the Internet of Things

2. LITERATURE SURVEY

Various smart locks are previously available. The majority of them are expensive. In this paper [5] "Arduino based electronic lock using RFID and password" which was proposed by "Ni Ni San Hlaing, San SanLwin". This digital door lock runs on the technology of audio-frequency identification and passcode-based with the help of an Arduino Uno MCU. In another paper named [6] "Secured password-based lock system" was put forward by "Arpita Mishra, Siddharth Sharma, Sachin Dubey, S.K.Dubey". This methodology is targeted to prevent unlocking of the door by unknown individuals. The formation of the home safety Service consists of the numeric keypad, the hook which is used for lifting, and a GSM module to establish dependable connection for communication conferred with the MCU. The control panel conferred with the device is employed because the passcode access combination opens/closes the door. In another paper named [7] "Smart Lock System Using RFID" was proposed by "ShrinidhiGindi, NaiyerShaikh, KashifBeig, AbdealiSabuwala". Here may be a Room security solution supported IoT using RFID, the system is often monitored

from anywhere within the world thanks to the continual updating of the status of the door. Moving forward to another paper named [8] “An OTP-based wireless smart door locking system” was proposed by “Mr. L. David William Raj, M. Deepika, V. Bhuvaneshwari, R. Harshitha, K. Haripriya”. In this innovation, the key phrase for security is initially put away within the Electrically Erasable Programmable ROM [EEPROM]. At the purpose when the client enters the proper secret phrase then the two-way confirmation of a haphazardly produced OTP is shipped off the client gadget. On the off chance that the OTP is coordinated, the framework is going to be opened, and therefore the required capacity is often started. Coming to the next paper named [9] “SMART DOOR UNLOCK SYSTEM USING FINGERPRINT” was proposed by K.Rajesh, Asst.Prof. B.VenkataRao, P.AV.S.K.Chaitanya, A.Ruchitha Reddy. In our paper, we apply the fingermark detector to scan one's character to instinctually function the gate of the car, under such situation we prefer to use a MCU for enabling for both opening and closing of the door if both the match for scanned and existing facts are true. In the upcoming document termed [10] “DOORWAY ROBOTIZATION network supported by CORDLESS for android Smartphone” was proposed by “Lia Kamelia, Alfin Noorhassan S.R, Mada Sanjaya, and W.S., Edi Mulyana”. In this a tool called a automated door lock with the support of Bluetooth and Android Smartphone door locks automation system using Bluetooth-based Android Smartphone's is recommended and prototyped. The equipment structure for the door lock setup is that a combination with an android Smartphone due to controller, Bluetooth device as an instructing factor, Arduino MCU as switch center/transforming center, and solenoid as door lock out-turn. Moving on to [11] “Android Based Smart Door Locking System” which was proposed by “Adarsh V Patil, Sreevarsha Prakash, Akshay S, Mahadevaswamy, Chandan B Patgar, Sharath Kumar A J”. The process executes on a pre-coded passcode notion. It improves the safety process to stop an unathletically destroying done by a fraudulent. Lastly, we have [12] “A locks which operate by a secret knock” which was put forward by “Dr.M.Siva Sangari, Dhivakar. E, Gowthaam. K”. To open and shut the lock by digging out the knocks sensed by the piezo sensor to unlock the door, a servo turns when it detects the knocks and opens and closes the door.

The above applied technologies are somehow related to our proposed operating technology but based on the future outlook with multiple alternatives we would like to propose a multi-approach strategy in a Single Digital Door Lock.

- Previously to access the fingerprint a separate module was required which can be easily damaged by crooks. By our developed system a user will have to authenticate their fingerprint through the mobile application as well as have to enter the correct PIN in order to access the lock i.e.; enhanced two level securities in the application.

- Earlier some applications have been developed with the help of Bluetooth and Wi-Fi technologies, the drawbacks were the range of access, and even in case of GSM many areas doesn't have network connectivity whereas Wi-Fi can be used to access the internet. We came to a discussion that we will include IoT, by which the lock can be operated from anywhere around the world with internet connection.
- Invention based only with IoT devices in a smart lock is that, it cannot be accessed if there is power-cut at the location where the lock is installed. Hence, we came to conclusion of including another way for unlocking the door by means of tapping the door with the pre-recorded pattern, which can be further changed as per user's satisfaction.
- Our development for accessing the lock during blackout is substantiated with a battery pack which can support power backup for minimum 4-5 hours.
- In case the user fails to recall whether the door is locked or not in that case they can see the status of lock in the application and can act accordingly.

We have studied them and decided to include some more innovative features in order to enhance the security of the system. As Smart locks which are currently available is quiet expensive and not affordable by all, hence we tried to fulfill the dream of every individual to bear a smart lock at low cost, without compromising on security.

3. SYSTEM DESIGN AND ARCHITECTURE

The design of the system is classified into two stages

A. THE BLOCK DIAGRAM

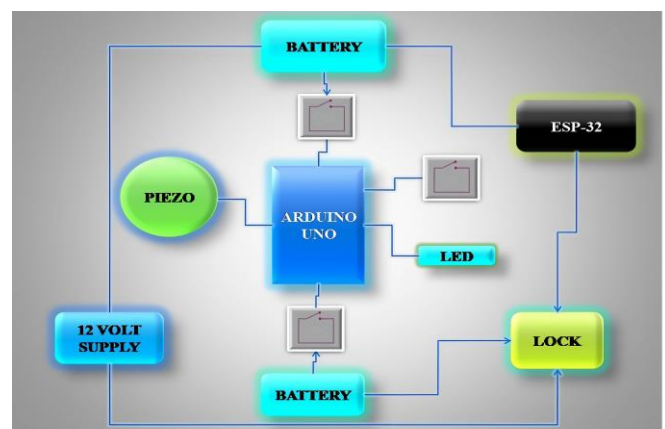


Fig2: BLOCK DIAGRAM

B. THE HARDWARE

a. ARDUINO UNO

These microcomputers are put together in Italy. The board consists of 14 digital absorption/out-turn links and out of those 14 digital links 6 can be accommodated as PWM out-turns. The board also contains 6 analog links. An ATmega328p MCU is attached on the board. The Arduino first takes the knock pattern input from the Piezo Disc (converts vibration to electrical charge) and then compares the Pattern with the recorded one. Then if the pattern entered by the user is correct then the Arduino sends a high signal to the relay which in turn will open the lock for couple of time and then turn close it again. But in case the knock pattern given by the user doesn't matches with the pattern which user previously recorded then it will keep door locked. The Knock pattern can be changed infinite times as per user satisfaction and a max of twenty knock patterns can be recorded to enhance security.



Fig 3: ARDUINO UNO

b. PIEZO DISC

Piezo disc is a device which makes use of the piezoelectric effect to receive that vibration that is generated by knocking and sends it to Arduino after the vibration is converted into electrical charge in order to be understood by the Arduino.



Fig 4 PIEZO SENSOR

c. RELAY

Relay is an electrical switch which is operated by an electro magnet, when a small amount of current is passed to the signal pin of it. In off state on the load side the "NC" and "C" pins are connected with each other, but when a small

amount of current is passed on signal pin then the "NO" and "C" pins gets connected. Two of the relays are used to control the lock either via mobile app or Knocking on the Piezo and one of them is used for switching the circuit to battery back-up in case of power-cut.



Fig5 : RELAY

d. ESP 32

This microcomputer is put together by Espressif systems. Besides being an efficient system, it is still very robust. To communicate via the internet this device is essential and to control from one's Smartphone using the forged mobile Application via Google Firebase. When an individual opens the application, they can see the current condition of the lock (i.e., if the door is opened then "Door is now opened" will be displayed, and if not then "Door is now closed" will be displayed when the user is connected to the internet). When the clicks the Unlock-button, the Application sends "1" to the firebase which in turn send that data to the ESP 32 via the internet, on receiving so the ESP32 as programmed changes the relay status to high and the lock opens and then after successfully opening of the lock the ESP-32 sends back "1" to the Firebase, which then send sit back to the Mobile Application and a message is displayed to the user showing that "Door is now Unlocked" remains so until the user locks the door by pressing the LOCK button. When pressed it again send a value but this time "0" is sent which is then received by the ESP-32 via Firebase and then the door is locked by turning the relay off, then again the ESP-32 sends a value back to the Mobile Application via Firebase, and the displayed message now changes to "Door is now Unlocked".

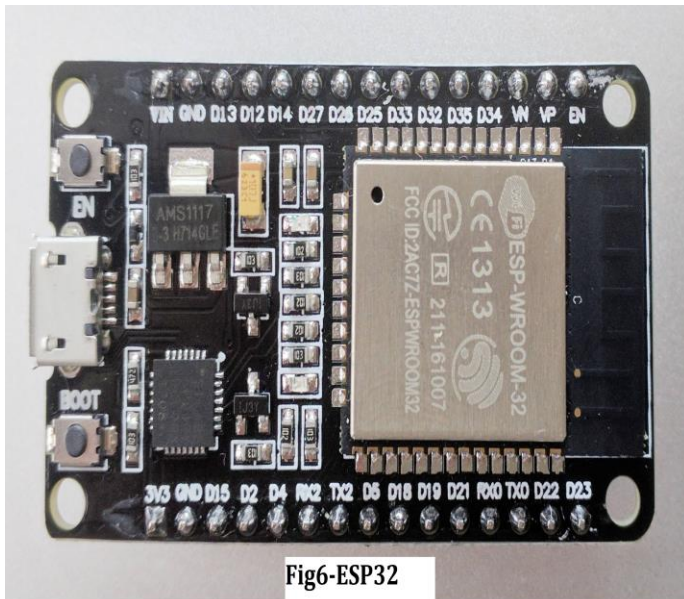


Fig6-ESP32

e. SOLENOID LOCK

This device is used to control the popper when they receive the command by passing the current through the coil inside it which in turn pulls the iron rod and activates unlocking the Door. And by receiving command when the current stops passing, the lock again goes back to its original position as it is supported by a spring and hence the door is locked.



Fig 7: SOLENOID LOCK

C. THE SOFTWARE

a. ARDUINO IDE

The common inventor tools in a single user interface are packed by this software for generating applications on distinguished operating systems. It is based on hardware programming language named processing, very similar to C Language. The sketch should be uploaded on the board with the help of Arduino IDE for execution.

b. GOOGLE FIREBASE

Google developed this platform for creating mobile and web applications. Storing and syncing data between your users has becomes faster and lot more easily with the help of cloud hosted no-sql real-time database by Google Firebase.

c. MIT APP INVENTOR

This was originally provided by Google as a web based common inventor tools in a single user interface is packed by this software for generating applications. Applications made are fully customizable by the user and can be developed by either using a connected Smartphone or web browser or by emulator. Besides storing your work it also guides to keep tract of one's activity.

4. PRINCIPLE OF ACTION

The entire circuit deals with a simple mechanism of activation and deactivation of the 12V solenoid lock via relay. When the 12V power is supplied to the circuit using the connected adapter and another adapter that supplies 5V is connected to the relay (+ goes to signal and "+" pin of the relay and - goes to the GND pin of the relay). Now the positive terminal of the 12V power supply goes to the NO pin of the relay and the negative terminal of the power supply goes to the Arduino, the positive terminal of the Arduino at the 12V barrel jack is connected to the common pin of the relay. Now another part NC pin of the relay is connected to the positive terminal of the battery pack and the negative terminal of the battery is connected to the barrel jack, and the positive terminal of the barrel jack is connected back to the common pin of the relay. The function of the relay is to switch between the power supply and the battery pack during the power cut to ensure that the device still works during a power cut. Now one terminal of the battery is connected to a switch and the other terminal of the switch is connected to the positive part of the adapter. The negative part of the battery is also connected to the negative terminal of the adapter. This is done in order to securely charge the battery pack. We have added a switch here because in order to save the battery from continuous discharging as the current flows and discharges the battery slowly. Now on pin number 4 & 5 the anode of the LEDs are connected via resistance, the cathode part of the LEDs are connected to the ground, a switch is connected with digital pin2 and Arduino's common return link, and the piezo is coupled with the A0 and Arduino's common return link, a resistance is connected across A0 and ground pin in order to save the Arduino from high Impulses that is generated by tapping on piezo, and the signal pin, Vin pin, the ground pin of a relay is connected to the D10, 5V, and ground respectively. Now on the opposite side of the relay, the Positive Terminal of the lock is connected to NO and the negative terminal of the lock is connected to the Battery. The positive terminal of the battery connected with the common of the relay. Now initially the user first in order to record a knock pattern has

to turn on the switch that is connected on pin number 2 of the Arduino and on doing so the red led will be turned on and whenever the user enters a knock both the led's (Green and Red) will blink simultaneously and after entering the knock just after one second the led blinks the way the user has entered the knock to visually show the user the pattern they have entered, after that the switch is to be turned off and the red led goes down, but the green remains solid. In this state, the user will use the Door Lock until and unless they have to change the knock Pattern. Now, on the other hand, ESP-32 gets 5V of power supply to operate the relay connected on the D14, VIN, and Ground, and the normally open pin of the relay gets 12V power supply from the adapter that we have used. The common pin of the relay is connected to the positive end of the lock and the negative end of the lock is connected to the negative terminal of the 12V power supply. First, the ESP32 established a connection with the local Hotspot in order to get connected to the internet. Now whenever the user access the Mobile application as it is highly secured first they have to authenticate their fingerprint (when successful they can proceed or else the app will be closed), after that they have to enter their secured pin, then only the user will be directed to the lock interface there the current status of the lock will be shown (Either Open or closed) after that if the user clicks on the unlock button then a value 1 is sent to the firebase and from there that value is sent to esp-32 via the internet, on receiving so the as in programming language 1 means -high, hence the esp-32 turns on the relay and the door is unlocked. After successfully doing so, the esp32 sends back the value -1 to the firebase, the firebase first receives the authentication token which is provided in the code that is programmed in esp32, and then gives access to do so. On receiving now the value goes from firebase to mobile application and a status (DOOR IS NOW UNLOCKED) is displayed on the application. In the same manner when the user clicks the lock button then the 0 is sent to the FIREBASE via Internet then it goes to ESP32 and receiving so it locks the door, and then the status (DOOR IS NOW LOCKED) is displayed on the application.5.

RESULT:

PROCESS OF "UNLOCKING" & "LOCKING" VIA MOBILE APPLICATION

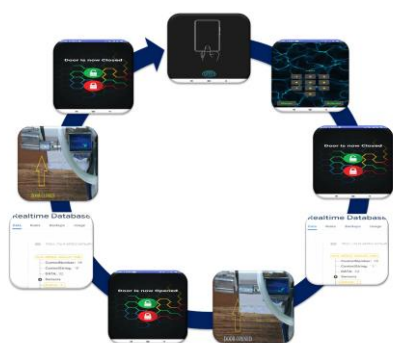


Fig 8: PROCESS OF "UNLOCKING" & "LOCKING" VIA MOBILE APPLICATION

ALTERNATE OPTION TO "UNLOCK" THE DOOR BY KNOCK SEQUENCE

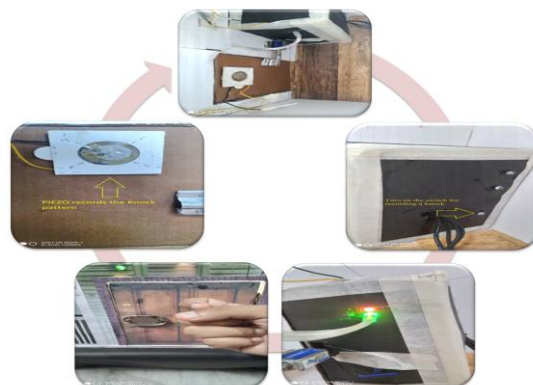


Fig 9: ALTERNATE OPTION TO "UNLOCK" THE DOOR BY KNOCK SEQUENCE

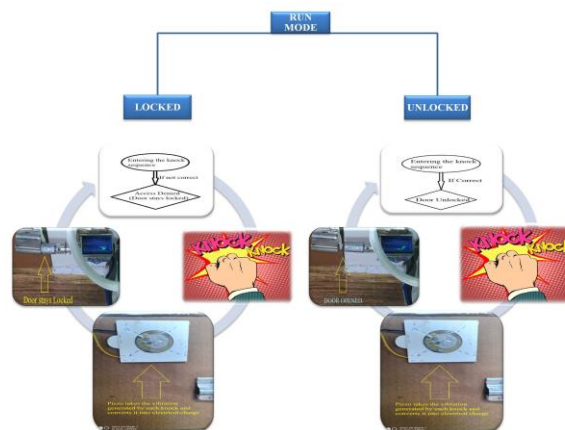


FIG 10 : Whether a door is going to stay locked or will be unlocked

TABLE AND GRAPH FOR WHEN A KNOCK IS ACCEPTED

WHEN A KNOCK IS GOING TO GET REGISTERED ?				
Sl-NO.	ANALOG READ >=70	EQUIVALENT DIGITAL READ (IN mV) >= 342mV	KNOCK REGISTERED (YES/NO)	EQUIVALENT BINARY VALUE
1	70	342	YES	1
2	75	366	YES	1
3	80	391	YES	1
4	85	415	YES	1
5	90	439	YES	1
6	95	464	YES	1
7	100	488	YES	1
8	105	513	YES	1

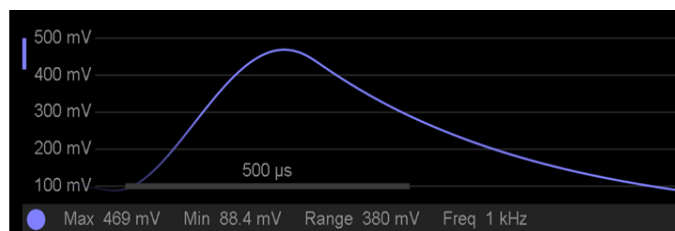
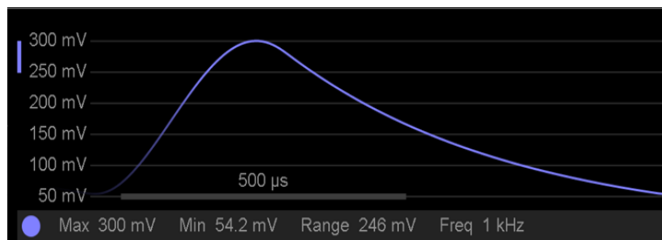


TABLE AND GRAPH FOR WHEN A KNOCK GETS REJECTED

WHEN A KNOCK IS NOT GOING TO GET REGISTERED ?				
SL-NO.	ANALOG READ < 70	EQUIVALENT DIGITAL READ (IN mV)- 342mV	KNOCK REGISTERED (YES/NO)	EQUIVALENT BINARY VALUE
1	30	146	NO	0
2	35	171	NO	0
3	40	195	NO	0
4	45	219	NO	0
5	50	244	NO	0
6	55	268	NO	0
7	60	293	NO	0
8	65	317	NO	0

Table 2



6. CONCLUSION

This paper introduces a technology that will make human lives more versatile with increased security, ease, and to lead an upper class lifestyle inevitably creating our life's much simpler, finer, accessible and more steady. It represents innovativeness for operating a house replacing manual keys with digital codes and knocks for a door lock at home, thereby keeping in view of the growing Security trends in years to come and resolving the use hi-tech manual locks for our existing doors with a Digital Smart Lock. Moreover, the cost of execution of the developed system has been kept at low cost making it reasonable to all who seeks Security for home. As differentiated with most of the used technologies as narrated in the literature review, the Digital Smart home is convenient to execute and manage. It assists IoT, cellular technology and a non-proprietary open-source android system platform. The proposed standpoint registers to operate with Wi-Fi technology for integration, android based App for client ingress, and client testimonial for reliability and authentication, perceive the desired architecture. Hereafter, the sketched structure can be broadened to embrace other characteristics of home modernization and reliability. In addition, these experimentation assignments are often supplemented to reinforce other OS platforms distant from Android.

7. FUTURESCOPE

Nowadays there are so many locks and smart devices for home security but most of them have high cost value as well as certain problems for operating and the major drawback is those need a lot of training and time to use, one of the main peculiarity of this innovation is, it is affordable for everyone. During usage on a large scale, adding a lot of improvements in the prototype will exorbitantly

benefit the community. Extensions within the app could also be viewing that who's passing through the door by adding the camera and sending the stream directly to the mobile device. Voice Commands can be also included to enhance the security. Motion Detection in case someone roams around the door for a longer time, then the camera will send a recording or that to the Smartphone. This can also extend to, if someone is trying to break in the door, the alarm will start beeping on a mobile device as well.

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BIOGRAPHIES



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