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KKSDLA - KNOCK and KNOCK SYSTEM FOR DOOR LOCK USING ARDUINO

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Abstract: Security has reliably been a huge concern in our regular daily existence. Locks are a piece of it whether it is the crucial door lock, interconnecting door lock, bathroom door lock, furniture lock, stuff lock, screen, and barbecue door lock, etc. Here, we have proposed making a Knock-Knock system for door lock using Arduino which can distinguish the example of your knocks at the door and will possibly open the lock on the off chance that the knocking example coordinates with the right example. This paper depends on uniquely crafted Arduino whose sole plan is cost cutting of the completed outcome and the calculation for knock design identification is created utilizing the Arduino programming condition. We have integrated a reset button close by two situations with that are important for the testing of the undertaking and joining up or enrolling new knock designs. Right when the client knocks, custom Arduino board arranges the knock plan with the knocking calculation and opens the door assuming the knock design coordinates with the model enrolled.

Key words: security, knock- knock, Arduino UNO, knock detection, sensor.

1. INTRODUCTION

The least complex and generally utilized lock framework incorporates lock and key. There is one key for one door so assuming many individuals approach the key this might make issues and may prompt diminished protection. It makes security issues in the event that the key is copied. On the off chance that the key is lost door can't be opened except if the key is found/lock is broken. And yet door opening ought to not be tedious. Along these lines, face acknowledgment, eye distinguishing door could create setback. Password door locks can create issues if the password is broken by somebody.

Current locks and the locking framework are undeniably more perplexing and frequently utilize a specked component on the key which give a more noteworthy security. Yet, the significant drawback now days is that it's the equivalent 'lock and key' system, meaning, the key can continuously be reproduced with some work. One of the arrangements is to dispose of the 'lock and key' component itself totally. This paper plans to do likewise by laying out solid security basingon a 'Secret knocking pattern', hence the name, "Knock Based Security System". This framework totally eliminates the feeling of dread toward replication as there is no key required to be reproduced.

There are numerous security frameworks that have been intended for door locking yet the extent of this paper is on another idea utilizing knock the locking and opening of the door should be possible by disposing of the burdens of existing customary accessible door security framework

2. INSPIRATION

a) PASSWORD BASED SYSTEM

“Password Based Security lock system” proposed by Arpita Mishra, Siddharth Sharma, Sachin Dubey, S.K.Dubey.[1] This proposed system works basically on construct this device it is used as T mega 8 microcontroller, 4×3 number keypad, 16×2 character LCD module, vehicle centre lock motor and power.

The fundamental idea of programming configuration is it ought to check the squeezed key qualities by the microcontroller and as indicated by that sign difference in the port D it returns which key has squeezed and look at whether that entered 4-digit secret phrase and put away secret phrase in the EEPROM are coordinating[2]. On the off chance that they will match engine is actuated and door is opened.

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b) BIOMETRIC BASED SYSTEM

The palmtop acknowledgment is the subsequent stage for finger impression acknowledgment. It [3] works on the picture of palmtop. First and foremost, framework takes a picture of the palmtop then it deals with that picture by it is expected to parcel it and cycle. Toward the end, confirm the perfect individual. Thus, it decreases the possibilities of blunder in other human acknowledgment techniques and explains the issues which were looked in the unique finger impression acknowledgment. The biometric strategy is exceptionally helpful in bank storage spaces. But unique finger impression acknowledgment the vein indicator and iris scanner give best and precise outcome thus, in the bank security framework [4], microcontroller ceaselessly screens the Vein Detector and Iris Scanner through keypad confirmed codes.During night the remote movement indicator will be dynamic, on the off chance that any variety happens in its result, it will be detected by the regulator and ready sounds will be given by it.

As of late, the quick based head part investigation approach is proposed in which the alteration of head part examination approach for the face acknowledgment and face discovery process is done [5]. The picture is caught by the web camera and it gets coordinated with the picture put away in the information base. New high level door lock securityframeworks are accessible in view of the example of the human iris for giving an elevated degree of safety. Furthermore, to make the framework more proficient n solid the recreation is done in MATLAB [6].

c) GSM BASED SYSTEM

In numerous door lock security frameworks, GSM is utilized for correspondence reason. The motivation behind a work developed by usage of a circuits like a GSM module which gets enacted by a regulator [7] for sending SMS in crisis to owner and for sending comparing administrations of safety at the hour of break in. For identifying hindrances, the framework requires different sensors. It assembles information from the sensors and makes a decision. With the assistance of GSM module, sends SMS to an individual number. An as of late made model for security of door [8] handily controlled like controller activities by a GSM hand set goes about as the transmitter and the other GSM telephone set with the DTMF related with the engine connected to door with the utilization of DTMF decoder, a stepperengine and microcontroller unit.

These days individuals need to be secure however they are away from home thus, the work proposed by Jayashri Bangali et. al. [9]. Whenever the proprietor isn't at his home, security of home and significant things is the huge issue before all. Two structures were made which relies upon GSM based innovation. For identification of the door crashes, ithappens by catching picture through web camera. At the point when people groups are not at their homes, the framework sends notice as far as SMS to the emergency number. An original head-based framework [10] can login withnext to no stretch to the framework and can see visitors record and listen their recorded messages and furthermore naturally lock the door utilizing versatile correspondence innovation.

d) SMART CARD BASED SYSTEM

A model door security framework [11] is intended to permit an authorized person for getting a safe (without need of any key) door where valid card of smart RFID is necessary for ensuring the pass of the door. Total control activity is performed by the microcontroller.

e) RFID BASED SYSTEM

These kinds of safety frameworks utilized for computerized door lock [12] are using idle RFID labels (latent). With the assistance of this, it guarantees that main substantial individual can get section. Such frameworks are working progressively essential for opening the door in which client need to put the tag in touch with RFID locator, then the entrance gets opens and in the focal server the enlistment information is put away with important information of the clients. Participation and individual following are conceivable by utilizing such sort of framework. RFID Based Gate Access Security System which calls attention to approved people groups and allows just them was actually made by K.Srinivasa et. al. [13]. This framework should have the ability to limit the prepared or concentrated human mistake during got door access.

Most recent RFID based door lock security framework depend on Arduino stage [14] with sound affirmation right when card put near the RFID module, it scrutinizes the card information and it coordinates with the information put away in the program memory and shows approve/unapproved passage. Arduino is additionally involved by numerous different applications for instance A particular Arduino ATMEL processor can be utilized for detecting and acknowledgment of individual [15], another model like ECG Parameter Identification and Monitoring [16] as they have open-source stage.

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f) DOOR PHONE BASED SYSTEM

The previous framework, a particular framework where recognizable proof of a visitant is finished the most part by direct correspondence with the arrangement of the lodging domain concerned [17]. A dialing up to the sets over the without hands phone is made by the system at the doorway. Guests enter inside through the door by controlling the doorwith the assistance of the phone set. The most recent framework depends on video door telephone reconnaissancewhich is utilized to distinguish the guests, created by Chau-Huang Wei et. al. [18]. The work used a novel powerline correspondence chip for develop an advanced arranged video door telephone. Besides, they traded sound and visual data and updated the way monitoring limits.

g) BLUETOOTH BASED SYSTEMS

Bluetooth based framework is a piece like survey house advancements that uses Bluetooth work accessible in shrewd gadgets [19]. The system utilizing Bluetooth ends up being more basic and useful for legitimate usage. Such frameworks are by and large in view of Arduino stage. The equipment of such structure is the combo of android advanced cell and Bluetooth module. Arduino microcontroller here is going about as a regulator and solenoid can be going about as result of locking framework.

h) SOCIAL NETWORKING SITES BASED SYSTEMS

A particular work [20], the digitalization and wellbeing viewpoints were achieved by using the telephone gadget and web camera. The model can enable a pin to close and open an door from designated area utilizing SMS from a (long range informal communication site) like Facebook, WhatsApp and so on.
As of late, another computerized door lock framework [21] get planned which identifies the obscure actual contact of a visitant then, at that point, quickly illuminates to the proprietor through the advanced mobile phone as displayed in Fig **3.** Right now, assuming that off-base secret word gets identified more than the predetermined times, theframework gets the image of the obscure visitant and sends it to the proprietor through brilliant gadget. Thusly, expands the strength of the security work.
With assistance of most recent trend setting innovation, show of a canny door framework utilizing Internet of Things is given by S. Nazeem Basha et. al. [22]. The framework gives warning of interruption by conveying email notice to the proprietor. It logs all the interruption information into Google spread sheet of owner's Google drive account. ADXL345 accelerometer distinguishes the adjustment of movement of the door and raspberry pi peruses the sensor interruption information and to convey to the Amazon Web Services Internet of Things (AWS IoT) console. Like the Arduino, Raspberry Pi module utilized generally as it is an economical PC that utilizes Linux-based working framework [23]. It is additionally having open-source stage for utilizing gadgets like GPIO, HDMI, 10/100 Ethernet and USB port and so on. It is additionally having spaces for SD cards in which Linux raspberry bundle can be put away [24]. It has huge degree in innovative work in the field of programmed door lock frameworks.

i) OTP BASED SYSTEMS

The proposed strategy in most recent work doesn't require administrator's help to get to the office assuming the client knows OTP method and has an enlisted cell phone [25]. Similarly, the OTP is produced and shipped off the proprietor's cell phone at whatever point client solicitations to get to office. Then, at that point, the OTP ought to enter through keypad on the door [26], the door will open. In the event that on the off chance that the portable isn't accessible or off then the choice to open the door is to address the security question ask by framework.

j) MOTION DETECTOR BASED SYSTEM

The Motion Detector System [27] working depends on the standard of measure of light falling on the photodiode. Exactly when the laser light is falling continually on the photodiode, its perusing is 255 in decimals. Yet, when it's ruined by obstacle, the voltage falls under 50 in decimals. This flares the caution and gives warning to the proprietor about the break in. Furthermore, programmed lock can be initiated.

k) VB BASED SYSTEM

Electronic eye [28] addresses the model for catching the door pictures with the assistance of microcontroller to guarantee the wellbeing for workplaces and houses. In this framework, the picture gets caught when the door is opened and these pictures are shown by utilizing VB application on figuring framework.

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l) COMBINED SYSTEM

The storage security framework is as displayed in Fig 4 considering RFID, FINGERPRINT, PASSWORD and GSM innovation [29] containing door locking structures which can be without a very remarkable stretch, started, verified and approved by the approved individual. It opens the storage door continuously way.

3. SYSTEM ARCHITECTURE

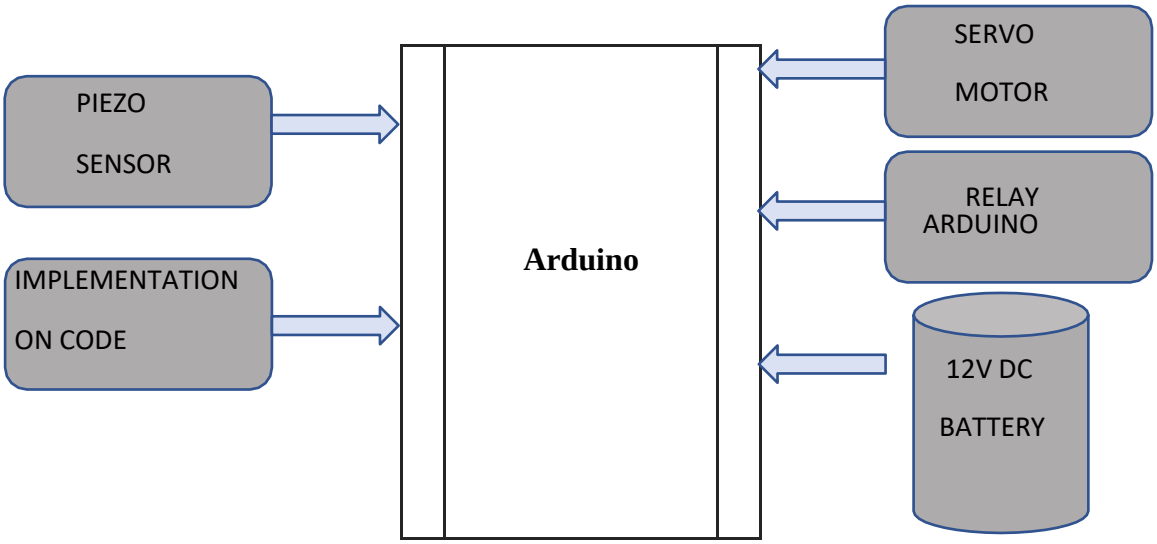

Figure 1. Architecture

In this Architecture outline, the Power supply is associated with all parts and hand-off which is associated with Arduino UNO and piezo sensor which methodically associated with framework to execute the code with the Arduino IDE and recognizes the sensor when the framework approves the knock the door opens and again identifies door locks. In the event that the contribution of knock is off-base, the servo engine won't run and the outcome will be inactive in the chronic screen

4. METHODOLOGY

Considering the above issues, we propose a shrewd knock distinguishing door utilizing Arduino which suits ideal concerning cost, effectiveness and security according as far as anyone is concerned and perception. This gadget will be introduced on the door and will recognize any error or obscure example whenever recorded. Door opens just when the knocked design coordinates with the one refreshed in the situation by the legitimate individual. This example alongside the cushion time frame can be refreshed by the proprietor as and when required. The gadget isn't associated with clearly alert when wrong example is knocked remembering the clamor and unsettling influence it could cause to neighbors and furthermore on the grounds that it could happen the client himself knocks inaccurately unintentionally.

4.1 COMPONENTS USED:

Software used – Arduino IDE

Hardware used –

1. Arduino UNO
2. Piezo sensor
3. Breadboard
4. Push button
5. Servo motor
6. Relay module 5V
7. Solenoid lock
8. Speaker
9. Resistor 220, 10k, 1M

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10. LED
11. Wires
12. Power

4.1.1 HARDWARE DESCRIPTION:

a) Arduino UNO

The **Arduino Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo.

Figure 4.1 Arduino pin Diagram

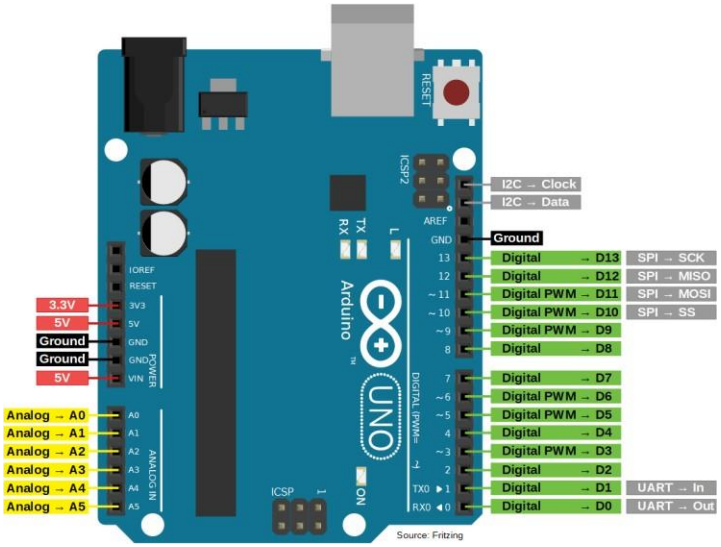

Figure 4.2 Arduino

b) Piezo-sensor

A **Piezoelectric Sensor** requires no external voltage or current source, they are able to generate an output signal from the strain applied. This makes them a popular choice for many applications. The use of them is growing significantly throughout different industries and they are sometimes incorporated into other sensors.
A piezoelectric sensor converts physical parameters - for example, acceleration, strain or pressure into an electrical charge which can then be measured. They are highly sensitive and very small in size making them well suited to everyday objects.

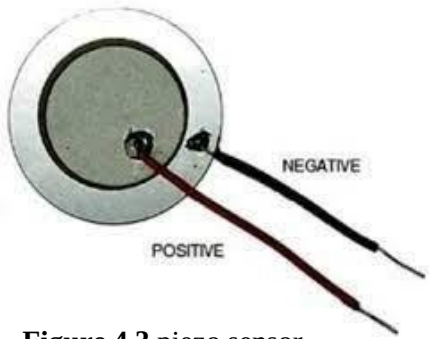

Figure 4.3 piezo sensor

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c) Servo motor

A servo motor is a rotary actuator that allows for precise control of angular position. It consists of a motor coupled to a sensor for position feedback. It also requires a servo drive to complete the system. The drive uses the feedback sensor to precisely control the rotary position of the motor.

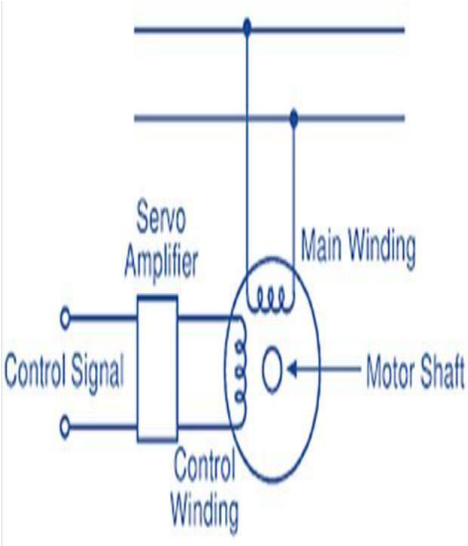

Figure 4.4 servo motor circuit diagram

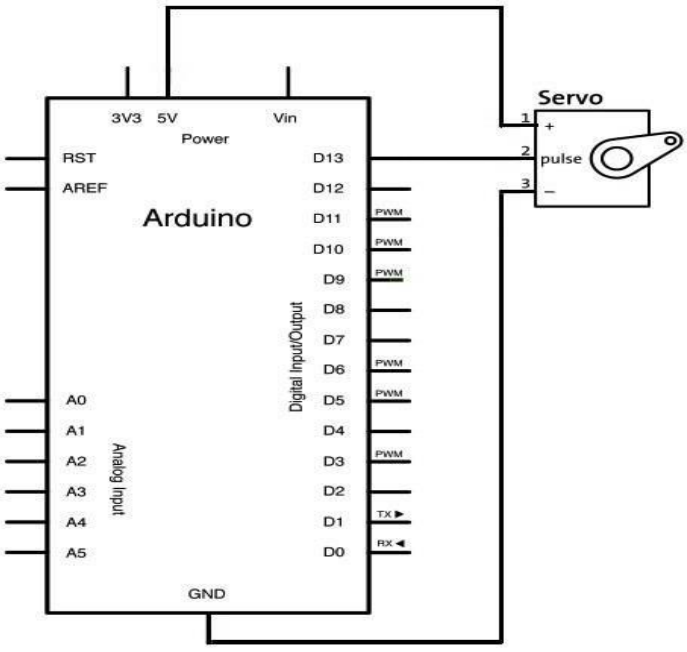

Figure 4.5 servo motor connections with Arduino

4.1.2. SOFTWARE DESCRIPTION

Arduino IDE:

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as **Windows, Mac OS X, and Linux**. It supports the

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programming languages C and C++. Here, IDE stands for **Integrated Development Environment**. The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuine and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ion.'

5. WORKING EXPLANATION

To lock the safe, we will use a servo motor with an attachment. We will also use a switch to turn the lock on and off and some LEDs to indicate the status of the lock. First, we should create a circuit. Make sure that nothing is connected to the board. Prepared the breadboard by connecting the ground and power rails on both sides. Start by connecting a pushbutton with a 10k pull down resistor. The state of the button will now be read by pin 2 that is connected to the resistor and ground side of the button. Next, connect the piezo sensor, and since we are using it to detect sound instead of playing sound. When using a piezo as a vibration sensor, it can generate large voltage spikes, so need a 1 mega ohm resistor to dampen it in order for the board to read the vibrations properly. Connect one terminal of the piezo to power and the other to ground through the resistor. Leave some room for the analog pin wire. Read the analog values from analog pin 0, which in this case will be used as input pin. Add the LED indicators. Connect the red, green and yellow LEDs to the breadboard. An connect them to digital pin 3,4, and 5. Finally, need to add the servo motor. Make sure to note where the terminals for power, ground and signals are on the header. Now, can take a closer look at the code whichis developed using the software Arduino IDE while uploading it to our board. Register the lock knock pattern using button. Now, it's ready to work. If we knock correctly in a registered pattern the lock will open.

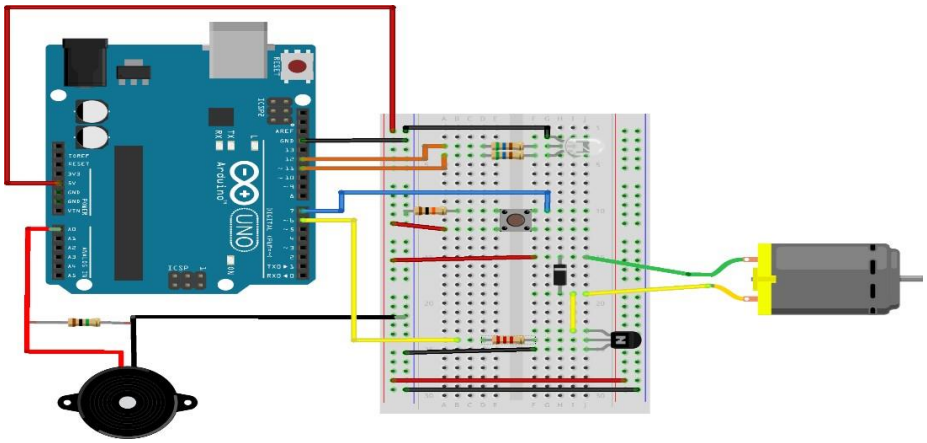

Figure 5.1 circuit Diagram

6. MECHANISM FOR LOCKING AND UNLOCKING

To unlock the door, a servo motor was used. A servo motor is an electric motor with fixed rotational freedom and a built-in sensor which keeps track of the motor's general position [30]. It is not a precision motor, but this is compensated by its price and size. Since the rotation needed to unlock a standard door lock is roughly 90°and precision is not vital, a servo motor was the perfect choice.

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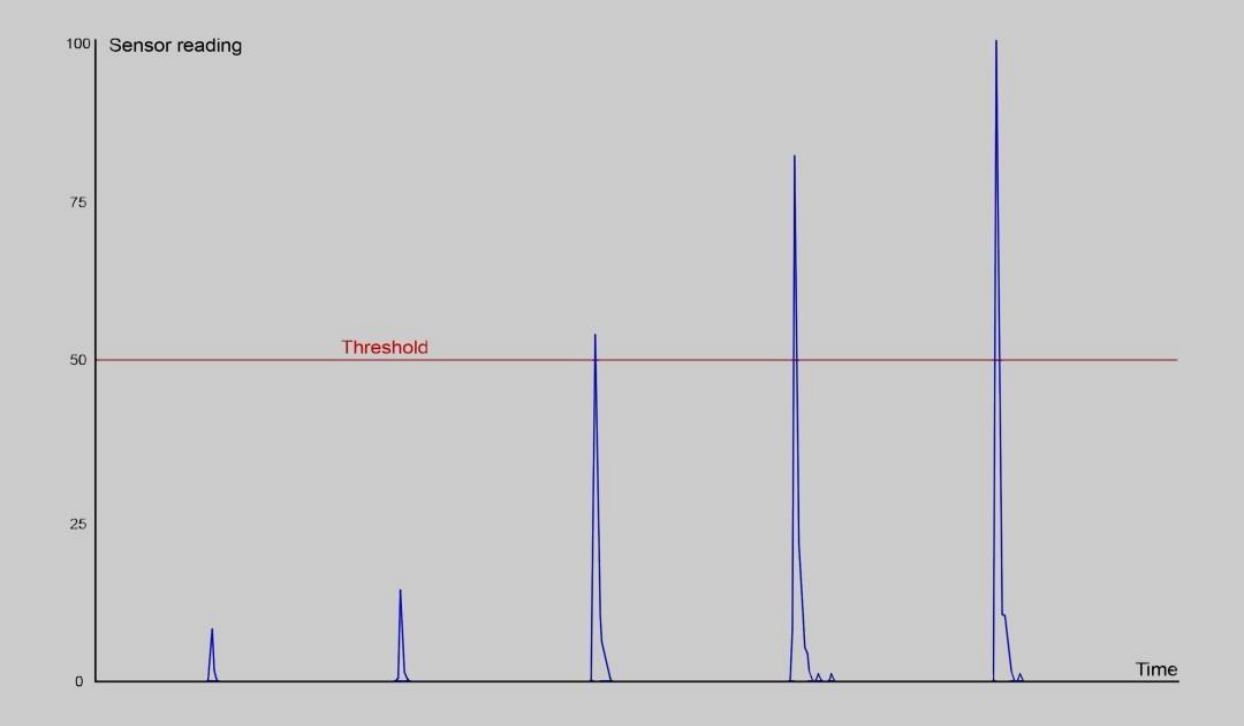

Figure 6.1 Plot of piezo sensor readings with increasing knock strength, gathered from the Arduino Serial Plotter.

Lock turning torque:

To pick a fitting engine for the assignment of turning a lock, information on lock turning force should have been gained. A testing apparatus was developed, and comprised of a switch which could be mounted on a lock turning handle. The switch could then be turned by pulling it at a known separation from the middle, L, with Newton meter toward the path opposite to the switch and enlisting the required force F. In this manner, the turning force could be determined utilizing conditio-6.1.

$$M = F \cdot L \qquad (6.1)$$

Seven different door locks were tested to determine the required torque from the servo. The tests yielded the results in Table 6.1.

Table I. Required lock turning torque for different door locks

Door Lock	1	2	3	4	5	6	7
Turning torque [Nm]	0.27	0.27	0.36	0.18	0.13	0.25	0.20

Localization of a knock:

A major blemish with the idea of a lock controlled with a straightforward knock grouping is that anybody just could tune in and rehash the knock arrangement to open the door. To forestall this, knocking at explicit pieces of the way to increment security was researched.There were multiple methods that could have been used to achieve this localization. What they all have in common is that the methods utilize multiple sensors placed at known locations. Depending on where on the door the knock is initiated, the sensors detect the knock at different times. The time difference then makes it possible to locate where the knock was initiated by geometrical calculations. This is known as Time Difference of

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Arrival (TDOA) methods [31], [32]. A problem which occurred while testing TDOA methods with the Arduino Uno was that the software had trouble measuring the time differences. The cause of the problem turned out to be the sampling frequency of the Arduino Uno, which was by default set at 9600 Hz, meaning one sample per 104µs. The time for the knock vibrations to travel from one sensor to another was close to this time, which resulted in that the software could not reliably determine which sensor was actually triggered first.

This issue was settled by expanding the example recurrence of the Arduino Uno from 9600 to 76 800 Hz by changing the prescaler to 16. With the higher inspecting recurrence of one example for every 13µs, the TDOA measurements were more exact.

Method 1: TDOA with geometrical constraints:

Conditions depicting the mathematical imperatives of the sensors and knock areas were figured out. Together they shaped an arrangement of nonlinear conditions, see Figure6.2 and condition 6.2-6.5. To stay away from thorough testing and high-level estimations, it was expected that the doors were isotropic, and communicated vibrations at the equivalent speed every which way.

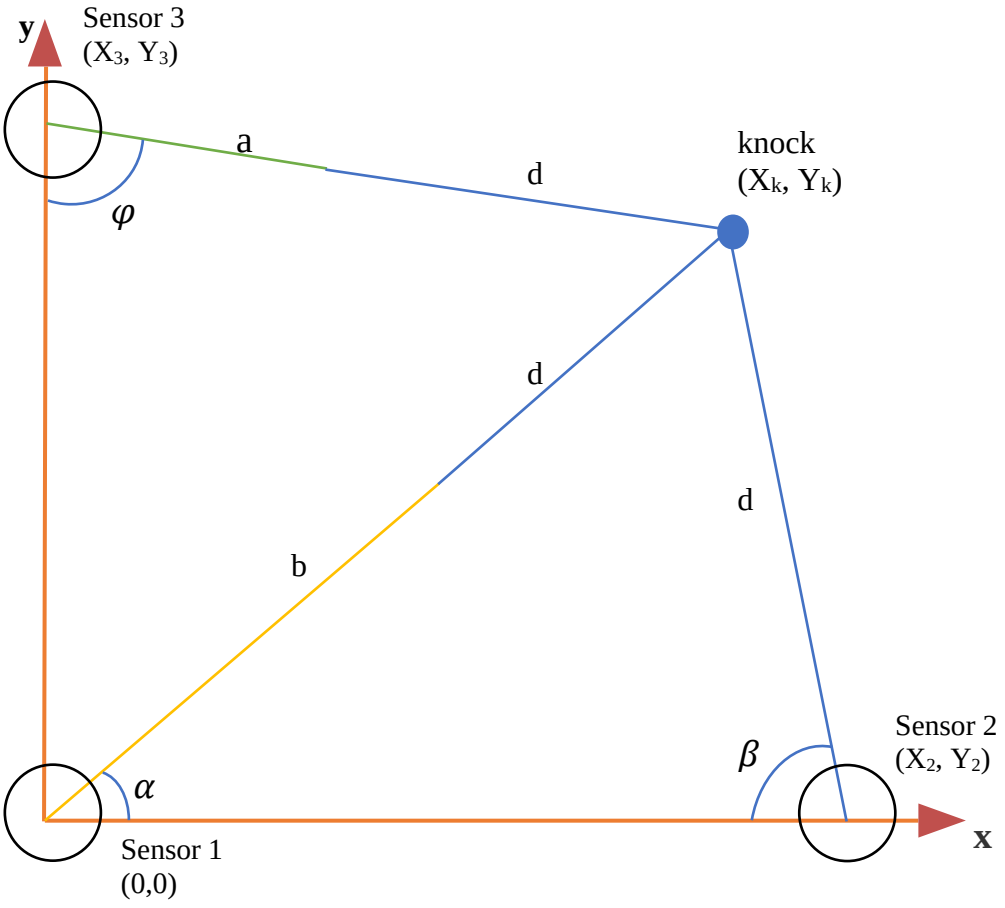
By having three sensors, the framework had four obscure boundaries; the distance d between the knock area and the nearest sensor, and the points a, b and f. Following are the conditions depicting the mathematical requirements of the case shown in Figure 6.2.

$$\vec{e}_x: (b + d) \cdot \cos(\alpha) + d \cdot \cos(\beta) = x_2 \qquad (6.2)$$

$$\vec{e}_y: (b + d) \cdot \sin(\alpha) - d \cdot \sin(\beta) = 0 \qquad (6.3)$$

$$\vec{e}_x: (b + d) \cdot \cos(\alpha) - (a + d) \cdot \sin(\varphi) = 0 \qquad (6.4)$$

Figure 6.2. Door sensor setup for method 1



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$\vec{e}_y: (b + d) \cdot \sin(\alpha) + (a + d) \cdot \cos(\varphi) = y_3$ (6.5)

When the first knock gets detected (in this case by sensor 2) the distances a and b can be calculated

$a = t3 \cdot v$ (6.6)

$b = t1 \cdot v$ (6.7)

where t1 and t3 are the time taken for sensor 1 and 3 to register the knock after sensor 2, and v is the vibration travel speed in the door.

To track down the area of the knock, the directions (xk, yk) must be determined. This should be possible by addressing for the foundations of the arrangement of conditions framed above, however because of the framework being nonlinear this is logically extremely difficult to do. In this manner mathematical techniques are more qualified, where Newton-Raphson's strategy is one of numerous that can be utilized to achieve this [33]. Applying such a strategy to thisframework would have required lattice activities like duplication and reversal, which would typically be done effectively in MATLAB. For this situation notwithstanding, it required to have been done progressively on the microcontroller.This would require progressed numerical C-programming and set aside some margin to carry out than utilizing more improved on way to deal with TDOA, portrayed in method 2.

Method 2: Simple TDOA

A less difficult approach to utilizing TDOA is to have sensors put so that knock vibrations in specific locales generally arrive at a particular sensor first, see Figure 6.3. A knock in sensor locale 1 will generally set off sensor 1 first, and a knock in sensor district 3 will generally set off sensor 3 first and so forth.

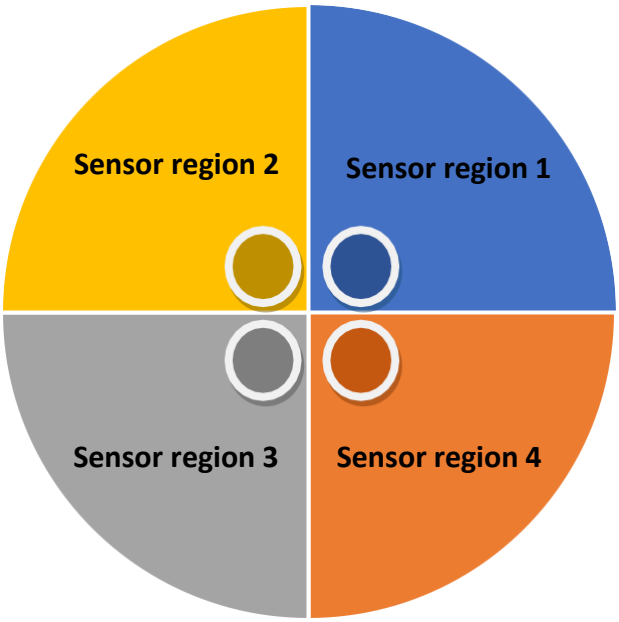

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Figure 6.3. Door sensor setup for method 2

Since this technique just recognizes contrasts between (for this situation) four unique locales, it is substantially less precise than strategy 1 which gives the specific position. This is anyway repaid by the way that it would be very hardfor most clients to recall and executes a knock arrangement with cadenced and mathematical accuracy. This sensor arrangement additionally makes it feasible for the end-client to situate them in any way they need, which expands its security fundamentally. Accordingly, the choice to go on with technique 2 was made.

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7. RESULT

The equipment arrangement is finished with the assistance of client support to fix in the door. Then subsequent to interfacing every one of the parts to Arduino and data of knocks been put away in the framework which can be effectively available and arrangement by the client to open and close the door lock. Furthermore, the outcome can be seen in the chronic screen when the client does the activities.

8. CONCLUSION:

Innovative methodology for executive of doorway opening framework through incomplete specialized and manual taking care. This method has many advantages like sensible expense, upgraded security, little size. The contributions of information which put away in the Arduino UNO and the framework which peruses by approving the quantity ofknocks and opens the door lock. The venture can without much of a stretch fulfill the client and furthermore easy to understand to make the way for each client. Here, to utilize servo library capacity to open and close the door. As aresult, the efficiency for detecting the knock has been increased.

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