G-Pay Integrated Sanitary Napkin Vending Machine

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ABSTRACT

Access to sanitary napkins remains a challenge in public and institutional areas due to limited availability and payment constraints. This paper presents an automated, cashless vending machine that exclusively accepts G-Pay transactions, ensuring seamless and hygienic access to menstrual hygiene products. The system is powered by an ESP8266 microcontroller, integrating a QR-based UPI payment system that verifies transactions in real time. Upon successful payment, the vending machine activates a motorized dispensing mechanism, delivering the product efficiently. An LCD display provides users with real-time stock availability, enhancing accessibility and ease of use. The key innovation of this system is its automated payment tracking and refund mechanism by using Google Sheets. By eliminating cash handling, the system enhances hygiene and operational efficiency, making it ideal for schools, workplaces, and healthcare facilities. The scalable design of this vending machine allows for future expansion to other essential products, contributing to a more accessible and digitally integrated vending ecosystem.

Keywords: Smart Vending Machine, G-Pay Integration, ESP8266

I. INTRODUCTION

Digital automation in recent times has been at the forefront in enhancing public hygiene and health, particularly in availing basic commodities such as sanitary napkins [1]. Conventional vending machines have also slowly evolved to become smart machines that are now able to make digital transactions, increase the ease of use and avoid the involvement of manual interventions [3]. With the growing acceptance of UPI platforms such as Google Pay (G-Pay), online payment solutions into vending systems guarantees quicker, touchless, and secure transactions [2], [5]. This paper presents a smart sanitary napkin vending machine integrated with G-Pay using Razor Pay's UPI platform [1]. The embedded system is developed with the ESP8266 Node MCU and is automated for payment verification, napkin dispensing, and payment transaction recording [2]. It employs Google Apps Script and Google Sheets for backend functions in real time [4]. The goal is to deliver a hygienic, low-maintenance, and user-friendly solution for schools, colleges, hospitals, and public places, while creating menstrual hygiene awareness and Digital India initiative support [1], [5]. The key contributions of this paper are:

1. Development of automatic napkin vending machine with ESP8266 MCU [2].
2. Integrating G-Pay for online payment transactions [5].
3. Registering all transactions by using Google Apps Script and Google Sheets for payment review process.

II. SYSTEM DESIGN

A. System Architecture

The Sanitary Napkin Vending Machine system is built as an integrated architecture where both hardware and software components work together to provide an automated and efficient solution for the user [2]. The core component is ESP8266 microcontroller, which serves as the heart of the system. The ESP8266 controls the entire operation by managing payment verification, dispensing of the napkin, and updating the transaction status [4].

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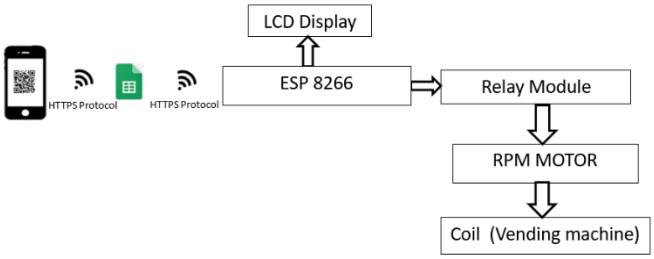

Fig 1: Block Diagram

The block diagram of the proposed automated napkin vending system is shown in Fig. 1. The major hardware components requited to develop the system are given in Table I. The proposed system is scalable to enhance its usability as per the requirements by the user.

Table 1: Hardware Components

Sl. No.	Components	Quantity
1	ESP 8266	1
2	LCD Display	1
3	Relay Module	1
4	RPM Motor	1
5	9 V Battery	1

The circuit diagram of the proposed system is shown in Fig.2. The embedded system requirements for developing the automatic vending machine is simple and scalable.

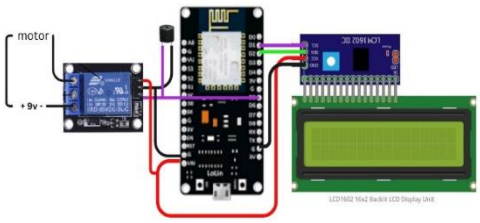

Fig 2: Circuit Diagram

The ESP8266 acts as the central controller, processing payment verification data from Google Sheets and managing communication between the cloud and hardware components [4], LCD display shows real-time updates to the user, such as payment confirmation and the status of the napkin dispensing, The relay module functions as an electronic switch, allowing the ESP8266 to control power flow to the RPM motor when the payment is verified and RPM motor is activated by the relay module to rotate the dispensing mechanism and release the sanitary napkin after payment is confirmed [1]. Google Sheets serves as a real-time cloud database that retains all transaction information and updates the vending machine stock status [4]. It provides remote monitoring and easy data accessibility by administrators. Google Sheets stores and logs transaction details in real-time, serving as a database that the ESP8266 queries to verify payment status. Google Apps Script does the backend automation by checking transactions from the payment gateway and updating the Google Sheets accordingly. It also sends approved responses to the ESP8266 to activate the dispensing mechanism. Here Webhooks facilitate real-time data transfer from the payment gateway to Google Sheets after a payment is made. They initiate automated scripts to authenticate transactions and trigger the vending process [2]. We also employed postman in development to test and simulate HTTP GET and POST requests in order to implement proper API communication. It assists in checking if the ESP8266 is receiving proper data from the server. Arduino IDE is a development environment in which code can be written, compiled, and uploaded to the ESP8266 microcontroller. It has a number of libraries that assist in controlling the hardware elements such as the motor, relay, LCD and real-time debugging via serial monitoring.

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B. Algorithm

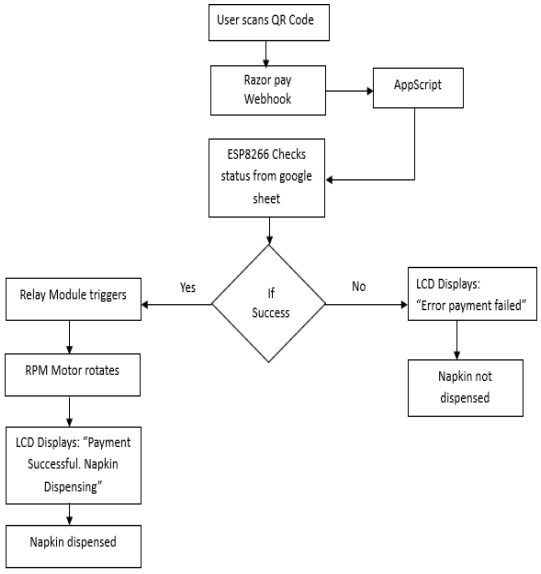

Fig 3: Algorithm

The algorithm of the proposed G-Pay integrated sanitary napkin vending machine is illustrated in Fig. 3 [2]. The process is initiated when the user scans the displayed QR code using a UPI-enabled application [5]. Upon completing the transaction, Razor Pay's webhook captures the payment details and sends them to a Google Apps Script. This script processes the data and updates the payment status in a connected Google Sheet [4]. The ESP8266 Node MCU continuously monitors the Google Sheet for any new payment entries [2]. If a successful transaction is detected, the relay module is activated, triggering the RPM motor. As a result, the napkin is dispensed, and the LCD displays a confirmation message: "Payment Successful. Napkin Dispensing." In case of an unsuccessful payment, the system aborts the dispensing process and the LCD displays: "Error Payment Failed," ensuring product security.

III. HARDWARE DEVELOPMENT

A. Hardware Implementation

Sanitary Napkin Dispensing Machine system includes a number of hardware parts designed to operate easily and automatically. The system core is based on the ESP8266 microcontroller due to its capability for Wi-Fi connectivity as well as adaptability[3]. This microcontroller oversees all the components within the system, such as accepting payments and energizing the dispenser mechanism [1]. Major hardware devices are a motor, which dispenses the sanitary napkin upon verification of payment, and an LCD screen, which displays current status of napkin availability and transaction. The prototype of napkin dispensing assembly developed for testing is shown in Fig. 4.

Fig 4: Hardware Prototype

The device also carries a QR code, which displays a personalized UPI payment link to users to facilitate secure and online transactions. There is also Wi-Fi connectivity to support communication with the cloud for remote monitoring. The Fig. 5 shows the availability of stock in the LCD Display and QR Code for scanning to initiate a transaction. The embedded system for implementing the automatic mechanism is shown in Fig. 6.

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Fig 5: LCD Display and QR

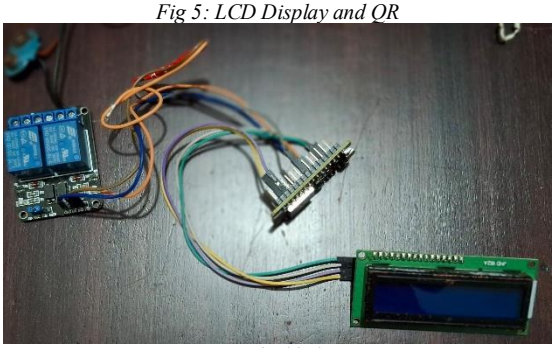

Fig 6: Embedded System

B. Software Implementation

The software for the system is developed by using the Arduino IDE, for programming the ESP8266 microcontroller to manage a range of key processes [2]. The software manages the QR code generation, generating a specific code per transaction, which is associated with the user's G-Pay account for secure verification of payment [5]. When the payment is verified through UPI, the system engages the motor to release a napkin. The software also has an integration with Google Sheets to ensure real-time monitoring of transactions and effective inventory management [4]. The integration ensures that the data is always updated, making it easier to manage inventory. The ESP8266 talks to the cloud-based server and Google Sheets to ensure effective and real-time transaction and stock information. The ESP8266's self-contained Wi-Fi connectivity allows real-time monitoring remotely, with meter updates and maintenance when needed to support uninterrupted, seamless operation.

IV. RESULTS

The proposed napkin vending machine is tested and verified the functionality. It takes 10 seconds to dispense the napkin after a successful payment. A sample Google Sheet is shown in Fig. 7 and Google App Script for registering the transactions is shown in Fig. 8.

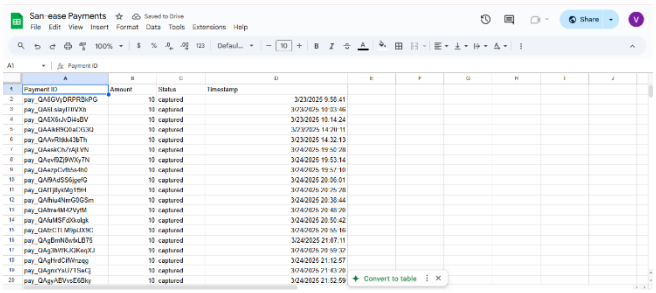

Fig 7: Sample Google Sheet

The vending machine system has revolutionized the way people access sanitary napkins by incorporating G-Pay and UPI payments, eliminating the need for cash. This results in a fast and easy way to get products immediately after payment. The QR code for payment is simple to use, even for newcomers. Google Sheets are used to track transactions and stock levels in real time, keeping everything organized and transparent. With Wi-Fi connectivity,

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the machine can be controlled remotely and maintains accurate data. By getting rid of cash transactions, the machine offers better hygiene and security. This makes it a reliable and low-maintenance option for ensuring important hygiene products are easily accessible in public areas.

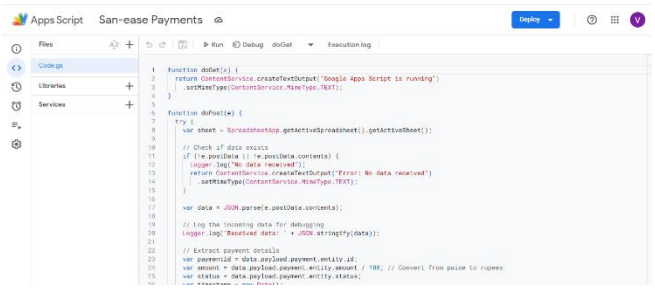

Fig. 8 Google App Script

V. Future Enhancement

The vending machine presents a scalable solution for accessible menstrual hygiene products. Several enhancements can be implemented to extend its usability and impact: Automated Refilling Alerts: Implementation of a smart notification system to alert maintenance personnel for timely restocking of sanitary napkins, Smart App Integration: Development of a mobile application for locating nearby vending machines and checking real-time availability, Customizable Dispensing: Support for dispensing various napkin sizes or pack options based on user preference, Eco-Friendly Options: Provision of biodegradable or reusable sanitary napkins to reduce environmental impact and promote sustainability.

VI. Conclusion

The vending machine provides a hassle-free and secure automated dispensing option through G-Pay payments, providing a cashless experience. This obviates the risk of physical cash transactions, greatly improving hygiene and security. The machine also provides smart inventory management through the integration of Google Sheets, allowing real-time transaction tracking and inventory availability. With user-friendliness as its strength, the QR code-based payment system provides easy accessibility, even for the very first time. The system demands minimal manual effort, minimizing maintenance expenses and labor. With Wi-Fi-supported connectivity, the machine provides seamless remote functioning and automatic updating of data, furthering digital transactions and automation.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest in this study.

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