IOT ENABLED SMART SANITARY NAPKIN VENDING MACHINE

A MINI PROJECT REPORT

Submitted by

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to

the APJ Abdul Kalam Technological University
in partial fulfillment for the award of the Degree of

BACHELOR OF TECHNOLOGY
in
ELECTRONICS AND COMMUNICATION ENGINEERING

under the supervision of

Ms.Asha Arvind

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DECLARATION

I hereby declare that this submission is my own original work. To the best of my knowledge and belief, it contains no material previously published or written by another individual, nor any material that has been submitted for the award of any other degree or diploma at any university or institution of higher learning, except where proper acknowledgment is provided in the text.

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CERTIFICATE

This is to certify that the report entitled **"IOT ENABLED SMART SANITARY NAPKIN VENDING MACHINE"**, submitted by **POOJA P MENON (ATP22EC026)** to APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Bachelor of Technology degree in Electronics and Communication Engineering, is a bona fide record of the project work related to the course (ECD 334) **MINI PROJECT**, carried out under our guidance and supervision. This report has not been submitted in any form to any other university or institution for any purpose.

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ABSTRACT

Women have become important decision-makers and contributors to the advancement of the country in modern society. Given the importance of their participation, it becomes crucial to protect their health, especially during menstruation, with a focus on hygiene. About 40have already been made possible via the Unified Payments Interface (UPI), which is a result of India39;s rapidly accelerating digital revolution. Thus, this study suggests that current coin- based payment methods be upgraded to UPI in a vending machine system. The microcontroller, which forms the center of the system, a stepper motor for the dispensing pads, and an intuitive LCD display that is connected with the microcontroller module for input are its essential parts.

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ABBREVIATIONS

Abbreviation	Expansion
IoT	Internet of Things
UPI	Unified Payments Interface
NGO	Non-Governmental Organisation
QR	Quick Response
SMS	Short Message Service
GSM	Global System for Mobile communication
LCD	Liquid Crystal Display
LED	Light Emitting Diode
IDE	Integrated Development Environment
API	Application Programming Interface
HTML	Hyper Text Markup Language

Chapter 1

INTRODUCTION

1.1 Socio-Economic Relevance Of The Project

An IoT-enabled sanitary napkin vending machine with features like UPI payment, stock monitoring, and low stock alerts is a groundbreaking solution for addressing menstrual hygiene challenges. By ensuring easy and consistent access to sanitary products, it empowers women, promotes inclusivity, and improves efficiency through advanced technology. This innovation not only enhances digital literacy but also stimulates economic growth by supporting local manufacturing. Furthermore, it aligns with public health priorities and sustainability objectives, making it a transformative step towards social and economic progress.

1. **Promotes Menstrual Hygiene and Health:** Convenient and discreet access to sanitary napkins ensures that menstrual products are readily available whenever needed, particularly in schools, workplaces, public areas, and underserved rural regions. By providing a private and anonymous solution, it helps combat the social stigma surrounding menstruation and encourages greater acceptance. Enhanced menstrual hygiene contributes to reduced health risks, such as infections, and significantly improves the overall well-being of menstruators, especially in disadvantaged communities with limited access to such essential products.

2. **Empowers Women and Supports Gender Equity:** Access to sanitary napkins enables women to engage in education, work, and public activities without interruptions caused by menstruation. Through the incorporation of technology, these machines promote inclusivity by addressing menstrual needs with dignity and consideration. The inclusion of UPI payment expands accessibility, ensuring

that even those who rely on cashless transactions can conveniently obtain these essential products.

3. **Encourages Technological Adoption and Digital Literacy:** Integrating IoT features and UPI payments enhances users' comfort with digital tools, fostering the widespread adoption of cashless transactions and advanced smart technologies. Real-time stock monitoring and low stock alerts optimize operational efficiency, ensuring a steady supply of products and eliminating the risk of shortages that might disrupt accessibility.

4. **Economic Impact and Sustainability:** Promotes the utilization of locally produced sanitary napkins, bolstering small-scale industries and generating employment opportunities in areas such as production, distribution, and machine maintenance. Decreases reliance on expensive imports, fostering self-sufficiency and strengthening the local economy. IoT-enabled monitoring minimizes waste by optimizing inventory management and preventing overproduction.

5. **Supports Public Health and Policy Goals:** Governments and NGOs can leverage IoT data from these machines to analyze usage trends and pinpoint areas with greater demand, enabling targeted allocation of resources and focused educational initiatives.These systems align seamlessly with Sustainable Development Goals (SDGs) related to gender equality, health, and sanitation.They also foster collaborations between public and private sectors, creating a comprehensive approach to tackling menstrual health challenges.

1.2 Existing System

- **Conventional Sanitary Napkin Vending Machines:**
  - These machines often rely on manual or coin-based operation, requiring physical cash for transactions and lacking modern digital payment options.
  - This limitation reduces their convenience in an increasingly cashless society. Additionally, stock levels are monitored manually, which can result

in inefficiencies like shortages or excess inventory, disrupting their usability.

- **Drawbacks:**
  - Existing systems rely on manual stock checks, which can result in inefficiencies like product shortages or excessive inventory. These challenges disrupt the consistent availability of sanitary products and hinder the overall reliability of the system.
  - The majority of vending machines operate using coin-based mechanisms, which diminishes their convenience in a cashless society and restricts accessibility for users without physical currency. machines do not incorporate advanced features such as IoT-based data tracking, automated stock alerts, or remote monitoring, which limits their operational efficiency and scalability.

1.3 Motivation

IoT-enabled sanitary napkin vending machines, equipped with features such as UPI payments, real-time stock tracking, and low stock alerts, are set to transform the way menstrual hygiene products are accessed and managed.

1. **Addressing Gaps in Menstrual Hygiene Management:** Millions of menstruators, particularly in underserved regions, encounter significant obstacles in obtaining hygienic menstrual products. This initiative seeks to offer a dependable and accessible solution to overcome these challenges, fostering improved health and safeguarding dignity.
2. **Promoting Gender Equality and Empowerment:** Providing consistent access to sanitary napkins allows women and girls to engage in education, employment, and community activities without interruption caused by menstruation. This initiative fosters both social and economic empowerment.

3. **Leveraging Technology for Social Impact:** The incorporation of IoT technology and digital payment systems advances the distribution of sanitary napkins while encouraging digital literacy and facilitating seamless cashless transactions for users.

4. **Operational Efficiency and Data-Driven Insights:** Real-time stock monitoring and low stock alerts facilitate seamless operations, reduce waste, and enable data-driven optimization of supply and demand, resulting in a highly scalable and efficient system.

   PO

5. **Supporting Sustainable Development Goals:** This project supports essential Sustainable Development Goals (SDGs), including good health and well-being, gender equality, and clean water and sanitation. By tackling a vital yet often neglected issue, it plays a significant role in fostering comprehensive social development.

Chapter 2

LITERATURE REVIEW

An extensive review of the literature emphasizes the effectiveness of sanitary napkin vending machines in enhancing access to menstrual hygiene products in public spaces. Multiple studies have validated the positive impact of making sanitary napkins readily available on women's health and overall well-being. For example, research conducted in Mumbai, India, revealed that providing sanitary napkins to teenage girls in schools led to a significant decline in absenteeism during their menstrual cycles, highlighting the role of such initiatives in promoting education and reducing stigma. [1]

Likewise, research conducted in rural Nepal highlighted the significant health benefits of improving access to sanitary napkins. The study observed a notable reduction in infection rates among women who obtained these hygiene products from community health centers. By addressing the gap in menstrual hygiene management, the availability of sanitary napkins not only contributed to better health outcomes but also empowered women with the ability to maintain proper hygiene during menstruation. This intervention showcased the importance of accessible menstrual products in fostering healthier communities and reducing risks associated with poor menstrual hygiene practices. [2]

Sanitary napkin vending machines provide an efficient and reliable solution for women to access menstrual hygiene products in public spaces. By offering a discreet and hassle-free method of obtaining sanitary napkins, these vending machines address the challenges often associated with accessibility and privacy. A study conducted within a university setting in the United States underscored the positive reception of

this innovation. The research revealed that a significant proportion of female students surveyed expressed a preference for using sanitary napkin vending machines over traditional methods, such as purchasing from stores or relying on shared supplies in restrooms. This preference highlights the machines' ability to meet the needs of women in environments where convenience and privacy are essential. Furthermore, the findings suggest that such vending machines can be effectively integrated into public spaces to promote ease of access and foster a supportive environment for menstrual health management. [3]

Similarly, research conducted in a bustling Indian mall highlighted the strong preference among women for sanitary napkin vending machines over traditional store purchases. The majority of women surveyed expressed that the vending machines provided a quicker, more convenient, and discreet solution to access sanitary products. Unlike purchasing from a store, where there may be concerns about privacy or social stigma, vending machines were perceived as a hassle-free and time-efficient option. This preference underscores the importance of accessibility and discretion in addressing the menstrual hygiene needs of women in public spaces. Such findings emphasize the potential of sanitary napkin vending machines to transform the way menstrual products are made available, fostering a more comfortable and inclusive experience for women in diverse public settings. [4]

While sanitary napkin vending machines present a convenient solution for menstrual hygiene management, they are not without their challenges. One of the primary issues is the cost associated with using these machines. The price of sanitary napkins dispensed through vending machines may be higher compared to purchasing them in bulk from traditional stores. This can make the products less affordable and accessible, particularly for women from economically disadvantaged backgrounds. Efforts to subsidize costs or collaborate with government and non-governmental organizations could address this concern, ensuring affordability for all users. Moreover, cultural and religious barriers can play a significant role in hindering the acceptance

and utilization of these machines in certain regions. In communities where menstruation is heavily stigmatized or considered a taboo subject, women may feel uncomfortable or hesitant to use the machines. Deep-rooted societal norms or conservative views could also prevent their installation in public spaces, thereby limiting their reach and effectiveness. Addressing these challenges requires a multifaceted approach, including community engagement, education campaigns to normalize conversations about menstrual health, and the inclusion of diverse cultural perspectives in the design and placement of the machines. By tackling these obstacles through policy support, community collaboration, and awareness-building initiatives, sanitary napkin vending machines can achieve broader acceptance and provide equitable access to menstrual hygiene products.[5]

Chapter 3

PROJECT DESCRIPTION

3.1 Working Principle

The working principle of an IoT-enabled sanitary napkin vending machine revolves around integrating advanced technologies to ensure seamless operations and enhanced accessibility. Here's how the system functions:

- **Digital Payment Integration:**The vending machine utilizes UPI (Unified Payments Interface) technology, a secure and popular digital payment system. Users simply scan a QR code on the machine with their smartphones, input the payment amount, and complete the transaction. This removes the dependency on physical cash or coins, offering a smooth and cashless payment process.

- **Product Dispensing Mechanism:**Once the payment is confirmed, the machine activates its motorized dispensing mechanism, which carefully releases a single sanitary napkin through the dispensing slot. The system is engineered to ensure the napkins are delivered intact, hygienically, and without errors, providing a seamless and user-friendly experience.

- **IoT-Enabled Stock Monitoring:**The machine features sensors linked to an IoT system, enabling continuous monitoring of sanitary napkin stock levels. These sensors transmit real-time updates to a central server or cloud platform, allowing stakeholders to access precise stock information remotely via a dashboard or mobile app at any time.

- **Low Stock Alert System:**When sanitary napkin stock levels drop below a predefined threshold, the IoT system automatically triggers a low stock alert. This notification, delivered via SMS, email, or push notification, informs the

assigned operators or administrators, enabling timely restocking to prevent any shortages.

- **Remote Operation and Maintenance:** Through a centralized interface, administrators can remotely track the machine's operational status, stock levels, and connectivity. If technical issues or malfunctions arise, diagnostic details are sent to service personnel, ensuring quicker and more effective maintenance. This approach reduces downtime and guarantees continuous functionality.

The IoT-enabled sanitary napkin vending machine simplifies operations and improves accessibility through advanced technological integration. With features like real-time stock tracking, automated low stock notifications, cashless payment options, and remote monitoring, it delivers a dependable, efficient, and user-centric solution. This development significantly improves functionality while tackling key issues in menstrual hygiene management.

3.1.1 Block Diagrams

3.1.1.1 Flow Chart

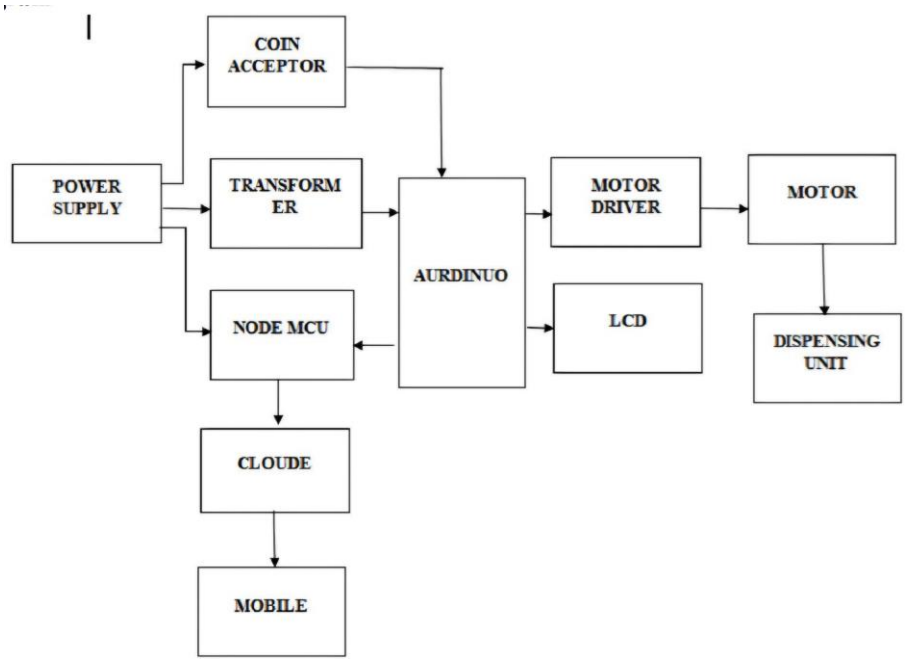

Figure 3.1: vending machine block diagram

3.1.1.2 Circuit Diagram

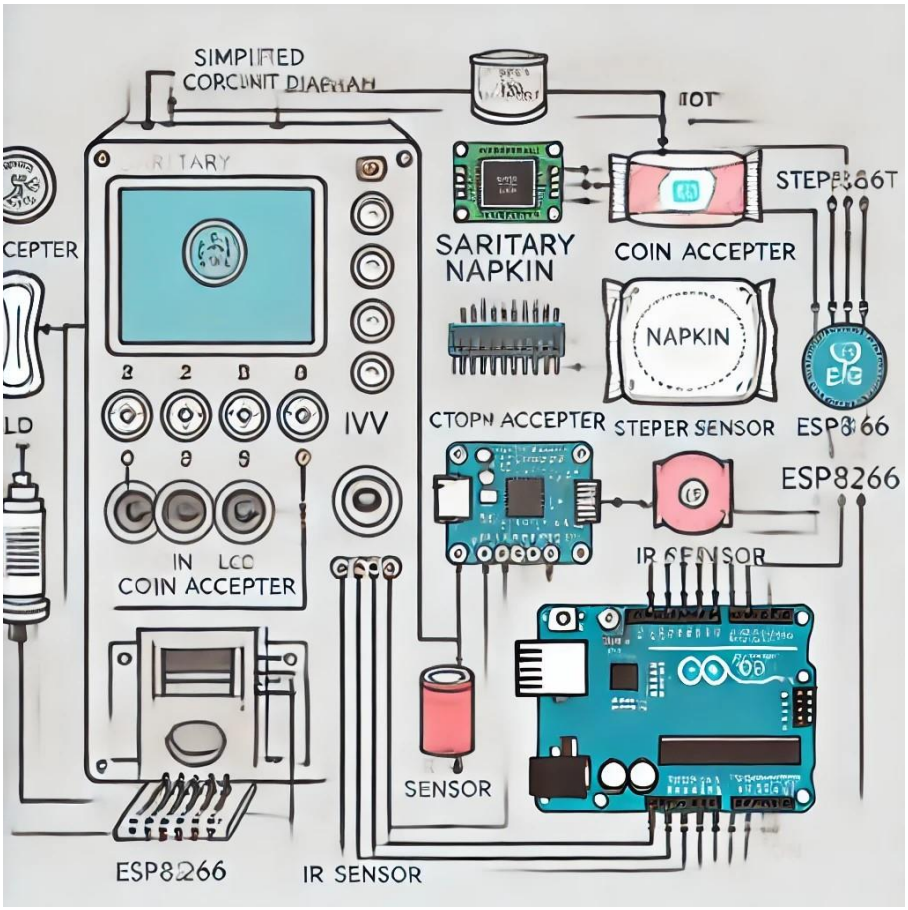

Figure 3.2: Graphical representation of circuit diagram

3.2 Hardware Description

The IoT-enabled sanitary napkin vending machine's hardware setup incorporates a range of precise components to ensure efficient and reliable operation. At its core lies a microcontroller like Raspberry Pi or ESP32, orchestrating tasks such as payment processing, stock level monitoring, and napkin dispensing. A motorized dispensing mechanism, driven by stepper motors, ensures seamless delivery of napkins. Stock levels are monitored using sensors like ultrasonic or infrared, which also trigger low-stock alerts when necessary. For cashless transactions, the system integrates a UPI-based QR code scanner, while connectivity is facilitated through Wi-Fi or GSM modules for communication with cloud platforms. Additional components, including an LCD

display for user guidance and a stable power supply, complete this innovative and user-friendly setup.

- Microcontroller/Processor
- Motorized Dispensing Mechanism
- Sensors
- Payment Module
- Connectivity Module
- Display
- Power Supply
- Cables and Connectors
- Casing
- Push Buttons/Keypad
- Buzzer or Indicator LEDs
- Cloud Storage Platform

3.3 Hardware setup

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display for user guidance and a stable power supply, complete this innovative and user-friendly setup.

1. **Microcontroller/Processor**

   Serves as the central control unit, orchestrating the operations of all components, managing data processing, and executing key functions such as payment processing, monitoring stock levels, and dispensing napkins.

Figure 3.3: Microcontroller/Processor

2. **Motorized Dispensing Mechanism**

   Handles the physical process of dispensing napkins, providing accuracy and control over the quantity dispensed.

Figure 3.4: Motorized Dispensing Mechanism

3. **Sensors**

Track the machine's stock levels by measuring distances or detecting items (napkins), enabling identification of whether the stock is adequate, running low, or depleted.

Figure 3.5: sensors

4. **Payment Module**

Enables cashless payments by allowing users to utilize a QR code scanner for transactions via Unified Payments Interface (UPI), providing a smooth and hassle-free purchase experience.

Figure 3.6: payment module

5. **Connectivity Module**

Allows the machine to establish connectivity with the internet or cellular network, facilitating IoT features like transmitting real-time stock data and triggering low-stock alerts to a cloud platform or mobile application.

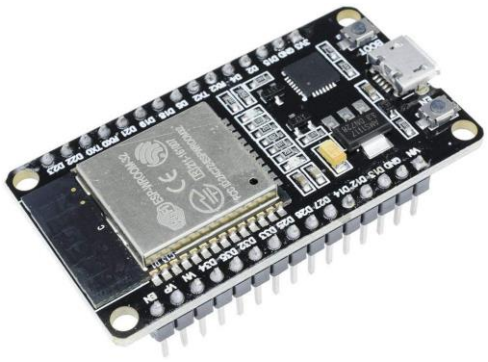

Figure 3.7: Connectivity Module

6. **Display**

Assists users throughout the transaction and operation by displaying messages, instructions, and payment confirmations.

Figure 3.8: Display

7. **Power Supply**

Supplies electrical power required to operate all components seamlessly, ensuring consistent functionality. This can be achieved using a reliable 12V adapter or a battery backup for uninterrupted performance.

Figure 3.9: Power Supply

8. Cables and Connectors

For connecting components and establishing proper electrical wiring.

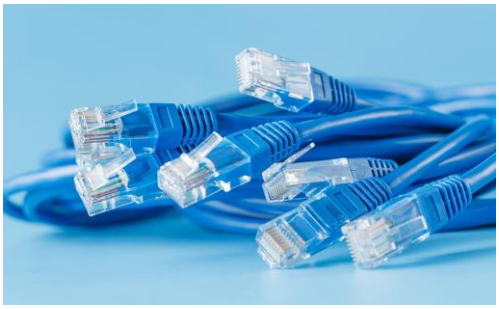

Figure 3.10: Cables and Connectors

9. casing

Shields internal components from environmental influences, enhances safety, and provides the machine with a functional and visually appealing design.

Figure 3.11: Casing

10. Push Buttons/keypad

Enables users to manually input commands, such as choosing a product or initiating a refund, when necessary.

Figure 3.12: Push Buttons/Keypad

11. Buzzer or Indicator LEDs

Delivers audio or visual cues for various actions, including payment success, dispensing completion, and low-stock notifications.

Figure 3.13: Buzzer or Indicator LEDs

12. Cloud Storage Platform

Handles data storage and processing for the machine, supporting functionalities such as real-time monitoring and low-stock alerts.

3.4 Software Description

3.4.1 Software setup

The software setup for the IoT-enabled sanitary napkin vending machine has been carefully crafted to ensure seamless integration and efficient operation. First, development environments such as Arduino IDE or Python-based IDEs like Thonny are installed, depending on the microcontroller. Essential libraries, including ‘IRremote‘ for sensors, ‘Stepper‘ for motor control, and communication libraries for IoT features, are added. The microcontroller is then programmed to manage critical functionalities such as payment validation, stock monitoring, dispensing, and cloud communication.

The QR code scanner is configured to work in harmony with the microcontroller. By integrating a UPI payment API, secure and reliable transaction validation is achieved, and thorough testing ensures successful payments trigger the dispensing mechanism. Ultrasonic or infrared sensors are programmed to

monitor stock levels and generate low-stock alerts. Additionally, servo or stepper motors are precisely controlled to dispense sanitary napkins efficiently.

To enable IoT features, connectivity modules like Wi-Fi or GSM are set up to provide internet access, using protocols such as MQTT or HTTP for transmitting real-time data. Cloud services like Firebase, AWS IoT, or Bolt IoT are utilized to store and manage data, such as stock levels, transaction logs, and machine status. An intuitive user interface is created for the LCD or LED display, offering clear instructions, payment confirmations, and important notifications to users.

Alerts for issues like low stock or system errors are implemented using APIs such as Twilio or Telegram, ensuring that notifications are sent via SMS or mobile apps. After each module is rigorously tested and all components are integrated, the final deployment process involves uploading the software to the microcontroller, connecting all hardware, and performing real-world tests. This meticulous process guarantees the vending machine operates as an IoT-enabled, user-friendly, and highly reliable solution.

3.4.2 Implementation code

The HTML code for the website setup of the restocking mechanism is provided below:

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Sanitary Napkin Vending Dashboard</title>
    <link rel="stylesheet" href="style.css">
</head>
<body>
    <div class="container">
        <h1>Sanitary Napkin Vending Machine Dashboard</h1>
        <div id="status">
            <p>Current Stock Level: <span id="stockLevel">Loading...</span></p>
            <p>Last Updated: <span id="lastUpdated">Loading...</span></p>
        </div>
        <button onclick="restockMachine()">Restock Machine</button>
    </div>

    <script src="https://www.gstatic.com/firebasejs/8.10.0/firebase-app.js"></script>
    <script src="https://www.gstatic.com/firebasejs/8.10.0/firebase-database.js"></script>

    <script>
        // Firebase setup
        var firebaseConfig = {
            apiKey: "your-api-key",
            authDomain: "your-project-id.firebaseapp.com",
            databaseURL: "https://your-database-name.firebaseio.com",
            projectId: "your-project-id",
            storageBucket: "your-project-id.appspot.com",
            messagingSenderId: "your-sender-id",
            appId: "your-app-id"
        };
        // Initialize Firebase
        firebase.initializeApp(firebaseConfig);
        var database = firebase.database();
```

Figure 3.14: HTML Code 1

```
        // Get stock level from Firebase
        var stockLevelRef = database.ref("vendingMachine/stockLevel");
        stockLevelRef.on("value", function(snapshot) {
            var stockLevel = snapshot.val();
            document.getElementById("stockLevel").textContent = stockLevel;
            var lastUpdated = new Date().toLocaleString();
            document.getElementById("lastUpdated").textContent = lastUpdated;
        });

        // Function to simulate restocking the machine
        function restockMachine() {
            stockLevelRef.set(50);  // Set stock to 50 napkins
        }
    </script>
</body>
</html>
```

Figure 3.15: HTML Code 2

Chapter 4

RESULTS AND DISCUSSIONS

1. **Result:** The deployment of the **Sanitary Napkin Vending Machine Using IoT** effectively demonstrates the use of modern technology to address a critical societal need. The vending machine operates efficiently, utilizing its IoT-powered real-time stock monitoring system to enable administrators to oversee inventory levels remotely. With the integration of **UPI payment methods**, the system offers secure and convenient cashless transactions, making it highly user-friendly and widely accessible. The mobile application's low-stock alert feature further enhances practicality by providing real-time notifications to administrators, ensuring timely replenishment and preventing product shortages. Moreover, the seamless interplay between the hardware and software components ensures consistent communication, enabling smooth and reliable operation. This project highlights the potential of IoT technology to deliver innovative solutions that advance public health and convenience.

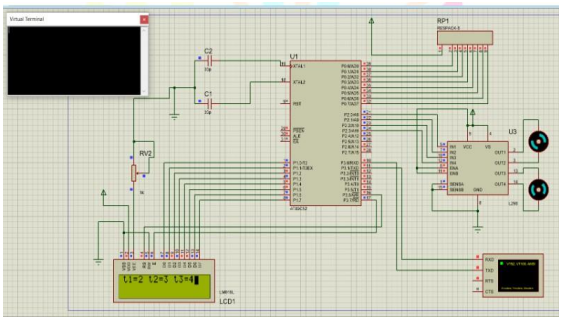

Figure 4.1: Circuit Setup

2. **Discussions:** The project's success lies in its remarkable ability to merge technological innovation with social responsibility. By providing accessible

sanitary products in public spaces, the vending machine plays a pivotal role in promoting menstrual health and hygiene. The integration of IoT technology for real-time stock monitoring enhances operational efficiency while minimizing the need for manual intervention. This makes it an ideal solution for high-traffic areas, such as schools, offices, and transportation hubs, where timely access to sanitary products is crucial. The incorporation of UPI payment systems significantly improves user convenience by supporting India's rapidly expanding digital payment ecosystem. It removes obstacles for users who may not carry cash, thereby fostering inclusivity and accessibility. Nonetheless, some challenges exist, such as potential network disruptions and payment gateway reliability, which could impact system functionality. Additionally, the reliance on consistent internet connectivity for the IoT module may pose limitations in regions with poor network infrastructure. One of the system's standout features is its scalability. The modular architecture allows for easy adaptation of the hardware and software to serve other purposes, such as distributing medicines or hygiene products. Future improvements could include AI-driven analytics to predict usage trends more effectively and refine inventory management strategies. Overall, this project demonstrates how IoT and digital payment technologies can be leveraged to create impactful, socially driven solutions. By addressing both practical and social challenges, it sets a strong example of how technology can contribute meaningfully to public welfare and drive innovation forward.

Chapter 5

FUTURE SCOPE

The future scope of the Sanitary Napkin Vending Machine Using IoT is vast, as it has the potential to address not only menstrual hygiene needs but also create a more inclusive and sustainable ecosystem through advancements in technology. Below is a detailed exploration of the future possibilities:

- The vending machine can incorporate advanced IoT sensors to significantly enhance its functionality. These state-of-the-art sensors would enable precise tracking of stock levels, early detection of potential malfunctions, and monitoring of environmental factors like temperature and humidity to maintain product quality. By leveraging predictive maintenance powered by IoT, the system could identify and address issues before they escalate, ensuring uninterrupted operation and optimal performance.
- Integrating artificial intelligence and machine learning into the system could revolutionize inventory management. By studying usage trends, the technology would predict periods of heightened demand and automatically adjust stock levels to ensure optimal availability. Additionally, AI could offer valuable insights into user behavior, empowering administrators to fine-tune operational strategies and make data-driven decisions for enhanced efficiency.
- Future versions of the vending machine could focus on incorporating eco-friendly solutions to enhance sustainability. This could include providing biodegradable sanitary products and equipping the system with energy-efficient hardware to reduce its environmental impact. Additionally, solar-

powered vending machines would be an ideal choice for rural areas or locations with limited access to electricity, promoting a greener and more sustainable operation.

- The modular design of the vending machine offers the flexibility to dispense a variety of essential products beyond sanitary napkins. It can be customized to provide items such as contraceptives, medications, hygiene kits, or baby care essentials. This adaptability enhances the machine's utility, making it a versatile solution suitable for addressing a wide range of public health requirements.
- Expanding the payment options beyond UPI integration could greatly enhance the system's accessibility and convenience. Future iterations could incorporate NFC-based contactless payments, QR code scanning, and compatibility with multiple mobile wallets to cater to diverse user preferences. Additionally, introducing offline payment solutions would ensure functionality in areas with unreliable internet connectivity, making the system more inclusive and widely accessible.

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