

## DIGITAL BELL WITH SCHEDULED SYSTEM

Rajabhau Thombare ,Poonam Musmade ,Rohan Talmure,Siddhi Lande, Prachi Patil, Shruti Raut,  
Premlata Sawant, Aditya Garad

Assistant Professor, Ajeenkya DY Patil School Of Engineering  
UG student, Ajeenkya DY Patil School Of Engineering Lohegaon ,Pune, India

**ABSTRACT:** The Digital Bell System is an automatic, microcontroller-based project that rings bells according to a preloaded timetable. It replaces traditional manual systems with an accurate and programmable design. The system uses an Arduino, RTC (Real-Time Clock) module, and a relay with a bell to automate ringing at specific times. It ensures punctuality, saves manpower, and provides easy modification of schedules when needed. This makes it a practical and low- cost automation solution for schools, colleges, and offices. This project presents an automated digital bell system designed to improve time management in educational institutions. By using a microcontroller, the system eliminates manual scheduling errors and ensures that bells ring precisely according to a pre-set timetable. The system features a digital display that provides clear, real- time information on class periods, which improves operational efficiency and reduces confusion for both students and staff.

### I. Introduction:

The Digital Bell System is an automated solution designed to replace traditional manual bell ringing in educational institutions. It uses a micro-controller-based circuit to control bell timings accurately according to a pre-programmed schedule. This system ensures that bells ring automatically at the correct time for each period, reducing human error and saving time. The digital display provides real-time information, making it easier for staff and students to follow the timetable efficiently. This project promotes punctuality, improves time management, and enhances the overall discipline within the institution. In educational institutions, maintaining punctuality and proper time management is essential for smooth operation. Traditionally, bells are rung manually to indicate class periods, breaks, and other scheduled activities, which often leads to human error and

inconsistency. The Digital Bell System aims to automate this process by using a micro-controller to control the bell according to a pre-set timetable. This system ensures accurate and timely ringing of the bell without the need for manual intervention. By integrating a digital display and programmable timer, it enhances efficiency, reduces workload, and improves the overall management of academics. This system uses a micro-controller to automatically ring the bell according to a pre-programmed timetable, ensuring precise and consistent operation throughout the day. The timing schedule can be easily modified to suit institutional requirements, providing flexibility and convenience. Additionally, the inclusion of a digital display allows real-time visibility of current periods and upcoming schedules. By minimizing human intervention, the Digital Bell System not only improves punctuality and efficiency but also contributes to better discipline within the institution. Its design promotes energy efficiency, low maintenance, and long-term reliability, making it a modern and cost-effective alternative to traditional manual bell systems.

### III. LITERATURE REVIEW

#### Traditional Bell Systems

In most schools and colleges, the bell is rung manually by a peon or operator. While this method is simple, it is prone to human error, inconsistency, and dependency on staff availability. According to **Kumar & Singh (2018)[1]**, manual bell systems often lead to irregular class timings, which affects institutional discipline and productivity. The need for automation was first recognized in early 2000s when programmable timers began replacing mechanical bells in some institutions.

**Recent research emphasizes integration with digital timetables to enhance adaptability.** **Ramesh et al. (2021) [2]** presented a digital bell

system linked with a database-driven timetable, enabling dynamic updates through a graphical interface. The system could be updated via computer or mobile application, making it more suitable for modern educational setups.

**IoT (Internet of Things)** integration has further enhanced functionality. **Gupta & Banerjee (2022)** [3] designed an **IoT-enabled digital bell** that syncs with cloud-based schedules. This allowed real-time synchronization across multiple campuses and remote access for administrators

The early versions of automated bell systems were built using electromechanical timers or micro-controller-based circuits.

Sharma et al. (2016)[4] proposed an 8051 micro-controller-based automatic school bell that triggers the bell at fixed time intervals. Though effective, these systems lacked flexibility and required reprogramming for any timetable change.

With the introduction of Arduino and Raspberry Pi platforms, automation became more user-friendly. Patel & Joshi (2020) [5] developed an Arduino-based automatic school bell system with an LCD display and real-time clock (RTC) integration. The system allowed users to store class timings in memory and automatically ring the bell according to the schedule

Manual vs. Digital Scheduling  
 Manual Scheduling Challenges  
 High probability of human errors  
 Difficulty rearranging classes during emergencies  
 Lack of transparency  
 Time-intensive process  
 Conflicts in faculty and room assignment [6].  
 Digital Timetable Advantage  
 Automated conflict resolution  
 Instant timetable generation  
 Real-time updates through apps or web portals  
 Notification systems for changes  
 Better record management and analytics. [7]

Case Studies & Related Work  
 Higher Education Systems Studies show that digital timetable systems in universities improve:  
 Lecture hall utilization  
 Faculty satisfaction  
 Student attendance  
 Scheduling accuracy  
 School Systems Research on secondary schools found that digital tools reduce:  
 Administrative coordination time  
 Conflicts during

exam scheduling  
 Communication gaps among departments [8]

#### IV. Methodology:

The methodology for developing the Digital Bell System involves both hardware and software components integrated to automate the bell ringing process in educational institutions. The following steps were followed systematically:

##### 1. Requirement Analysis:

The first step was to identify the need for an automated system that can ring bells at accurate intervals without human intervention. Existing manual systems were studied to understand their limitations, such as dependency on human accuracy and time delays.

##### 2. System Design:

The system was designed to operate using a micro-controller (Arduino/8051/PIC) as the central control unit. The circuit design included components like a real-time clock (RTC) module, relay driver, buzzer or bell, and power supply. The software design involved creating a logical flow of operations and setting predefined time intervals for the bell

##### 3. Hardware Setup:

The hardware was assembled on a breadboard or PCB. The RTC module was interfaced with the micro-controller to maintain accurate timekeeping. The relay module was connected to control the electric bell according to the time signals from the micro-controller.

##### 4. Final Integration:

After successful testing, all components were enclosed in a protective casing, and the system was installed in a suitable location. The device was powered and monitored for continuous operation and reliability.

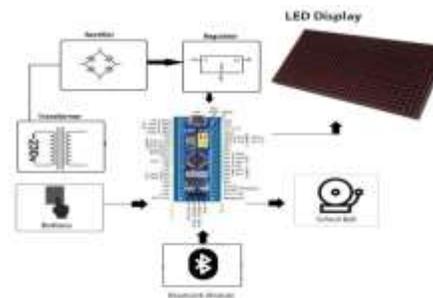


Fig: Block-diagram of digital bell

## V. MATERIAL REQUIRED

### 5.1 Arduino nano:

Arduino is an open-source microcontroller platform designed to simplify the development of embedded systems. It consists of programmable hardware boards, such as the Arduino Uno, which are built around the ATmega328P microcontroller. A key feature of Arduino is its pre-installed bootloader, which allows code uploading directly through a USB interface without requiring any external programmer. The platform uses a simplified version of C/C++, where the Arduino IDE automatically manages low-level functions such as compilation, linking, and configuration of the main program structure. Most Arduino boards operate at a fixed 16 MHz clock frequency, ensured by a crystal oscillator that maintains high timing accuracy for delay generation, PWM signals, and serial communication. Each GPIO pin on Arduino supports multiple modes—INPUT, OUTPUT, and INPUT\_PULLUP—enabling flexible interfacing with sensors, switches, and digital modules.

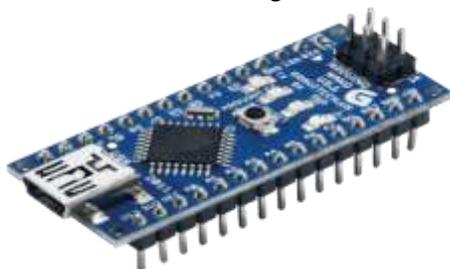


Fig.5.1 Arduino nano

### 5.2 PUSH BUTTON:

The push button in a digital bell serves as the user input interface, acting as a momentary switch that initiates the bell's electronic process. When pressed, it temporarily completes an electrical circuit, and when released, it automatically returns to its original state, breaking the circuit.

Key features of Push Button:

**1.Switch Functionality:** Available in momentary (returns to default state once released) or maintained (toggle on/off with each press) configurations.

**2.Contact Configuration:** Offered in single-pole single-throw (SPST), double-pole double-throw

(DPDT), and other multi-pole variants to suit diverse electrical circuit requirements.

**3.IP Ratings for Environmental Protection:** Waterproof, dust-proof, and corrosion-resistant designs are available for hazardous or outdoor applications.

**4.Backlight and Lamp Indicators:** Custom options such as LED backlight push buttons enhance visibility and provide immediate system status feedback.

**5.Terminal Types:** Includes solder, quick-connect, and screw terminals, making field installation and maintenance efficient in various electrical and electronic systems.

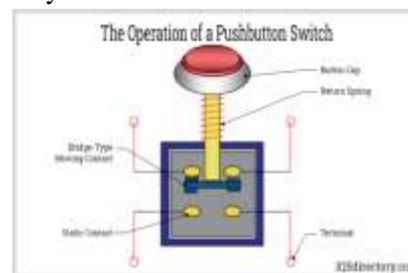


Fig.5.2 Push Button

### 5.3 BC547 TRANSISTOR:

The BC547 transistor is commonly used as a low-power, general-purpose NPN transistor in electronic circuits. It is widely used for switching small loads such as LEDs, buzzers, and small relays, as well as for amplifying weak signals in audio, sensor, and hobby circuits. By applying a small current to its base terminal, it can control a larger current flowing between the collector and emitter, making it useful for signal control and amplification. Its low cost, easy availability, and reliable performance make it a popular choice in educational projects, prototypes, and everyday electronic devices.

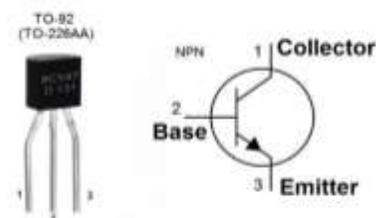


Fig. 5.3 Transistor

#### 5.4 RELAY:

A relay is used to control high-power or high-voltage devices using a low-power signal. It acts as an electrically operated switch, allowing a small current from a control circuit—such as a micro-controller, sensor, or low-voltage switch—to safely operate larger loads like motors, lights, heaters, and power supplies. Relays provide electrical isolation between the control side and the load side, protecting sensitive electronics from high voltages. Because of this, they are widely used in automation systems, home appliances, automotive electronics, and protection circuits

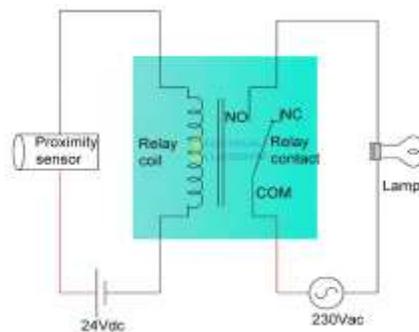


Fig.5.4 Relay internal algorithm

#### 5.5 1N4007 diode:

The 1N4007 diode is widely used as a general-purpose rectifier in electronic circuits. Its main function is to allow current to flow in only one direction, making it ideal for converting AC voltage to DC in power supply circuits. Because it can handle high reverse voltage (up to 1000 V) and moderate current, it is often used in chargers, adapters, and household electronic devices. The 1N4007 also protects circuits from reverse polarity by blocking unwanted reverse current that could damage components. Its reliability, low cost, and versatility make it one of the most commonly used diodes in electronics.



Fig. 5.5 Diode

#### 5.6 RESISTOR

A 1K ohm resistor (1000 ohm) in a digital bell circuit primarily used as a current limiter or a pull-up/pull-down resistor to protect sensitive components used in several specific ways. The flow of the charge through any material encounters an opposing force similar in many respects to mechanical friction. This opposing force is called resistance of the material, in some electric circuit resistance is deliberately introduced in form of the resistor.



Fig. 5.6 Digital Variable Resist

SEVERAL WAYS OF USING THE RESISTOR IN THE DIGITAL

BELL ARE:

#### CURRENT LIMITING:

A primary use is to limit the current flowing to components such as an LED indicator or the base of a transistor, preventing them from being damaged by excessive current.

#### PULL-UP and PULL-DOWN RESISTOR:

A PULL-UP resistor in digital bell circuit connects input pin to positive voltage ( $V_{cc}$ ) to ensure the input stay at high (logic 1) level when no active signal is present, similarly the PULL-DOWN resistor is used to connect the input pin to the ground ( $0V$ ) to ensure the input stays at a low (logic 0) level when no signal is applied.

#### VOLTAGE DIVISION:

The resistor can be part of a voltage divider network, which adjusts signal levels or provides a specific, lower voltage to different parts of a circuit, such as a sensor interface.

#### TRANSISTOR PROTECTION:

If the bell's chime mechanism is driven by a transistor and relay, a resistor at the transistor's base can protect it from excessive base current or reverse voltage.

### 5.7 Led Display:

#### LIQUID CRYSTAL DISPLAY .

The mis popular LEDs that are linked to a microcontroller are 16 x 2.



Fig.5.7 Led Display

This translates to 16 characters to 16 characters per lines. The standard is known as HD44780U, which refers to the regulator chip that makes data from an external source (and communicates directly with the TV). If 8-bit data machine is used the TV will bear 11 data lines. The three control lines appertained to as EN, RS, and RW.

### 5.9 Normal Electrical Bell:

In a digital bell circuit a normal bell is often replaced with a digital bell system by using its electromagnet and gong or other sound, but replacing the manual switch with a digital timer or micro-controller

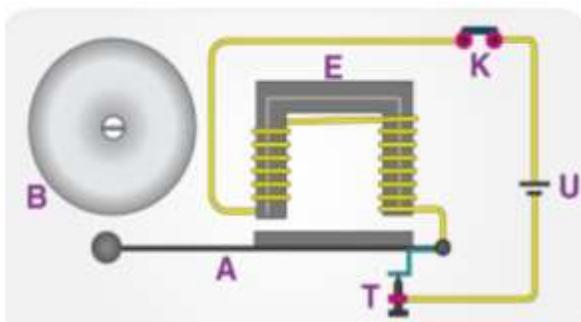


Fig.5.8 Normal Electrical Bell

## VI. Conclusion

The Digital Bell with Timetable system represents a significant step towards smart institutional automation. Research over the last decade has evolved from simple micro-controller-based designs to intelligent, connected, and remotely managed systems. Future advancements may include AI-based adaptive timetabling and integration with full-fledged school ERP systems to create a fully automated academic environment.

## VII. References

1. These papers offer detailed technical insights and often include citations for further research:
2. “Arduino-Based Automatic School Bell System: A Simple and Cost-Effective Solution” by Siddhartha Subedi and Ajay Raj Chalise, published in the International Journal of Research and Review (2024).
3. “Design and Implementation of a Smart School Bell System” via IEEE (2024).
4. Sushil Khairnar. “Application of Blockchain Frameworks for Decentralized Identity and Access Management of IoT Devices”. International Journal of Advanced Computer Science and Applications (IJACSA) 16.6 (2025). <http://dx.doi.org/10.14569/IJACSA.2025.0160604>
5. “Power Aware Automatic Microcontroller Based Smart, College Electric Bell System with Time Display” available on ResearchGate (2009).
6. Khairnar, S., Bansod, G., Dahiphale, V. (2019). A Light Weight Cryptographic Solution for 6LoWPAN Protocol Stack. In: Arai, K., Kapoor, S., Bhatia, R. (eds) Intelligent Computing. SAI 2018. Advances in Intelligent Systems and Computing, vol 857. Springer, Cham. [https://doi.org/10.1007/978-3-030-01177-2\\_71](https://doi.org/10.1007/978-3-030-01177-2_71)
7. Poonam Musmade, S. M. Khairnar, Sachin Rajas, A GRAPH THEORY–BASED APPROACH TO TRAFFIC FLOW MANAGEMENT , 2025, *International Journal of Engineering Sciences and Advanced Technology*, 25(12), Page 255-258, ISSN No: 2250-3676.
8. Sushil Khairnar and Deep Bodra. “Recommendation Engine for Amazon Magazine Subscriptions”. International Journal of Advanced Computer Science and Applications (ijacsa) 16.7 (2025).

<http://dx.doi.org/10.14569/IJACSA.2025.0160796>

9. “Design and Development of a Low Cost Smart Electronic School Bell” in the International Journal of Latest Technology in Engineering, Management & Applied Science (2024).
10. Naga Charan Nandigama, “Data-Driven Cyber-Physical Customer Experience Management In Iort-Enabled Banking Infrastructures,” International Journal of Data Science and IoT Management System, vol. 2, no. 3, pp. 22–27, Aug. 2023, doi: 10.64751/ijdim.2023.v2.n3.pp22-27.
11. “IOT based wireless automated bell ringing system in an institution” via ResearchGate (2020).
12. Naga Charan Nandigama, “A Data Engineering And Data Science Approach To Strengthening Cloud Security Through MI-Based Mfa And Dynamic Cryptography,” American Journal of AI Cyber Computing Management, vol. 5, no. 4(2), pp. 76–81, Nov. 2025, doi: 10.64751/ajacm.2025.v5.n4(2).pp76-81.
13. Sushil Khairnar. “Application of Blockchain Frameworks for Decentralized Identity and Access Management of IoT Devices”. International Journal of Advanced Computer Science and Applications (IJACSA) 16.6 (2025). <http://dx.doi.org/10.14569/IJACSA.2025.0160604> [6] Zhou, C., Liu, J., & Li, X. (2020). Smart personal protective equipment for occupational safety: A review. *Safety Science*, 130, 104890.
14. AUTOMATIC BRAKING SYSTEM. (2026). *International Journal of Engineering Research and Science & Technology*, 22(1), 19-22. <https://doi.org/10.62643/ijerst.2026.v22.n1.pp19-22>
15. Poonam Musmade, Snehal Shevade, Prakash Mali, Shubhdarshini Patil , Srushti Pawar , Shruti Pawar , Prachi P. Patil , Kartik Pawar, “Smart Ev Charging System”, Journal of Science Engineering Technology and Management Science, Vol. 03, Issue 01, January 2026,pp: 1-5, DOI: <http://doi.org/10.64771/jsetms.2026.v03.i01.pp1-5>
16. Sachin Dilip Rahinj (<sup>1</sup>School of Engineering, Ajeenkya DY Patil University, Pune 412105, India), Samina F. Waglawala (<sup>1</sup>School of Engineering, Ajeenkya DY Patil University, Pune 412105, India), Akhileshwar Singh (<sup>1</sup>School of Engineering, Ajeenkya DY Patil University, Pune 412105, India), and Deepak Kumar Singh (<sup>1</sup>School of Engineering, Ajeenkya DY Patil University, Pune 412105, India), International Journal of Modern Physics C 0 0:0