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BUILDING A SIMPLE ARDUINO-BASED ELECTRIC DOORBELL

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ABSTRACT:
Traditional doorbells, reliant on household electrical connections, are susceptible to power outages and require fixed wiring, limiting their reliability and flexibility. This project presents a batterypowered electric doorbell designed to operate independently of household wiring. An Arduino Uno R3 microcontroller serves as the system's core, driving a piezo buzzer for sound output. Power is supplied by 9V batteries, eliminating the need for external wiring and enabling portability, easy installation, and functionality in areas lacking electrical infrastructure. The circuit, constructed on a breadboard using jumper wires and 1kΩ resistors for current regulation and component protection, offers improved energy efficiency compared to conventional doorbells. This allows for deployment in temporary setups, outdoor locations, and emergency situations where fixed power is unavailable. Furthermore, the project provides a valuable hands-on learning experience, allowing students to explore microcontroller programming, electronic circuits, and sound production. In their work on Arduino-based buzzer systems, Sharma et al. highlighted the versatility of microcontrollers for creating customizable alert mechanisms. They emphasized the ease of implementing different sound patterns and the potential for integrating such systems into broader applications like home automation. This aligns with the design principles of this batterypowered doorbell, which aims to provide a reliable and adaptable notification solution. The present project also benefits from the focus on low-power operation discussed by Sharma et al., ensuring efficient battery usage and extended operational life.

INTRODUCTION:

Doorbells are essential for signaling visitors. Traditional wired doorbells, reliant on household power, are vulnerable to outages. This project designs a battery-powered doorbell for independent [1] operation, offering increased reliability and flexibility, especially where wired systems are impractical or unavailable [2]. This portable design eliminates the constraints of fixed wiring. Using an Arduino Uno R3 microcontroller, a piezo buzzer for sound, and readily available batteries, the system provides a self-contained and easily deployable notification solution. A breadboard, jumper wires, and appropriately sized resistors facilitate straightforward circuit construction, making the project accessible for educational purposes. As highlighted in "Embedded Systems for Home Automation: Integrating Push Button and Buzzer with Arduino" , efficient circuit design and careful component selection are crucial for optimizing Arduino-based systems.

This project directly incorporates these principles, with a particular focus on efficient buzzer integration and the implementation of current limiting to protect the components and ensure clear sound output. This battery-powered doorbell offers a cost-effective, scalable, and energy-efficient solution suitable for various scenarios, from temporary installations to remote locations. Furthermore, it serves as an excellent platform for inspiring hands-on learning in embedded systems and electronics, demonstrating the practical application of microcontrollers in everyday devices.

LITERATURE :

The development of doorbell systems has evolved from mechanical chimes to sophisticated electronics. Traditional wired doorbells, while simple, are susceptible to power outages. This review

examines advancements in doorbell technology, the role of microcontrollers, and the potential of battery-powered systems.

1. Role of Microcontrollers in Modern Electronics Microcontrollers are essential for compact, programmable, and energy-efficient systems. Arduino is popular for its ease of use (Banzi & Shiloh, 2022). In doorbells, microcontrollers enable customizable sounds, smart home integration, and low-power operation, simplifying circuit design (Williams, 2020). Zhang et al. [3] demonstrate the effectiveness of microcontrollers in alert systems using piezo buzzers and push buttons, directly applicable to doorbell design.
2. Evolution of Doorbell Systems Early doorbells were mechanical. Electric doorbells followed, but their dependence on household electricity limited portability (Smith, 2015). Wireless doorbells offered some improvement but often still required mains power (Johnson, 2018). Battery-powered systems now offer greater flexibility.[4]
3. Educational and Practical Applications Microcontroller-based battery-powered doorbells offer both practical and educational benefits. Arduino projects provide hands-on experience in programming and circuit design (Martinez, 2021). Das et al. [5] explore automating alert systems using Arduino and sensors, showcasing real-world applications relevant to battery-powered doorbells and other notification systems.
4. Battery-Powered Systems and Energy Efficiency Battery-powered systems are ideal for portable applications. Advances in battery technology enable extended operation (Chen et al., 2021). For doorbells, they eliminate wiring, suiting various environments. Energy efficiency is crucial. Lowpower modes, piezo buzzers (Lee, 2019), and optimized circuits extend battery life. Gupta et al. emphasize efficient microcontroller-based buzzer systems and power optimization, key for battery-powered doorbells. Park et al. [6] contribute to this area by exploring energy-efficient designs for Arduino-based notification systems, directly relevant to maximizing battery life in battery-powered doorbells.
5. Comparative Analysis of Doorbell Technologies Traditional doorbells are reliable but inflexible. Wireless doorbells offer some flexibility but may still rely on mains power. Battery-powered doorbells offer complete independence (Taylor, 2023).

METHODOLOGY :

Components Specifications
ARDUINO UNO R3:
Microcontroller: ATmega328P (16 MHz, 5V).
I/O Pins:
14 Digital (6 PWM).
6 Analog (A0–A5).
Memory:
32 KB Flash.
2 KB SRAM. 1 KB
EEPROM
Use Case:
Prototyping, education, and small-scale projects. Programmed via
Arduino IDE (C/C++).

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Fig.3.1 Arduino UNO R3

PIEZO BUZZER
Voltage:3V–12V **Current**:<30mA
Sound:≥85dB
Frequency:~2kHz **Types**: Active(DC),Passive(PWM) Use: Alarms, doorbells, alerts.

Fig.3.2 Piezo Buzzer
Jumper wires:-
Here's the same concise format for **jumper wires**: **Jumper Wires - Specs**
Types: Male-Male, Male-Female, Female-Female
Length: 10cm–30cm (varies)
Gauge: ~28 AWG
Material: Copper or Tinned Copper
Use: Breadboarding, prototyping, circuit connections Let me know if you want any tweaks!

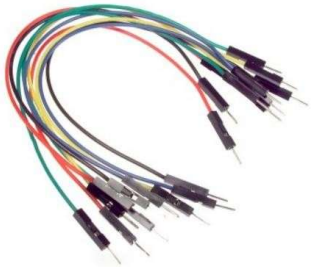

Fig.3.3 Jumper Wires

Push Button:-
Type: Momentary(Normally Open/Closed)
Voltage:3V–12V(typical)

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Current: <50mA
Pins: 2or4 **Use**: Switching, user input, circuit control.

Fig.3.4 Push Button

9V BATTERY:-
Voltage: 9V (nominal)
Capacity: ~400–600mAh (alkaline)
Chemistry: Alkaline, Lithium, or Rechargeable (NiMH)
Use: Electronics, Arduino, toys, alarms

Fig.3.5 Battery

BREADBOARD (400 Tie-Points):
Size:~8.2cm×5.5cm
Tie-Points:400 **PowerRails**: Yes(+/-)
Pitch:2.54mm(0.1inch) **Use**: Small circuit prototyping

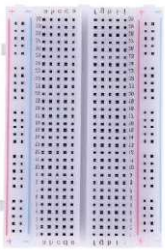

Fig.3.6 Breadboard

BLOCK DIAGRAM:-

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BLOCK DIAGRAM:-

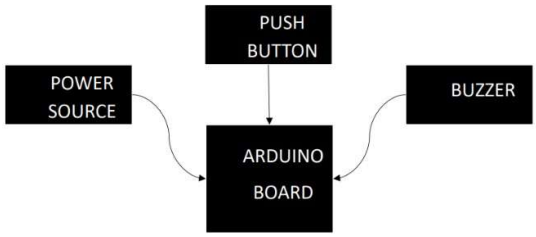

Fig.4.1 Block Diagram

The block diagram represents a simple **Arduino-based buzzer system** that operates using a push button. The **power source** supplies the required voltage to the **Arduino board**, ensuring proper functionality. When the **push button** is pressed, it sends an input signal to the Arduino, which then processes the signal and activates the **buzzer**. The buzzer produces sound as an alert or notification. This system is commonly used in applications such as **doorbells, alarms, and basic notification mechanisms**, providing a simple yet effective way to control a buzzer using an Arduino.

RESULTS :

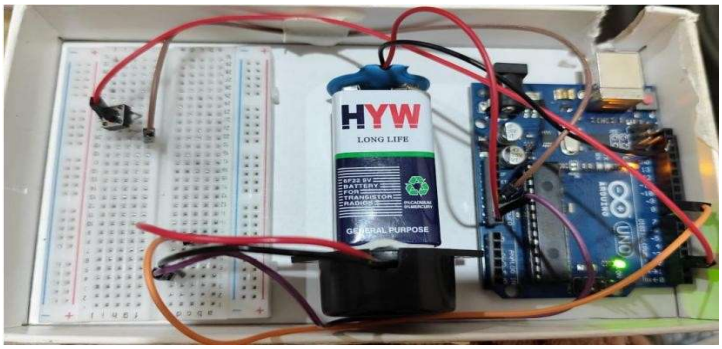

Fig.5.1 Final Circuit

CONCLUSION :

The battery-powered electric doorbell designed in this project offers a simple, reliable, and portable alternative to traditional wired doorbells. By utilizing an Arduino Uno R3, a piezo buzzer, and AA batteries, it eliminates dependency on household wiring, ensuring functionality even during power outages. The modular design, assembled on a breadboard with jumper wires and resistors, makes it easy to build, modify, and expand with additional features like wireless communication, security cameras, and fingerprint sensors. This project not only demonstrates the practical application of electronics and microcontroller programming but also highlights the importance of innovation in addressing real-world challenges. It provides a foundation for further enhancements, such as integrating IoT capabilities and security systems, making it an ideal platform for learning and development in modern home automation technologies..

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