CONTACTLESS DOOR BELL SYSTEM USING ULTRASONIC SENSOR

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this Thesis titled **"CONTACTLESS DOOR BELL SYSTEM USING ULTRASONIC SENSOR**" is the bonafide work of "**MADHULIKA G (2116210701139)** and **MERCY N (2116210701157)** who carried out the work under my supervision. Certified furtherthat to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred onan earlier occasion on this or any other candidate.

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ABSTRACT

Traditional doorbell systems, consisting of a push button outside the door connected to a chime unit inside the house via wiring and a transformer, offer a simple and reliable means of alerting occupants to visitors. However, their installation and maintenance can be complex due to wiring requirements, and they lack advanced features like video cameras or remote connectivity. Moreover, their susceptibility to damage from weather or vandalism and dependence on uninterrupted power supply are notable disadvantages. In contrast, automatic doorbell systems, typically wireless and battery-powered, provide greater flexibility and convenience. While they eliminate the need for wiring and offer features like customizable chimes and easy installation, they require regular battery maintenance and may be susceptible to signal interference.

The existing systems have used a face recognition system to recognize the face of visitors. This system uses a camera and algorithm to detect the person. Other systems have used a notification system through SMS and wearables. The notification systems needs internet and it may delay due to the connectivity. There is also a chance when the user did not notice the notification. This reduces the effectiveness of the system. These systems did not consider people with disability.

The proposed system is a doorbell automation based on IOT which is made up of Arduino UNO, LED, buzzer, ultrasonic sensors and wires. The ultrasonic sensor is used to detect the people in front of the door. Once the sensor detects the person in front of the door, the LED will be glowed and sound from the buzzer will come to indicate the user the presence of a person. The LED is glowed to indicate the visitor, for the people who cannot hear. The buzzer helps the blind people to know about the visitors.

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MADHULIKA G

MERCY N

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CHAPTER 1

INTRODUCTION

1.1PROBLEM STATEMENT:

Traditional doorbells require physical contact with a button or surface, which can potentially contribute to the spread of pathogens, especially in public spaces or multi-unit residential buildings. This project aims to address this issue by developing a contactless doorbell system that eliminates the need for touch, thereby improving hygiene and reducing the risk of transmitting infectious diseases.

1.2OBJECTIVES:

The primary objectives of this project are to design and implement a contactless doorbell system using an ultrasonic sensor. The system will integrate the ultrasonic sensor with an Arduino microcontroller for detecting visitor presence and triggering the doorbell. It aims to develop a user-friendly system that provides an audible alert when a visitor is detected within a predefined range. Additionally, the project seeks to create a hygienic solution for activating a doorbell, reducing the risk of pathogen transmission through shared surfaces.

1.3SCOPE:

The scope of this contactless doorbell project encompasses a comprehensive integration of hardware components, microcontroller programming, and system enclosure design to create a fully functional and practical solution. It includes the selection and integration of an appropriate ultrasonic sensor with an Arduino Uno microcontroller board, incorporating a buzzer or chime module to produce an audible doorbell sound. The project involves prototyping and testing the hardware components, developing algorithms and code in the Arduino IDE to process sensor data and trigger the buzzer

upon visitor detection within a predefined range. Additionally, the scope covers the design and construction of a suitable enclosure to house the system components, considering factors such as durability, weather resistance, and aesthetic appeal. Comprehensive testing and evaluation of the assembled contactless doorbell system in various scenarios will be conducted to assess its performance, reliability, and user experience. Finally, the project entails detailed documentation, including schematics, code, and a comprehensive report summarizing the objectives, methodology, results, and potential future enhancements.

Hardware integration of an ultrasonic sensor, Arduino Uno microcontroller, and a buzzer or chime for producing the doorbell sound. Programming the Arduino Uno to process sensor data, detect visitor presence within a specific range, and activate the buzzer accordingly. Designing and constructing a suitable enclosure for the doorbell unit to house the components and ensure proper functionality. Testing and evaluating the performance of the contactless doorbell system in simulated scenarios.

1.4RESOURCES:

The resources are required for the successful completion of this project are Arduino Uno microcontroller board, ultrasonic sensor (e.g., HC-SR04), buzzer or chime for producing the doorbell sound, breadboard and jumper wires for prototyping, power supply (e.g., 9V battery or USB cable) and Arduino IDE software for programming the microcontroller

1.5MOTIVATION:

The motivation behind developing a contactless doorbell system stems from the growing emphasis on hygiene and safety, particularly in the wake of the COVID-19 pandemic. Traditional doorbells that require physical contact pose a potential risk for the transmission of pathogens, as shared surfaces can harbour and spread infectious agents.

This project aims to address this concern by providing a touchless solution that eliminates the need for direct contact with the doorbell.

Moreover, contactless technologies have gained significant traction across various sectors, driven by the desire for enhanced convenience and accessibility. The proposed system aligns with this trend, offering a user-friendly experience by allowing visitors to activate the doorbell without the need for physical interaction. This can be particularly beneficial in scenarios where hands may be occupied, such as when carrying packages or in situations where hygiene is of utmost importance, like in healthcare facilities or food service establishments.

2. LITERATURE SURVEY:

1. "Design and implementation of door access control and security system based on IoT"

The study explored various authentication mechanisms, including fingerprint recognition and password-based systems, to facilitate secure remote access. Integration of biometric sensors, such as fingerprint scanners, provides an additional layer of security against unauthorized intrusions. Moreover, sensor-based alerts enable the detection of environmental conditions and potential security threats, ensuring timely responses to mitigate risks. However, challenges related to internet dependency remain a significant consideration for ensuring the reliability and effectiveness of these IoT-based systems. Overall, the literature emphasizes the potential of IoT technology to strengthen home security.

2. "IOT Based Door Access Control Using Face Recognition"

The researchers have integrated both hardware and software. The study has used Raspberry Pi for human detection and capturing the image of the human. If the face is recognized, the door will be unlocked; otherwise, it gets permission from the user. The

PIR sensor detects the presence of a human. It uses algorithms for face recognition. Then it sends the image to the authorized user through email. This system is dependent on face recognition; if the accuracy of the system fails, it will reduce performance and security.

3. "MQTT-Enabled Smart Door Access System: Design and Implementation Using NodeMCU ESP 8266 and HiveMQ"

The proposed IoT-enabled smart door access system offers a keyless approach, granting access only to authorized individuals. Central to its design is the integration of a NodeMCU ESP 8266 microcontroller, which manages door operations. Access control is facilitated through the Virtuino IoT application, allowing individuals to unlock doors using their smartphones. Furthermore, the implementation of an MQTT broker, specifically HiveMQ, facilitates seamless machine-to-machine communication among IoT components. This research rationale is grounded in the recognition of the limitations inherent in traditional physical key door locks, emphasizing their susceptibility to damage and replication, thus compromising security measures. By addressing these weaknesses, the IoT-based solution presented herein offers a promising alternative to bolster home security measures and mitigate risks associated with unauthorized access.

4. "An IoT based Automated Door Accessing System for Visually Impaired People"

The study provides security to visually impaired people to detect the visitors accessing the door. The researchers used face recognition, object detection, and audio alert. The audio alert feature overcomes the SMS alert implementations in other existing systems. The SMS alert may be missed by the user. The components used in this study are Webcam, Sonar sensor, Raspberry Pi, Arduino, and Speaker. The limitations of the proposed system are the delay in face recognition system. This study provides security to visually impaired people in the home.

5. "Smart security system for door access based on unique authentication"

The study proposes a method to provide security to people using voice recognition, biometrics, and SMS alerts to indicate unauthorized visitors to the users. A buzzer is also used as an alert. A database is used to store the details of the people who access the door. The study explores a method to provide a high level of security to the user. The limitation of the system is the SMS alert might be missed by the user.

3. PRESENT TECHNOLOGY:

Several technologies are currently being employed for contactless doorbell systems to provide a touch-free solution for activating doorbells. These technologies aim to address hygiene concerns and offer convenience by eliminating the need for physical contact with surfaces.

Motion Sensor-Based Systems:

One of the prevalent technologies used in contactless doorbells is motion sensor integration. These systems typically employ passive infrared (PIR) sensors or radar-based motion detectors to detect the presence of a visitor within a specific range. When a visitor is detected, the system triggers the doorbell, eliminating the need for manual activation.

Proximity Sensor Systems:

Another approach involves the use of proximity sensors, such as capacitive or infrared sensors. These sensors detect the presence of an object or person within a predetermined distance, triggering the doorbell accordingly. Proximity sensor-based systems can offer a more precise detection range compared to motion sensors, ensuring that the doorbell is activated only when a visitor is in close proximity.

Video Doorbell Systems:

Video doorbells have gained popularity in recent years, combining contactless activation with video surveillance and communication capabilities. These systems typically incorporate a camera and motion detection algorithms to identify visitors and automatically trigger the doorbell. Video doorbells often include additional features like two-way audio communication, night vision, and cloud storage for recorded videos.

Voice-Activated Doorbells:

Some advanced contactless doorbell systems integrate voice recognition technology, allowing visitors to activate the doorbell using voice commands. These systems typically employ microphones and speech recognition algorithms to detect specific phrases or keywords spoken by the visitor, triggering the doorbell accordingly.

Gesture-Based Systems:

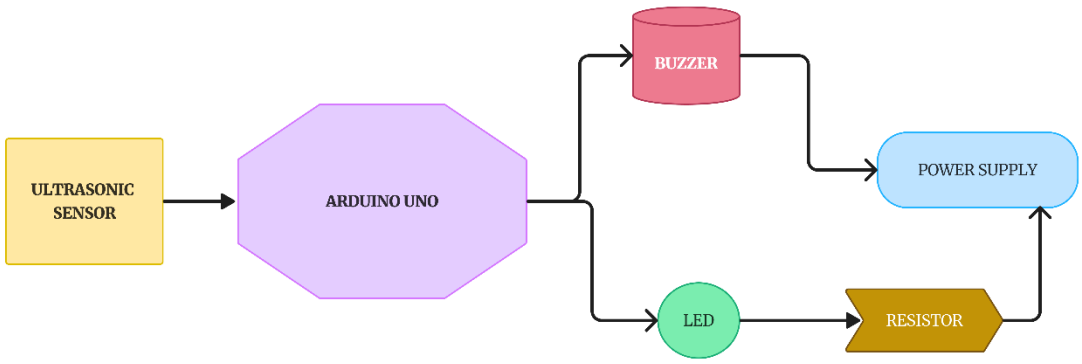
Emerging technologies in the field of gesture recognition have also found applications in contactless doorbells. These systems use cameras or depth sensors to detect specific hand gestures performed by visitors, such as waving or making a specific motion, and activate the doorbell in response.

While these present technologies offer contactless solutions, they may have limitations in terms of accuracy, reliability, or complexity. Some systems may be more expensive or require additional infrastructure, such as Wi-Fi connectivity or cloud services. Additionally, privacy concerns may arise with technologies that involve video or audio recording.

Additionally, the use of ultrasonic sensors enhances the system's versatility by enabling it to detect visitors regardless of lighting conditions, making it suitable for both indoor and outdoor applications. Moreover, the integration of microcontroller programming

allows for customizable features such as adjustable detection range and sensitivity, providing users with greater control and flexibility. Furthermore, the cost-effectiveness of the system makes it accessible to a wider range of users, contributing to its potential for widespread adoption in residential and commercial settings alike. Lastly, the reliability of the ultrasonic sensor-based contactless doorbell system offers peace of mind to users, ensuring consistent performance and seamless operation in various environments.

3.1 BLOCK DIAGRAM:



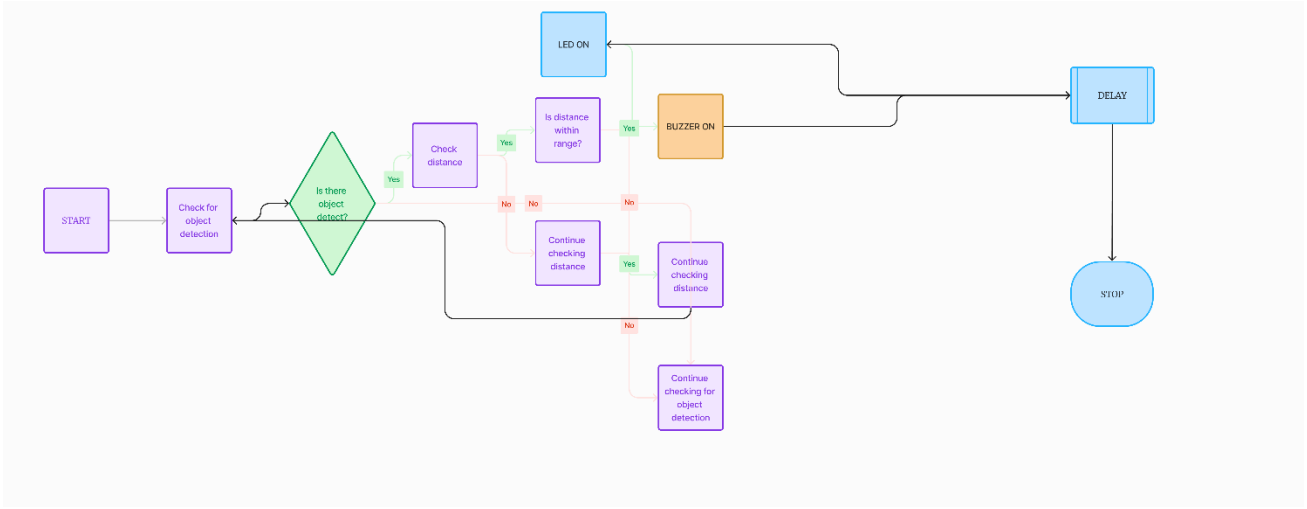
3.2 LIMITATIONS:

While offering benefits like improved hygiene and convenience, contactless doorbell systems face several limitations that must be addressed. False activations due to environmental factors or interference can lead to unnecessary ringing and frustration. The detection range is often limited, causing potential misses for visitors approaching from far away or in large areas. Environmental conditions like extreme temperatures or

moisture can affect sensor performance and durability. Power requirements, either through batteries or wired connections, introduce maintenance needs and potential disruptions. Installation complexity increases for systems relying on precise camera/sensor alignment or integration with existing home automation setups. Privacy concerns arise with implementations involving video/audio recording of visitors. Overcoming these limitations related to reliability, effectiveness, usability, and privacy compliance is crucial for widespread adoption of contactless doorbell technology.

4. PROPOSED TECHNOLOGY:

4.1 SEQUENCE DIAGRAM:



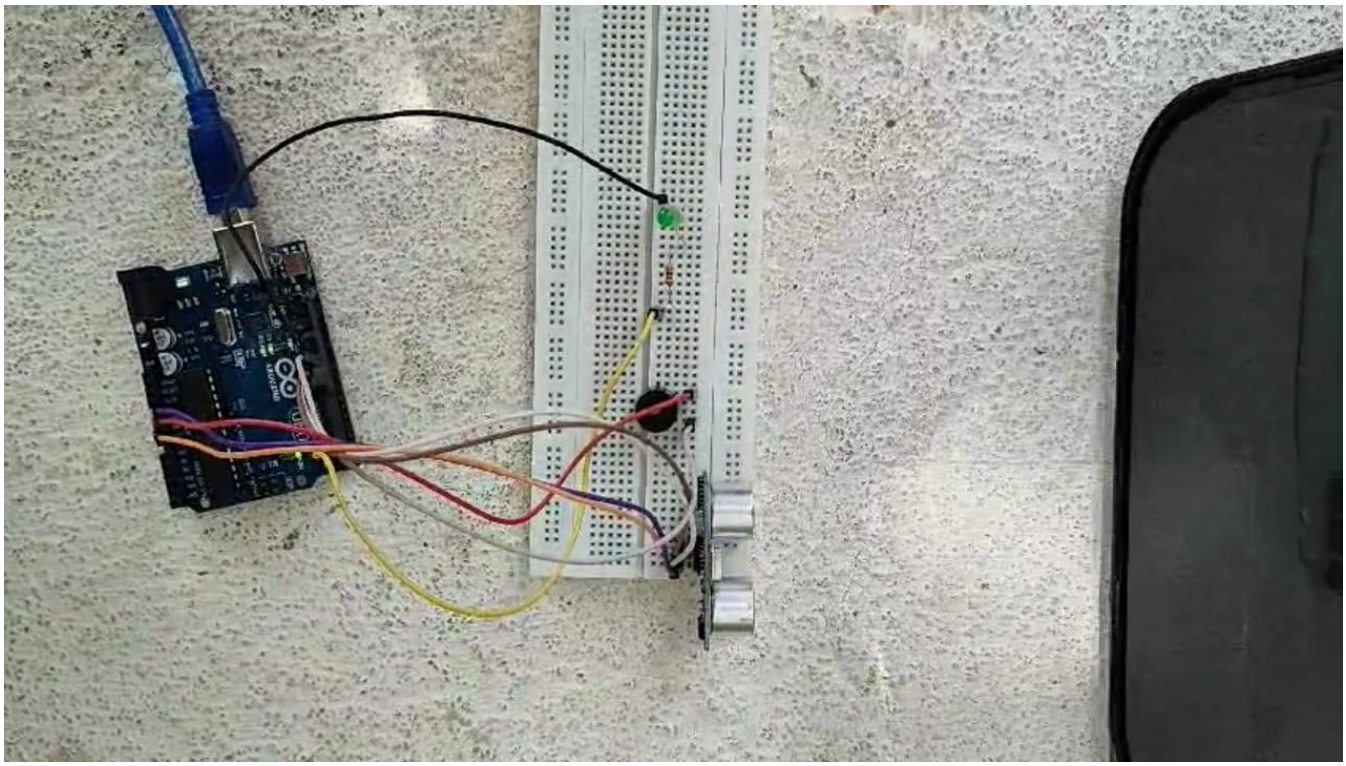
4.2 ADVANTAGES:

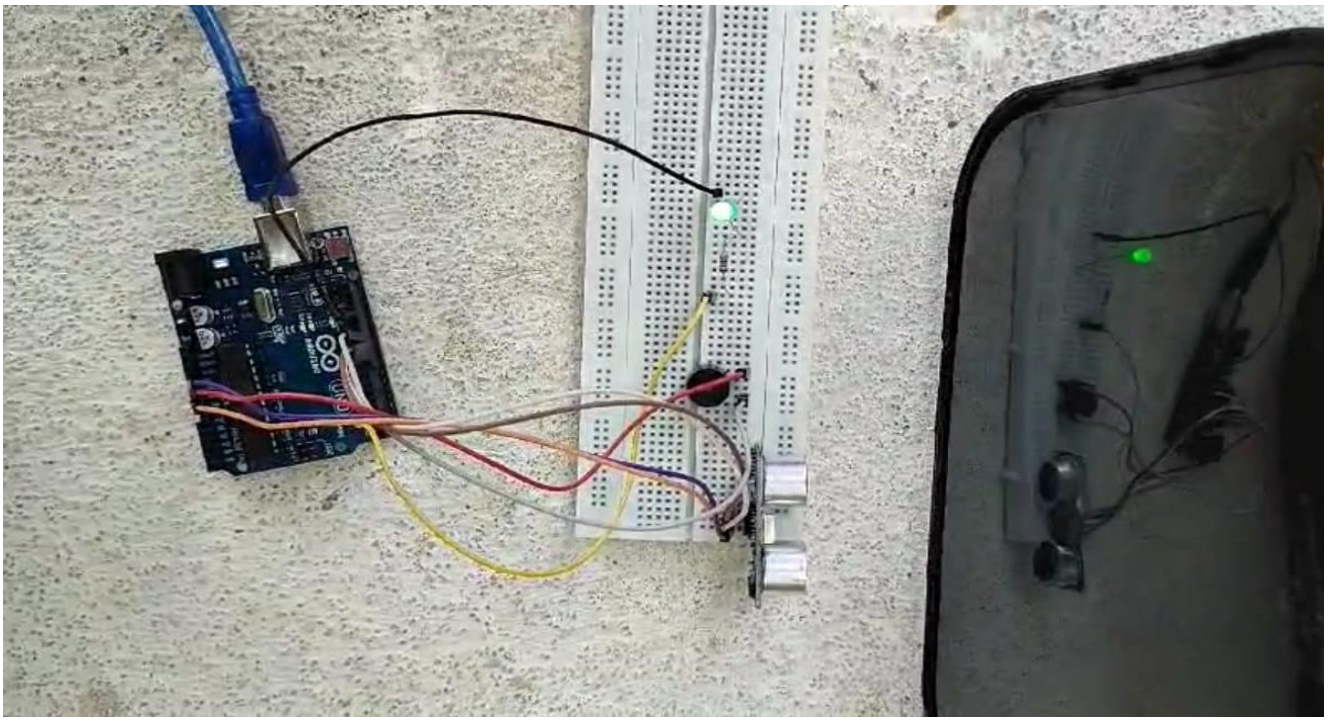
Contactless doorbells offer a host of advantages, including enhanced hygiene by eliminating the need for physical contact, which is particularly valuable during health concerns. They provide convenience through motion or proximity sensors, enabling easy use without manual interaction, ideal for individuals carrying items or with limited mobility. Furthermore, they promote accessibility, catering to those with disabilities

who may struggle with traditional doorbells. Their integration with smart home systems modernizes properties, offering features like video recording and remote access. Enhanced security comes from built-in cameras or motion sensors, providing visual verification of visitors and deterring potential intruders. Additionally, customization options allow users to tailor settings to their preferences, while weather resistance ensures reliability in various conditions. Overall, contactless doorbells combine convenience, hygiene, and security, making them a compelling choice for modern homes and businesses.

5. RESULTS AND DISCUSSIONS:

5.1 OUTPUT:





5.2 PSEUDO CODE:

START

SET trigpin=9

SET echoPin=10

SET buzzerPin=11

SET ledPin=2

DECLARE duration,distance,safetyDistance

SET pinMode trigPin to OUTPUT

SET pinMode echoPin to INPUT

SET pinMode buzzerPin to OUTPUT

START SERIAL COMMUNICATION

SET digitalWrite(trigPin,LOW)

SET digitalWrite(trigPin,HIGH)

SET digitalWrite(trigPin,LOW)

SET duration=pulseIn(echoPin,HIGH)

SET distance=duration*0.034/2

SET safetyDistance=distance

IF safetyDistance<=10

SET buzzerPin to HIGH

SET ledPin to HIGH

ELSE

SET buzzerPin to LOW

SET ledPin to LOW

END

5.3 RESULT:

Contactless doorbells have emerged as a significant innovation, reshaping the landscape of home security and convenience. These modern devices offer a myriad of advantages, addressing concerns ranging from hygiene to accessibility and beyond. At the forefront of their appeal is the heightened hygiene they afford, particularly in a world increasingly mindful of contagion. By eliminating the need for physical contact, contactless doorbells minimize the spread of germs and bacteria, a feature that has become particularly relevant

in the wake of global health crises. Users no longer need to worry about touching potentially contaminated surfaces, making everyday interactions safer and more hygienic.

Beyond hygiene, contactless doorbells also offer unparalleled convenience. Equipped with motion sensors or proximity detectors, these devices respond to the mere presence of an individual, obviating the need for manual interaction. This proves invaluable in scenarios where users are laden with groceries or packages, allowing them to enter their homes seamlessly without juggling additional tasks. Moreover, the simplicity of operation makes contactless doorbells inherently inclusive, catering to individuals with disabilities or mobility impairments who may find traditional doorbells cumbersome or inaccessible

In addition to their practical advantages, contactless doorbells represent a significant step forward in modernizing residential and commercial properties alike. As integral components of smart home systems, these devices seamlessly integrate with other technological innovations, offering homeowners a comprehensive suite of features aimed at enhancing security and convenience. From video recording capabilities to remote access via smartphone applications, contactless doorbells empower users with unprecedented control over their home environments. The ability to monitor and interact with visitors from anywhere in the world not only augments security but also provides peace of mind to occupants, particularly in an era marked by heightened security concerns.

Furthermore, contactless doorbells contribute to the customization and personalization of the user experience. With adjustable settings for volume, chime selection, and sensitivity, users can tailor their doorbell preferences to suit their individual needs and preferences. This level of customization fosters a sense of ownership and control, enhancing the overall user experience and satisfaction. Moreover, contactless doorbells are designed to withstand various weather conditions, ensuring reliable performance in rain, snow, or

extreme temperatures. This resilience further underscores their utility and dependability, making them an indispensable addition to any home or business.

In summary, contactless doorbells represent a paradigm shift in the realm of home security and convenience. By prioritizing hygiene, accessibility, and modernization, these devices offer a host of advantages that resonate with users across diverse demographics. From their ability to mitigate health risks to their seamless integration with smart home systems, contactless doorbells epitomize the intersection of technology and practicality. As the demand for innovative solutions continues to grow, contactless doorbells stand poised to redefine the way we interact with our living spaces, promising a future where security and convenience are seamlessly intertwined.

6. CONCLUSION AND FUTURE ENHANCEMENT:

6.1 CONCLUSION:

In conclusion, contactless doorbells epitomize the intersection of innovation and practicality, offering a holistic solution to the evolving needs of modern homeowners. By prioritizing hygiene, accessibility, and integration with smart home systems, these devices have revolutionized the way we approach home security and convenience. The ability to eliminate physical contact not only enhances cleanliness but also addresses health concerns prevalent in today's world, providing reassurance to occupants and visitors alike. Moreover, the seamless operation afforded by motion sensors and proximity detectors ensures that users of all abilities can effortlessly engage with their doorbell, fostering inclusivity and ease of use. The integration of contactless doorbells into broader smart home ecosystems further amplifies their utility, empowering users with advanced features such as remote access and integration with other connected devices. Looking ahead, the potential for enhancement and refinement is vast, with opportunities to further streamline functionality, enhance accuracy, and elevate design

aesthetics. As we continue to embrace the possibilities of technology, contactless doorbells stand as a testament to the power of innovation in enhancing the quality of everyday life.

6.2 FUTURE ENHANCEMENT:

Future enhancements for contactless doorbells could encompass several exciting avenues of development, catering to evolving user needs and technological advancements. One promising area for improvement lies in enhancing the integration of contactless doorbells with emerging technologies, such as artificial intelligence (AI) and machine learning. By leveraging AI algorithms, contactless doorbells could become more adept at recognizing and distinguishing between various types of visitors, thereby enhancing security and personalization. For example, advanced facial recognition technology could enable doorbells to identify familiar faces and adjust settings accordingly, providing tailored responses to different individuals.

Furthermore, there is considerable potential for the incorporation of augmented reality (AR) and virtual reality (VR) features into contactless doorbells, expanding their functionality beyond simple video recording. AR overlays could provide real-time information about visitors, such as their identity or purpose of visit, while VR simulations could offer immersive experiences for remote monitoring and interaction. These enhancements would not only enhance security but also enrich the user experience, transforming contactless doorbells into versatile tools for communication and engagement.

Another area of future enhancement lies in improving the environmental sustainability of contactless doorbells. By integrating renewable energy sources such as solar panels or kinetic energy harvesting mechanisms, doorbells could operate more efficiently and reduce their reliance on traditional power sources. Additionally, advancements in battery technology could lead to longer-lasting and more energy-efficient devices, further reducing their environmental impact.

In terms of design, future contactless doorbells could explore more innovative and aesthetically pleasing form factors, blending seamlessly with different architectural styles and preferences. Modular designs could allow for greater customization and flexibility, enabling users to personalize their doorbell to suit their unique needs and tastes. Moreover, advancements in materials science could lead to the development of more durable and weather-resistant doorbells, ensuring reliable performance in a variety of conditions.

Overall, the future of contactless doorbells is ripe with possibilities for innovation and improvement. By embracing emerging technologies, prioritizing sustainability, and reimagining design aesthetics, contactless doorbells have the potential to become even more indispensable tools for enhancing home security and convenience in the years to come.

APPENDIX:

```
// defines pins numbers
const int trigPin = 9;
const int echoPin = 10;
const int buzzerPin = 11;
const int ledPin = 2;

// defines variables
long duration;
int distance;
int safetyDistance;

void setup() {
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT);  // Sets the echoPin as an Input
  pinMode(buzzerPin, OUTPUT);
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600); // Starts the serial communication
}

void loop() {
```

```
// Clears the trigPin
digitalWrite(trigPin, LOW);
delayMicroseconds(2);

// Sets the trigPin on HIGH state for 10 microseconds
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

// Reads the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);

// Calculating the distance
distance = duration * 0.034 / 2;

safetyDistance = distance;
if (safetyDistance <= 10) {
  digitalWrite(buzzerPin, HIGH); // Turn on the buzzer
  tone(buzzerPin, 4000); // Set a tone of 1000 Hz
  digitalWrite(ledPin, HIGH);
  delay(500);
```

```
    digitalWrite(ledPin, LOW);
  } else {
    noTone(buzzerPin); // Turn off the buzzer
    digitalWrite(buzzerPin, LOW);
    digitalWrite(ledPin, LOW);
  }

  // Prints the distance on the Serial Monitor
  Serial.print("Distance: ");
  Serial.println(distance);
}
```

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