IOT-Based Smart Dress Vending Machine

Rashmitha R S[1], Suba S L[2], Nivethitha R[3], Sri Gowshika S[4]
[1,2,3,4]*Department of Information Technology, Arunachala College of Engineering for Women*

***Abstract*—Internet of Things (IoT) has become one of the most influential technologies in modern automation systems. It enables physical devices to communicate with each other through the internet, allowing remote monitoring, intelligent decision-making, and efficient resource management. In modern society, people frequently buy dresses for special occasions such as weddings, festivals, and parties. However, many of these dresses are worn only once and then remain unused in wardrobes. It leads to wastage of clothing, money, and resources. At the same time, many people cannot afford new clothes. Therefore, there is a need for a smart system that promotes reuse and redistribution of clothing. The Machine provides an easy and automated way to donate or sell unused dresses. In the retail industry, IoT has introduced smart vending machines that offer customers a fast, convenient, and contactless shopping experience. Unlike traditional vending machines that mainly dispense snacks and beverages, the proposed IoT-Based Smart Dress Vending Machine is designed to automatically dispense clothing items such as T-shirts, uniforms, jackets, socks, and Tops etc.**

***Index Terms*—Internet of Things, Color Sensor, ESP32 controller**

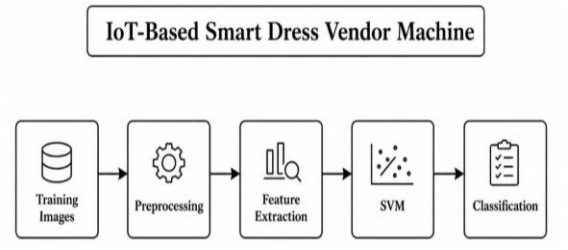
I. INTRODUCTION

Automation has transformed various sectors, including manufacturing, healthcare, banking, and retail. Modern consumers expect quick service, secure transactions, and convenient shopping experiences. Conventional clothing stores require manual billing, inventory management, and customer assistance, which increases operational expenses and limits service availability. During peak hours, customers often experience long waiting times, while retailers face challenges in maintaining accurate stock records. The Internet of Things (IoT) provides an effective solution to these problems by enabling smart devices to communicate over the internet. IoT-based systems allow real-time monitoring, automatic inventory updates, and remote management of retail operations. Smart vending machines represent one of the most successful applications of IoT in retail automation. The IoT-Based Smart Dress Vending Machine is designed to automate the sale of garments without human intervention. Customers can select clothing items using a touchscreen interface and complete payment through QR code scanning or UPI. After successful payment verification, the vending machine automatically dispenses the selected garment. Every transaction is recorded in the cloud database, where inventory levels and sales records are continuously updated. The administrator can remotely monitor machine performance, inventory status, and customer transactions using a cloud-based dashboard. Automatic alerts are generated whenever inventory falls below the predefined limit, enabling timely stock replenishment. The system offers several advantages over conventional clothing stores, including continuous operation throughout the day, reduced manpower, secure digital payments, improved inventory management, and enhanced customer convenience. By integrating IoT technology with embedded systems and cloud computing, the proposed vending machine demonstrates the future of automated clothing retail.

connectivity. Customers can browse available clothing items through a touchscreen display, select the desired product, and complete payment using

digital payment methods such as QR code or UPI. Once the payment is verified, the ESP32 activates the motor-driven dispensing mechanism to deliver the selected clothing item. Simultaneously, inventory data is updated on the cloud server, allowing administrators to monitor stock levels in real time. Automatic notifications are sent whenever stock reaches a minimum threshold, ensuring timely replenishment. The machine provides 24-hour service without requiring sales personnel, thereby reducing labor costs while improving customer convenience. Cloud-based monitoring enables administrators to access sales reports, inventory information, and machine status remotely. The proposed system combines embedded systems, IoT, The proposed system is built around the ESP32 microcontroller, which provides both processing capability and Wi-Fi cloud computing, digital payment technologies, and automation to create a modern retail solution suitable for shopping malls, airports, railway stations, educational institutions, hospitals, hotels, and tourist destinations. To design and develop an automated clothing vending machine. To integrate IoT technology for remote inventory monitoring. To implement secure digital payment methods. To reduce manpower and operational costs. To provide 24-hour shopping services. To maintain accurate sales and inventory records. In today's fast-paced world, people expect quick and convenient shopping experiences, but clothing stores often involve long queues, limited-service hours, and dependence on sales staff. The IoT-Based Smart Dress Vending Machine addresses these challenges by integrating IoT, embedded systems, cloud technology, and digital payment to automate the dress purchasing process. This system enables customers to buy dresses anytime while allowing retailers to monitor inventory remotely in real time.

II. PROPOSED SYSTEM

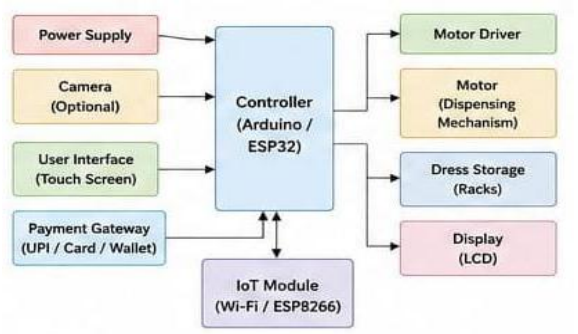


Training and Testing Images

If the vending machine incorporates artificial intelligence for clothing recognition or product verification, a comprehensive image dataset is required for training and testing the machine learning model. To improve the intelligence and efficiency of automated retail systems, machine learning techniques can be integrated for clothing recognition and classification. A well-prepared image dataset is essential for training and evaluating the performance of the recognition model. This section describes the preparation of training and testing datasets, image preprocessing methods, and evaluation metrics used for validating the classification model.

Training Images

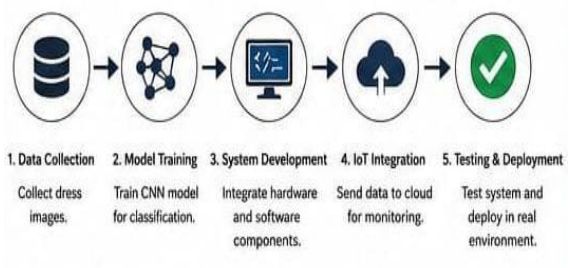
The training dataset consists of labeled images of different categories of clothing such as T-shirts, shirts, uniforms, hoodies, jackets, jeans, socks, caps, and towels. Each category contains approximately 200–500 images captured under different lighting conditions, backgrounds, viewing angles, and orientations. Image preprocessing techniques such as resizing, normalization, noise removal, and augmentation are applied before training. A Convolutional Neural Network (CNN) or MobileNet model can be used for training. During training, the model learns the unique features of each clothing category, including testing. Testing images are completely different from the training dataset. These images are used to evaluate the performance of the trained model. The system predicts the category of each test image and compares it with the actual label. Performance metrics such as accuracy, precision, recall, and F1-score are calculated to measure the effectiveness of the model. A classification accuracy above 95% indicates reliable performance for real-world applications.



A block diagram provides a clear representation of the overall architecture of the proposed system and illustrates the interaction between hardware and software components. It explains the flow of information from the customer interface to the cloud platform and dispensing mechanism, helping readers understand the complete working process of the smart dress vending machine. The proposed IoT-Based Smart Dress Vending Machine consists of several functional blocks that work together to provide an automated and efficient dress vending system. Initially, a set of labeled training images is used to train the machine learning model. The images undergo preprocessing to improve quality, followed by feature extraction to identify important characteristics such as color, texture, and shape. The extracted features are classified using the Support Vector Machine (SVM) algorithm for accurate dress recognition. Customers interact with the system through a touchscreen display to browse and select the desired dress and size. Payment is completed securely using a QR code or UPI. After successful payment, the ESP32 controller processes the request, communicates with the cloud through Wi-Fi, and controls the motor driver. The motor driver activates the dispensing mechanism to release the selected dress. The cloud server stores transaction details and updates the inventory database automatically, while the admin dashboard enables remote monitoring of stock, sales, and machine status. Optional sensors can also be used to detect product availability and confirm successful dispensing, ensuring reliable system operation.

III. METHODOLOGY

The operation of the proposed system consists of several stages. Initially, the customer approaches the vending machine and views the available clothing items displayed on the touchscreen interface. The customer selects the desired product and size. The ESP32 controller checks product availability from the cloud database. If the selected item is available, the machine generates a QR code for digital payment. The customer scans the QR code using a UPI-enabled mobile application and completes the payment. The cloud server verifies the transaction and sends confirmation to the ESP32 controller. After receiving confirmation, the controller activates the motor driver, which rotates the appropriate servo or stepper motor connected to the selected clothing compartment. The garment is released through the dispensing slot. A touchscreen display provides an interactive interface through which customers browse products, view prices, and make selections.



Immediately after dispensing, the inventory count is reduced by one in the cloud database. Sales information is stored automatically for reporting purposes. If the stock quantity reaches the minimum threshold, the administrator receives a notification through the IoT dashboard or mobile application. This process ensures uninterrupted service while minimizing manual inventory management. The methodology describes the systematic approach followed to design, implement, and evaluate the proposed IoT-Based Smart Dress Vending Machine. It outlines the sequence of operations from customer interaction to product dispensing, inventory updates, and cloud communication. This structured workflow ensures reliable and efficient system performance. The IoT-Based Smart Dress Vending Machine consists of hardware and software components working together to provide a fully automated retail solution. The ESP32 microcontroller acts as the brain of the system. It receives input from the touchscreen interface, communicates with the cloud server through Wi-Fi, verifies payment status, and controls the dispensing motors. The motor driver provides sufficient current to operate servo or stepper motors responsible for releasing the selected garment. Digital

payment is facilitated through QR code generation and UPI applications. Once payment is confirmed, the dispensing mechanism rotates the appropriate compartment to deliver the clothing item.

The cloud platform stores inventory information, sales records, customer transactions, and machine status. Administrators access this information through a web dashboard or mobile application. Automatic alerts are generated whenever inventory levels become low or system faults are detected. Software development is carried out using Arduino IDE and Embedded C programming. Firebase, Thing Speak, or Blynk IoT platforms may be used for cloud communication and remote monitoring. The proposed system consists of multiple hardware and software components that work together to provide an automated clothing vending solution. Each component performs a specific function, including product selection, payment verification, cloud communication, inventory management, and product dispensing. This section explains the role and functionality of every major component used in the system.

IV. RESULT AND DISCUSSION

The developed prototype successfully demonstrated automated clothing dispensing using IoT technology. Customers were able to select clothing items, complete digital payments, and receive products without human assistance. The ESP32 controller accurately communicated with the cloud server and updated inventory information after each transaction. Experimental testing showed that payment verification was completed within a few seconds, and the dispensing mechanism operated reliably with high accuracy. Cloud synchronization ensured that administrators received real-time updates regarding inventory levels and sales records. Automatic low-stock notifications reduced the possibility of inventory shortages. The proposed system achieved reliable operation, secure transactions, reduced manpower requirements, and improved customer convenience. It demonstrated the feasibility of implementing IoT technology in automated clothing retail systems. After implementing the proposed system, several experiments were conducted to evaluate its performance under different operating conditions. The obtained results demonstrate the effectiveness of the vending machine in terms of dispensing accuracy, payment verification, cloud synchronization, and inventory management. This section discusses the experimental observations and analyses the overall performance of the developed prototype.

V. CONCLUSION

The IoT-Based Smart Dress Vending Machine successfully integrates embedded systems, cloud computing, IoT technology, and digital payment systems into a modern automated retail solution. The project provides customers with a fast, secure, and convenient shopping experience while enabling administrators to monitor inventory remotely. The automated system minimizes operational costs, improves inventory accuracy, and supports continuous 24-hour operation. The prototype demonstrates the practical application of IoT in smart retail and has the potential to replace conventional clothing sales in selected environments. Automation has become an essential component of modern retail systems due to the increasing demand for faster and more efficient customer service. Integrating IoT technology with vending machines enables continuous operation, real-time inventory management, and secure digital transactions. This section introduces the motivation behind the proposed smart dress vending machine, discusses the need for such a system, and explains how IoT can improve the overall shopping experience. The rapid advancement of Internet of Things (IoT) technology has significantly transformed the retail industry by enabling automated, intelligent, and connected systems. Smart vending machines have emerged as an innovative solution for providing products and services with minimal human intervention. The proposed IoT-Based Smart Dress Vending Machine

is designed to offer customers a fast, secure, and convenient method of purchasing clothing items while allowing administrators to monitor inventory remotely through cloud technology. The following abstract summarizes the objectives, methodology, and outcomes of the proposed system. The implementation of the proposed system demonstrates the practical application of IoT in automated retail solutions. The project achieves its objectives by providing secure, efficient, and user-friendly clothing vending services.

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