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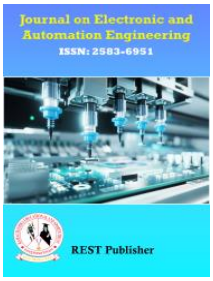

Android Based Smart and Cost-Effective Wireless Electronic Notice Board

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Abstract: *Notice boards play a vital role in offices, in shops and mostly in educational institutions. The events, occasions or any news, which has to be passed to the students, will be written on the notice boards present in every floor in the colleges or schools. The present system is like, a person will be told the news and he has to update this news on all the notice boards present in the college or school. This will be seen mostly during the examination seasons. The time table or the schedule of the exams has to be given to the students. This will be done by writing the details on the notice boards. But this process consumes a lot of time to update the news on all the notice boards and there may be chances that the person responsible may commit some mistakes or he may be absent sometimes. So, this may create disturbances and the entire schedule may be disturbed. To avoid all these, Wireless Notice Board have been designed which completely eliminates the manual work. Now a day's so many useful technologies are coming out to make our life style more comfort, luxurious and secure. Especially in mobile field so many applications are being developed to give us more information and entertainment. This project is designed with combination of two latest and most demanding technologies that are Android and Embedded Systems In this project we will create an application to update the message on electronic notice board. We have to type the message on our android phone and sends to notice boards using this application then this will be received by controlling section using Bluetooth. At controlling system side, we have Bluetooth module, microprocessor and electronic notice board. Whenever this blue tooth module receives new message or notice from android application then it transfers this command to microprocessor. Microprocessor will update this new notice on electronic notice board.*

1. INTRODUCTION

A notice board is a place where people can leave public messages to advertise things, announce events or provide updated information in any organization. For a long time, manual (paper-based) notice boards have been used by posting the paper on building walls or the prepared board made from wood. However, using these techniques is; (1) wastage of paper and paper ink and human power due to posting thus, it is not cost-effective, (2) it minimizes the appearances of the building wall and then it harms the environment since the papers will be discarded after use, lastly,(3) it takes much time to reach the receiver because of the process of printing and posting paper hence it is not time effective .Therefore, all these limitations are very serious issues because there may be information loss as well as time and energy. Nowadays people from different parts of the globe need to communicate with one another in fractions of seconds using wireless communication. Therefore, replacing those manual notices boards using wireless notice boards is currently required. A wireless electronic notice board is possible through embedded systems. Being a wireless-based system offers flexibility to display flash news or announcements faster than the manual or traditional system. The authors of the study cited in proposed sending a message to a Digital Monitor through a Raspberry Pi card from an authenticated mobile phone. Bluetooth is used for data transfer. We can add, remove, or change the wording at any moment to meet our needs. The Bluetooth is in-built in the Raspberry Pi on the receiving end. The notice is received by the receiver when it is sent by an authorized user from his system. Wireless is a common technology that allows an electronic device to send and receive data via a computer network, including high-speed wireless connections. The information comes from a verified user.

2. LITERATURE SURVEY

Design and development of intelligent wireless electronic notice board system, Mulu Keta Dekekan Kemeda, Ayane LebetaGoshu, Leta Lebeta Goshu, 2011 : The project "Design and Development of Intelligent Wireless Electronic Notice Board System" by Mulu Keta Dekekan Kemeda, Ayane LebetaGoshu, and Leta Lebeta Goshu (2011) focuses

on developing a smart, wireless notice board that enables remote message updates using GSM or RF communication technology. The system consists of a micro-controller that receives and processes message sent from an authorized mobile device, displaying them in real-time on an LED or LCD screen. This eliminates the need for manual updates, reducing paper usage and enhancing communication efficiency. The system can be widely used in educational institutions, offices, railway stations, hospitals, and other public places for quick and hassle-free message dissemination. Additionally, it allows for real-time updates, emergency alerts, and scheduled announcements. While the system offers advantages such as convenience, cost-effectiveness, and easy message management, it also faces challenges related to power consumption, network reliability, and data security. This project serves as a foundation for IoT-based smart communication systems, contributing to the advancement of modern digital signage solutions. IOT based digital notice board using Arduino Atmega328 (march 2019): The project "IoT-Based Digital Notice Board Using Arduino Atmega328" (March 2019) focuses on developing a smart electronic notice board system that enables remote message display using the Internet of Things (IoT). The system is built around the Arduino Atmega328 microcontroller, which receives messages via Wi-Fi or GSM from an authorized user and displays them on an LED or LCD screen. This project eliminates the need for traditional paperbased notice boards and manual updates, making communication more efficient and ecofriendlier. It allows real-time message updates, emergency alerts, and scheduled announcements, making it ideal for schools, colleges, offices, railway stations, and other public spaces. The system can be controlled remotely using a mobile application or a web-based platform, providing flexibility and ease of operation. The main advantages of this IoT-based system include remote accessibility, real-time updates, low maintenance, and improved communication efficiency. However, challenges such as network reliability, power consumption, and data security need to be addressed. This project represents an important step toward modern digital signage solutions and smart communication systems. The software is based on a easy and less expensive android bulletin board, Divya shulka, sambavi awasthi, neeraj khera The project by Divya Shukla, Sambavi Awasthi, and Neeraj Khera focuses on developing a cost-effective and user-friendly Android-based bulletin board system for digital communication. This software replaces traditional notice boards with an easily accessible mobile application, allowing users to post and update messages remotely. The system is designed to be affordable and simple to use, making it ideal for educational institutions, offices, and public spaces. The main components of this system include an Android application, a microcontroller (such as Arduino), a Wi-Fi or GSM module for wireless connectivity, and a display unit like an LCD. By leveraging Android technology, it provides real-time updates, reducing the need for manual intervention and paper usage. The key advantages include low cost, ease of use, and efficient information dissemination, while challenges may involve network connectivity and security concerns. This project contributes to modern digital notice board solutions, enhancing communication through smart technology. design and development of a smart wireless electronic notice board system(2021): The "Design and Development of a Smart Wireless Electronic Notice Board System" (2021) focuses on creating an advanced, wireless digital notice board that allows remote message updates via IoT-based technology. This system replaces traditional notice boards with a smart, efficient, and eco-friendly alternative, enabling users to update messages in real-time using a mobile app or web interface. It is ideal for educational institutions, offices, hospitals, and public spaces where instant communication is required. The main components of this system include a microcontroller (Arduino or Raspberry Pi), a Wi-Fi or GSM module for wireless connectivity, a display unit (LCD or LED screen) for message visualization, and a mobile or web-based interface for sending updates. The system operates by receiving messages from an authorized user, processing them through the microcontroller, and displaying them on the screen.This smart notice board improves communication efficiency, reduces manual work, and eliminates paper waste, making it a sustainable solution. It also allows for scheduled announcements, emergency alerts, and remote accessibility. However, challenges such as network reliability, power consumption, and cybersecurity risks must be considered. Design and development of GSM based multiple LED Display boards(2013): The "Design and Development of GSM-Based Multiple LED Display Boards" (2013) focuses on creating a wireless communication system for displaying messages on multiple LED boards using GSM (Global System for Mobile Communication) technology. This system enables users to update messages remotely via SMS, making it ideal for applications in schools, colleges, railway stations, bus stops, offices, and public places where information needs to be conveyed efficiently across multiple locations. The main components of this system include a micro-controller (such as 8051 or Arduino) to process incoming messages, a GSM module (SIM900 or similar) for wireless message reception, multiple LED display units for message visualization, a power supply unit, and a mobile device for sending SMS commands. The system works by receiving an SMS from an authorized user, decoding the message through the microcontroller, and displaying it simultaneously on multiple LED boards. This project offers real-time message updates, remote accessibility, and reduced manual effort, making it a costeffective and efficient solution for digital communication. However, challenges such as network signal dependency, message security, and power management need to be addressed for optimal performance. This system plays a key role in the development of smart digital signage solutions by enabling centralized control of multiple display boards.

Block Diagram:

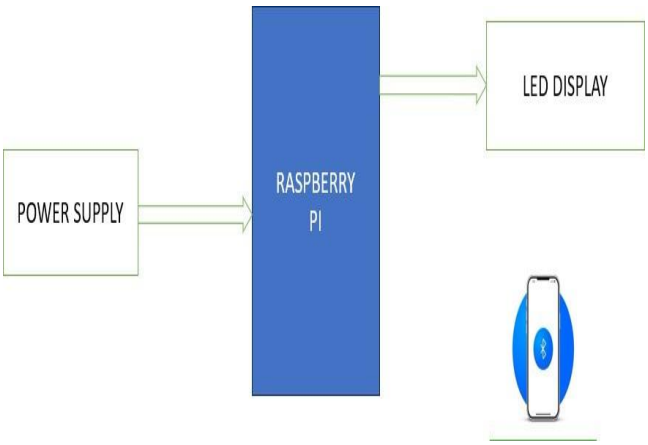

FIGURE 1. Block Diagram

Raspberry Pi 3 Model B+: The Raspberry Pi 3 Model B+ acts as the central controller in an electronic notice board, processing and displaying messages on an LED screen. It connects to a network for remote updates, making it ideal for real-time, wireless communication in educational and corporate settings. It consists of inbuilt Bluetooth through which communication is established. The Raspberry Pi 3 Model B+ is a single-board computer developed by the Raspberry Pi Foundation. It's a compact, low-cost, and highly capable device designed for various applications, including prototyping, DIY projects, and education.

FIGURE 2.

P10 LED BOARDS: A P10 LED board is a type of LED display module that consists of a matrix of LEDs arranged in a 16x16 or 32x16 grid. The "P10" designation refers to the pixel pitch, which is 10mm.

FIGURE 3.

SMPS: SMPS stands for Switch-Mode Power Supply, which is a type of power supply that uses switching electronics to regulate the output voltage. SMPS is more efficient, compact, and reliable compared to traditional linear power supplies. Specifications: 5V 20A Output Voltage: 5V (nominal) Output Current: 20A (maximum) Power Rating: 100W (5V x 20A)

FIGURE 4.

The working principle of a Smart and Cost-Effective Wireless Notice Board using Bluetooth and Raspberry Pi is based on enabling remote communication between a smartphone, tablet, or computer and the notice board through Bluetooth technology. The Raspberry Pi acts as the core processing unit and displays information on an electronic screen, such as an LED display. The system is designed to be both smart (for ease of updating and customization) and cost-effective. Bluetooth Communication: The Raspberry Pi is equipped with a Bluetooth module (either onboard or through an external HC-05/HC-06 Bluetooth module). The smartphone, tablet, or PC communicates wirelessly with the Raspberry Pi via Bluetooth. The user can send a message or notice from the device to the Raspberry Pi. User Interface: A Bluetooth app is on the smartphone app store or computer for sending text messages. This could be a simple Bluetooth terminal app or a more complex one with a user friendly interface where text can be typed and sent to the Raspberry Pi. Raspberry Pi Reception: When the Raspberry Pi receives the Bluetooth signal, it decodes the data (the text or message) sent from the smart phone or tablet. The Raspberry Pi uses Python scripts to handle the Bluetooth connection and manage incoming messages. Python's Py Bluez or Bluetooth libraries are commonly used for this purpose. Message Display: Once the message is received, the Raspberry Pi processes the data and displays it on the attached display (LED). Depending on the display, the message can be shown in a scrolling fashion (for LED displays) or in static text on a larger screen.

3. FLOWCHART

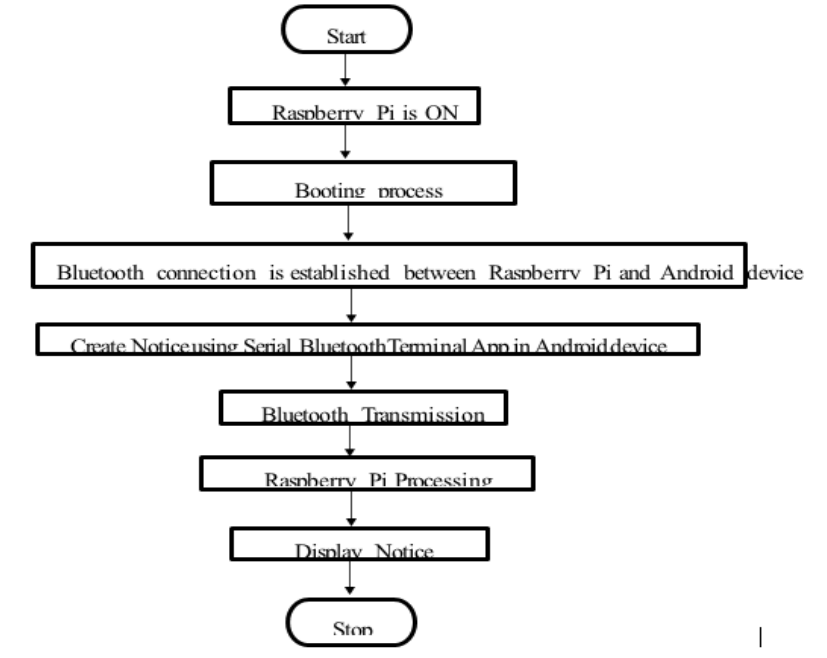

FIGURE 5. Flowchart

Description: The system begins with the powering on of the Raspberry Pi, which then begins its standard booting process to load the operating system and necessary background services. After the system is fully operational, a Bluetooth connection is established between the Raspberry Pi and an Android device. This connection serves as the primary communication channel for transmitting data. Once the connection is successful, the user interacts with a Android application which is Serial Bluetooth Terminal Application to create a digital notice or message. This notice is prepared within the app's interface and, upon submission, is transmitted via Bluetooth to the Raspberry Pi. Upon receiving the notice, the Raspberry Pi processes the incoming data to ensure it is correctly formatted and ready for display. After processing, the notice is displayed on an appropriate output device, such as an electronic display board connected to the Raspberry Pi.

4. HARDWARE DESCRIPTION

RASPBERRY PI

FIGURE 6. Raspberry Pi

Raspberry Pi, developed by Raspberry Pi Foundation in association with Broadcom, is a series of small single-board computers and perhaps the most inspiring computer available today. From the moment you see the shiny green circuit board of Raspberry Pi, it invites you to tinker with it, play with it, start programming, and create your own software with it. Earlier, the Raspberry Pi was used to teach basic computer science in schools but later, because of its low cost and open design, the model became far more popular than anticipated. It is widely used to make gaming devices, fitness gadgets, weather stations, and much more. But apart from that, it is used by thousands of people of all ages who want to take their first step in computer science. It is one of the best-selling British computers and most of the boards are made in the Sony factory in Pencoed, Wales. Generations and Models: In 2012, the company launched the Raspberry Pi and the current generations of regular Raspberry Pi boards are Zero, 1, 2, 3, and 4. Generation 1 Raspberry Pi had the following four options: Model A, Model A +, Model B, Model B +, Among these models, the Raspberry Pi B models are the original credit-card sized format. On the other hand, the Raspberry Pi A models have a smaller and more compact footprint and hence, these models have the reduced connectivity options. Raspberry Pi Zero models, which come with or without GPIO (general-purpose input output) headers installed, are the most compact of all the Raspberry Pi boards types. USES Like a desktop computer, you can do almost anything with the Raspberry Pi. You can start and manage programs with its graphical windows desktop. It also has the shell for accepting text commands. We can use the Raspberry Pi computer for the following: Playing games, Browsing the internet, Word processing, Spreadsheets, editing photos, paying bills online, Managing your accounts. The best use of Raspberry Pi is to learn how a computer works. You can also learn how to make electronic projects or programs with it. It comes with two programming languages, Scratch and Python. Through GPIO (general purpose input output) pins, Raspberry Pi can be connected to other circuits, so that you can control the other devices of your choice. Raspberry Pi — Configuration: Raspbian configuration For configuring Raspberry Pi in Raspbian, we are using Raspbian with PIXEL desktop. It is one of the best ways to get Raspbian started with the Raspberry Pi. Once we finish booting, we will be in the PIXEL desktop environment. Now to open the menu, you need to click the button that has the Raspberry Pi logo on it. This button will be in the top left. After clicking the button, choose Raspberry Pi configuration from the preferences. Configuration tool Following is the configuration tool in PIXEL desktop:

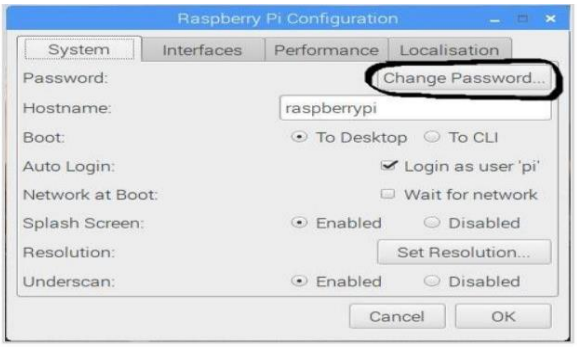

FIGURE 7.

By default, the configuration tool opens to its system tab which has the following options: Change Password: The default password is raspberry. You can change it by clicking the change password button. Change the hostname: The default name is raspberry pi. You can also change it to the name, which you want to use on the network. Boot: You can choose from the two options and control whether Raspberry Pi boots into the desktop or CLI i.e., command line interface. Auto Login: With the help of this option, you can set whether the user should automatically log in or not. Network at Boot: By choosing this option, you can set whether the pi user is automatically logged in or not. Splash screen: You can enable or disable it. On enabling, it will display the graphical splash screen that shows when Raspberry Pi is booting. Resolution: With the help of this option, you can configure the resolution of your screen. Under scan: There are two options, enable or disable. It is used to change the size of the displayed screen image to optimally fill the screen. If you see a black border around the screen, you should disable the under scan. Whereas, you should enable the under scan, if your desktop does not fit your screen. There are three other tabs namely Interfaces, Performance, and Localization. The job of interface tab is to enable or disable various connection options on your Raspberry Pi. You can enable the Pi camera from the interface tab. You can also set up a secure connection between computers by using SSH (short for Secure Shell) option. If you want to remote access your Pi with a graphical interface then, you can enable Real VNC software from this tab. SPI, I2C, Serial, 1-wire, and Remote GPIO are some other interfaces you can use. There is another tab called Performance, which will give you access to the options for overclocking and changing the GPU memory. The localization tab, as the name implies, enable us to set: The character set used in our language. Our time zone. The keyboard setup as per our choice. Our Wi-Fi country. Data Partition Setup: As we know that data partition is that area on your memory card (SD or MicroSD) which can be shared by various distributions. One of the best examples of use of a data partition is transferring the files between distributions. The data partition has the label data. You can use this labelled data to make a directory point to it as follows: Step 1: First, you need to boot the Raspberry Pi into Raspbian. Step 2: Now, click the Terminal icon to get to the command line. Step 3: Next, type the command mkdir shared. It will create a directory named shared. Step 4: Write the command sudo mount -L data shared. This command will point the directory to the shared partition. Step 5: Write the command sudo chown $USER: shared. It will set the permission for writing in this shared folder. Step 6: Now, to go to this shared folder, you need to type the command cd shared. Once all the files are created in this shared folder, they will be available to all the distributions that have the permission to access the data partition.

RASPBERRY PI 3 MODEL B+:

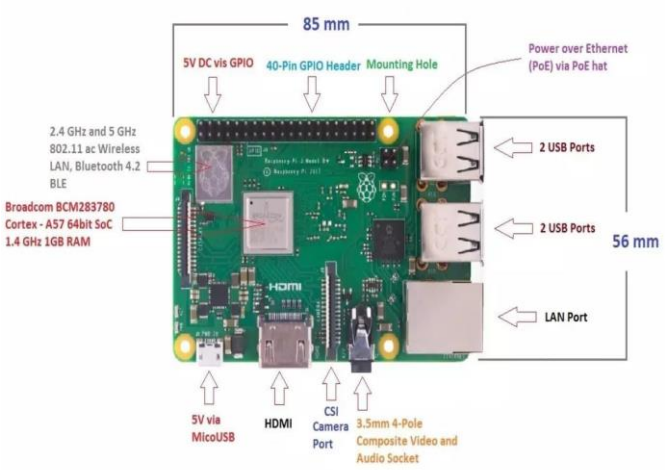

FIGURE 8. Raspberry Pi 3 Model B+

In this project Raspberry pi 3 model b+ is used. So the detailed overview of raspberry pi is given below. Raspberry Pi 3 B+ was introduced by Raspberry Pi foundation on 14th March 2018. It is an advanced version of Raspberry Pi 3 B model that was introduced in 2016.It is a tiny computer board that comes with CPU, GPU, USB ports, I/O pins, Wi-Fi, Bluetooth, USB and network boot and is capable of doing some functions like a regular computer. Features of the B+ version are almost same as B model; however, USB and Network Boot and Power over Ethernet facility only come with B+ model. Also, two extra USB ports are added to this device. The SoC (system on chip) combines both CPU and GPU on a single package and turns out to be faster than Pi 2 and Pi 3 models. Improvements The model B+ stays ahead in terms of processing speed and comes with an improved wireless capability. The dual-band Wi-Fi 802.11ac runs at 2.4GHz and 5GHz and provides a better range in wireless challenging environments and Bluetooth 4.2 is available with BLE support. The top side is painted with metal shielding, instead of plastic in the earlier models, that acts as a heat sink and drains the excessive amount of heat if the board is subjected to the high temperature or pressure. This B+ model is three times faster than Pi 2 and 3 which is a major development in terms of speed, capable of executing different functions at a decent pace. The ethernet port comes with 300 Mbit/s which is much faster than earlier version with 100 Mbit/s speed. It is known as gigabit ethernet based on USB 2.0 interface. Four pin header is added on the board that resides near 40 pin headers. This allows the Power over Ethernet (PoE) i.e. provides the necessary electrical current to the device using data cables instead of power cords. It is very useful and reduces the number of cables required for the installation of a device in the relevant project. PoE works only in the presence of PoE hat.

Raspberry Pi 3 B+ Pinout

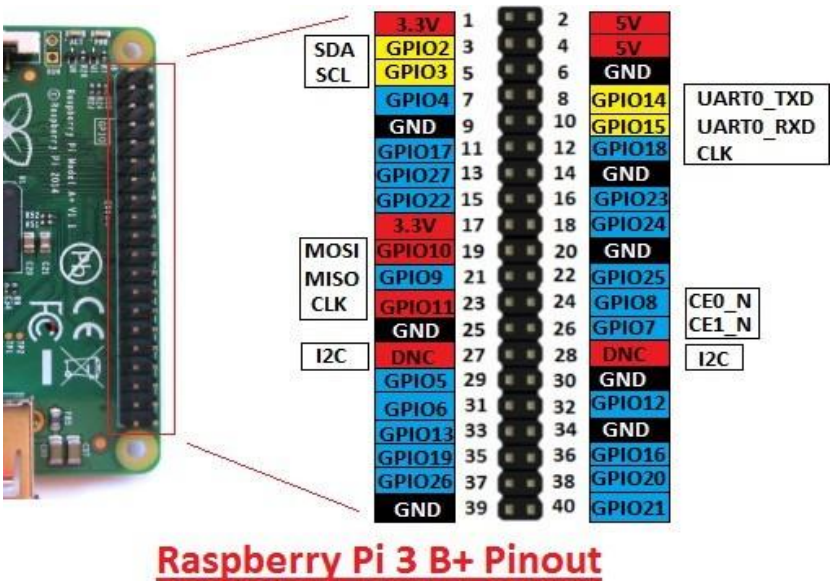

FIGURE 9. Raspberry Pi 3 B+ Pinout

40 Pin header is used to develop an external connection with the electronic device. This is the same as the previous versions, making it compatible with all the devices where older versions can be used. Out of 40 pins, 26 are used as a digital I/O pin and 9 of the remaining 14 pins are termed as dedicated I/O pins which indicate they don't come with alternative function. Pin 3 and 5 comes with an onboard pull up resistor which 1.8 kO and Pin 27 and 28 are dedicated to ID EEPROM. In B+ model the GPIO header is slightly repositioned to allow more space for the additional mounting hole. The devices that are compatible with the B model may work with the B+ version; however, they may not sit identically to the previous version. Hardware Specifications CPU: The CPU is a brain of this tiny computer that helps in carrying out a number of instructions based on the mathematical and logical formulas. It comes with a capacity of 64 bit. Clock Speed and RAM: It comes with a clock speed of 1.4 GHz Broadcom BCM2837B0 that contains quad-core ARM Cortex-A53 and RAM memory is around 1GB (identical to the previous version) GPU: It stands for graphics processing unit, used for carrying out image calculation. Broadcom video core cable is added in the device that is mainly used for playing video games. USB Ports: Two more USB ports are introduced in this new version, setting you free from the hassle of using an external USB hub when you aim to join a number of peripherals with the device. Micro USB Power Source Connector: This connector is used for providing 5V power to the board. It draws 170 to 200mA more power than B model. HDMI and Composite Connection: Both audio output socket and video composite now reside in a single 4-pole 3.5mm socket which resides near HDMI. And the power connector is also repositioned in new B+ model and lives next to HDMI socket. All the power and audio video composite socket are now placed on the one side of the PCB, giving it a

clean and precise look. USB Hard Drive: The USB hard drive is available on the board that is used to boot the device. It is identical to the hard drive of regular computer where windows is used to boot the hard drive of the computer. PoE: B+ model comes with a facility of Power over Ethernet (PoE); a new feature added in this device which allows the necessary electrical current using data cables. Other Changes: The B+ version comes with little improvement in the features and poses slightly different layout in terms of location of the components. The SD memory slot is replaced by a micro SD memory card slot (works similar to the previous version). The status LEDs now only contain red and green color and relocated to the opposite end of the PCB.

5. RASPBERRY PI TECHNICAL SPECIFICATIONS

Raspberry Pi 3 B+ Technical Specifications : CPU is 64 bit with 1GB RAM (random access memory), Contains Broadcom BCM2837B0 chipset, Comes with 1.4GHz Quad-Core ARM Cortex-A53, 4 cores, Consists of 40 pin header (26 GPIOs), Stereo audio and composite video are supported by 3.5mm jack connector, 4 USB 2.0 ports, Gigabit Ethernet, PoE (power over Ethernet) is a major feature incorporated in this device that lacks in B Model, 2-pin reset header, Micro SD socket, used to enhance the memory capacity of the board, Micro USB power connector, used for transferring power to the device, HDMI, CSI camera interface, Comes with Wi-Fi and Bluetooth facility that were not present in previous Raspberry Pi 1 and 2 versions, DSI connector for official screen, The mechanical dimensions of this B+ are same as B version i.e. 85mm x 56mm. (Width x Height),

RASPBERRY PI PIN DIAGRAM

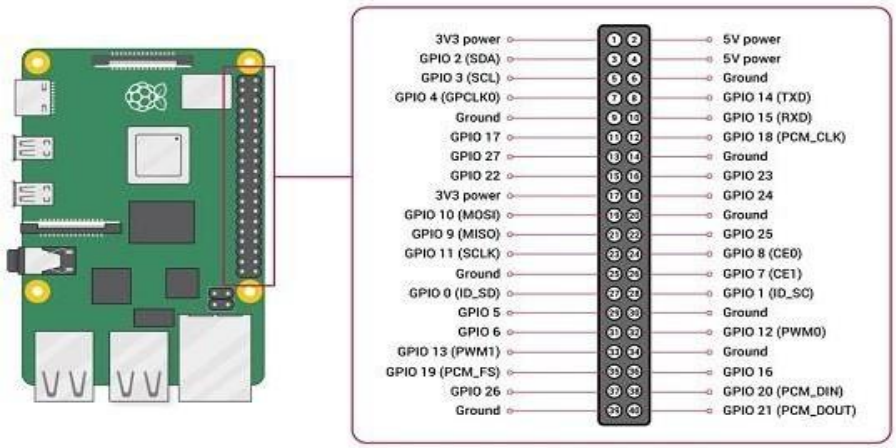

FIGURE 10. Raspberry Pi Pin Diagram

Ground pins: The ground is very useful for making a common reference between all components in your circuit. Always remember to connect all components to the ground. If you connect 2 circuits together, add a wire between both grounds to make it common. If you add a new sensor/actuator to an existing circuit, connect the ground of the component to the ground of the circuit. That's very important. Without that, you may burn some parts of the circuit, you may have components that do not function correctly, give wrong values, etc. 8 out of the 40 GPIOs are connected to the ground. You can find them with the 3 letters GND. One additional warning: don't ever connect the ground directly to a power supply pin (3.3V or 5V)! This creates a short circuit and can definitively burn your Raspberry Pi 4 board. Power pins: You can find 2 pins bringing 3.3V and 2 pins bringing 5V. Those pins can be used to power components such as sensors or small actuators. Note that they are certainly not powerful enough to actuate motors such as servo or stepper motors. For that you'll need an external power source. The power pins are used as a source to power external components, not to power the Raspberry Pi itself from an external source. (Well there is a way to power the Raspberry Pi from the GPIO header, but you have a high probability of burning it, so just use the micro-USB port) And just another word of caution: as previously said in the Ground pins section, don't ever connect one of the power pin directly to one of the GND of the Raspberry Pi 4! Reserved pins: The pins 27 and 28 are reserved pins. They are usually used for I2C communication with an EEPROM.

If you just begin with Raspberry Pi 4 pins, just don't connect anything to those pins. There are many other available pins for you to use. Well, that's 14 slots already taken for GND, power supply and reserved pins. Now let's see how the other 26 GPIOs are used for communication. Raspberry Pi 4 GPIOs: GPIO means General Purpose Input/Output. Basically,

that's one pins you can use to write data to external components (output), or read data from external components (input). If you embed your Raspberry Pi board with some hardware components, the GPIO header will become quite useful. GPIOs will allow you to read some basic sensors (ex: infrared), control some actuators (those which are working with a ON/OFF mode), and communicate with other hardware boards, such as Raspberry Pi, Arduino, Beagle bone, Jetson Nano, etc. GPIOs are digital pins: The Raspberry Pi 4 GPIOs are quite similar to what we call "digital pins" on an Arduino board. First you need to choose whether you want to use them as input or output. If you configure a GPIO as input, you'll be able to read a value from it: HIGH or LOW (1 or 0). And if you configure a GPIO as output, you'll be able to write a value to it, also HIGH or LOW.

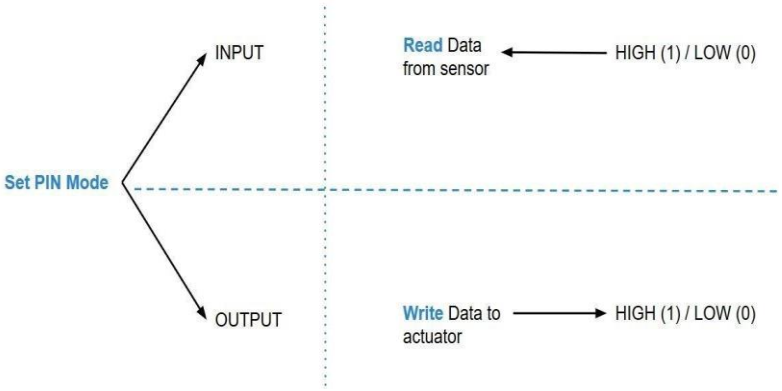

FIGURE 11.

A digital pin has only two states. LOW usually means 0V, and HIGH means 3.3V (with some tolerances). That's very simple, it's like a switch that you turn on and off. GPIOs voltage: All GPIOs work at 3.3V. It's important for you to know that, in case you need to plug in a component with a different voltage. Sometimes, you'll find sensors that are powered with 5V, but all the communication pins are running with 3.3V. In this case, no problem: you can use the 5V power pin from the Raspberry Pi to power the component, and then use any 3.3V GPIO for the communication. If you don't mix the 5V signal with the 3.3V signals, everything should be alright. Now if you need to make your Raspberry Pi 4 GPIOs communicate with 5V pins directly (ex: Arduino Uno or Mega), you'll need to use a 3.3V to 5V level shifter. You can either buy one or build one yourself.

How to use GPIOs

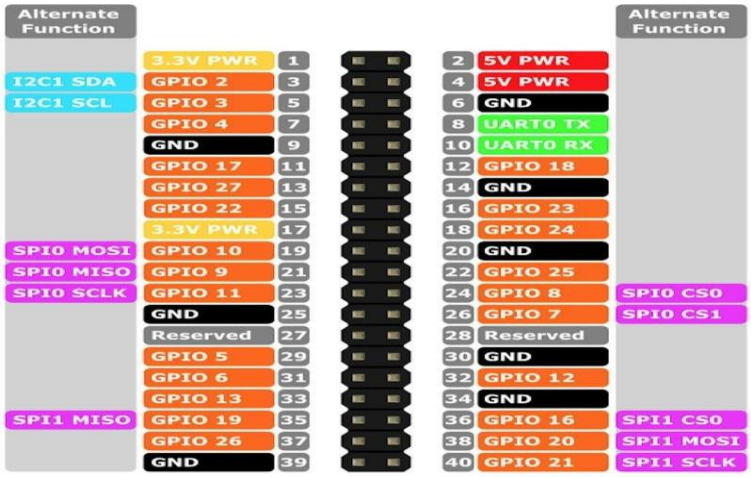

FIGURE 12.

To use a GPIO, first you need to know its number. As you can see, the pin numbers and GPIO numbers are different. Pin numbers are in grey, and GPIO numbers in orange. Depending on the library you use to manipulate GPIOs, you'll either have to use the number of the pin or the GPIO number. For example, pin 29 corresponds to GPIO 5. Any time you have a doubt, just check the pinout again and you'll know! So, to use any of those GPIO, first you need to configure it as input or output, and after that you can write to it, or read from it. Now, you might wonder: how can you configure and use the

GPIOs from your code? Do you need to dive into complex hardware stuff to do that? Well, good news for you. There are at least 2 libraries that will allow you to easily use those pins. For Python, you can use RPi. GPIO, and for Cpp you can use Wiring Pi. Communication protocols through Raspberry Pi 4 pins: You can use some hardware communication protocols directly with the Raspberry Pi 4 GPIOs. Those communication protocols are in fact the same ones that you can natively use on many Arduino boards. With those protocols you'll be able to transfer far more information than with just a bunch of GPIOs configured as digital pins. On the Raspberry Pi 4 pinout schematics, you can see a column for alternate functions. Well, the communication protocols are all there! In fact, saying that a GPIO is a digital pin is an overly exaggerated simplification. It's much more than that. For each GPIO you have at least one alternate function, and sometimes many more. UART: UART is multi master communication protocol. This protocol is quite easy to use and very convenient for communicating between several boards: Raspberry Pi to Raspberry Pi, or Raspberry Pi to Arduino, etc.

FIGURE 13.

For using UART you need 3 pins: GND that you'll connect to the global GND of your circuit. RX for Reception. You'll connect this pin to the TX pin of the other component. TX for Transmission. You'll connect this pin to the RX of the other component. If the component you're communicating with is not already powered, you'll also have to use a power pin (3.3V or 5V) to power on that component. By using a UART to USB converter, you can communicate between your laptop and Raspberry Pi with UART. Now, to use UART in your code, you can use the Serial library in Python, and WiringPi in Cpp. If you're interested in communicating between a Raspberry Pi board and an Arduino board via Serial,

I2C: I2C is a master-slave bus protocol (well it can have multiple masters but you'll mostly use it with one master and multiple slaves). The most common use of I2C is to read data from sensors and actuate some components. The master is the Raspberry Pi, and the slaves are all connected to the same bus. Each slave has a unique ID, so the Raspberry Pi knows which component it should talk to.

FIGURE 14.

For using I2C you'll need 3 pins: GND: I guess you start to get used to that! SCL: clock of the I2C. Connect all the slaves SCL to the SCL bus. SDA: exchanged data. Connect all the slaves SDA to the SDA bus. And as most of the time you'll need to power on the component, you'll also need a power pin (3.3V or 5V), linked to the Vcc pin of the component. Make sure you know which voltage is accepted by the component before you plug anything. But don't worry too much though: usually, hobby components will accept 3.3V and/or 5V. Note that the SDA and SCL pins on the Raspberry Pi are alternate functions for GPIO 2 and 3. When you use a library (Python, Cpp, etc) for I2C, those two GPIOs will be configured so they can use their alternate function. Some of the best and easy-to-use libraries for I2C are SM Bus for Python and Wiring Pi for Cpp.

SPI: SPI is yet another hardware communication protocol. It is a master-slave bus protocol. It requires more wires than I2C, but can be configured to run faster. So, when to use I2C vs SPI on your Raspberry Pi 4? Well, the answer is quite simple. Sometimes you'll find a sensor that is only I2C or SPI compatible. And sometimes, you'll just want to have a balance between those protocols, so for example you'll choose to use I2C if you already have many components using the SPI. As you progress you'll start to know the differences better, and be able to make a better choice between those two protocols. But for now, let's keep things simple.

FIGURE 15.

For using SPI you'll need 5 pins: GND: what a surprise! Make sure you connect all GND from all your slave components and the Raspberry Pi together. SCLK: clock of the SPI. Connect all SCLK pins together. MOSI: means Master Out Slave In. This is the pin to send data from the master to a slave. MISO: means Master In Slave Out. This is the pin to receive data from a slave to the master. CS: means Chip Select. Pay attention here: you'll need one CS per slave on your circuit. By default, you have two CS pins (CS0 – GPIO 8 and CS1 – GPIO 7). You can configure more CS pins from the other available GPIOs.

SMPS: SMPS stands for Switch-Mode Power Supply, which is a type of power supply that uses switching electronics to regulate the output voltage. SMPS is more efficient, compact, and reliable compared to traditional linear power supplies. Specifications: 5V 20A, Output Voltage: 5V (nominal), Output Current: 20A (maximum), Power Rating: 100W (5V x 20A)

FIGURE 16. SMPS

Features: High Efficiency: SMPS has high efficiency (typically >80%) due to the use of switching electronics, which reduces heat generation and energy losses. Compact Size: SMPS is designed to be compact and lightweight, making it ideal for space-constrained applications. Low Noise: SMPS typically produces low noise and ripple, making it suitable for sensitive electronic equipment. Short-Circuit Protection: SMPS often includes built-in short-circuit protection, which prevents damage to the power supply and connected equipment. Over-Voltage Protection: SMPS may also include over-voltage protection, which prevents damage from voltage spikes or surges. P10 LED BOARDS: A P10 LED board is a type of LED display module that consists of a matrix of LEDs arranged in a 16x16 or 32x16 grid. The "P10" designation refers to the pixel pitch, which is 10mm.

FIGURE 17. P10 LED Boards Features

High-Brightness LEDs: P10 LED boards use high-brightness LEDs that provide excellent visibility even in daylight. High-Resolution Display: The 16x16 or 32x16 grid of LEDs provides a high-resolution display for text, images, and videos. Scalability: P10 LED boards can be easily connected together to form larger displays. Low Power Consumption: P10 LED boards consume relatively low power, making them suitable for battery-powered applications. WORKING PRINCIPLE: LED Matrix: The P10 LED board consists of a matrix of LEDs, with each LED representing a pixel. Driver ICs: The LED matrix is controlled by driver ICs, which receive data from a microcontroller or computer. Data Transmission: The driver ICs receive data in the form of serial or parallel signals, which are then decoded and sent to the LED matrix. LED Control: The driver ICs control the LEDs, turning them on or off to display the desired image or text. CONTROL METHODS: Serial Communication: P10 LED boards can be controlled using serial communication protocols such as SPI, I2C, or UART. Parallel Communication: Some P10 LED boards can be controlled using parallel communication protocols, which provide faster data transfer rates. Microcontroller Interface: P10 LED boards can be directly interfaced with microcontrollers such as Arduino or Raspberry Pi.

FRC CABLES: An FRC cable, also known as a flat ribbon cable, is a type of cable that consists of multiple insulated wires or circuits placed side by side in a flat, ribbon-like configuration.

FIGURE 18. FRC Cable

Construction:

Insulated Wires: FRC cables consist of multiple insulated wires, each with its own conductor and insulation. Flat Configuration: The insulated wires are placed side by side in a flat configuration, forming a ribbon-like structure. Reinforcement: Some FRC cables may have a reinforcement material, such as a polyester or fiberglass tape, to add strength and stability. WORKING: Signal Transmission: FRC cables transmit signals between devices, such as computers, peripherals, and other electronic equipment. Data Transfer: FRC cables can transfer data at high speeds, making them suitable for applications such as data storage, networking, and more. Connectivity: FRC cables provide connectivity between devices, enabling communication, data transfer, and control. Types of FRC Cables: IDE FRC Cables: Used for connecting IDE devices, such as hard drives and CDROM drives. SATA FRC Cables: Used for connecting SATA devices, such as hard drives and solid-state drives. USB FRC Cables: Used for connecting USB devices, such as printers, scanners, and external hard drives. SERIAL CONNECTORS: Serial Connectors in P10 LED Boards: P10 LED boards typically use serial connectors to receive data from a controller, such as a Raspberry Pi. The most common serial connectors used in P10 LED boards are: JST SM 4-Pin Connector: A 4-pin connector that carries the clock, data, ground, and power signals. JST XH 4-Pin Connector: A 4-pin connector that carries the clock, data, ground, and power signals. Serial Connectors in Raspberry Pi: Raspberry Pi boards have several serial connectors that can be used to connect to P10 LED boards: UART (Serial Console) Connector: A 3-pin or 4-pin connector that carries the TX, RX, GND, and sometimes VCC signals. SPI Connector: A 4-pin or 6-pin connector that

carries the MOSI, MISO, SCK, and sometimes GND and VCC signals. Connection Between P10 LED Board and Raspberry Pi: To connect a P10 LED board to a Raspberry Pi, you'll need to: Match the serial connector: Ensure the serial connector on the P10 LED board matches the one on the Raspberry Pi. Connect the signals: Connect the clock, data, ground, and power signals from the Raspberry Pi to the corresponding pins on the P10 LED board. Configure the Raspberry Pi: Configure the Raspberry Pi to use the serial interface and send data to the P10 LED board.

MICRO SD CARD: A MicroSD card is a type of removable flash memory card used to store data in devices such as smart phones, tablets, cameras, and more.

FIGURE 19. Micro SD Card

Characteristics: Small size: Micro SD cards are extremely small, measuring 15mm x 11mm x 1mm. High storage capacity: MicroSD cards are available in various storage capacities, ranging from a few gigabytes to several hundred gigabytes. Fast data transfer: MicroSD cards support fast data transfer speeds, with some cards reaching speeds of up to 100MB/s. Types of MicroSD Cards: MicroSD: The standard microSD card, suitable for most devices. Micro SDHC (High Capacity): Supports storage capacities up to 32GB. Micro SDXC (Extended Capacity): Supports storage capacities up to 2TB. Micro SDUC (Ultra Capacity): Supports storage capacities up to 128TB. Uses: Smartphones and tablets: MicroSD cards are used to expand storage capacity in mobile devices. Cameras: MicroSD cards are used to store photos and videos in cameras. Raspberry Pi and other single-board computers: MicroSD cards are used as the primary storage device. Gaming consoles: MicroSD cards are used to store games and data in gaming consoles.

6. SOFTWARE DESCRIPTION

Raspbian OS: Raspbian OS (also known as Raspberry Pi OS), a Linux-based operating system tailored for the Raspberry Pi's hardware. This OS not only handles the booting process but also provides the necessary run-timeruntime environment and built-in support for essential services such as Bluetooth communication, system control, and interfacing with hardware peripherals like the display. Its lightweight design and comprehensive support for various programming tools make it an ideal choice for embedded projects. Python: Python is a powerful and beginner-friendly programming language widely used in IoT, automation, and embedded systems due to its readability and extensive library support. Renowned for its simplicity and extensive library support, Python is used extensively for establishing Bluetooth connections, receiving messages from the Android device, processing this data, and controlling the display output. The development involves several Python libraries such as pybluez (or the bluetooth module), which handles the Bluetooth communication, as well as standard modules like OS, sub-process, and time to facilitate system commands and timing functions. Additionally, depending on the display technology used (for example, an LCD or LED matrix), other specialized libraries such as RPi.GPIO or third-party modules like Adafruit_CharLCD might be employed to manage screen output effectively. The use of Python programming language in this project offers several significant advantages that contribute to the overall simplicity, flexibility, and effectiveness of the Bluetooth-based wireless notice board system. Python is well known for its clean syntax and easy-to-read code structure, which makes it particularly suitable for students and developers working on embedded and IoT projects. This readability accelerates development time and reduces the chances of coding errors, making debugging and maintenance much easier. One of the biggest advantages of Python is its rich collection of libraries and community-supported modules. For this project, libraries like pybluez (or bluetooth) are used to enable Bluetooth communication, allowing the Raspberry Pi to receive data from the Android device effortlessly. Additionally, libraries for handling GPIO pins, displays, and file systems are readily available and well-documented. This eliminates the need for writing complex low-level code, allowing the developer to focus more on application logic than hardware interfacing. Python is also platform-independent, which means that the code written for the Raspberry Pi can often be tested on other operating systems like Windows or Linux before deployment. Its compatibility with Raspbian OS ensures seamless integration, as Python comes pre-installed on most Raspberry Pi distributions, with easy access to the command line and scripting environments. Furthermore, Python scripts are interpreted rather than compiled, making real-time code updates and testing faster—an important advantage during the development and testing phases of the project. Another noteworthy benefit is Python's community support and online resources. Whether it's troubleshooting an error, finding examples for Bluetooth communication, or exploring new ways to display text on an LCD or LED screen. This support significantly reduces the learning curve and helps in overcoming project roadblocks efficiently.

7. INSTALLATIONAND CONNECTION

Before going to connect to the app first connect your PC or Desktop to the Raspberry Pi using Ethernet cable or HDMI cable. Firstly, check the IP address of desktop or laptop- The IP address should be in the format of 192.168.0.10 or 192.168.0.12, etc. in the system. Then download the VNC viewer application

FIGURE 20.

Then a window will be opened on the screen. Then create an account in that window. Type the IP address 192.168.0.10 in the search bar. Then a window will be opened on the screen.

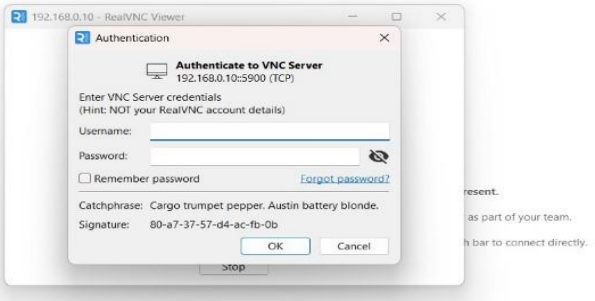

FIGURE 22.

The opened window which will ask the username that is pi and password is raspberry. Then a fresh Desktop window will be opened on the screen. There will be a Bluetooth symbol on the top right corner. Click on the Bluetooth symbol and add Bluetooth devices that you want to connect to the raspberry pi.

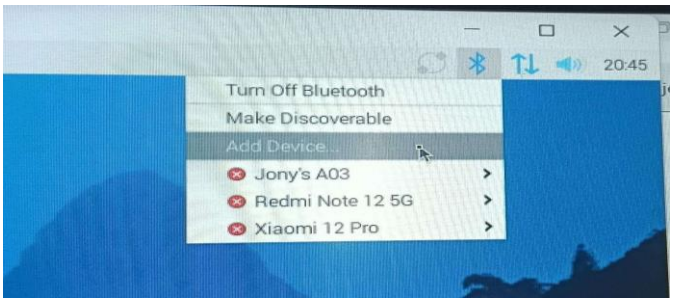

FIGURE 23.

After adding the devices Download the Serial Bluetooth Terminal App available in the Play store app in the Android Phone The serial terminal app is shown below After downloading the app, turn on Bluetooth in the Android Phone and connect to the Raspberry piaster the app is open you will able to see the below images. Figure says that go to devices and check whether raspberry pi connected or not. After connecting open the Bluetooth Terminal App in the Android Phone and then connect to raspberry pi as shown in After connecting, it displays as raspberry is connected in the app and then wait for some time until it displays as “LED DISPLAY IS READY”.

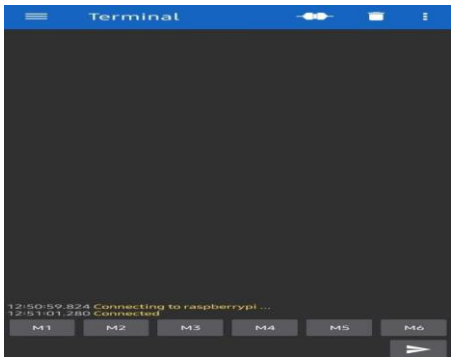

FIGURE 24.

After displaying, type a text that need to display on the LED Board in the Bluetooth Terminal App including "@" symbol at starting of the text and "$" symbol at ending of the text. For example: @ ECE DEPARTMENT $. Once you send the message it will receive by the Raspberry pi and send it to the LED Board and then it will display on the Screen and until you change it again it will display the same message on the Screen.

FIGURE 25. Process Image of the Project

8. RESULTS

The Android-based smart notice board using Raspberry Pi successfully displays notices sent from an Android device via Bluetooth. ADVANTAGES: Easy to use and reduces man power. No need to connect notice board to PC to update the message Safe and secured It is echo friendly; with this we can eliminate usage of paper. It offers flexibility and scalability for future enhancements. **Applications:** Educational institutions (colleges, schools). Offices and corporate buildings. Public spaces (railway stations, bus stands, etc.). Hospitals, malls, and community centers.

9. CONCLUSION

The Smart and Cost-Effective Wireless Electronic Notice Board using Bluetooth and Raspberry Pi is an innovative, practical, and affordable solution for displaying dynamic information in various settings, such as educational institutions, offices, public spaces, and more. By leveraging the capabilities of Bluetooth for wireless communication and the versatility of Raspberry Pi as a central processing unit, this system eliminates the need for costly, complex infrastructure and traditional wired setups. This wireless electronic notice board offers a compelling balance of simplicity, cost efficiency, and functionality, making it an ideal choice for both personal and commercial use, where budget constraints and flexibility are key considerations. A Wireless Smart Notice Board based on Bluetooth and Raspberry Pi is an affordable solution for displaying information remotely. The system provides an easy way to send and display messages on an electronic board wirelessly, making it an excellent option for schools, offices, or other public spaces. With a few lines of code and low-cost hardware, the setup can be scalable and smart. **Future Scope**: The future scope for Android-based smart and cost-effective wireless notice boards looks very promising due to the increasing adoption of smart technologies, connectivity, and the growing demand for efficient communication solutions. Let's break it down into key areas of development and expansion: Integration with IoT (Internet of Things). Enhanced Connectivity: By integrating the notice board with IoT, wireless notice boards can receive real-time updates and notifications from multiple sources

(e.g., mobile phones, cloud platforms, etc.). Automation and Smart Scheduling: Using sensors and smart algorithms, the notice board could display messages automatically based on time, location, or priority. For instance, it could update content based on a set schedule or trigger messages when certain events occur (e.g., class start time, upcoming meetings, etc.). Cost Reduction and Accessibility: Affordable Displays: The development of more affordable and energy-efficient display technologies (e.g., e-ink screens) would make wireless notice boards even more cost effective and sustainable. Low Power Consumption: Utilizing wireless technologies like Bluetooth Low Energy (BLE) or Wi-Fi Direct could further reduce the operating costs and make these notice boards suitable for a wide range of environments (schools, offices, public places). Cloud Integration and Remote Management Cloud-based Content Management: Android-based wireless notice boards could be integrated with cloud services, allowing content to be updated and managed remotely via an app or web portal. Administrators can send updates from any device without being physically present near the board. Multi-location Management: A central server could manage multiple notice boards in different locations. For example, a school or organization could have wireless notice boards in various departments, and all can be updated simultaneously from a single device or platform. Interactive Features and User Engagement: Touchscreen Functionality: In addition to displaying notices, the system could include touch-interactive screens, allowing users to interact with the content (e.g., tap to get more information, scroll through announcements, or even respond to messages). Feedback Mechanisms: The boards could integrate user feedback features, such as surveys or polls, which could be useful in educational institutions or corporate settings. Security and Privacy: Secure Wireless Communication: With increasing reliance on wireless technologies, ensuring that data transmitted to and from the notice board is secure is essential. Strong encryption and secure communication protocols would be crucial to prevent unauthorized access. Access Control: For managing content, the system could have different access levels to ensure that only authorized personnel can modify the displayed information. Customization and Content Variety: Dynamic Content: Rather than static notices, the system could allow for dynamic content such as videos, images, live feeds, and animations. This could make the boards more engaging and informative. Localized Content: Android-based notice boards could display information in multiple languages based on user location or preferences, increasing their versatility in diverse environments. Applications in Various Industries: Educational Institutions: Schools and colleges can use wireless notice boards for announcements, event schedules, class changes, etc. The Android app could allow teachers and students to contribute and manage content. Corporate Offices: In office environments, they can serve as communication hubs, displaying HR updates, meeting schedules, and internal notices. They can also be integrated with company calendars and workflows. Public Spaces: These could be installed in public areas such as airports, malls, and train stations to display real-time information such as schedules, announcements, and news. Healthcare: Hospitals can use them to display patient instructions, announcements, or news updates for visitors and staff. Advanced Features: Voice Integration: Integration with voice assistants (e.g., Google Assistant) could allow users to query the board for specific announcements or news by voice command. Real-time Data Display: For example, displaying live weather updates, traffic conditions, or news feeds based on the location and time. Sustainability: Environmentally Friendly: As more emphasis is placed on sustainability, Android based wireless notice boards can use energy-efficient displays like e-ink, which consume very little power, making them eco-friendly. Recyclable Materials: The construction of the notice boards could incorporate recyclable materials, further contributing to sustainability.

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