VIRTU BOT: INTERACTIVE TOUCH-BASED NOTICE BOARD SYSTEM WITH VOICE INTERACTION AND REMOTE-CONTROL USING RASPBERRY PI

Chiranthana G[1*], Pavitra Bai S[2], Rohini T V[3], Damini A[4], Jatin K Naik[5], Mouna H R[6]

Abstract

In today's fast-paced world, notice boards serve as crucial information systems across diverse settings such as educational institutions, railway stations, bus stations, and offices. This paper presents the development and design of an innovative touch-based interactive information system for notice boards, offering remote control capabilities via the internet and integrating Raspberry Pi technology. The proposed system enables administrators to seamlessly manage notice board content using internet connectivity. Information updates are facilitated using Telegram, a popular messaging platform, ensuring near-instantaneous dissemination to the notice board. The display mechanism employed incorporates touch screen technology, providing a user-friendly interface for browsing and accessing the displayed information. To enhance user experience and accessibility, the system integrates voice interaction capabilities. Through voice commands, users, including students, can conveniently access relevant information and provide feedback. This feature promotes inclusivity and facilitates an interactive and engaging experience for all users. The versatility of this system makes it applicable across various fields, serving as a comprehensive solution to address information dissemination needs. It caters to the information requirements of students, staff, and departments, covering a wide range of relevant topics and updates. Moreover, the adoption of KIOSK's technology enhances the system's efficiency, reliability, and security. In conclusion, this research introduces a technologically advanced notice board system that leverages internet connectivity, touch screen displays, Raspberry Pi integration, and voice interaction. By combining these elements, the system offers an efficient and user-friendly approach to manage and access information, transforming traditional notice boards into dynamic and interactive communication platforms. This solution has the potential to revolutionize information dissemination across various domains, enabling seamless access and enhancing the overall user experience.

Keywords: Robotics, User-Friendly, Raspberry-Pi, Intelligent Systems, Voice Interaction

[1,4,5,6] Students, Department of Information Science and Engineering, SJB Institute of Technology, Bengaluru, Karnataka, India.
[2]Associate Professor, Department of Information Science and Engineering, SJB Institute of Technology, Bengaluru, Karnataka, India.
[3]Associate Professor, Department of Computer Science and Engineering, Dayanand Sagar College of Engineering, Bengaluru, Karnataka, India.

***Corresponding Author:** Pavitra Bai S
*[2]Associate Professor, Department of Information Science and Engineering, SJB Institute of Technology, Bengaluru, Karnataka, India.

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1. INTRODUCTION

The continuous advancements in robotics have led to a wide range of applications, with service robots gaining popularity in various daily activities such as home automation, entertainment, education, and elderly assistance [1]. This growing prevalence of service robots is evident through the emergence of commercial products and research prototypes in these fields [2-7]. One of the main attractions of robotic systems is their ability to reduce human labour, effort, time, and errors.

Traditionally, information on notice boards has been manually posted by individuals, resulting in a loss of time and manpower. To address this inefficiency, our system incorporates a processor connected to a monitor, enabling the display of information in various formats such as text, images, and PDF documents on a large screen. This not only simplifies day-to-day operations but also enhances the experience of students and university staff.

In our system, we have chosen the internet as the medium for transferring information. By utilizing high-definition display devices, we can capture more people's attention compared to conventional notice boards. Unlike traditional wireless notice boards that can only display text messages, our newly implemented system has the capability to showcase images, PDF documents, and text messages. This is particularly beneficial in educational institutions where important information is often conveyed by higher authorities in image or PDF format, making our system more efficient and user-friendly.

By embracing these advancements, our system aims to revolutionize the conventional notice board experience, offering a dynamic and interactive platform for displaying a wide range of information. The following sections will delve into the design, features, and benefits of our system, highlighting its potential to enhance communication and streamline operations in educational institutions and beyond.

2. RELATED WORK

The digital notice we use digital and electronic components. It is designed to display notices or messages from anywhere or at any time. Patrick et. al [8] A humanoid robot utilizes speech and gestures to provide directions on a map, incorporating non-verbal social signals for an enhanced user experience. The interaction focuses on spatial communicative cues, allowing the robot to respond appropriately. G. Lavanya, T. Sangeetha [9] explores a notice designed and developed using the Internet of Things. It uses a Mobile App that send message to display on the notice. it uses Wi-Fi module which limits the distance from which the message is to be sent**.** digital board is an essential information gathering system in our life. In our day-to-day life we can see notice boards in various places like, schools, railway station, malls, Bus stand, offices etc. So, we can say that Notice boards are the places to leave public information like advertise events, announce events, or provide attention to the public, etc. Now a separate person should stick the information on the notice board. It will lead to loss of time and usage of manpower.

Modi Tejal Prakash, Ayaz [10] explores a Notice Board mainly consists of Raspberry Pi in which there is mobile application which is connected to the LCD display. This project needs a continuous internet connection that too with registered network**.** digital board can be replaced in place of a conventional notice which reduces manpower and resources. The digital board uses digital technology and electronic components. It is to display notices or messages from anywhere or at any time. So, there is a usage of huge amount of paper for displaying those endless counts of information. The problems faced by the wooden or conventional type notices are resolved by the implementation of our digital board.

E.N. Ganesh [11] explores the usage of Digital board using Raspberry Pi in which PC is used to sending information and processor is connected to internet at the receiving side. The need of a continuous internet connection is one of the system drawbacks**,** admin can control notice from the internet. So, information can be sent anywhere, and it shows within seconds. The PC is to send information and processor is connected to the internet at the receiving side.in this application which is installed on the admin's mobile phone can serve the same purpose. This application also contains a speech to text converter. So, the admin will send text messages from his/her own voice.

Suma M.N., Amogh H. Kashyap [12]. explores Voice Over Wi-Fi based Smart Board. This is a system to wirelessly transmit short notice using Wi-Fi. This system uses Raspberry Pi for the Transfer of the information. Zigbee based Electronic Notice. This Notice Boards are a part of communication in any institutions or organizations which are used to display any notification that reach quickly to intended persons. In the current scenario the notice boards can be digitally managed due to advanced

wireless technology and can be remotely controlled. User should make voice announcements anywhere in the campus as required or sent messages which is display on board placed at the required location.

Mulugeta Tegegn Gemeda [13] explores Development of a Smart Wireless Board System. For this paper-based notice boards are largely used in the different organizations, and school share information with the customer. using these techniques is waste of paper and paper ink and human power. The WiFi is connected to the processor on receiving side. Notice is received by the receiver when it is sent by his system. Wireless is a technology that allows an electronic device to send and receive data through a computer network, it has high-speed wireless connections. The information comes from a user. wireless-based system offers flexibility to display news or announcements vary faster than the other system.

Divyashree M, Harinag Prasad [14] explores Wireless Web Controlled Notices Now a day's individuals like wireless connection so people can easily, and it require less time. The main thing of this is to do a digital board that displays the notices and to build an easy-to-install, user-friendly system, which may get and notices in a very specific manner with specific date and the time used to help to simply see the digital board each time. In Web Controlling Digital Board, the Internet is used to send the notice from internet to crystal display. A local web server is created, this can be a global server over net. At the Raspberry Pi, LCD is used to see message and flask for receiving the message over network.

M.Arun. P. Monika [15] explores IoT based web-controlled notice board has the Raspberry Pi2 with Touch display. Wireless technology provides fast transmission over a long- range data transmission, use in paper. It saves time, cost of cables, system size. Data can be sent anywhere in the world. Username and password type authentication system is provided for adding security. Previously the notice board using Wi-Fi module was used. In that, there was the restriction of coverage area, in our system internet is use by communication medium. So, the problem with the coverage area. Multimedia data can be stored on a SD card. Text messages and multimedia data can be seen as fast as possible with best quality.

Pragati Tate and Nisha Mohite [16] came up with an idea to create an Android app that can be used to control a digital notice board using your voice. This means that instead of typing out messages to be displayed on the board, you can simply speak to them out loud and the app will convert your spoken words into text. The app can be downloaded onto any device that uses the Android operating system, like a smartphone or a tablet. However, it does require an internet connection in order to work. Using a voice-controlled notice board has many advantages over traditional methods. It is more comfortable and user-friendly because you don't need to spend time typing out messages, and it allows you to use your own voice to control the board. Overall, the app is easy to use and install, making it a convenient option for anyone who needs to manage a digital notice board.

Vinod Jadhav B. and Tejas Nagwanshi S [17] developed a system that allows users to remotely display notices on a digital screen using a Raspberry Pi device. Authorized users can send notices using an Android application or website. The system allows users to upload notices in different formats, such as PDF, JPG, and TXT, from the input unit. These notices are then hosted on a web server, which is also known as a web portal based on cloud service, using an internet or Wi-Fi connection. At the receiver side, the Raspberry Pi device is connected to a Wi-Fi network. The web platform enables notices that are posted on the web server to be broadcasted to multiple digital display screens via the internet. This provides a user-friendly interface and allows for fast data transmission between the user and the LCD screen using the Raspberry Pi. Overall, this system provides a convenient way for users to display notices on digital screens remotely. It allows for a variety of notice formats and can be accessed using an Android application or website. The use of a Raspberry Pi device and a web server ensures fast and reliable transmission of data.

Mani Teja P and Neha Teja P [18] have developed a system for displaying notices on a notice board using a Raspberry Pi device. The notices are sent from a mobile device and transmitted to the notice board via a web server, using the internet for wireless data transmission. The Raspberry Pi device is used as a transmitter at the input side, and it allows users to create notices at any time and transmit them over the internet. To receive the notices, a connection between the transmitter (Raspberry Pi) and the receiver (LCD screen) must be established by providing an IP address. Once the connection is established, notices can be sent remotely from anywhere in the world. This system provides a convenient way for users to display

notices on a notice board without physically being present. It uses the internet to transmit data wirelessly, making it easy to send notices from anywhere. The use of a Raspberry Pi device as a transmitter also ensures that users can create notices at any time and from any location. Overall, the system is easy to use and provides a practical solution for remotely displaying notices on a notice board. It can be set up using an IP address and allows for wireless data transmission, making it a convenient option for users.

A scoping review was conducted to explore the understanding of anthropomorphism [19] in human-robot interaction (HRI) and social robotics research. The review included 57 studies involving 43 different robots and 2947 participants. Researchers used seven different definitions of anthropomorphism and commonly assessed it using amended versions of existing questionnaires or idiosyncratic questionnaires addressing various themes. The lack of standardized definitions and assessment tools hinder cross-study comparisons and may impact the quality of results.

A field study was conducted to gain insights into user reactions and challenges associated with the deployment of a service robot in public spaces. The study involved observing lay users' reactions to a cleaning robot at a train station, conducting interviews to explore passersby's preferences for human-robot interaction (HRI) [20] strategies, and assessing trust and acceptance through questionnaires. Challenges identified included robot navigation in crowded areas, inclusive communication, informing staff and the public about the robot's purpose, and the need for conflict resolution strategies. The study highlights the importance of addressing these challenges and provides recommendations for future research in public HRI.

3. PROPOSED METHODOLOGY

The main thing of the system is to make digital boards. The information also displays in the form of images, text, document, pdf, etc… In this model we are using Raspberry Pi as a processor. In this Raspberry Pi is equipped with a touch display. The system will send this message to the cloud then it passes to the board which is connected to the internet. The processor processes the message and displays it on the digital board. So, the functionality in this module includes admission inquiry, showing course information, searching about staff details, getting feedback and photo gallery etc. We can display messages and can do easily set or changed from ay place. In addition, mobile is used to convert voice or text.

In this architecture as shown in Figure 1, has two sections called Sender and receiver, the sender is an Admin, and the receiver is user. When the data is sent through a telegram it can display on a board and ask any queries in voice input on microphone it receives the output in voice output on speaker.

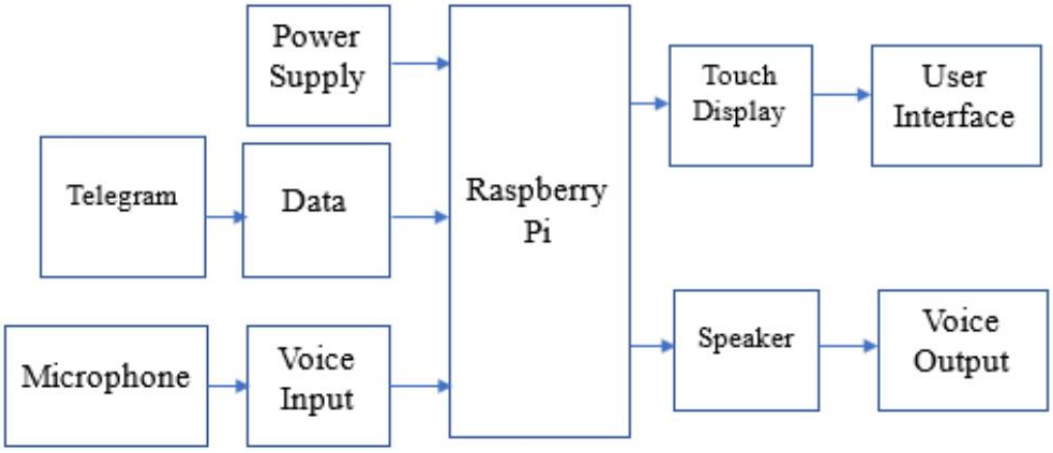

Figure 1. Proposed Methodology

Senders oversee sending valuable information's from the network. Digital board the sender must enter the corresponding web address. To make the proposed system easier make an android application. By using this application sender can directly send the information through telegram. this android application contain voice to speech converter. So, the sender can send text messages through his own voice without typing messages. These messages including text file, image file and pdf file will send to the cloud. In the simplest terms, cloud means storing and accessing data and programs over the Internet instead of our

computer's hard drive. The cloud is just a metaphor for the Internet.
Receiver is wait for receiving valuable information in the wireless device. It will collect data from the cloud. The web address for collecting data from the cloud is already specified through program written in the processor. receiving messages will be displayed on the digital board. The received text messages are displayed on the screen like scrolling manner. Similarly received images will display on the screen. For displaying Pdf files, first it converted into image file by the program written in the Raspberry pi. We are going to propose an Intelligent Notice Board System Algorithm.

Intelligent Notice Board System Algorithm

Step-1: Initialize the system by booting up the processor and establishing an internet connection.
Step-2: Retrieve the information to be displayed from the database or external source.
Step-3: Process the information to ensure compatibility with the display format (text, images, PDF documents).
Step-4: Display the information on the monitor, utilizing the appropriate screen layout and design.
Step-5: Implement user interaction capabilities, such as voice commands or touch screen functionality, to enable users to navigate and interact with the displayed information.
Step-6: Continuously monitor for any updates or changes in the information source.
Step-7: Upon detecting updates, retrieve the new information and repeat steps 3-5 to display the updated content.
Step-8: Handle any user requests or feedback, such as providing additional details or accessing specific sections of the information.
Step-9: Periodically check the internet connection to ensure uninterrupted communication and data transfer.
Step-10: If there is a loss of internet connectivity, display a notification or message indicating the issue and attempt to reconnect.
Step-11: Implement security measures to protect the system from unauthorized access or tampering.
Step-12: Regularly maintain and update the system software and hardware components to ensure optimal performance and functionality.

4. Materials

4.1. Hardware Requirements:

Raspberry Pi Board:

This is a small, affordable computer that can run various operating systems and software. This is a powerful computing platform that features a broad range of capabilities, including high-definition video playback, multimedia streaming, and hardware acceleration for tasks such as image processing and machine learning. The Figure 2 shows the Raspberry Pi Board used in the work. It has a variety of input/output (I/O) options, including HDMI, USB, Ethernet, and GPIO (General Purpose Input/Output) pins, it can be connected to a wide range of peripherals, such as cameras, sensors, and displays.

Figure 2. Raspberry Pi Board

The Raspberry Pi runs on various operating systems, including Linux-based distributions such as Raspbian and Ubuntu, as well as specialized operating systems like RetroPie for gaming and Pi-hole for network-wide ad blocking. It also supports programming languages such as Python, Scratch, and C++, making it an excellent tool for learning and teaching coding and electronics.

In addition to its educational and hobbyist applications, the Raspberry Pi has been used in a wide range of commercial and industrial applications, such as home automation, robotics, and IoT projects. Its cost is low, and versatility make it an attractive option for prototyping and proof-of-concept projects in many fields. For a receptionist robot project, a Raspberry Pi 4 Model B or newer is recommended to ensure optimal performance. The Raspberry Pi will serve as the brain of the robot, controlling speech, and interactions with visitors. The Raspberry Pi will connect to touch display, which will serve as the robot's user interface, allowing visitors to interact with the robot through a web-based interface.

Touch Display:
The touch display is a critical component of the receptionist robot project, as it provides a user-friendly interface for visitors to interact with the robot through a web-based interface. The touch display's small size and low power make it an ideal choice for the receptionist robot, it will be easily integrated into the robot's design without taking up too much space or power. The touch display's capacitive screen as shown in Figure 3 allows responsive user interactions, enabling visitors to easily navigate the robot's menus and input information. The display's high resolution also provides clear and detailed visuals, making it easy for visitors to read text and view images. Its direct connection to the Raspberry Pi through the HDMI port ensures fast response times and high-quality visuals, making it an excellent choice for a wide range of Raspberry Pi projects.

Figure 3. Touch Display

HDMI Cable and Power Supply:
An HDMI cable as shown in Figure 4 is a high-speed audio and video cable that is commonly used to connect devices such as televisions, monitors, and projectors to other devices like DVD players, game consoles, and computers. The HDMI cable provides a digital connection that allows for high-quality audio and video transmission, without any separate audio and video cables. The receptionist robot project, the Raspberry Pi is connected to a touch display via an HDMI cable. This provides a high-quality, digital connection that allows for fast and reliable transmission of data between the Raspberry Pi and the touch display. It's important to select a high-quality HDMI cable that is compatible with both the Raspberry Pi and the touch display to know the data is transmitted without interference or degradation.

Figure 4. HDMI Cable

Figure 5. Power Supply

The Raspberry Pi requires a power supply to function. The Figure 5 Shows the Power Supply cable which is 5v used in the proposed work. The power flow is typically provided through a micro-USB port on the board, and it must be rated appropriately for the Raspberry Pi's power requirements. The power flow must provide enough power to support the Raspberry Pi, as well as any peripherals that are being used. It's important to choose a high-quality power supply that is with the Raspberry Pi, as this will ensure that the power supply provides stable and reliable power. Using a low-quality power supply can result in unstable performance or even damage to the processor.

In addition to the processor, the touch display also requires a separate power supply. This is typically provided through a USB port on the display itself.

The power supply must be rated appropriately for the display's power requirements, and it's important to ensure that the power supply is compatible with both the touch display and the Raspberry Pi. By providing a separate power supply to the touch display, it's possible to ensure that the display receives stable and reliable power. This can help to prevent issues such as flickering, distortion, or even damage to the display.

4.2. Software Requirements:

Operating System:

The first software requirement is the operating system. Raspbian OS is a popular choice for processor projects, including the receptionist robot project. It is an operating system designed and is optimized for performance and compatibility.

Web Server:

The web server software is necessary for serving the web pages to the visitors. Apache, Nginx, or Lighttpd are popular options. However, for this project, Apache Web server is used.

Programming languages:

Programming languages used in this project include Python, HTML, CSS, and JavaScript. Python is used for the backend development, while HTML, CSS, and JavaScript are used for the frontend development of the web-based interface. Python is the programming Raspberry Pi projects, making it a natural choice for this project. HTML, CSS, and JavaScript are used for web development and provide the foundation for creating a user-friendly and interactive interface for the receptionist robot. Python Flask is as the web framework to create the web-based interface. Flask is an excellent choice because it is a lightweight and flexible web framework that is easy to learn and use, making it ideal for this project.

Speech Recognition Software:

To enable the receptionist robot to talk with visitors, speech recognition and synthesis software are required. Google's Speech API, IBM's Watson Speech API, and others are popular options. Here we used Google's Speech API to Convert user voice to text. It uses advanced machine learning algorithms to transcribe speech into text and vice versa, making it an excellent tool for talk to visitors. The Speech API can recognize many different languages and dialects, making it versatile and accessible to a broad audience. Additionally, it can be easily integrated with Python using the Google Cloud Speech-to-Text and Text-to-Speech APIs.

5. RESULTS AND DISCUSSIONS

The Figure 6 shows the Digital board Connected to Raspberry Pi, it displays all the information related to our department, where we can get class, labs, staffs' information, and it displays circulars, pdf, images, text etc. All the information can be sent through telegram. This has touch based interface and can be easily interact. We can ask queries through mic, and you can receive those answers from the speaker. Both are connected to Raspberry Pi.

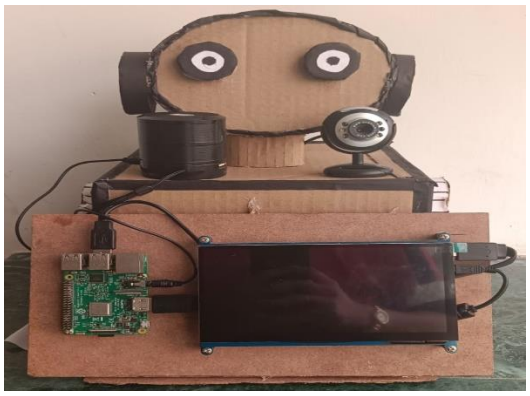

Figure 6. Receptionist Robot

Figure 7. Home Page

The Figure 7 shows the welcome Page, there are 4 Sub-Division Parts Whereas Home, Staff information, Notice, Voice, and Department Information as shown in the above figure.

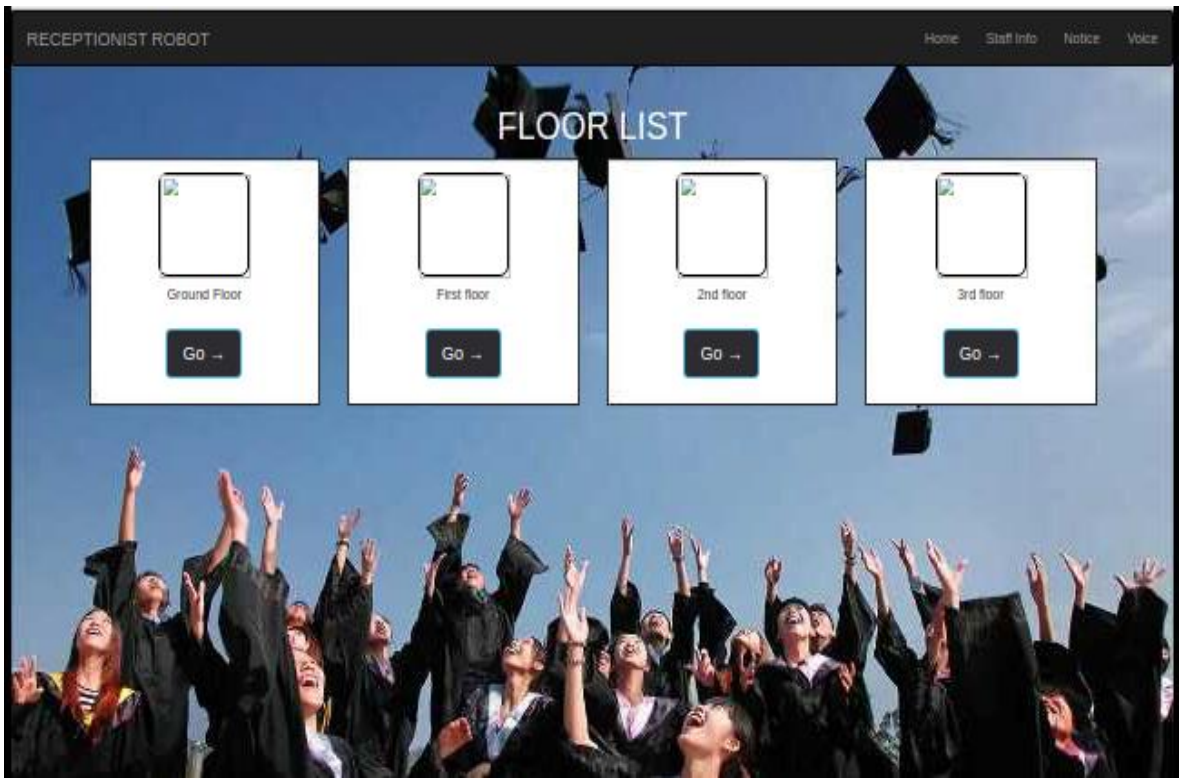

Figure 8. Floor List

The Figure 8 shows the web page showing the Floor List. This page displays when we click on "GO" button in Home Page. This is about floor list where we can get all floor information.

Figure 9. HOD Cabin and Laboratories

The Figure 9 shows the pages related to floors. This page will display when we click on a particular floor, then the classrooms and Labs of that floor will be shown.

Figure 10. Staff Details

This page will display when we click on "STAFF INFORMATION" this is the page where we can get all staff name, designation, department, email and phone number of the staffs at a time

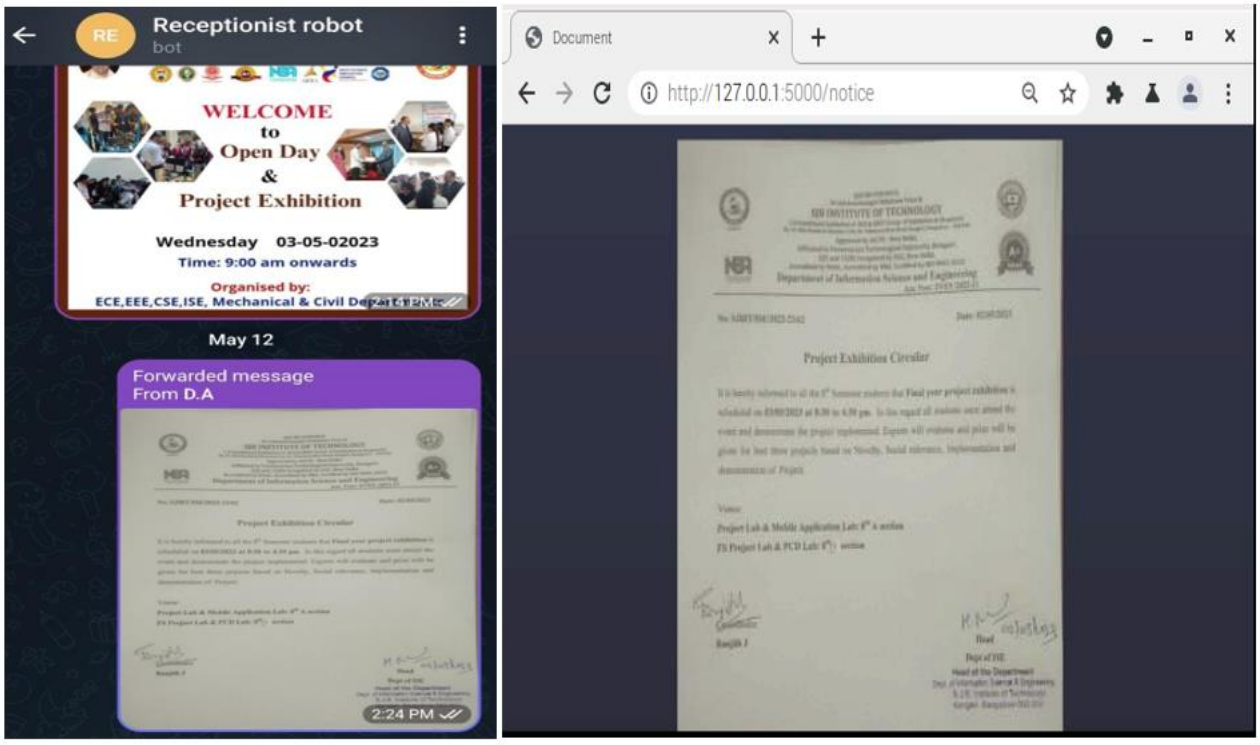

Figure 11. Notice Sent from the Admin

This page will display when we click on "NOTICE" here admin can send circulars, images, documents through telegram all the information will be displayed on the digital board.

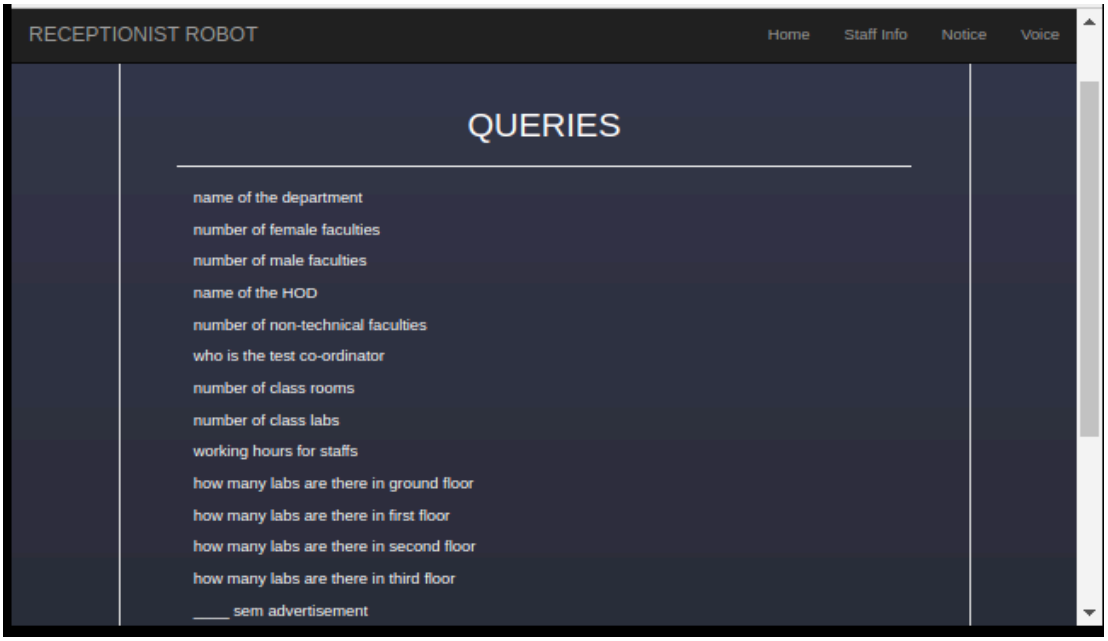

Figure 12. Voice Queries

This page will display when we click on "VOICE" these are the queries where user can interact with robot.

6. CONCLUSION AND FUTURE SCOPE

In this work, we have successfully designed a receptionist robot using a Raspberry Pi and a touch screen display. The robot incorporates a web-based interface that provides essential information such as staff details, class schedules, lab availability, and room allocations. Additionally, notices sent through Telegram are seamlessly displayed on the robot's screen. The integration of a voice query system allows visitors to ask questions verbally, enhancing user interaction and convenience. The system has proven to be user-friendly, providing accurate and helpful information.

Future Work: The receptionist robot project has significant potential for future development and expansion. One possible area for further improvement is the incorporation of natural language processing (NLP) technologies to enhance the robot's understanding and response to user queries. Additionally, advanced facial recognition capabilities could be implemented for visitor identification and personalized interactions. Cloud-based services can be utilized to offload processing tasks and enhance the system's capabilities. Autonomous navigation could be integrated, allowing the robot to move independently within its environment, making it more versatile and adaptable to different settings.

As technology continues to advance, the receptionist robot project can leverage the latest advancements in AI, machine learning, and robotics to become even more intelligent and valuable in various contexts, including homes, offices, and public spaces. Continuous research and development efforts will be essential to keep pace with evolving technologies and provide a more enhanced and engaging user experience.

In conclusion, the receptionist robot project using a Raspberry Pi and web-based interface has demonstrated promising results and numerous possibilities for future enhancements. By embracing emerging technologies, the receptionist robot can evolve into a more intelligent and personalized assistant, making a significant impact in various domains.

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