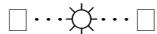


**ĐẠI HỌC QUỐC GIA THÀNH PHỐ HỒ CHÍ MINH  
TRƯỜNG ĐẠI HỌC BÁCH KHOA**



**SOFTWARE ENGINEERING  
SOFTWARE REQUIREMENTS SPECIFICATION FOR:  
A SMART PRINTING SERVICE FOR STUDENTS AT HCMUT  
CLASS CC01 --- GROUP 15 --- SEMESTER 241**

**Lecturer: Truong Tuan Anh**

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**Ho Chi Minh – 2024**

**DEPARTMENT OF SOFTWARE  
ENGINEERING  
FACULTY OF COMPUTER SCIENCE  
AND ENGINEERING  
HO CHI MINH CITY UNIVERSITY OF  
TECHNOLOGY - VNU - HCM**

**REPORT ON GROUP WORK RESULTS AND ASSIGNMENT SCOREBOARD  
SOFTWARE ENGINEERING (CODE: CO3001)**

*Class: CC01. Group: 15. Semester 241. Year 2024 - 2025*

*Topic:*

**A SMART PRINTING SERVICE FOR STUDENTS AT HCMUT**

	<b>Task 1</b>	<b>Task 2</b>	<b>Task 3</b>	<b>Task 4</b>	<b>Task 5</b>
<b>Khoa</b>	1.4&1.5	2.4	3.1		
<b>Bách</b>	1.4&1.5	2.4	3.1		
<b>Minh</b>	1.1	2.1	3.2		
<b>Vy</b>	1.2	2.2	3.1		
<b>Sơn</b>	1.3	2.3	3.2		
<b>Tùng</b>	1.4&1.5	2.4	3.2		

DEPARTMENT OF SOFTWARE ENGINEERING  
FACULTY OF COMPUTER SCIENCE AND ENGINEERING  
HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY - VNU - HCM

**REPORT ON GROUP WORK RESULTS AND ASSIGNMENT SCOREBOARD**

*Subject : SOFTWARE ENGINEERING (CODE: CO3001)*

*Class: ..CC01.. Group: ....15....Semester ....241....Year .....2024.....*

STT	ID	Family name	First name	Group work	% score	Final Score	Sign
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2	2252058	Trần Xuân	Bách	1.4 & 1.5, 2.4, 3.1	100%		BÁCH
3	2252494	Tù Khánh	Minh	1.1, 2.1, 3.2	100%		MINH
4	2252936	Võ Huỳnh Khanh	Vy	1.2, 2.2, 3.1	100%		VY
5	2252720	Võ Trúc	Sơn*	1.3, 2.3, 3.1	100%		SƠN
6	2252886	Vũ Hoàng	Tùng	1.4 & 1.5, 2.4, 3.1	100%		TÙNG

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## **I. Task 1: Requirement elicitation**

### **1. Requirement elicitation (1.1, 1.2)**

#### **1.1. Domain Context**

The Ho Chi Minh City University of Technology (HCMUT) is considering the implementation of a Student Smart Printing Service (HCMUT\_SSPPS). This system aims to facilitate students' printing needs within the university campuses. The system comprises various printers stationed throughout the university premises. Each printer is identifiable through a unique ID, brand or manufacturer name, model, a brief description, and its specific location. The system facilitates students by allowing them to upload their documents onto the system, select a printer, and specify their printing preferences. HCMUT\_SSPPS will also log all printing actions, and the Student Printing Service Officer (SPSO) will have the ability to view these logs. It is worth noting that the university will provide students with a default number of pages for printing each semester, but students can also buy additional pages if required. The system will be accessible through a web-based application and a mobile application.

#### **1.2. Stakeholders and Needs**

- Students: students need the ability to upload and print documents at various campus printers, configure printing options, monitor their printing history and page balance, and purchase additional printing pages when needed. They also require convenient access through both web and mobile apps.
- SPSO (Administrator): the SPSO, responsible for managing the system, needs features to add, enable, or disable printers, configure settings like default page quotas and accepted file types, and monitor student and printer usage through detailed logs. Additionally, the SPSO must generate and view monthly and annual reports on system usage.
- University Administrators: need the system to function efficiently and seamlessly, ensuring smooth printing services, monitoring usage patterns, and making informed decisions based on system-generated reports. They also require integration with HCMUT's SSO for authentication and BKPay for payments.
- HCMUT IT Staff: responsible for maintaining the system's infrastructure, ensuring uptime, and providing technical support.
- Printer Manufacturer: need to ensure their devices are compatible with the system and provide any necessary support to ensure smooth operation.

### **1.3. Benefits of the System**

- Students: convenience and easy to get printings from various printers at any time, any campus printer, get risks of waiting for printing. Easy to manage their printing histories. Both web and mobile apps can access the campus printers. Easy to pay since students mostly choose banking as payment option.
- SPSO(Administrator): easy to maintain the system, including managing, adding functional, enable or disable printers at any time, any place. SPSO can manage the printing order, therefore, can give a fit schedule to each campus printer at a time, not to let some printers be too crowded and some aren't used. Also, a monthly checking and annual reports is conveniently provided to the SPSO.
- University Administrators: easy for them to check the efficiency, seamless of the printing system through the annual report. Easy to require integration with the system for authentication and get payments through BKpay.
- HCMUT IT Staff: easy to maintain the system in real time. Students and University Administrators can get technical support immediately when staff get a report.
- Printer Manufacturer: easy to get printing order. Get risks of overcapacity printing when the system can order another campus printer when there are too many orders at the same printers at the same time. Therefore, minimize the support so that the least printer manufacturers are at work. we can still give a smooth operation printing service.

### **1.4. Functional Requirements**

- **For Student:**
  - + They must be able to login, logout and see an overview of their account.
  - + They must be able to choose a printer for printing their file.
  - + They must be able to choose and upload their documents to print.
  - + They must be able to set the time for the printer to print their file.
  - + They must be able to send feedback about printers which they have experienced with.
  - + The system must store the information of each time that they have printed like which printer is selected, date, time, their documents and number of pages that they have printed.
  - + The system must notify students when their documents have been done through email.
- **For SPSO (Administrator):**
  - + They must be able to create, update and delete printers or student accounts.
  - + They must have access to see a report like a bar chart about the number of students choosing each printer in a week, month or year.

- + They must have access to see a report like a line chart about the changes of the number of students choosing that printer through each week, month or year.
  - + They must have access to see information about each printer.
  - + They must have access to see information about each student.
  - + They must be able to set up the limitation of pages for each printer and a time that students can choose that printer to print their documents.
  - + The system must provide real-time data on printer status (e.g., online, offline, paper levels)
- **University Administrators:**
- + They must be able to create, update or delete printers or student accounts.
  - + The system must allow University Administrators to manage user roles like student, faculty, guest,...
  - + They must be able to set prices for different types of printing jobs like printing color, printing grayscale, printing black and white,...
  - + The system must notify University Administrators when printing jobs have errors or issues.
  - + Administrators must be able to set permissions for different user roles to prevent unauthorized access
- **HCMUT IT Staff:**
- + They must be able to update a system to make its performance faster.
  - + They must be able to change the UI of a website or mobile app to make its interface better for users to experience.
  - + They can remotely access, diagnose issues and apply fixes on the Software without needing physical access to the device.
  - + Software must log all errors and malfunctioning states. IT staff should be able to access these logs, with automatic notifications for critical errors.
  - + They can add BKpay on the system for everyone in HCMUT to pay easier.
- **Printer Manufacturer:**
- + The printers must be able to print documents, images and other files.
  - + The printers must be able to handle paper's size like A3, A4, A5,...
  - + The printers should support multiple connectivity options like USB, Ethernet, Wi-fi, Bluetooth,...
  - + The printers must be able to print in color, grayscale and black and white.
  - + The printer must come with drivers compatible with major operating systems like Windows, Macos, Linux,...

- + The printers must support different printing technologies like inkjet, laser,...

## **1.5. Non - Functional Requirements**

### **Performance Requirements**

The response time of the system should respond to user interactions (uploading a document, selecting a printer, submitting a print job, ...) within a reasonable time (don't exceed 5 seconds for common tasks).

The system must support multiple concurrent users, both student and SPSO, using the web and mobile apps simultaneously.

### **Compatibility Requirements**

For user Interface (UI) the web and mobile apps should have intuitive, user-friendly interfaces, making it easy for students to upload documents, select printers, and manage their print jobs and available for the newest OS and web browser. SPSO should be able to easily manage printers and view logs.

For mobile users, the web app should be responsive, ensuring that it works well on various screen sizes and devices in addition to the dedicated mobile app.

### **Usability Requirements**

The system must be available 95% during university business hours, excluding maintenance periods.

The average time to restore the system after a system failure shall not exceed 30 minutes during university business hours.

### **Security Requirements**

For Authentication and Authorization all users (students and SPSOs) must be authenticated through the HCMUT\_SSO authentication service. Authorization should ensure that users can only access their respective data (students see their log, SPSO manage printers and configurations).

Sensitive information such as student IDs, document files, and payment details must be encrypted during transmission.

The system should strictly enforce the file type limitations set by the SPSO to prevent malware or other security issues.

Online payments for additional printing pages should be securely handled, integrating with the BKPay system while ensuring the security of financial data.

### **Scalability Requirements**

The system should be able to scale to accommodate the entire student population and potentially handle increased demand during peak periods (end of semester).

The system must be able to handle a large volume of print jobs and varying document sizes without delays or crashes.

### **Language Requirements**

The system must support English, Vietnamese, and French to accommodate the needs of students and staff across the two campuses.

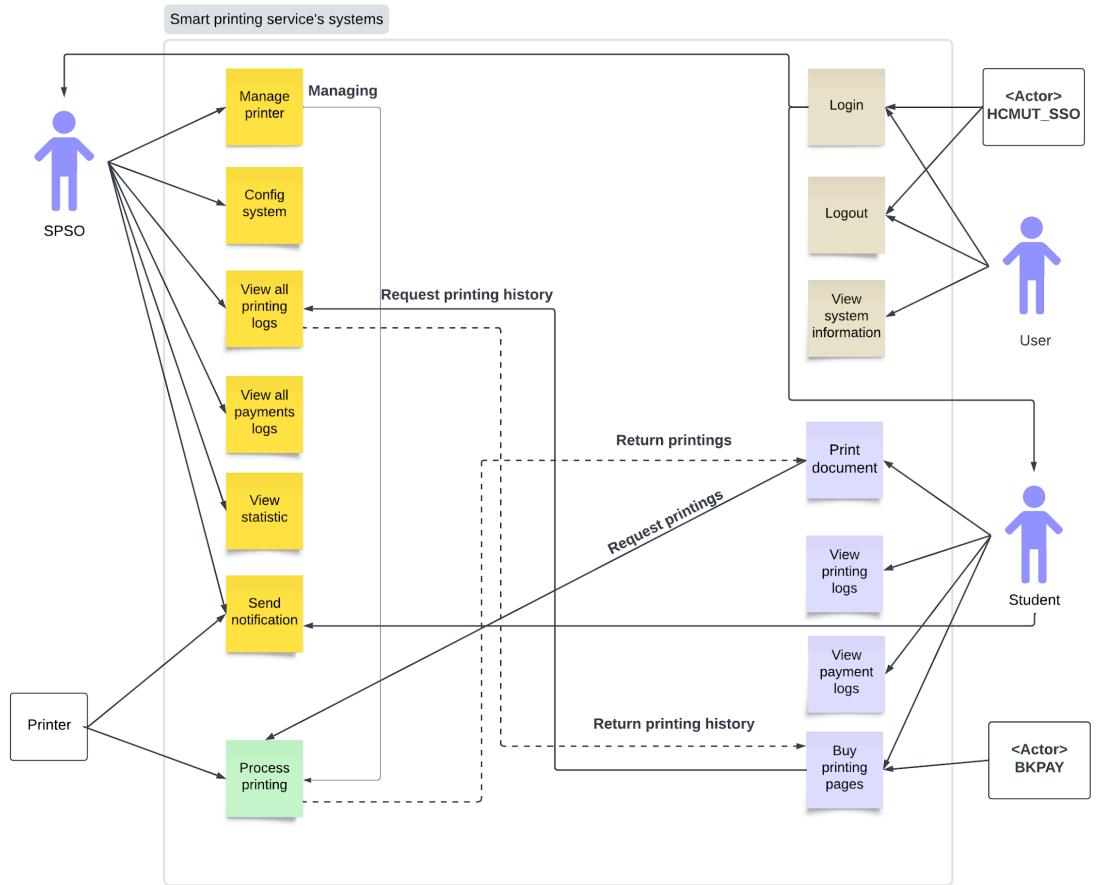
## **2. Use-case Diagrams (1.3)**

### **2.1. Use-case Diagram for the Whole System**

#### **2.1.1. Actors**

ID	Actor	Description
1	Student	The primary user of printing service
2	Printer	The printing system
3	SPSO	The system administrator
4	HCMUT_SSO	The authentication system
5	BKPay	The online payment system

## 2.1.2. Use-case diagram of the whole system:



1. System use-case diagram

## 2.1.3. List of use cases

Use Case ID	Use Case Name	Description
UC001	Login / Logout	Describes the process of a user (student or SPSO) logging in to the Student Smart Printing Service (HCMUT_SSPPS) via HCMUT_SSO authentication, and logging out after the session is over.
UC002	Print Documents	Users can upload a document file, select a printer from the printer system, specify printing properties, and submit a printing request. The system will log all printing actions.
UC003	Buy Printing Pages	Users can purchase additional printing

		pages for their account through the system, using online payment methods provided by BK_PAY.
UC004	View Printing Logs	Describes an action that shows a history of student's printings with an order list from newest to oldest and can filter through some parameters (printing's date, number of pages, printing's color).
UC005	Manage Printers	Describes an action that manage all the printers on a system
UC006	Manage Configurations	SPSO can manage certain system configurations, including determining the file formats that students are allowed to upload, change unit prices, enabling features
UC007	View Report	SPSO can view a periodic statistical report by month and year.

## 2.2. Authentication use-case diagram

### 2.2.1. Diagram:



2. Login/logout use-case diagram

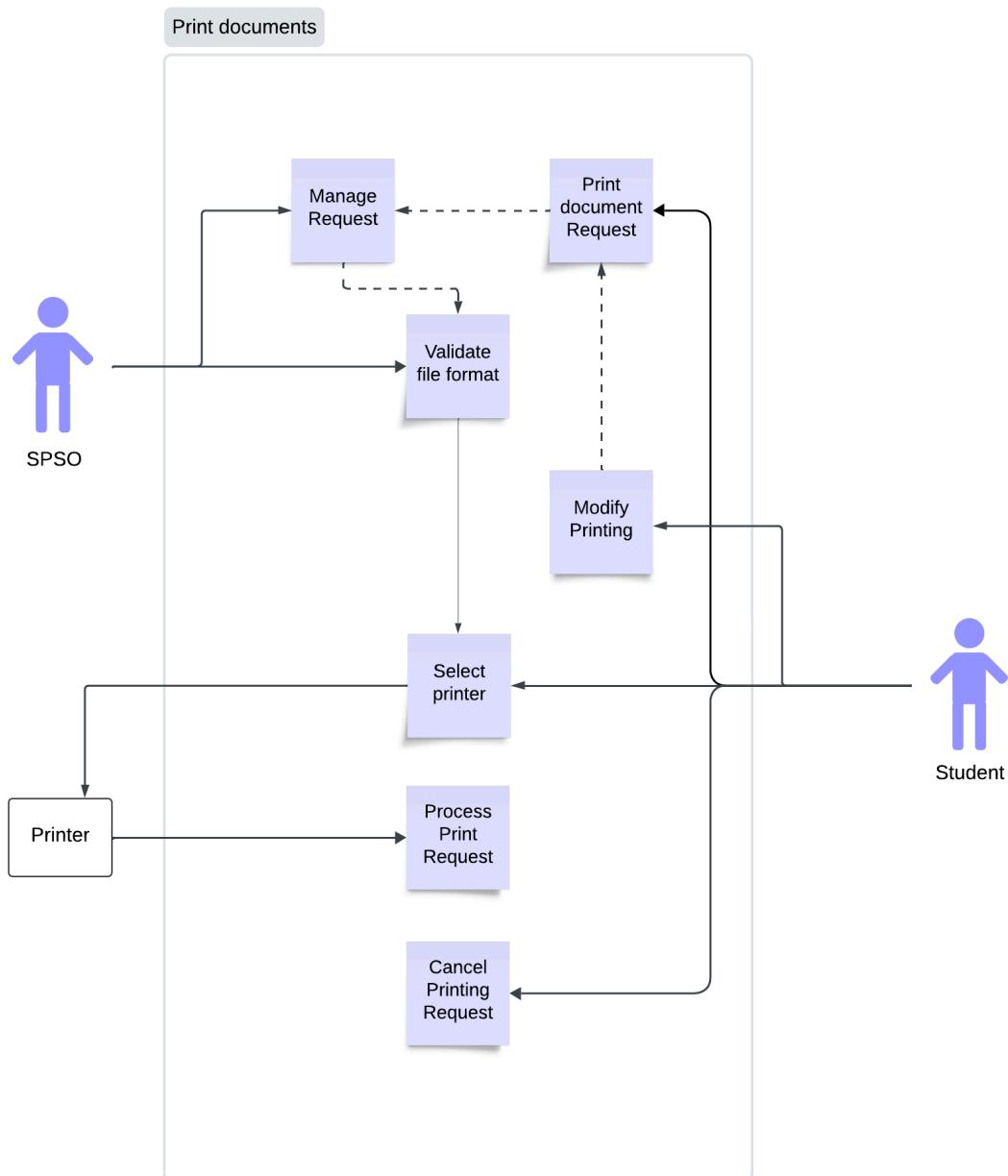
### 2.2.2. Use-case table:

ID and Name:	UC001 Login/Logout		
Created By:	Xuân Bách	Date Created:	27/09/2024
Primary Actor:	Student	Secondary Actors:	SPSO,HCMUT_SSO Authentication System
Description:	Describes the process of a user (student or SPSO) logging in to the Student Smart Printing Service (HCMUT_SSPPS) via HCMUT_SSO authentication, and logging out after the session is over.		
Trigger:	User need to access the HCMUT_SSPPS system to print documents or manage printing services.		
Preconditions:	<ul style="list-style-type: none"> <li>- User must be registered in the HCMUT_SSO authentication system.</li> <li>- User has valid credentials (username and password).</li> <li>- User devices must be connected to the internet.</li> </ul>		
Postconditions:	<ul style="list-style-type: none"> <li>- Ensures the session is over and the user cannot perform any actions until they log in again.</li> <li>- User print request completed successfully.</li> <li>- User activity recorded after logout.</li> </ul>		
Normal Flow:	<ol style="list-style-type: none"> <li>1. User launches the HCMUT_SSPPS web/mobile application.</li> <li>2. The system requests the user to enter login credentials via the HCMUT_SSO authentication system.</li> <li>3. User enter valid username and password</li> <li>4. The system authenticates the user via HCMUT_SSO.</li> <li>5. User is logged in and perform actions such as printing or viewing logs.</li> <li>6. User logout after finishing activities.</li> <li>7. The system logs the user out and terminates the session.</li> </ol>		
Alternative Flow:	<ol style="list-style-type: none"> <li>2.1 User register new account.</li> <li>3.1 User forgets the password and reset the password.</li> </ol>		
Exceptions:	<ul style="list-style-type: none"> <li>- Login non-existing account</li> </ul>		

- Login while the system is down
- When printing, logging out corrupts the data.

## 2.3. Print document:

### 2.3.1. Use-case diagram:



### 3. Document-printing use-case diagram

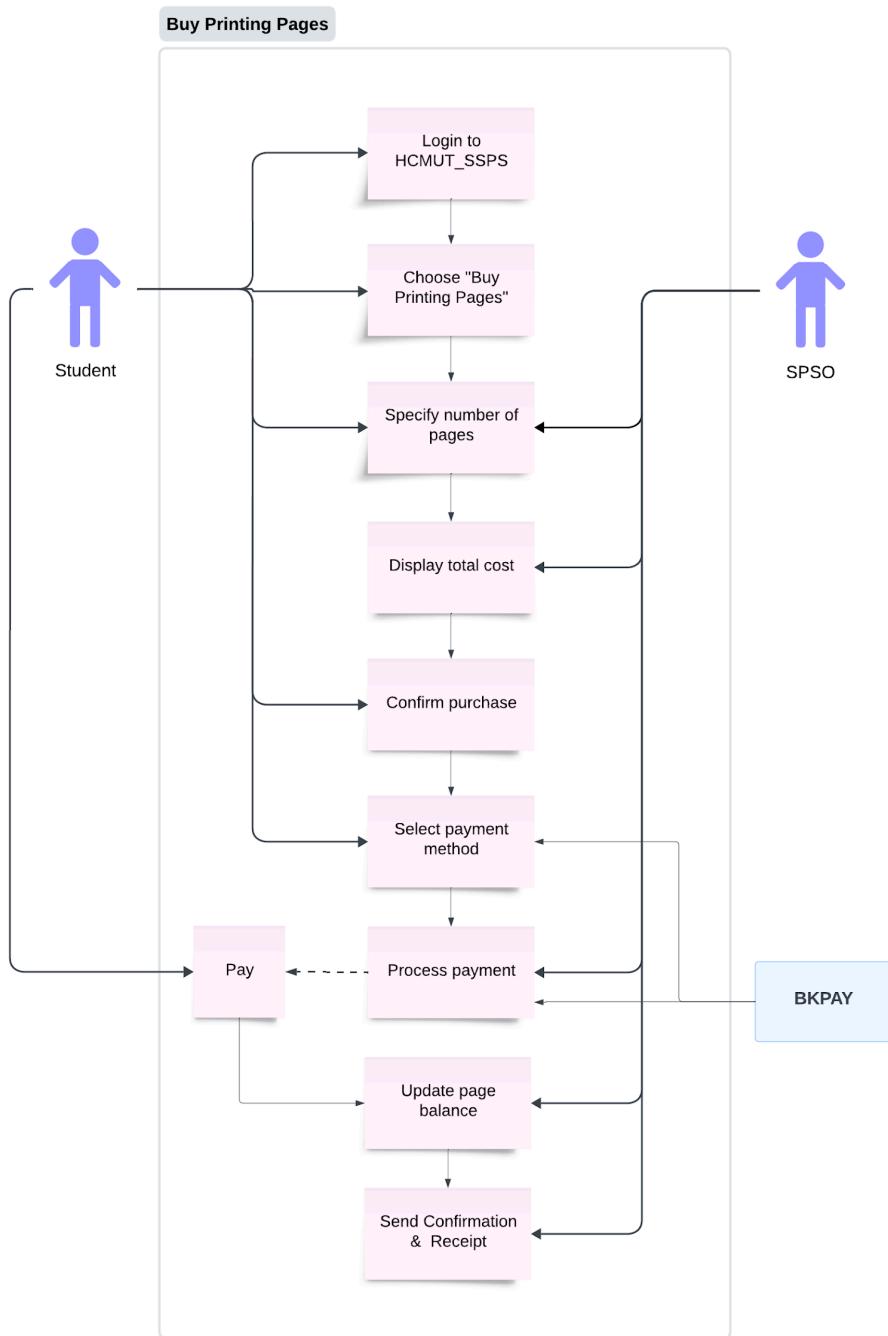
#### 2.3.2. Use-case table:

ID and Name:	UC002 Print Documents		
Created By:	Xuân Bách	Date Created:	27/09/2024
Primary Actor:	Student	Secondary Actors:	SPSO, Printer System
Description:	User can upload a document file, select a printer from the printer system, specify printing properties, and submit a printing request. The system will log all printing actions.		
Trigger:	When user need to print		
Preconditions:	<ul style="list-style-type: none"> <li>- User must have a sufficient balance of printing pages.</li> <li>- The printer selected must be available and enabled by the SPSO.</li> <li>- The document file must be in a permitted format as configured by the SPSO.</li> </ul>		
Postconditions:	<ul style="list-style-type: none"> <li>- The document is printed successfully according to the specified properties.</li> <li>- The printing action is logged in the system with all relevant details.</li> <li>- User's page balance is updated according to the number of pages printed.</li> </ul>		
Normal Flow:	<ol style="list-style-type: none"> <li>1. User logs in to the HCMUT_SSPPS via web or mobile app.</li> <li>2. User selects the "Print Documents" option.</li> <li>3. User uploads a document file.</li> <li>4. The system validates the file format.</li> <li>5. User selects a printer from the printer system.</li> <li>6. User specifies printing properties (paper size, pages to print, one-/double-sided, number of copies).</li> <li>7. User submits the print request.</li> <li>8. The system checks the user page balance and confirms sufficient balance.</li> <li>9. The system logs the printing action (student ID, printer ID,</li> </ol>		

	<p>file name, start time, end time, number of pages).</p> <p>10. Document is printed.</p>
Alternative Flow:	<p>3.1 User can modify the number of pages to print before submitting.</p> <p>7.1 User cancel printing.</p>
Exceptions:	<ul style="list-style-type: none"> <li>- The system displays an error message indicating that the file type is not permitted.</li> <li>- The system alerts the user to a lack of printed pages and requests them to buy more printed pages or adjust the print parameters.</li> <li>- The selected printer is offline or disabled:</li> </ul>

## **2.4. Buying printings:**

### **2.4.1. Use-case diagram:**



4. Printings-purchasing use-case diagram

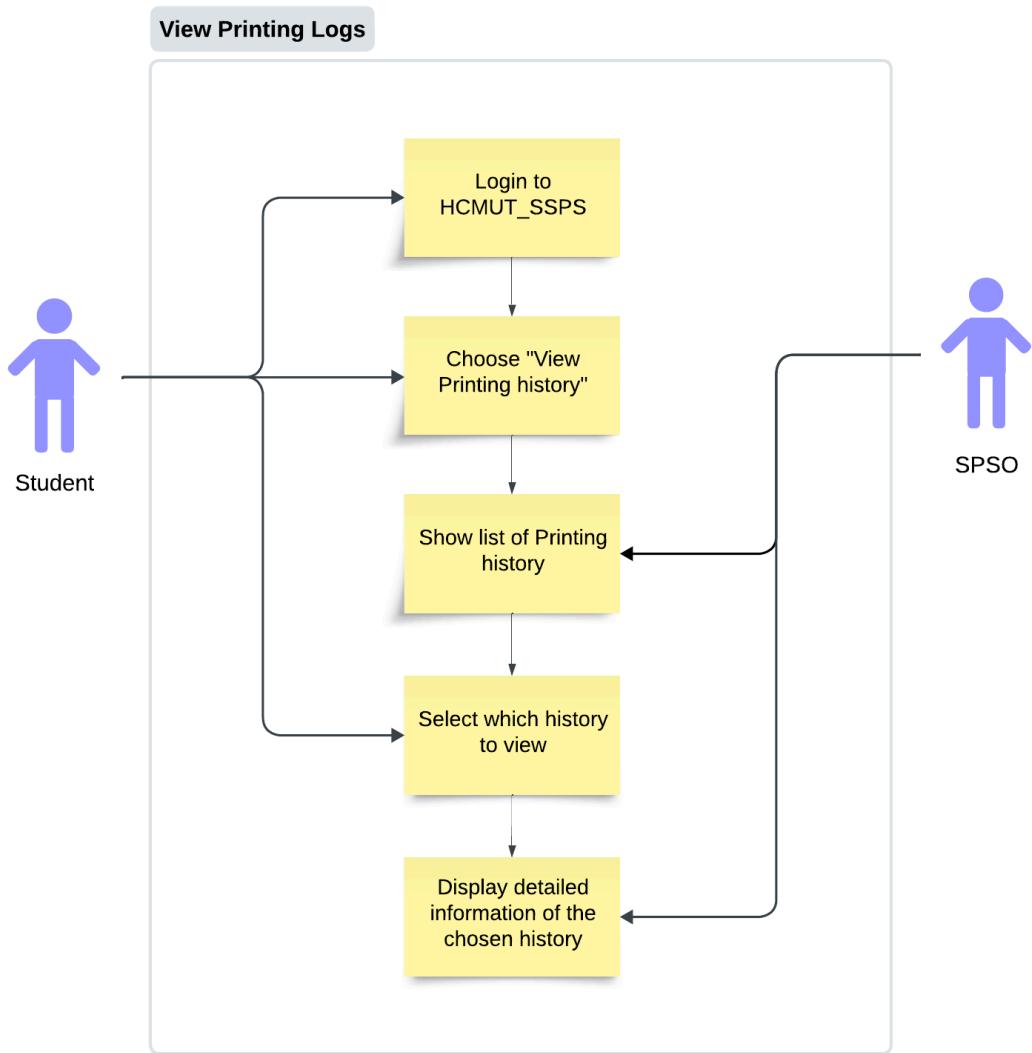
### 2.4.2. Use-case table:

ID and Name:	UC003 Buy Printing Pages		
Created By:	Xuân Bách	Date Created:	27/09/2024
Primary Actor:	Student	Secondary Actors:	SPSO, BKPAY
Description:	Users can purchase additional printing pages for their account through the system, using online payment methods provided by BK_PAY.		
Trigger:	User select the option to buy additional printing pages from the system or when they do not have enough paper in balance.		
Preconditions:	<ul style="list-style-type: none"> <li>- The system and the BKPAY payment service must be available for processing transactions.</li> <li>- User must have a valid payment method set up in the BKPAY system, such as a bank account or payment card.</li> </ul>		
Postconditions:	<ul style="list-style-type: none"> <li>- User's account balance is updated with the newly purchased printing pages.</li> <li>- A transaction log entry is created for the purchase, including student ID, amount paid, and number of pages bought.</li> </ul>		
Normal Flow:	<ol style="list-style-type: none"> <li>1. User logs into the HCMUT_SSPPS.</li> <li>2. User choose the "Buy Printing Pages" option.</li> <li>3. User specify the number of additional printing pages to purchase.</li> <li>4. The system displays the total cost for the requested number of pages.</li> <li>5. User confirms the purchase.</li> <li>6. User selects the online payment method (BKPAY) and BK processes the payment.</li> <li>7. After successful payment, it notified the HCMUT_SSPPS about the transaction.</li> <li>8. The system updates the user's account with the new page balance.</li> <li>9. The system generates a confirmation message and sends a receipt to the user.</li> </ol>		
Alternative Flow:	3.1 User decide to change the number of pages to purchase.		

	<p>6.a The system redirects the user to the BKPAY payment interface.</p> <p>6.a.1 User pay through banks associated with BKPAY</p> <p>6.a.2 User completes the payment process via BKPAY.</p> <p>6.b User chooses internet banking via momo e-wallet.</p> <p>6.b.2 The system generates a QR code for MoMo payment.</p> <p>6.b.3 User opens the MoMo app and scans the QR code to pay.</p>
Exceptions:	<ul style="list-style-type: none"> <li>- If the user entered an invalid quantity of pages (a negative number or a non-numeric value)</li> <li>- BK_PAY payment service is temporarily unavailable</li> <li>- Payment is unsuccessful due to issues such as insufficient funds, expired payment methods</li> </ul>

## 2.5. View printing logs:

### 2.5.1. Use-case diagram:



### 5. Printing logs - viewing use-case diagram

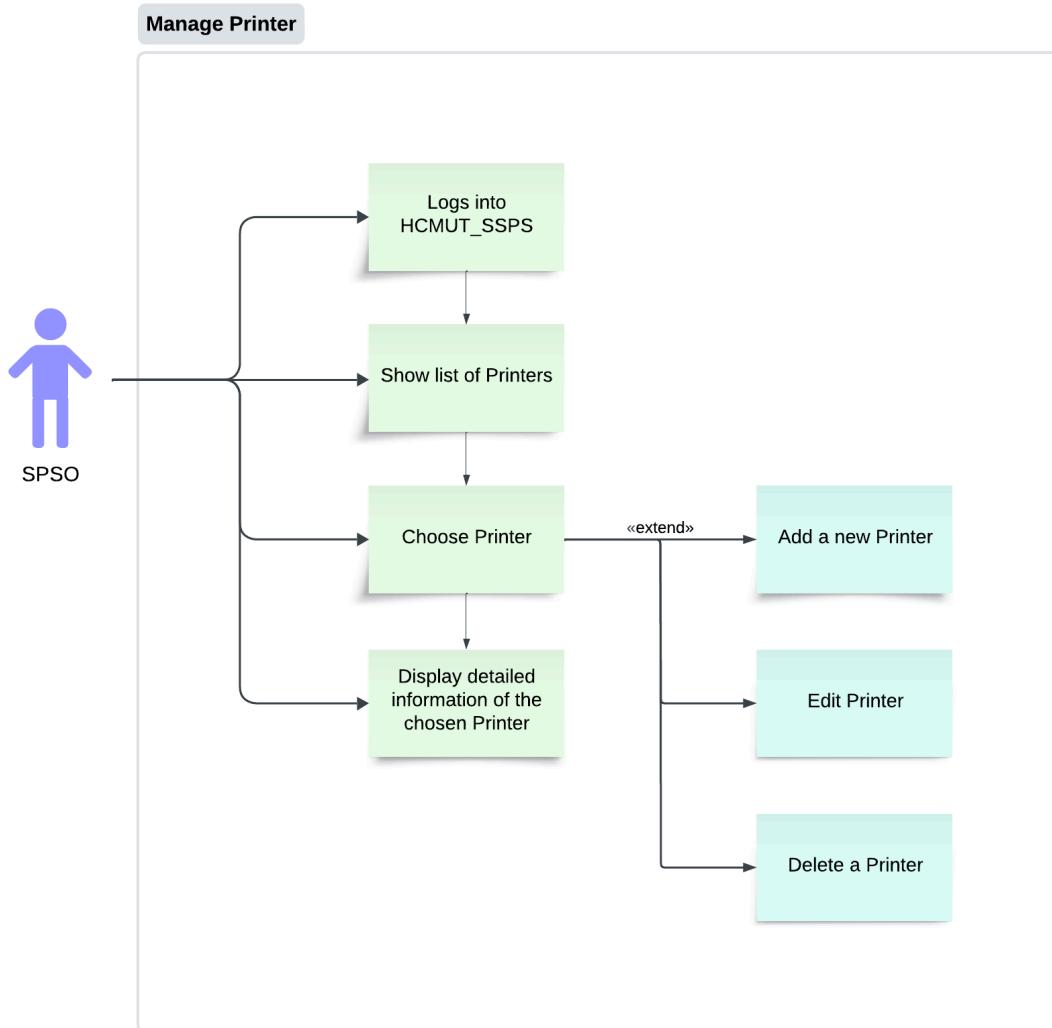
### 2.5.2. Use-case table:

ID and Name:	UC004 View Printing Logs		
Created By:	Minh Khoa		
Primary Actor:	Student	Date Created:	28/09/2024
Description:	Describes an action that shows a history of student's printings with an order list from newest to oldest and can filter through some parameters (printing's date, number of pages, printing's color).		

Trigger:	Students needs to view their printing's history
Preconditions:	<ul style="list-style-type: none"> <li>- Students have logged into HCMUT_SSPPS as user's account</li> <li>- Student's devices have connected to Internet</li> </ul>
Postconditions:	<ul style="list-style-type: none"> <li>- An action showing a history of student's printing has been finished.</li> </ul>
Normal Flow:	<ol style="list-style-type: none"> <li>1. Students log into HCMUT_SSPPS.</li> <li>2. Students choose the viewing history section.</li> <li>3. The system will show a list of printing's history from the newest to the oldest with the information of the printing's date, printing's code and printing's status.</li> <li>4. Students choose which history they want to view.</li> <li>5. The system will show all the information of that history which are code, date, status, number of pages to print, color to print, size of paper, starting time, finishing time.</li> </ol>
Alternative Flow:	<p>3a. Students choose some parameters like time period or status to filter that list or they input some information about status, date or code to show exactly what they want to view.</p>
Exceptions:	<ul style="list-style-type: none"> <li>- If students input an invalid date like 30/2/2024, a system will log an error.</li> <li>- If students input a non-existing code, date or status, a system will log an error.</li> </ul>

## 2.6. Manage printer:

### 2.6.1. Use-case diagram:



6. Printer-managing use-case diagram

### 2.6.2. Use-case table:

ID and Name:	UC005 Manage Printer		
Created By:	Minh Khoa		
Primary Actor:	SPSO	Date Created:	29/09/2024
Description:	Describes an action that manage all the printers on a system		
Trigger:			
Preconditions:	- SPSO has logged into HCMUT_SSPPS as admin's account.		

	<ul style="list-style-type: none"> <li>- SPSO's devices have connected to the Internet.</li> <li>- SPSO access to managing printer's page.</li> </ul>
Postconditions:	<ul style="list-style-type: none"> <li>- An action managing printer has been finished.</li> </ul>
Normal Flow:	<ol style="list-style-type: none"> <li>1. SPSO logs into HCMUT_SSPPS.</li> <li>2. A list of printers will show on a system.</li> <li>3. SPSO chooses a printer to see its information.</li> <li>4. The information about that printer will show (code, name, added date, number of users choosing this printer).</li> </ol>
Alternative Flow:	<ol style="list-style-type: none"> <li>3a. SPSO can search the printer's code or name to filter that list.</li> <li>5. Extended flow: <ul style="list-style-type: none"> <li>- SPSO can add new printers to a system.</li> <li>- SPSO can edit printers on a system.</li> <li>- SPSO can delete printers on a system.</li> </ul> </li> </ol>
Exceptions:	<ul style="list-style-type: none"> <li>- If SPSO searches a non-existing printer's code or name, a system will log an error.</li> </ul>

ID and Name:	UC005-1 Add a Printer		
Created By:	Minh Khoa		
Primary Actor:	SPSO	Date Created:	29/09/2024
Description:	Describes an action that add a printer to a system		
Trigger:	SPSO wants to add a new printer to a system.		
Preconditions:	<ul style="list-style-type: none"> <li>- SPSO has logged into HCMUT_SSPPS as admin's account.</li> <li>- SPSO's devices have connected to the Internet.</li> <li>- SPSO access to managing printer's page.</li> </ul>		
Postconditions:	<ul style="list-style-type: none"> <li>- An action adding printer has been finished.</li> </ul>		
Normal Flow:	<ol style="list-style-type: none"> <li>1. SPSO logs into HCMUT_SSPPS.</li> </ol>		

	<p>2. SPSO clicks into the adding section.</p> <p>3. A form to add will appear with some input field:</p> <ul style="list-style-type: none"> <li>- SPSO fills in the printer's code.</li> <li>- SPSO fills in the printer's name.</li> <li>- SPSO fills in the created date of the printer.</li> <li>- SPSO fills in the printer's description.</li> <li>- SPSO chooses a location to place: the building's name and a room number of that building.</li> </ul> <p>4. SPSO clicks into the save button.</p> <p>5. A system confirms that form and adds to a list of printers.</p>
Alternative Flow:	No
Exceptions:	<ul style="list-style-type: none"> <li>- If SPSO chooses a non-existing building's name or non-existing room number, a system will log an error.</li> </ul>

ID and Name:	UC005-2 Edit a Printer		
Created By:	Minh Khoa		
Primary Actor:	SPSO	Date Created:	29/09/2024
Description:	Describes an action that edit a printer on a system		
Trigger:	SPSO wants to update the information of a printer.		
Preconditions:	<ul style="list-style-type: none"> <li>- SPSO has logged into HCMUT_SSPPS as admin's account.</li> <li>- SPSO's devices have connected to the Internet.</li> <li>- SPSO access to managing printer's pages.</li> </ul>		
Postconditions:	<ul style="list-style-type: none"> <li>- An action editing printer has been finished.</li> </ul>		
Normal Flow:	<ol style="list-style-type: none"> <li>1. SPSO logs into HCMUT_SSPPS.</li> <li>2. SPSO clicks into the editing section.</li> <li>3. SPSO chooses a printer on a list to edit.</li> <li>4. A form to edit will appear with some input field:</li> </ol> <ul style="list-style-type: none"> <li>- SPSO fills in the printer's code if SPSO wants to change.</li> </ul>		

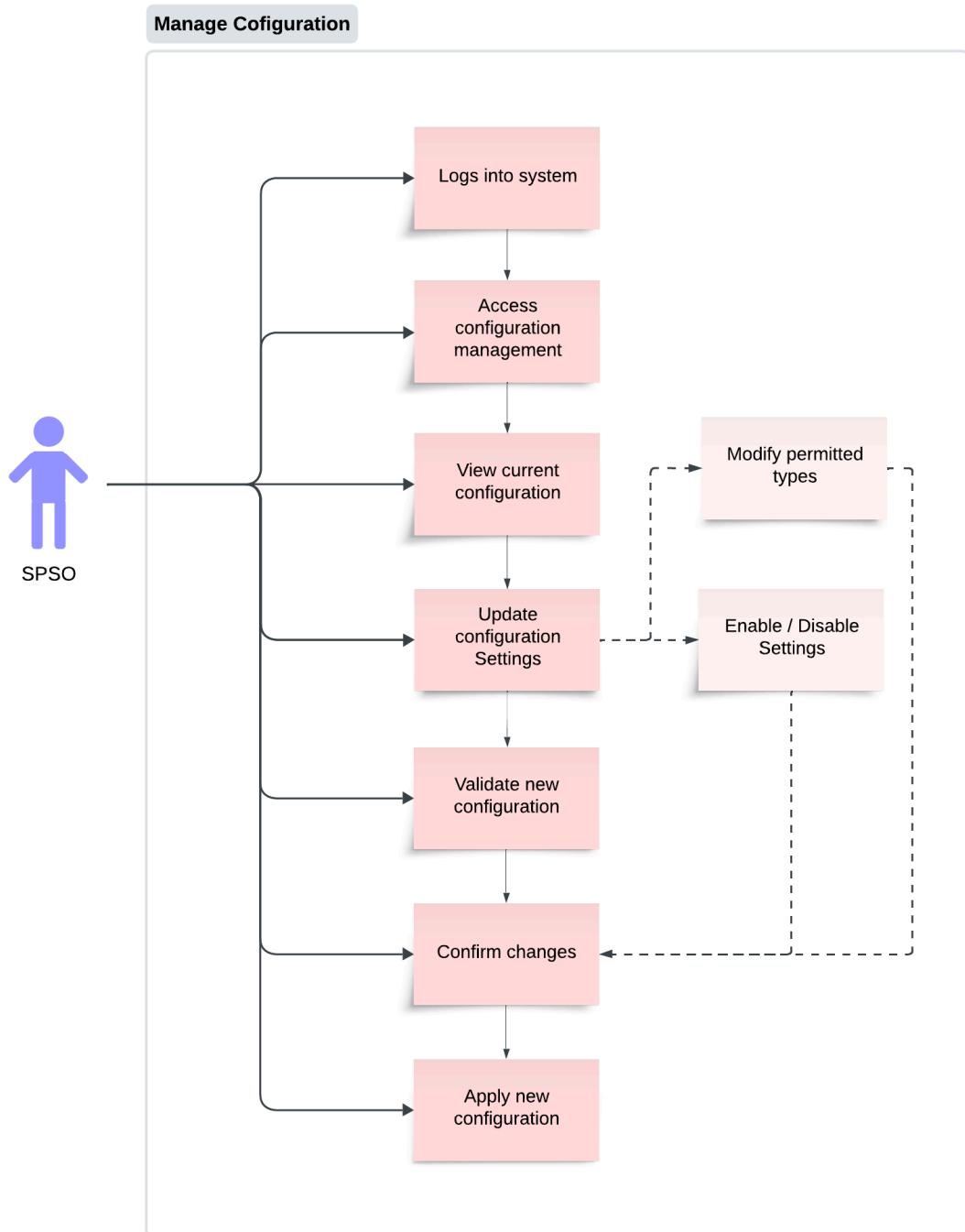
	<ul style="list-style-type: none"> <li>- SPSO fills in the printer's name if SPSO wants to change.</li> <li>- SPSO fills in the created date of the printer if SPSO wants to change.</li> <li>- SPSO fills in the printer's description if SPSO wants to change.</li> <li>- SPSO chooses a location to place: the building's name and a room number of that building, if SPSO wants to change.</li> </ul> <p>5. SPSO clicks into the save button.</p> <p>6. A system confirms that form and edits the information about that printer.</p>
Alternative Flow:	3a. SPSO can search the printer's code or name to filter that list.
Exceptions:	<ul style="list-style-type: none"> <li>- If SPSO chooses a non-existing building's name or non-existing room number, a system will log an error.</li> <li>- If SPSO searches a non-existing printer's code or name, a system will log an error.</li> </ul>

ID and Name:	UC005-3 Delete a Printer		
Created By:	Minh Khoa		
Primary Actor:	SPSO	Date Created:	29/09/2024
Description:	Describes an action that delete a printer on a system		
Trigger:	A printer wants to delete a printer on a system.		
Preconditions:	<ul style="list-style-type: none"> <li>- SPSO has logged into HCMUT_SSPPS as admin's account.</li> <li>- SPSO's devices have connected to the Internet.</li> <li>- SPSO access to managing printer's page.</li> </ul>		
Postconditions:	- An action deleting printer has been finished.		
Normal Flow:	<ol style="list-style-type: none"> <li>1. SPSO logs into HCMUT_SSPPS.</li> <li>2. SPSO clicks into the deleting section.</li> <li>3. SPSO chooses a printer to delete.</li> </ol>		

	<ol style="list-style-type: none"><li>4. SPSO clicks the save button</li><li>5. A system confirms that request and deletes that printer.</li></ol>
Alternative Flow:	3a. SPSO can search the printer's code or name to filter that list.
Exceptions:	<ul style="list-style-type: none"><li>- If SPSO searches a non-existing printer's code or name, a system will log an error.</li></ul>

## 2.7. Manage configuration:

### 2.7.1. Use-case diagram:



7. Manage configuration use-case diagram

### **2.7.2. Use-case table:**

ID and Name:	UC006 Manage Configuration	
Created By:	Vũ Hoàng Tùng	
Primary Actor:	SPSO	Date Created: 30/09/2024
Description:	SPSO can manage certain system configurations, including determining the file formats that students are allowed to upload, change unit prices, enabling features.	
Trigger:	SPSO wants to change configuration of the software.	
Preconditions:	<ul style="list-style-type: none"><li>- SPSO has logged into HCMUT_SSPPS as admin's account.</li><li>- SPSO's devices have connected to the Internet.</li><li>- SPSO access to managing configuration pages.</li></ul>	
Postconditions:	<ul style="list-style-type: none"><li>- The configuration is successfully updated or applied to the relevant environment.</li><li>- The system operates with the new or updated configurations without error.</li></ul>	

Normal Flow:	<ol style="list-style-type: none"> <li>1. SPSO logs into the system with admin privilege and accesses the configuration management section.</li> <li>2. The system displays a list of current configurations.</li> <li>3. SPSO updates configuration settings (e.g., toggling a feature flag, updating permitted file types, .....</li> <li>4. The system validates the new configuration and notifies SPSO.</li> <li>5. SPSO confirms changes.</li> <li>6. The system applies the new configuration.</li> </ol>
Alternative Flow:	<ul style="list-style-type: none"> <li>- Modify permitted types (UC006 – 1).</li> <li>- Enable/disable features (UC006 – 2).</li> </ul>
Exceptions:	<ul style="list-style-type: none"> <li>- If SPSO enters invalid configuration data (e.g., syntax error, invalid values), the system rejects the changes and provides an error message indicating what is wrong.</li> <li>- If there's a system failure when applying the new configuration: <ul style="list-style-type: none"> <li>• The system rolls back to the previous configuration to prevent downtime.</li> <li>• SPSO is notified of the failure, and logs are saved for debugging (if needed).</li> </ul> </li> </ul>

ID and Name:	UC006 – 1 Modify permitted types
Created By:	Vũ Hoàng Tùng

Primary Actor:	SPSO	Date Created:	30/09/2024
Description:	SPSO can change the file formats that students are allowed to upload to the system.		
Trigger:	The allowed file formats need to be changed.		
Preconditions:	<ul style="list-style-type: none"> <li>- SPSO has logged into HCMUT_SSPPS as admin's account.</li> <li>- SPSO's devices have connected to the Internet.</li> <li>- SPSO access to managing configuration pages.</li> </ul>		
Postconditions:	<ul style="list-style-type: none"> <li>- The action to change the allowed file upload formats is successfully completed.</li> </ul>		
Normal Flow:	<ol style="list-style-type: none"> <li>1. SPSO logs into the system with admin privilege and accesses the configuration management section.</li> <li>2. In the list of configurations, SPSO clicks on the "Change allowed file upload formats" option.</li> <li>3. The system displays a list of allowed file formats.</li> <li>4. SPSO adds or removes file formats in the list by selecting the "Add format" option or "Remove format" option in the displayed list.</li> <li>5. SPSO confirms the changes.</li> <li>6. The system updates the list of allowed file formats.</li> </ol>		
Alternative Flow:	<ul style="list-style-type: none"> <li>- None</li> </ul>		

Exceptions:	<ul style="list-style-type: none"> <li>- SPSO accidentally deletes all file types. If so, error message is sended, and the permitted file types is automatically updated into .docx and .pdf</li> </ul>
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ID and Name:	UC006 – 2 Enable/Disable Settings	
Created By:	Vũ Hoàng Tùng	
Primary Actor:	SPSO	Date Created: 30/09/2024
Description:	SPSO can disable or enable existing features of the software.	
Trigger:	SPSO wants to enable or disable a feature	
Preconditions:	<ul style="list-style-type: none"> <li>- SPSO has logged into HCMUT_SSPPS as admin's account.</li> <li>- SPSO's devices have connected to the Internet.</li> <li>- SPSO access to managing configuration pages.</li> </ul>	
Postconditions:	<ul style="list-style-type: none"> <li>- The action to toggle features is successfully completed.</li> </ul>	

Normal Flow:

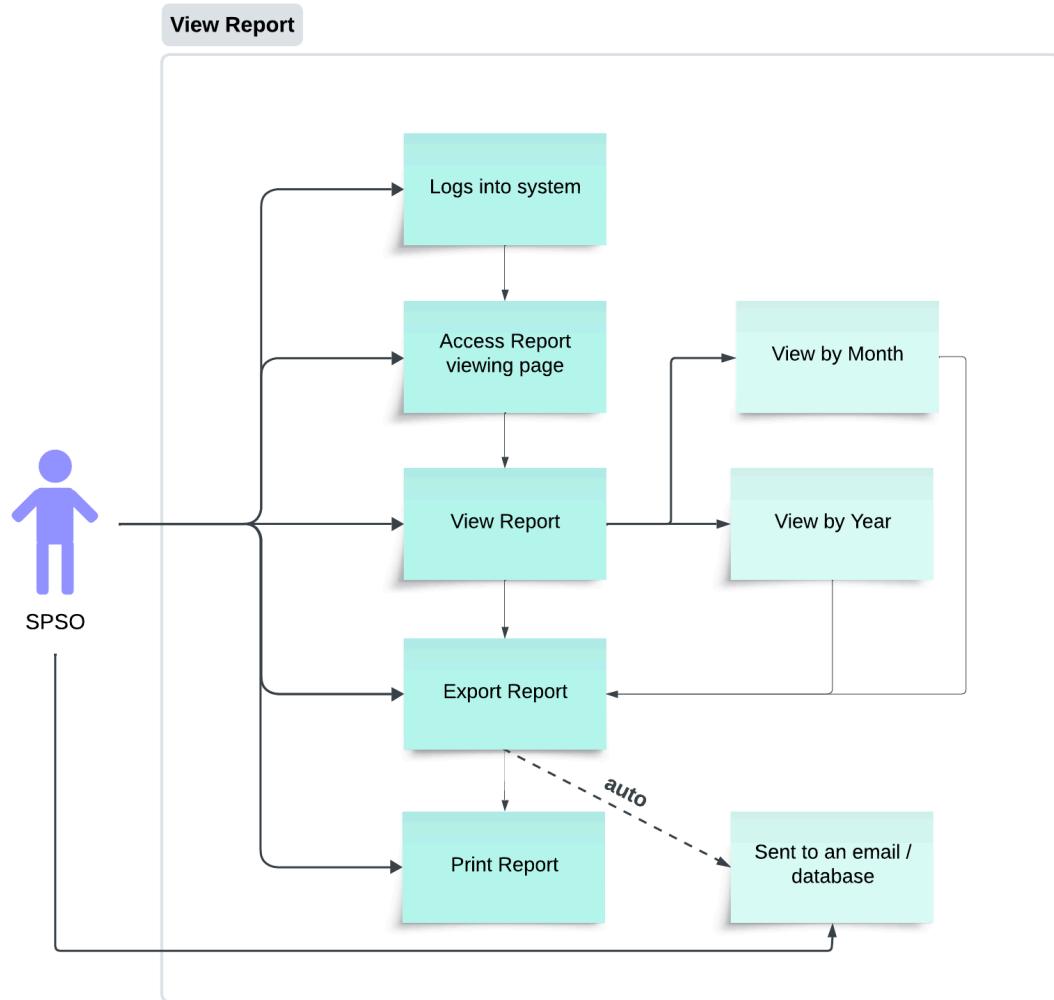
1. SPSO logs into the system with admin privilege and accesses the configuration management section.
2. In the list of configurations, numerous features are displayed to SPSO.
3. SPSO turn on/turn off targeting features.
4. SPSO confirms the changes.
5. The system updates the list of allowed file formats.

Alternative Flow: - None

Exceptions: - None

## 2.8. View Report:

### 2.8.1. Use-case diagram:



8. Report-viewing use-case diagram

### 2.8.2. Use-case table:

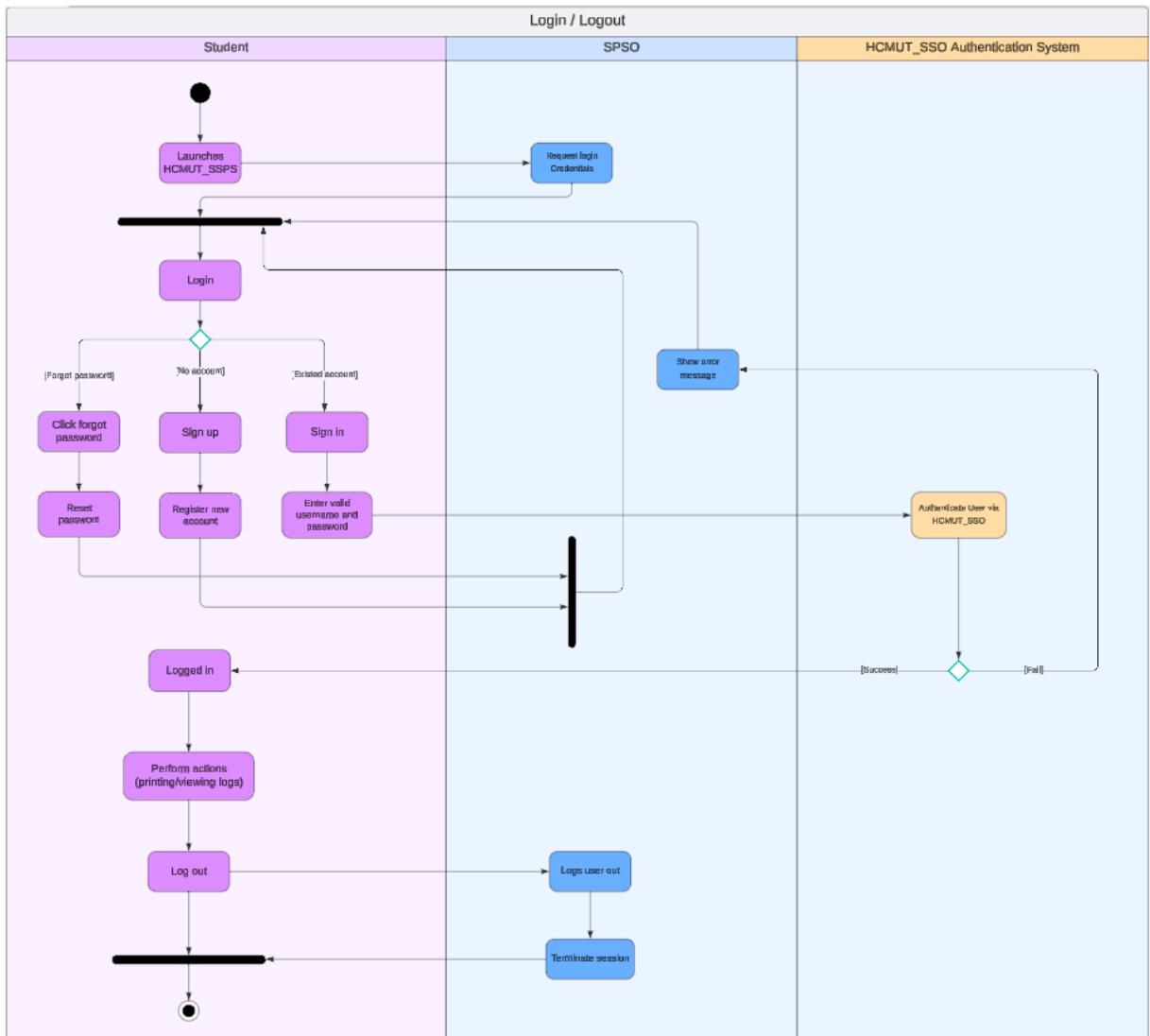
ID and Name:	UC007 View Report		
Created By:	Vũ Hoàng Tùng		
Primary Actor:	SPSO	Date Created:	30/09/2024
Description:	SPSO can view a periodic statistical report by month and year.		
Trigger:	The school requests to see the system's printing statistic.		
Preconditions:	<ul style="list-style-type: none"> <li>- SPSO is logged into the system with admin privileges.</li> <li>- SPSO's device is connected to the internet.</li> </ul>		
Postconditions	<ul style="list-style-type: none"> <li>- SPSO successfully performs the operation.</li> <li>:</li> </ul>		
Normal Flow:	<ul style="list-style-type: none"> <li>- After logging into the system, SPSO accesses the report viewing page.</li> <li>- SPSO can choose to view the report by month or by year.</li> <li>- SPSO can choose to export the report to a file or print the report as a hard copy.</li> </ul>		
Alternative Flow:	<ul style="list-style-type: none"> <li>- The report can be configured to be sent automatically to an email or database every month.</li> </ul>		

Exceptions: - None

## II. Task 2

### 2.1. Activity Diagram

#### 2.1.1. Account management and authentication

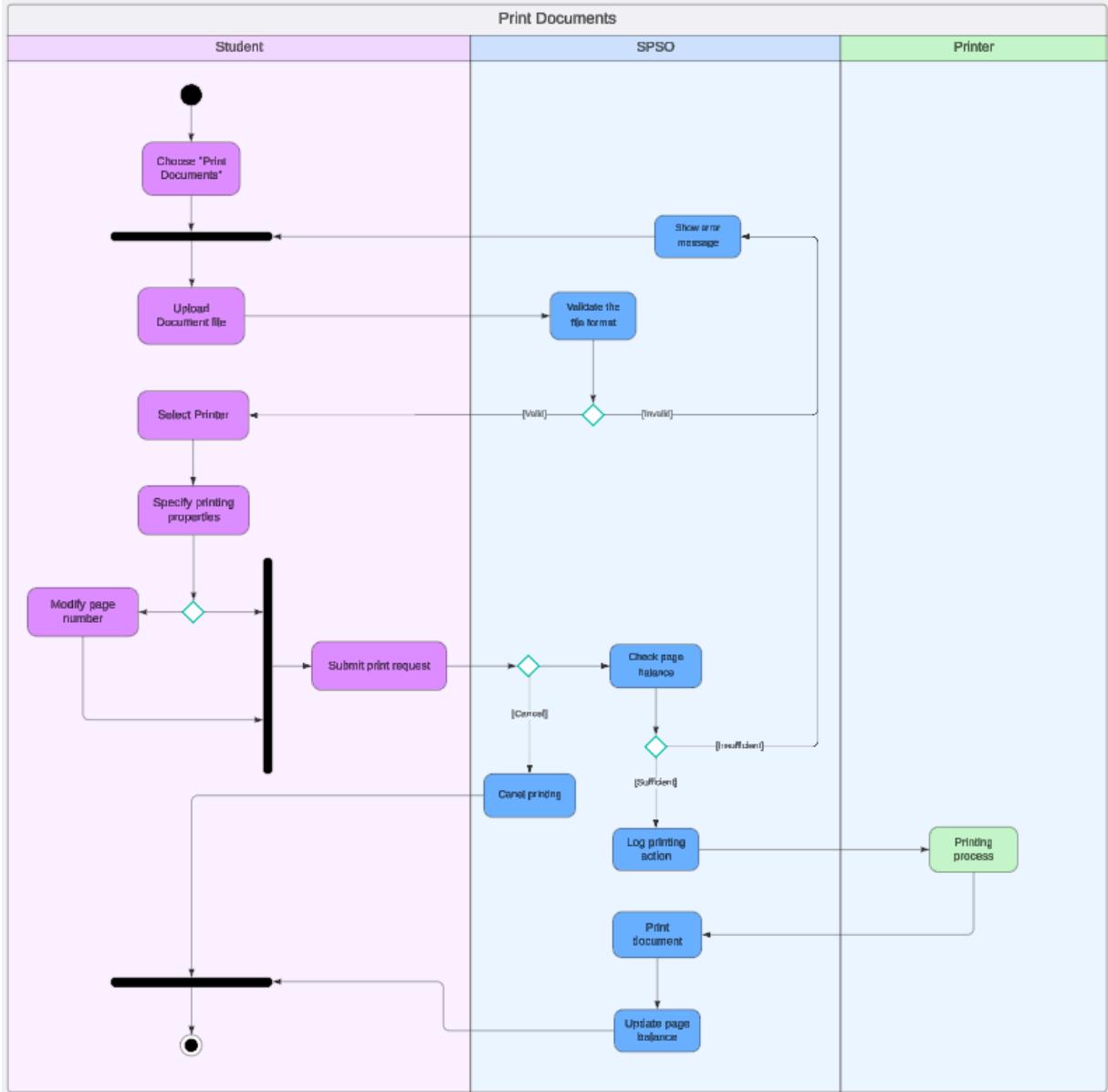


9. Login / Logout activity diagram

#### Account Management and Authentication:

The system begins with user account management through the HCMUT\_SSO Authentication System. Users can either log in with existing credentials or sign up for a new account. If an account exists but the user has forgotten the password, they can reset it. Successful authentication allows users to perform actions such as printing or viewing logs. For security, users can log out to terminate their session, ensuring their account remains protected.

### 2.1.2. Print documents

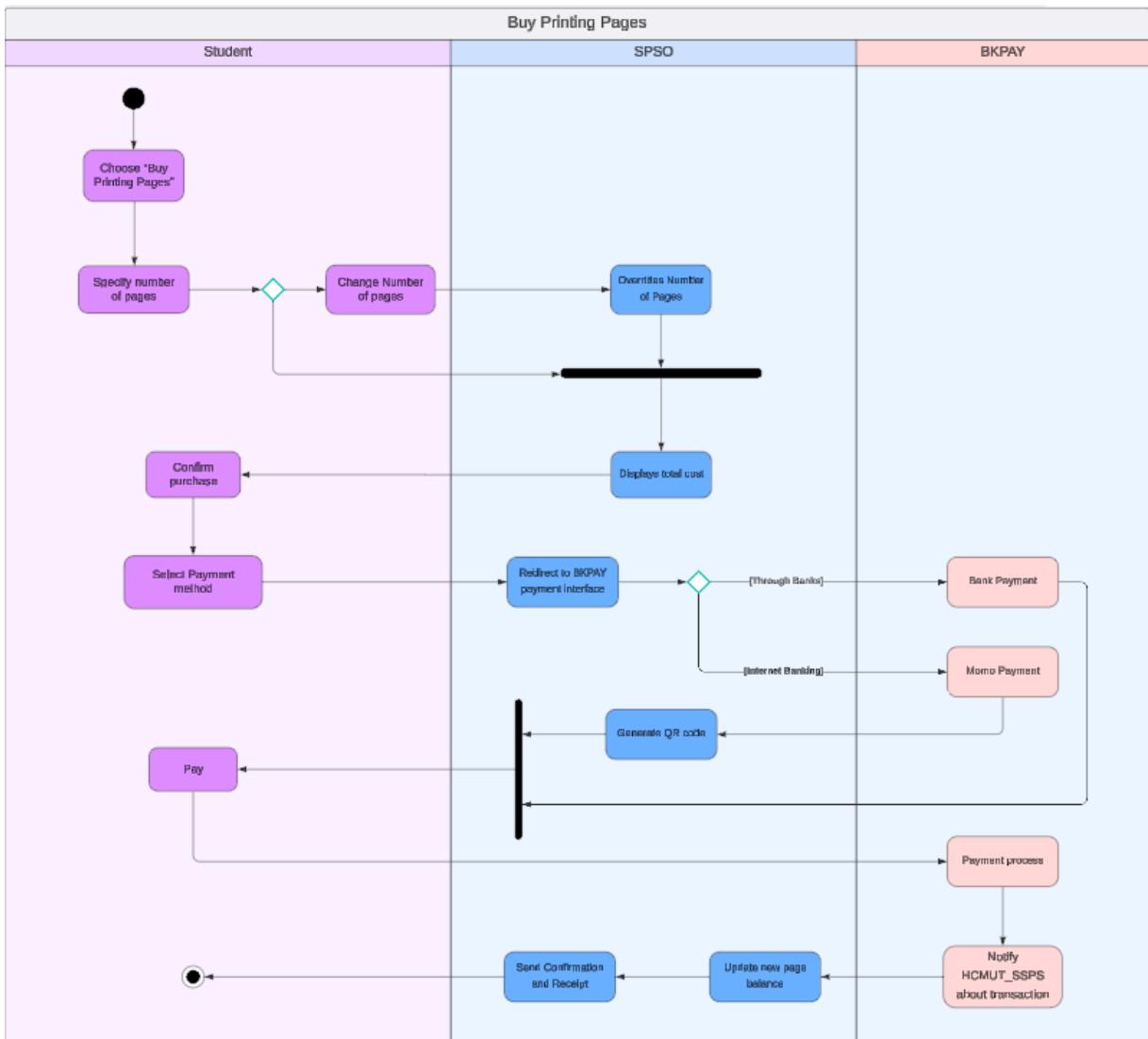


10. Print document activity diagram

#### Document Printing Workflow:

The document printing process involves selecting "Print Documents," uploading the desired file, and validating its format. Users specify the number of pages they wish to print, which is checked against their page balance. If the balance is sufficient, the print request is submitted; otherwise, an error message prompts users to resolve the insufficiency. Users can select a printer and specify printing properties before finalizing the action.

### 2.1.3. Buy printing pages

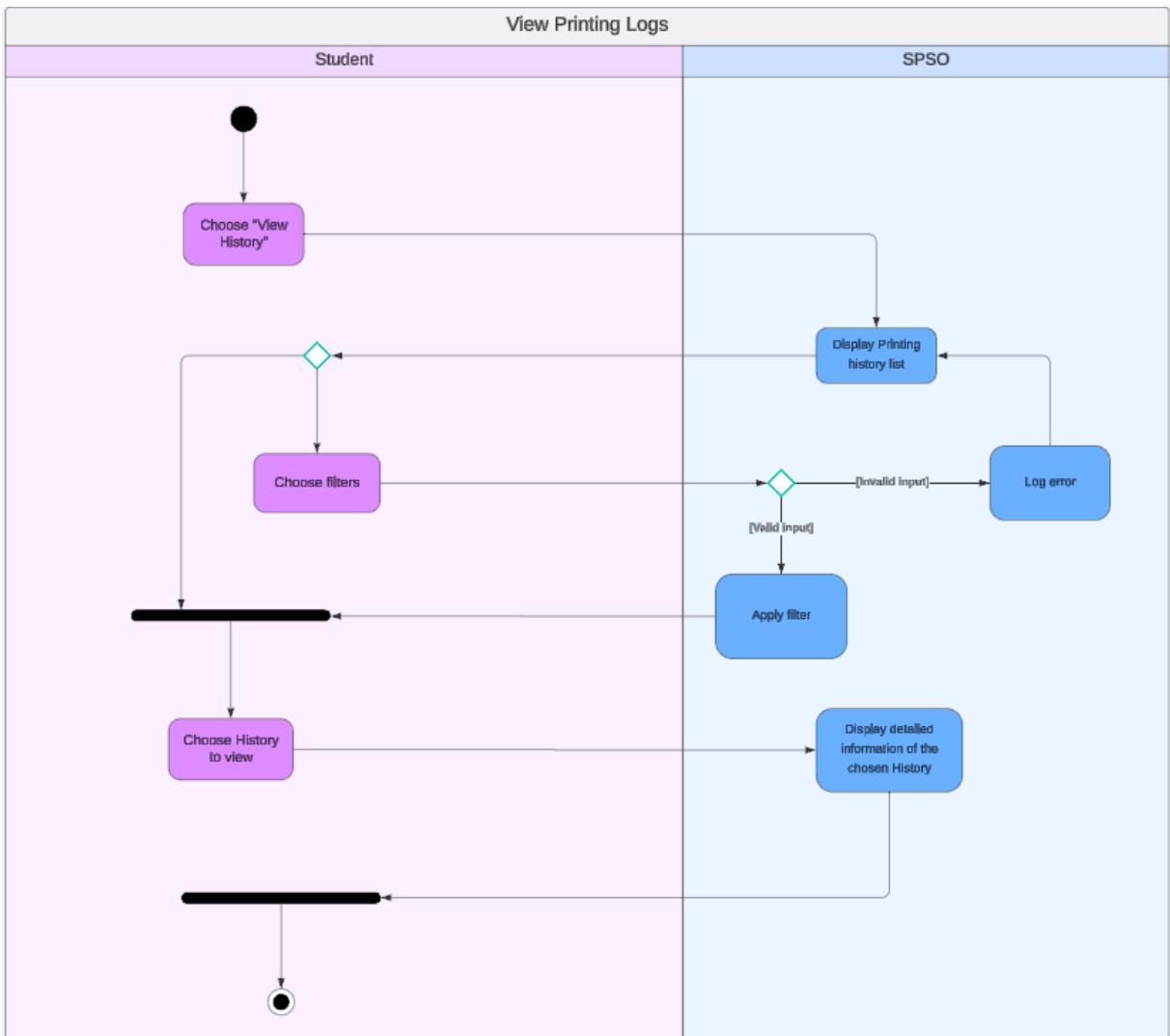


11. Buy printing pages activity diagram

#### Purchasing Printing Pages:

Users have the option to buy printing pages through a straightforward process. They select "Buy Printing Pages," choose their preferred payment method, and proceed to pay. Upon successful payment, a confirmation and receipt are sent, updating the user's account with the purchased credits. If there are issues during payment, users receive error messages guiding them to resolve the problem.

#### 2.1.4. View printing log:

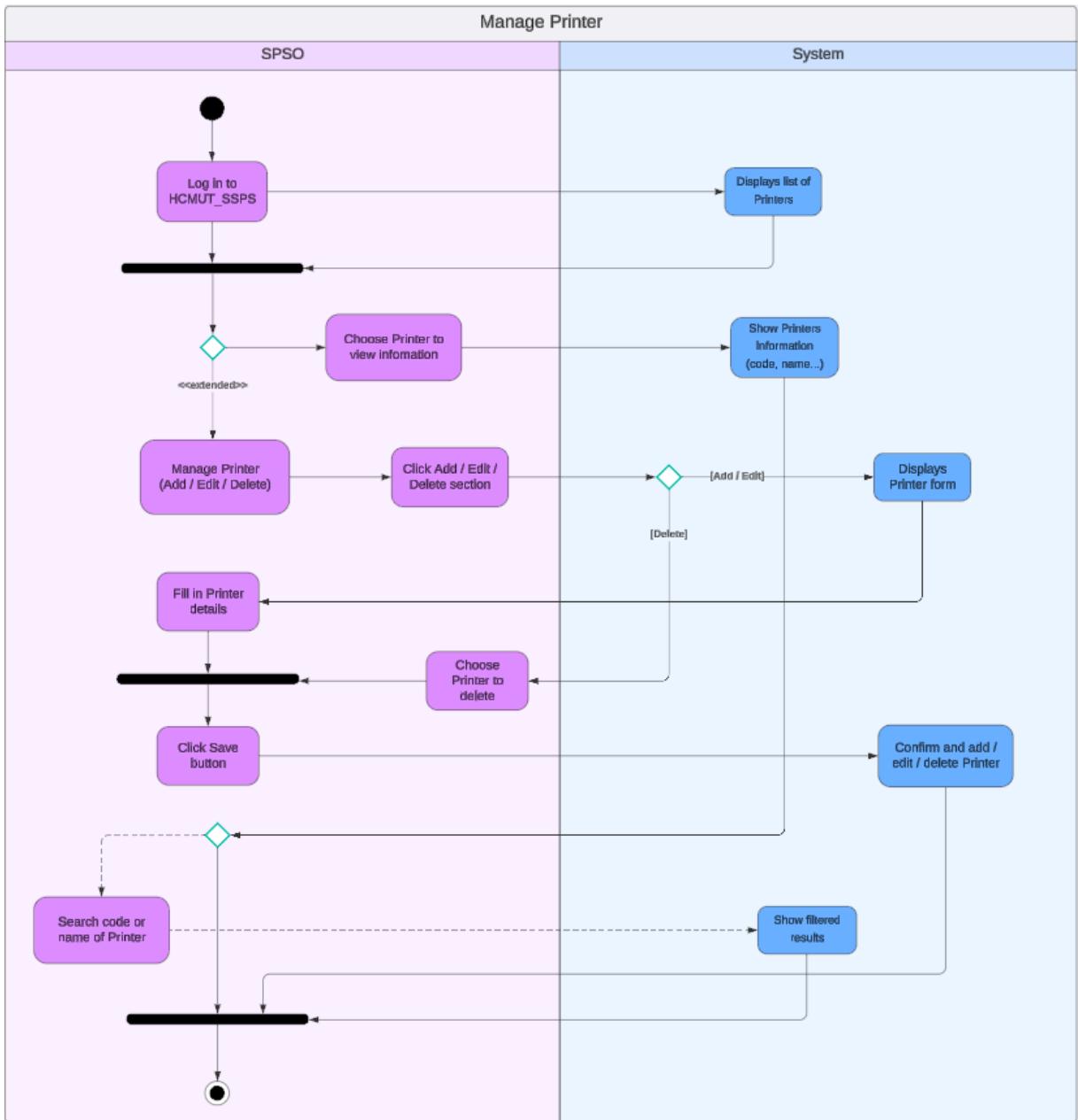


12. View printing log activity diagram

#### Viewing and Managing Printing Logs:

Users have access to view their printing history via the "View History" option. Valid inputs display a list of past printing actions. Users can choose specific history entries to view detailed information. Additionally, they can apply filters to refine their search results, making it easier to track and manage their printing activity over time.

### 2.1.5. Manage printer

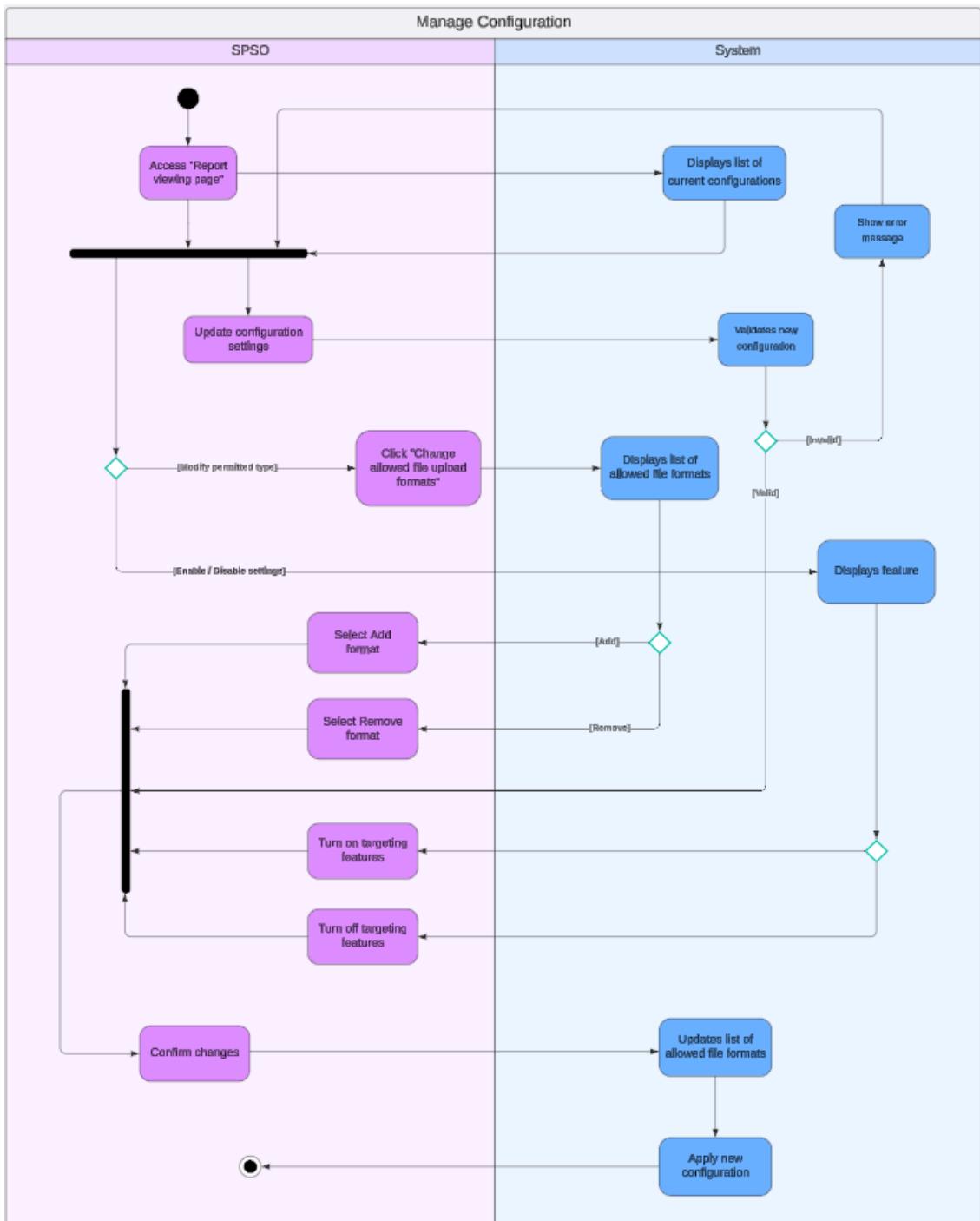


13. Manage printer activity diagram

#### Printer Management:

The system provides comprehensive management of printers, allowing users to add, edit, or delete printer details. Users can view a list of printers with information like code and name, and make changes through a form interface. Searching and managing printers is streamlined, with options to confirm and save changes ensuring that the printer inventory is kept up-to-date and accurate.

## 2.1.6. Manage Configuration

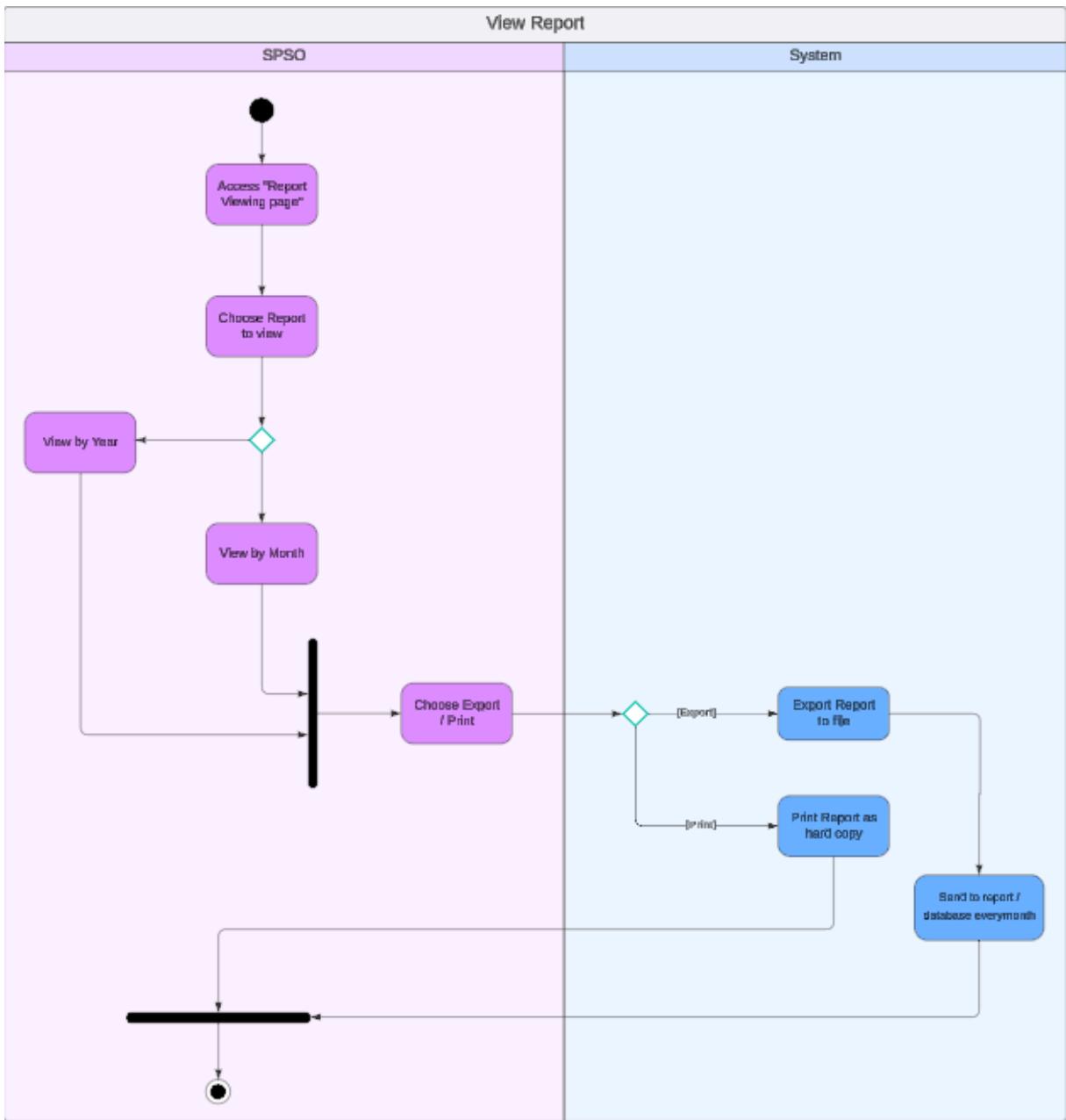


### 14. Manage configuration activity management

#### Configuration Management:

Configuration management includes modifying system settings, such as enabling or disabling specific features and updating configuration settings. Users can access current configurations, make permitted modifications, and apply new settings. The system validates changes to ensure they meet the required standards before implementation.

### 2.1.7. View report



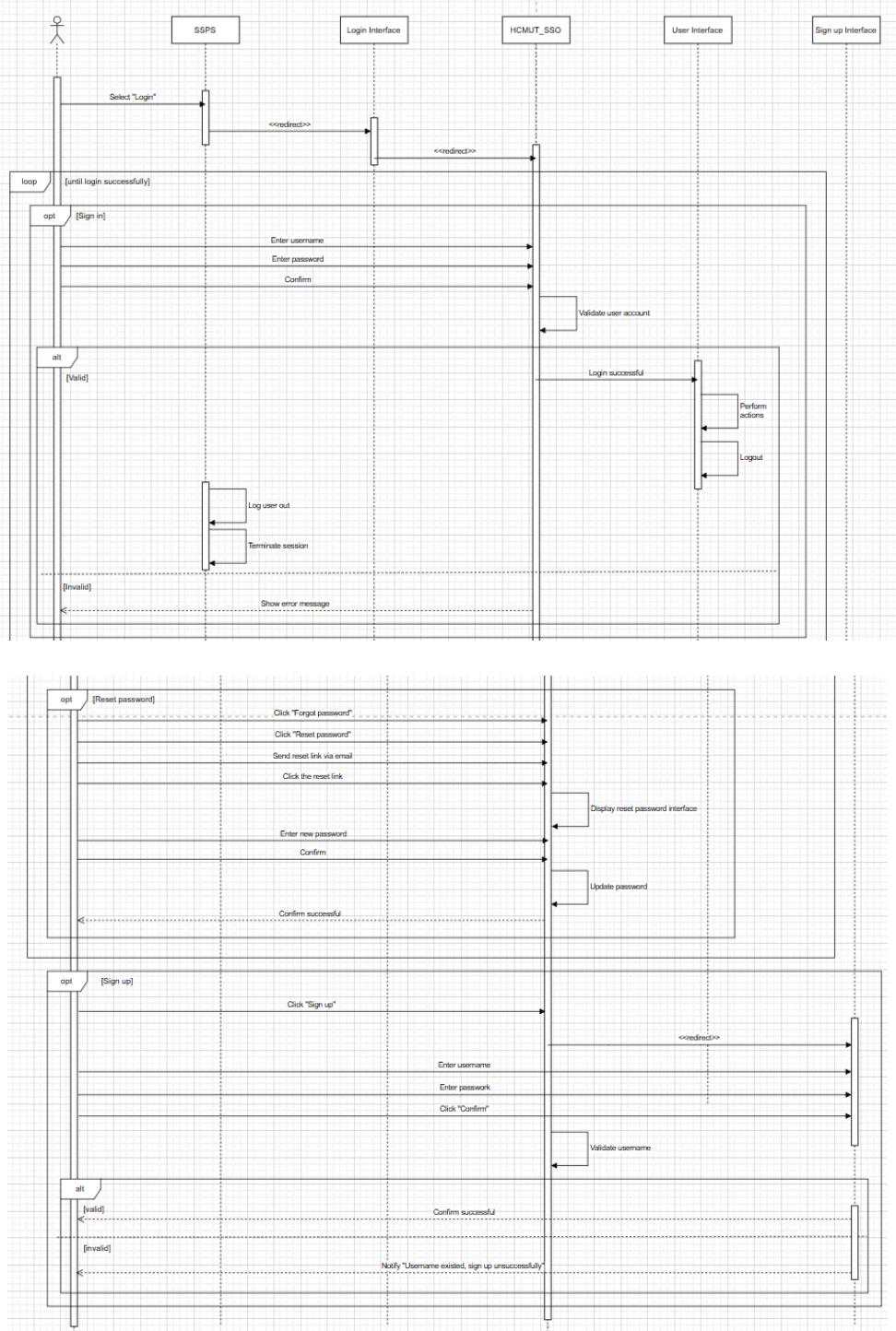
15. View report activity diagram

*Report Viewing and Exporting:*

Users can access and view reports categorized by year or month. The system allows reports to be exported to a file or printed as a hard copy. This functionality helps users keep track of their printing activities and manage their resources efficiently.

## 2.2. Sequence diagram

### 2.2.1. Authentication



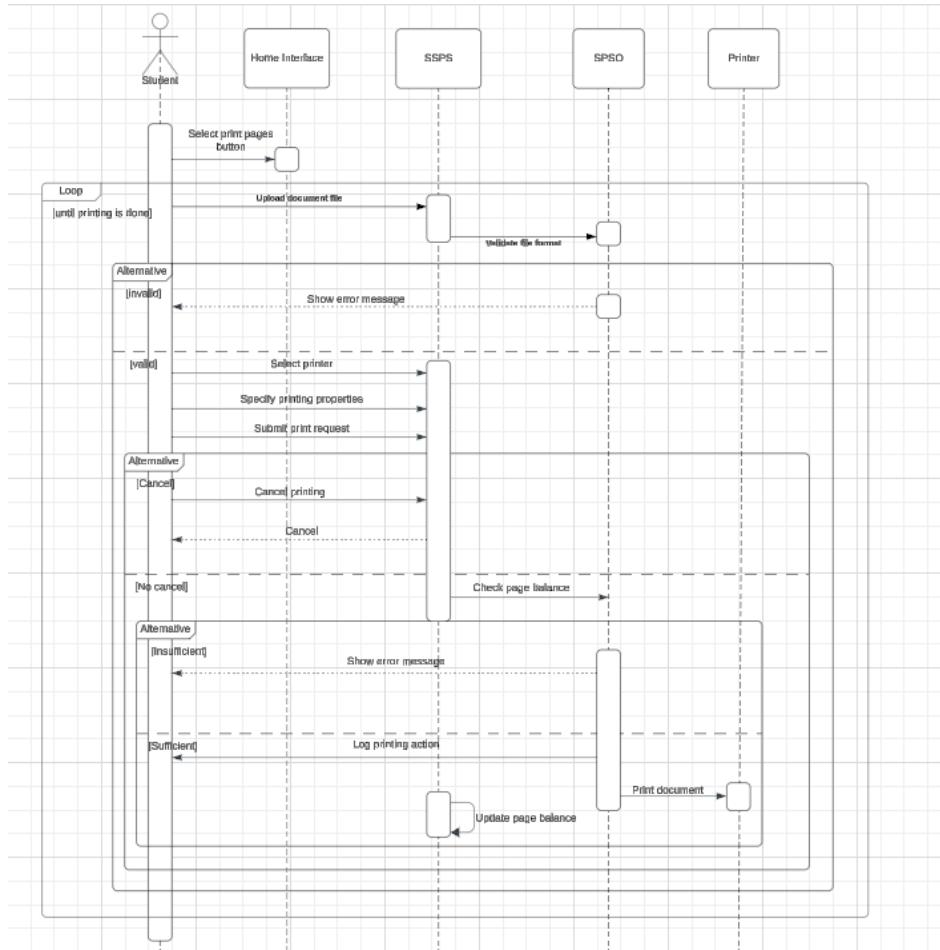
16. Authentication sequence diagram

*Login:*

The sequence diagram for the login process of the SSPS system starts with the user selecting the login interface, entering their credentials (username and password), and

receiving feedback depending on the validity of the information. If the credentials are valid, the login is successful, and the user is authenticated to proceed. In case of invalid credentials, an error message is displayed. The diagram also outlines the password reset process, where users can request a reset link, receive it via email, and update their password, successfully completing the reset.

### 2.2.2. Print document

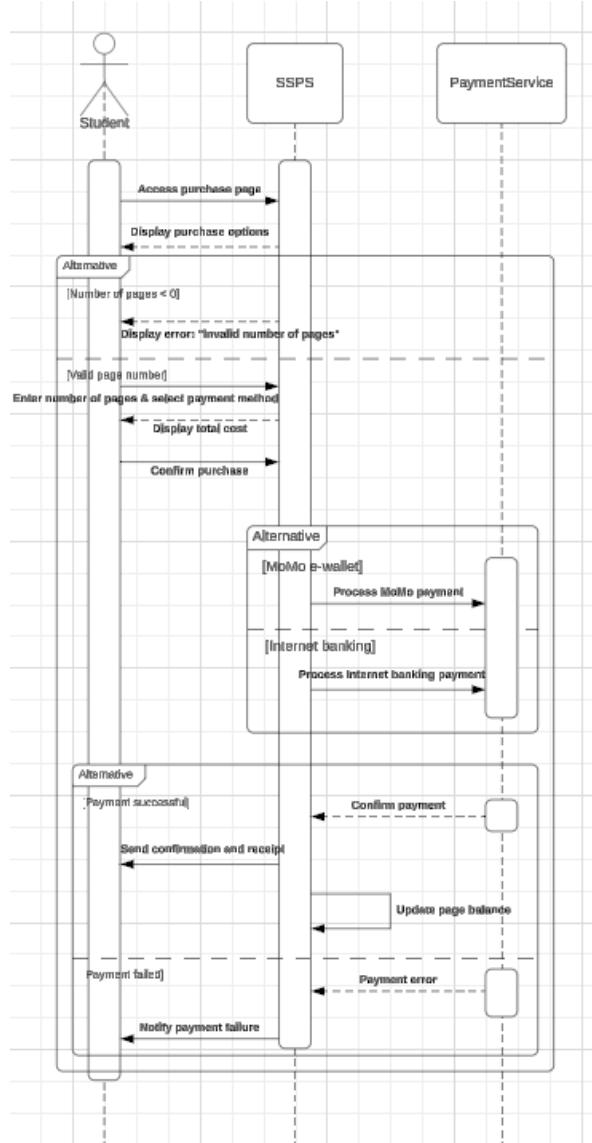


17. Print documents sequence diagram

*Print documents:*

The sequence diagram for printer management in the SSPS system illustrates the process of adding, editing, deleting, and viewing printer information. It begins with a user selecting the printer management interface, displaying the list of printers, and interacting with individual printers by adding new entries, editing details, or deleting a printer. The system also validates input data, confirming or rejecting operations such as adding or updating configurations. The diagram shows how the database is updated accordingly, providing confirmation of successful operations.

### 2.2.3. Buy printing pages

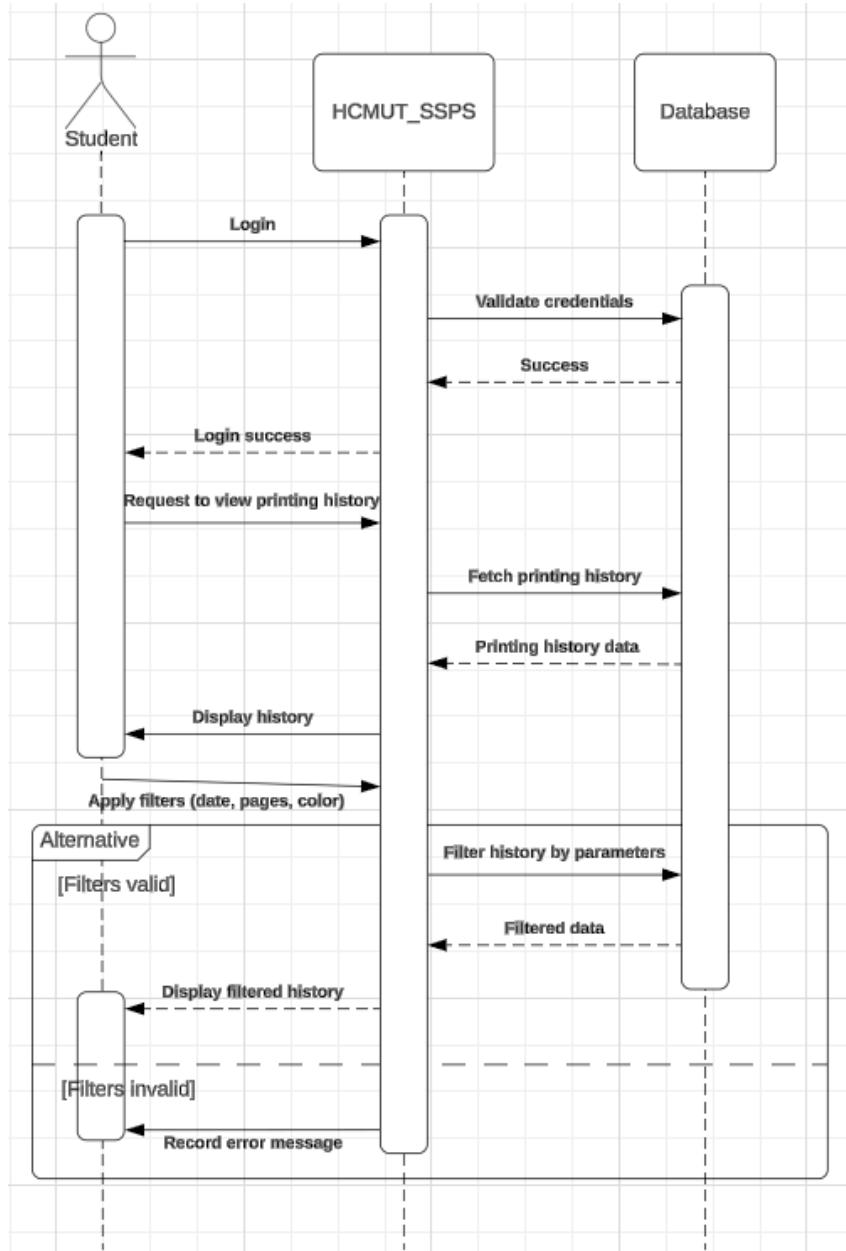


18. Buy printing pages sequence diagram

*Buy printing pages:*

The sequence diagram illustrates the steps involved in purchasing printing pages. It begins with the student entering the number of pages and selecting a payment method, which leads to a validation check for the page number. If the page number is valid, the student accesses the purchase page to see payment options, including MoMo and internet banking. After the payment method is chosen, the system processes the payment, confirming success or failure, and updates the page balance accordingly. A confirmation message is sent to the student upon successful payment, while any errors trigger a notification.

#### 2.2.4. View printing logs

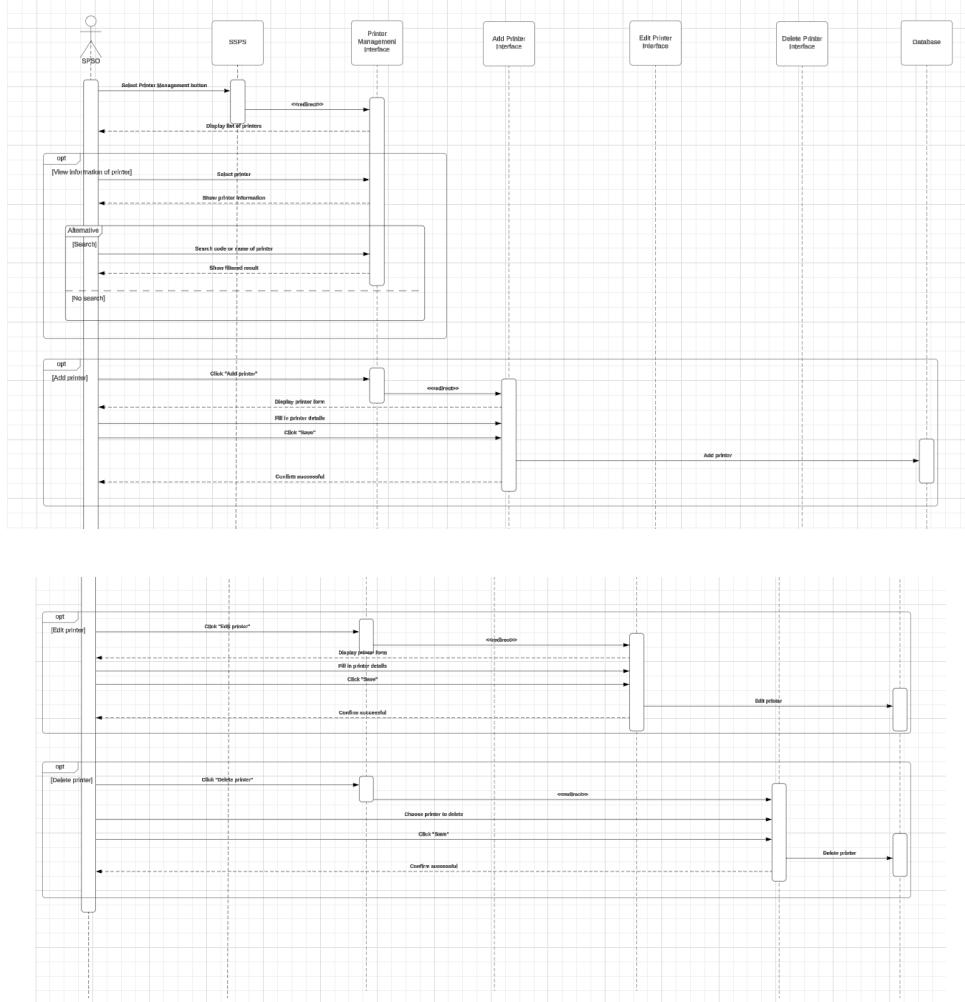


19. View printing log sequence diagram

*View printing logs:*

The sequence diagram describes the process for viewing printing logs. It starts with the user logging in and validating their credentials. Upon successful login, the user requests to view their printing history, prompting the system to fetch and display the data. The user can apply various filters, such as date, pages, and color, to refine the history displayed. If the filters are valid, the filtered data is presented; otherwise, an error message is recorded for the user. This sequence ensures that users can effectively manage and review their printing records.

## 2.2.5. Manage printer

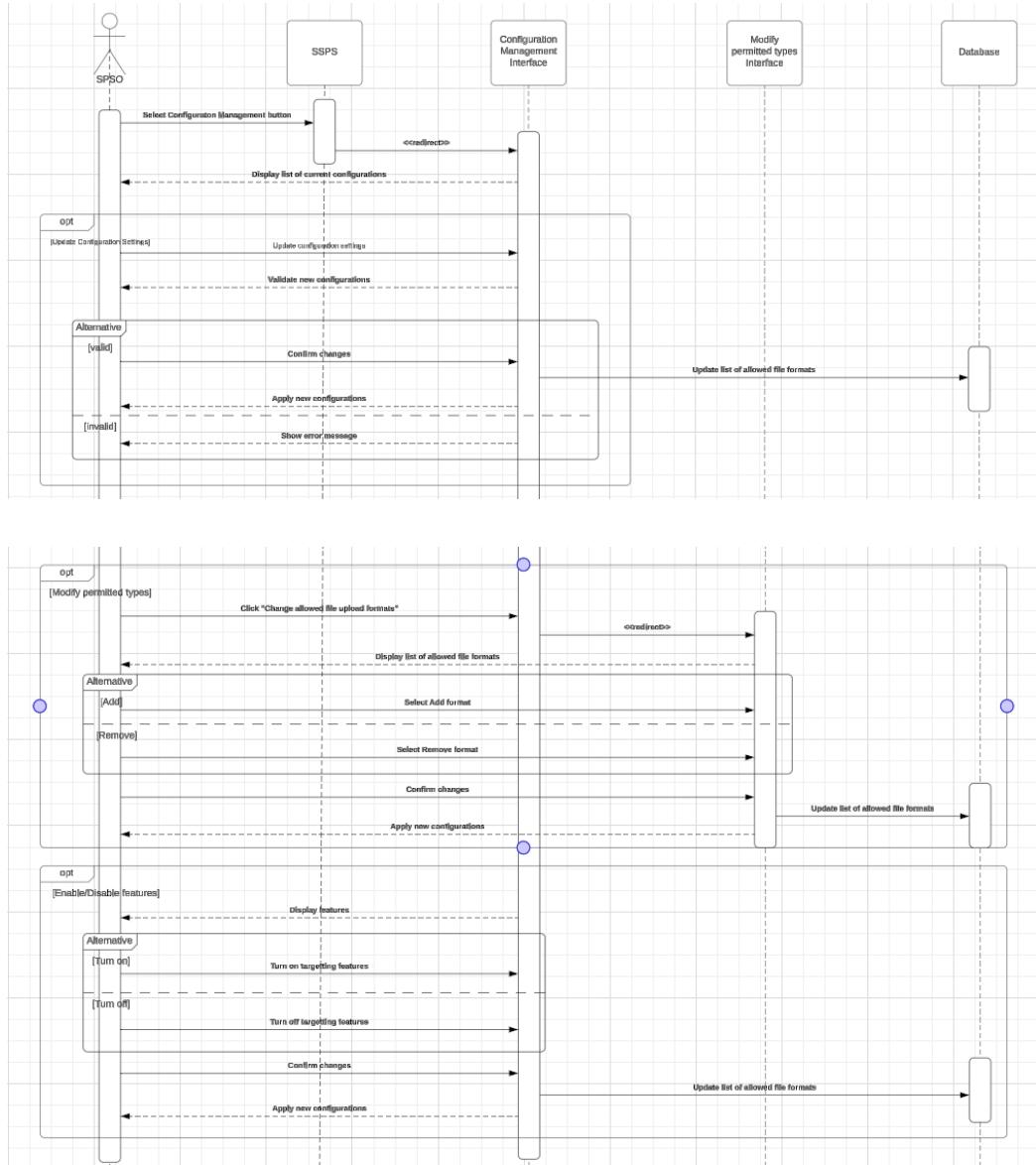


20. Manage printer sequence diagram

*Manage printer:*

In this sequence diagram, the focus is on printer management. The process starts when the user selects the Printer Management button, displaying a list of current printers. The user can search for a printer by code or name, and the system shows filtered results. Options for adding, editing, or deleting printers are available, with each action leading to a form where details can be filled out. After the user submits changes, the database is updated accordingly, confirming the success of each operation for adding, editing, or deleting printers.

## 2.2.6. Manage configuration

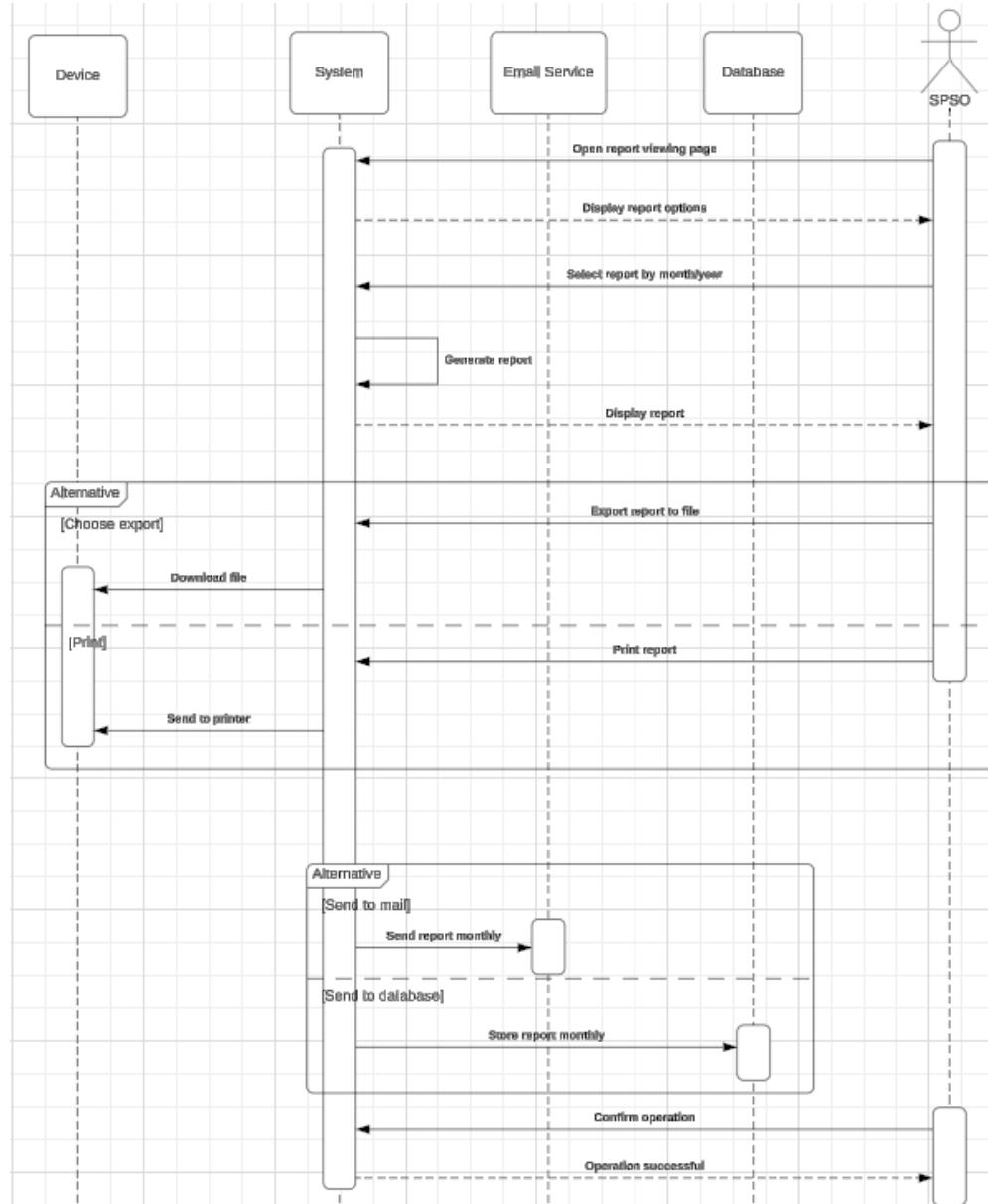


21. Manage configuration sequence diagram

*Manage configuration:*

This sequence diagram details the management of configuration settings. It begins with the user selecting the Configuration Management button, which displays the current configuration list. The user can update settings by validating new configurations, modifying permitted file types, or enabling/disabling features. Options to add or remove formats are available, and the system ensures that all changes are confirmed and applied. Any errors encountered during the process trigger appropriate messages, ensuring clarity and correctness of the updates made to the configurations.

### 2.2.7. View report



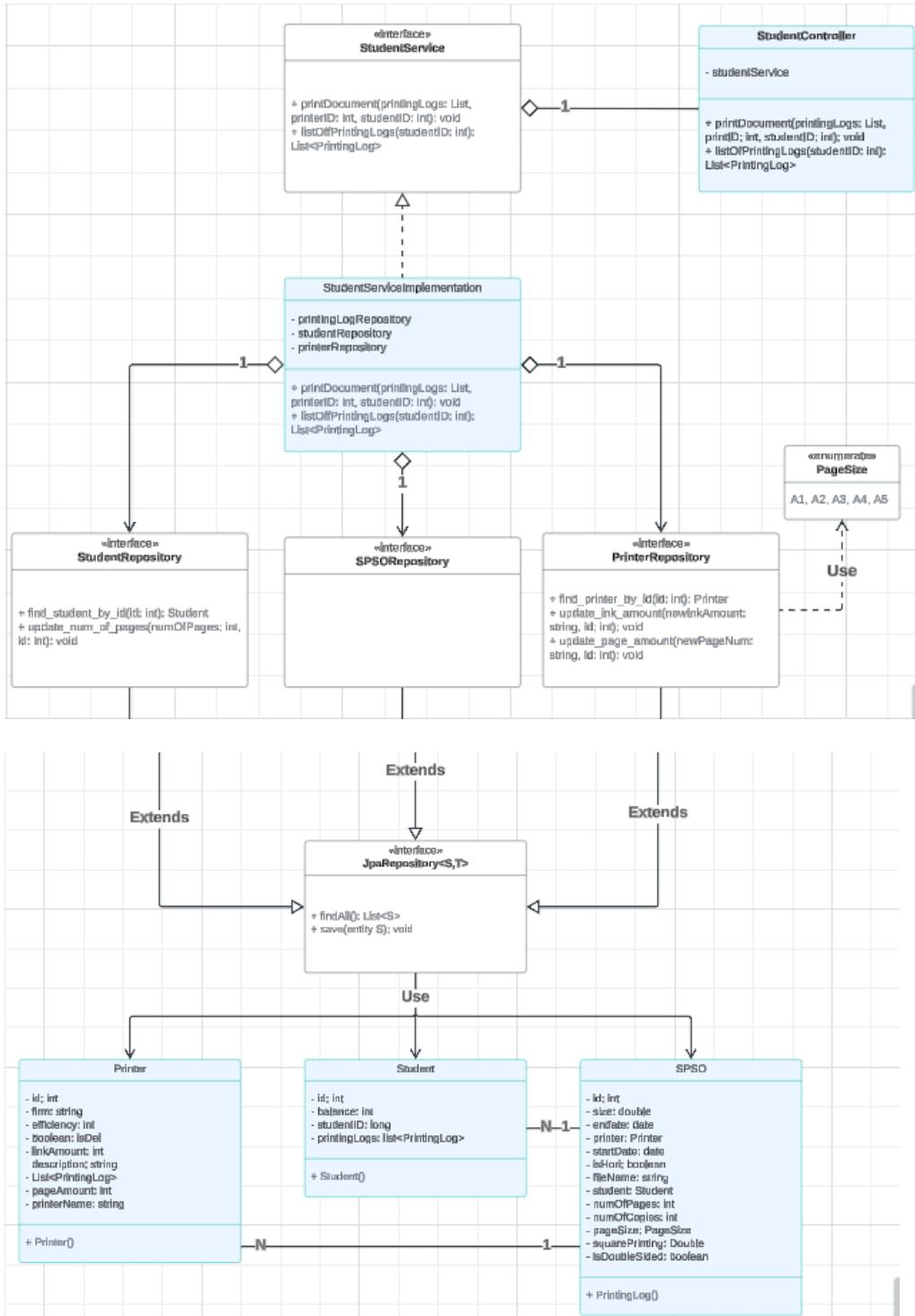
22. View report sequence diagram

*View report:*

This sequence diagram focuses on viewing reports. It begins with the user opening the report viewing page, where they can select a report by month or year and generate the desired report. Once displayed, the user has the option to export the report to a file, print it, or send it to an email or database. Each operation confirms its success, ensuring that the report is either downloaded, printed, or stored as specified. This process highlights the flexibility and accessibility of report management within the system.

## 2.3. Class Diagram

### 2.3.1. Print document



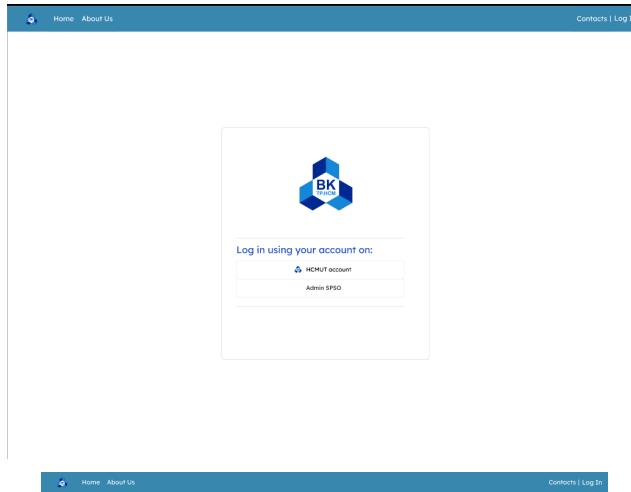
23. Print document class diagram

## 2.4. User Interface

### 2.4.0. Source:

[https://www.figma.com/proto/bNSXjhPBP9J0XTaDBn8QEL/LMS?node-id=224-704&t=bRQSnTIP7dlPa3JC-1&fbclid=IwY2xjawGIj2JleHRuA2FlbQIxMAABHTZqvO11SNZUSQ3R44aGolS6jTjirDsfoxIRLyzBBG9biddnbP3Q1CBbZg\\_aem\\_f6kJiYBWezE2XstIvqR8Q](https://www.figma.com/proto/bNSXjhPBP9J0XTaDBn8QEL/LMS?node-id=224-704&t=bRQSnTIP7dlPa3JC-1&fbclid=IwY2xjawGIj2JleHRuA2FlbQIxMAABHTZqvO11SNZUSQ3R44aGolS6jTjirDsfoxIRLyzBBG9biddnbP3Q1CBbZg_aem_f6kJiYBWezE2XstIvqR8Q)

### 2.4.1. Authentication



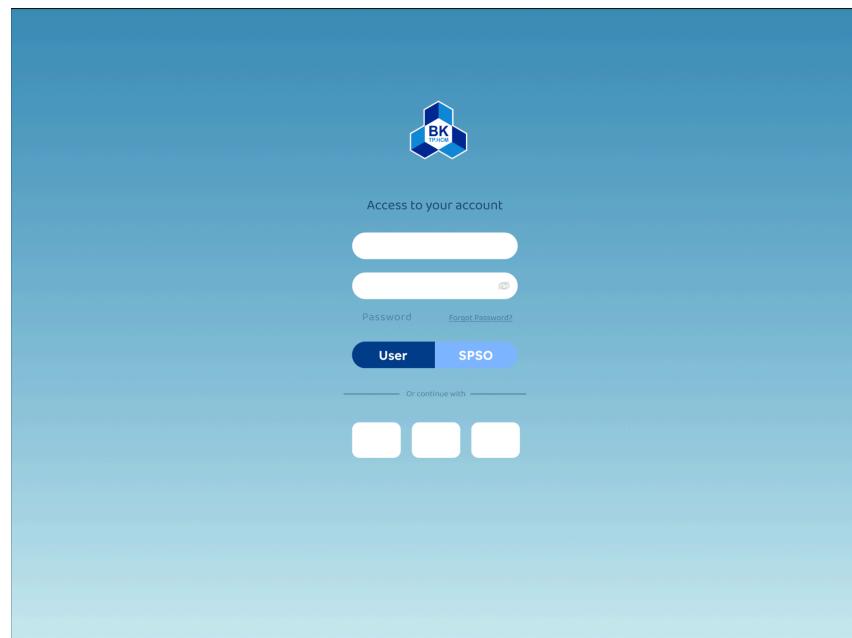
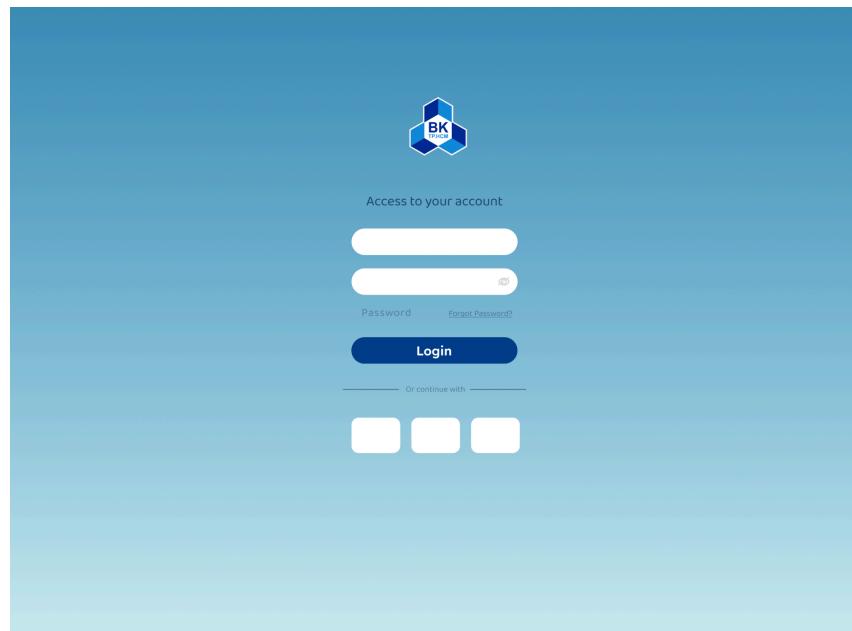
### HCMUT Student Smart Printing Service

A suitable place to print documents,  
assignments, slides, research papers  
and more.

[Print now](#)



24. Home page



25. Login page

**Ho Chi Minh City University of Technology  
Smart Printing Service**

**Control Panel**

- Printing Properties
- Printer
- Sign Out

**Recent Commands**

- Document\_for\_software.pdf (Without Color, 2 Sided)
- Document\_for\_software.pdf (With Color, 1 Sided)
- Document\_for\_software.pdf (With Color, 2 Sided)
- Document\_for\_software.pdf (Without Color, 1 Sided)
- Document\_for\_software.pdf (Without Color, 2 Sided)
- Document\_for\_software.pdf (With Color, 1 Sided)
- Document\_for\_software.pdf (Without Color, 1 Sided)
- Document\_for\_software.pdf (Without Color, 2 Sided)
- Document\_for\_software.pdf (With Color, 1 Sided)
- Document\_for\_software.pdf (Without Color, 1 Sided)

**Current Balance** \$ 2004    **Total Commands** 0/0    **Remaining Paper** 16

**Current Commands**

- Blank (Create New Command)

**Available Printer**

- Printer A (With Color, 2 Sided, Direction®) 304 - A4
- Printer A (With Color, 1 Sided, Direction®) 504 - A4
- Printer A (Without Color, 2 Sided, Direction®) 504 - A4

26. User page

**Ho Chi Minh City University of Technology  
Smart Printing Service**

**Control Panel**

- Printing Properties
- Printer
- Sign Out

**Number of Printers** 6    **Total Commands** 0/0    **Total Paper** 16200

**Statistics**

**Recent Commands**

- Document\_for\_software.pdf (Without Color, 2 Sided) Printed by XuanBeck
- Document\_for\_software.pdf (With Color, 1 Sided) Printed by XuanBeck
- Document\_for\_software.pdf (With Color, 2 Sided) Printed by XuanBeck
- Document\_for\_software.pdf (Without Color, 1 Sided) Printed by XuanBeck
- Document\_for\_software.pdf (Without Color, 2 Sided) Printed by XuanBeck
- Document\_for\_software.pdf (With Color, 1 Sided) Printed by XuanBeck
- Document\_for\_software.pdf (Without Color, 1 Sided)

**Notifications**

- Printer A is out of ink

**Current Commands**

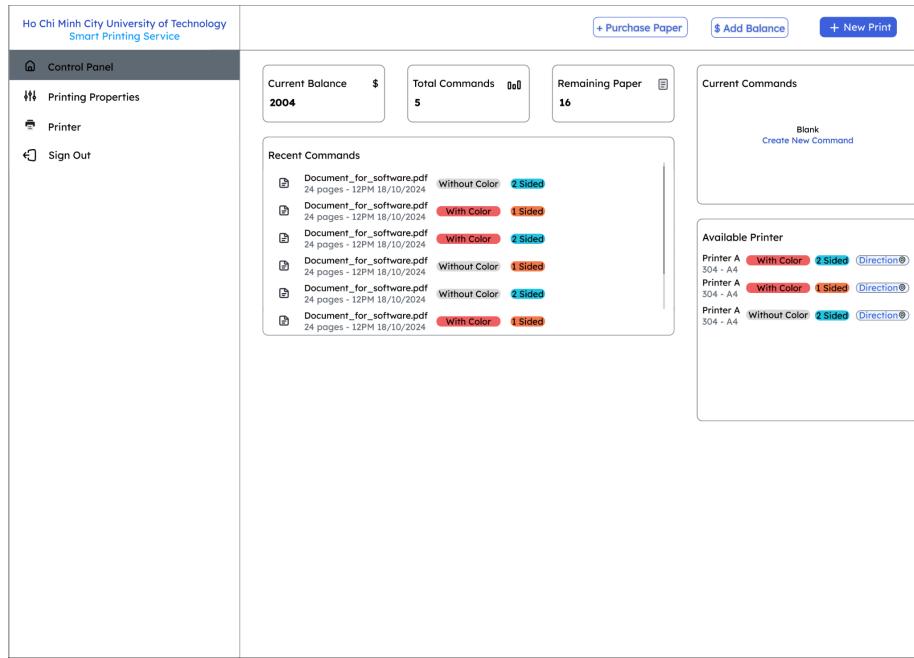
- Printer B 304 - A4 (Printing 5/20)
- Printer A 304 - A4 (Done)
- Printer A 304 - A4 (Waiting)

**Available Printer**

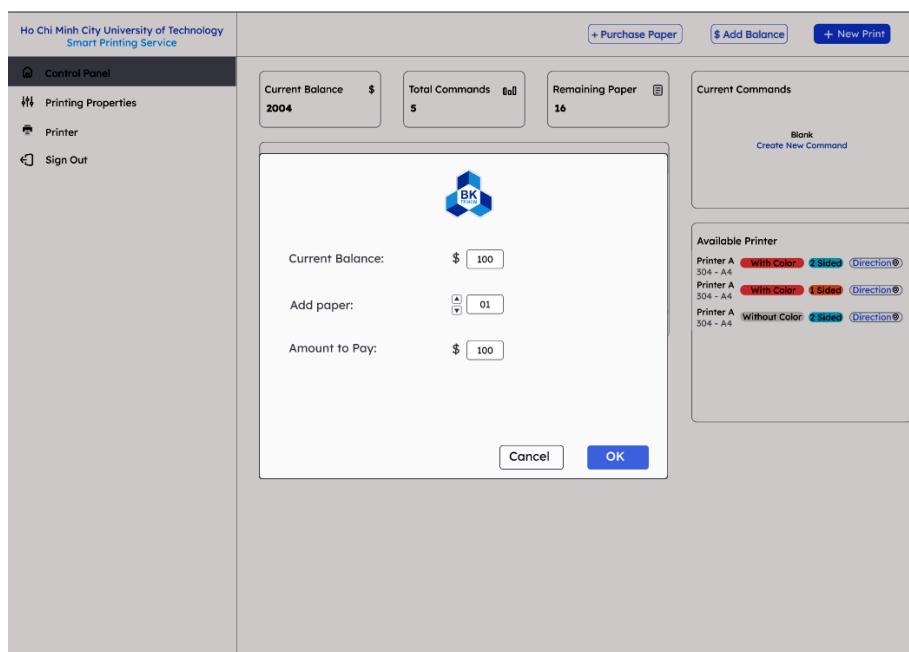
- Printer A (With Color, 2 Sided, Direction®) 2/150
- Printer B (With Color, 1 Sided, Direction®) 150/150
- Printer C (Without Color, 2 Sided, Direction®) 120/150

27. SPSO page

## 2.4.2. Buy Printing

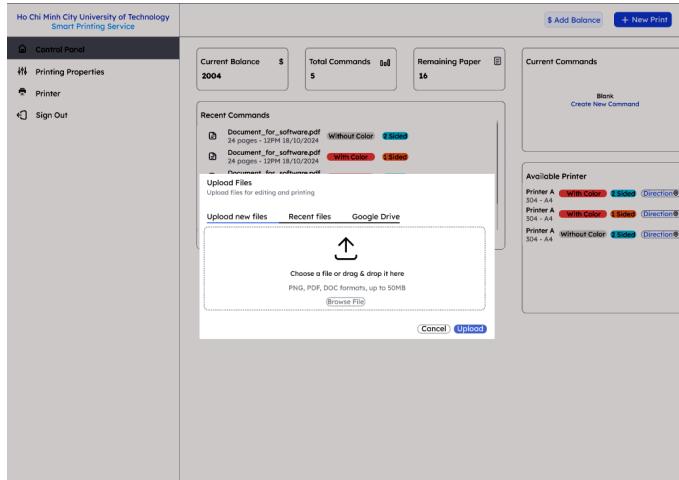


28. View printing page

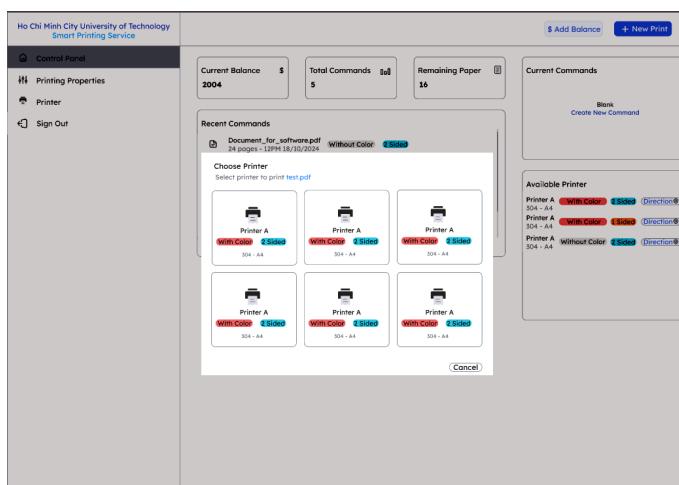


29. Buy printing pages

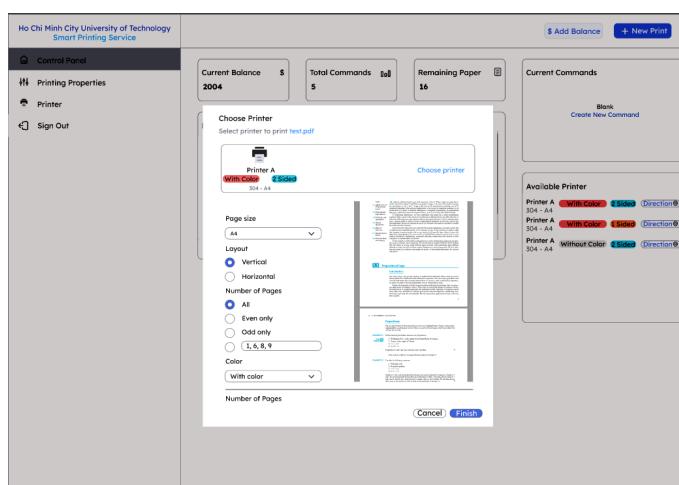
### 2.4.3. Print document



30. Upload printing page



31. Choose printer page



32. Format printing view page

#### 2.4.4. Printing log

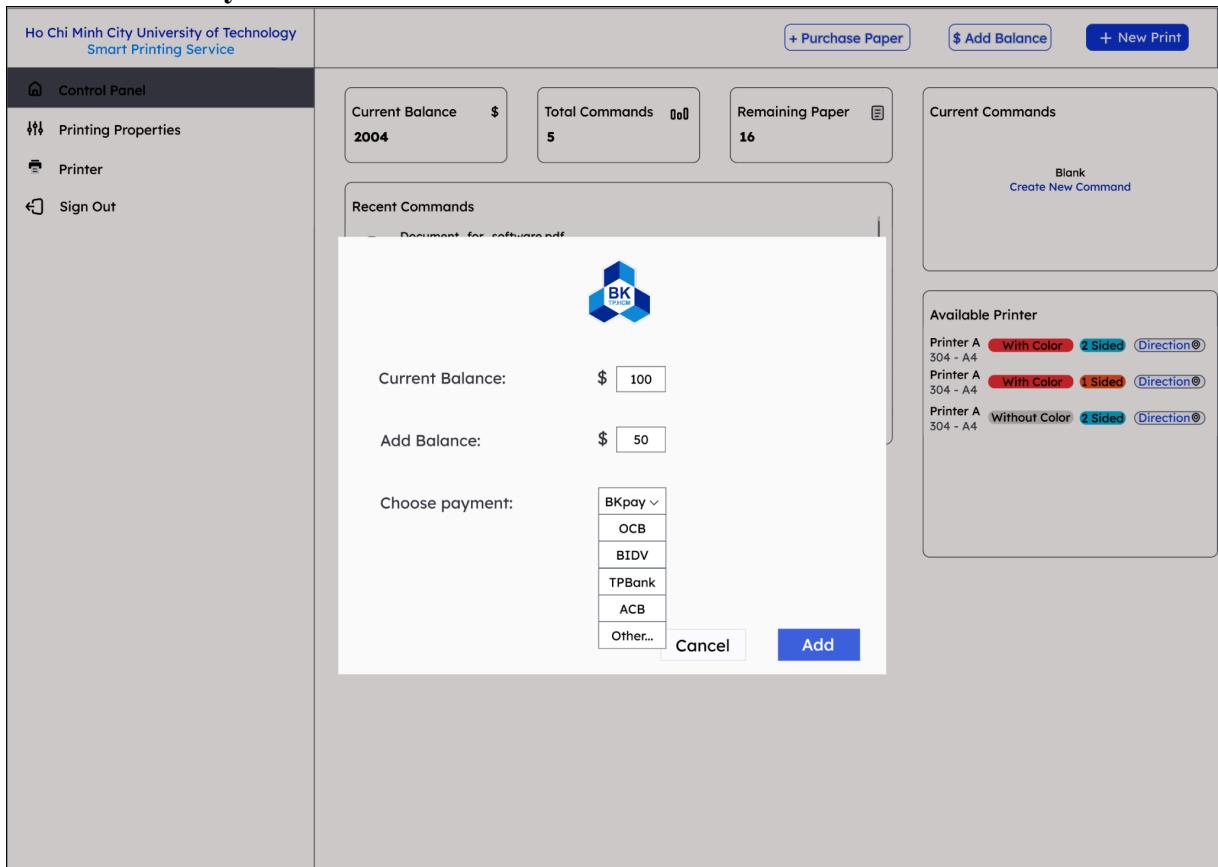
The screenshot shows the 'Ho Chi Minh City University of Technology Smart Printing Service' control panel. The main area displays a summary of current resources: Current Balance \$2004, Total Commands 5, and Remaining Paper 16. Below this, a 'Recent Commands' section lists six recent print jobs, each with a preview thumbnail, file name, page count, date, and color/print side information. To the right, a 'Current Commands' section shows a single 'Blank' command with a 'Create New Command' button. At the bottom, an 'Available Printer' section lists three printer entries, each with a status icon, color, sides, and direction.

File	Date	Pages	Color	Sides
Document_for_software.pdf	18/10/2024	24	Without Color	2 Sided
Document_for_software.pdf	18/10/2024	24	With Color	1 Sided
Document_for_software.pdf	18/10/2024	24	With Color	2 Sided
Document_for_software.pdf	18/10/2024	24	Without Color	1 Sided
Document_for_software.pdf	18/10/2024	24	Without Color	2 Sided
Document_for_software.pdf	18/10/2024	24	With Color	1 Sided

Printer	Color	Sides	Direction
Printer A	With Color	2 Sided	Direction
Printer A	With Color	1 Sided	Direction
Printer A	Without Color	2 Sided	Direction

33. Printing log page

## 2.4.5. Payment



The screenshot shows the Ho Chi Minh City University of Technology Smart Printing Service interface. On the left, a sidebar includes 'Control Panel' (selected), 'Printing Properties', 'Printer' (with a printer icon), and 'Sign Out'. The main area displays 'Current Balance \$ 2004', 'Total Commands 5', and 'Remaining Paper 16'. A 'Recent Commands' section lists 'Document for software.pdf'. On the right, there's a 'Current Commands' section with 'Blank' and 'Create New Command' options. Below it is an 'Available Printer' section listing three printers: 'Printer A With Color 2 Sided Direction 304 - A4', 'Printer A With Color 1 Sided Direction 304 - A4', and 'Printer A Without Color 2 Sided Direction 304 - A4'. The central part of the screen shows a payment form with fields for 'Current Balance: \$ 100', 'Add Balance: \$ 50', and a dropdown menu for 'Choose payment:' containing 'BKpay', 'OCB', 'BIDV', 'TPBank', 'ACB', and 'Other...'. It also features 'Cancel' and 'Add' buttons.

34. Payment page

### **III. Task 3**

#### **3.1. Architectural diagram**

##### **Layered architecture**

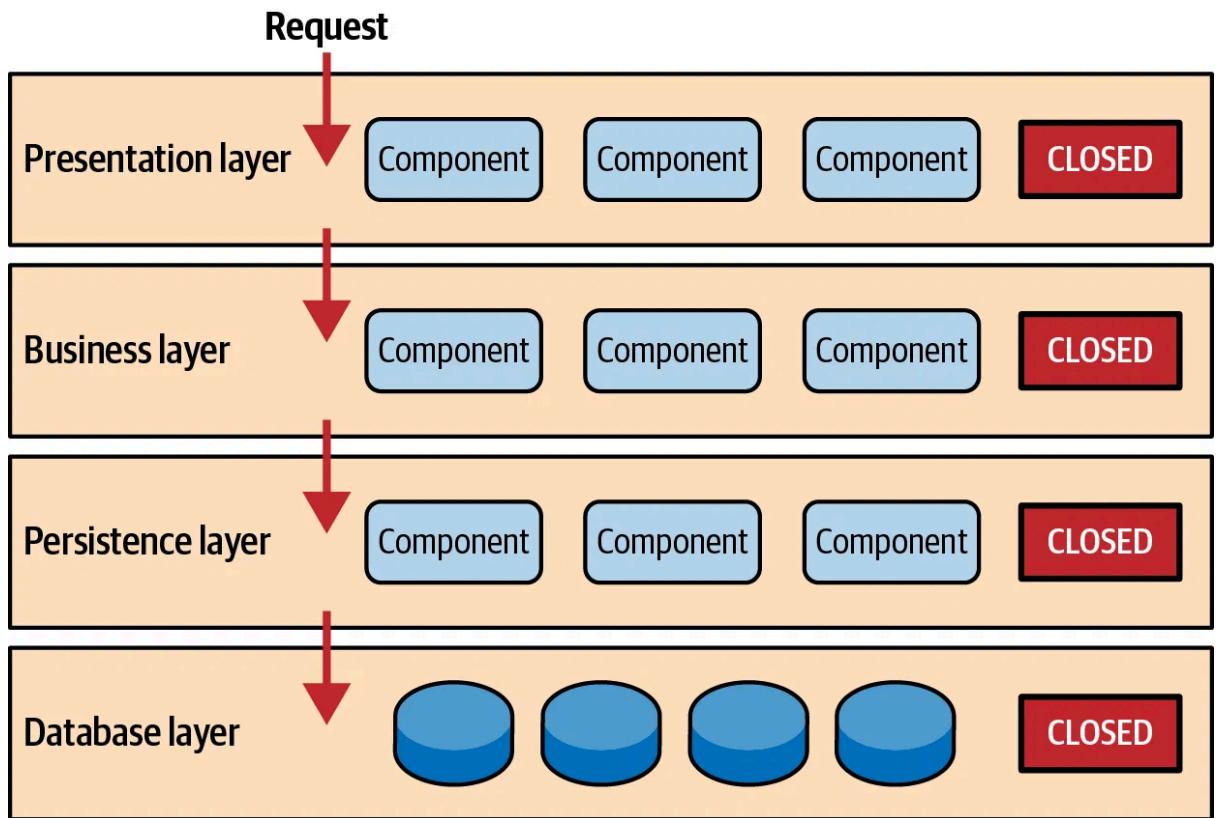
Is best described as a single deployment unit with functionality grouped by technical categories which concern technical partition. Processing requests generally flow down through the architecture starting at the top layer while each layer can be open or closed. The concept of open and close is when like for example business layer want to get to the database layer but if persistence layer is closed so we have to go through it to get to database layer which make no sense, so to open it or can choose to bypass that layer (which can be guidance for development team to known which layer can bypass and which can't)

Presentation layer: Includes components such as user interface, browser, mobile application, or other user interaction components. It has the function of displaying information and results from the Logic layer to the user and transferring user input data to the Logic layer.

Business layer: Sometimes also called the Service layer. It is responsible for processing business logic, receiving requests from the Presentation layer, processing it and sending the corresponding request to the Persistence layer.

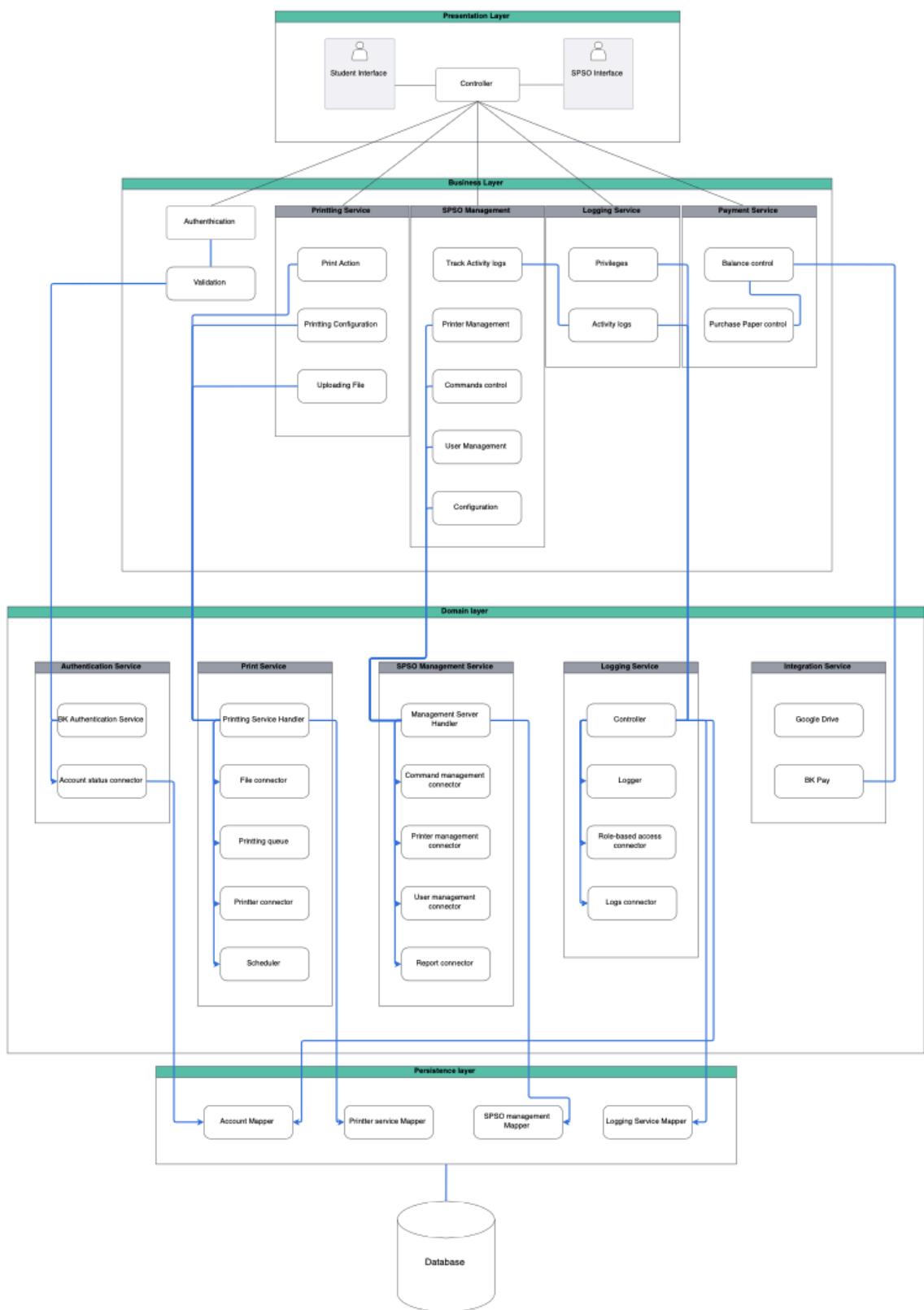
Persistence layer: Responsible for sending requests to the Database layer to perform data-related operations.

Database layer: Includes the database and related components such as the database management system. It is responsible for managing the database, performing data reading and writing operations, and implementing queries and storing data in the manner defined by the Persistence layer.



**Advantages:** The top layer can be changed while the other layer stays the same, when the team is divided by technical area.

**Disadvantages:** In practice, providing a clean separation between layers is often difficult and a high-level layer may have to interact directly with lower-level layers rather than through the layer immediately below it. Performance can be a problem because of multiple levels of interpretation of a service request as it is processed at each layer and because it is a monolithic architecture, maintainability, testability, deployability is not well supported.



35. Architectural Diagram

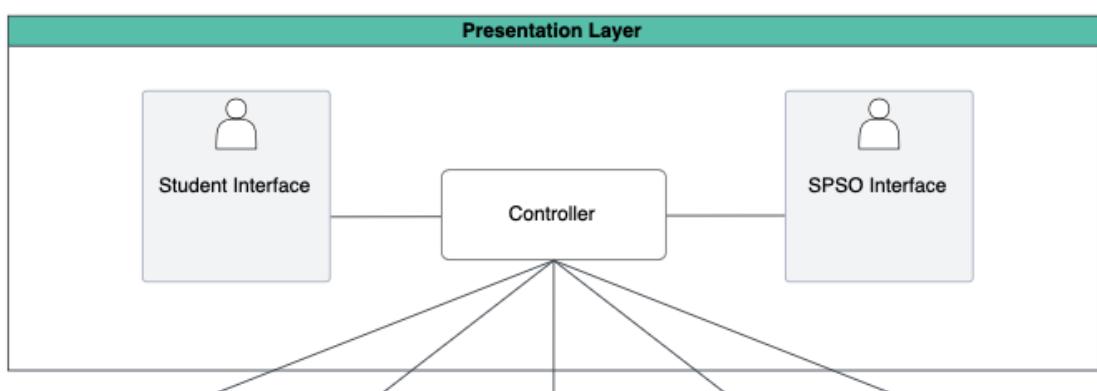
## Presentation layer

This layer manages the user interface and interactions, handling user commands and displaying information. It consists of two main components: the **Student Interface** and the **SPSO Interface**. Both share common elements like a Home page, which serves as the entry point for users accessing or logging into BKPrint, and a Login page that varies for students and administrators.

The Student Interface offers features tailored to students' needs. It includes a "Available printer" box, allowing students to view available printers and their status, helping them find operational printers quickly. The Printing Documents page lets users upload documents and choose the desired printer and settings, ensuring efficient printing. If a student's paper supply is low, the interface transitions to the Buying Printing Pages, where they can easily top up their paper balance. If he/she wants to view his/her printing history, the interface lets him/her to Printing Logs page.

The SPSO Interface is designed for administrators, providing tools to manage the BKPrint system. The Dashboard page acts as a command center, offering an overview of user activities, print history, printer status, and allowing real-time changes to printer settings. Administrators can also export periodic reports, which are crucial for tracking system performance and usage trends.

In summary, the User Interface and Interaction layer bridges users and the system's functionality, enhancing the efficiency and effectiveness of printing services.



### 3.1.1 Students interface

The students interface contains 5 pages:

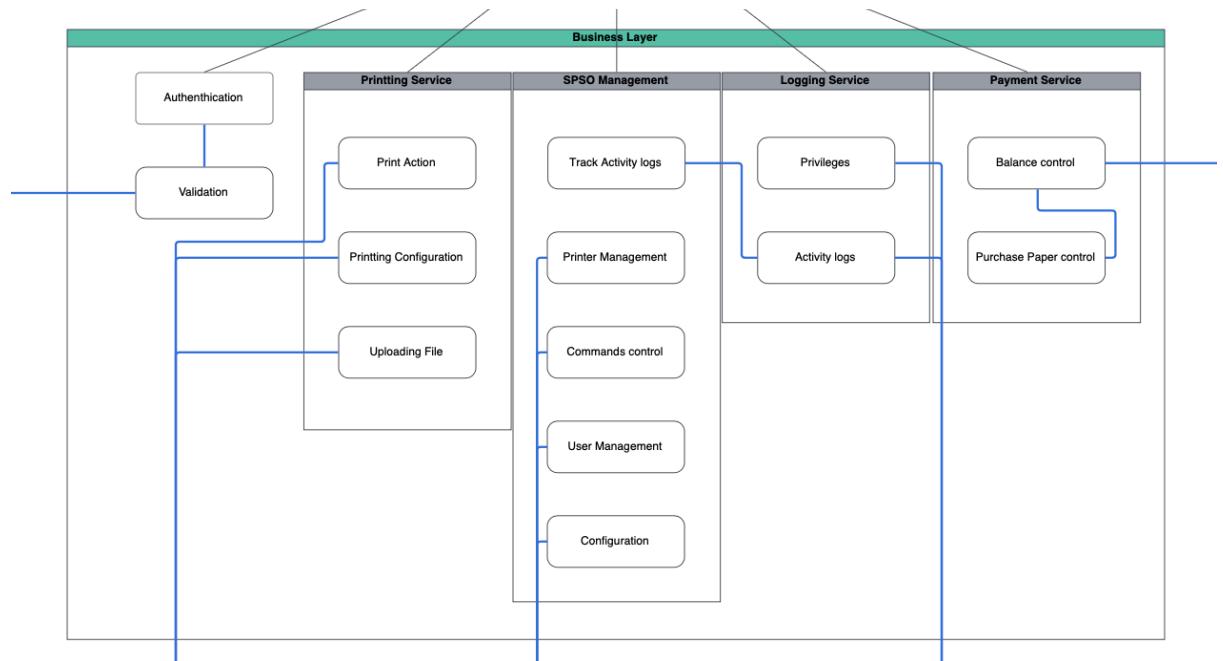
- Home page
- Log in
- Available printer
- Printing Documents
- Buying Printing Pages
- Printing Logs

### 3.1.2 Admin interface

The admin interface contains 3 pages:

- Home page
- Log in
- Dashboard page

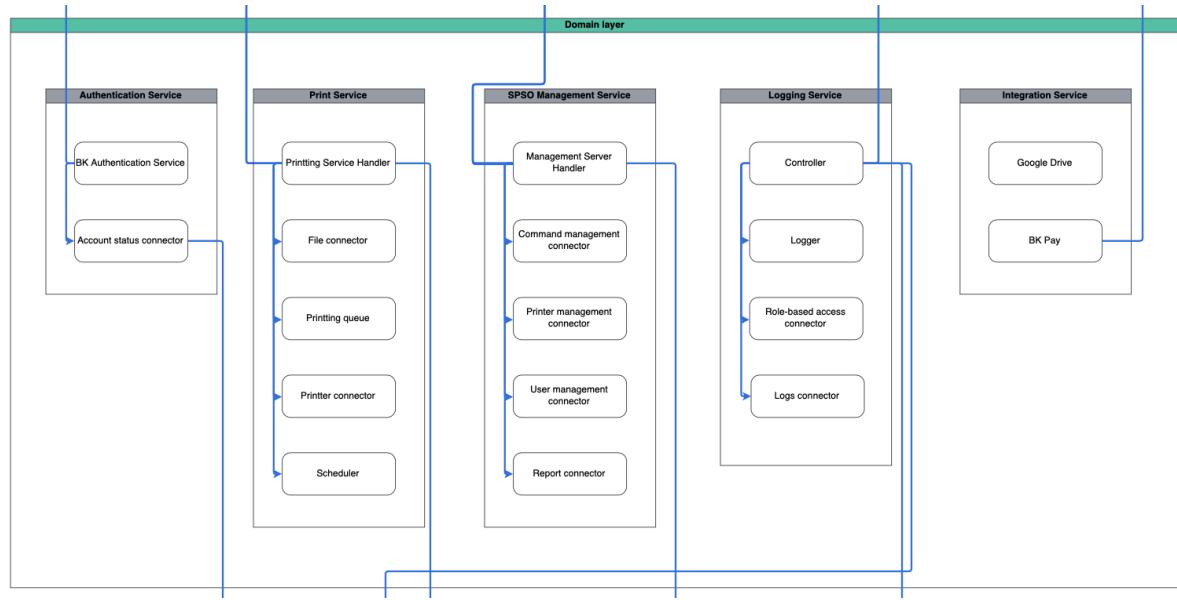
## Business layer



- The Print Service Business Logic manages actions related to printing, including printing configuration, and uploading file
- The SPSO Management Business Logic oversees printer management, commands control, activity log tracking, user management, and system configuration.

- The Logging Service Business Logic handles privileges, logger activity logs.
- The Authentication manages user authentication if it is banned or not, valid or not.
- The payment is to handle logger balance and how they purchase it to paper

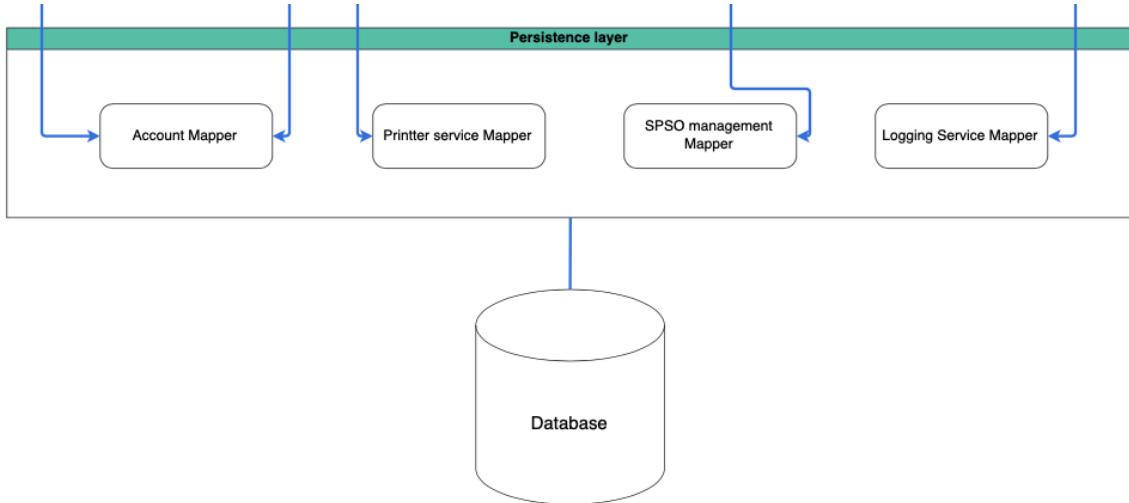
## Domain layer



The connectors and handlers facilitate the communication between the services and the business logic, ensuring a continuous flow of data and operations.

- The Authentication Service facilitates secure user authentication through the BK Authentication Service.
- The Print Service handles file receive, printing tasks, utilizing the Printing Service Handler, Printing Queue, Printer Connector all orchestrated by the Scheduler for efficient task management.
- The SPSO Management Service oversees printer and user management and reporting functionalities via the Management Service Handler, Printer Management Connector, Command management, User Management Connector, and Report Connector.
- The Logging Service records and manages system logs using the Logging Service Handler, Logger, Logs connector and handles the privileges of logger by Role-based access connector.

## Persistence Layer/Database



- The Account Mapper connects and maps user status to the database system.
- The Printer Service Mapper manages data related to printer services.
- The SPSO Management Service Mapper handles the mapping of SPSO management data.
- The Logging Service Mapper maintains data related to system logs and activities.

### - API management:

External service / API:

- + Printer API: SPSO will be able to add a new printer to the system, see the information of each printer, update their configuration and delete printers.
- + Logging API: Users will be able to send a request to see the history of each printing time. SPSO will be able to send a request to see each time printer printing.
- + Profile handler API: Users will be able to create an account when sign up, see their profile, update their profile in settings and delete their profile.
- + Printing API: Users will be able to send a request to the printer to print their documents with some information like paper size, paper layout, number of pages and colors. Users will also be added into a printing queue to wait for their turn and the system will send a message to notify users about printing status.
- + BKpay API: Integrate BKpay into the system for users to add balance easier.

- + BK Authentication API: Integrate BK authentication to authenticate users when they login the system.
- + Google Drive: Integrate Google Drive to store documents for printing.
- + JavaMailSender API: Use JavaMailSender to send a notification to users through email that they have input.

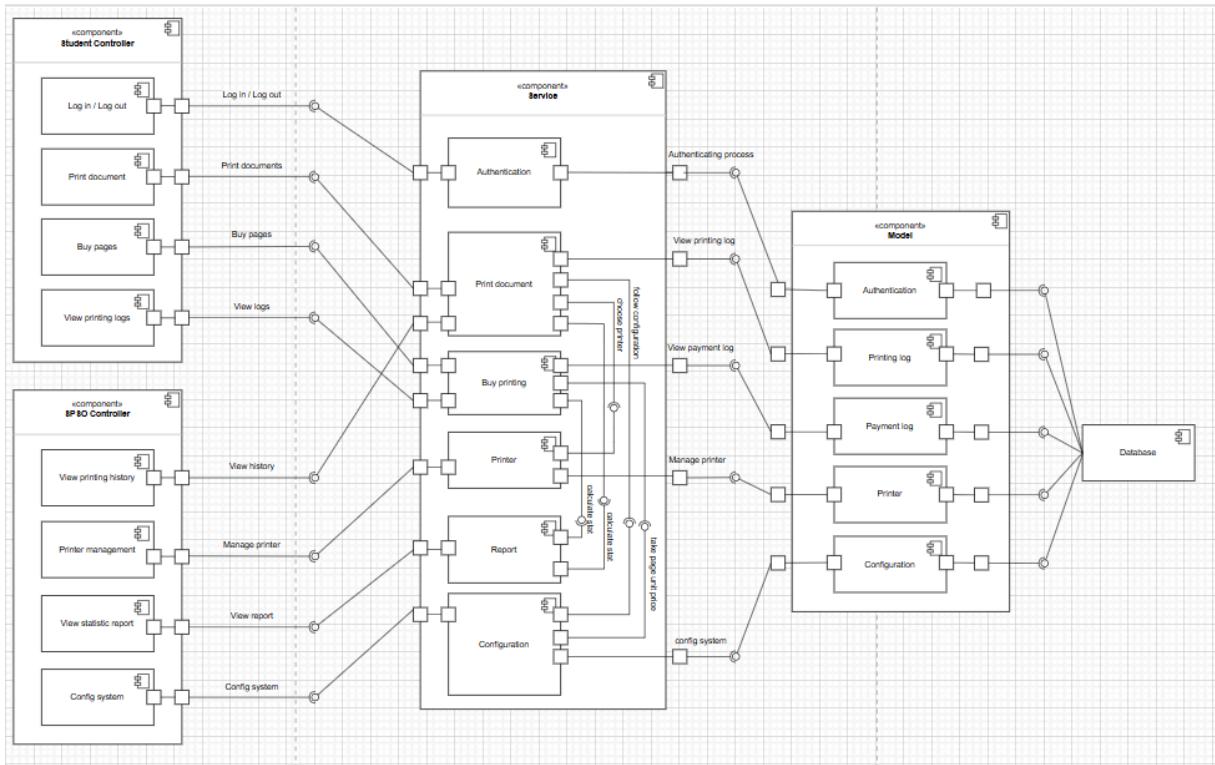
**- Data storage:**

We will use MySQL for this SPSS service:

- + User's table: store all user's information which are id, username, password which is encoded, first name, last name, sex, birth date, address, creating account's date, balance, account's status and role.
- + Printer's table: store all printer's information which are id, name, place, active status, number of remaining pages and some tools to support.
- + History printing's table: store all information which are id, printing date, printer's id, document's id, user's id, cost, printing's status.
- + Printer\_log's table: store all information which are id, status which is on or off, number of printing's time, number of papers, number of added papers, added paper's date.
- + Upload document's table: store all information which are id, user's id, paper size, paper layout, color, uploaded date.
- + Payment's table: store all information which are id, user's id, the amount of money, payment method, payment's date.
- + Role's table: store all information which are id and role to give a permission to user.

These CRUD activities will be implemented through models, services, repositories and controllers building from Java / Spring Boot and connecting to MySQL through Spring Data JPA.

### 3.2. Task 3.2



36. Component diagram

The system is organized into four main components: Student Controller, SPSO Controller, Service, and Model, each responsible for distinct aspects of the printing management system.

#### SPSO & Student Controller:

- Student Controller allows students to log in, print documents, view print/purchase history, and buy additional pages.
- SPSO Controller provides administrators with functionalities to manage printers, view histories, configure the system, and generate reports.
- Communicates with the Service layer via APIs for data retrieval and action handling.

#### Service Component:

- Acts as an intermediary between controllers and data models.
- Comprises six sub-components: Authentication, Print Document, Buy printing, Printer, Report, Configuration.

- Responsible for processing requests, applying business logic, and interacting with the Model component to ensure efficient data management.

### **Model Component:**

- Manages data with models for printing logs, payments, printer details, and system configurations.
- Facilitates organized data storage and efficient access to support system operations.

#### **IV. Task 4**

## **V. Task 5**

## **VI. References**