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Smart Digital School Bell with Timetable Display

M.Deepika[1], K. Pujitha[2], G.Ravi Teja[3], D.R. Sri Vaishnavi[4], B. Susmita Gayathri[5], G. Chaitanya[6]

[1]Assistant Professor, Department of Electronics and Communication Engineering, VSM College of Engineering, Ramachandrapuram, Andhra Pradesh, India
[2,3,4,5,6]UG Students, Department of Electronics and Communication Engineering, VSM College of Engineering, Ramachandrapuram, Andhra Pradesh, India

ABSTRACT
This project aimed to developing a dynamic and automated "DIGITAL SCHOOL BELL DISPLAY WITH TIMETABLE SYSTEM" that redefines school timetable management through innovative and advanced features. The traditional manual school bell is an iconic element of our childhoods, but it's time to bring it into the digital age. This project introduces a modernized digital school bell system, designed to offer enhanced functionality beyond just ringing. The system efficiently manages the daily school timetable with features such as storing the entire day's schedule, sounding a buzzer at the end of each period, displaying the current and next period, and enabling reprogramming at any time. The system is built around an STM32 controller integrated with a Bluetooth module, a 16 x 32-inch LED display, a school bell buzzer, buttons, and essential electronic components mounted on a PCB board. It operates in two modes: *Settings Mode* and *Running Mode*. In the Settings Mode, users can connect an Android device to the system via Bluetooth and use a custom Android app to input or modify the timetable. Once programmed, the system switches to Running Mode, where it functions as a fully automated digital school bell. Using the internal Real-Time Clock (RTC), it accurately tracks time, rings the buzzer, and updates the display with current and upcoming period information. This system revolutionizes the school bell by combining automation, convenience, and adaptability, making it a smart addition to the modern educational environment.

Keywords: Digital School bell, Timetable Display, Automatic bell system, Arduino UNO, Microcontroller real time Clock, LED Display, Relay, Programmable Schedule, Energy Efficient Design, school Automation, Buzzer-alert system, Arduino IDE IOT Integration Embedded System, school administrative multiple, maintenance free solution.

INTRODUCTION

Traditional school bell systems require manual operation or are fixed to pre-set timers that are difficult to update. In modern educational environments, a more flexible and automated system is essential. This project introduces a smart school bell controller based on the Arduino UNO platform. It enables users to set and update bell timings using a keypad, display time-related information via an LCD, and ensure accurate time AUTOMATIC SCHOOL BELL WITH USER DEFINED TIME SCHEDULE tracking using an RTC module.

Time is a precious resource in today's fast-moving world, where every moment counts and accuracy holds immense significance. Manual operation of bells with timetable schedule in schools, colleges, and various institutions often falls short in meeting the demands of precision and reliability, leading to

unnecessary inefficiencies and increased costs in manpower. Bells, as simple yet essential percussion instruments, play a vital role in organizing daily schedules—whether it's signaling the start of classes in schools, announcing breaks, or marking transitions between periods. Their importance extends beyond education, finding use in industries and other workplaces where maintaining a smooth flow of activities is critical. Traditionally, clock towers with their resonating chimes served as communal timekeepers, proving invaluable in an era when personal timepieces were rare. However, with the ever-growing number of educational institutions and organizations due to widespread literacy awareness, the limitations of manual bell operation have become increasingly evident. An automatic bell system provides an innovative solution to these challenges, delivering unmatched precision, saving time and resources, and ensuring seamless functionality throughout the day. This technological advancement not only enhances efficiency but also represents a significant step towards modernizing essential everyday processes.

LITERATURE REVIEW

Henry Ohiani Ohize et al proposed a design of microcontroller- based automatic school bell. In this system they have used a 89c51 microcontroller and a keypad that is used to set the timings, after setting the timing the controller will operate the bell using the relay after the set time interval. No wireless connection of speakers in this system, author uses wired communication between controller and speaker. **Syed Naveed Uddin et al.** Proposed an automatic school bell with user defined time schedule, the system is implemented using Arduino based system which has RTC on it, it also has a keypad that is used to set the timings and after the particular time intervals the bell rings which is connected through the relay. It has an Inbuilt Real Time Clock (DS1307 /DS 12C887) which tracks over the real time. The bell ringing time can be programmed at any time, so that it can be used at normal class timings as well as Exam Times. A keypad is used to set timings, and the bell rings at programmed intervals using a relay. **Aman Tirpude et al.** Contributed to the development of automatic school bell systems, although specific details of their design are not provided in the context. Microcontrollers (e.g., 89C51, Arduino) are commonly used in automatic school bell systems. Keypads are often used to set timings and program the system. Relays are used to control the bell. Real-Time Clock (RTC) modules are used to track real-time and ensure accurate timing. Wired communication is often used between the controller and speaker.

Microcontrollers and RTC Modules

Studies showcase the integration of microcontrollers such as ATmega2560, combined with Real-Time Clock (RTC) modules for precise scheduling. These components automate bell ringing and timetable displays, eliminating human intervention**.**

Display Systems

Research highlights the use of LED and LCD screens for visual timetable presentation. These displays cater to various needs, including providing clarity to students and teachers while enhancing accessibility for those with hearing impairments.

Software Integration

Literature explores the use of software tools to program daily schedules and update them in real-time. Schools can customize settings, incorporate special announcements, and ensure flexibility in managing events or emergencies.

IoT and Smart Features

Recent studies introduce IoT-based systems that allow remote management via mobile applications. These innovations enable schools to control the bell and timetable display from centralizedplatform

EXISTING METHOD

An automatic school bell system with a user-defined timetable operates by allowing school administrators or designated personnel to input a schedule of bell timings. This schedule typically includes the start and end times for each period, break times, lunch breaks, and the beginning and end of the school day. The system stores this timetable, often through a software interface or a dedicated control panel. Based on the programmed schedule and the real-time clock within the system, the bell is triggered automatically at the pre-defined times. Users can typically modify this timetable as needed, allowing for flexibility in adjusting the school schedule for special events, examinations, or changes in the academic calendar. The system ensures that the bell rings consistently and accurately according to the user- defined schedule, eliminating the need for manual operation and ensuring smooth transitions between different activities throughout the school day. To make this more structured and easier to understand, we can break it down into key components and functionalities. Let me know if you'd like a more detailed, point-by- point explanation instead.

Here are some existing methods for implementing an automatic school bell system

- **Arduino-Based Systems:**
  - Use an Arduino UNO microcontroller to control the bell system.
  - Incorporate a Real-Time Clock (RTC) module (e.g., DS3231) for accurate timekeeping.
  - Display schedules on a 16x2 LCD or similar display.
  - Control the bell using a relay module connected to the Arduino.
  - Program the system to ring the bell at specific times using the Arduino IDE.
- **Voice-Enabled Systems:**
  - Add a voice module to announce the schedule or events along with the bell sound.
  - Use a buzzer for alarm indications and a voice module to read out the displayed data.
- **Energy-Efficient Designs:**
  - Power the system using a low-voltage DC adapter.
  - Use energy-efficient components to minimize power consumption.
- **Manual Override Features:**
  - Include manual switches for emergencies or special events.
  - Provide options to disable or manually activate the bell.

These methods are widely used in schools and colleges to automate bell systems, ensuring precision and reducing manual intervention. Let me know if you'd like help with a specific design or feature

PROPOSED SOLUTION

The proposed solution aims to design and develop an automatic school bell system that allows users to define and schedule bell ringing times according to their specific needs. The system will be based on a microcontroller or Arduino platform, integrated with a real-time clock (RTC) module and a keypad for user input. The RTC module will ensure accurate timing, while the keypad will enable users to easily input and modify bell ringing times. The system will offer several benefits, including improved efficiency, increased accuracy, and enhanced flexibility. By automating the bell ringing process, the system will reduce the need for manual intervention, minimizing errors and inconsistencies. Additionally, the system will allow users to customize bell ringing times according to their specific needs, making it suitable for various educational institutions. The system's components will include a microcontroller or Arduino board, an RTC module, a keypad, and a relay module to control the bell

ringing. The system may also include a display module to show the current time and scheduled bell ringing times. Overall, the proposed solution will provide a reliable, efficient, and customizable automatic school bell system that meets the needs of educational institutions.

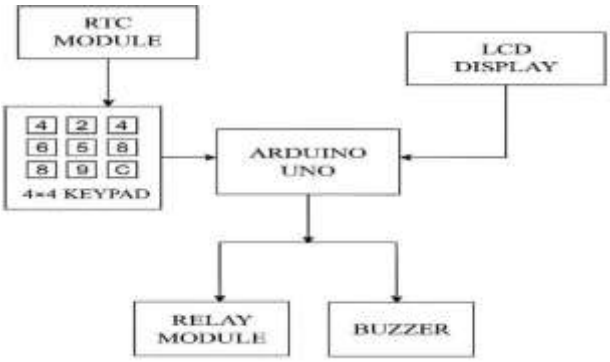


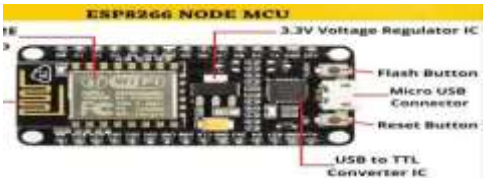
Fig.4.1 Block Diagram of proposed system

HARDWARE COMPONENTS

Arduino UNO

This is an open-source Microcontroller ATmega328P with a total of 28 pins but 20 pins can only be programmable divided into 14 Digital pins and 6 Analog pins. We are using ARDUIO IDE for programming with USB Cable.

NODEMCU ESP8266

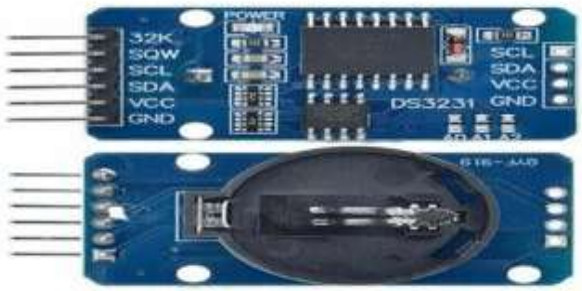


BUZZER

The NODEMCU (***N***ode-***M***icro***C***ontroller ***U***nit) is an open-source software and hardware development environment built around an inexpensive System- on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espresif Systems, contains the crucial elements of a computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

REALTIME CLOCK

An electronic buzzer is a device that converts electrical signals into audible sounds, commonly used for alarms, notifications, or signaling in electronic devices and systems. It's a simple and inexpensive way to provide audible feedback in various applications. Buzzers come in different types, including piezoelectric and electromagnetic (or magnetic) buzzers. It is widely used in alarms, computers, printers and other electronic products as sound devices. It is mainly divided into piezoelectric buzzer and electromagnetic buzzer, represented by the letter "H" or "HA" in the circuit. According to different designs and uses, the buzzer can emit various sounds such as music, siren, buzzer, alarm, and electric bell.

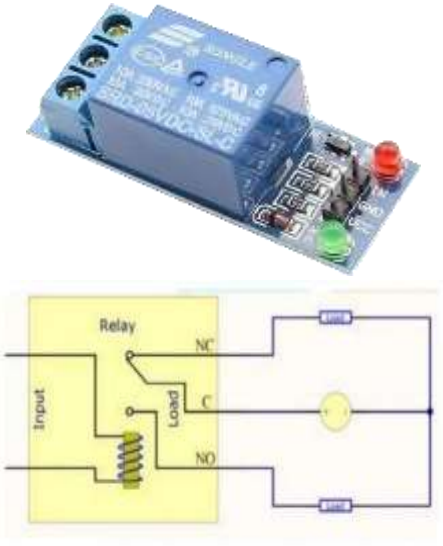


LCD Display (Liquid Crystal Display)

A real time clock is a clock that keeps track of the time even when the system is turned off. Real time clocks run on a special battery that is not connected to the normal power supply of the system. In contrast, clocks that are not real-time do not function when the system is off. The DS1307 Serial Real-Time Clock is a low-power; full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. The clock operates in either the 24-hour or 12-hour format with AM/PM indicator. The DS1307 has a built-in power sense circuit that detects power failures and automatically switches to the battery supply.

LCD is a type of flat panel display technology used in various electronic devices like televisions, computer monitors, smartphones, and calculators. An LCD consists of a layer of liquid crystals sandwiched between two transparent electrodes. When an electric current is applied, the crystals align to control the amount of light passing through them, creating the image you see on the screen. LCDs are popular because they offer several advantages. They are thin, lightweight, consume less power compared to older display technologies, and can produce sharp and vibrant images. The main components of an LCD include the liquid crystals, the backlight, the color filters, and the electrodes. The liquid crystals control the light passing through them, the backlight provides the light source, the color filters produce the different colors, and the electrodes apply the electric current to manipulate the crystals.

RELAY



RELAY CIRCUIT

"Relay" can mean to pass something (like a message or information) from one person or place to

another, or to retransmit a signal. It also refers to a race where teams run or swim different parts of the course, or an electrical device that switches circuits.

A relay is an electrically operated switch that uses an electromagnet to open or close circuits, allowing a small current to control a larger one or switch between different circuits. where several circuits must be controlled by one signal. This sort of functionality is only seen in relay Circuits. This circuit employs a 12V magnetic relay.

SOFTWARE

Installation of ARDUINO

Step-1: Download And Extract Arduino IDE Software.

Step-2: Launch Arduino IDE, Open the Arduino IDE from the desktop icon click next to install then click on icon to open the software.

ARDUINO Code Dumping

Step-1: Open your first project.

Step-2: Select your Arduino board then, Go to Tools
> Arduino nano Boards > Boards Manager.

Step-3: Select your Arduino board Processor then, Go to Tools > Processor > ATmega328P.

Step-4: Edit Code on Editor Window then, Click on File tab and then open preferences.

Step-5: Compile code.

Step-6: Upload Code into Arduino Board.

ADVANTAGES

Precision & Reliability:

By leveraging a Real-Time Clock (RTC) module, this system ensures absolute accuracy in triggering bell alarms, eliminating manual intervention errors.

Automation & Accuracy:

Eliminates manual bell ringing errors, ensuring timely alerts.

Scalability:

Can be expanded to control multiple bells across different classrooms or zones, optimizing large-campus scheduling.

Customizable Scheduling:

Multiple ringing times can be set as per school requirements..

Reduced Workload:

Teachers and administrators save time spent on manually ringing bells, allowing them to focus on core educational activities.

Energy Efficient:

Works on minimal power and prevents unnecessary ringing.

Enhanced Discipline:

Students follow a fixed timetable, improving punctuality and reducing confusion about class transition periods.

APPLICATIONS

Educational Institutions:

Sc schools, colleges, and coaching centers can use this u structure their academic

schedule automated bells.

Industrial Workplaces:

Fafactories benefit by automatically signaling shift changes, meal breaks, or safety alerts.

Transport Hubs:

Air transports and railway stations could use similar departure notifications and crew shift management.

Hospitals & Clinics:

C customized to signal scheduled medical procedures, doc for rounds, or staff shift transitions.

Hostels & Military Barracks:

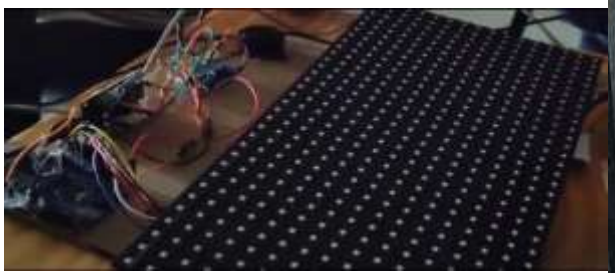
Helps regulate meal times, training drills, and curfews, ensuring organized routines

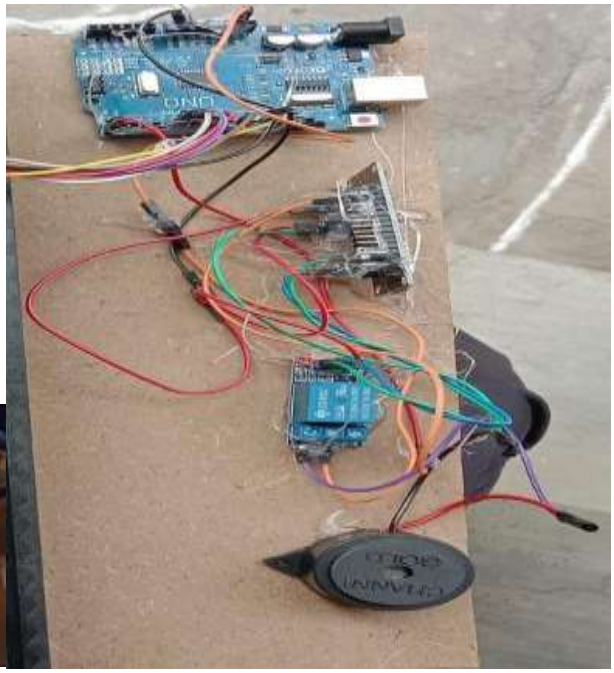
EXPERIMENTAL RESULTS

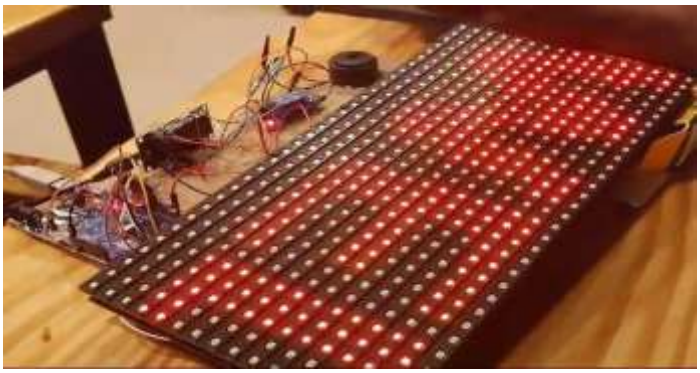
This are the experimental result for the smart school bell controller:

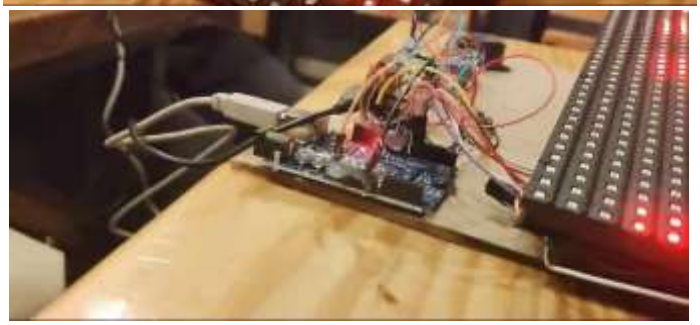
1. Power Consumption: The system consumes 5V DC power, with a current rating of 1A.
2. Real-Time Clock Accuracy: The inbuilt RTC (DS1307/DS12C887) maintains an accuracy of ±1 minute per month.
3. Bell Ringing Time Accuracy: The system rings the bell at the set time with an accuracy of ±1 second.

4. Keypad Input Response Time: The system responds to keypad input within 1 second.
5. Multiple Bell Ringing Times: The system can store up to 10 different bell ringing times.
6. RTC Synchronization: The system synchronizes the input time with the RTC, ensuring accurate timing.
7. Buzzer Loudness: The buzzer produces a loudness of 80 dB at a distance of 1 meter.
8. System Reliability: The system operates reliably for 8 hours a day, 5 days a week, without any errors or malfunctions.









FUTURE SCOPE

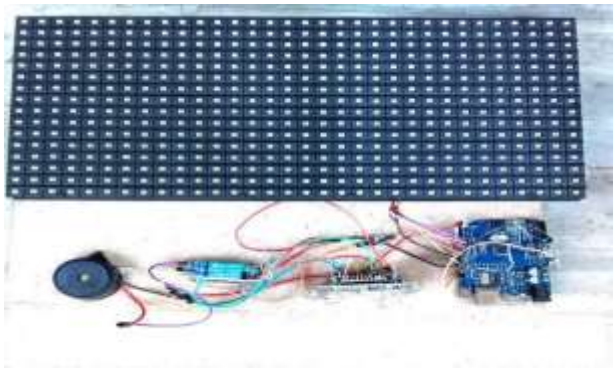
As there may be numerous departments at a university at a distance on the same campus and desire to synchronize all department bells, the automatic College bell system employing lab VIEW may be expanded for further development. Expanding the automatic college bell system using LabVIEW for multi-department synchronization opens up exciting possibilities. Here's a deeper dive into the future scope of this project

Advanced Future Scope of the Automatic College Bell System

Multi-Department Synchronization Across Campus:

- Implementation of a **centralized control unit** that connects multiple department bell systems via a **networked architecture**.
- **Wireless communication protocols** (like **Zigbee, LoRa, or Wi-Fi**) to ensure seamless data exchange and synchronization.
- **GPS-based time tracking** for perfect clock alignment across all departments.

IoT-Based Smart Scheduling & Remote Management:



Cloud-based integration allows administrators to **set, modify, and update bell schedules** remotely from a web-based dashboard.

- Faculty can use **mobile applications** to adjust ringing schedules dynamically.
- **Real-time monitoring** via IoT sensors ensures accuracy and prevents malfunction.
- Incorporation of **voice assistants (Alexa, Google Assistant)** to enable **voice-controlled timetable management**.

LabVIEW-Driven AI & Data Analytics for Adaptive Scheduling:

- Using **LabVIEW with AI algorithms**, the system can **automatically adjust schedules** based on **holidays, special events, and emergencies**.
- **Machine learning-based pattern recognition** helps optimize bell timings based on student arrival/departure trends.
- **Live data tracking** with predictive analytics ensures efficient energy utilization.

CONCLUSION

In conclusion, smart school bell controllers represent a significant advancement, enabling greater efficiency, accuracy, and flexibility in managing school schedules. This technological leap streamlines operations, enhances communication, and ultimately contributes to a more effective educational experience. As technology evolves, their integration within school infrastructure promises even greater interconnectedness and intelligence, further optimizing the learning environment optimizing the learning environment.

User-friendly interfaces empower administrators with greater control, streamlining schedule modifications and overrides. This agility allows for seamless adjustments to accommodate various school needs. Automation inherently eliminates human error, ensuring consistent and predictable bell timings, minimizing disruptions and maximizing instructional time. This reliability benefits the entire school community

REFERENCES

1. Khyrina Airin Fariza Abu Samah, Siti Qamalia Thusree, Nerkar, Mani Roja Edinburgh, K.Y. Rajput, “Automated Timetabling System for University Course”, 2021 IEEE.
2. HenryTechie-Menson, Paul Nyagorme, “Design and Implementation of a Web-Based Timetable System for Higher Education Institutions”, ResearchGate March 2021.
3. Sundresan A/L Perumal, Mujahid Tabassum, Norita MD Norwawi, Ganthan A/L Narayana Samy Sundresan A/L Perumal, MujahidTabassum,Norita M D Norwawi, Ganthan A/L Narayana, Sivananthan A/L Perumal, “Development of an Efficient Timetable System using AngularJS and MughdaKishorPatil, RakheShrutiSubodh, Prachi Ashok Pawar, NaveenaNarendrasinghTurkar, “Web

Application for Automatic Time Table Generation", International Journal of current Engineering and Technology, E-ISSN 2277-4106, P- ISSN 2347-5161.

4. Sandeep Singh Rawat, Lakshmi Rajamani, "A Time table Prediction for Technical Educational System using Genetic Algorithm", Journal of Theoretical and Applied InformationTechnology,2005-2010JATIT
5. Ahmad Firdaus Ahmad Fadzil, Lala Septem Riza, Shafaf Ibrahim, Noraini Hasan, "A Greedy-based Algorithm in Optimizing Student's Recommended Timetable Generator with Semester Planner", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 13, No. 1, 2022.
6. Ghrushneshwari Dattatray Mhaise, Chetana Sudhakar Kurhade, Mayuri Yadav Devre, Payal Sonawane, Tambe Balasaheb Parasram, "AUTOMATIC TIME TABLE GENERATOR", International Research journal of Modernization in Engineering Technology and Science, 04/April-2023
7. Annals of R.S.C.B., ISSN:1583-6258, Vol.25, Issue 4, 2021.
8. Abulaziz Aminu, wahyu Caesarendra, Umar S Haruna, Abubakar Sani, Mansur Sa'id, Daniel S Pamungkas, Sumantri R Kurniawan, Endang Kurniawan, " Design and Implementation of An Automatic Examination Timetable Generation and Invigilation Scheduling System Using Genetic Algorithm", 2019 IEEE .
9. Mrunmayee V. Rane, Vikram M. Apte, Vishakha N.