IOT Based Smart Trolley System For Automated Billing Using RFID

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ABSTRACT:

This paper presents an IoT based smart trolley system for automated billing using RFID, ultrasonic sensor, Nodemcu, Arduino Uno, BO motors, WIFI module, buzzer, LCD, and webserver. The proposed system aims to provide a convenient and efficient way of shopping by automating the billing process. The system employs RFID technology to identify the products placed in the trolley and ultrasonic sensors to detect the distance of the trolley from obstacles. The trolley is powered by four BO motors controlled by an Arduino Uno and a Nodemcu is used to connect the system to the internet. The WIFI module enables the user to connect to the system through a mobile app to control the trolley movement, while the buzzer and LCD provide real-time feedback to the user. The webserver facilitates the management of the inventory and generates to show an electronic bill for the customer. The cart overall information and total value will be displayed on the own webpage.

INTRODUCTION:

Shopping is an essential part of our daily lives, but it can be a time-consuming and inconvenient task, especially during peak hours. The traditional checkout process further adds to the inconvenience, requiring customers to wait in long queues to pay for their items. The Internet of Things (IoT) is rapidly transforming various industries, including the retail industry. The traditional shopping experience often involves long waiting times at the checkout counters, which can be frustrating for customers. To address this issue, this paper proposes an IoT based smart trolley system for automated billing using RFID and NodeMCU. The proposed system employs an RFID reader and tags to identify the products placed in the trolley and a Nodemcu to connect the system to the internet. The system's automated billing process is highly efficient, reducing the time and effort required for both customers and store employees. The system can generate bills instantly, allowing customers to pay and leave the store quickly, making shopping more enjoyable and convenient for customers.

Moreover, the proposed system offers a high level of security, with each RFID tag being uniquely identified and encoded, making it difficult to tamper with the system. The use of Nodemcu enables the system to connect to the internet, allowing for real-time data transfer, inventory management, and bill generation. The system's connectivity enables the store to keep track of their stock levels and generate a more accurate billing system for customers. The use of RFID and Nodemcu technology in a smart trolley system for automated billing provides numerous benefits over traditional checkout processes. It provides a more efficient and convenient way of shopping, reduces waiting times, improves inventory management, and enhances the overall shopping experience for customers. Moreover, the system's connectivity allows for real-time data transfer, enabling the

store to improve their inventory management and billing processes.

EXISTING SYSTEM:

The existing System Contains the RFID based offline billing system data transfer via Bluetooth. They are using Microcontrollers with different sensors as billing system. The detail was not savable, and trolley can't move automatically. So he proposed IoT-based smart trolley system for automated billing using RFID and NodeMCU technology offers a revolutionary approach to streamline the checkout process and make shopping more convenient for customers.

II. LITERATURE SURVEY

[1] The proposed an IoT-based smart shopping trolley system that integrates RFID technology and sensors to automate the billing process. The system allows customers to scan items using RFID tags and sensors on the trolley, and the billing is done automatically without the need for a cashier. The study reported that the system reduces waiting time for customers and increases operational efficiency for retailers.

[2] A similar study proposed an IoT-based smart shopping cart system that uses RFID technology and computer vision to automate the billing process. The system allows customers to scan items using RFID tags on the cart and computer vision technology that detects items and adds them to the bill. The study reported that the system reduces checkout time and increases customer satisfaction.

[3] A similar study proposed an Arduino-based smart shopping cart system that uses RFID technology and an LCD screen to display item prices and the total bill. The system allows customers to scan items using RFID tags on the cart, and the billing is done automatically through the Arduino microcontroller. The study reported that the system is cost-effective and easy to implement.

[4] IoT-based smart trolley system that integrates with a NodeMCU microcontroller, RFID technology, the system allows customers to scan items using RFID tags on the trolley, and the billing is done automatically through the NodeMCU microcontroller. The webserver provides real-time monitoring of the system, while the message sending feature alerts the customers about their total bill. The study reported that the system enhances operational efficiency for retailers and provides a seamless customer experience.

[5] The proposed an RFID-based smart trolley system that integrates with an Arduino Uno microcontroller, Bluetooth module, and a mobile application for automated billing and payment. The system allows customers to scan items using RFID tags on the trolley, and the billing is done automatically through the mobile application. The Bluetooth module connects the system to the mobile application, allowing customers to view their bill and make payments in real-time. The study reported that the system enhances customer experience and reduces queue times. The use of Arduino Uno microcontroller makes the system cost-effective and easy to implement.

[6] One study proposed an RFID-based smart trolley system that integrates with an Arduino Uno microcontroller, GSM module, and a mobile application for automated billing and payment.

The system allows customers to scan items using RFID tags on the trolley, and the billing is done automatically through the mobile application. The GSM module connects the system to the mobile application, allowing customers to view their bill and make payments in real-time.

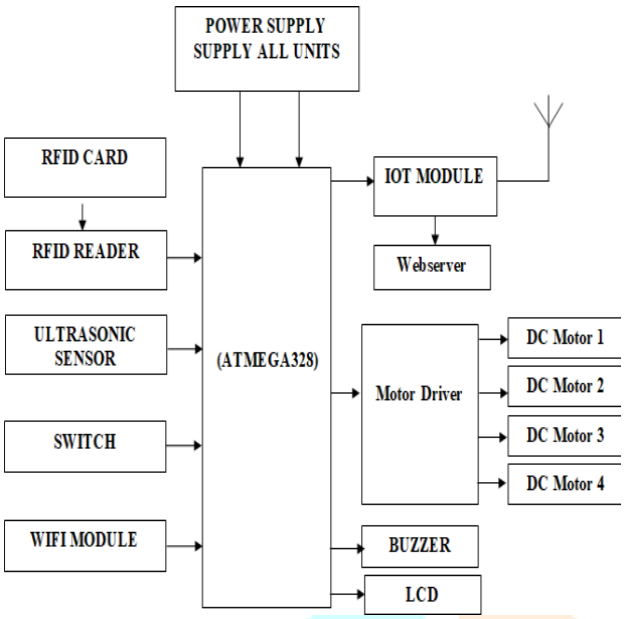
[7] The proposed System is RFID-based smart trolley system that integrates with a Raspberry Pi microcontroller, camera, and RFID technology for automated billing. The system allows customers to scan items using RFID tags on the trolley, and the billing is done automatically through the Raspberry Pi microcontroller. The camera captures images of the items in the trolley, which can be used to verify the items and ensure accurate billing. The study reported that the system enhances customer experience, reduces queue times, and minimizes billing errors. The use of Raspberry Pi microcontroller and camera provides more processing power and capabilities, makingthe system more robust and versatile.

[8] A movable trolley system for automated billing using RFID, Arduino, and Bluetooth control is an innovative solution to streamline the shopping experience. To understand the current research on this topic, a literature survey was conducted. Several studies have shown that RFID technology is a reliable and efficient way of tracking inventory and managing stock levels. Additionally, Arduino is a versatile and affordable microcontroller that can be used to automate various tasks, including billing. Bluetooth technology provides a convenient wireless communication method for controlling the trolley.

[9] The concept of a movable trolley system for automated billing using RFID, Arduino, and Wi-Fi control has gained significant attention in recent years. Researchers have explored the use of Arduino in combination with other technologies such as RFID, sensors, and Wi-Fi to create a robust and reliable system for automated billing. Finally, the use of Wi-Fi control in the movable trolley system has been studied extensively. Researchers have investigated the use of Wi-Fi to provide real-time communication between the trolley and the billing system, enabling the automatic calculation of the total amount to bepaid.

[10] The implementation of a movable trolley system for automated billing using RFID, Arduino, load cell, and ultrasonic sensor has been studied in the literature.. RFID technology is used for automatic product identification and tracking, while Arduino provides the necessary processing and control capabilities. Load cells are used to measure the weight of products, and ultrasonic sensors are used to detect the presence of products on the trolley.

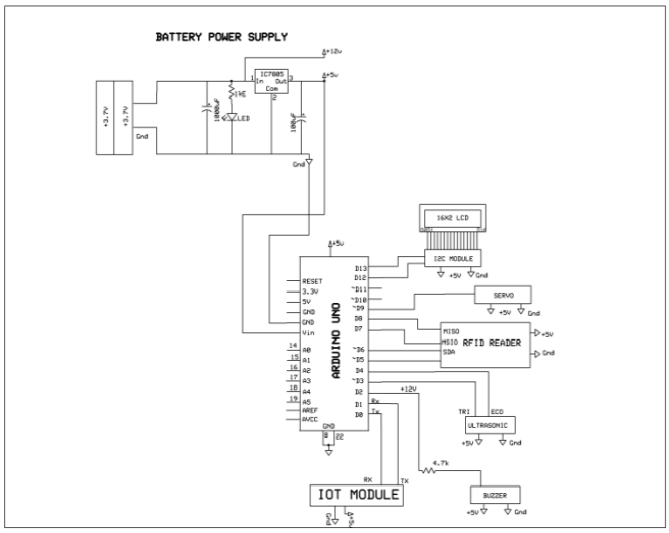
BLOCK DIAGRAM

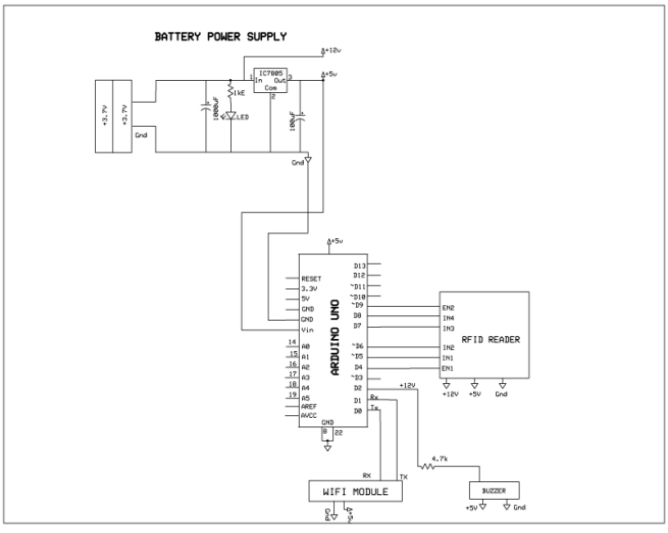


PROPOSED SYSTEM:

In the present era of automation and digitalization, the concept of a smart trolley system with automated billing is an attractive option for many customers in the retail industry. The IoT-based smart trolley system using RFID is a proposed system that will provide a hassle-free shopping experience to customers. In this system, an RFID reader will be attached to the trolley to scan the RFID tags attached to the products. Ultrasonic sensors will be used to detect the distance of the trolley from the billing counter and any obstacles

CIRCUIT DIAGRAM:





in its path. The NodeMCU will act as the main controller to collect data from all sensors and control the trolley's movement. The Arduino Uno will be used to control the four BO motors that drive the trolley. A WIFI module will be used to communicate with the trolley from a mobile application. A buzzer will provide audio feedback to the user, and an LCD will display the product information and billing details. The webserver will store all transactional data and generate bills automatically.

Working of the System

The proposed system's working can be divided into three stages: Product scanning, Trolley Movement, and Billing.

Product Scanning

Each product in the retail store will be attached with an RFID tag containing its unique identification number. The RFID reader attached to the trolley will scan these tags, and the NodeMCU will collect and store this data. The NodeMCU will compare the scanned product IDs with the products already present in the trolley. If the product is new, it will add the product to the list of products in the trolley. If the product is already present, it will update the quantity of the product in the trolley.

Trolley Movement

The trolley will move autonomously, following the customer, with the help of the ultrasonic sensor. The ultrasonic sensor will detect the distance between the trolley and the customer and adjust its speed accordingly. It will also detect any obstacles in the trolley's path and stop the trolley to prevent any collision. The trolley's movement will be controlled by the NodeMCU, which will send signals to the Arduino Uno to control the four BO motors.

Billing

When the customer reaches the billing counter, the trolley's ultrasonic sensor will detect the distance to the billing counter and stop the trolley. The NodeMCU will send the product information and quantity to the webserver, which will calculate the bill automatically. The webserver will generate a bill containing the product name, quantity, price, and total amount. The bill will be displayed on the LCD attached to the trolley. The customer can then confirm the bill and proceed with payment. After payment, the NodeMCU will clear the trolley's product list, and the trolley will return to the starting point.

METHODOLOGY:

The methodology for an IoT based smart trolley system for automated billing involves both hardware and software components.

HARDWARE EXPLANATION:

. The proposed system aims to provide a convenient and efficient way of shopping by automating the billing process. This paper presents an IoT based smart trolley system for automated billing using RFID, ultrasonic sensor, Nodemcu, Arduino Uno, BO motors, WIFI module, buzzer, LCD,.

COMPONENTS LIST:

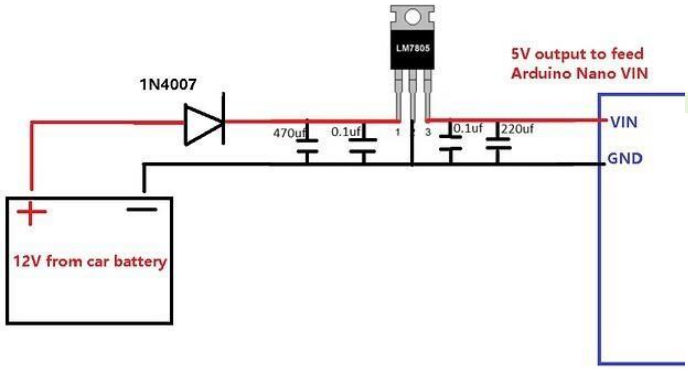
- Battery Power supply system
- Arduino Uno
- Nodemcu
- Ultrasonic sensor
- Motor Driver
- RFID Reader
- LCD Module
- I2C Module
- Buzzer
- DC motors

HARDWARE COMPONENTS DESCRIPTION:

BATTERY POWER SUPPLY SYSTEM:

A 12V to 5V battery power supply is a device that converts a 12V voltage source to a 5V voltage source, typically used to power electronic devices that require a 5V power supply. This conversion is achieved using a DC-DC step-down converter or voltage regulator.

This signal is then rectified and filtered to produce a stable output voltage. Voltage regulators, on the other hand, use a feedback loop to adjust the output voltage to a constant value regardless of input voltage fluctuations. When selecting a converter, it is important to consider the input voltage range, output voltage, and output current requirements of the device being powered. The input voltage range of the converter should be able to handle at least 12V to accommodate the 12V battery. The output voltage should be 5V to match the device's power requirements. The converter's output current rating should be higher than the device's maximum current draw to avoid overloading the converter.



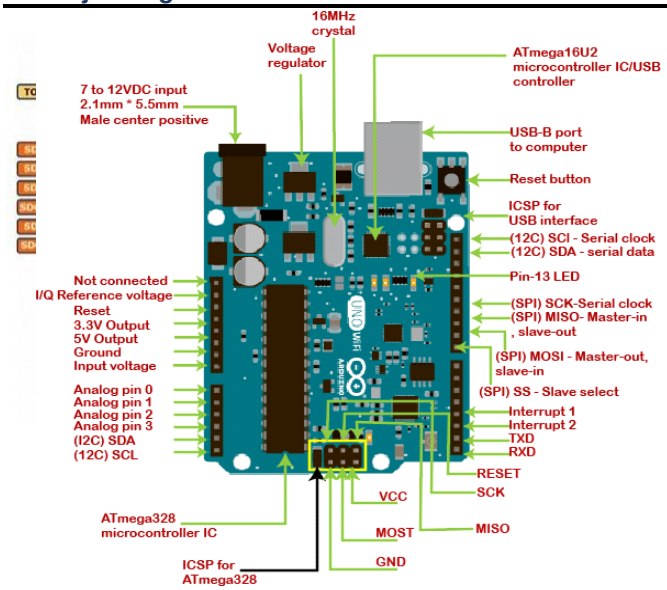
To use the converter, the positive and negative wires from the 12V battery are connected to the input terminals of the converter. The positive and negative wires from the output terminals of the converter are then connected to the device that requires 5V power. It is important to follow the manufacturer's instructions for the specific converter being used and take necessary precautions to avoid electric shock or short circuits.

Voltage Regulator: The voltage regulator is the fourth and final component in the power supply system. Its function is to regulate the output voltage to a constant 5V DC voltage. The voltage regulator uses a feedback mechanism to adjust the output voltage to a constant value, even if the input voltage or load current changes.

ARDUINO UNO:

Arduino Uno is a main Brain of the Project. The Arduino Uno is a microcontroller board based on the ATmega328P microcontroller chip. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal oscillator, and a USB connection. The ATmega328P microcontroller has 32 KB of flash memory, 2 KB of SRAM, and 1 KB of EEPROM. The digital input/output pins are grouped into two sets of 8 pins each, with each set capable of being configured as either input or output. The analog inputs can read signals in the range of 0 to 5 volts, and are converted to a 10-bit digital value by the on-board analog-to-digital converter. The board can be powered either by connecting it to a computer via the USB cable, or by connecting it to a 9-volt battery or an external power supply.

The board also has a power jack and an ICSP header for programming the microcontroller using an external programmer. The board is programmed using the Arduino Integrated Development Environment (IDE), which is a free software tool that provides a user-friendly interface for writing, compiling, and uploading code to the board.



The IDE supports the C++ programming language and provides a large library of pre-written code, making it easy for beginners to get started with programming the board.

NodeMCU:

NodeMCU is a low-cost open-source firmware and development board based on the ESP8266 WiFi module. The board has an 80 MHz 32-bit Tensilica CPU, 4 MB flash memory, and integrated WiFi connectivity, which allows it to connect to the internet and exchange data with other devices. The board also features 11 digital input/output pins and one analog input pin, which can be used to interface with a variety of sensors and actuators.

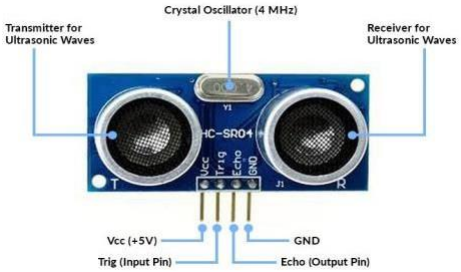
The NodeMCU firmware is based on the Lua scripting language and can be programmed using the NodeMCU Lua API. It also has support for the Arduino IDE, allowing it to be programmed using the familiar C++ programme ng language. Additionally, the NodeMCU supports the MicroPython programming language, which is a popular choice for IoT projects.

The board can be powered using a micro-USB cable or an external power supply, and can be programmed and debugged using a USB-to-serial converter. The NodeMCU firmware provides a range of networking protocols, including HTTP, HTTPS, MQTT, and Web Socket, which makes it an ideal choice for IoT applications that require cloud connectivity. NodeMCU is widely used for a range of IoT applications, such as home automation, weather stations, robotics, and wireless sensor networks. The open-source nature of NodeMCU means that it has a large community of developers who have created libraries, tools, and resources to help users get started with their projects. Overall, NodeMCU is a versatile and powerful development board that offers an affordable solution for IoT projects.

ULTRASONIC SENSOR:

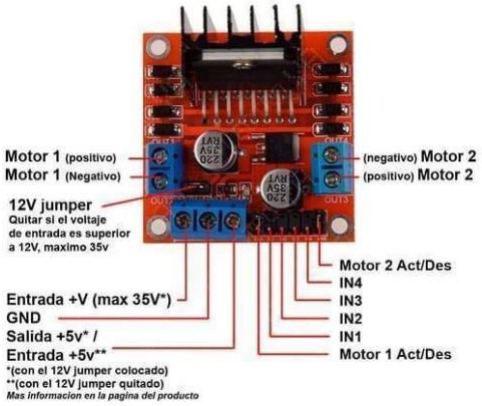
The HC-SR04 is an ultrasonic sensor module that is commonly used for distance measurement applications in robotics and automation. It operates by emitting ultrasonic waves from a transmitter and detecting their reflection from nearby objects using a receiver. The time taken for the waves to travel to the object and back is measured, and this is used to calculate the distance to the object using the speed of sound in air. The sensor requires a 5V power supply and has four pins: Vcc (power), GND (ground), Trig (trigger), and Echo (echoed signal). To use the sensor, a trigger signal is sent to the Trig pin, and the resulting echo signal is received at the Echo pin. The distance to the object can then be calculated using the formula Distance = (Time * Speed of Sound) / 2. The HC-SR04 is a

low-cost, easy-to-use, and accurate sensor that has become popular in many applications.

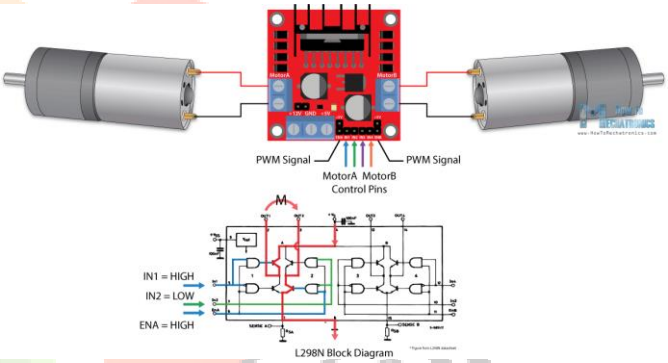


L298N MOTOR DRIVER:

The L298N motor driver is an integrated circuit that provides control over the speed and direction of DC motors or stepper motors. The IC consists oftwo H-bridge circuits that can drive two DC motors or one stepper motor. The H-bridge circuitscontrol the direction of the motor by switching on and off pairs of transistors, allowing current to flow in either direction through the motor. The L298N motor driver is widely used in robotics and automation applications, where precise control over motor movement is essential. It can handle a maximum current of 2A per channel, with a peak current rating of 3A, making it suitable for a wide range of motor types and sizes. It can operate over a wide voltage range, from 5V to 35V, which makes it compatible with a wide range of power sources.



The L298N motor driver requires a control circuit, such as a microcontroller, to send the appropriate signals to the IC. The control signals consist of two digital signals for each motor, one to set the direction and the other to set the speed. The speed signal is typically generated using pulse width modulation (PWM) to adjust the duty cycle of the signal, which varies the average voltage applied to the motor and controls its speed. The L298N motor driver also includes built-in protection features to prevent damage to the IC or the motor. These protections include thermal shutdown, which shuts down the IC if it overheats, overcurrent protection, which limits the current flowing through the motor to prevent damage, and under voltage lockout, which prevents the IC from operating when the input voltage is too low. The L298N motor driver is commonly used in a variety of applications, including robotics, automation, electric vehicles, and industrial control systems.

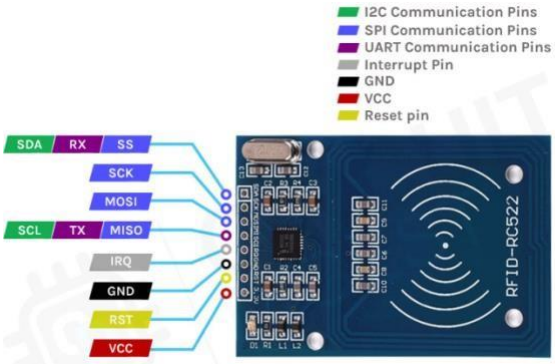


When using the L298N motor driver, it is important to follow the manufacturer's instructions and take necessary precautions to avoid electric shock or short circuits. Careful consideration of the motor specifications and control signals is also necessary to ensure proper operation and avoid damage to the motor or the IC.

RFID READER:

The RC522 RFID reader is a popular integrated circuit (IC) used for reading RFID tags. RFID stands for Radio Frequency Identification, and it is a technology that uses radio waves to communicate information between a tag and a

reader. The RC522 RFID reader operates at a frequency of 13.56 MHz, which is a commonly used frequency range for RFID systems. The RC522 RFID reader consists of an antenna, a radio frequency module, and a control unit. The antenna receives the radio waves from the RFID tag and converts them into electrical signals. The radio frequency module amplifies and demodulates the signals, and the control unit processes the signals and communicates with the host system.

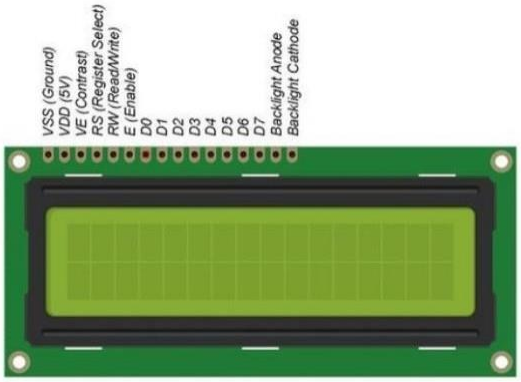


The RC522 RFID reader can read and write data to RFID tags that are compliant with ISO/IEC 14443A/MIFARE standard. The reader can detect tags within a range of up to 10 cm, depending on the size and type of the antenna used. The RC522 RFID reader supports both MIFARE Classic and MIFARE Ultralight tags, which are commonly used in access control systems, public transportation, and payment systems. The RC522 RFID reader communicates with the host system using a serial interface, such as SPI or I2C. The control unit of the RC522 RFID reader provides a command interface for controlling the reader and accessing the data stored on the RFID tags. The command interface includes commands for initializing the reader, selecting and authenticating a tag, reading and writing data to the tag, and setting the configuration of the reader.

The RC522 RFID reader includes built-in security features, such as a 48-bit unique ID number for each device and support for encryption and authentication protocols. These features ensure the security and privacy of the data stored on the RFID tags and prevents unauthorized access to the system.

LCD MODULE 16X2:

The LCD 16x2 is a display module that can show up to 16 characters per row with a total of 32 characters across the entire display. It uses liquid crystal display (LCD) technology for low power consumption and high contrast. The display is typically controlled by an integrated circuit (IC) driver, such as the HD44780, which communicates with a microcontroller or other digital device. The LCD 16x2 module typically requires 16 pins to be connected to a microcontroller or other digital device, which are used for power, ground, and data communication. The data communication is typically done using a parallel interface, where eight data pins are used to transmit the character data, along with other control pins for selecting the display row and column. The LCD 16x2 display can be programmed to display text, symbols, and even simple graphics, and the backlight can be turned on or off to improve visibility in different lighting conditions.



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I2C MODULE:

I2C, or Inter-Integrated Circuit, is a communication protocol commonly used in microcontroller-based systems. The I2C protocol uses a two-wire serial interface consisting of a data line (SDA) and a clock line (SCL). This allows multiple devices to be connected to the same bus, with each device having a unique address. An I2C module is a hardware module that provides support for the I2C protocol. It typically consists of an integrated circuit (IC) that interfaces with a microcontroller and handles the low-level details of I2C communication, such as generating clock pulses, transmitting and receiving data, and addressing devices on the bus. The I2C module allows for simple and efficient communication between multiple devices, making it useful in many applications such as sensor networks, displays, and memory devices. Its simplicity and low pin count make it a popular choice for embedded systems, especially for communication between sensors and microcontrollers.

BUZZER:

A buzzer is a device that generates sound, typically used to provide audible alerts or signals in electronic devices. Buzzer modules are commonly used in electronic projects and can be found in a variety of shapes and sizes. A buzzer typically consists of a metal or plastic housing that contains an electromagnetic coil and a spring-mounted armature. When an electrical current is passed through the coil, it creates a magnetic field that pulls the armature towards the coil. This movement of the armature causes the device to vibrate, producing a sound. Buzzer modules are typically driven by a digital signal from a microcontroller or other digital device. The sound produced by the buzzer can be controlled by varying the frequency and duration of the digital signal. Buzzer modules can produce a wide range of sounds, from simple beeps and tones to more complex melodies. Some buzzers have built-in sound generators, allowing them to produce a variety of pre-programmed sounds or music.

DC MOTOR:

DC BO gear motor is a type of DC motor that is designed with a gearbox attached to it. The gearbox is used to reduce the speed of the motor output shaft and increase the torque. This makes the motor suitable for applications that require high torque and low speed, such as robotics, industrial machinery, and automation equipment.

The DC BO gear motor stands for "Brushed Output", which means that the motor is a brushed DC motor with an output shaft that is connected to a gearbox. Brushed DC motors are commonly used in low-cost applications because they are simple, reliable, and easy to control. They have a rotor with a commutator and brushes that transfer power to the rotor windings, creating a rotating magnetic field that drives the motor shaft. The gearbox attached to the DC BO gear motor is typically made up of a set of gears with different sizes, arranged in a specific sequence to provide the desired speed reduction and torque increase. The gearbox also protects the motor from external impacts and reduces noise and vibration duringoperation.

DC BO gear motors are available in a wide range of sizes, power ratings, and gear ratios, making them suitable for a variety of applications. They can operate on different voltage levels and have different output shaft configurations, such as round, D-shaped, or keyed shafts. The motor speed and torque can be adjusted by changing the voltage applied to the motor or by changing the gear ratio of the gearbox.

SOFTWARE DESCRIPTION:

ARDUINO IDE:

Arduino IDE (Integrated Development Environment) is a software tool used for programming and development of Arduino boards. It is an open-source platform, available for free, and is compatible with multiple operating systems including Windows, Mac OS, and Linux.

The main features of the Arduino IDE include:

- **Code Editor:** The code editor is the main interface of the Arduino IDE where you can write, edit and upload code to the Arduino board. It includes features such as syntax highlighting, auto-completion, and code snippets to make programming easier.

- **Sketches:** Arduino programs are referred to as "sketches" and can be easily created and saved within the IDE. The sketch contains two main functions: the setup() function, which is called once at the start of the program, and the loop() function, which is called repeatedly as long as the program is running.

- **Library Manager:** The Library Manager allows users to easily install and manage libraries for their Arduino projects. It includes a collection of pre-built libraries that can be used to add functionality to your projects. Users can also create their own libraries and add them to the IDE.

- **Serial Monitor:** The Serial Monitor allows users to communicate with the Arduino board and monitor the data being sent and received through the serial port. This is particularly useful for debugging and troubleshooting.

- **Board Manager:** The Board Manager allows users to select the type of Arduino board they are using, configure settings, and install the necessary drivers. This is important because different Arduino boards may have different specifications and require different drivers.

- **Upload:** The Upload feature allows users to upload their sketches to the Arduino board and begin executing the program. Users can select the correct board and serial port before uploading the sketch.

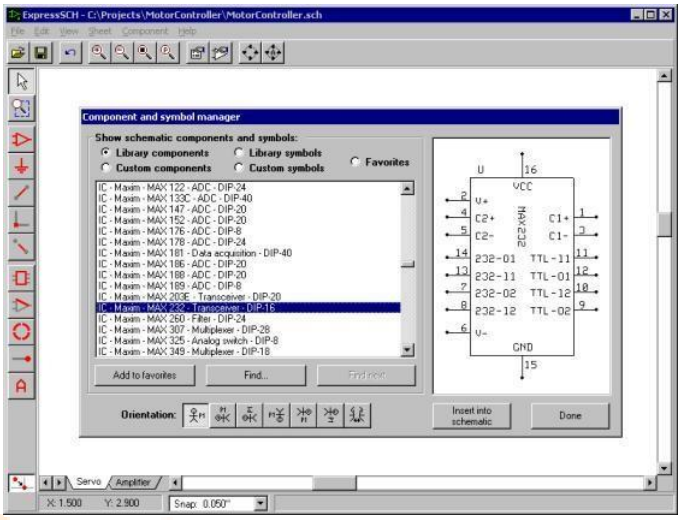
- **Tools:** The Tools menu includes a range of options for configuring and customizing the IDE. This includes options for setting the board type, serial port, programmer, and other settings.

Overall, the Arduino IDE is a user-friendly software tool that simplifies the programming process for beginners and experienced users alike. It is compatible with a wide range of Arduino boards and shields, making it a versatile tool for a variety of applications. With its many features and community support, the Arduino IDE is an essential tool for anyone interested in electronics and programming.

In addition to the basic features listed above, the Arduino IDE also supports advanced features such as debugging and profiling tools, version control integration, and multiple file editing. The IDE can also be extended through plugins and add-ons, allowing users to customize the tool to their specific needs. Additionally, the Arduino community provides a wealth of resources and tutorials to help users get started and troubleshoot any issues they may encounter.

EXPRESS PCB:

Express PCB is a free-to-use software program for designing printed circuit boards (PCBs). It is a simple and user-friendly tool that is ideal for beginners and hobbyists who want to design and create their own PCBs.



Some of the key features of Express PCB include:

- **Schematic Capture:** Express PCB allows users to create schematic diagrams of their circuits using a library of pre-built symbols. The software also provides a range of editing tools to help users create and modify their schematic diagrams.
- **Board Layout:** Express PCB includes a powerful board layout editor that allows users to place components on the board, route traces between components, and add text and graphics. The software also includes a range of design rules to ensure that the PCB meets the required specifications.
- **Gerber Export:** Once the board design is complete, Express PCB allows users to export the design as Gerber files, which can be used to manufacture the PCB.
- **Parts Library:** Express PCB comes with a large library of pre-built parts and components that users can use to create

their designs. Users can also create their own custom parts library.

- **Auto-Router:** The software includes an auto-router feature that can automatically route traces between components on the board. This can save users a lot of time andeffort, especially for complex designs.
- **3D Viewer:** Express PCB includes a 3D viewer that allows users to view their board designs in 3D, providing a realistic view of how the final product will look.

Overall, Express PCB is a powerful and user-friendly software tool that can help users design and create their own PCBs quickly and easily. The software is free to download and use, making it accessible to hobbyists and beginners who may not have a large budget for PCB design software. Additionally, Express PCB provides a range of tutorials and resources to help users get started and troubleshoot any issues they may encounter during the design process.

WEB SERVER:

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capabilities. It can be used as a standalone microcontroller or as a Wi-Fi enabled communication module with other microcontrollers. One of its popular applications is to create a webserver page to control and monitor devices over the internet.

Here are the details on how to create a webserver page with ESP8266:

- Set up the ESP8266 with Arduino IDE and connect it to Wi-Fi.
- Import the required libraries such as ESP8266WiFi.h and ESP8266WebServer.h.
- Create a web server object using the ESP8266WebServer class.
- Define a callback function that will handle requests made to the webserver. The callback function can take inputs from HTML forms and execute specific actions on the ESP8266.
- Write HTML code for the web page that the user will see.
- Create a server.begin() statement in the setup() function to start the web server.
- In the loop() function, run the server.handleClient() method to handle incoming client requests.
- Upload the sketch to the ESP8266 and test the web page in a browser by entering the IP address of the ESP8266 in the browser address bar.

By following these steps, the ESP8266 can serve up a web page to control and monitor devices over the internet. This can be useful for remote control of home automation devices or other internet of things (IoT) applications.

CONCLUSION:

In conclusion, the proposed IoT-based smart trolley system for automated billing using RFID, has the potential to revolutionize the retail industry. The system provides a hassle-free shopping experience to customers by automating the billing process and making the entire shopping experience faster and more convenient. The system's ability to autonomously follow the customer and detect obstacles in its path ensures a safe shopping experience. The use of RFID tags and ultrasonic sensors in the proposed system improves the accuracy and reliability of the product scanning and trolley movement. The NodeMCU acts as the brain of the system, collecting data from all sensors and controlling the

trolley's movement. The Arduino Uno controls the four BO motors, ensuring the trolley's smooth and efficient movement.

Overall, the proposed system is an innovative solution that has the potential to enhance the customer experience in the retail industry. It can also be customized and scaled as per the needs of the retail industry, making it an attractive option for retailers looking to automate their operations and provide better customer service.

DISCUSSION:

The proposed IoT-based smart trolley system for automated billing using RFID has several advantages over traditional manual shopping methods. Here are some points of discussion:

Advantages:

- **Accurate and efficient product scanning:** The use of RFID tags ensures that the system can accurately scan and identify products in the trolley. This eliminates the need for manual scanning and reduces the chances of errors and discrepancies in the billing process.
- **Improved customer experience:** The smart trolley system improves the customer shopping experience by automating the billing process, making it faster and more convenient. Customers can simply add products to their trolley and receive an automated bill at the end of their shopping experience.
- **Increased efficiency:** The proposed system increases the efficiency of the retail industry by automating several processes that are traditionally done manually. This saves time and reduces the need for human intervention, making it an attractive option for retailers.
- **Real-time updates**: The integration of the system with a mobile application via WIFI allows customers to receive real-time updates on the products in their trolley and the bill generated. This feature ensures transparency and enhances the customer experience.
- **Safe and reliable:** The use of ultrasonic sensors ensures that the trolley can detect obstacles in its path and avoid collisions. This makes the shopping experience safe and reliable for customers.
- **Cost-effective:** The proposed system can reduce the cost of operation for retailers in the long run by eliminating the need for manual labor and reducing errors in the billing process.

Limitations:

- **Initial cost:** The initial cost of setting up the system can be high, especially for small retailers, which can be a barrier to adoption.
- **Maintenance:** The system requires regular maintenance and updates to ensure its smooth functioning, which can be a challenge for some retailers.

- **System complexity**: The integration of multiple components and technologies can make the system complex, which may require specialized skills and knowledge to operate and maintain.

- **Dependence on technology:** The system is dependent on technology, which can be a limitation in case of power outages or othertechnical issues.

- **Privacy concerns:** The use of RFID technology raises privacy concerns as it can track customers' movements and shopping habits.

- **Customer adoption:** Some customers may not be comfortable with using technology for shopping and may prefer the traditional method of manually scanning and billing their products.

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