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Design And Implementation Of Wireless Electronic Menu System

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ABSTRACT:

The Wireless Electronic Menu (EWM) System revolutionizes traditional restaurant operations by replacing paper-based menus with a digital, interactive ordering system. Traditional menus require frequent reprinting due to updates in food offerings, leading to increased costs and paper waste. Additionally, the manual order-taking process is prone to human error, often resulting in miscommunication between customers, wait staff, and the kitchen, affecting order accuracy and service speed. The EWM system offers a streamlined solution by enabling customers to place orders directly through an intuitive digital interface at their tables. This direct interaction minimizes human error and reduces communication delays, ensuring faster service and improved order accuracy. Orders are transmitted wirelessly using LoRa technology, which enhances efficiency and reliability. Operationally, the EWM system reduces staffing needs for order taking, allowing staff to focus on higher-value tasks like customer service and food preparation. This not only improves efficiency but also lowers operational costs associated with printing and updating physical menus. The digital approach also aligns with sustainability initiatives by reducing paper waste and promoting eco-friendly practices. Dynamic digital menus allow seamless updates without additional printing costs, contributing to a greener environment. Overall, the EWM system enhances the dining experience by providing a faster, more accurate, and environmentally conscious alternative to traditional menus. It modernizes restaurant management,

offering benefits such as cost savings, improved staff productivity, and a positive impact on the environment, setting a new standard for efficiency and customer satisfaction in the restaurant industry.

INTRODUCTION:

In today's dynamic dining landscape, efficiency and customer experience are paramount. The Wireless Electronic Menu System is designed to revolutionize the ordering process by replacing traditional paper menus with a fully digital, interactive solution. This system harnesses advanced microcontroller technology, robust wireless communication, and intuitive user interfaces to streamline order placement and processing in real time. At its core, the system leverages the capabilities of the ESP32 microcontroller, which not only manages the digital display and input from a keypad and switches but also supports wireless connectivity.

This connectivity is enhanced by the integration of LoRa transceivers, ensuring that orders are reliably transmitted from the customer interface to the kitchen or central server. The inclusion of a USB-to-serial converter, based on the CH340 chip, further facilitates system configuration, debugging, and seamless integration with external computing devices. Additionally, the system features a dedicated buzzer and driver circuit that provides clear audible feedback, enhancing user interaction and ensuring prompt acknowledgment of inputs. A well-designed power supply network, incorporating both 5V and 12V sources along with appropriate regulation components, guarantees stable operation across all modules.

Literature survey

[1]. Meghana Nandre et al[1] authored a paper on a restaurant autonomous system

using IoT. The present study proposed a system in which customers place orders through a resistive touchscreen interface. In recent times, users prefer convenient options for ordering food at restaurants. The traditional method of taking orders becomes challenging during peak times, holidays, and is prone to human errors. The touch-based interface provides seamless access, ensuring that instructions are conveyed clearly. It should be sufficiently transparent for menu visibility, with enhanced response time and reliability.

[2]. Raviprakash Shriwas et al[2] presented an article on a touchscreen-enabled restaurant ordering system. The study suggested which the system minimizes the waiters burden while improving efficiency. Customers place orders through a contact-based interface utilizing a graphical LCD. The challenges associated with manual order-taking are addressed through graphical LCD technology. Food items are displayed as images or pictures, along with their total price. For better comprehension and an intuitive display, this system was primarily designed to facilitate the ordering process.

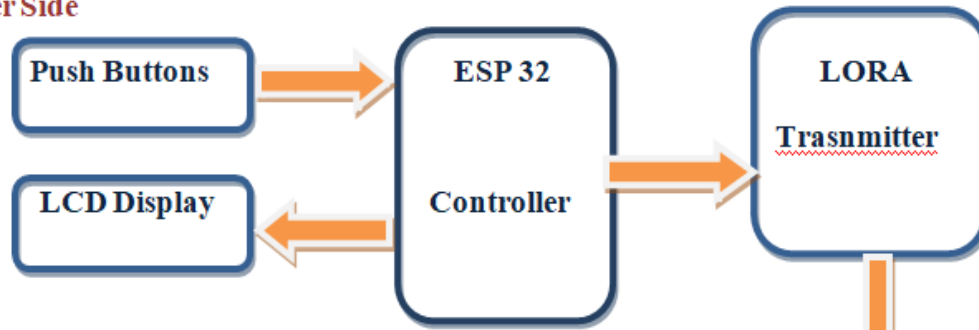
[3]. Annu Lambora et al[3] authored a paper on wireless menu implementation using IoT. This study proposed a wireless approach for data transmission through a wireless module from sender to the receiving unit. A standard wireless network links customer orders are sent to the kitchen display and the customers tablet, directly integrating with the kitchen unit. The system setup enhances the restaurant efficiency, minimize time usage, substantially eliminates individual mistakes.

PROPOSED SYSTEM

Block Diagram:

Customer Table Unit- Kitchen Unit

Customer Side



Kitchen Side

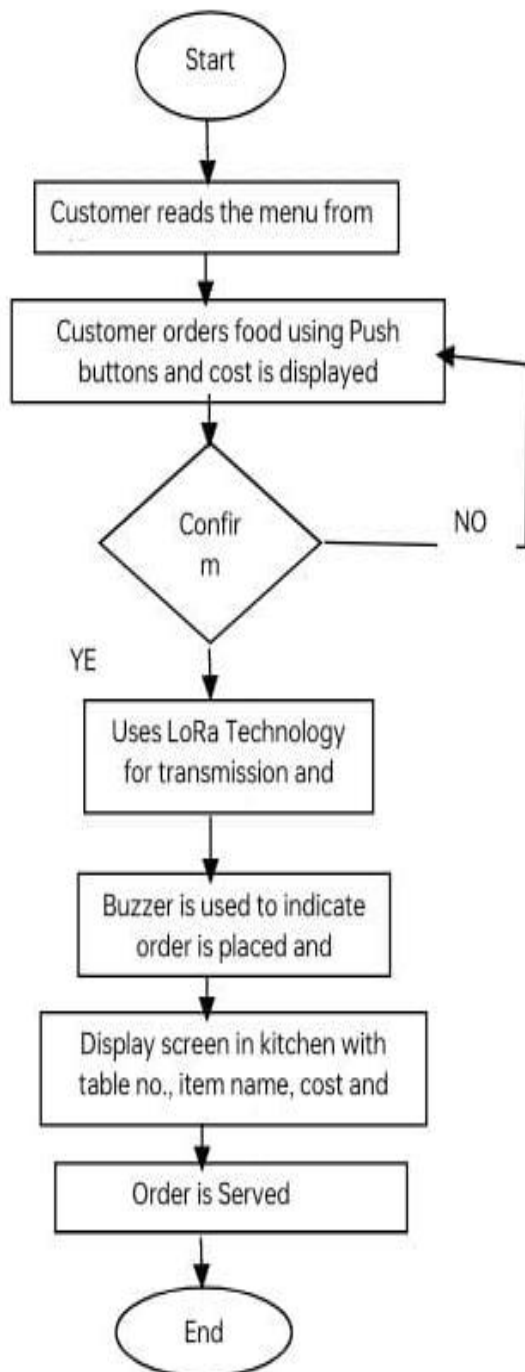


WORKING

The restaurant ordering system begins with the **push button**, which is located at the customer's side, allowing users to select menu items and confirm their orders. Each button corresponds to a specific function or menu option. Once an order is placed, the **LCD display** presents the menu options and provides feedback such as order confirmation to ensure a user-friendly experience. The **ESP32 controller** serves as the central processing unit, managing inputs from the push buttons, updating the LCD, and transmitting the order details to the

kitchen using **LoRa technology**. The **LoRa transmitter** then sends the digital order data wirelessly over long distances to the **LoRa receiver** on the kitchen side. The receiver forwards this data to either an **IC 555 timer** or a **laptop** for further processing. The **IC 555 timer** generates timing signals or activates a buzzer to alert the kitchen staff when a new order is received. Simultaneously, the **laptop** displays the received orders, acting as the main interface for order management, allowing the kitchen staff to efficiently process and prepare meals.

FLOW CHART



Hardware description

[1]. ESP32

The ESP32 is a 2.4 GHz wireless and Bluetooth combo chip developed using 40 nm energy efficient technology. It's optimized for superior power efficiency and RF performance, ensuring robustness, flexibility, and reliability across diverse applications and power conditions.



Characteristics of ESP32

- ☐ Wireless Connectivity
- ☐ Processing Power
- ☐ Memory & Storage
- ☐ Low Power Consumption
- ☐ Peripheral Interfaces
- ☐ Security Features
- ☐ Operating Voltage & Power Supply
- ☐ Robustness & Industrial Applications
- ☐ Development Support

[2].PUSH BUTTONS:

A push button, located at the customer's side, enables users to select menu items and confirm their orders. Each button is assigned to a specific function or menu option, allowing for a simple and intuitive ordering process. By pressing the button, a signal is sent to the system, ensuring accurate order placement with minimal effort.

[3].LORA TRANSMITTER

A LoRa transmitter is an advanced device designed for long-range, low-power wireless communication, primarily used in Internet of Things (IoT) applications. It utilizes chirp spread spectrum modulation, where a narrowband signal is continuously swept over a wide frequency range. This technique enhances signal resilience, making it highly resistant to interference and multipath fading, ensuring reliable data transmission over several kilometers, even in challenging environments.

LoRa transmitters are optimized for energy efficient consumption, make perfect for battery-powered devices that require long operational lifespans with minimal maintenance. A key feature of LoRa technology is the adjustable spreading factor, which allows users to balance data rate and transmission range. Higher spreading factors improve range and signal robustness at the expense of speed, while lower factors enable higher data rates over shorter distances.

Internally, a LoRa transmitter integrates RF circuitry, digital baseband processing, and an optimized antenna interface, ensuring secure and energy-efficient communication. It offers strong interference resistance, robustness against Doppler shifts, and adaptability to dynamic channel conditions, making it a crucial component in smart cities, industrial automation, remote monitoring, and large-scale IoT networks. Its ability to provide cost-effective, long-range connectivity with minimal power consumption makes LoRa technology a preferred choice for wireless communication in energy-efficient applications.



LoRa Transmitter and Receiver

[4].LORA RECEIVER:

A LoRa receiver is a critical component in long-range, low-power wireless communication systems, designed to capture and decode the chirp-modulated signals transmitted by LoRa devices operating in unlicensed frequency bands. Using advanced demodulation techniques, the receiver is capable of extracting data from signals that are extremely weak or distant, making it highly effective for, long-range communication applications. One of its key strengths lies in its high sensitivity, which allows it to detect signals even below the noise floor, ensuring reliable communication in environments with significant interference or obstacles. The receiver incorporates robust error correction algorithms and interference rejection mechanisms, which enhance its ability to maintain data integrity even in noisy conditions.

Additionally, LoRa receivers operate with adaptive spreading factors, meaning they can dynamically adjust their data rate and range based on the strength and quality of the received signal, optimizing both power consumption and transmission efficiency. This flexibility makes LoRa receivers particularly useful in IoT networks.

[5].BUZZER:

A buzzer is an electronic signaling device commonly used in automobiles, household appliances like microwave ovens, and game shows. It typically consists of switches or sensors linked to a control unit that detects button presses or preset time intervals. When triggered, it produces an audible alert through a constant or periodic buzzing or beeping sound, often accompanied by a visual indicator. Originally, buzzers operated in an electromechanical system resembling an electric bell but without the metal gong. Some versions used the wall or ceiling as a sounding board for amplification. In AC-powered devices, a circuit was sometimes employed to convert AC current into an audible signal through a simple 8-ohm speaker.

Modern buzzers predominantly use piezoelectric technology, such as ceramic-based sounders like Sonalert, which generate high-pitched tones. These are often integrated with driver circuits that modulate pitch or pulse the sound to create different alert patterns. Due to their compact size, energy efficiency, and reliability, piezoelectric buzzers have become the preferred choice in various applications requiring audible alerts.

[6].LED:

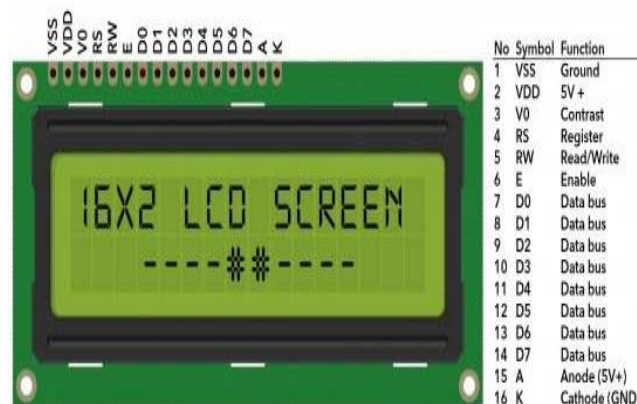
It is a semiconductor diode that undergoes radiative recombination, emitting light as a result of electron-hole recombination. When an electron transitions during the transition from the conduction band to the valence band, the energy released can manifest as a photon, leading to light emission. This phenomenon, known as injection luminescence, occurs in forward-biased LEDs, where the emitted radiation lies within the infrared or visible spectrum.

In some cases, the released energy may be absorbed by another electron or cause lattice vibrations instead of producing light. However, in junctions when biased in the avalanche breakdown region, a range of high-energy photons is produced, leading to near-white light emission from microplasma breakdown regions, particularly in silicon junctions.

Gallium Arsenide (GaAs) LEDs exhibit significantly higher radiative recombination efficiency compared to germanium or silicon diodes. Although their internal efficiency can approach nearly 100%, only a small fraction of the emitted light escapes due to the high refractive index of the material. Despite this limitation, GaAs LEDs are widely used in visual display units and optically coupled circuits. The efficiency of light emission improves with increased injection current and reduced temperature, with most of the generated light concentrated near the diode junction, where charge carriers are densely distributed within one diffusion length.

LIQUID CRYSTAL DISPLAY:

LCD technology, initially created by RCA Laboratories in 1968, is now widely used in digital devices, from watches to televisions. It functions as a light valve, controlling the passage of light through Liquid Crystal Cells (LCCs) by applying an electric field to modify their light absorption properties. While the LCCs themselves are monochrome, colors are added through filters. Light from an LED or fluorescent backlight passes through a polarizer to ensure uniform polarization before reaching the LC matrix, which determines whether a pixel is "on" or "off." When "on," molecules align to allow light through, while "off" pixels scatter molecules to block light. In color displays, light then passes through RGB filters before reaching a final polarizer that enhances contrast and clarity. Active Matrix LCDs (AMLCDs) improve performance by individually controlling each LCC using technology.



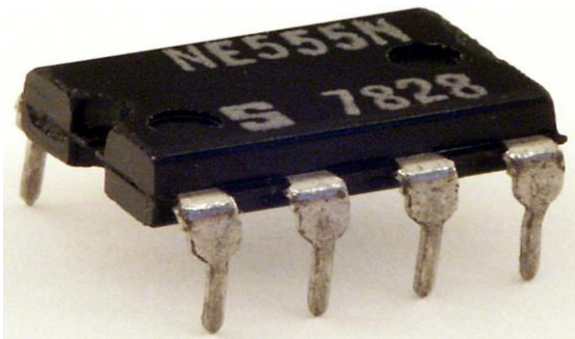
LCD modules are commonly interfaced with microcontroller via parallel ports. Additionally, they include multiple instructions such as Clear Display, Cursor Control, Display Shift, and Blink Mode, along with a built-in reset circuit that activates on power-up. These features make LCDs efficient, reliable, and easy to integrate into microcontroller-based systems.

POWER SUPPLY:

The power supply is a fundamental requirement for the project, providing the necessary DC power for both the base and recharging units. It is derived from the mains using center-tapped 12V-0-12V transformer, which steps down the voltage. A 7805 positive voltage regulator is used to generate a stable +5V output, capable of delivering up to 800mA. Rectification, the process of converting AC to DC, is achieved using a rectifier that allows current flow only during the positive half-cycle of the AC input, producing a pulsating DC output. To ensure a smooth and stable DC supply, additional filter circuits are incorporated.

IC 555 TIMER:

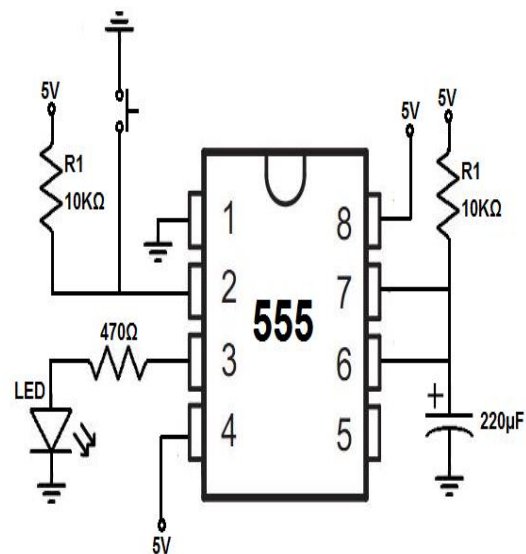
The **IC 555 timer** is a versatile integrated circuit widely used in various electronic applications, including timing, pulse generation, and oscillation. It operates in three modes: **monostable**, **astable**, and **bistable**, making it useful for different functions.



MONOSTABLE MODE:

In monostable mode, the IC 555 timer operates as a one-shot pulse generator, producing a single output pulse upon receiving an external trigger.

When a negative pulse is applied to the trigger pin (Pin 2), the internal flip-flop sets, driving the output (Pin 3) HIGH. Meanwhile, a capacitor connected to the threshold pin (Pin 6) charges through an external resistor. The output remains HIGH for a duration given by $T = 1.1 \times R \times C$, where R is the resistor and C is the capacitor. Once the capacitor voltage reaches two-thirds of the supply voltage (V_{cc}), the internal comparator resets the flip-flop, bringing the output LOW. The circuit remains in this stable LOW state until another trigger pulse is received. Monostable mode is commonly used in pulse generation, switch debouncing, delay circuits, and frequency dividers.



Software Description

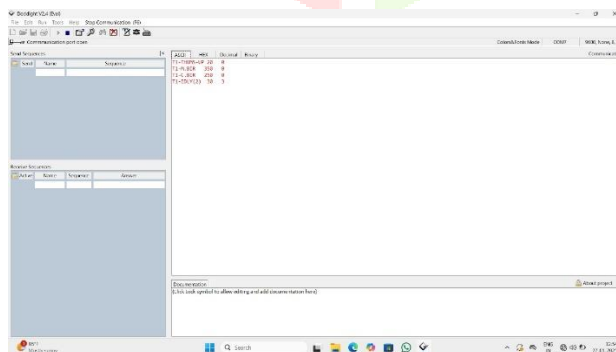
- Arduino IDE
- Docklight V2.4

Arduino IDE: The Arduino Integrated Development Environment (IDE) is a software platform used to write, compile, and upload code to Arduino microcontroller boards. It provides a user-friendly interface that supports C/C++ programming and allows users to interact with hardware easily.

The IDE includes built-in libraries and tools for programming various Arduino boards, such as the Arduino Uno, Mega, and Nano. Users can write their programs, compile them into machine code, and then upload them to the board via USB or serial communication. The Arduino IDE also supports third-party libraries and provides a serial monitor to debug and interact with the microcontroller in real-time.

Docklight V2.4: Docklight V2.4 is a software tool designed for testing, analyzing, and monitoring serial communication protocols. It is commonly used for applications such as debugging RS-232, RS-485, and TTL serial communications. Docklight allows users to visualize the data being transmitted between devices, configure serial port settings, send and receive data in real-time, and log the communication for later analysis. It supports protocols such as Modbus, NMEA 0183, and various custom protocols, making it ideal for troubleshooting and developing communication systems. The user interface allows for flexible configuration of the data exchange, making Docklight a versatile tool for engineers and developers working with serial communication.

RESULTS



ASCII	HEX	Decimal	Binary
T1-THUMS-UP 20	0	0	
T1-M.BIR 350	0	0	
T1-C.BIR 250	0	0	
T1-IDLY(2) 30	3	3	

The above picture displays that

T1→Table1 customer ordered **IDLY (2)** and Price is **30/-** and they ordered the quantity of **3** plates

M.BIR → MUTTON BIRYANI

C.BIR →CHICKEN BIRYANI

APPLICATIONS:

The applications of a **wireless electronic menu system** span various industries, improving efficiency and customer experience.

Restaurants and Cafes – Enables customers to browse menus, place orders, and request service without needing a waiter, reducing wait times and improving order accuracy.

Hotels – Used in room service ordering, allowing guests to order food or services conveniently from their rooms using a digital interface.

Casinos and Gaming Venues – Streamlines food and drink ordering for customers engaged in gaming, ensuring uninterrupted entertainment with efficient service..

Food Trucks and Pop-up Shops – Speeds up ordering and reduces human errors, making the system ideal for fast-paced, mobile food businesses.

Conclusion

In conclusion, the wireless electronic menu system represents a transformative advancement in the food and hospitality industry,

revolutionizing traditional ordering processes and offering numerous benefits to both businesses and customers. By replacing paper-based menus with digital solutions, these systems streamline operations, reduce errors, and enhance the customer experience through interactive, personalized interfaces. They allow businesses to make real-time updates, optimize efficiency, and gain valuable data insights for better decision-making. Additionally, the shift to digital menus supports sustainability efforts by reducing paper waste, while also providing flexible payment options that cater to modern consumer preferences. The adaptability of these systems extends beyond restaurants, benefiting various sectors such as hotels, airlines, and casinos. In challenging times, like the COVID-19 pandemic, wireless electronic menus have proven essential in ensuring safety and minimizing physical contact. Overall, implementing a wireless electronic menu system not only boosts operational efficiency and profitability but also positions businesses for long-term success in an increasingly digital world.

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