ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct887

Self Service Documents Printing Machine Using Raspberry Pi

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Publication Date: 2026/10/26

Abstract: The increasing demand for document printing services in educational institutions highlights the need for a convenient, efficient, and automated printing solution. Conventional printing facilities may require students to wait in queues and depend on the availability of operators. This review paper examines existing research on self-service printing platforms, automated pay-and-use printing machines, cloud-based print queue management, and smart printing kiosks. Based on the reviewed approaches, a Raspberry Pi-based self-service document printing machine is proposed to simplify the printing process. The proposed system allows users to scan a QR code, upload PDF documents or images through a mobile interface, select A4 and Legal paper size and black-and-white or colour printing, and complete payment using the Unified Payments Interface (UPI). After successful payment verification, the Raspberry Pi will manage the print job and communicate with the connected printer to initiate printing. The system also proposes automatic deletion of uploaded documents after the printing process to improve user privacy. In addition, ink-level and paper-availability monitoring will be explored to identify resource shortages and notify users about possible printing interruptions. A comparative analysis of existing systems will help identify research gaps and potential improvements in automation, payment integration, privacy, and printer status monitoring. The proposed system aims to provide an accessible, user-friendly, and cost-effective self-service printing facility for educational institutions. Since the project is currently at the planning stage, its functionality and performance will be evaluated during future implementation and testing.

Keywords: *QR Code, Self-Service Printing, Raspberry Pi, Flask, CUPS, UPI Payment, Print Queue, College Automation.*

How to Cite: Vedant Dayalkar; Roshan Chendulkar; Aditya Tawar; Rafe Zeeshan; Shravani Mhala; R. M. Gharat (2026) Self Service Documents Printing Machine Using Raspberry Pi. *International Journal of Innovative Science and Research Technology*, 11(10), 1675-1680. https://doi.org/10.38124/ijisrt/26oct887

I. INTRODUCTION

Printing is an essential requirement in colleges for assignments, laboratory records, seminar papers, project reports, examination documents, application forms, and other academic work. Although digital learning resources are widely used, many academic activities still require printed copies. In several institutions, students depend on a staff-operated printing counter or a nearby print shop. During busy periods, especially before assignment submissions and examinations, students may have to wait for their turn and repeat instructions about page count, paper size, colour mode, number of copies, and single- or double-sided printing. These manual steps can make the process time-consuming and inconvenient.

Traditional printing workflows also require a student to transfer a file to the operator through a USB drive, email, messaging application, or another method. The operator then opens the file, checks the required settings, calculates the charge, receives payment, and starts printing. Apart from waiting time, this process can create risks such as selecting incorrect print settings, confusion about the total cost, misplaced files, and accidental exposure of personal or academic documents. A more organized self-service method could allow students to manage the main steps themselves while keeping print jobs and transaction records properly organized.

A self-service printing kiosk provides an alternative by allowing users to submit documents and choose printing options without depending on an operator for every job. QR codes can make access simple: a student scans the code displayed on the machine using a smartphone and opens a mobile-friendly web application. This approach can avoid the need to install a separate application and can make the interface accessible through a familiar browser. The web page can guide the user through document upload, paper-size

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct887

selection, colour or black-and-white printing, duplex selection where supported, and the number of copies required.

Embedded platforms such as the Raspberry Pi can support this type of automation because they can run an operating system, web services, a database, and printer-management software on one compact device. In the proposed system, the Raspberry Pi acts as the central controller. Python and Flask can be used to develop the application logic and web interface, while CUPS can manage compatible printers and their print queues. SQLite or MySQL can store job information, print settings, transaction status, and history records. The system can calculate the printing charge from the selected settings and display the amount before the student confirms the request.

Digital payment is another important part of a self-service printing workflow. The proposed system uses a PhonePe UPI QR-based payment process, but the application must distinguish between merely displaying or scanning a QR code and confirming that a payment for a particular job has actually been received. Automatic release of a paid print job should therefore depend on a reliable payment-verification method or a controlled administrative reconciliation process. This is important to prevent unpaid jobs from being printed and to reduce mistakes when several students use the machine close together.

The project also proposes a feature called Clearance Mode for students who are temporarily unable to pay at the time of printing. If the college approves this facility, an eligible student could be identified and the printing charge recorded against their account for settlement through the institution's later clearance process, such as at the end of the academic year. This feature would require defined eligibility rules, limits, authorized access, and proper reconciliation of outstanding amounts; it should not operate as an unrestricted payment bypass.

The main aim of this project is to develop a convenient, user-friendly, and traceable self-service printing system for college students. It is intended to reduce dependence on staff for routine printing steps, provide clear print-setting and cost options, connect payment or approved clearance with print-job release, and maintain useful history for students and administrators. The system will also be designed to handle print jobs in an orderly queue, show understandable job status, and protect uploaded documents by restricting access and removing temporary files according to a defined policy. These functions will be evaluated through prototype testing, including checks of QR access, document upload, cost calculation, payment-state handling, printer compatibility, job completion, and record accuracy.

This review paper examines existing research on automated printing kiosks, printer-vending machines, digital-payment systems, and print-queue management. It then presents the proposed Raspberry Pi-based architecture and its implementation methodology, discusses practical considerations such as printer compatibility, privacy, payment verification, and Clearance Mode, and identifies areas for future testing. The report describes a proposed system; claims about reduced waiting time, reliability, or user satisfaction will need to be supported by results from the completed prototype.

II. LITERATURE REVIEW

- *Efficient Printing Solutions through the Automated Kiosk System*

Arevalo et al. proposed a QR-code-based automated printing kiosk using Raspberry Pi 4B and Arduino Mega. The system supports document uploading, print-setting selection, QR-code ticket generation, and automated document retrieval. It demonstrates the potential to reduce waiting time and improve printing convenience. However, its performance depends on network connectivity, QR-code scanning, and reliable paper handling [1].

- *Smart Coin-Operated Printing Kiosk with SMS Notifications*

Falcon, Saligue, and Saligue developed a coin-operated printing kiosk using Arduino and GSM technology for SMS notifications. The study reported positive results for effectiveness, usability, and prototype evaluation. It highlights the importance of user notifications and fault alerts, although inconsistencies in coin accumulation indicate the need for reliable payment validation [2].

- *PrintFlow: A Cloud-Based Queue Management System*

Mustafa, Parad, Shaikh, and colleagues proposed PrintFlow, a cloud-based printing system that supports remote document uploading, print-job scheduling, and secure document transmission. Its queue-management approach can improve coordination when multiple print requests arrive simultaneously. However, the system depends on network availability and secure cloud services [4].

- *My-Print: A Microcontroller-Based Smart Printing System*

Fernandez, Teleron, and Sulima presented My-Print for academic institutions, integrating document uploading, print customization, cashless payment, and administrative controls. The study reported positive user-satisfaction results and examined deployment requirements. It highlights the importance of usability, secure document handling, and institutional demand when designing automated printing services [5].

- *IoT-Based Printer Vending Machine*

Perucho and Diamante proposed an autonomous printer vending machine and evaluated it using software-quality characteristics based on ISO/IEC 25010. The study considered usability, reliability, security, compatibility, and maintainability. It demonstrates the importance of evaluating overall system quality rather than focusing only on automated printing functionality [6].

- *Bond-Paper Printing Vending Machine*

Sangil et al. proposed a self-service printing vending machine for educational environments. It supports document

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct887

transfer through USB, phone-cable connection, or Bluetooth, along with print-setting selection and coin-based payment. The study emphasizes convenient access to printing services, although supporting multiple transfer methods increases compatibility and security requirements [7].

- *Automated Pay-and-Use Browsing and Printing Machine*

Parameswari, Thangavel, and Priyanka proposed a Raspberry Pi-based system combining browsing and printing services with coin-based payment and an LCD interface. The design also considers IoT-based monitoring of print counts and browsing time. Its approach is relevant to automated service management, but public-access terminals require strong session control and secure handling of temporary files [8].

- *Self-Service Printing Automation: Retrofit Print Payment Device*

Prajwal, Vinayak, Shubham, and Navale proposed a retrofit device for adding self-service capabilities to existing printers. The design includes document submission, print configuration, QR/UPI or NFC payment, payment verification, and temporary-file deletion. This approach may reduce hardware replacement costs, although compatibility with different printers and secure file deletion require practical verification [9].

- *AutoPrinting: Self-Service Printing Platform*

Rajendra, Abhang, Sonawane, and colleagues presented AutoPrinting, a software-based platform for managing document submission, online payments, print queues, and status notifications. It also includes administrative dashboards and automated file processing. The study highlights the benefits of integrated print-shop management while identifying challenges related to internet connectivity, printer compatibility, and third-party service dependency [3].

- *IoT-Based Smart Vending Machine Using Digital Payment*

Alam et al. proposed an IoT-based vending machine integrating QR codes, a mobile application, cloud services, and a payment gateway. The system activates the physical vending mechanism after payment authorization. Although designed for vending rather than printing, its payment-verification workflow is relevant to ensuring that a print job starts only after successful payment confirmation [10].

- *QR Code for Contactless Data Collection*

Ajayi, Bello, Omoniyi, and Sofolahan examined a QR-code-based system for contactless data collection using mobile scanning and digital interfaces. The study demonstrates how QR codes can connect physical service points with online workflows. This approach is applicable to opening a printing interface or identifying a print job, provided suitable authorization and privacy protections are implemented [11].

- *Scan&Go: QR-Code Vending Machine Business Model*

Chowdhury, Mehran, Al-Mohamadi, and Dahlan presented Scan&Go, a conceptual cashless vending-machine model based on QR codes and mobile applications. The study focuses on customer convenience, digital transactions, and service design. Although it does not directly address printing automation, its approach provides useful insights into designing a simple and user-friendly self-service interface [12].

III. METHODOLOGY

This review follows a document-based comparative approach. The supplied final review-paper document was used as the structural template, and the uploaded research papers relating to automated printing, kiosk operation, digital payments, QR workflows and queue management were used as the main source material. The review identifies each paper's stated purpose, described technology, reported evaluation results and limitations. Findings from different studies are presented separately because their settings, evaluation methods, sample sizes and measured outcomes are not identical.

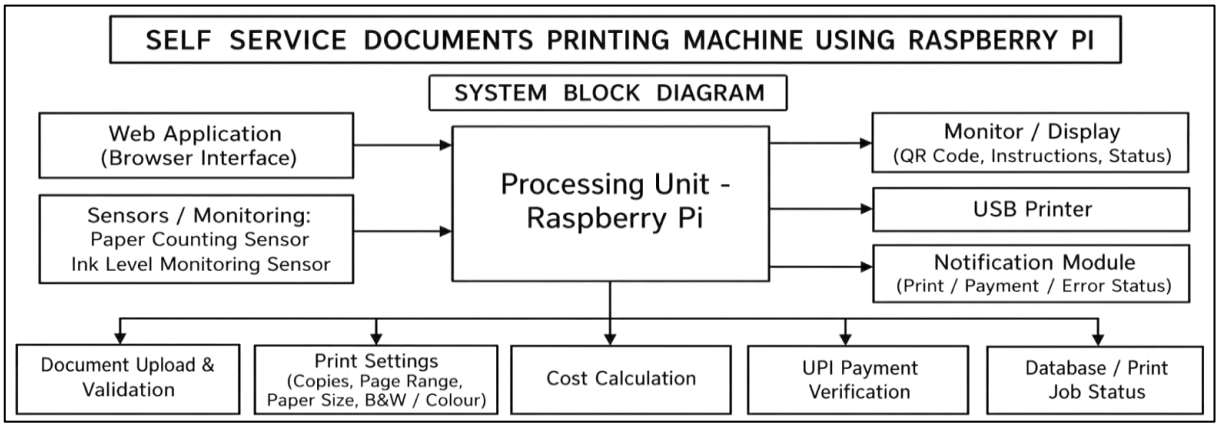

Fig 1 Block Diagram of Methodology

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct887

The proposed self-service printing system is designed to automate document printing through a web application integrated with printer monitoring, payment verification, and notification modules. The methodology consists of several functional stages, as described below.

➢ *PDF Document Upload and Validation*

The user uploads a PDF document through the web application. The system validates the uploaded file to ensure that it is accessible and suitable for printing. After successful validation, the user can configure the required printing parameters.

➢ *PDF Printing Configuration*

The web application allows users to select the number of copies, page range, paper size, and printing mode, such as black-and-white or colour printing. These settings are used to determine the printing requirements and calculate the estimated cost.

➢ *Cost Calculation and UPI Payment Verification*

The system calculates the printing cost based on the selected printing options and the number of pages or copies. The user then makes a payment through UPI. The printing process begins only after successful payment verification, helping prevent unauthorized or unpaid print jobs.

➢ *Sensor Monitoring System*

The proposed system includes printer-status monitoring, paper counting, and ink-level monitoring. These functions help identify paper shortages, low ink levels, and potential printing interruptions. Monitoring information can be displayed to the user or administrator to support timely action.

➢ *Database*

The database stores relevant print-job information, payment status, and transaction or job records as required. Uploaded documents should be handled securely, with suitable access controls and deletion policies.

➢ *USB Printer and Monitor Display*

After payment verification, the system sends the validated document and selected print settings to the connected USB printer. The monitor display presents relevant system information, including print-job progress, printer status, and completion messages.

➢ *Overall System Operation*

The complete workflow integrates document submission, print configuration, cost calculation, payment verification, printer monitoring, database management. The proposed architecture aims to provide a convenient and automated printing facility while reducing manual intervention and improving print-job management. The effectiveness of the system would need to be evaluated through implementation and testing.

➢ *Complete Flow:*

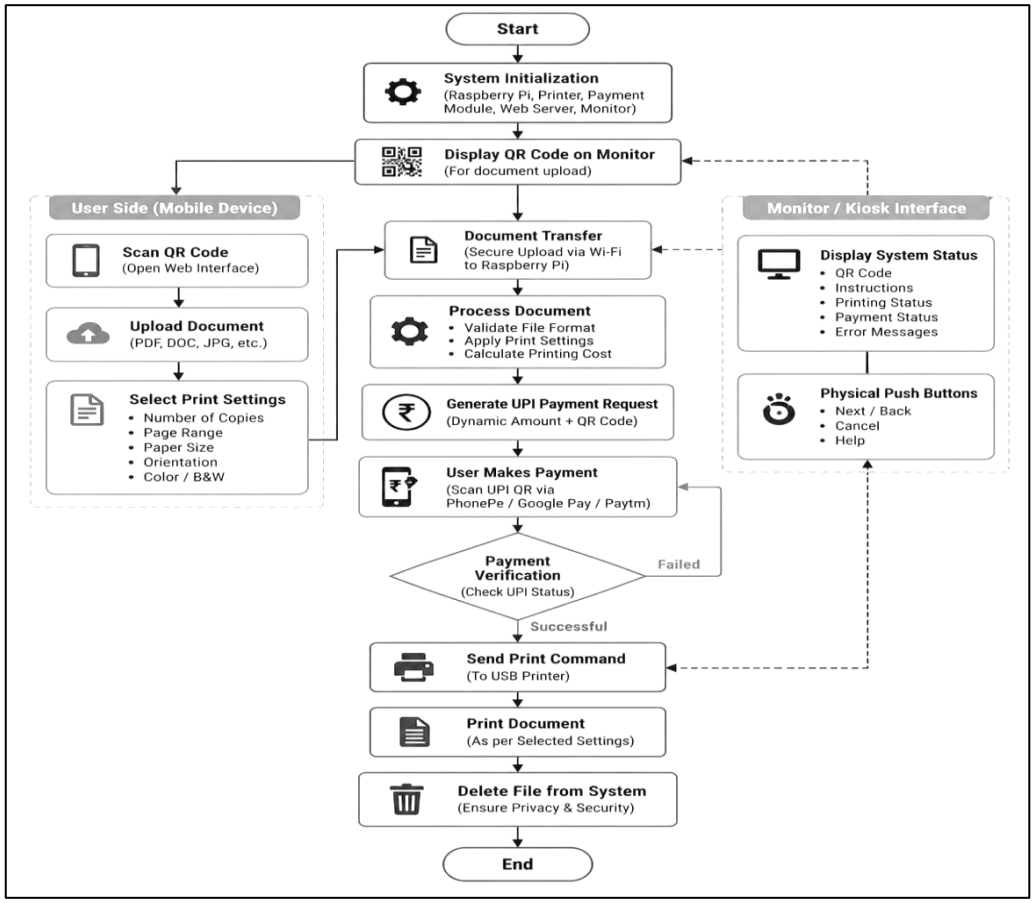

Fig 2 Flowchart

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26oct887

IV. DISCUSSION

The reviewed research papers highlight the growing importance of automated printing systems in improving accessibility, reducing waiting time, and simplifying document printing services in educational institutions. Various existing systems incorporate technologies such as QR codes, web-based applications, microcontrollers, and automated payment mechanisms to provide convenient and efficient printing solutions. These approaches demonstrate the potential of automation in reducing manual intervention and improving the overall user experience.

Based on the reviewed literature, the proposed Self Service Documents Printing Machine Using Raspberry pi aims to integrate document uploading, print option selection, cost calculation, digital payment verification, and automated printing into a single system. Users will be able to upload documents through a web interface by scanning a QR code and select printing parameters such as paper size, colour mode, and number of copies. After successful payment verification, the Raspberry Pi will process the request and communicate with the printer to execute the printing operation. The uploaded document will be deleted after successful completion of the process to improve user privacy.

The proposed system is intended to provide a convenient, time-saving, and user-friendly printing solution for students and staff in educational institutions. By combining web-based document submission, digital payment, and Raspberry Pi-based control, the system has the potential to reduce dependence on manual printing services and improve access to printing facilities. However, its practical effectiveness will depend on reliable network connectivity, secure payment verification, printer compatibility, and proper handling of failed or interrupted print jobs. Further implementation and testing will be required to evaluate its performance, reliability, security, and overall suitability for college environments.

V. CONCLUSIONS

This review paper presents a study of existing automated printing systems and their associated technologies, including QR code-based access, web-based document uploading, digital payment mechanisms, and automated printing control. The reviewed literature highlights the importance of developing efficient, accessible, and user-friendly printing solutions, particularly in educational institutions where students frequently require printing and photocopying services.

Based on the findings of the literature review, a Self Service Documents Printing Machine Using Raspberry pi is proposed to simplify the document printing process. The proposed system integrates QR code scanning, online document submission, print option selection, cost calculation, payment verification, and automated printing. It is intended to reduce manual intervention, minimize waiting time, and provide convenient access to printing facilities within college premises. Secure document handling and automatic file deletion are also considered to improve user privacy.

In conclusion, the proposed system offers a practical approach to modernizing conventional printing services through automation and digital technologies. Its successful implementation could provide a reliable and cost-effective printing solution for educational institutions. Future development will focus on prototype implementation, system testing, payment security, printer integration, and performance evaluation to assess its practical effectiveness and reliability.

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