Scan and Pay

System that enables seamless self-service printing through QR-based document upload, automated page count, and integrated online payment

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***Abstract*—This paper presents Scan and Pay, a self-service web-based printing system designed to automate and streamline the document printing process. The system empowers users to initiate printing by scanning a QR code, uploading their files, and completing payment through an integrated online gateway. It automatically calculates the number of pages and determines the payable amount based on predefined rates. Once the payment is confirmed, the system triggers a print command without any manual intervention. By eliminating traditional bottlenecks such as front-desk assistance or login terminals, Scan and Pay provides a fast, contactless, and user-friendly printing experience. The solution is particularly valuable for educational institutions, libraries, and workplaces seeking efficiency, scalability, and minimal resource overhead.**

I. Introduction

The "Scan and Pay" web application aims to simplify and streamline the process of document printing by automating file uploads, payment calculations, and print commands through a QR code interface. Users can scan a QR code, upload their documents, and instantly receive a payment request based on the number of pages. Once the payment is processed, the system automatically sends the print command to a connected printer, reducing the need for human intervention. This solution enhances convenience, saves time, and improves efficiency for users seeking a quick, hassle-free printing experience.

II. Related Work

A. Overview of Existing QR Code-Based Public Printing Systems

Several research studies have contributed to the development of self-service printing and QR code-based systems. Singh et al. (2023) proposed a secure QR-based document management system focused on encrypted uploads and user authentication for public printing. Vamsi et al. (2023) demonstrated a cloud-based document upload and payment model using QR codes for contactless printing. Sharma and Rajkumar (2022) emphasized scalable QR code payment systems to handle high user volumes efficiently.

Kulkarni et al. (2022) introduced a self-service kiosk integrating document processing and payment through a user-friendly interface. Nguyen and Pham (2022) explored the use of NFC and QR for hybrid access in public printing environments. The consensus across literature points to the need for seamless, secure, and user-oriented printing workflows, validating the approach taken in this project.

III. System Design and Methodology

The system employs a modular architecture built around a web-based interface and mobile device compatibility. Users interact with the system by scanning a printed QR code placed near the printer. This redirects them to a secure webpage where they can upload documents, set preferences (e.g., color or black white), and complete payment using integrated gateways like Razorpay or PayPal.

A. System Architecture Overview

The proposed system employs a modular web-based architecture that integrates mobile technology, cloud computing, and secure printing. The overall design comprises three main layers: the client interface, the backend server, and the printer integration layer.

B. Units

For consistency and clarity, all measurements and quantities in this project adhere to the International System of Units (SI). Where applicable, English units are mentioned in parentheses for reader familiarity.

- **Standardization of Units:** SI units (MKS system) are used throughout the project. For example, paper sizes are measured in millimeters (mm) and data sizes in megabytes (MB). English units may appear as references, e.g., "3.5-inch disk drive".
- **Avoidance of Mixed Unit Systems:** To ensure dimensional consistency in equations and computations, SI and CGS units are not combined. If exceptions occur, each quantity's unit is clearly stated. For instance, current is measured in amperes (A), and magnetic fields in tesla (T), not oersteds.
- **Consistent Formatting:** Do not mix spelled-out and abbreviated units. For example, use either "webers per square meter" or "Wb/m^2", but not "webers/m^2". Spell out units in body text such as "a few henries", not "a few H".

- **Numerical Standards:** Always place a zero before decimal points (e.g., "0.25" instead of ".25"). Use "cm^3" for volume instead of "cc".

C. Equations

All equations in this document are numbered consecutively and formatted for clarity and consistency. Roman variables and symbols representing physical quantities are italicized, while standard functions and Greek letters remain upright. Equations are punctuated as part of their sentences, and long dashes (–) are used for subtraction in text explanations.

Equations may use solidus notation ("/") or exponential functions where it improves compactness.

1) Cost Calculation: To compute the total cost C of printing, the equation is:

$$C = p \times r \tag{1}$$

where:

- C is the total cost in INR,
- p is the number of pages,
- r is the rate per page.

2) Upload Time Estimation: The time T required to upload a document is given by:

$$T = \frac{8s}{v} \tag{2}$$

where:

- T is the upload time in seconds,
- s is the file size in megabytes (MB),
- v is the upload speed in megabits per second (Mbps).

3) Queue Delay Estimation: To estimate the delay D based on the number of pending jobs:

$$D = n \times t \tag{3}$$

where:

- D is the estimated delay in seconds,
- n is the number of users in queue,
- t is the average time taken per job.

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use "(**??**)", not "Eq. (**??**)" or "equation (**??**)", except at the beginning of a sentence: "Equation (**??**) is . . ."

D. Key Features of Scan and Pay

The Scan and Pay system offers a wide range of innovative features designed to deliver a user-friendly, secure, and efficient document printing experience:

- **QR-Based Access:** Users can instantly access the print portal by scanning a QR code displayed near the printer.
- **Contactless Printing:** The process requires no physical interaction with any terminal or staff.
- **Mobile Compatibility:** The application is optimized for both mobile and desktop browsers, providing flexibility.
- **Multiple File Support:** Accepts PDF, DOCX, JPG, PNG, and other commonly used file types.
- **Custom Print Options:** Allows selection of color mode (black-and-white or color), number of copies, and page size.
- **Secure Payment Integration:** Digital payment gateways such as Razorpay and PayPal ensure secure transactions.
- **Real-Time Notifications:** Users receive live updates on upload status, payment confirmation, and job completion.
- **Print History Tracking:** Users can track past prints and reprint from history without re-uploading.
- **Scalable Infrastructure:** The system supports multiple printers, print queues, and is adaptable to various public environments.
- **Low Maintenance:** The automated nature reduces staff involvement and simplifies technical support.

IV. Challenges and Solutions

Throughout the development and implementation of the Scan and Pay system, several technical and user-related challenges were encountered. Each was addressed through tailored solutions to ensure robust and efficient system performance.

- **Printer Incompatibility:** Some printers lacked API support or platform compatibility. This was resolved using the Common Unix Printing System (CUPS), which allows cross-platform printing support and universal printer control.
- **Payment Failure Handling:** During integration with Razorpay and PayPal, some transactions failed due to network interruptions. A retry mechanism with fallback logic was added, along with user alerts and recovery options.
- **File Format Restrictions:** Users sometimes uploaded unsupported formats. The backend includes a pre-processing module that auto-converts DOCX, images, and other formats to PDF for standardization.
- **Security Concerns:** As user documents and transactions are sensitive, the system implements end-to-end HTTPS encryption, file storage expiration policies, and JSON Web Token (JWT) authentication.
- **Queue Conflicts:** With multiple users accessing the same printer, job collisions occurred. We introduced a job-locking mechanism using unique queue tokens that prevent simultaneous job submissions.
- **User Misunderstanding of QR Flow:** Some users struggled with understanding how QR redirection worked. To address this, an onboarding pop-up was added with a visual walkthrough of steps.
- **Real-Time Notification Delay:** Initially, users received delayed feedback. Socket-based communication (WebSockets) was integrated to provide real-time status updates during the upload and print process.

V. Expected Outcomes and Impact

The proposed system introduces a transformative shift in public printing infrastructure. It eliminates the need for human intervention and offers a seamless, automated

experience from document upload to printing. The expected benefits include:

- **Reduced wait times:** Users can upload and print documents instantly, minimizing queues.
- **Lower operational costs:** Automation removes the necessity of staff supervision or assistance.
- **Improved user experience:** A mobile-friendly and intuitive interface enables hassle-free document handling.
- **High scalability:** The system can be easily deployed across different public spaces with minimal setup.
- **Contactless operation:** Promotes hygienic and efficient service, especially relevant in post-pandemic scenarios.

Overall, this system addresses the inefficiencies of traditional setups and provides a scalable, secure, and user-centric approach to document printing.

VI. Conclusion

The QR code-based automated printing system redefines public document printing by offering a contactless, efficient, and scalable solution. Through the seamless integration of document upload, payment, and print execution, the system addresses common inefficiencies in traditional setups.

Designed with modular architecture and modern technologies, it provides a user-friendly interface that ensures accessibility from any mobile device. The elimination of human assistance not only reduces operational costs but also enhances user satisfaction by streamlining the entire process.

This system serves as a foundation for future innovations in public utility services, emphasizing automation, user autonomy, and digital transformation.

VII. Purpose

The purpose of the **Scan and Pay** project is to develop a self-service printing system that enables users to conveniently print documents by scanning a QR code, uploading files, and completing payment online—without the need for human assistance. This system aims to reduce wait times, eliminate manual intervention, and streamline the entire printing process. It is especially useful in environments like colleges, libraries, and co-working spaces where quick, contactless, and reliable access to printing is essential.

The platform integrates multiple components such as file upload handling, automatic page count detection, cost calculation based on number of pages, secure online payment, and seamless printer integration. By automating the entire workflow, **Scan and Pay** ensures efficiency, user-friendliness, and improved accessibility to printing services.

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