e-ISSN:2582-7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 6, June 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.521

6381 907 438 6381 907 438 ijmrset@gmail.com www.ijmrset.com

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |

Design and Implementation of a Multi-Mode IoT Alert Notification System using NodeMCU

Yatrikkumar S. Patel[1], Shahera S. Patel[2]

Ph.D. Research Scholar, Department of Electronics, Sardar Patel University, V.V. Nagar, Gujarat, India[1]

Professor, Department of Electronics, Sardar Patel University, V.V. Nagar, Gujarat, India[2]

ABSTRACT: Manual alerting systems in educational and institutional settings are often inefficient, prone to human error and lack of flexibility in scheduling. This paper presents the design and implementation of a Multi-Mode IoT Alert Notification System using the NodeMCU microcontroller and DS3231 Real-Time Clock (RTC) module. The proposed system supports four operational modes: Manual, Routine, Exam, and IoT Mode enabling users to set and manage alerts based on varying institutional needs. Through IoT integration schedules can be configured remotely via a smartphone application or web interface. A high-decibel electromagnetic alert device is used to ensure audible notifications across large facilities. The system was tested for timing accuracy, mode functionality and user interaction efficiency. Results demonstrate that the solution is reliable, scalable and significantly reduces manual effort while providing precise time-based auditory alerts suitable for schools, colleges and similar institutions.

KEYWORDS: Alert Notification, Modes, NodeMCU, Real Time Clock, Internet of Things

I. INTRODUCTION

In every institute, task scheduling is the most important. The task scheduling process is very easy but the most important is to follow a schedule. Every educational institute has a bell to inform that the period is finished. For a bell one person is also required to ring a bell and most importantly on exact time. So sometimes a person may forget to ring a bell or maybe be bell does not ring at the exact time. There are models available in the markets but in those models single modes of operations are available. In this model 4 x 4 matrix is used to set the time in this model. The OLED display is used to see all the actions of the model. Bluetooth module is used to set time wireless [1]. Burgoji Santhosh Kumar developed an automatic college bell using Arduino. In this model, programming is done for a bell that will ring every 50 minutes[2]. S. Mathanki and their colleagues developed a microcontroller-controlled automatic college bell and display using RF. In this module, the PIC16F877A microcontroller is used to control the other modules. In this model relay module is used at the output and connected with a bell[3]. Shruti p and their colleagues designed a microcontroller-based low-cost automatic college bell ringing system. In this module, code is developed in such a way that at every 60 minutes bell will ring for 10 seconds [4]. Akhileshkumar Sanodiya and their colleagues have developed an automatic college bell using NodeMCU and Matrix Display. In this work, they have taken NodeMCU as a controller and used a sensor for detection of the current time and ring the bell and set time[5]. Nalini, Naveen raj, and their colleagues have worked on IoT-based wireless automated bell-ringing system in an institution. In this work, they have used Arduino uno and they designed this in a way that after every 50 minutes bell will ring for 10 seconds in every block of the college[6]. Abyash Gautam, Deepak Rasaily, and Sejal Dahal have researched Microcontroller Controlled Automated College Bell. They used AT89C52 as a controller and a hex keypad was used for changing the time. DS1307 clock is used to give the accurate time to the developed system[7]. In this developed model different modes are given and as per the requirement user can select the mode by given input buttons. These different modes are Routine Mode, Manual Mode, Exam Mode, and IoT Mode. IoT mode works on a Wi-Fi connection and mobile application over an internet facility. We have developed this module and tested at our Department of Electronics. We have demonstrated another two modules for two other Department and programmed according the their time table. The developed modules are already installed at the Bio-Science Department and MBA Department of the Sardar Patel University.

II. BLOCK DIAGRAM

The block diagram of the Design and Implementation of a Multi-Mode IoT Alert Notification System Using NodeMCU is given in Figure 1. As shown in the block diagram there is a controller, timer, power supply, display, and output units are interconnected to achieve specific task.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |

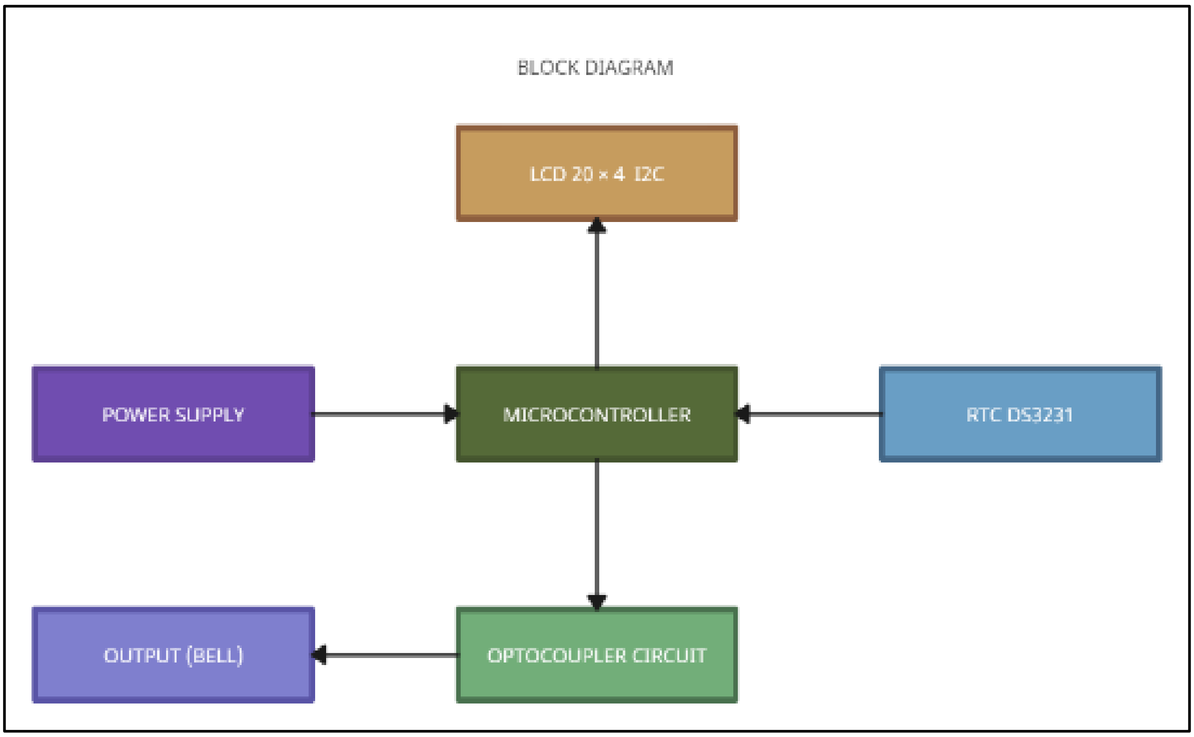


Figure 1: Block Diagram of the Design and Implementation of a Multi-Mode IoT Alert Notification System Using NodeMCU

MICROCONTROLLER

ESP8266 NodeMCU Module is shown in Figure 2.

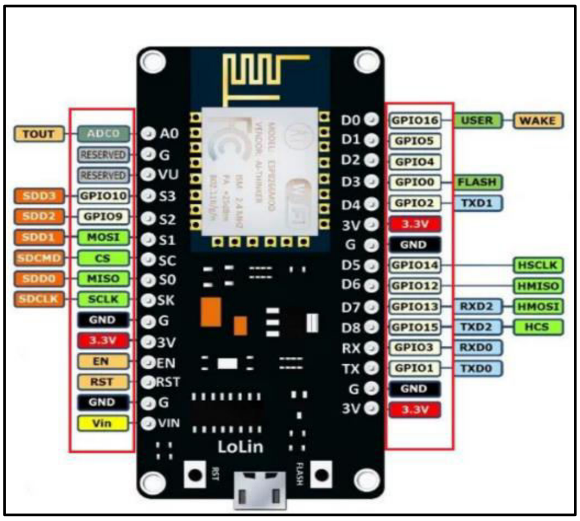


Figure 2: ESP8266 V3 Module

Esp8266 NodeMCU as a microcontroller provides an easy and convenient way to implement and upload code. It is a 30-pin microcontroller module with a total of 13 General Purpose Input Output (GPIO) that helps to connect any node as Output or Input on each pin. It has I2C protocol communication pins that help to connect multiple slaves to masters with different communication addresses[8]. It has an in-built EEPROM that can store up to 4KB of data. it has built-in wireless communication facilities like Wi-Fi and Bluetooth so users can select according to their application. This module is

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |

perfectly suited to use in Internet of Things based applications where data monitoring and controlling from remote locations is required [9,10].

RTC DS3231:

RTC DS3231 module is shown in Figure 3.

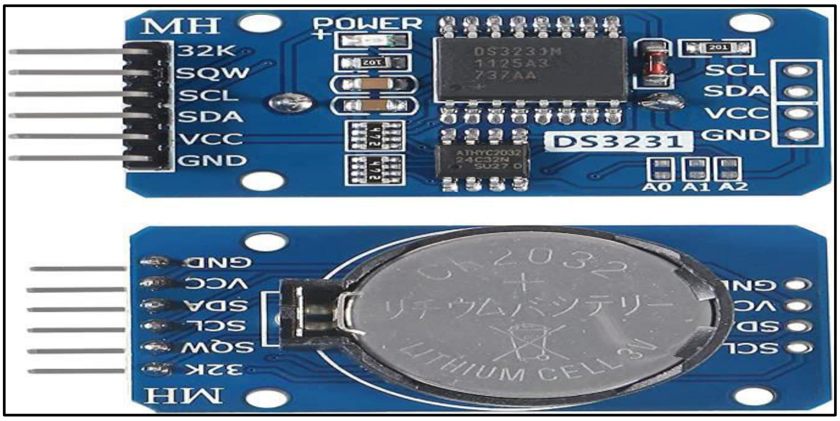


Figure 3: RTC DS3231 Module

RTC DS3231 module is used to get precise real-time. It has a feature to count every single second accurately. This module has a built-in temperature sensor to measure internal temperature. This module has the advantage of operating at low voltage with low power consumption. This module has a battery backup that continuously keeps an eye on the time when there is no power. It will continuously feed a real time to the developed system[11].

LCD I2C:

Liquid Crystal Display is shown in below Figure 4.

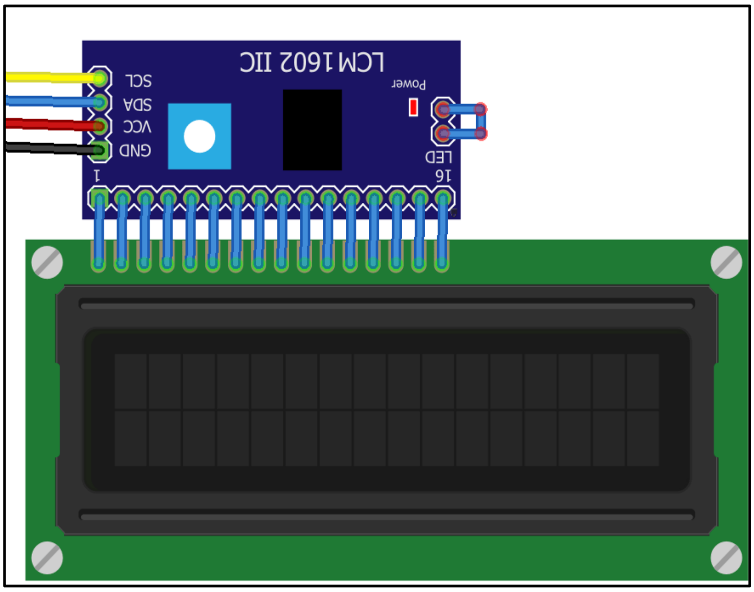


Figure 4: Liquid Crystal Display (LCD) 20 * 4

Liquid Crystal Display (LCD) is used where all the messages will be displayed. It has 20 columns and 4 Rows for displaying any characters. It communicates using the I2C Protocol with an address of 0x27 or 0x3F. Using display users can easily monitor the different parameters and understand the sequence of action that happens in the developed model[12].

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |

POWER SUPPLY:
The schematics of the Power Supply is given in Figure 5.

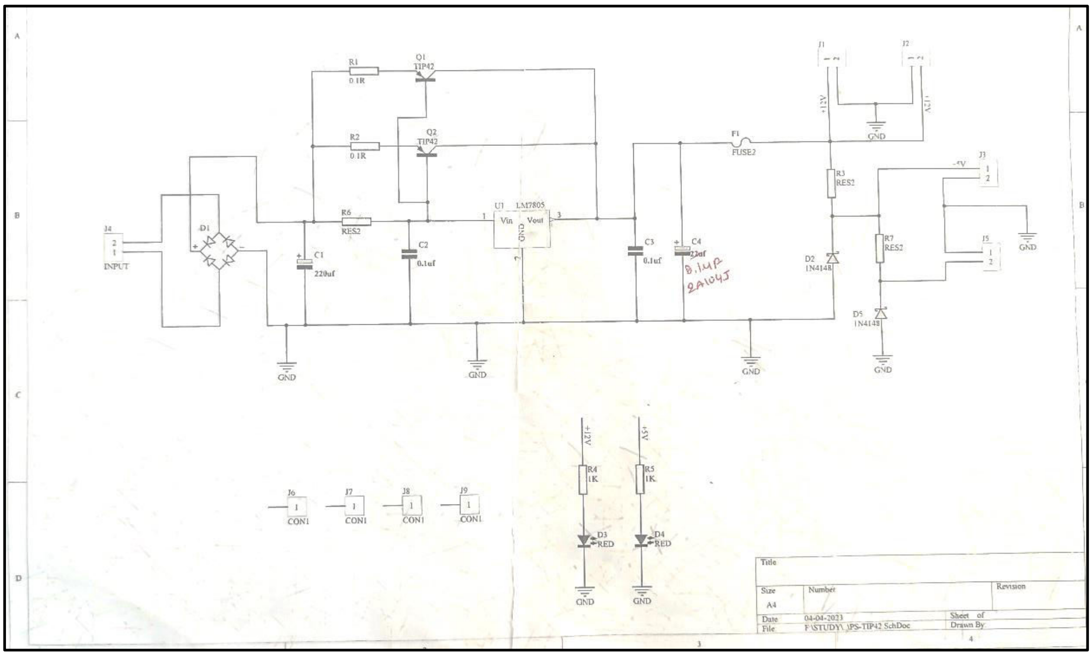


Figure 5: Schematics of the Power Supply

The power supply for this model is designed with two different voltage levels of 12V and 5V. The microcontroller operates at a 12V supply and other modules operate at a 5V supply. This circuit consists of a 12v Step-Down transformer followed bridge rectifier and TIP42C used for higher power capacity. A regulator section 7812 and 7805 ICs are used to maintain 12V and 5V levels. To provide extra protection and safety Fuse is used in the circuit.

OPTOCOUPLER:
The optocoupler internal circuit is given in Figure 6.

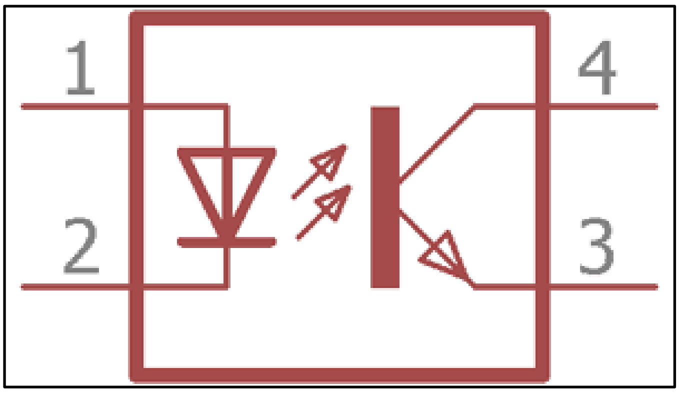


Figure 6: Optocoupler Internal Circuit

The optocoupler internal circuit has LED and a Phototransistor. When a signal from one circuit activates the LED it also triggers a phototransistor at another side. Using this optocoupler circuit we can isolate two circuits. The main advantage of using it is that it provides more safety to the circuit [13].

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |

III. CIRCUIT DIAGRAM

The compile circuit diagram of Design and Implementation of a Multi-Mode IoT Alert Notification System Using NodeMCU is given in Figure 7.

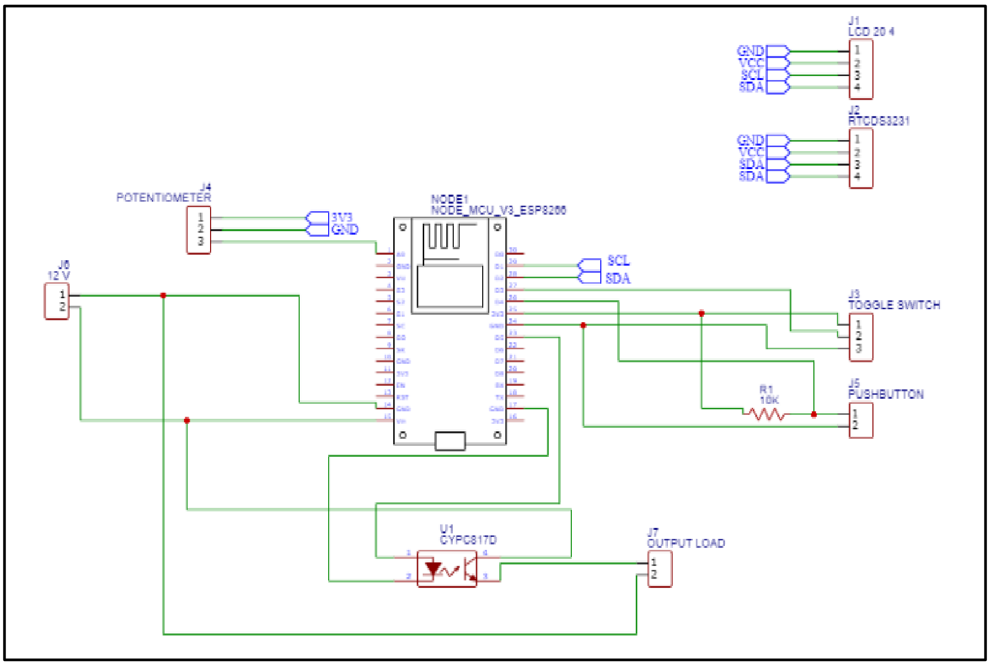


Figure 7: Compiled Circuit Diagram of Design and Implementation of a Multi-Mode IoT Alert Notification System Using NodeMCU

As shown in the circuit diagram the developed model consists of NodeMCU, DS3231, LCD 20 * 4 I2C, Optocoupler circuit, Potentiometer, Toggle switch, and Pushbutton. NodeMCU esp8266 version 3 is used here and it has both Wi-Fi and Bluetooth on a single chip [14,15]. In this circuit diagram toggle switch is connected to the GPIO pin 0. For a selection of the different modes in this model toggle switch is used. After selecting the mode, now it requires to set the time. So, the Pushbutton is connected to the GPIO pin 2 of the NodeMCU. This push button is connected to the pull-up resistor and the resistor is connected to the 5v and GPIO pin of the controller. The potentiometer is connected to the analog2 pin A0 of the controller. Using this potentiometer, we can select the values of the Hours and Minutes in a time set. An opto-coupler circuit is connected with GPIO pin 14 and it is configured as the output pin in the program. So, the Bell is connected with an optocoupler circuit that isolates the both AC and DC Supply. LCD Display and the RTC DS3231 is connected with D1 and D2 of the controller using I2C communication protocol.

IV.MODES AND OPERATION

In this developed module there are 3 modes given as below,

1. Manual Mode
2. Routine Mode
3. Exam Mode
4. IoT Mode

In a manual mode user can set the time and the bell will ring at a set time. This mode is as simple as an alarm.

In a Routine mode, time is already pre-programmed in a code according to the schedule. The bell will ring as per schedule by selecting Routine mode in the model.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |

Table No 1: Bell Ring Sequence for Exam Mode

Exam Start Time: 11:00		
No of Bell Ring	TIME	BELL RING PERIOD
1st Bell	10:50	10 Sec
2nd Bell	11:00	5 Sec
3rd Bell	12:00	3 Sec
4th Bell	12:30	3 Sec
5th Bell	12:45	3 Sec
6th Bell	12:55	5 Sec
7th Bell	1:00	10 Sec

A special mode is programmed added in this model is an Exam Mode. In this mode, the user has to feed only the exam starting time and according to the program bell will ring at a regular interval of time.

As shown in above Table 1. A sequence of bell ringing in exam mode is shown. In exam mode user has to enter the Exam starting time and then the rest of the thing will done by the device itself. This device bell rings a warning bell 10 Minutes before the exam time.

V. RESULT & DISCUSSION

The Multi-Mode IoT Alert Notification System was successfully developed using the NodeMCU microcontroller and the DS3231 Real-Time Clock (RTC) module. The system was tested in four different operational modes: Manual Mode, Routine Mode, Exam Mode, and IoT Mode. In Manual Mode, the system was activated by pressing a button or sending a remote command. Routine Mode allowed the system to operate at regular daily timings, such as class start and end times. Exam Mode was useful for setting custom timings during exams or special events. IoT Mode enabled users to control the system through a mobile application or web interface, making it highly flexible and user-friendly.

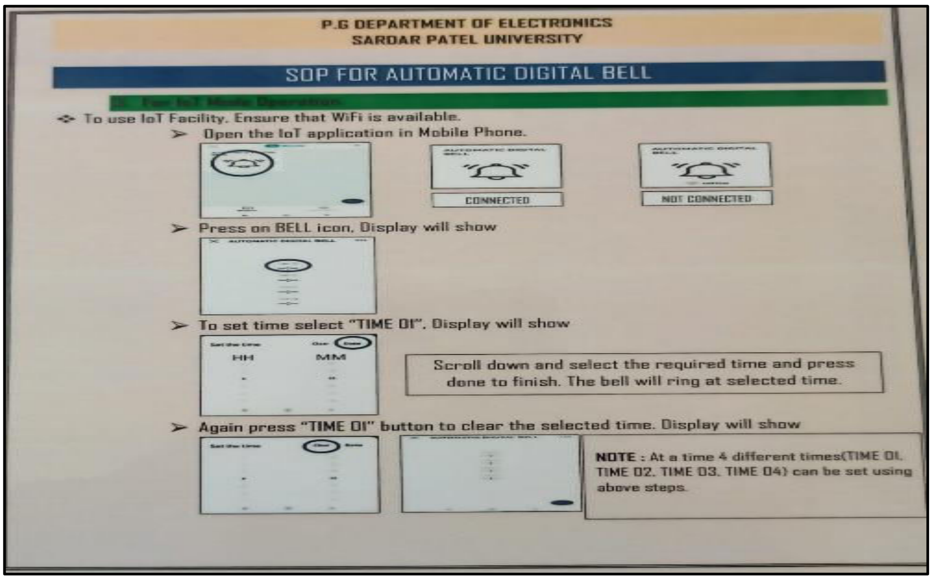
The DS3231 RTC provided excellent time accuracy. During testing, the system operated exactly at the scheduled times, with a maximum error of less than one second per day. This level of accuracy is suitable for institutional environments where precise timing is very important. A high-decibel electromagnetic alert device was used to ensure that the system's notifications could be clearly heard across classrooms and corridors, up to a distance of 70 meters. The delay after the scheduled time was very minimal, usually between 0.5 to 1 second, which is acceptable for real-time alerting.

The IoT feature allowed remote configuration and monitoring of the system using smartphones or computers. Users were able to update schedules and switch between modes remotely, with the system responding to changes within 3 to 5 seconds. This made the system very easy to manage, especially in situations where frequent changes are required. Compared to traditional manual systems, this IoT-based solution offers higher accuracy, better flexibility, and greater reliability. It also helps reduce human error and saves time for the institution's staff. The standard Operating Procedure is as shown below in Figure 8.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |



P.G DEPARTMENT OF ELECTRONICS
SARDAR PATEL UNIVERSITY

SOP FOR AUTOMATIC DIGITAL BELL

- To use IoT Facility. Ensure that WiFi is available.
  - Open the IoT application in Mobile Phone.

CONNECTED | NOT CONNECTED

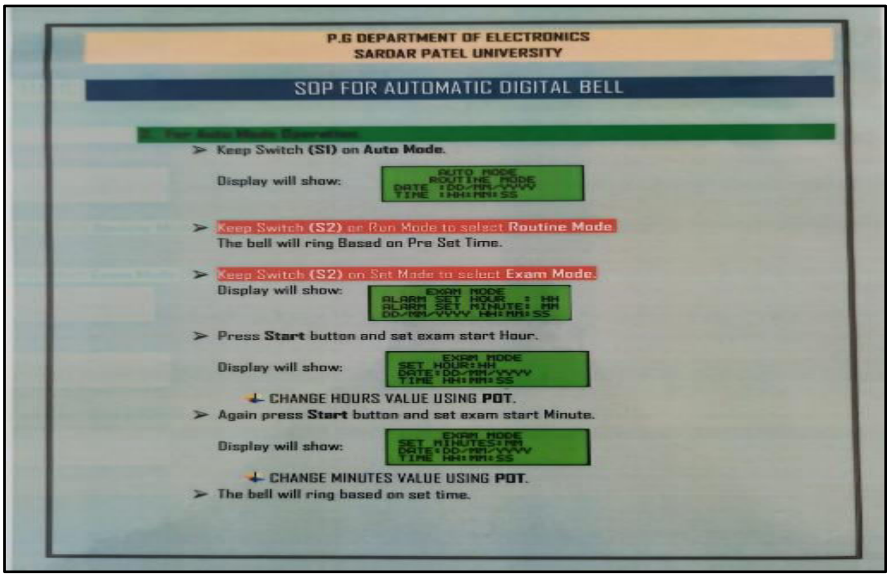
  - Press on BELL icon. Display will show
  - To set time select "TIME 01". Display will show

HH MM

Scroll down and select the required time and press done to finish. The bell will ring at selected time.

  - Again press "TIME 01" button to clear the selected time. Display will show

NOTE : At a time 4 different times(TIME 01, TIME 02, TIME 03, TIME 04) can be set using above steps.



P.G DEPARTMENT OF ELECTRONICS
SARDAR PATEL UNIVERSITY

SOP FOR AUTOMATIC DIGITAL BELL

- Keep Switch **(S1)** on **Auto Mode.**

Display will show: AUTO MODE / ROUTINE MODE / DATE :DD-MM-YYYY / TIME :HH:MM:SS

- Keep Switch **(S2)** on Run Mode to select **Routine Mode**

The bell will ring Based on Pre Set Time.

- Keep Switch **(S2)** on Set Mode to select **Exam Mode.**

Display will show: EXAM MODE / ALARM SET HOUR : HH / ALARM SET MINUTE: MM / DD-MM-YYYY HH:MM:SS

- Press **Start** button and set exam start Hour.

Display will show: EXAM MODE / SET HOUR:HH / DATE:DD-MM-YYYY / TIME HH:MM:SS

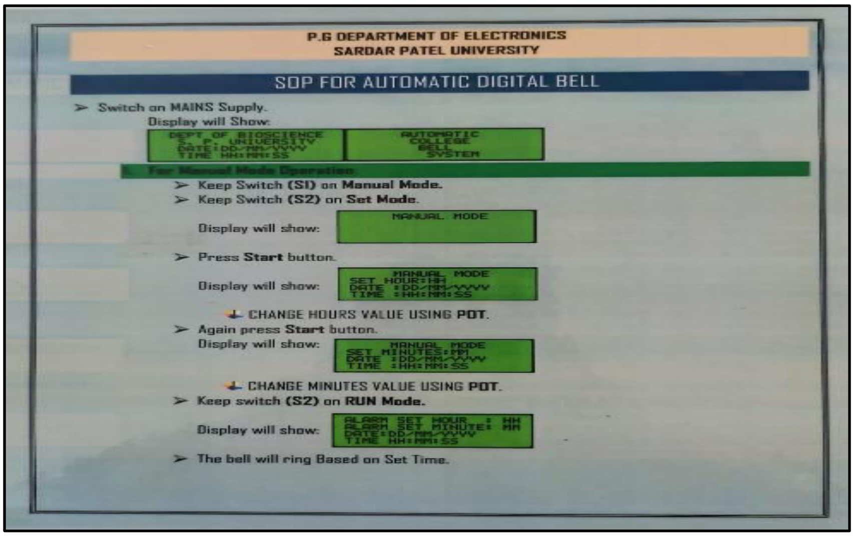
CHANGE HOURS VALUE USING **POT.**

- Again press **Start** button and set exam start Minute.

Display will show: EXAM MODE / SET MINUTES:MM / DATE:DD-MM-YYYY / TIME HH:MM:SS

CHANGE MINUTES VALUE USING **POT.**

- The bell will ring based on set time.



P.G DEPARTMENT OF ELECTRONICS
SARDAR PATEL UNIVERSITY

SOP FOR AUTOMATIC DIGITAL BELL

- Switch on MAINS Supply.

Display will Show: DEPT OF BIOSCIENCE / S. P. UNIVERSITY / DATE:DD-MM-YYYY / TIME HH:MM:SS | AUTOMATIC COLLEGE BELL SYSTEM

- Keep Switch **(S1)** on **Manual Mode.**
- Keep Switch **(S2)** on **Set Mode.**

Display will show: MANUAL MODE

- Press **Start** button.

Display will show: MANUAL MODE / SET HOUR:HH / DATE :DD-MM-YYYY / TIME :HH:MM:SS

CHANGE HOURS VALUE USING **POT.**

- Again press **Start** button.

Display will show: MANUAL MODE / SET MINUTES:MM / DATE :DD-MM-YYYY / TIME :HH:MM:SS

CHANGE MINUTES VALUE USING **POT.**

- Keep switch **(S2)** on **RUN Mode.**

Display will show: ALARM SET HOUR : HH / ALARM SET MINUTE: MM / DATE:DD-MM-YYYY / TIME HH:MM:SS

- The bell will ring Based on Set Time.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |

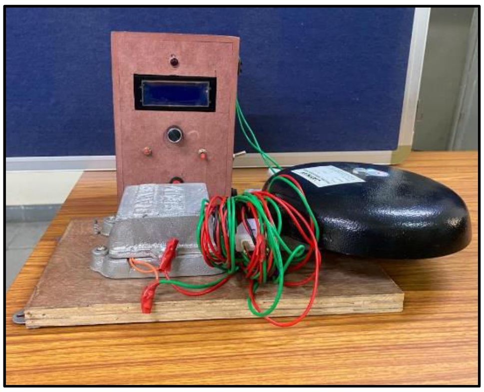


Figure 8: Standard Operating Procedure

Actual Working model is as shown in figure 9.

Figure 9 : Actual Working Model

VI. CONCLUSION

The designed Multi-Mode IoT Alert Notification System successfully meets the requirements of modern educational and institutional settings by offering accurate, timely, and flexible alert notifications. The integration of the NodeMCU with the DS3231 RTC and IoT connectivity ensures precise timekeeping and remote control. The system's ability to operate in Manual, Routine, Exam, and IoT modes makes it adaptable to various real-life scenarios. Its user-friendly interface and reliable performance reduce manual effort and human error significantly. The system is scalable, cost-effective, and can be easily implemented across institutions of different sizes. Future enhancements could include mobile app integration, voice alerts, and battery backup for uninterrupted operation.

REFERENCES

1. Vaishnavi D. R., Neha Khanum, Apoorva Singh A., Sumaya Afreen, "Automated College Bell System with Wireless Control," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, vol. 6, no. 5, pp. –, May 2017. ISSN (Print): 2320-3765, ISSN (Online): 2278-8875.
2. Burgoji Santhosh Kumar, "Implementation of Automatic College Bell System Using Arduino," *International Journal of Current Engineering and Scientific Research (IJCESR)*, vol. 5, no. 4, 2018. ISSN (Print): 2393-8374, ISSN (Online): 2394-0697.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly, Peer Reviewed & Referred Journal|

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706145 |

3. S. Mathanki, M. Vidhya, G. Abinaya, "Microcontroller Controlled Automatic College Bell and Display Using RF," *International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)*, vol. 3, Special Issue 24, Mar. 2017. ISSN (Online): 2395-695X.
4. Sruthi P., Dr. C. Periasamy, V. Krishnapriya, Nirmin Raheem V., "Design and Implementation of Microcontroller Based Low Cost Automatic College Bell Ringing System," *International Journal of Emerging Trends in Engineering and Development*, vol. 5, no. 3, Mar. 2023. e-ISSN: 2582-5208.
5. Akhileshkumar Sanodiya, Mayuri Kale, Badal Khandare, Rohan Shende, "Automatic College Bell Using NodeMCU and Matrix Display," *International Journal of Advanced Research in Computer and Communication Engineering*, vol. 12, no. 4, Apr. 2023. ISSN (Online): 2278-1021, ISSN (Print): 2319-5940.
6. Nalini, Naveen Raj, Sharwanjana, Satish Kumar, Vijay, "IoT Based Wireless Automated Bell Ringing System in an Institution," *International Journal of Creative Research Thoughts (IJCRT)*, vol. 8, no. 3, Mar. 2020. ISSN: 2320-2882.
7. Abyash Gautam, Deepak Rasaily, Sejal Dahal, "Microcontroller Controlled Automated College Bell," *International Journal of Engineering Trends and Technology (IJETT)*, vol. 32, no. 4, pp. 184–187, Feb. 2016. ISSN: 2231-5381.
8. "Introduction to NodeMCU V3," *The Engineering Projects*, Oct. 2018. [Online]. Available: https://www.theengineeringprojects.com/2018/10/introduction-to-nodemcu-v3.html
9. Kushwah, V. S., & Jain, R. (2020). IoT based smart notification system using NodeMCU and Telegram bot. *International Journal of Engineering and Advanced Technology (IJEAT)*, *9*(4), 717–721.
10. Rani, K. U., & Rani, M. U. (2018). Real-time smart monitoring system using IoT and cloud computing. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, *3*(1), 50–56.
11. "DS3231 RTC Module With Arduino," *Last Minute Engineers*. [Online]. Available: https://lastminuteengineers.com/ds3231-rtc-arduino-tutorial/
12. "How to Use I2C Serial LCD 20x4 Yellow Backlight," *Instructables*. [Online]. Available: https://www.instructables.com/How-to-Use-I2C-Serial-LCD-20X4-Yellow-Backlight/
13. "What is an Optocoupler and How it Works," *Jameco Electronics*. [Online]. Available: https://www.jameco.com/Jameco/workshop/Howitworks/what-is-an-optocoupler-and-how-it-works.html
14. Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of Things: A survey on enabling technologies, protocols, and applications. *IEEE Communications Surveys & Tutorials*, *17*(4), 2347–2376. https://doi.org/10.1109/COMST.2015.2444095
15. Singh, D., Tripathi, G., & Jara, A. J. (2014). A survey of Internet-of-Things: Future vision, architecture, challenges and services. In *2014 IEEE World Forum on Internet of Things (WF-IoT)* (pp. 287–292). IEEE. https://doi.org/10.1109/WF-IoT.2014.6803177

INNO SPACE
SJIF Scientific Journal Impact Factor

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com