Software Requirements Specification

for

SMART PRINTING SERVICE FOR STUDENTS AT HCMUT

Version 1.0 approved

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Revision History

Name	Date	Reason For Changes	Version
Requirement elicitation (1.1, 1.2)	September 22nd, 2024	Complete domain context, stakeholders and needs, benefits of each stakeholder of the system, functional requirements and non-functional requirements.	1.0
Use Case Diagram (1.3)	September 30th, 2024	Use case diagram for the whole system, use case diagram and the detail of each use case of Printing Documents Module.	2.0

1. Requirement elicitation

1.1 Domain Context

Printing study materials at Ho Chi Minh City University of Technology (HCMUT) has long been difficult due to the absence of an on-campus printing system. Instead, students are dependent on off-campus vendors, which introduces significant inconvenience and unpredictability. Not only can the pricing be uncertain, but the physical distance to these vendors often means students face unexpected costs and additional travel time, further compounding the frustration.

The HCMUT Student Smart Printing Service (SSPS) addresses these issues by offering a dependable and straightforward alternative by:

- **Enabling Digital Uploads:** Students can upload files and configure print settings through a user-friendly web and mobile application.
- **Providing Clear Options**: Offers straightforward choices for paper size, colour, and quantity, with transparent pricing.
- **Managing Print Quotas:** Allows students to easily monitor and manage their print quotas, ensuring no unexpected costs.

With SSPS, students benefit from a reliable and efficient printing service, minimizing the uncertainties and inconvenience associated with off-campus vendors and enhancing their overall academic experience.

1.2 Stakeholders and Needs

1.2.1 Student Printing Service Officer (SPSO)

- Description: SPSO is the one who manages and monitors the printing activities in the system
- Needs:
    + Manage all printers across the campus.
    + Configure system-wide settings about files, printing pages, policies.
    + Access logs and reports of all students using printing service.
    + Monitor the status of the printing system.
    + Resolve students' complaints and issues related to printing.

+ Maintenance requirements, refilling paper/ink.

1.2.2 University Administration (HCMUT)

− Description: Manages the overall operation and efficiency of the printing service, ensures student satisfaction, and monitors financial and operational performance.

− Needs:

+ Keep track and manage the resources and financial efficiency of the service.

+ Ensure a reliable printing service is provided for students.

+ Ensure data security and privacy.

+ Control over system policies, such as page limits, semester-based allocations, and pricing.

+ Generate reports on overall system usage for budget planning and service improvements.

1.2.3 Students

− Description: Main users of the system's printing services. They are the ones who create printing and download requests, upload documents, select printers, and make payments

− Needs:

+ Easy access to print documents via both web and mobile platforms, user-friendly and reliable.

+ Ability to create requests to print documents quickly and can access affordable prices for students.

+ Ability to upload files, select printer locations, and configure print settings.

+ View and keep track printing history, page summary and available balance.

+ Can buy more printing pages through the BK-Pay system.

1.2.4 Student Management System

− Description: This system is responsible for storing and managing student data, such as student ID, name, major, faculty, and status (active, graduated, on leave,...). It provides this information to the HCMUT_SSPS to facilitate smooth authentication, tracking, and management of student-related activities within the printing service.

− Needs:

+ Seamless integration with the HCMUT_SSPS to ensure accurate and up-to-date student information.

+ A secure and reliable connection to transfer sensitive student data without compromising privacy.

+ Regular updates to student records that reflect any changes in student status (graduation, withdrawal, etc.) in real-time.

+ The ability to log access requests for auditing purposes to ensure data security.

1.2.5 Payment System (BKPay system)

– Description: processes online payments for students buying additional printing pages, ensuring secure and reliable payment transactions.

– Needs:

+ Secure and process online payments made by students to buy more printing pages.

+ Ensure the reliability and uptime of the payment platform.

1.2.6 Finance Department

– Description: Manages the financial aspects of the printing service, including tracking payments made by students and generating financial reports on the service's usage.

– Needs:

+ Integration with the BKPay for student transactions.

+ Track and manage payments made by students when purchasing additional printing pages.

+ Generate financial reports related to printing usage and income from printing services.

1.2.7 Guests

– Description: Guests are users who do not log in to the system but can view general information about the HCMUT Student Smart Printing Service

– Needs:

+ Access to basic information about the printing service, such as available printer locations, operating hours, and pricing details.

+ Information on how to use the system and any frequently asked questions

+ Security to ensure that while viewing general information, no sensitive data is exposed or accessed.

1.2.8 Development Team

- Description: This team is responsible for maintaining the technical infrastructure of the system, ensuring secure authentication, integration with payment systems, and resolving any technical issues.
- Needs:
    + Develop the printing system.
    + Maintain system security and data integrity, including student data, printing logs, and payment details.
    + Ensure system scalability and reliability for large numbers of students and printers.
    + Handle any system issues, security threats, or technical problems quickly.

1.2.9 Printer Manufacturers

- Description: Supply and maintain the printers used in the system, ensuring they are compatible and functioning properly, and providing technical support as needed.
- Needs:
    + Provide, install and maintain the printer across the campus.
    + Ensure technical support related to the printers and repair when needed.

1.3 Benefits of the System

1.3.1 Student Printing Service Officer (SPSO)

- Streamlined Printer Management: Simplifies the management of printers across campus with centralized controls and monitoring.
- Policy Configuration: Provides flexibility to set printing policies such as page limits, file types.
- Efficient Issue Resolution: Quickly address student complaints and resolve printing issues.
- Access to Reports: Automatically generated monthly and yearly reports for improvement.
- Maintenance Tracking: Helps manage paper and ink refill needs, ensuring minimal downtime for printers.

1.3.2 University Administration (HCMUT)

- Operational Efficiency: Automates student page allocations and usage tracking, allowing better resource management and cost control.

– Data Security: Ensures secure handling of sensitive student data with HCMUT_SSO authentication, preventing unauthorized access.

– Financial Planning: Provides insights through usage reports, which help in budgeting and resource allocation for the printing service.

– Service Reliability: Increases student satisfaction by maintaining a stable, reliable printing service across campuses.

1.3.3 Students

– Convenience and Accessibility: Easy access to printing services via both web and mobile platforms, offering flexible usage from anywhere on campus.

– User-Friendly Interface: Allows students to upload files, select printers and have personalized settings.

– Flexible Payment Choices: The ability to purchase additional pages through BKPay ensures affordability and flexibility in managing printing needs.

– History Tracking: Students can view their printing logs, track usage, and monitor their available balance, promoting accountability.

1.3.4 Student Management System

– Seamless Integration: Results in up-to-date student data, facilitating accurate and smooth authentication and tracking within the HCMUT_SSPS.

– Data Privacy: The secure transfer of sensitive information protects student data, following privacy guidelines.

– Real-Time Updates: Reflects any changes in student status (e.g., graduation, leave) instantly, resulting in system accuracy.

– Audit Logs: Logs access requests for auditing purposes, ensuring data security and regulatory compliance.

1.3.5 Payment System (BKPay System)

– Secure Payments: Facilitates secure, real-time online payments for students purchasing additional printing pages.

– Reliability: Ensures high availability and uptime, which is crucial for uninterrupted transactions and student convenience.

– Integration: Streamlined with the HCMUT-SSPS to provide seamless payment experiences.

1.3.6 Finance Department

- Transaction Tracking: Tracks payments made by students for additional printing pages, providing accurate financial records.
- Report Generation: Generates financial reports on the system's usage and income, aiding in financial planning and analysis.
- BKPay Integration: Facilitates easy integration with the BKPay system for reliable tracking and management of financial data related to printing services.

1.3.7 Guests

- Access to Information: Provides basic information like printer locations, pricing, and operational hours, ensuring transparency.
- Guides and FAQs: Offers helpful resources on how to use the system and common queries, making it easier for newcomers to understand.
- Security: Results in no sensitive data is accessible while browsing general information, protecting the integrity of the system.

1.3.8 Development Team

- Streamlined System Development: Enables efficient development, updates, and customization of the printing system, reducing development time and improving system functionality.
- Security and Data Integrity: Ensures the protection of student data, payment details, and printing logs through secure authentication (HCMUT_SSO) and data management.
- Scalable and Reliable Infrastructure: Provides a scalable system that can support a large number of students and printers, reducing the need for major overhauls and ensuring long-term stability.
- Proactive Issue Resolution: Enables faster detection and resolution of system issues or security threats, minimizing downtime and improving overall system reliability.
- Seamless System Integration: Ensures smooth integration with third-party systems like BKPay and the Student Management System, simplifying technical maintenance and improving user experience.

1.3.9 Printer Manufacturers

- Maintenance and Support: Enables manufacturers to maintain and provide technical support for printers effectively, ensuring ongoing service quality.
- System Compatibility: Ensures that printers are fully compatible with the system, leading to a smoother operation and fewer issues.

- Repair Services: Streamlines the process for identifying and addressing technical problems, resulting in quick turnaround times for repairs.

1.4 Functional Requirements

1.4.1 Student Printing Service Officers (SPSOs)

- SPSOs can access and view student account information by using the system's administrative interface.
- SPSOs can view the status and information of all printers in the system by accessing the printer management dashboard.
- SPSOs can add, activate, or deactivate printers by configuring the system's printer settings.
- SPSOs can manage system configurations, including adjusting the default number of pages allocated to students and selecting file formats for upload through the system's settings panel.
- The system must generate monthly and yearly statistical reports, which only SPSOs can access through the reporting function.

1.4.2 University Administration (HCMUT)

- The university administration can access analytics on printing resource usage through a reporting dashboard for budget planning and resource allocation.
- The system must enforce user authentication through HCMUT_SSO by integrating the university's Single Sign-On (SSO) system.
- The university administration can set policies regarding print quotas and pricing for students by accessing the system's policy configuration tools.
- The system must implement data security measures to ensure the protection of user information and printing logs by using encryption protocols.
- The system should facilitate communication between students and SPSOs by enabling a feedback mechanism within the platform.

1.4.3 Students

- Students can access and view personal information by logging into the system through their account.
- Students can select a file from their device and upload it to the system by using the file upload feature.

- Students can select a specific printer based on their desired location by using the printer selection tool within the system.
- Students can choose a time to receive their print jobs by scheduling through the system's time management feature.
- The system must notify students via email when their print job is completed by sending an automated email.
- Students can adjust printing settings (e.g., page size, number of copies, single or double-sided) by configuring options within the system.
- The system must store all print history, including student ID, printer ID, start and end times, and page counts by logging each print activity.
- Students can access and review their previous print jobs by using the system's history feature and filtering based on time or printer location.
- The system must allocate a specific number of printing pages to each student at the beginning of each semester.
- Students can purchase additional printing pages through the integrated electronic payment system (BKPay).

1.4.4 Student Management System

- The student management system can provide real-time access to student data for authentication purposes by integrating with HCMUT-SSPS.
- The student management system must support secure data transfer for student information by using encrypted communication protocols.
- The student management system should automatically update student records (e.g., graduation or withdrawal) by synchronizing data with HCMUT-SSPS.
- The student management system must log access requests by maintaining detailed logs of who accessed student data and when for auditing.
- The student management system must allow efficient retrieval of student information by HCMUT-SSPS for operational tasks through a secure API.

1.4.5 Payment system (BKPay)

- The payment system can securely process payments for students purchasing additional printing pages by using the integrated payment gateway.
- The payment system must ensure uninterrupted transaction processing by maintaining high availability and reliability.
- The payment system should provide instant confirmation of successful transactions by sending notifications through the integrated user interface.

– The payment system must support refunds and transaction history retrieval by enabling access to payment logs within the system.

– The system must send email receipts to students after successful payments through the automated email function.

1.4.6 Finance Department

– The finance department can access detailed reports on student payments for printing services by generating financial reports from the system.

– The finance department can track and manage all financial transactions related to the printing service by accessing system transaction logs.

– The finance department should generate financial summaries for budget planning by using the system's financial reporting tools.

– The finance department must ensure compliance with financial regulations by auditing student transactions through the system.

– The finance department must provide financial oversight by conducting regular audits of the printing service's operations through detailed reports.

1.4.7 Guest

– The system provides a homepage containing general information for guests by displaying system details.

– Guests can view information about the system by accessing the homepage.

– Guests can review key features of the system by navigating through the homepage.

– Guests can view usage instructions by accessing the dedicated help section on the system.

– Guests can contact support by using the contact information provided on the system.

– Guests can log in to the system by following the authentication process to access services.

– The system must assign roles (students, SPSO, staff) upon successful login through the authorization module.

1.4.8 Development Team

– The development team can deploy new system features and updates by using a continuous integration/continuous deployment (CI/CD) pipeline.

– The system must allow the development team to monitor system performance and detect errors in real-time by using integrated logging and monitoring tools.

– The maintenance team can schedule system maintenance windows by configuring downtime periods within the system's maintenance module.

– The development team must implement security patches and updates by following secure coding standards and best practices.

– The system must allow the maintenance team to back up and restore data by using an automated backup solution.

– The development team can track and resolve bugs by using an integrated issue-tracking system linked to the development environment.

– The system must notify the development and maintenance team of critical system issues through automated alerts via email or messaging platforms.

– The development team must document all system changes and updates by maintaining version control and update logs.

– The maintenance team can roll back system updates or changes by using the version control system when issues arise.

– The system must facilitate communication between development, maintenance, and other stakeholders by providing a ticketing and communication platform (BKSI) for issue reporting.

1.4.9 Printer Manufacturers

– Printer manufacturers must provide installation and setup support for all printers deployed on campus by dispatching technical teams as needed.

– Printer manufacturers must ensure all printers are compatible with HCMUT-SSPS by providing technical documentation and system integration support.

– Printer manufacturers must supply technical specifications for each printer by including documentation within the system for reference.

– Printer manufacturers must offer ongoing technical support and maintenance services by providing a dedicated support team for troubleshooting and repairs.

– Printer manufacturers must supply updates or patches for printer firmware by releasing them, when necessary, through the system's update management tool.

– Printer manufacturers must ensure that parts and supplies are readily available for maintenance and repairs by maintaining stock at local service centers.

1.5 Non - Functional Requirements

1.5.1 Performance Requirements

– Response Time: System should process requests within 2 seconds under normal load.

– Scalability: Support up to 10 000 concurrent users without performance degradation.

- Throughput: Handle up to 100 print job submissions per minute.
- System Load: Maintain optimal performance for up to 100 000 active users daily.

1.5.2 Safety Requirements

- Data Backup: Automated daily backups to ensure data safety.
- Data Recovery: Restore lost data within 30 minutes in case of failure.
- Failure Handling: Ensure safe shutdown to prevent data loss during system failures.

1.5.3 Security Requirements

- Authentication: Integrate with HCMUT's Single Sign-On (SSO) for secure user authentication.
- Data Encryption: Use SSL/TLS for data transmission and AES-256 for data storage.
- Access Control: Implement role-based access control (RBAC) for system functionalities.
- Logging: Log access and data changes for auditing, retaining logs for 2 years.

1.5.4 Software Quality Attributes

- Usability: Provide a user-friendly interface requiring minimal training.
- Reliability: Ensure 99.9% uptime to minimize service disruptions.
- Maintainability: System updates and patches should be easy to deploy with minimal service impact.
- Compatibility: Ensure cross-browser support (Chrome, Firefox, Safari) and mobile compatibility.

1.5.5 Business Rules

- Print Quotas: Students receive 100 pages per semester, with additional pages available for purchase.
- Refunds: System failures will trigger automatic refunds or equivalent solutions.

2. Use-case Diagrams

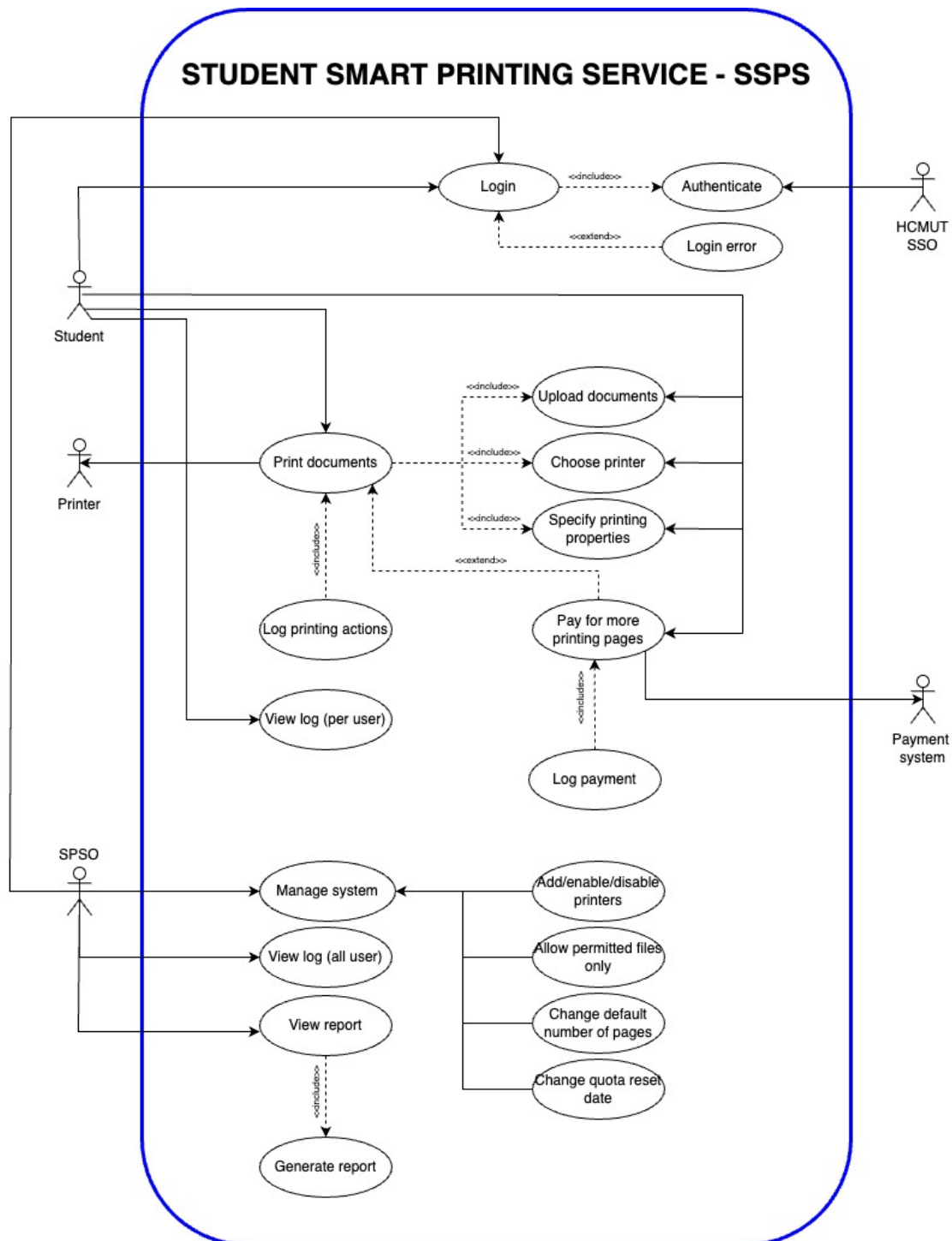## 2.1 Use-case Diagram for the Whole System

Figure 1: Use Case Diagram for The Whole System

2.2 Use-case Diagram for Printing Documents Module
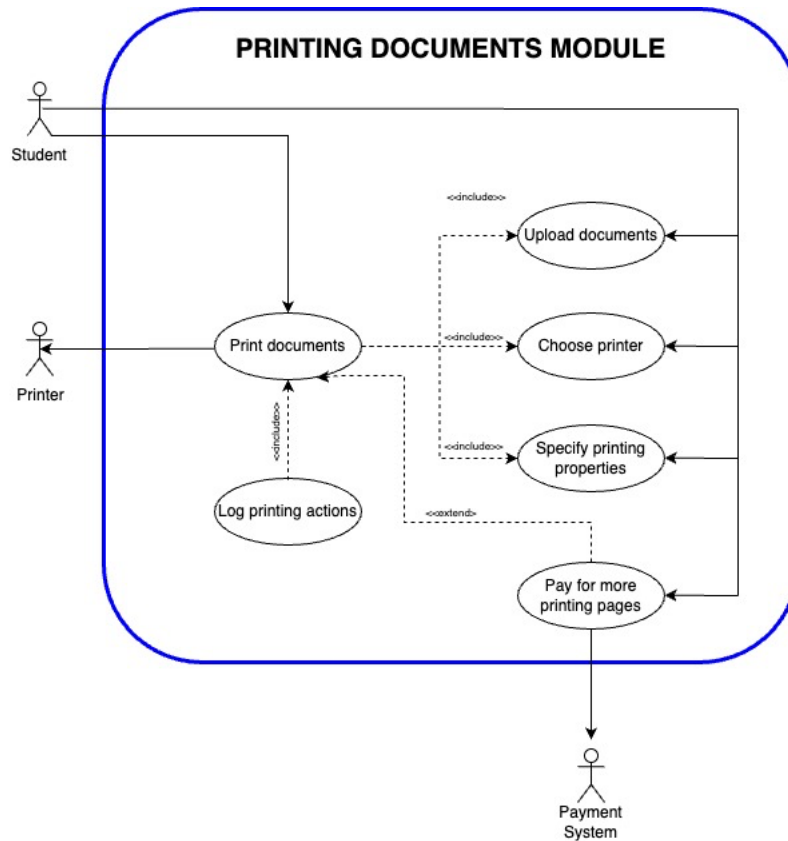

Figure 2: Use Case Diagram for Printing Documents Module

2.3 The Details of Use Cases in Printing Documents Module

2.3.1 Use case Print Document

ID and Name	**UC-1 Print Document**
Created By	Tran Thi Hong Hanh
Date Created	September 28th, 2024
Primary Actor	Student
Secondary Actors	Printer
Description	Student prints documents uploaded into HCMUT_SPSO

Trigger	After completing all printing configuration, students clicks to **Print** button to trigger this use case
Preconditions	PRE-1: The device has to be connected to the internet. PRE-2: The student has to log in to the system and be authenticated by HCMUT_SSO. PRE-3: The student has to upload documents, identify printing properties, and choose the printer. PRE-4: The student has enough available pages to print. PRE-5: Printer is available.
Postconditions	POST-1: Documents are printed successfully. POST-2: Page balance is updated. POST-3: Printing history is recorded.
Normal Flow	1. The student has to be authenticated by HCMUT_SSO. 2. The student uploads documents to the system. 3. Student configs printing properties. 4. Student chooses the printer that is available. 5. Student presses the **Print** button to trigger this action. 6. The system accepts requests and sends the request to the chosen printer. 7. Printer starts printing documents. 8. The system logs the printing activities.
Alternative Flow	None
Exceptions	E1. Invalid login credentials. E2. Invalid file type or file size limit. E4. No printer is available. E6a. The student's remaining printing pages are not enough. E6b. Printer rejects the request due to an error (e.g., printer jam, no paper).

Table 1: Detail of Use Case Print Document

2.3.2 Use case Upload Documents

ID and Name	**UC-2 Upload Documents**
Created By	Phan Thanh Son

Date Created	September 28th, 2024
Primary Actor	Student
Secondary Actors	None
Description	The student uploads a document to the HCMUT_SPSO system for printing. The system validates document format and the document is available for printing if it passes the validation.
Trigger	When a student decides to print a document by uploading it into the HCMUT_SPSO system.
Preconditions	PRE-1: The student must be authenticated through the HCMUT_SSO service. PRE-2: The document must be in a permitted file format. PRE-3: The system must be connected to the internet.
Postconditions	POST-1: The document is successfully uploaded and stored in the system. POST-2: The student can view the preview of uploaded documents. POST-3: The document is available for further actions (to be sent to printers for printing).
Normal Flow	1. The student has to be authenticated by HCMUT_SSO. 2. The student selects the "Upload Document" option. 3. The system displays the document upload interface. 4. The student selects and uploads a document from their device. 5. The system validates the document's file type and size. 6. The system confirms that the upload is successful. 7. The student can proceed with printing if all the requirements are satisfied.
Alternative Flow	None
Exceptions	E5a: The document is in an unsupported file format. E5b: The document exceeds the file limit.

Table 2: Detail of Use Case Upload Documents

2.3.3 Use case Specify Printing Properties

ID and Name	**UC-3 Specify Printing Properties**

Created By	Tran Hoang Phuc
Date Created	September 28th, 2024
Primary Actor	Student
Secondary Actors	None
Description	Student specifies printing properties for a document to be printed, involves paper size, pages (of the file) to be printed, one-/double-sided, number of copies, etc
Trigger	The student needs to print the document with their preferred configuration and the student clicks the **Edit Properties** button.
Preconditions	PRE-1: The student must be authenticated via the HCMUT_SSO authentication service. PRE-2: The student must have sufficient page balance in their account. PRE-3: The document has been chosen or uploaded and must be of a permitted file type.
Postconditions	POST-1: The document is configured with the specified properties. POST-2: The properties are displayed to the screen.
Normal Flow	1. The student has to be authenticated by HCMUT_SSO. 2. The student uploads documents to the storage. 3. The student selects the printing document option including paper size, pages (of the file) to be printed, one-/double-sided, number of copies and decides to choose to save the properties or not. 4. System validates if the page balance is sufficient. 5. Student confirms selected printing properties.
Alternative Flow	2.1. The student chooses documents that have been uploaded before in the storage. 3.1. The student chooses printing properties that have been selected and saved before.
Exceptions	E2. The uploaded files are not valid in terms of size and file type. E4. Insufficient page balance.

Table 3: Detail of Use Case Identify Printing Properties

2.3.4 Use case Choose Printer

ID and Name	**UC-4 Choose Printer**
Created By	Tran Dang Hien Long
Date Created	September 28th, 2024
Primary Actor	Student
Secondary Actors	None
Description	The student selects a printer from the available printers connected to the system to proceed with printing the document.
Trigger	The student needs to select a printer to initiate the document printing process by clicking the **Choose Printer** button.
Preconditions	PRE-1: The student must be authenticated via the HCMUT_SSO authentication service. PRE-2: The student has to choose or upload documents to print. PRE-3: The student has to select the printing properties. PRE-4: At least one printer must be available and connected to the network. PRE-5: The printer must be enabled and ready to accept print jobs.
Postconditions	POST-1: The selected printer is assigned for the printing job. POST-2: The printer details are saved and linked to the printing job in the system.
Normal Flow	1. The student has to be authenticated by HCMUT_SSO. 2. The student uploads the document that needs to be printed. 3. The student chooses printing properties. 4. The system displays a list of available printers. 5. The student selects the desired printer from the list. 6. The system confirms the selection and updates the print job with the chosen printer. 7. The student proceeds to configure the print properties and finalize the printing process.
Alternative Flow	None
Exceptions	E4. If no printers are available, the system will notify the student and prompt them to try again later.

	E5. If the selected printer encounters an error (e.g., offline or malfunctioning), the system will prompt the student to choose a different printer.

Table 4: Detail of Use Case Choose Printer

2.3.5 Use case Pay For More Printing Pages

ID and Name	**UC-5 Pay For More Printing Pages**
Created By	Tran Nguyen Anh Khoa
Date Created	September 29th, 2024
Primary Actor	Student
Secondary Actors	Online Payment System
Description	The student purchases additional printing quota when their printing quora is insufficient.
Trigger	When a student's A4 paper provided by the university is insufficient and they want to buy more by clicking the **Buy More Page** button.
Preconditions	PRE-1: The student has to be authenticated by HCMUT_SSO. PRE-2: The student chooses an online payment system like BKpay or other similar systems. PRE-3: The student must have an existing page balance from their default allocation. PRE-4: The student's printing quota is insufficient.
Postconditions	POST-1: The student's printing quota is increased by the amount of A4 pages purchased. POST-2: The transaction is recorded in the system, including details of the purchases. POST-3: A payment confirmation is sent to the student, indicating the successful transaction. POST-4: The updated page balance is reflected in the student's account. POST-5: The payment log (history) will be updated and the student can view their printing history.
Normal Flow	1. The student has to be authenticated by HCMUT_SSO.

	2. The student selects the buy printing quota option. 3. The system displays the printing quota price. 4. The student selects the number of A4 papers to purchase. 5. The system processes the payment through the payment system (BKPay). 6. Upon successful payment, the system updates the student's printing quota. 7. The system sends a confirmation of the transaction to the student. 8. The system will save the details of the transaction and can be viewed by SPSO anytime.
Alternative Flow	6.1. The system processes the payment through VNPay.
Exceptions	E1: If the student is not authenticated, the system denies access to the purchase option. E5a: If the payment system encounters an error, the system notifies the student and suggests trying again later. E5b: If the student's account is inactive or blocked, the system informs them that they cannot make purchases until the issue is resolved. E5c: If the requested purchase amount exceeds the allowed quota, the system informs the student to adjust the number of pages they wish to buy.

Table 5: Detail of Use Case Pay For More Printing Pages

2.3.6 Use case Log Printing Actions

ID and Name	**UC-6 Log Printing Actions**
Created By	Tran Thien Phu
Date Created	September 28th, 2024
Primary Actor	Student
Secondary Actors	None
Description	After the printers successfully print the document, the system logs each printing event initiated by students, including the details of the document printed, the printer used, and the print properties specified.

Trigger	After the printer prints the documents successfully, prompting the system to log the action.
Preconditions	PRE-1: Student must be authenticated via the HCMUT_SSO authentication service PRE-2: The document is successfully uploaded and print properties are specified.
Postconditions	POST-1: The print action is recorded in the system log. POST-2: Relevant information (e.g., student ID, document name, printer ID, and timestamp) is saved for future reference.
Normal Flow	1. The print job is successfully sent to the printer. 2. The system records the details of the print job. 3. The system waits for the completion of the print job. 4. The system saves the print action in the log with a timestamp. 5. The student and HCMUT_SPSO can view the printing history.
Alternative Flow	None
Exceptions	E3. Job failed due to printer errors.

Table 6: Detail of Use Case Log Printing Actions